

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

Matériel testé :
Equipment under test:

ST / STM32WL5MOCH
(Trademark / Marketing name or product reference)

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

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

Numéro d'affaire : 15100
Work number :

Référence de la proposition : 012022-25243-1
Proposal number:

Date de l'essai : 22 mai 2023 au 10 Juin 2023
Date of test: May 22nd to June 10th, 2023

Objectif des essais : EMC qualification accordingly to following standards:
Test purpose: - 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 3
(Digital Transmission Systems Operating in the Bands 902–928 MHz)
Measurement standards:
ANSI C63.10 (2013)

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

Test réalisé par : Chemseddine KERMICHE
Test realized by:

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

Ed.	Date	Modifications Pages	Written by : Visa	Approved by: Visa
1	January 9, 2024	Initial Edition	Chemseddine KERMICHE Test operator 	Laurent Chapus Technical Manager

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Contents

1. NORMATIVES REFERENCES	3
2. TEST SYNTHESIS.....	4
3. EQUIPMENT UNDER TEST (EUT)	5
4. TEST CONDITIONS.....	7
5. MODIFICATIONS OF THE EUT	7
6. SPECIAL ACCESSORY	7
7. MEASUREMENT UNCERTAINTY	7
8. FIELD STRENGTH CALCULATION.....	7
9. TEST SETUP DIAGRAM.....	8
10. TEST EQUIPMENT LIST	10
11. CONDUCTED EMISSION MEASUREMENT (150KHZ-30MHZ)	11
12. 6DB BANDWIDTH	14
13. FUNDAMENTAL EMISSION OUTPUT POWER.....	15
14. MAXIMUM POWER SPECTRAL DENSITY LEVEL IN THE FUNDAMENTAL EMISSION	17
15. UNWANTED SPURIOUS EMISSIONS (CONDUCTED EMISSIONS).....	18
16. UNWANTED EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS (RADIATED EMISSIONS)	20
17. UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS	22
18. OCCUPIED BANDWIDTH (99%)	29

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 (June 2023)	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 (Issue3/2023)	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	Measure at 300m 9-490kHz: 2400µV/m/F(kHz) 6.370µA/m/F (kHz) Measure at 30m 0.490-1.705: 24000µV/m/F(kHz) 63.70µA/m/F (kHz) 1.705-30MHz: 30µV/m 0.08µA/m Measure at 3m 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
Antenna requirement	FCC 15.203 RSS-GEN § 6.8		PASS

- General conclusion:**

Measures and tests performed on the sample of the product STM32WL5MOCH, 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

ST / STM32WL5MOCH
(Trademark / Marketing name or product reference)

Note

The STM32WL5MOCH module is set on the MB1779 card. (B-WL5M-SUBG1 connectivity expansion board)
MB1779-HIGH-BAND-B0

FCC ID:

FCC ID: YCP-32WL5MOCH01

IC:

IC: 8976A-32WL5MOCH01

Product name / PMN:

STM32WL5MOCH

Model / HVIN:

32WL5MOCH6 / 32WL5MOCH6S

Différence de modèles /
Model differences

The STM32WLMOCH module can be delivered with or without the STSAFE option.
Ordering information:
- STM32WL5MOCH: Without STSAFE (HVIN: 32WL5MOCH6)
- STM32WL5MOCH6S : With STSAFE (HVIN: 32WL5MOCH6S)

Carte testée /
Tested Board

	SN	Cond. emissions test	6dB Bandwidth	Maximum Peak Output Power	Maximum Power Spectral Density	Unwanted emissions into Non Restricted Frequency Bands	Unwanted emissions into Restricted Frequency Bands	Occupied Bandwidth
SW HP	C231200164	X	X	X	X	X	X	X
SW HP 6S	C231200210						X	
SB HP	C231200116						X	

Note:

SW HP: High power mode with DC switch configuration
SB HP: High power mode with solder bridge switch configuration
(Solder bridge replacing the DC switch)
6S: STSAFE option (STM32WL5MOCH6S)

Alimentation /
Power supply

Input 5V on the MB1779 board. (3.5V to 5V)

Auxiliaires /
Auxiliaries

Laptop ASUS, model F200M

Entrées-Sorties /
Input / Output

	Câbles pour essai / Cables for test	Blindé / Shielded	Prévu pour >3m / Intended for >3m
None	-	-	-

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

v1.0

Programme de test /
Test program /

PC test: serial command terminal
AT slave command:
For 925MHz High Power
AT+TCONF=925000000:22:6:10:4/5:0:1:16:25000:2:3
AT+TTX=5000

**Informations
supplémentaires /
Additional informations**

Declaration of the applicant:

- Type of technology: Proprietary RF protocol
- Frequency transmission band: 925MHz.
- 1 channel used in DTS mode
- Power setting: 22dBm (Max) for High Power
- Modulation: LORA with 500kHz nominal BW / SF10
- 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**

122mm x 30 x 12 (Board)
Antenna length is 56.8mm

Note: The above information are declared by the manufacturer/customer and are under his responsibility.

4. Test conditions

Power supply voltage:

Equipment under test:

Auxiliaries:

3.7V DC (Battery) or 5V from external power supply (conducted emission)

120V/60Hz (AC mains for 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 (30-200MHz, SAC 3m)	± 5.6dB
Radiated emission test (200-1000MHz, SAC 3m)	± 5.3dB
Radiated emission test (1-18GHz, FAC 3m)	± 5.6dB
Radiated emission test (18-40GHz, FAC 3m)	± 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

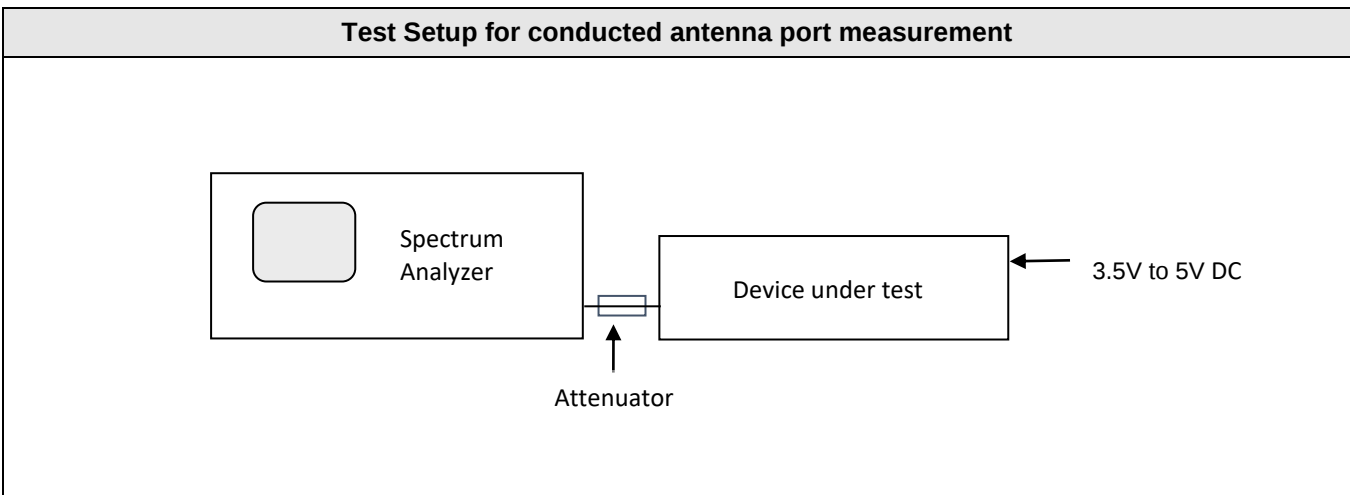
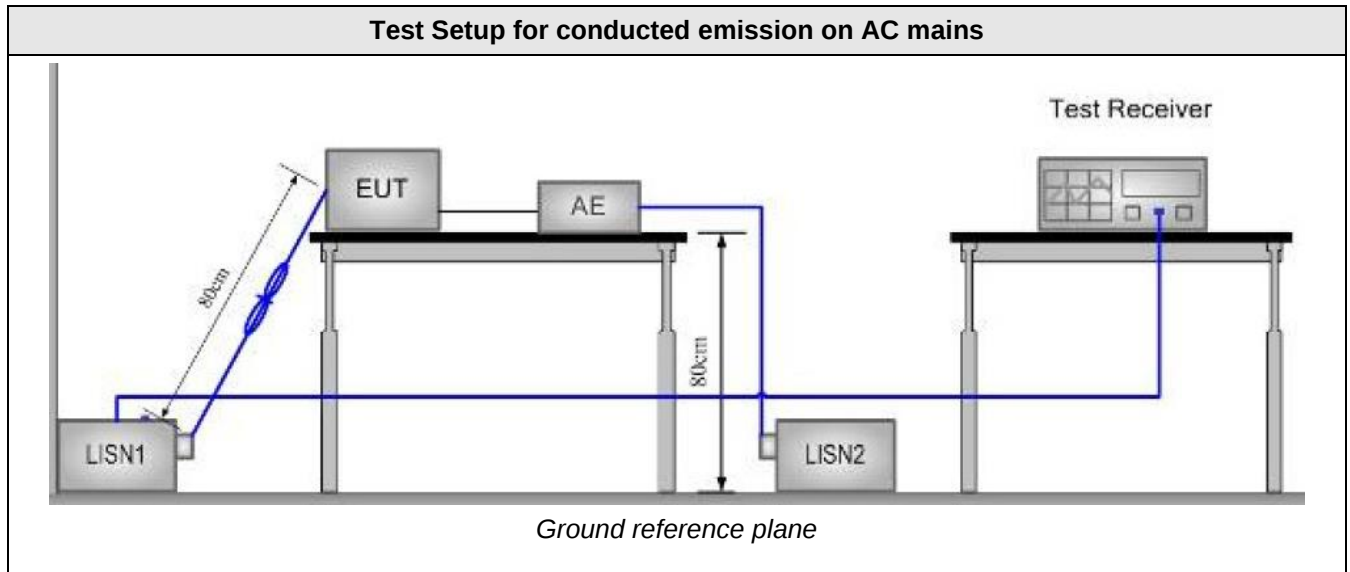
Example:

