

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

Matériel testé :
Equipment under test:

ENHANCIA - NEOVA (HUB)
(Trademark / Marketing name or product reference)

Client / Demandeur:
Customer / Applicant : **ENHANCIA**
3, Parvis Louis Néel
38000 Grenoble – France

Rapport délivré à :
Issued to: **ENHANCIA**
M. Mario Viola
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38000 Grenoble – France

Numéro d'affaire :
Work number : 13199

Référence de la proposition :
Proposal number: 072019-23699-1

Date de l'essai :
Date of test: Du 4 au 5 novembre 2019
November 4th to 5th, 2019

Objectif des essais :
Test purpose: EMC qualification according to following standards:
- CFR 47, FCC Part 15, Subpart C
(Chapter 15.249 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz, and 24.0–24.25 GHz)
- Industry Canada, RSS-Gen Issue 5 & RSS-210 Issue 9, section B.10
(Bands 902–928, 2400–2483.5 and 5725–5875 MHz)
Measurement standards : ANSI C63.10 (2013)

Lieu du test:
Test location: SMEE, Rue de Taille
38500 VOIRON - France

Test réalisé par :
Test realized by: Laurent CHAPUS

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	February 18 th , 2020	Initial Edition	Laurent CHAPUS <i>Technical Manager</i>  Signature numérique de Chapus Laurent	Regis ANCEL <i>General Manager</i>  Signature numérique de Ancel Régis

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1. Normatives References

FCC qualification according to:		
Standards	Applied	Title
ANSI C63.4 (2014)	X	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C63.10 (2013)	X	American National Standard for Testing Unlicensed Wireless Devices
CFR47, Part 15	X	Telecommunication – Federal Communication Commission – Radio frequency devices, Sections 15.207 / 15.209 / 15.249

Industry Canada qualification according to:		
Standards	Applied	Title
RSS-Gen (Issue 5/March 2019)	X	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 (Issue9/2016)	X	License-exempt Radio Apparatus: Category I Equipment, Section B.10: Devices Operating in Frequency Bands for Any Application, Band 2400-2483.5MHz.

Deviation from standards: None.

2. Test synthesis

TEST	Paragraph number FCC Part 15 IC RSS-210	Spec. FCC Part 15 IC RSS-210	RESULTS (comments)
Conducted emissions test	15.207 (a) RSS-Gen: Issue 5, §8.8	15.207 (a) Table 4, §8.8	PASS
Field Strength of fundamental	15.249 (a) (c) RSS-210: Issue 9, §B.10 (a)	94dBµV/m @3m (50mV/m @ 3m)	PASS
Field Strength of harmonics	15.249 (a) (c) (e) RSS-210: Issue 9, §B.10 (a)	54dBµV/m @3m (0.5mV/m @ 3m)	PASS
Unwanted emissions outside the specified frequency band and harmonics	15.209 / 15.249 (d) (e) RSS-210: Issue 9, §B.10 (b) / RSS-Gen: Issue 5, §8.9	Whichever is less stringent, either: - 50dB below level of fundamental, or; - General field strength limits, as follow: <u>Measure at 300m</u> 9-490kHz: 2400µV/m/F(kHz) <u>Measure at 30m</u> 0.490-1.705: 24000µV/m/F(kHz) 1.705-30MHz: 30µV/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: Issue 5, §6.7	BW at 99%	PASS

- General conclusion:**

Measures and tests performed on the sample of the product *ENHANCIA - NEOVA (HUB)*, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart C and Industry Canada RSS-Gen & RSS-210.

3. Equipment Under Test (EUT)

Nom /
Identification

ENHANCIA - NEOVA (HUB)
(Trademark / Marketing name or product reference)

Sn: Sample #1

FCC ID:
IC:
Model:

FCC ID: 2AUJX-H1
IC: 25446-H1
NEOVA-H1

Alimentation /
Power supply

HUB: 5V DC from USB port

Auxiliaires /
Auxiliaries

- Customer laptop (ASUS)
- Enhancia NEOVA Ring (Model NEOVA-R1)

