

FCC Test Firm Designation Number: FR0014
ISED Wireless Device Testing Laboratory CAB Number: FR0004

Matériel testé :
Equipment under test:

ST / NUCLEO-WL55JC1 (MB1389E)
(Trademark / Marketing name or product reference)

Demandeur:
Applicant : **ST Microelectronics Rousset SAS**
190, rue Célestin Coq
13106 ROUSSET Cedex – France

Client :
Customer: **ST Microelectronics**
M. Patrice Derouet
9-11 rue Pierre Félix Delarue
72100 Le Mans – France

Numéro d'affaire :
Work number : 13860

Référence de la proposition :
Proposal number: 022021-24484

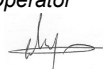
Date de l'essai :
Date of test: 6 Mai 2021 et 10 Mai 2021
May 6th and May 10th, 2021

Objectif des essais :
Test purpose: EMC qualification accordingly to following standards:
- CFR 47, FCC Part 15, Subpart C
(Chapter 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz)
- Industry Canada RSS-247, Issue 2
(Digital Transmission Systems Operating in the Bands 902–928 MHz)
Measurement standards:
ANSI C63.10 (2013)

Lieu du test:
Test location: SMEE - 385 rue René Rambaud, ZA le Parvis 2
38500 VOIRON - France

Test réalisé par :
Test realized by: Laurent Chapus / Chemseddine KERMICHE

Conclusion :
Conclusion: L'équipement satisfait aux prescriptions et essais des normes citées en référence.
The appliance complies with requirements and tests of above mentioned standards.

Ed.	Date	Modifications Pages	Written by : Visa	Approved by: Visa
1	June 16 th , 2021	Initial Edition	Laurent CHAPUS	Régis ANCEL
2	October 29 th , 2021	TCB review (ATCB027692)	Test Operator  Signature numérique de CHAPUS L.	General Manager  Signature numérique de Ancel Régis

La copie de ce document n'est permise que sous sa forme intégrale. Ce document est le résultat d'essais effectués sur un échantillon. Il ne préjuge pas de la conformité de l'ensemble des produits fabriqués à l'objet essayé.
This document shall not be reproduced, except in full. This document contains results related only to the item tested. It does not imply the conformity of the whole production to the item tested.



Accréditation
N° 1-6356
Portée disponible sur :
Scope available on :
www.cofrac.fr

COORDONNEES

SMEE
385, Rue René Rambaud, ZA Le Parvis 2
38500 VOIRON - France

TEL : 04 76 65 76 50
FAX : 04 76 66 18 30

SAS au capital de 50 000 € / RC Grenoble B534 796 453 / SIRET 534 796 453 00015 / code APE 7490B / n° TVA : FR 59 534 796 453

Contents

1. NORMATIVES REFERENCES	3
2. TEST SYNTHESIS.....	4
3. EQUIPMENT UNDER TEST (EUT).....	5
4. TEST CONDITIONS.....	5
5. MODIFICATIONS OF THE EUT.....	5
6. SPECIAL ACCESSORY	5
7. MEASUREMENT UNCERTAINTY	6
8. FIELD STRENGTH CALCULATION.....	6
9. TEST SETUP DIAGRAM.....	7
10. CONDUCTED EMISSION MEASUREMENT (150KHZ-30MHZ)	11
11. 6DB BANDWIDTH	13
12. FUNDAMENTAL EMISSION OUTPUT POWER.....	14
13. MAXIMUM POWER SPECTRAL DENSITY LEVEL IN THE FUNDAMENTAL EMISSION.....	16
14. UNWANTED SPURIOUS EMISSIONS (CONDUCTED EMISSIONS)	17
15. UNWANTED EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS (RADIATED EMISSIONS)	19
16. UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS.....	21
17. OCCUPIED BANDWIDTH (99%).....	27

1. Normatives References

FCC qualification according to:		
Standards	Applied	Title
ANSI C63.10 (2013)	X	American National Standard for Testing Unlicensed Wireless Devices
CFR47, Part 15 (May 2021)	X	Telecommunication – Federal Communication Commission – Radio frequency devices, Sections 15.109 / 15.209 / 15.247

ISED qualification according to:		
Standards	Applied	Title
RSS-Gen (Issue 5/2018, amendments 2019 and 2021)	X	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 (Issue2/2017)	X	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Note: Following guidance are used

- DTS Measurement Guidance 558074 D01 v05r02
- Determining ERP and EIRP Guidance 412172 D01 v01r01

Deviation from standard: None

2. Test synthesis

TEST	Paragraph number FCC Part 15 / ISED ICES & RSS	Spec. FCC Part 15 / ISED ICES & RSS	RESULTS (comments)
Conducted emissions test	15.207 (a) RSS-Gen § 8.8	Table 15.207 (a) Table 4 / RSS-Gen	PASS
6dB Bandwidth	15.247 (a) (2) RSS-247 § 5.2 (a)	At least 500kHz	PASS
Maximum Peak Output Power	15.247 (b) (3) & (4) RSS-247 § 5.4 (d)	1W max / 30dBm (Conducted) 4W max / 36dBm (EIRP)	PASS
Maximum Power Spectral Density	15.247 (e) RSS-247 § 5.2 (b)	8dBm in a 3kHz band segment	PASS
Unwanted emissions into Non Restricted Frequency Bands	15.247 (d) / RSS-247 § 5.5	-30dBc in any 100kHz outside frequency band.	PASS
Unwanted emissions into Restricted Frequency Bands	15.209 (a) / 15.247 (d) / 15.205 (a) RSS-GEN §8.9, § 8.10 / RSS-247 § 5.5	<u>Measure at 300m</u> 9-490kHz: 2400µV/m/F(kHz) 6.370µA/m/F (kHz) <u>Measure at 30m</u> 0.490-1.705: 24000µV/m/F(kHz) 63.70µA/m/F (kHz) 1.705-30MHz: 30µV/m 0.08µA/m <u>Measure at 3m</u> 30MHz-88MHz : 40 dBµV/m 88MHz-216MHz : 43.5 dBµV/m 216MHz-960MHz : 46.0 dBµV/m Above 960MHz : 54.0 dBµV/m	PASS
Occupied Bandwidth	RSS-GEN § 6.7	BW at 99%	PASS

- General conclusion:**

Measures and tests performed on the sample of the product *ST / NUCLEO-WL55JC1*, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart C and RSS-Gen & RSS-247.

3. Equipment Under Test (EUT)

**Nom /
Identification**

NUCLEO – WL55JC1

MB1389-HIGHBAND-E02
Sn: C204800140

FCC ID:

FCC ID: YCP-MB1389001

IC:

IC: 8976A-MB1389001

Model / HVIN:

MB1389E

**Alimentation /
Power supply**

5V DC from STLINK (Micro-USB cable)

**Auxiliaires /
Auxiliaries**

Laptop ASUS, model F200M

**Entrées-Sorties /
Input / Output
US**

	Câbles pour essai / Cables for test	Blindé / Shielded	Prévu pour >3m / Intended for >3m
USB Micro-B (STLK+5V)	1.0m (USB 2.0)	Yes	No

**Mode de fonctionnement /
Running mode**

Equipment running modes are:

The tested sample is able to be set in following modes:

- Transmit a modulated carrier frequency at 925MHz

**Version programme interne /
Firmware version**

LoRa_ATSlave_hopping (Test mode)

Demo_Concentrator (Normal running mode)

**Programme de test /
Test program /**

PC test : serial command terminal

**Informations supplémentaires /
Additional informations**

Declaration of the applicant:

- Type of technology: Proprietary RF protocol
- Frequency transmission band: 925MHz.
- 1 channel used in DTS mode
- Rated conducted output power: 21dBm
- Modulation: LORA with 500kHz nominal BW / SF12
- Equipment intended for use as a mobile station
- Equipment designed for continuous operation
- Antenna type: Dipole antenna with max gain 2dBi

**Dimensions de l'EST /
Dimensions of EUT**

70mm x 65 x 20 (Board)

Antenna length is 53mm

4. Test conditions

Power supply voltage:

Equipment under test:

5V DC from STLINK (Micro-USB cable)

Auxiliaries:

230V/50Hz (Radiated emission)

110V/60Hz (Conducted emission)

5. Modifications of the EUT

None.

6. Special accessory

None.