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

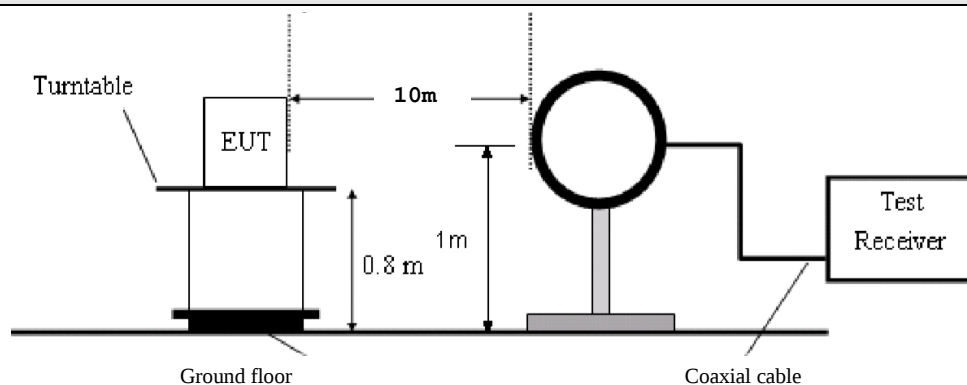
→ Total factor: 5dBm⁻¹

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

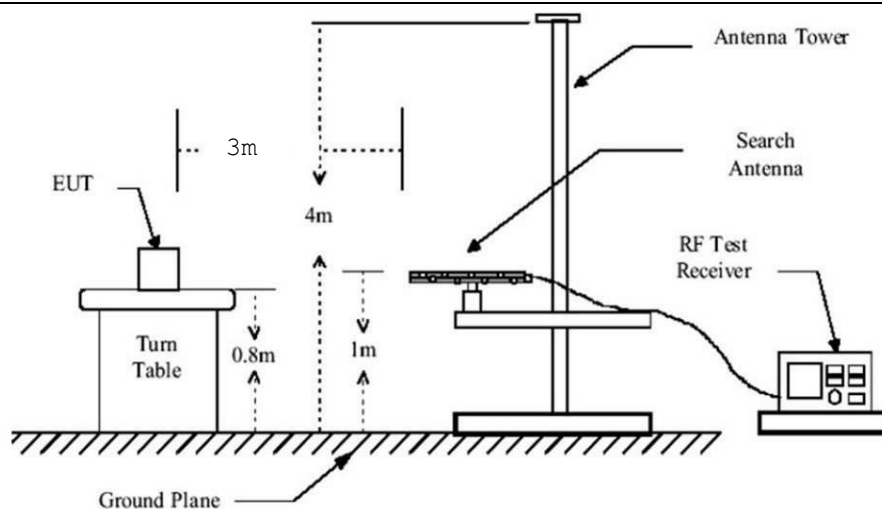
9. Test Setup Diagram



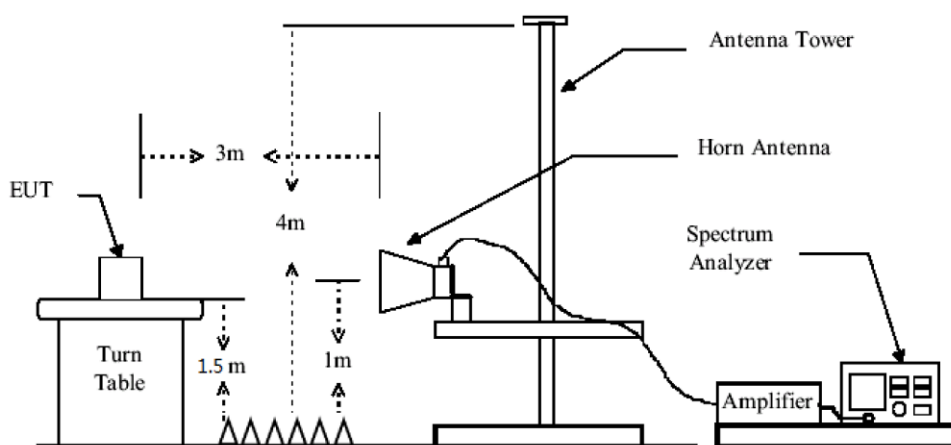
Test Setup for radiated emission



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)

10. Test Equipment List

Test Equipment Used for conducted emission on AC mains					
Description	Manufacturer	Model	ID	Date Cal.	Nxt. Cal.
AC power supply	PACIFIC POWER	AMX-125	ALI-101-002	-	-
Attenuator / limiter	SMEE	ATT#2	ATT-171-010	2023/4	2024/4
Cable RF	RADIALL	RG58 / BNC	CAB-211-042	2023/4	2024/4
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2021/9	2023/11
LISN (50Ω / 50μH) (Meas.)	AFJ	LS16C	RSI-101-001	2021/7	2023/7
EMC Software	NEXIO	BAT EMC	SOF-101-001	-	-

Test Equipment Used for conducted antenna port measurement					
Description	Manufacturer	Model	ID	Date Cal.	Nxt. Cal.
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2021/9	2023/11
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2021/10	2023/10
RF Attenuator	Mini-Circuit	BW-N10W5+	ATT-171-008	2023/4	2024/4
EMC Software	NEXIO	BAT EMC	SOF-101-001	-	-

Test Equipment Used for radiated measurement					
Description	Manufacturer	Model	ID	Date Cal.	Nxt. Cal.
Log-periodic antenna	EMCO	3146	ANT-191-019	2021/7	2024/1
Biconnic antenna	COM-POWER	AB- 900A	ANT-201-021	2023/1	2025/1
Horn antenna	COM-POWER	AH-118	ANT-101-004	2021/7	2024/7
Loop antenna	EMCO	6502	ANT-101-009	2021/8	2023/8
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2021/10	2023/10
RF cable	HUBER+SUHNER	SF126E / 2m	CAB-231-043	2023/4	2024/4
RF cable	HUBER+SUHNER	SF104E / 5.3m	CAB-231-044	2023/4	2024/4
RF cable	HUBER+SUHNER	SF126E / 7m	CAB-231-045	2023/4	2024/4
Semi anechoic room	COMTEST	218292	CAG-201-002	2022/4	2025/2
High-Pass filter	Wainwright Inst.	HK6-948-1200	FIL-141-004	2023/4	2024/4
Antenna mast	Innco- Systems	MA4640-XP-ET	MAT-201-002	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-
Turntable	Innco- Systems	DS1500-S-1t	PLA-201-003	-	-
Pre-amplifier	COM-POWER	1-18GHz	PRE-221-005	2023/4	2024/4
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2021/9	2023/11
FS OATS	Div	10m	SIT-201-002	-	-
EMC Software	NEXIO	BAT EMC	SOF-101-001	-	-

