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 2	June 16th, 2021 October 29th, 2021	Initial Edition TCB review (ATCB027692)	Laurent CHAPUS *Test Operator* Signature numérique de CHAPUS L.	Régis ANCEL *General Manager* Signature numérique de Ancel Régis

Contents

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	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 Bandwidwth	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***

	Câbles pour essai / *Cables for test*	Blindé / *Shielded*	Prévu pour >3m / *Intended for >3m*
US 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: Expended uncertainty at 95% confidence (k=2)

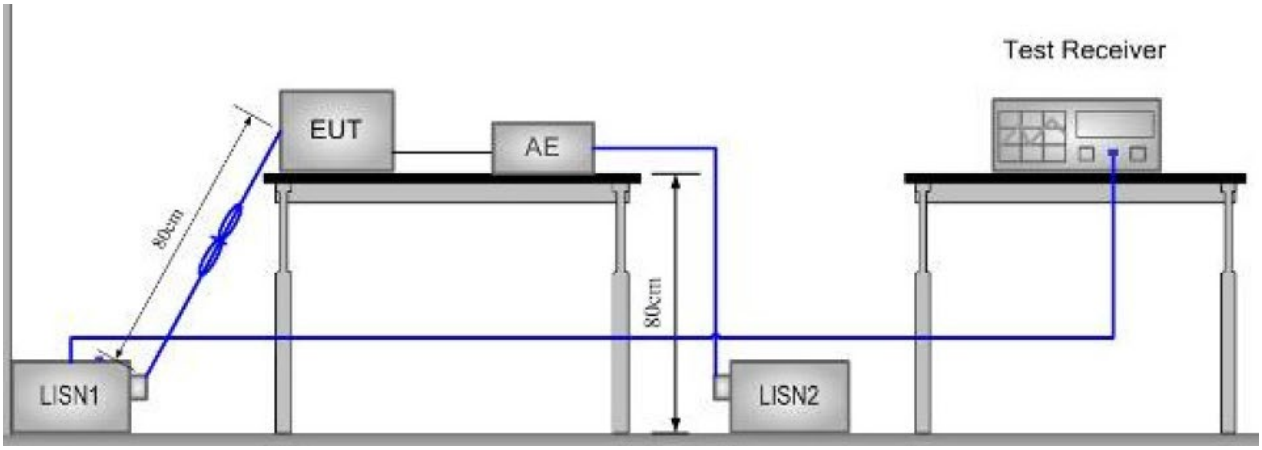
8. Field Strength Calculation

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

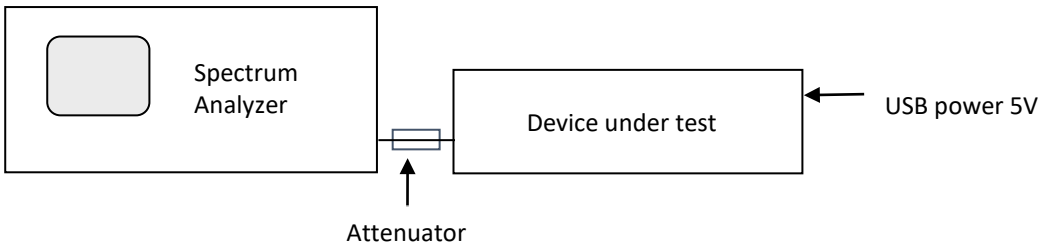
Test Setup for conducted emission on AC mains



Ground reference plane

Test Equipment Used for conducted emission on AC mains

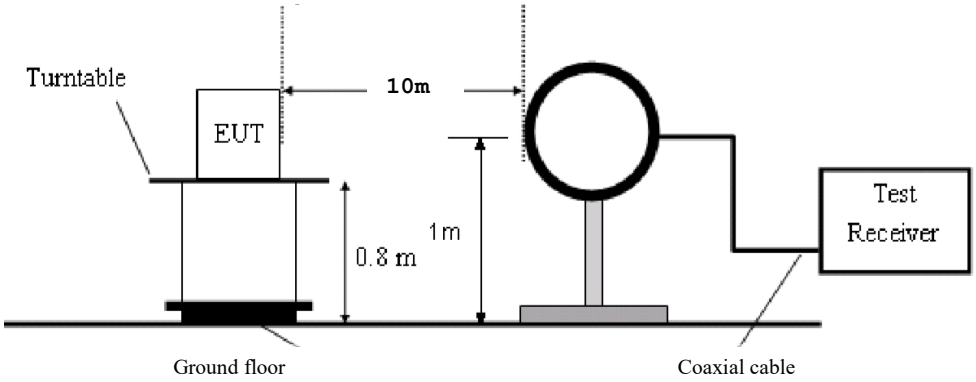
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
AC power supply	PACIFIC POWER	AMX-125	ALI-101-002	-	-
Attenuator / limiter	SMEE	ATT#2	ATT-171-010	2021/3	2022/3
Cable RF	Div	1m	CAB-101-021	2021/3	2022/3
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2019/9	2021/9
LISN (50Ω / 50µH) (Meas.)	AFJ	LS16C	RSI-101-001	2019/6	2021/6
LISN (50Ω / 50µH) (Aux.)	AFJ	LS16C	RSI-111-002	2019/6	2021/6
EMC Software	NEXIO	BAT EMC V3.18	SOF-101-001	-	-