7. Measurement Uncertainty

Test Description	Expanded uncertainty
Conducted emissions test (150k-30MHz, AC mains)	± 3.5dB
Radiated emission test (9kHz-30MHz, electric field)	± 4.0dB
Radiated emission test (30-300MHz, SAC 3m)	± 5.6dB
Radiated emission test (300-1000MHz, SAC 3m)	± 5.3dB
Radiated emission test (1-40GHz, SAC)	± 5.6dB
Conducted RF output power at antenna port	± 1.6dB
Radiated RF output power (Peak, Power density)	± 5.6dB
DTS Bandwidth, 99% OBW	±4%
Temperature	± 1°C
Time and duty cycle calculation	±1%
AC and DC voltage	±1%

Note: Expanded uncertainty at 95% confidence (k=2)

8. Field Strength Calculation

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

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

Where FS = Field Strength (Level)

RA = Receiver Amplitude (Meter Reading)

AF = Antenna Factor

CF = Cable Factor

AG = Amplifier Gain

Margin value = Emission level – Limit value

Example:

RA: 14.0dBμV / AF: 16.5 dBm⁻¹ / CF: 3.5dB / AG: 15dB

→ Total factor: 5dBm⁻¹

→ Field level: 19.0dBμV/m (-21.0dB for margin if limit is 40dBμV/m)

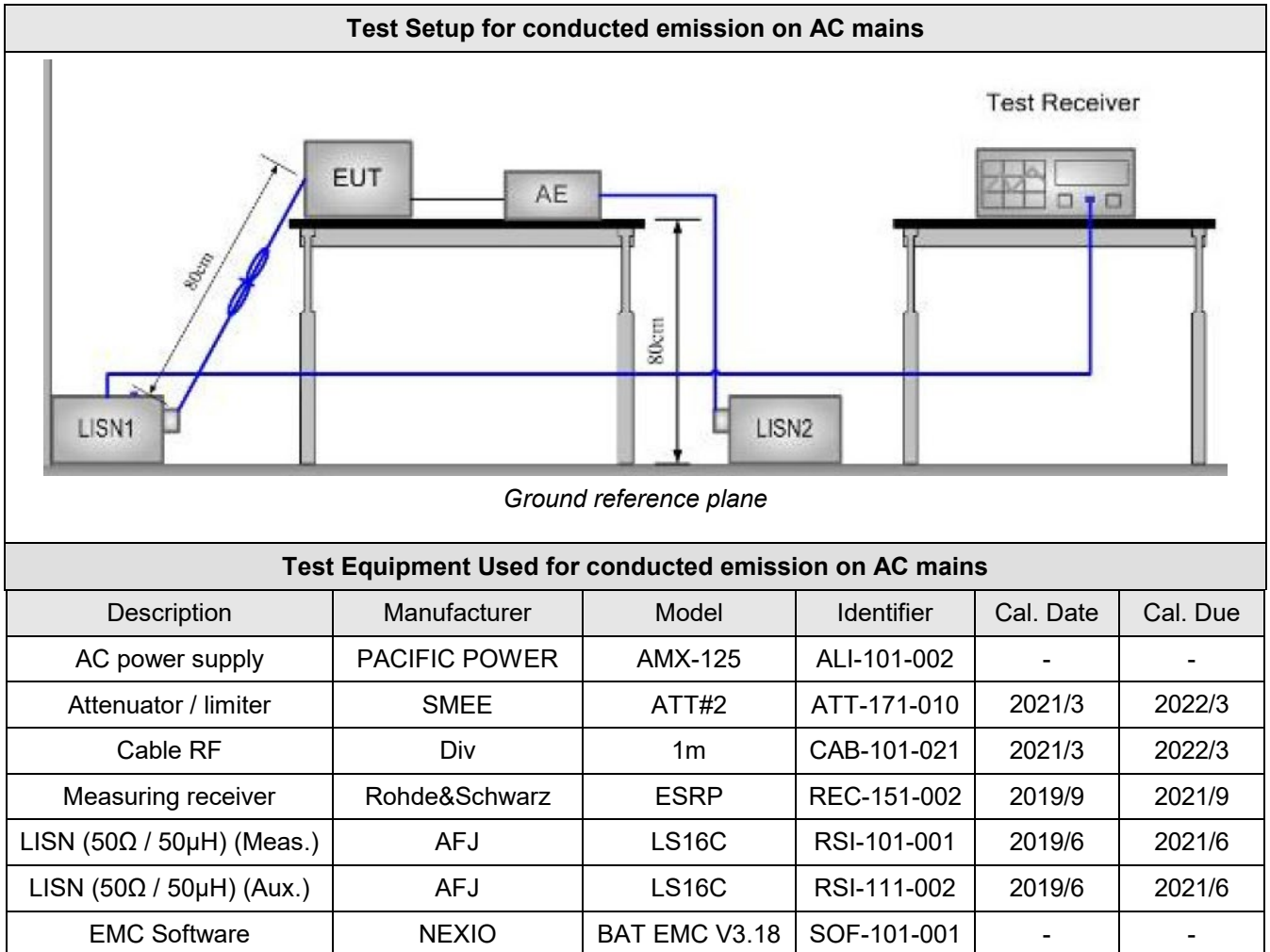


SME

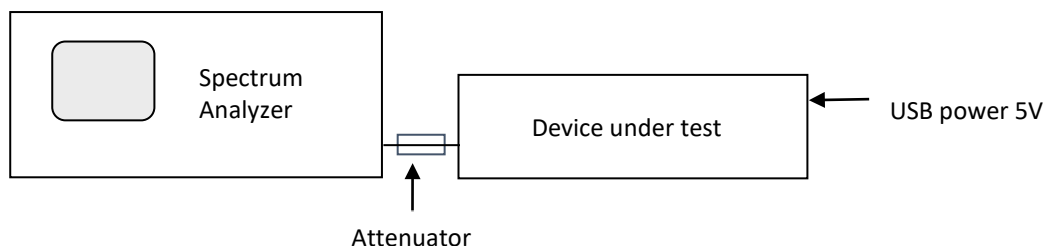
Rapport d'essai / Test Report

N° : 13860-FCC-IC-2

9. Test Setup Diagram



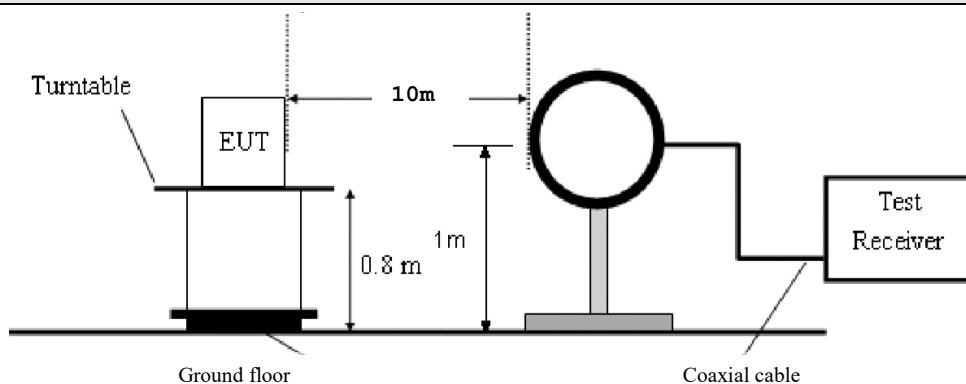
Test Setup for conducted antenna port measurement



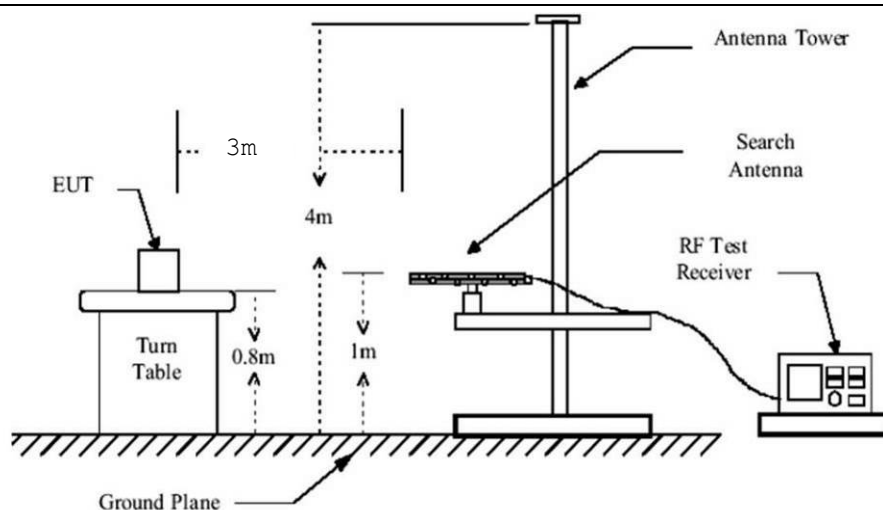
Test Equipment Used for conducted antenna port measurement