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

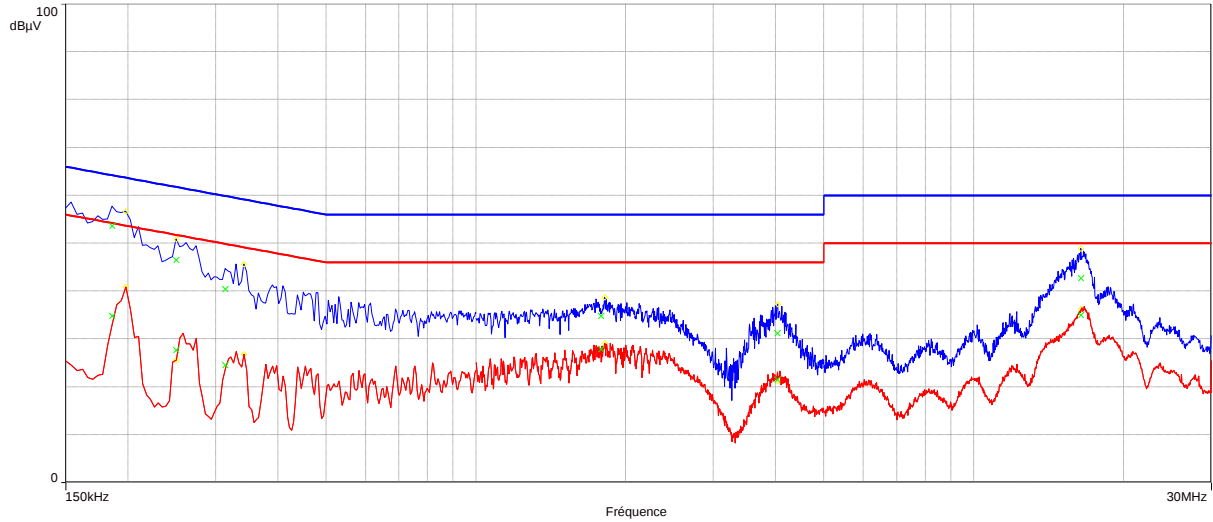
TEST: Limits for conducted disturbance 150kHz – 30MHz				Verdict
<u>Method:</u> The LISN is placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane. This distance was between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment 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 (120V)
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: June 26 th , 2023 by C. KERMICHE. Power supply voltage: 5V DC via Port-USB and 120V AC 60Hz for the laptop.				

Tabulated Results for Mains Terminal Disturbance Voltage on AC port

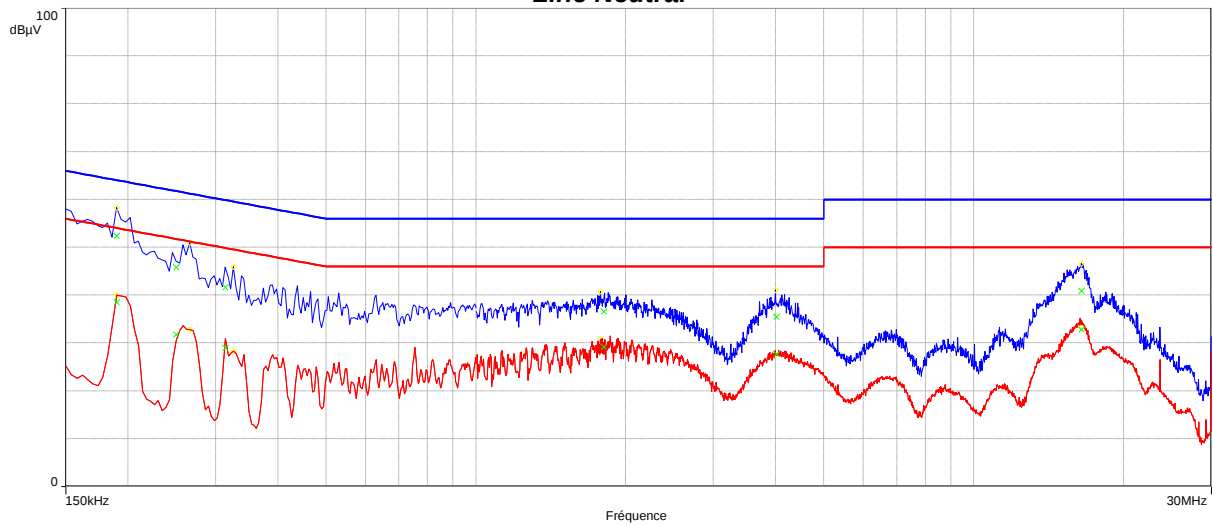
FREQ	Meas. PK	Mes. QP	LIMIT QP	Margin QP	Mes. AV	LIMIT AV	Margin AV	Line
(MHz)	(dBμV)	(dBμV)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.187928	57.50	53.64	64.21	-10.57	34.76	54.21	-19.45	L1
0.25	50.85	46.45	61.76	-15.30	27.67	51.76	-24.09	L1
0.313259	45.58	40.44	59.86	-19.43	24.51	49.86	-25.36	L1
1.784909	38.76	34.77	56.00	-21.23	27.83	46.00	-18.17	L1
4.031583	37.11	31.15	56.00	-24.85	21.53	46.00	-24.47	L1
16.417453	48.57	42.66	60.00	-17.34	34.97	50.00	-15.03	L1
0.189566	58.14	52.38	64.04	-11.65	38.51	54.04	-15.52	N
0.25037	51.87	45.87	61.76	-15.89	31.72	51.76	-20.03	N
0.315146	48.54	41.61	59.86	-18.26	28.97	49.86	-20.89	N
1.807959	40.96	36.57	56.00	-19.43	29.17	46.00	-16.83	N
4.015369	41.01	35.42	56.00	-20.58	27.70	46.00	-18.30	N
16.463195	46.66	40.88	60.00	-19.12	32.81	50.00	-17.19	N
Frequency band investigated:		150kHz-30MHz						
RBW:		9kHz						
Voltage:		120V / 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						
Note:		Same results for all running modes / tested boards						

Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) - AC port -

Line L1



Line Neutral



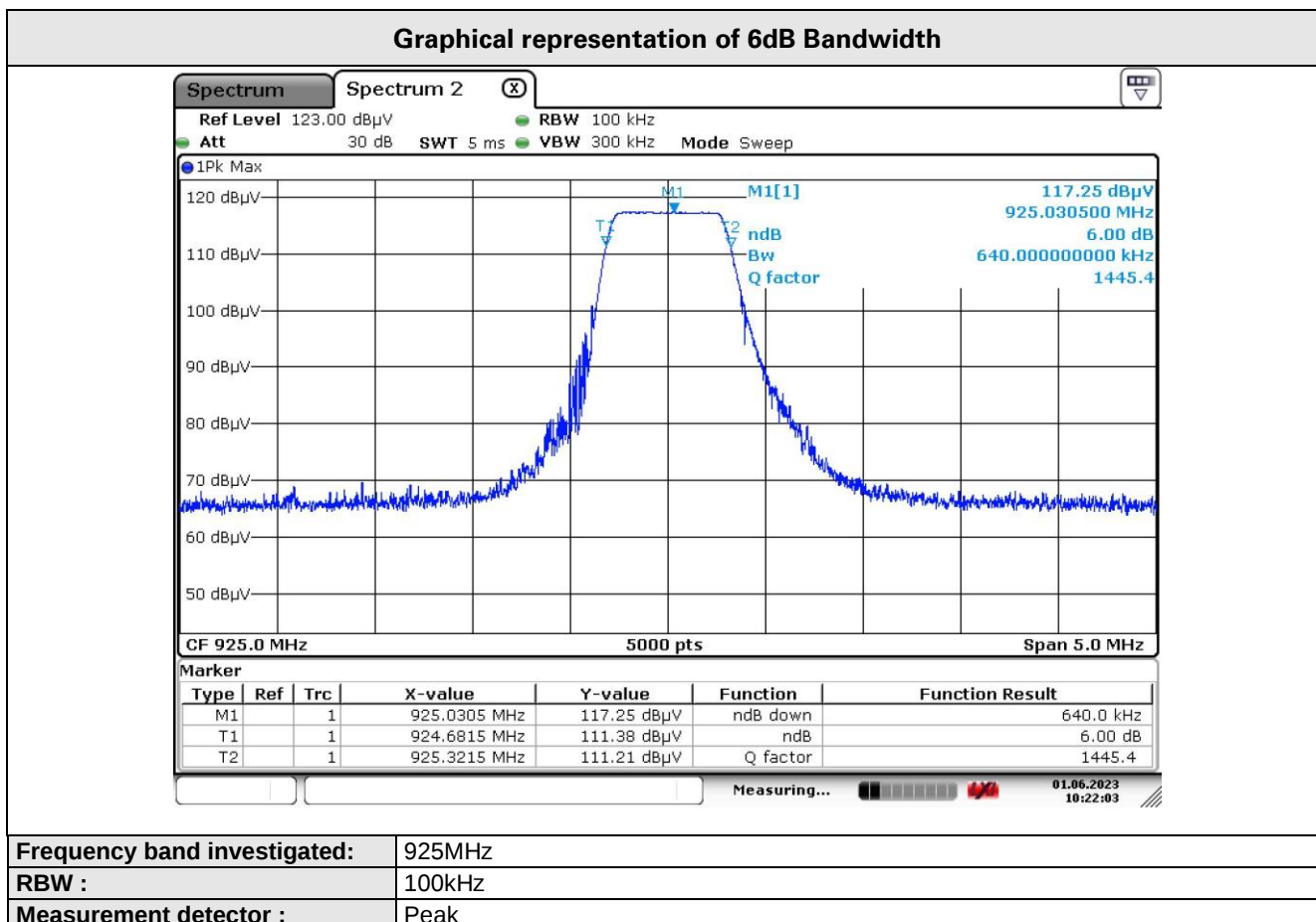
----: Peak

----: Average

12. 6dB Bandwidth

TEST: 6dB Bandwidth		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	
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: June 1 st , 2023 by C. KERMICHE Power supply voltage: 3.7V		

Tabulated Results for Occupied Bandwidth		
Frequency (MHz)	6dB Bandwidth (kHz)	Result
925.0	640.0	Pass



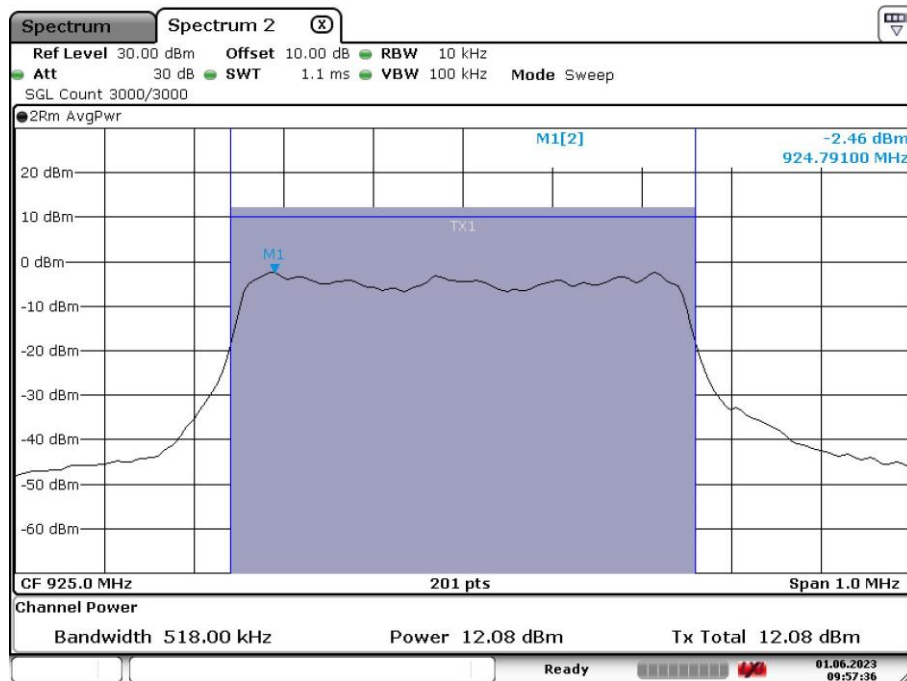
13. Fundamental emission output power

TEST: Maximum conducted output power			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	22°C ± 2	
Relative Humidity	25 to 65 %	45% ± 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: June 1 st , 2023 by C. KERMICHE Power supply voltage: 3.7V			

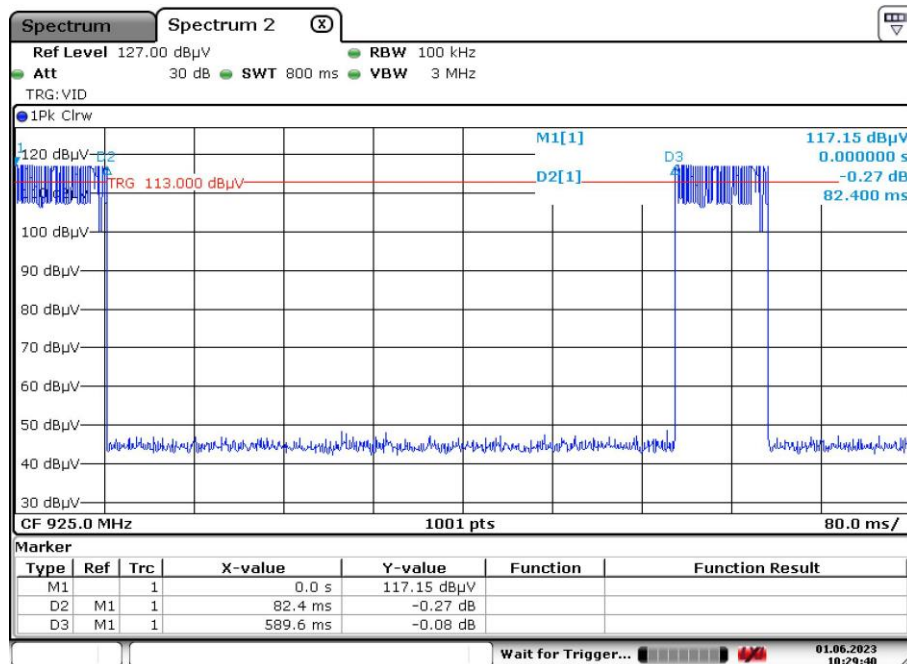
Tabulated Results for Maximum (Average) output power (Conducted)					
FREQ (MHz)	Measured conducted power (dBm)	Duty cycle factor (dB)	Maximum output power (dBm)	Limit (dBm)	Result
925.0	12.08	8.6	20.6	30.0	Pass
RESULT:		PASS			
Note:		- Method used is AVGSA-2 - Duty cycle factor is $10 \cdot \log(1/D)$ where D is the duty cycle - Duty cycle measurement as per 11.6 of ANSI C63.10: $T_{X\ ON} = 82.4\text{ms}$ $T_{TOTAL} = 589.6\text{ms}$ $D = 0.14$			

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	20.6	2.0	22.6	36.0	Pass
RESULT:		PASS			