Test Setup for conducted antenna port measurement


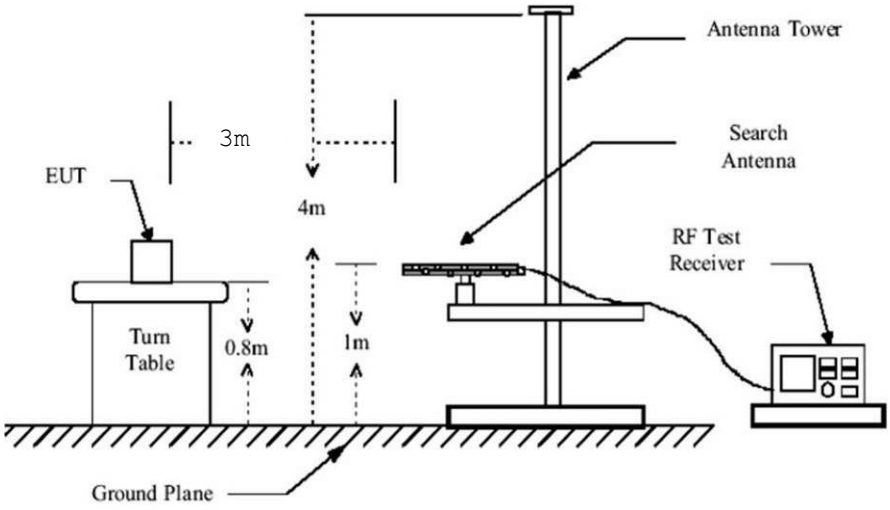
Test Equipment Used for conducted antenna port measurement

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	-	-

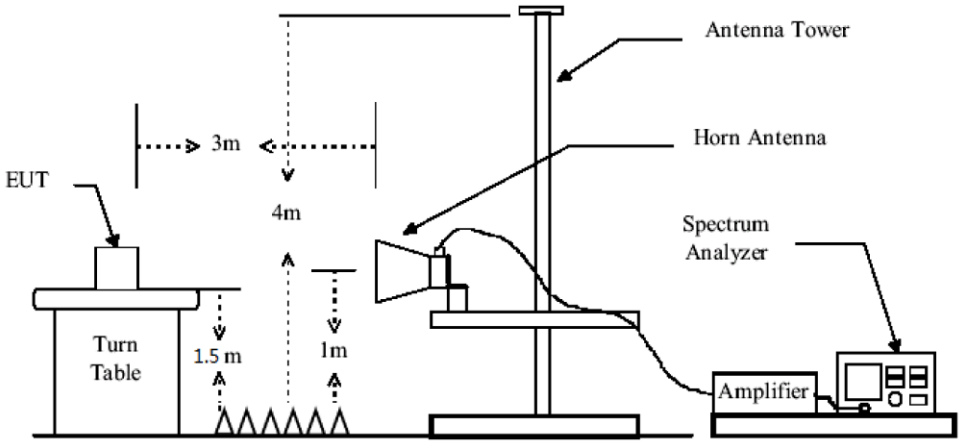
Test Setup for radiated emission



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**

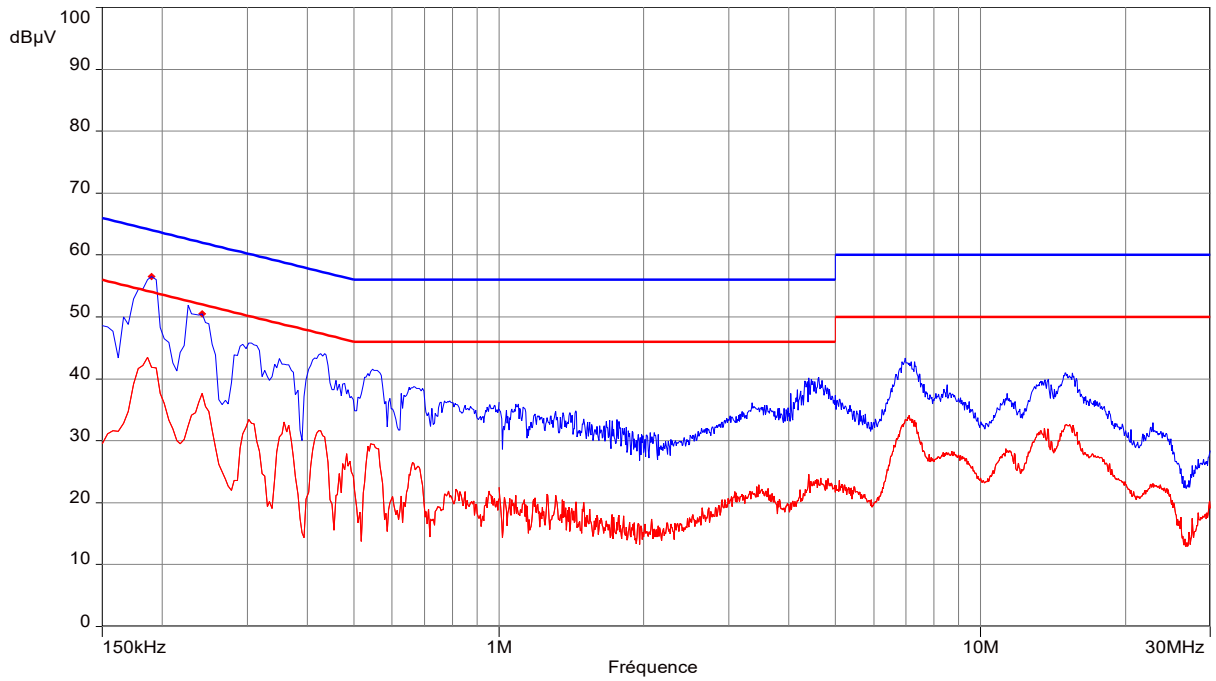
Supplementary information:
Test location: SMEE
Test date: May 10th, 2021. Tested by C. KERMICHE
Power supply voltage: AC mains 110V/60Hz