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2019/8	2021/8
RF Attenuator	Mini-Circuit	BW-N10W5+	ATT-171-008	2021/3	2022/3
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2019/9	2021/9
EMC Software	NEXIO	BAT EMC V3.18	SOF-101-001	-	-

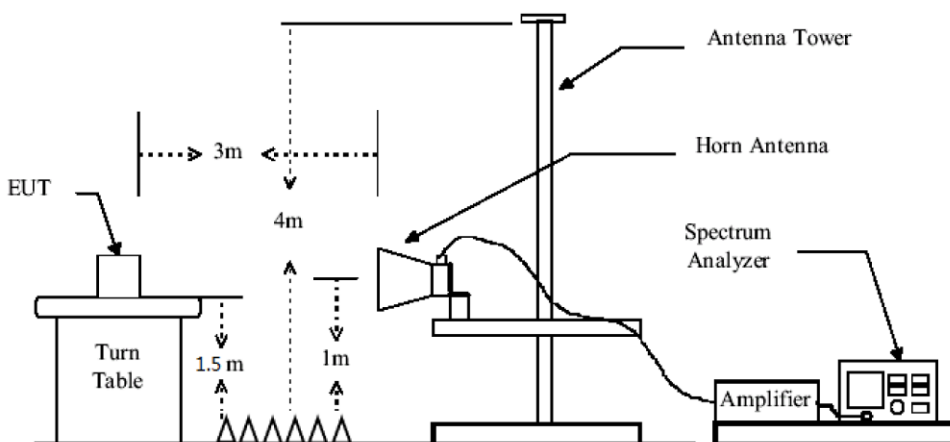
Test Setup for radiated emission



Test setup for 9k-30MHz (FS OATS)



Test setup for 30-1000MHz (SAC 3m)



Test setup for 1-10GHz (SAC 3m, tilt antenna mast used)

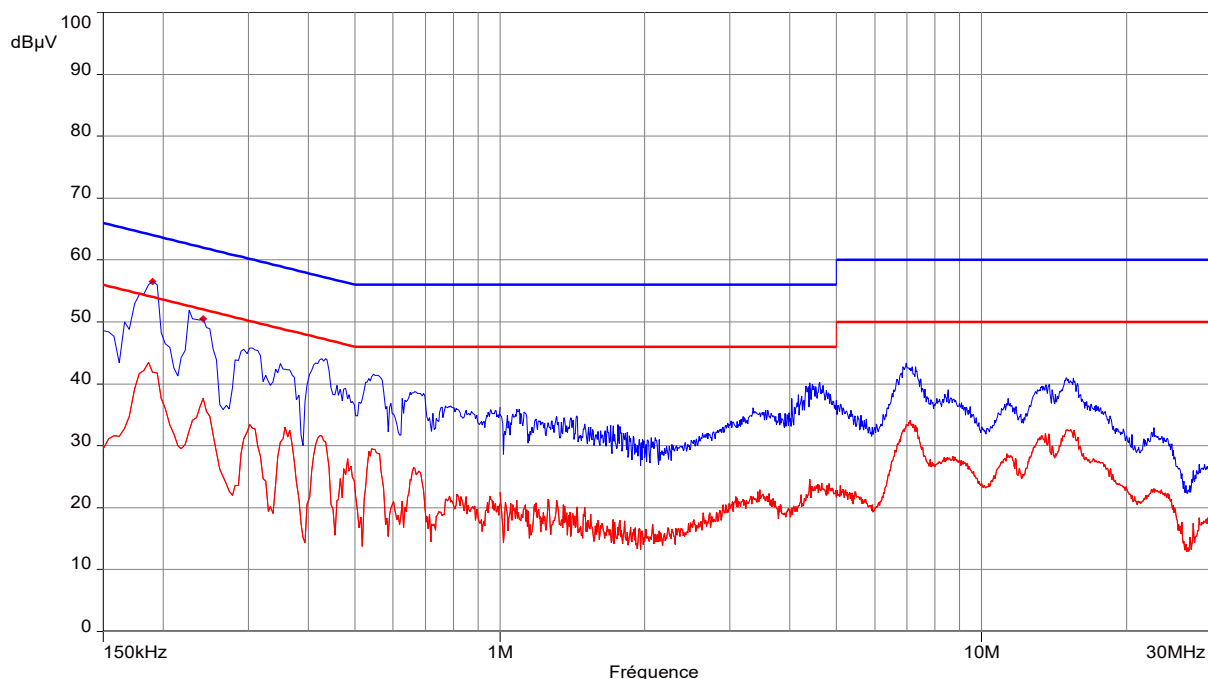
Test Equipment Used for radiated measurement					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2019/6	2021/6
Horn antenna	COM-POWER	AH-118	ANT-101-004	2018/10	2021/10
Loop antenna	EMCO	6502	ANT-101-009	2019/8	2021/8
Log-periodic antenna	EMCO	3146	ANT-191-019	2019/6	2021/6
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2019/8	2021/8
RF cable	Div	OATS/25m	CAB-101-017	2021/3	2022/3
RF cable	Pasternack RF	PE302-120	CAB-131-023	2021/3	2022/3
RF cable	HUBER+SUHNER	SF102 (KN6m)	CAB-171-033	2021/3	2022/3
RF cable	TMS	LMR-400 / 9m	CAB-201-039	2021/3	2022/3
Semi anechoic room	COMTEST	218292	CAG-201-002	2021/2	2022/2
High-Pass filter	Wainwright Inst.	HK6-948-1200	FIL-141-004	2021/3	2022/3
Antenna mast SAC	Innco- Systems	MA4640-XP-ET	MAT-201-002	-	-
Turntable	Innco- Systems	CT0800	PLA-141-002	-	-
Turntable SAC	Innco- Systems	DS1500-S-1t	PLA-201-003	-	-
Pre-amplifier	PE	1524	PRE-101-002	2021/3	2022/3
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2019/9	2021/9
FS OATS	Div	10m	SIT-201-002	-	-
EMC Software	NEXIO	BAT EMC V3.18	SOF-101-001	-	-

10. Conducted Emission Measurement (150kHz-30MHz)

TEST: Limits for conducted disturbance 150kHz – 30MHz				Verdict
Method: The LISN is placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane. This distance was between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment were at least 0,8 m from the AMN. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on lines were made at the output of the LISN. The EUT is 80cm above the ground reference plane and 40cm from the vertical ground plane. The AC power cable is 1m length.				Pass
Laboratory Parameters:		Required prior to the test		During the test
Ambient Temperature		17 to 27°C		21°C ± 2
Relative Humidity		25 to 65 %		51% ± 5
Fully configured sample scanned over the following frequency range		Frequency range on each side of line		Measurement Point
		150kHz to 30MHz		AC input port (110V)
Limits				
Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Result	Average	Result
0.15 – 0.50	66 \ 56	PASS	56 \ 46	PASS
0.50 - 5	56	PASS	46	PASS
5 – 30	60	PASS	50	PASS
Supplementary information: Test location: SMEE Test date: May 10 th , 2021. Tested by C. KERMICHE Power supply voltage: AC mains 110V/60Hz				

Tabulated Results for Mains Terminal Disturbance Voltage on AC port								
FREQ (MHz)	Meas. PK (dBµV)	Mes. QP (dBµV)	LIMIT QP (dBµV)	Margin QP (dB)	Mes. AV (dBµV)	LIMIT AV (dBµV)	Margin AV (dB)	Line
0.19	54.97	49.41	64.04	-14.62	37.37	54.04	-16.66	L1
0.242	50.94	47.35	62.03	-14.68	35.37	52.03	-16.66	L1
0.17	54.29	50.49	64.96	-14.47	35.84	54.96	-19.12	N
4.58	41.53	34.85	56	-21.15	24.85	46	-21.15	N
RBW:			9kHz					
Voltage:			110V/60Hz					
Limit:			FCC Part 15.209 a) / RSS-Gen: Issue 5, §8.8 Table 4					
Final measurement detector:			Quasi-Peak and CISPR Average (AV)					
RESULT:			PASS					
Measured value calculation:			The measured value (level) is calculated by adding the Cable Factor, the Transient suppressor attenuation and LISN attenuation from the receiver amplitude reading. The basic equation is as follow: $\text{Meas.} = \text{RA} + \text{CF} + \text{ATT}_{\text{TRAN}} + \text{ATT}_{\text{LISN}}$ Where Meas. = Level (dBµV) RA = Receiver Amplitude CF = Cable Factor ATT_{TRAN} = Transient suppressor attenuation ATT_{LISN} = LISN attenuation Margin value = Emission level – Limit value (A negative margin shows compliance to limit)					

Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line L1

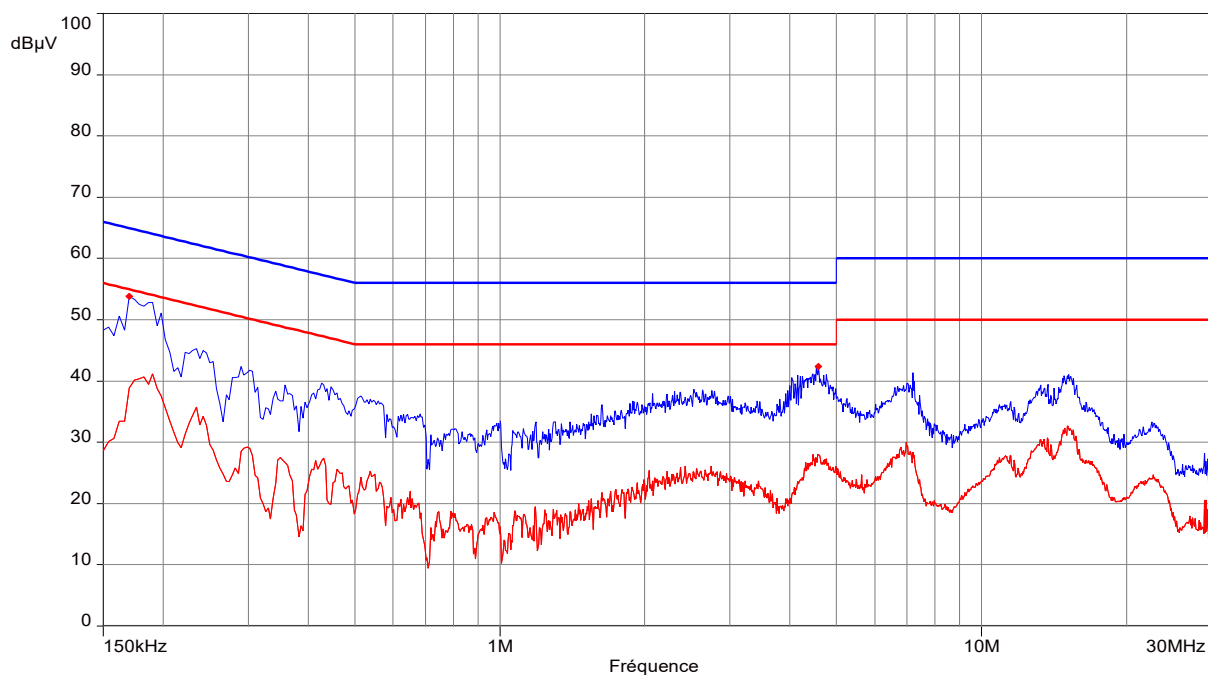


Note : Same result for all transmit modes on all channels.

----: Peak

----: Average

Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line Neutral



Note : Same result for all transmit modes on all channels.

----: Peak

----: Average



SME

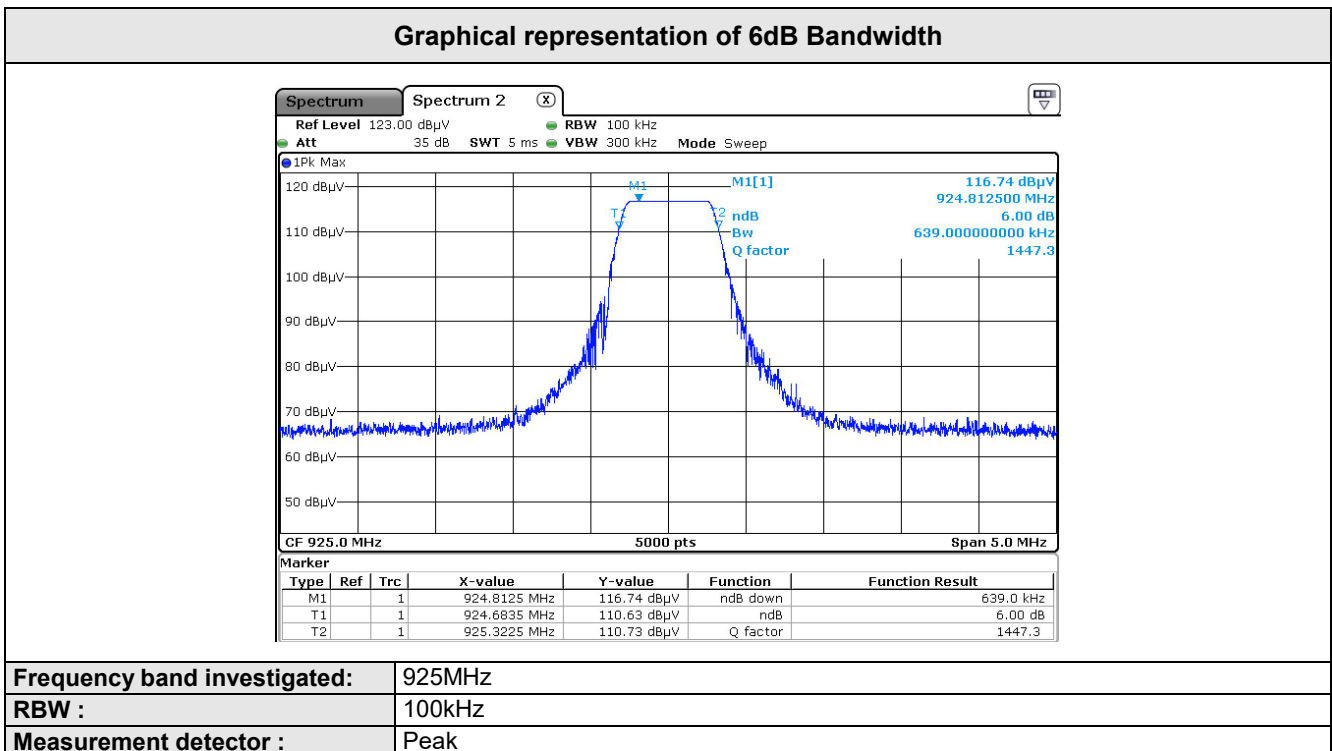
Rapport d'essai / Test Report

N° : 13860-FCC-IC-2

11. 6dB Bandwidth

TEST: 6dB Bandwidth			Verdict
<u>Method:</u> The setup is in an anechoic chamber. The spectrum analyzer is connected to the antenna port of the device under test. A conducted measurement is performed. The tested equipment is set to transmit operation with modulation on its nominal channel			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	17 to 27°C	21°C ± 2	
Relative Humidity	25 to 65 %	42% ± 5	
Limits – FCC Part 15.247 (a) / RSS-247 §5.2 (a)			
Frequency (MHz)	Level for Bandwidth	Limit	
925	6dB below the maximum output power	At least 500kHz	
Supplementary information: Test location: SMEE Test date: May 06 Th , 2021. Tested by LC / CK			

Tabulated Results for Occupied Bandwidth		
Frequency (MHz)	6dB Bandwidth (kHz)	Result
925.0	639.0	Pass