Graphical representation of Conducted output power



925MHz



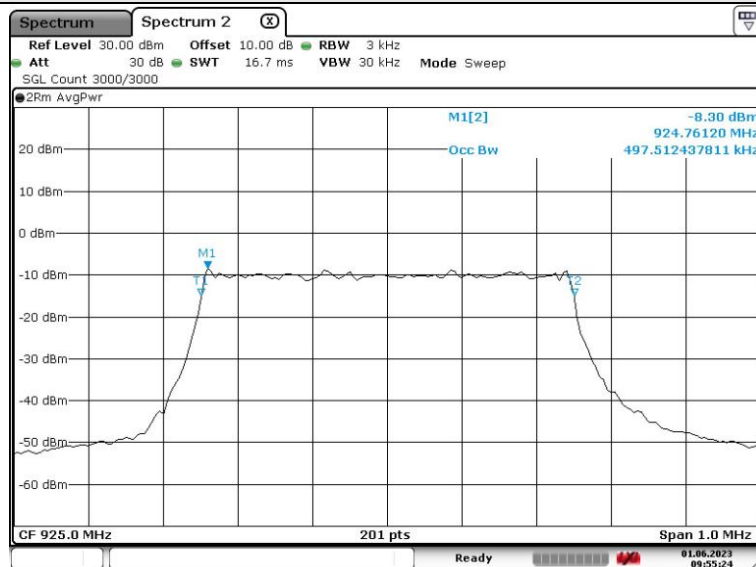
Duty cycle measurement

14. Maximum Power Spectral Density Level in the fundamental emission

TEST: Maximum Peak Power Spectral Density			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	22°C ± 2	
Relative Humidity	25 to 65 %	45% ± 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: June 1 st , 2023 by C. KERMICHE Power supply voltage: 3.7V			

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	-8.3	8.6	0.3	8dBm/3kHz	Pass
RESULT:		PASS			
Note:		- RBW used is 3kHz - Method used is AVGPSD-2 - Duty cycle measurement as per 11.6 of ANSI C63.10: $T_{x\text{ ON}} = 82.4\text{ms}$ $T_{\text{TOTAL}} = 589.6\text{ms}$ $D = 0.14$			

Graphical representation of Conducted output power density

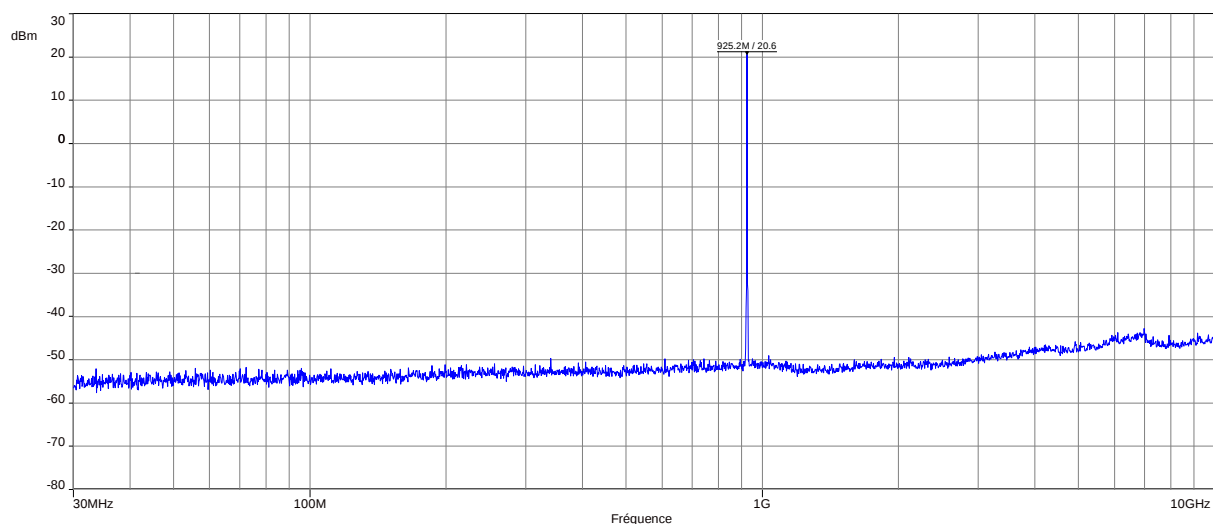


925MHz

15. Unwanted Spurious Emissions (Conducted emissions)

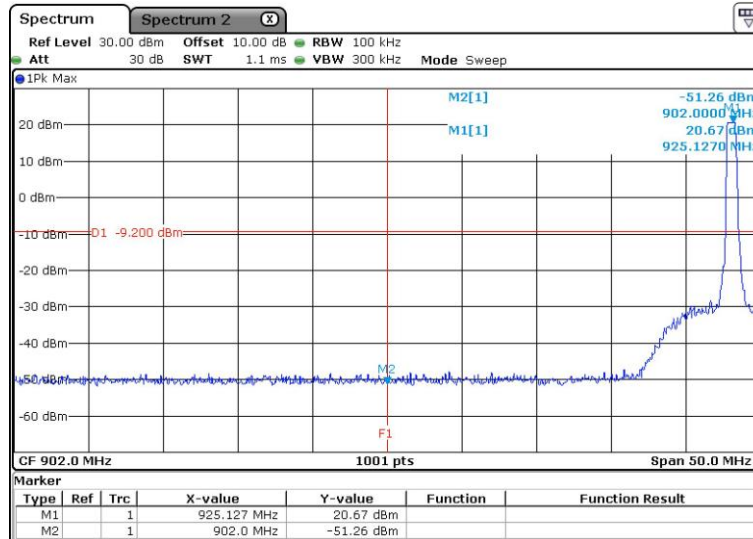
TEST: Conducted Spurious emissions			Verdict
<u>Method:</u> The setup is in an anechoic chamber. The spectrum analyzer is connected to the antenna port of the device under test. A conducted measurement is performed. The tested equipment is set to transmit operation with modulation on its nominal channel			Pass
Laboratory Parameters:	Required prior to the test		During the test
Ambient Temperature	17 to 27°C		22°C ± 2
Relative Humidity	25 to 65 %		45% ± 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: June 1 st , 2023 by C. KERMICHE Power supply voltage: 3.7V			

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



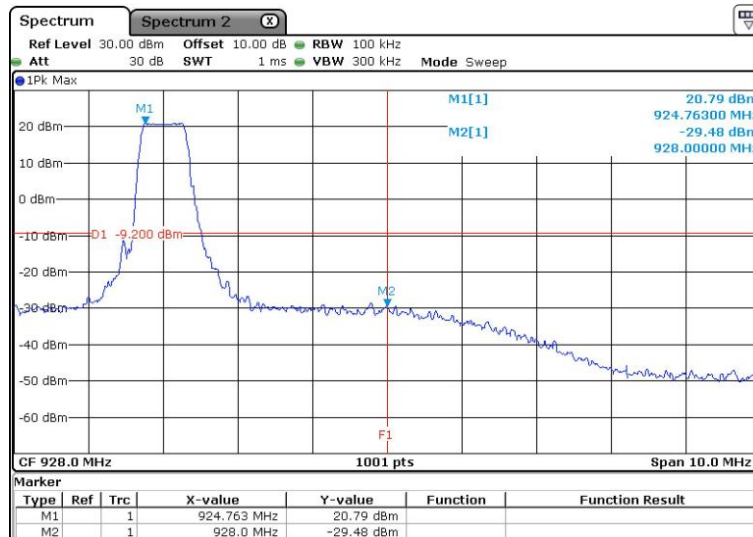
Frequency band investigated:	30MHz-10GHz
Unit:	dBm
RBW:	100kHz (Frequency step 50kHz)
Measurement detector:	Peak
Limit:	-9.4 dBm

Graphical representation of Band-edge compliance (LOW)



Unit :	dBm
RBW :	100kHz
Measurement detector:	Peak
Limit:	-9.3dBm
Note:	F1 is 902MHz

Graphical representation of Band-edge compliance (High)



Unit :	dBm
RBW :	100kHz
Measurement detector:	Peak
Limit:	-9.2dBm
Note:	F1 is 928MHz

16. 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	22°C ± 2	
Relative Humidity	25 to 65 %	45% ± 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)		
	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 26 th , 2023 by C. KERMICHE Power supply voltage: 3.7V			

Tabulated Results for Peak Output Radiated level	
FREQ	Field Strength 3m
(MHz)	(dBμV/m)
925	119.7
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 89.7 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	Field Strength 3m	Limit	Margin	Result
(MHz)	(dBμV/m)	(dBμV/m)	(dBμV/m)	(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.			

17. 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 26th, 2023 by C. KERMICHE Power supply voltage: 3.7V		

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 10dB 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.					