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)	
0.19	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: Meas. = RA + CF + ATT_{TRAN} + ATT_{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)

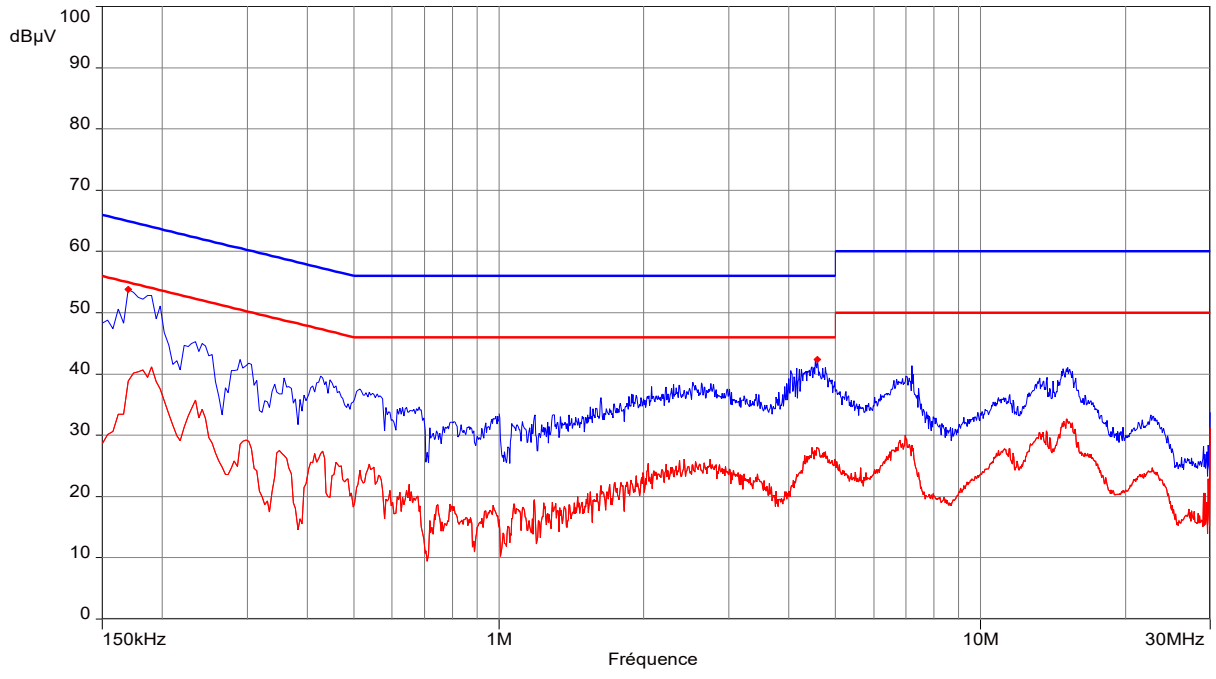
Graphical representation of Conducted Disturbance Measurement (Peak and Average detection)
AC port, Line L1



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.

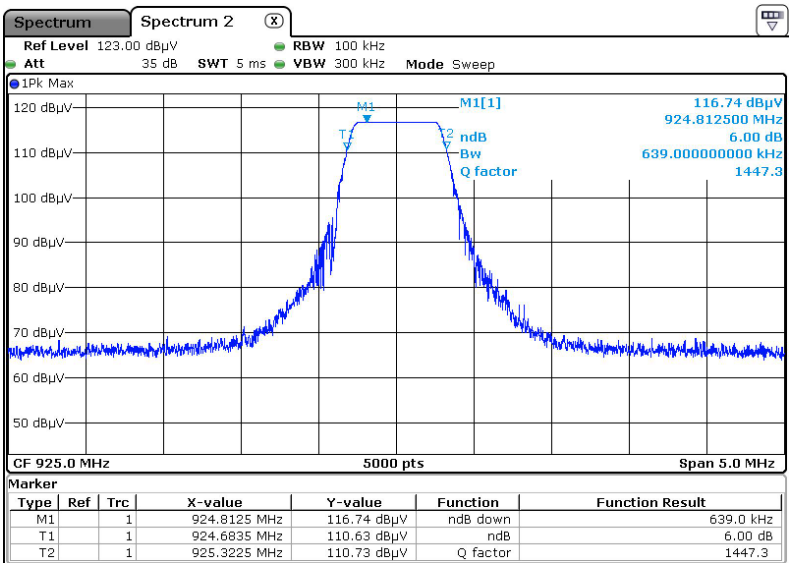
----: Peak	----: Average	

11. 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	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 06Th, 2021. Tested by LC / CK		