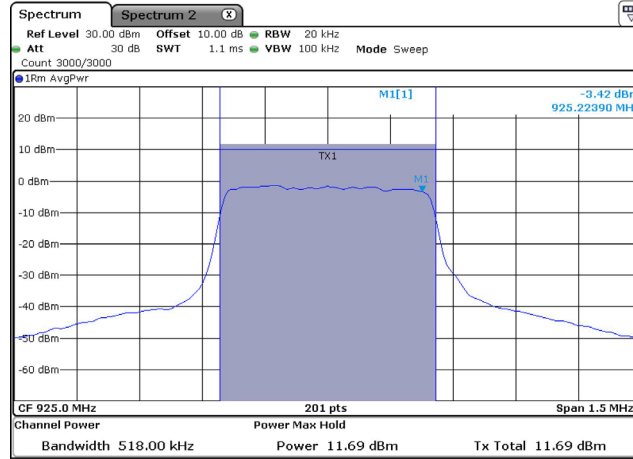
12. Fundamental emission output power

TEST: Maximum conducted output power			Verdict
<u>Method:</u> The setup is in an anechoic chamber. The spectrum analyzer is connected to the antenna port of the device under test. A conducted measurement is performed. The tested equipment is set to transmit operation with modulation on its nominal channel			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	17 to 27°C	21°C ± 2	
Relative Humidity	25 to 65 %	42% ± 5	
Limits – FCC Part 15.247 (b) / RSS-247 §5.4			
Frequency (MHz)	Limits		
	Level	Results	
925.0	30 dBm (Conducted)	Pass	
	36 dBm (Radiated, EIRP)	Pass	
Supplementary information: Test location: SMEE Test date: May 06 Th . 2021. Tested by LC / CK			

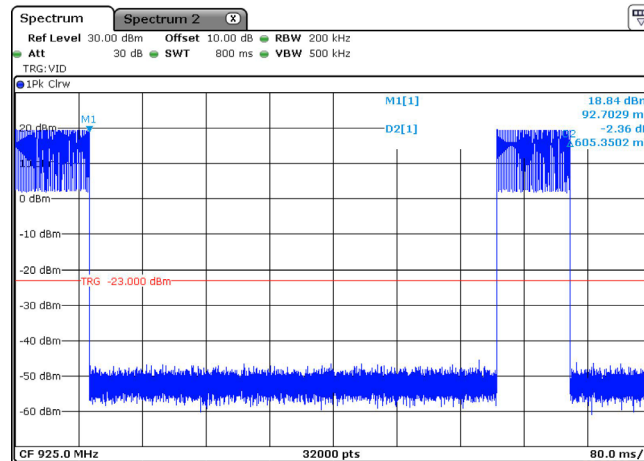
Tabulated Results for Maximum (Average) output power (Conducted)					
FREQ (MHz)	Measured conducted power (dBm)	Duty cycle factor (dB)	Maximum output power (dBm)	Limit (dBm)	Result
925.0	11.7	8.2	19.9	30.0	Pass
RESULT:		PASS			
Note:		- Method used is AVGSA-2 - Duty cycle factor is $10 \cdot \log(1/D)$ where D is the duty cycle - Duty cycle measurement as per 11.6 of ANSI C63.10: $T_{x\text{ ON}} = 92.7\text{ms}$ $T_{\text{TOTAL}} = 605.35\text{ms}$ $D = 0.153$			

Tabulated Results for Maximum (Average) output power (Radiated)					
FREQ (MHz)	Maximum output power Conducted (dBm)	Max Antenna Gain (dBi)	Maximum output power Radiated (dBm)	Limit (dBm)	Result
925.0	19.9	2.0	21.9	36.0	Pass
RESULT:		PASS			

Graphical representation of Conducted output power



925MHz



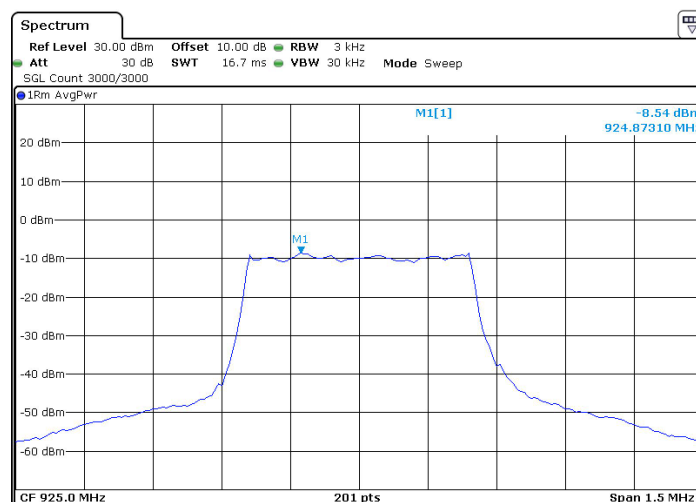
Duty cycle measurement

13. Maximum Power Spectral Density Level in the fundamental emission

TEST: Maximum Peak Power Spectral Density			Verdict
<u>Method:</u> The setup is in an anechoic chamber. The spectrum analyzer is connected to the antenna port of the device under test. A conducted measurement is performed. The tested equipment is set to transmit operation with modulation on its nominal channel			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	17 to 27°C	21°C ± 2	
Relative Humidity	25 to 65 %	42% ± 5	
Limits – FCC Part 15.247 (e) / RSS-247 §5.2 (b)			
Frequency (MHz)	Level	Limit	
925	8 dBm/3kHz	Pass	
Supplementary information: Test location: SMEE Test date: May 06 th , 2021. Tested by LC / CK			

Tabulated Results for Maximum (Average) Power Spectral Density					
FREQ (MHz)	Measured conducted power (PSD) (dBm)	Duty cycle factor (dB)	Maximum output power (PSD) (dBm)	Limit (dBm)	Result
925	-8.5	8.2	-0.3	8dBm/3kHz	Pass
RESULT:		PASS			
Note:		- RBW used is 3kHz - Method used is AVGPSSD-2 - Duty cycle measurement as per 11.6 of ANSI C63.10: T_{x ON} = 92.7ms T_{TOTAL} = 605.35ms D = 0.153			