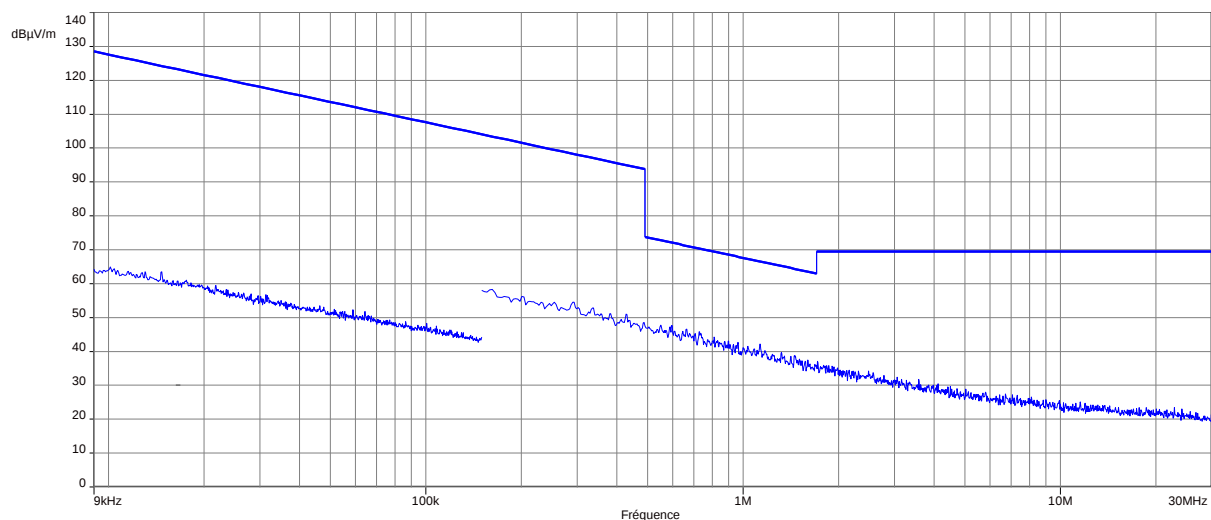
Tabulated Results for Unwanted emissions (490kHz-30MHz)							
FREQ	RF field @ 30m	Limit @ 30m	Detector	Margin	Ant. angle	Table angle	Correc. Fact. (CF)
MHz	dBμV/m	dBμV/m	Pk / QP	dB	Degree	Degree	dB
All levels are at least 10dB below applicable limits							
Supplementary information: Frequency list 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 / RSS-Gen clause 6.5) (M@30m = M@10m-19.1dB) Loop antenna used and rotated about its axis to maximize any emission.					

Tabulated Results for Radiated Disturbance (3m measurement in semi anechoic room, 30MHz-1GHz)								
FREQ MHz	Field level (Pk) dBμV/m	Field level (QP) dBμV/m	Limit (QP) dBμV/m	Margin dB	Table angle Degree	Antenna height m	Total factor dB	Pol H/V
All levels are at least 10dB below applicable limits								
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					

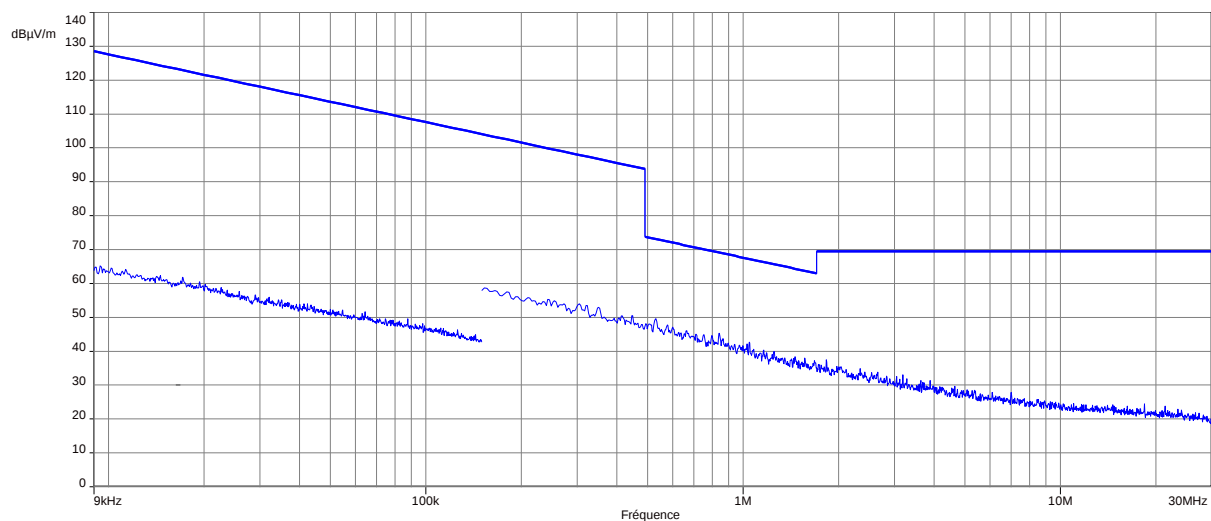
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 9kHz-30MHz / 3m / Parallel & Perpendicular antenna position / Transmit mode)

Board SW HP: SN C231200164

Parallel



Perpendicular



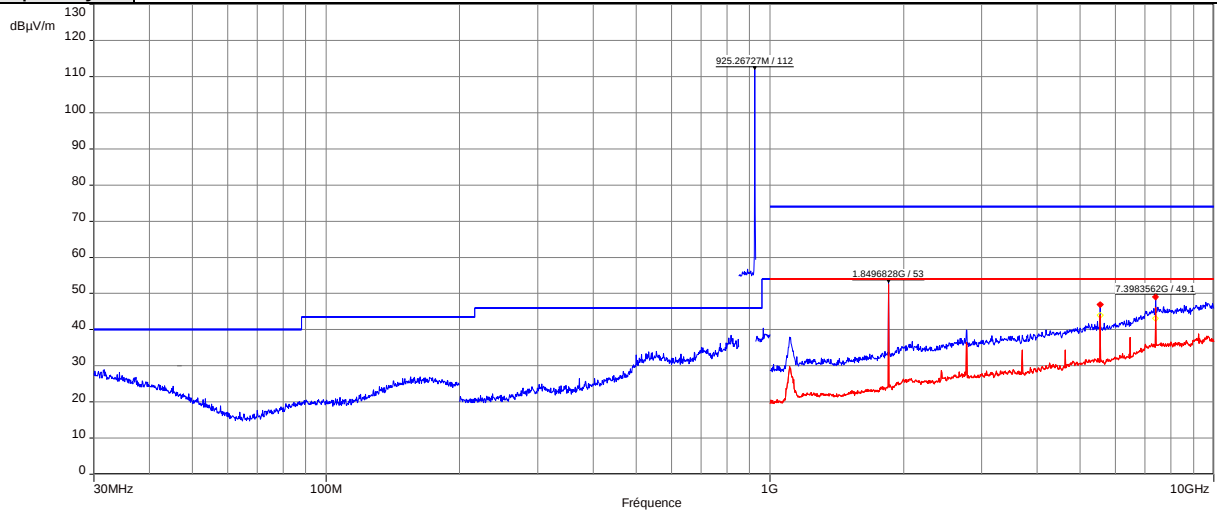
Frequency band investigated:	9kHz-30MHz
Unit :	dBμV/m
RBW :	200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)
Antenna polarization :	Parallel & Perpendicular to measurement axis.
Measurement detector:	Peak.
Notes:	Pre-scan graph only for identification purpose. Same result for all tested boards.