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

Graphical representation of 6dB Bandwidth



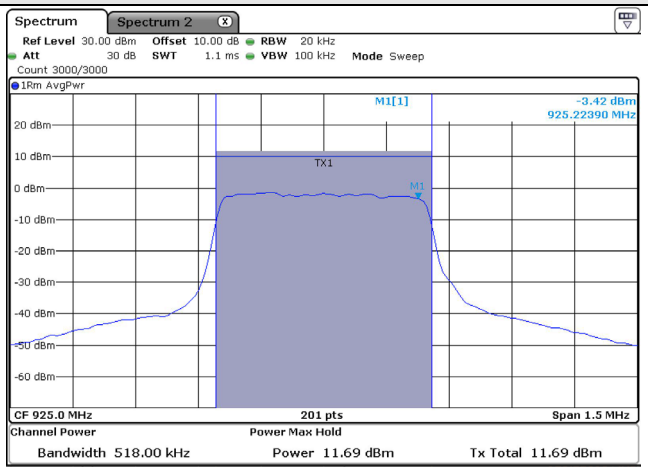
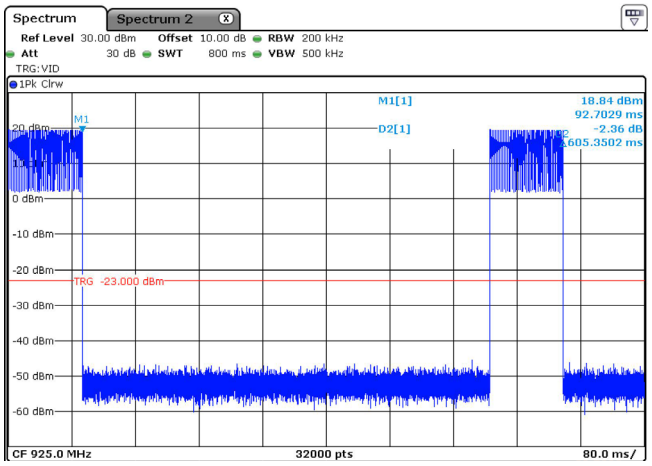
Frequency band investigated:	925MHz
RBW :	100kHz
Measurement detector :	Peak

12. 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	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) 36 dBm (Radiated, EIRP)	**Pass** **Pass**
Supplementary information: Test location: SMEE Test date: May 06Th, 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*log (1/D) where D is the duty cycle - Duty cycle measurement as per 11.6 of ANSI C63.10: $T_{x\,ON}$ = 92.7ms T_{TOTAL} = 605.35ms 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			

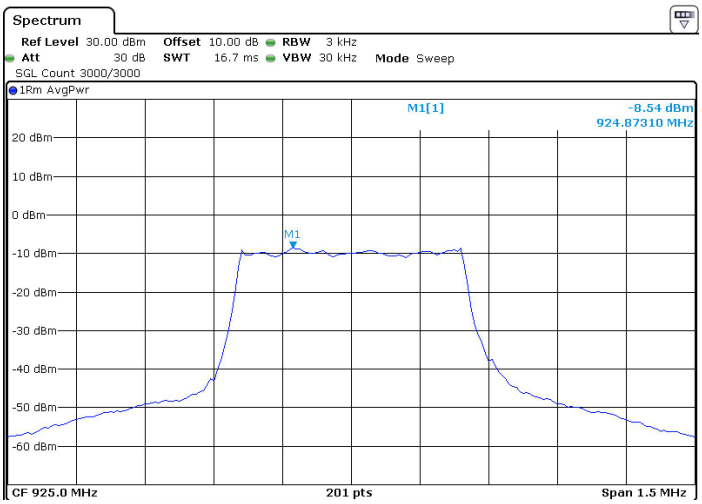
Graphical representation of Conducted output power
 *925MHz*
 *Duty cycle measurement*

13. Maximum Power Spectral Density Level in the fundamental emission

TEST: Maximum Peak Power Spectral Density		**Verdict**
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
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 06Th, 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 AVGPSD-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