Graphical representation of Conducted output power density

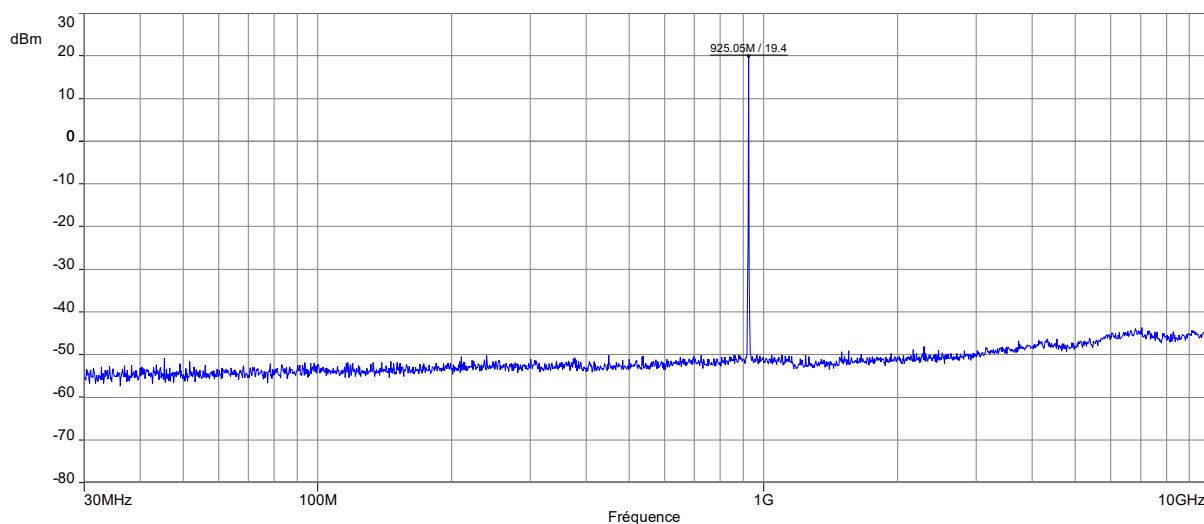


925MHz

14. Unwanted Spurious Emissions (Conducted emissions)

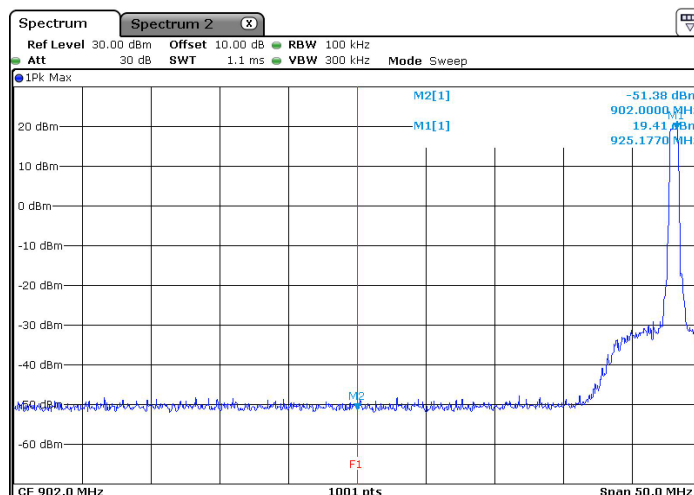
TEST: Conducted Spurious emissions			Verdict
<u>Method:</u> The setup is in an anechoic chamber. The spectrum analyzer is connected to the antenna port of the device under test. A conducted measurement is performed. The tested equipment is set to transmit operation with modulation on its nominal channel			Pass
Laboratory Parameters:	Required prior to the test		During the test
Ambient Temperature	17 to 27°C		21°C ± 2
Relative Humidity	25 to 65 %		42% ± 5
Fully configured sample scanned over the following frequency range	Frequency range on each side of line		Measurement Point
	30MHz – 10GHz		Antenna port
Limits – FCC Part 15.247 (d) / RSS-247 § 5.5			
Frequency (MHz)	Limits (dBµV/m)		
	Detector / Analyser RBW	Limit	Results
30 to 10000	Pk / 100kHz	30dB below the maximum Peak level	Pass
Supplementary information: Test location: SMEE Test date: May 06 Th , 2021. Tested by LC / CK			

Graphical representation of Conducted Spurious emissions (LORA mode / 925MHz channel)



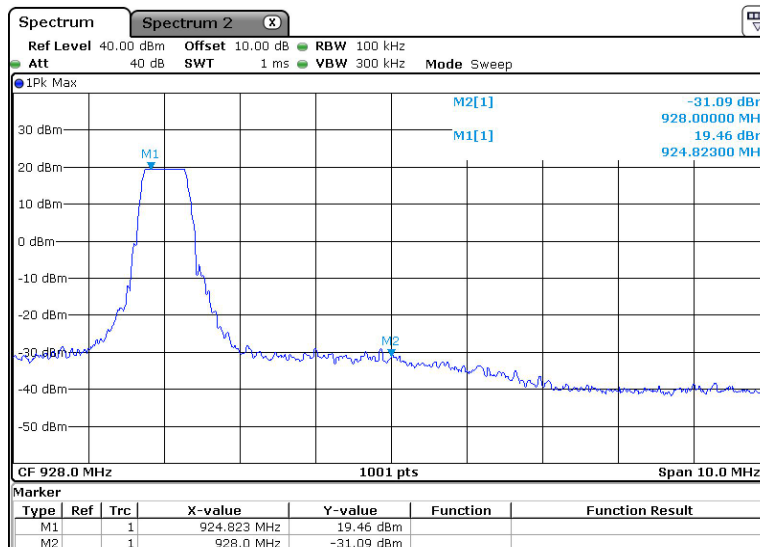
Frequency band investigated:	30MHz-10GHz
Unit :	dBm
RBW :	100kHz (Frequency step 50kHz)
Measurement detector:	Peak
Limit:	-10.6 dBm

Graphical representation of Band-edge compliance (LOW)



Unit :	dBm
RBW :	100kHz
Measurement detector:	Peak
Limit:	-10.6dBm
Note:	F1 is 902MHz

Graphical representation of Band-edge compliance (High)



Unit :	dBm
RBW :	100kHz
Measurement detector:	Peak
Limit:	-10.6 dBm
Note:	F1 is 928MHz

15. Unwanted emissions in Non-Restricted Frequency bands (Radiated emissions)

TEST: Unwanted emissions in Non-Restricted Frequency Bands			Verdict
<u>Method:</u> Measurements were made in a 3-meter Semi Anechoic Room (SAR) up to 1GHz and in a 3-meter Full Anechoic environment (SAR with floor absorbers) above 1GHz. The Semi Anechoic Room complies with CISPR16-1-4 / ANSI C63.4 requirements. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meter. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. The pre-characterization graphs are obtained in PEAK detection. Final measurements (Peak, Quasi-peak, Average) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength.			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	17 to 27°C	21°C ± 2	
Relative Humidity	25 to 65 %	42% ± 5	
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point	
	30MHz – 10GHz	3 m measurement distance	
Limits – FCC Part 15.247 (d) / RSS-247 § 5.5			
Frequency (MHz)	Limits (dBµV/m)		Results
	Detector / Analyser RBW	Limit	
30 to 10000	Pk / 100kHz	30dB below the maximum Peak level	Pass
Supplementary information: Test location: SMEE Test date: Mav 06 Th . 2021. Tested by LC / CK			

Tabulated Results for Peak Output Radiated level	
FREQ	Field Strength 3m
(MHz)	(dBμV/m)
925	118.8
RBW:	100kHz
Measurement distance:	3m
Limit:	Ref. level only – For 15.247 (d) / RSS-247 § 5.5
Final measurement detector:	Peak
Note:	(1): Only for identification of limit in non-restricted band Limit is 88.8 dBμV/m Peak for out-of-band frequencies in Non-Restricted bands (with a 100kHz RBW on the spectrum analyser)

Tabulated Results for Unwanted emissions in Non-Restricted bands				
FREQ (MHz)	Field Strength 3m (dBμV/m)	Limit (dBμV/m)	Margin (dBμV/m)	Result (dBμV/m)
Levels are at least 10 dB below the -30dBc limit See pre-scan graphs in chapter 17.				
RBW:	100kHz			
Measurement distance:	3m			
Limit:	15.247 / RSS-247			
Final measurement detector:	Peak			
RESULT:	PASS			
Note:	3-axis measurement performed for device under test.			

16. Unwanted emissions in Restricted Frequency bands

TEST: Unwanted emissions into Restricted Frequency Bands		Verdict
Method: Measurements were made in a 3-meter Semi Anechoic Room (SAR) for frequency 30MHz to 1GHz and in a 3-meter Full Anechoic environment (SAR with floor absorbers) above 1GHz. The Semi Anechoic Room complies with CISPR16-1-4 / ANSI C63.4 requirements. For frequency 9kHz to 30MHz, measurements are performed on a free-space open area test site at 10m distance. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meter. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak, Quasi-peak, Average) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength.		Pass
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	17 to 27°C	21°C ± 2
Relative Humidity	25 to 65 %	42% ± 5
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point
	9kHz – 30MHz	10 m measurement distance
	30MHz – 10GHz	3 m measurement distance
Limits – FCC Part 15.205, 15.209 (a), 15.247 (d) / RSS-GEN §8.9, §8.10, RSS-247 §5.5		
Frequency (MHz)	Limits (dBµV/m)	
	Level / Detector / Distance	Results
0.009 to 0.090	107.6 – 87.6 / AV / 10m 127.6 – 107.6 / PK / 10m	Pass
0.090 to 0.110	87.6 – 85.9 / QP / 10m	Pass
0.110 to 0.490	85.7 – 72.9 / AV / 10m 105.7 – 92.9 / PK / 10m	Pass
0.490 to 1.705	52.9 – 42.1 / QP / 10m	Pass
1.705 to 30	48.6 / QP / 10m	Pass
30 to 88	40.0 / QP / 3m	Pass
88 to 216	43.5 / QP / 3m	Pass
216 to 960	46.0 / QP / 3m	Pass
960-1000	54.0 / QP / 3m	Pass
Above 1GHz	54.0 / AV / 3m 74.0 / PK / 3m	Pass
Supplementary information: Test location: SMEE Test date: May 06th, 2021. Tested by LC / CK		