Graphical representation of Radiated Disturbance Measurement (Peak detection, Full Anechoic Chamber pre-scan, 30MHz-10GHz / 3m / Transmit mode / Worst position)

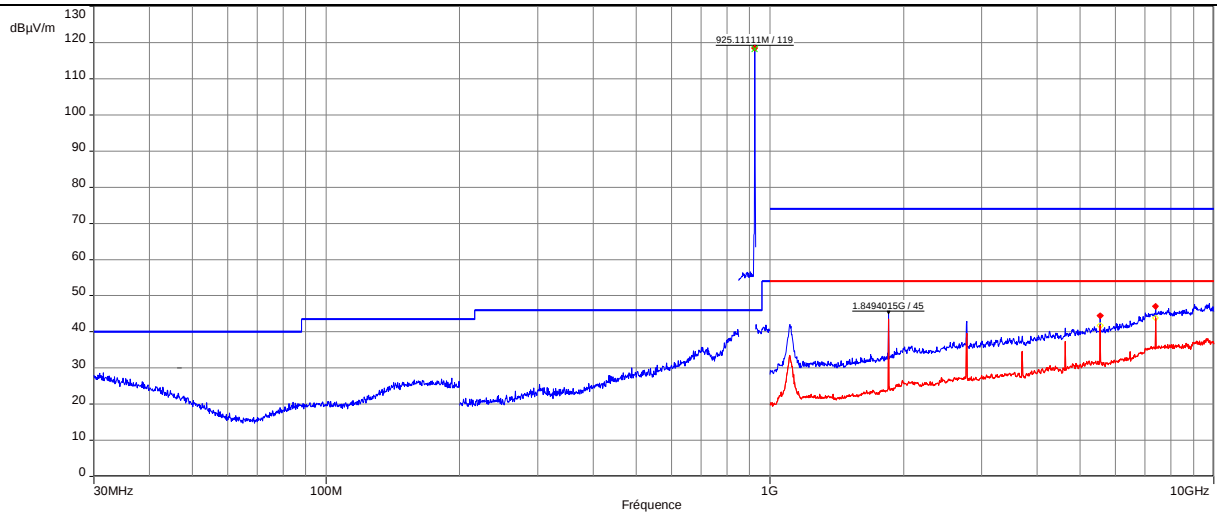
Board : SW HP: SN C231200164

Center frequency: 925 MHz

HORIZONTAL POLARIZATION



VERTICAL POLARIZATION



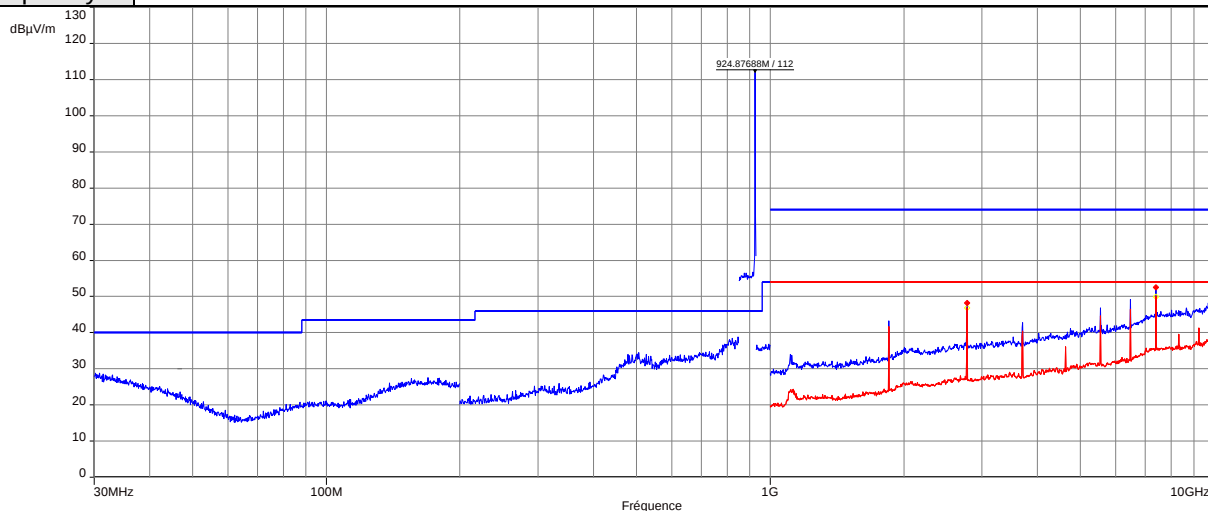
FREQ	Field level	Field level	Limit	Margin	Limit	Margin	Table angle	Ant height	Total factor	Pol	Note
MHz	(PK) dBμV /m	(AV) dBμV/m	(PK) dBμV/m	(PK) dB	(AV) dBμV/m	(AV) dB	Degree	m	dB		
5550.09929	46.45	29.94	74.00	-27.55	54.00	-24.06	169.10	1.09	0.20	H	(1)
7398.24124	50.34	34.06	74.00	-23.66	54.00	-19.94	61.90	2.04	5.11	H	(1)
5550.31125	45.09	29.24	74.00	-28.91	54.00	-24.76	231.00	1.61	0.20	V	(1)
7400.47152	50.53	34.38	74.00	-23.47	54.00	-19.62	211.10	2.62	5.11	V	(1)
RBW :			100kHz < 1GHz and 1MHz > 1GHz.								
Final measurement detector:			Quasi-Peak below 1GHz. Peak and CISPR Average above 1GHz.								
Note:			(1) Restricted band.								

Graphical representation of Radiated Disturbance Measurement (Peak detection, Full Anechoic Chamber pre-scan, 30MHz-10GHz / 3m / Transmit mode / Worst position)