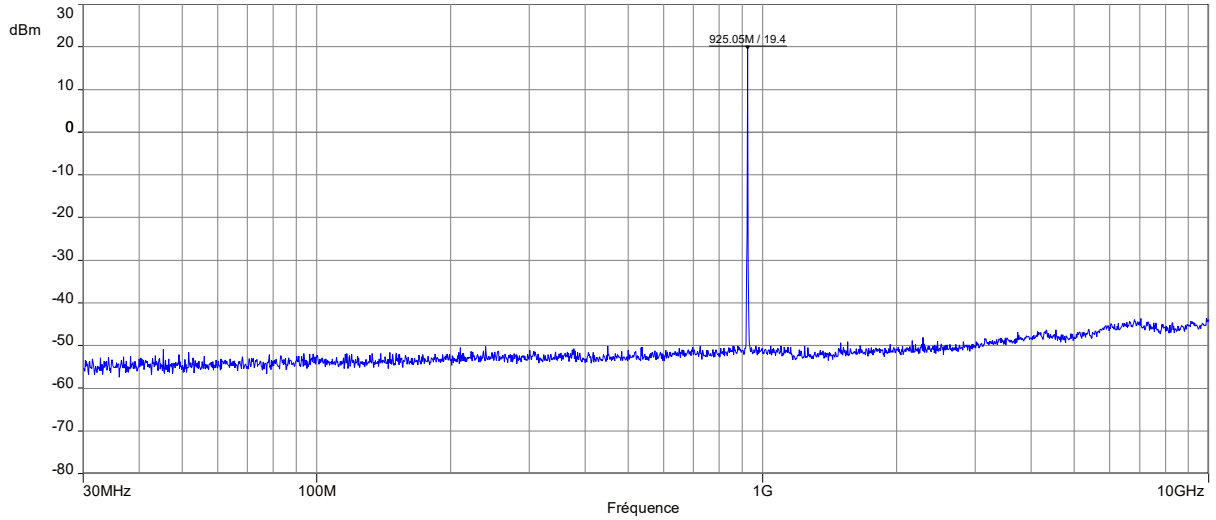


925MHz

14. Unwanted Spurious Emissions (Conducted emissions)

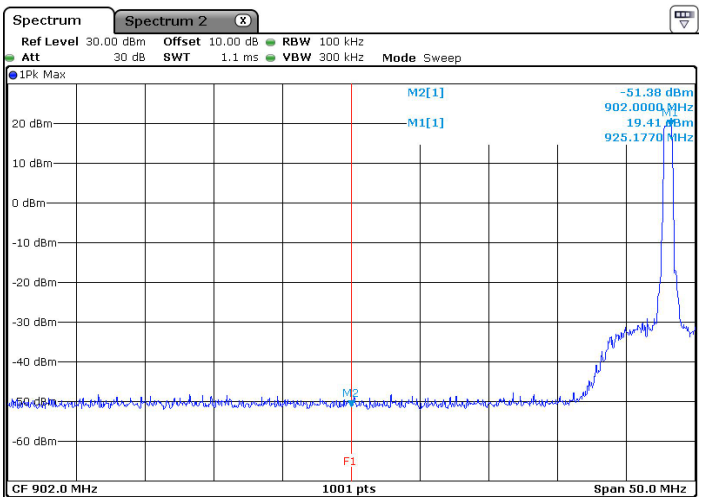
TEST: Conducted Spurious emissions			**Verdict**
Method: The setup is in an anechoic chamber. The spectrum analyzer is connected to the antenna port of the device under test. A conducted measurement is performed. The tested equipment is set to transmit operation with modulation on its nominal channel			**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
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 06Th, 2021. Tested by LC / CK			

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



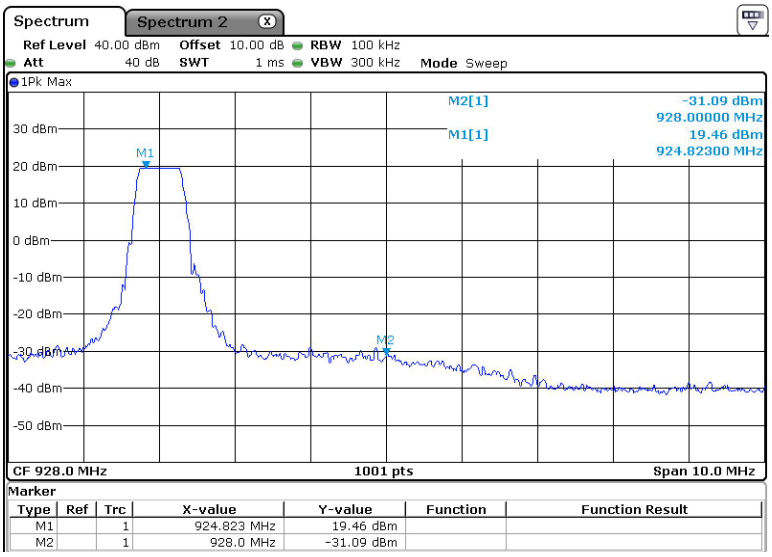
Frequency band investigated:	30MHz-10GHz
Unit :	dBm
RBW :	100kHz (Frequency step 50kHz)
Measurement detector:	Peak
Limit:	-10.6 dBm

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)