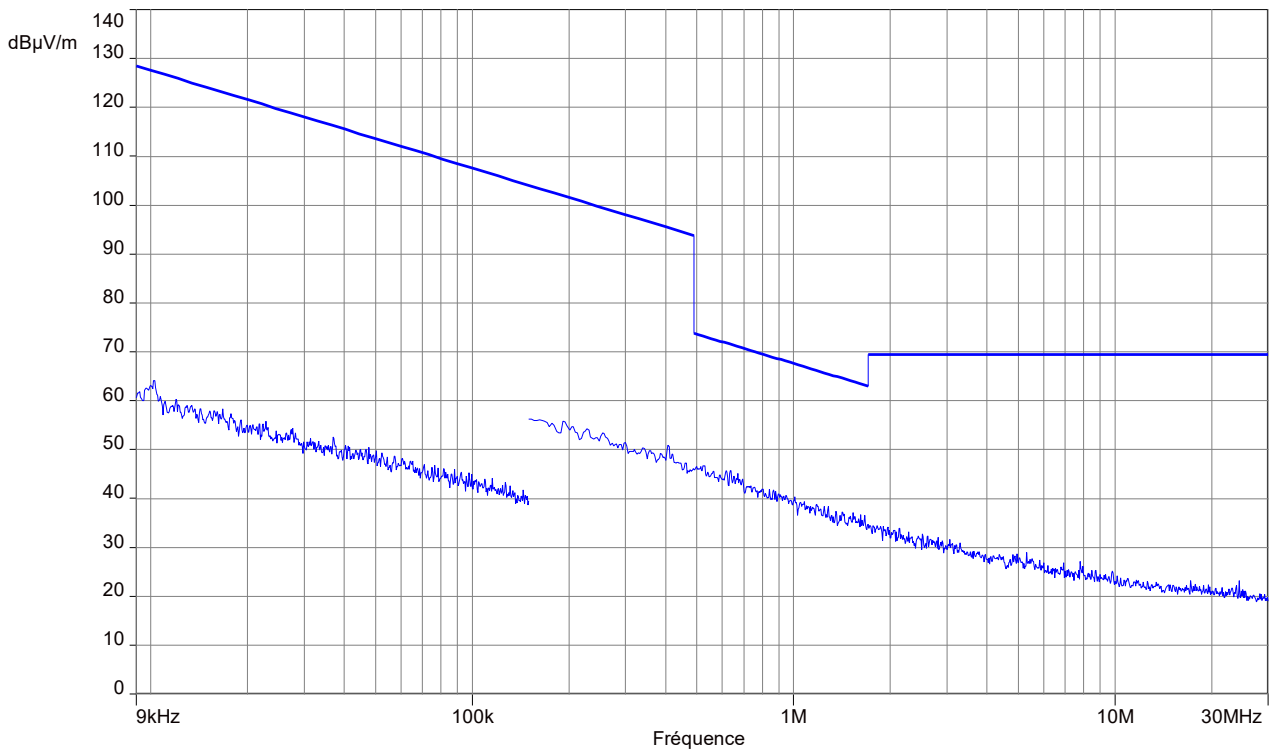
Tabulated Results for Unwanted emissions (9kHz-490kHz)							
FREQ	RF field @ 300m	Limit @ 300m	Detector	Margin	Ant. angle	Table angle	Correc. Fact. (CF)
MHz	dBµV/m	dBµV/m	Pk / QP / AV	dB	Degree	Degree	dB
All levels are at least 20dB below applicable limits							
Supplementary information: Frequency list measured has been created with pre-scan results.							
Frequency band investigated:		9kHz-490kHz					
RBW:		200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)					
Measurement distance:		10m					
Final measurement detector:		Peak / Quasi-Peak / Average					
Limit:		FCC Part 15.209 / RSS-Gen					
Note:		CF: Correction factor = Antenna factor + Cable loss *1: Measure have been done at 10m distance and corrected according to requirements of 15.209.e / RSS-Gen clause 6.5) (M@300m = M@10m-59.1dB) Loop antenna used and rotated about its axis to maximize any emission.					

Tabulated Results for Unwanted emissions (490kHz-30MHz)							
FREQ	RF field @ 30m	Limit @ 30m	Detector	Margin	Ant. angle	Table angle	Correc. Fact. (CF)
MHz	dBµV/m	dBµV/m	Pk / QP	dB	Degree	Degree	dB
All levels are at least 20dB below applicable limits							
Supplementary information: Frequency list measured has been created with pre-scan results.							
Frequency band investigated:		490kHz-30MHz					
RBW:		9kHz (150kHz-30MHz)					
Measurement distance:		10m					
Final measurement detector:		Quasi-Peak					
Limit:		FCC Part 15.209 / RSS-Gen					
Note:		CF: Correction factor = Antenna factor + Cable loss *1: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB) Loop antenna used and rotated about its axis to maximize any emission.					

Tabulated Results for Unwanted emissions (30MHz-1GHz)										
FREQ	Meter reading	Meter reading	Total factor	Field level	Field level	Pol	Antenna height	Table angle	Limit	Margin
MHz	(QP) dBμV	(Pk) dBμV	dB	(QP) dBμV/m	(Pk) dBμV/m		cm	Degree	(QP) dBμV/m	dB
Levels are at least 10dB below limits										
Supplementary information: Frequency list has been created with pre-scan results.										
Frequency band investigated:				30MHz-1GHz						
RBW:				120kHz						
Measurement distance:				3m						
Limit:				FCC Part 15.205 - 15.209 / RSS-GEN						
Final measurement detector:				Quasi-Peak						
RESULT:				PASS						

Tabulated Results for Unwanted emissions (1GHz-10GHz)										
FREQ	Field level	Field level	Limit	Margin	Limit	Margin	Table angle	Ant height	Total factor	Pol
MHz	(PK) dBμV/m	(AV) dBμV/m	(PK) dBμV/m	(PK) dB	(AV) dBμV/m	(AV) dB	Degree	cm	dB	
7401.52	58.45	43.45	74	-15.55	54	-10.55	160.8	2.07	27.15	H
8323.91	56.35	42.89	74	-17.65	54	-11.11	143	1.84	27.19	H
9289.84	53.76	41.94	74	-20.24	54	-12.06	249.3	2.34	26.82	H
7401.22	57.62	39.6	74	-16.38	54	-14.4	51.9	1.46	27.15	V
8297.67	54.32	39.7	74	-19.68	54	-14.3	107.2	1.72	27.22	V
9250.99	56.11	42.14	74	-17.89	54	-11.86	210.7	1.88	26.69	V
Supplementary information: Frequency list has been created with pre-scan results.										
RBW					1MHz					
Measurement distance:					3m					
Limit:					FCC Part 15.205, 15.209, 15.247 / RSS-Gen, RSS-247					
Final measurement detector:					Peak / CISPR Average					
RESULT:					PASS					
Notes:					(1): The field strength (level) is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follow: $FS = RA + AF + CF - AG$ Where FS = Field Strength RA = Receiver Amplitude AF = Antenna Factor CF = Cable Factor AG = Amplifier Gain Total factor (dB) is $AF + CF - AG$ Margin value = Emission level – Limit value (2): All frequencies not specified have margin < -10dB (for peak and average detector)					

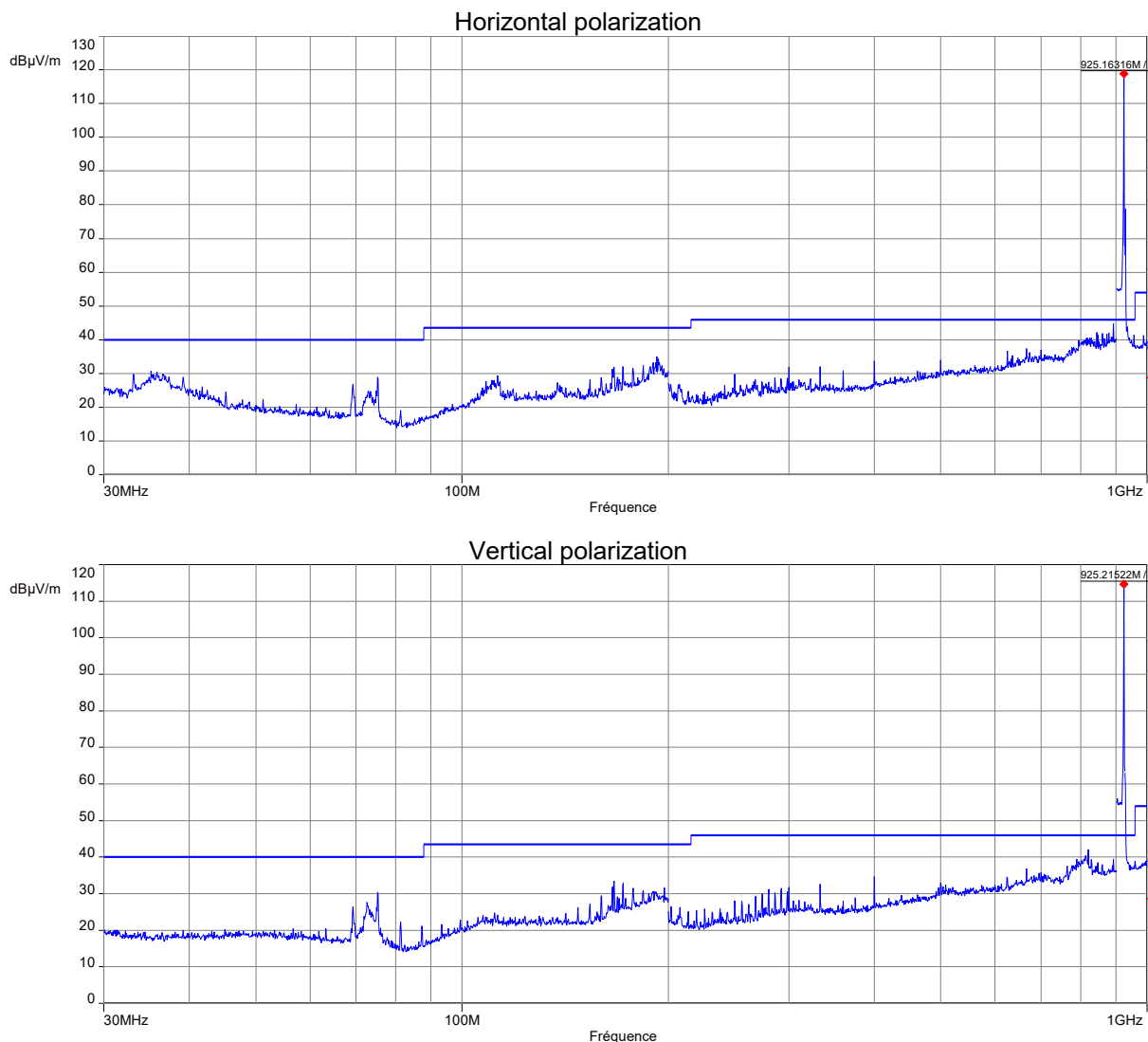
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 9kHz-30MHz / 3m / Parallel & Perpendicular antenna position / Transmit mode)