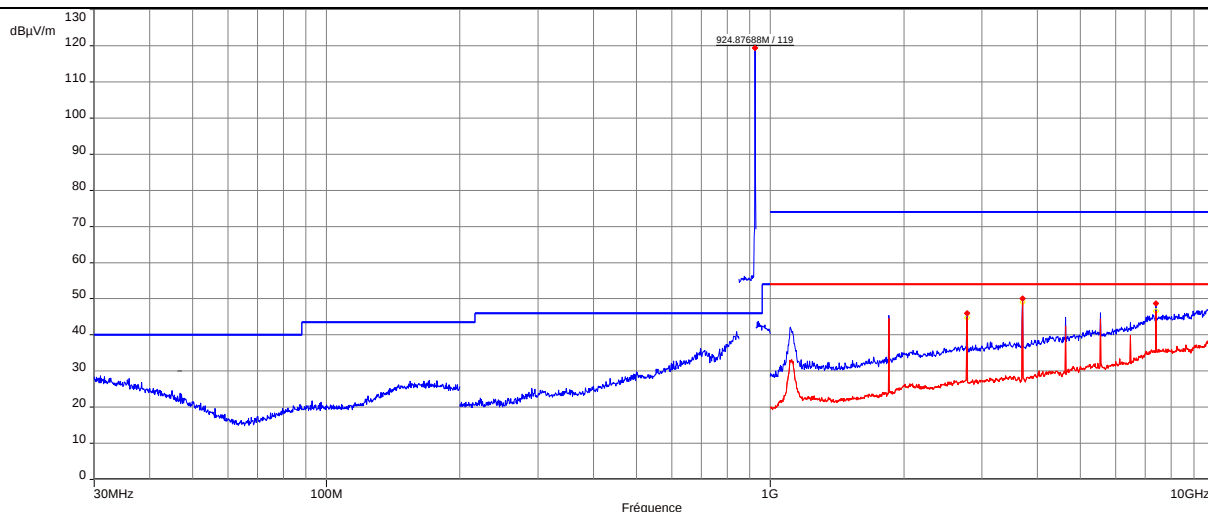
Board : SW HP 6S: SN C231200210

Center frequency: 925 MHz

HORIZONTAL POLARIZATION



VERTICAL POLARIZATION



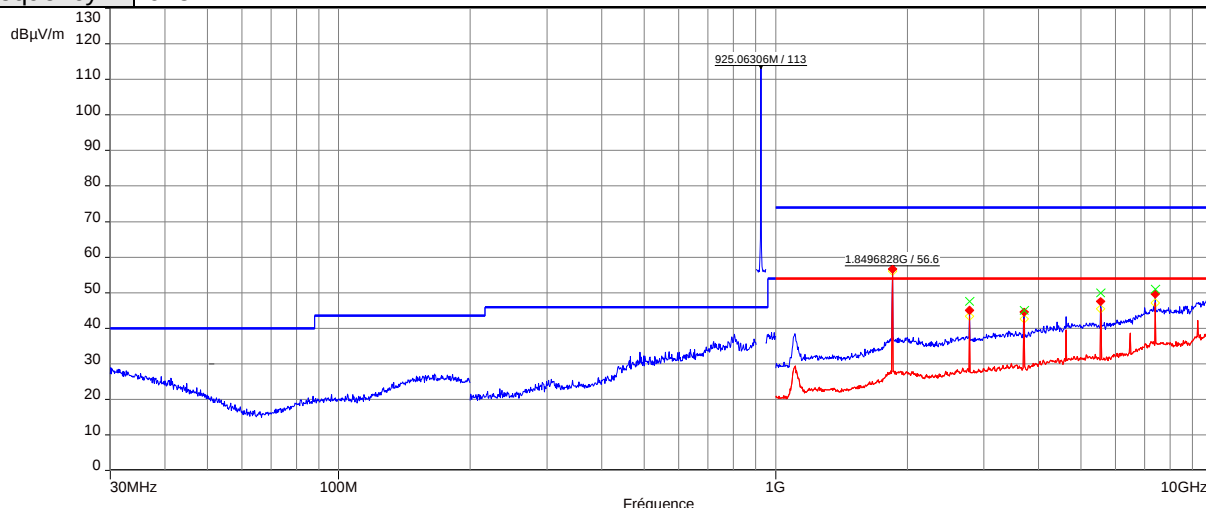
FREQ	Field level	Field level	Limit	Margin	Limit	Margin	Table angle	Ant height	Total factor	Pol	Note
MHz	(PK) dBμV/m	(AV) dBμV/m	(PK) dBμV/m	(PK) dB	(AV) dBμV/m	(AV) dB	Degree	m	dB		
2775.45418	52.63	30.29	74.00	-21.37	54.00	-23.71	88.70	1.09	-6.77	H	(1)
7401.2721	52.59	35.25	74.00	-21.41	54.00	-18.75	239.20	2.38	5.11	H	(1)
2775.59297	50.47	27.68	74.00	-23.53	54.00	-26.32	159.90	1.39	-6.77	V	(1)
3698.93521	47.74	26.25	74.00	-26.26	54.00	-27.75	158.50	1.33	-5.62	V	(1)
7401.48917	51.19	34.20	74.00	-22.81	54.00	-19.80	271.30	1.09	5.11	V	(1)
RBW :			100kHz < 1GHz and 1MHz > 1GHz.								
Final measurement detector:			Quasi-Peak below 1GHz. Peak and CISPR Average above 1GHz.								
Note:			(1) Restricted band.								

Graphical representation of Radiated Disturbance Measurement (Peak detection, Full Anechoic Chamber pre-scan, 30MHz-10GHz / 3m / Transmit mode / Worst position)

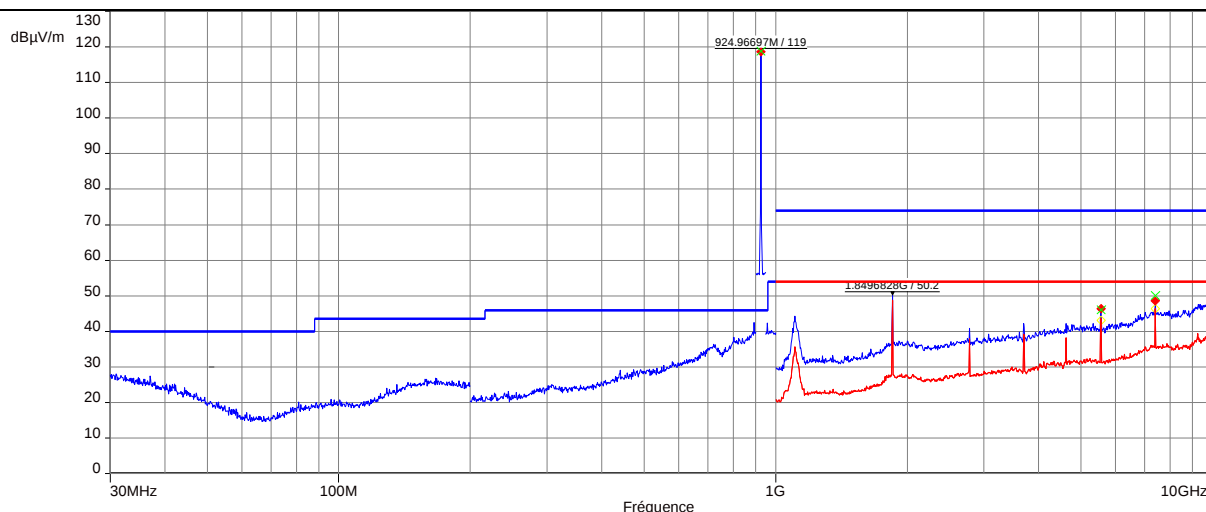
Board: SB HP: SN C231200116

Center frequency: 925 MHz

HORIZONTAL POLARIZATION



VERTICAL POLARIZATION



FREQ	Field level	Field level	Limit	Margin	Limit	Margin	Table angle	Ant height	Total factor	Pol	Note
MHz	(PK) dBμV /m	(AV) dBμV/m	(PK) dBμV/m	(PK) dB	(AV) dBμV/m	(AV) dB	Degree	m	dB		
2775.34546	47.64	30.56	74.00	-26.36	54.00	-23.44	257.00	1.09	-5.57	H	(1)
3700.58041	44.96	28.87	74.00	-29.04	54.00	-25.13	127.00	2.63	-4.12	H	(1)
5550.25911	49.92	33.27	74.00	-24.08	54.00	-20.73	60.80	2.36	0.90	H	(1)
7398.70108	50.93	34.96	74.00	-23.07	54.00	-19.04	249.20	2.64	6.21	H	(1)
5551.53687	46.14	30.11	74.00	-27.86	54.00	-23.89	260.00	1.09	0.41	V	(1)
7399.74247	50.05	34.06	74.00	-23.95	54.00	-19.94	88.70	2.17	5.51	V	(1)
RBW :			100kHz < 1GHz and 1MHz > 1GHz.								
Final measurement detector:			Quasi-Peak below 1GHz. Peak and CISPR Average above 1GHz.								
Note:			(1) Restricted band.								

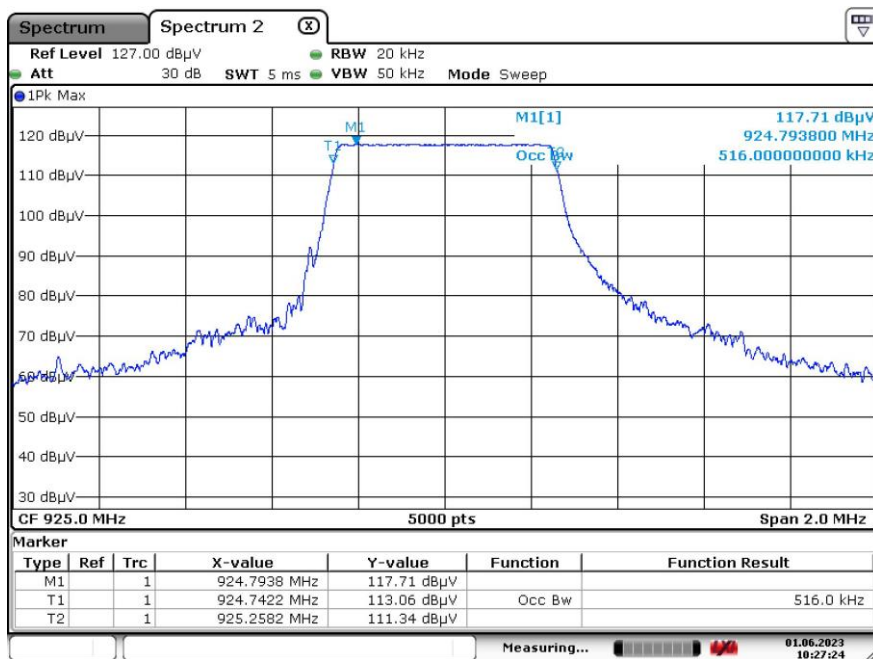
18. Occupied bandwidth (99%)

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	22°C ± 2	
Relative Humidity	25 to 65 %	45% ± 5	
Supplementary information: Test location: SMEE Test date: June 1 st , 2023 by C. KERMICHE Power supply voltage: 3.7V			

Tabulated Results for Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (kHz)
925.0	516.0

Graphical representation of Occupied Bandwidth



END OF TEST REPORT.