<table>
<tr><td colspan="3">TEST: Unwanted emissions in Non-Restricted Frequency Bands</td><td>Verdict</td></tr>
<tr><td colspan="3">Method: 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.</td><td>Pass</td></tr>
<tr><td>Laboratory Parameters:</td><td>Required prior to the test</td><td>During the test</td></tr>
<tr><td>Ambient Temperature</td><td>17 to 27°C</td><td>21°C ± 2</td></tr>
<tr><td>Relative Humidity</td><td>25 to 65 %</td><td>42% ± 5</td></tr>
<tr><td rowspan="2">Fully configured sample scanned over the following frequency range</td><td>Frequency range on each side of line</td><td>Measurement Point</td></tr>
<tr><td>30MHz – 10GHz</td><td>3 m measurement distance</td></tr>
<tr><td colspan="3">Limits – FCC Part 15.247 (d) / RSS-247 § 5.5</td></tr>
<tr><td rowspan="2">Frequency (MHz)</td><td colspan="2">Limits (dBµV/m)</td></tr>
<tr><td>Detector / Analyser RBW</td><td>Limit</td><td>Results</td></tr>
<tr><td>30 to 10000</td><td>Pk / 100kHz</td><td>30dB below the maximum Peak level</td><td>Pass</td></tr>
<tr><td colspan="4">Supplementary information:
Test location: SMEE
Test date: May 06Th, 2021. Tested by LC / CK</td></tr>
</table>

Tabulated Results for Peak Output Radiated level	
FREQ (MHz)	**Field Strength 3m** (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

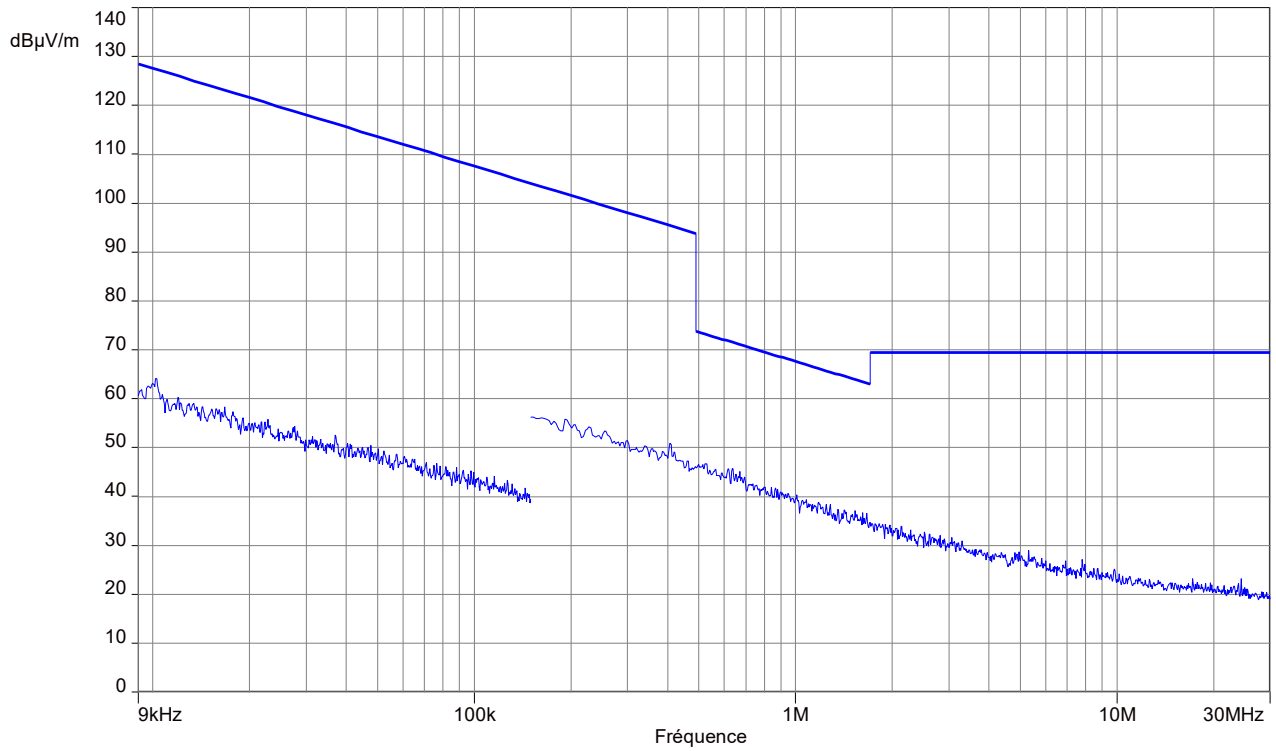
Tabulated Results for Unwanted emissions (9kHz-490kHz)							
FREQ	**RF field @ 300m**	**Limit @ 300m**	**Detector**	**Margin**	**Ant. angle**	**Table angle**	**Correc. Fact. (CF)**
MHz	dBµV/m	dBµV/m	Pk / QP / AV	dB	Degree	Degree	dB
All levels are at least 20dB below applicable limits							
Supplementary 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)