Notes: Pre-scan graph only for identification purpose.
Same result for all channels.

Frequency band investigated:	9kHz-30MHz
Unit :	dBμV/m
RBW :	200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)
Antenna polarization :	Parallel & Perpendicular to measurement axis
Measurement detector:	Peak

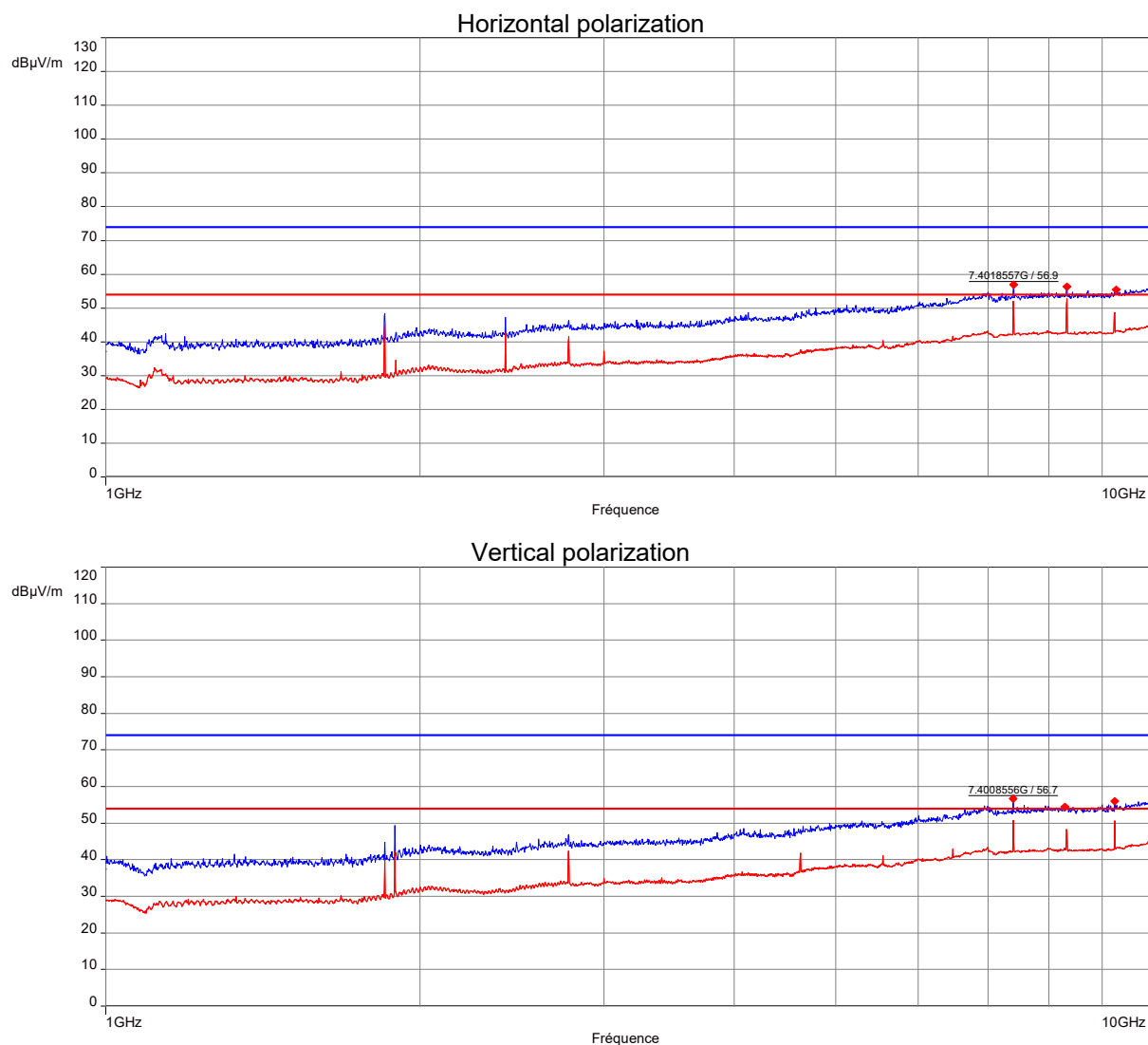
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal & Vertical



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:		30MHz-1GHz			
Unit :		dBμV/m			
RBW :		100kHz			
Antenna polarization :		Horizontal & Vertical			
Limit:		FCC 15.247 / RSS-247			
Measurement detector:		Peak			
PEAK LIST FROM PRE-SCAN					
Frequency (MHz)	Peak Level (dBμV/m)	Angle (°)	Limit (dBμV/m)	Polarization	Comments
None	-	-	-	-	Only PC's frequency

Graphical representation of Radiated Disturbance Measurement (Anechoic chamber pre-scan, 1GHz-10GHz / 3m / Horizontal & Vertical)



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-10GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average

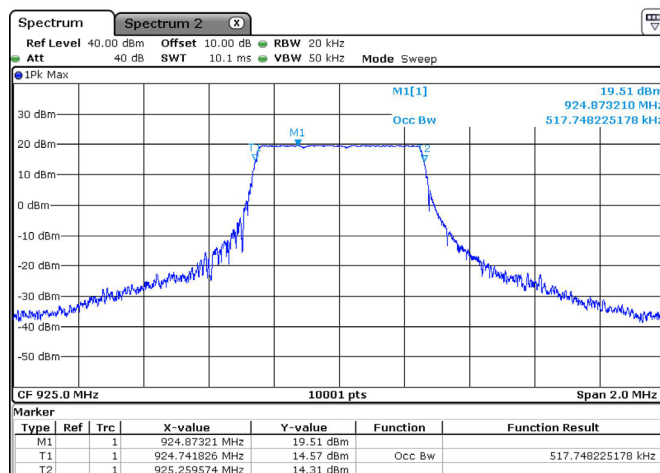
17. Occupied bandwidth (99%)

TEST: Occupied bandwidth (99%) / RSS-GEN			Verdict
Method: The setup is in an anechoic chamber. The spectrum analyzer is connected to the antenna port of the device under test. A conducted measurement is performed. The tested equipment is set to transmit operation with modulation on its nominal channel			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	17 to 27°C	21°C ± 2	
Relative Humidity	25 to 65 %	42% ± 5	
Supplementary information: Test location: SMEE Test date: May 06 Th , 2021. Tested by I C / CK			

Tabulated Results for Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (kHz)
925.0	517.748

Graphical representation of Occupied Bandwidth



END OF TEST REPORT