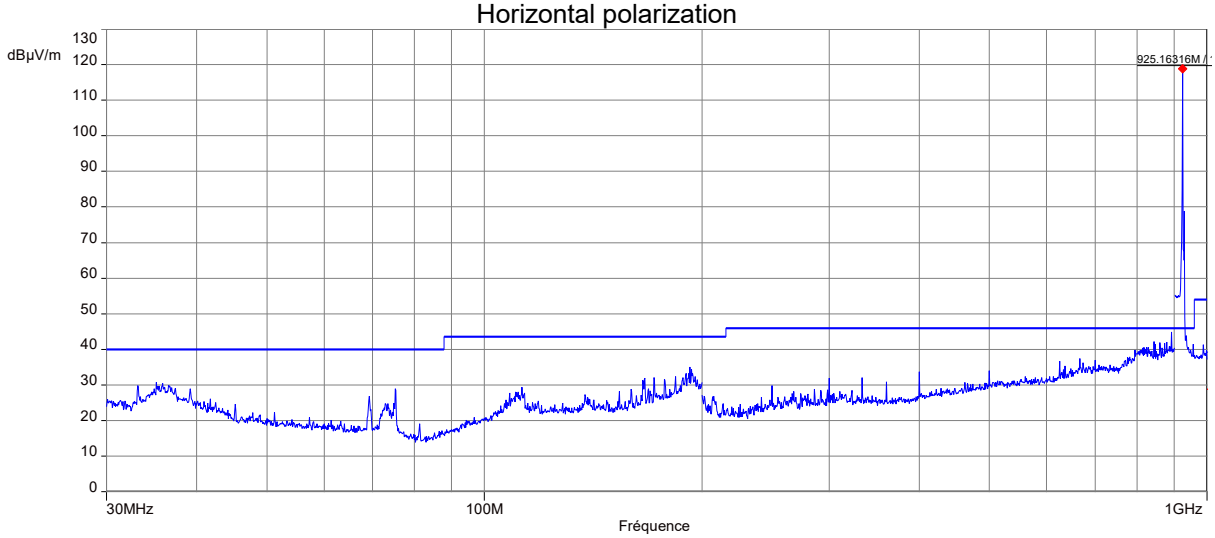


Notes: Pre-scan graph only for identification purpose.
Same result for all channels.

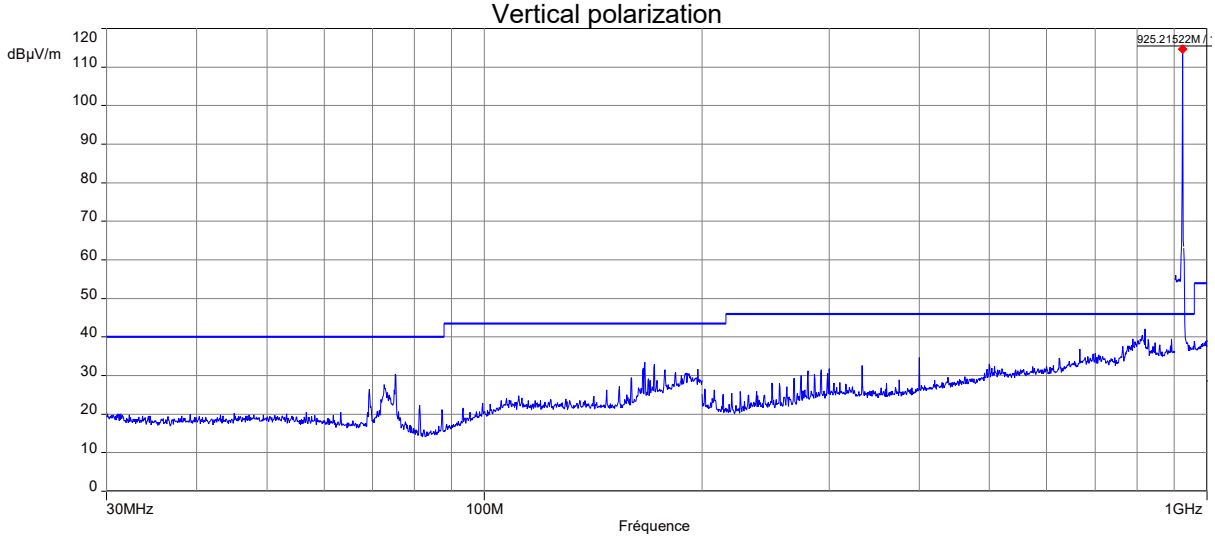
Frequency band investigated:	9kHz-30MHz
Unit :	dBµV/m
RBW :	200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)
Antenna polarization :	Parallel & Perpendicular to measurement axis
Measurement detector:	Peak

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

Horizontal polarization



Vertical polarization



Note: Pre-scan graph only for identification purpose.

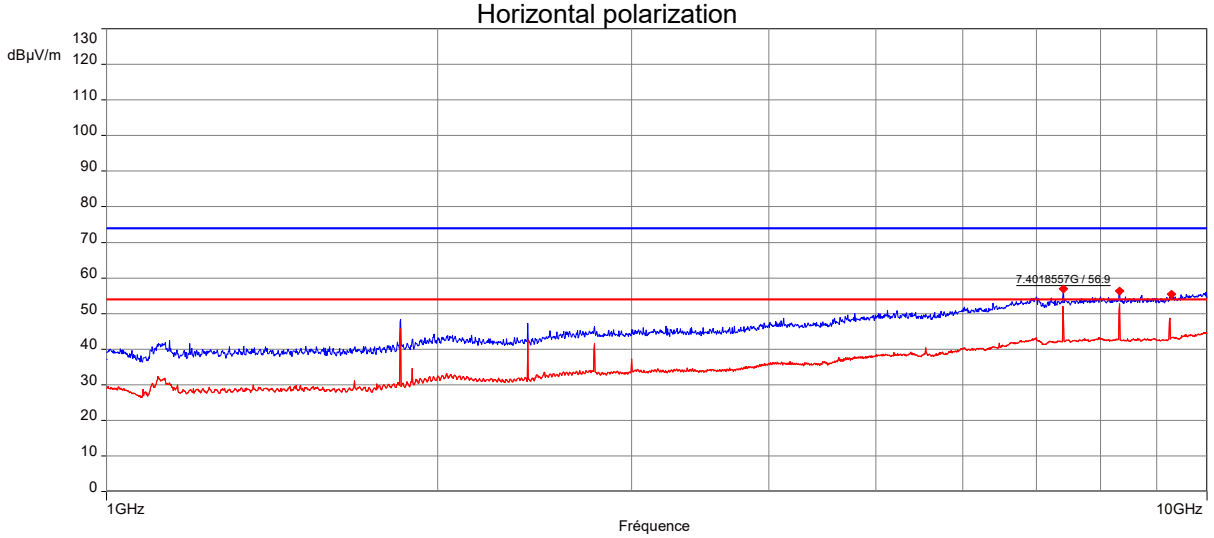
Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Horizontal & Vertical
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak

PEAK LIST FROM PRE-SCAN

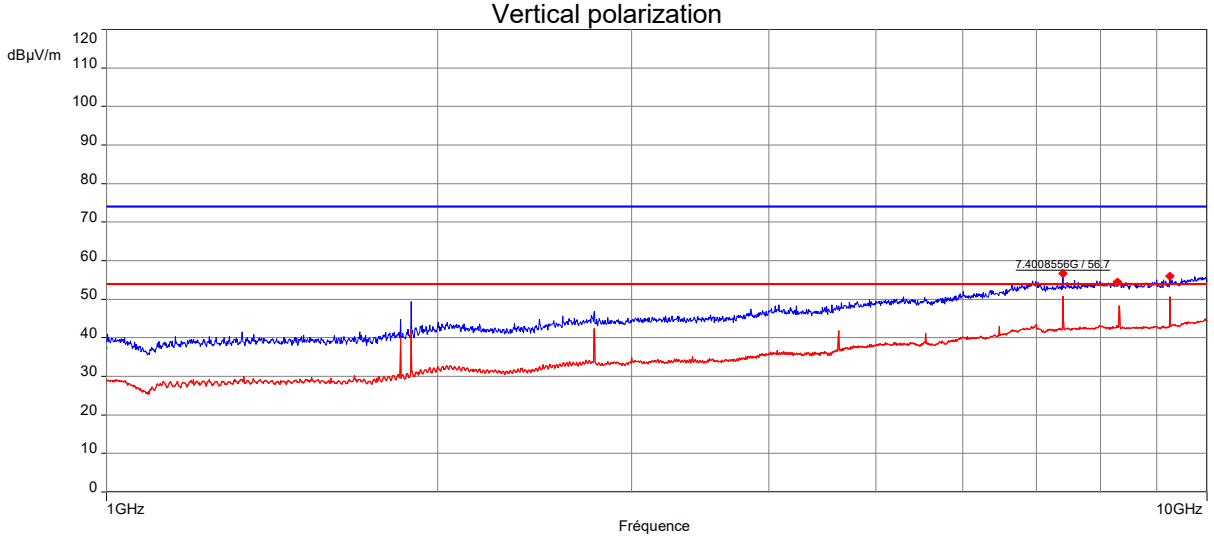
Frequency (MHz)	Peak Level (dBµV/m)	Angle (°)	Limit (dBµV/m)	Polarization	Comments
None	-	-	-	-	Only PC's frequency

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

Horizontal polarization



Vertical polarization



Note: Pre-scan graph only for identification purpose.

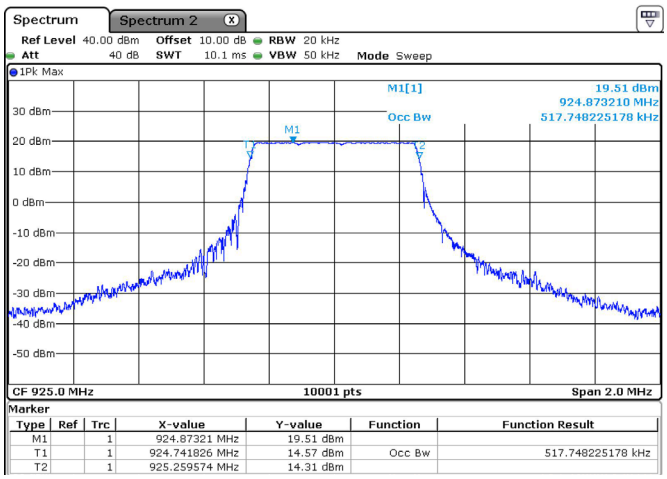
------ : Peak measure	------ : Average measure
Frequency band investigated:	1GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average

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 06Th, 2021. Tested by LC / 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