Entrées-Sorties /
Input / Output

	Câbles pour essai / Cables for test	Blindé / Shielded	Prévu pour >3m / Intended for >3m
USB port on hub (2.0)	1.0m	Yes	No
Midi_In (jack on hub)	1..5m	Yes (Audio)	No
Midi_Out (jack on hub)	1.0m	Yes (Audio)	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 on low, middle and high channels
- Charging the ring (Ring plugged onto the hub)

Programme de test /
Test program /

NEOVA Dashboard running on Windows PC

Informations supplémentaires /
Additional informations

Declaration of the applicant:

- Type of technology: Proprietary RF protocol
- Emission bands: 2400-2483.5MHz
- Frequency transmission band: 2402MHz to 2479MHz.
- Equipment intended for use as a mobile station
- Equipment designed for continuous operation
- Antenna type: CMS (Peak gain: 2.2dBi)
- Rated conducted output power: 4dBm
- Max internal EUT frequency: 64MHz (Except intentional RF)

Dimensions de l'EST /
Dimensions of EUT

100mm x 97 x 20

4. Test conditions

Power supply voltage:

Equipment under test:

Auxiliaries:

5V DC from USB port

110V/60Hz (Conducted emission)

5. Modifications of the EUT

None

6. 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, OATS)	± 5.6dB
Radiated emission test (300-1000MHz, OATS)	± 5.3dB
Radiated emission test (1-40GHz, OATS / FAC)	± 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)

7. 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

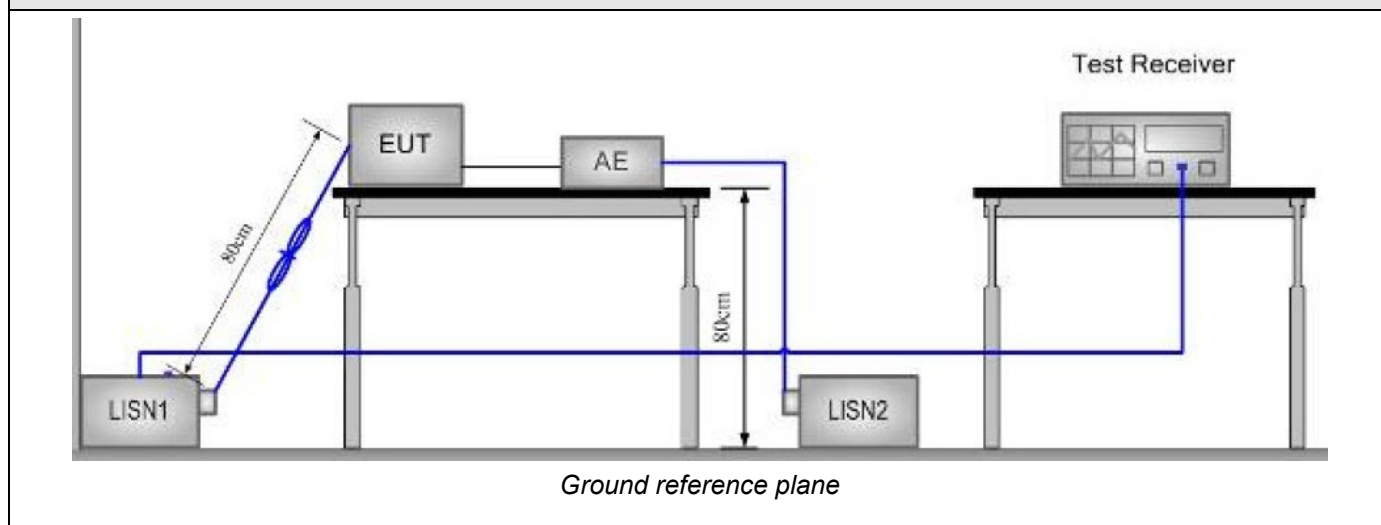
→ Field level: 19.0dBμV/m (-21.0dB for margin if limit is 40dBμV/m)

8. 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		20 to 30 °C		23°C ± 2
Relative Humidity		25 to 70 %		55% ± 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) Personal Computer
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: November 4 th , 2019. Tested by L. Chapus Power supply voltage: AC mains 110V/60Hz				

Test Equipment Used					
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	2019/6	2020/6
Cable RF	Div	1m	CAB-101-021	2019/4	2020/4
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
EMC Software	NEXIO	BAT EMC V3.8	SOF-101-001	-	-

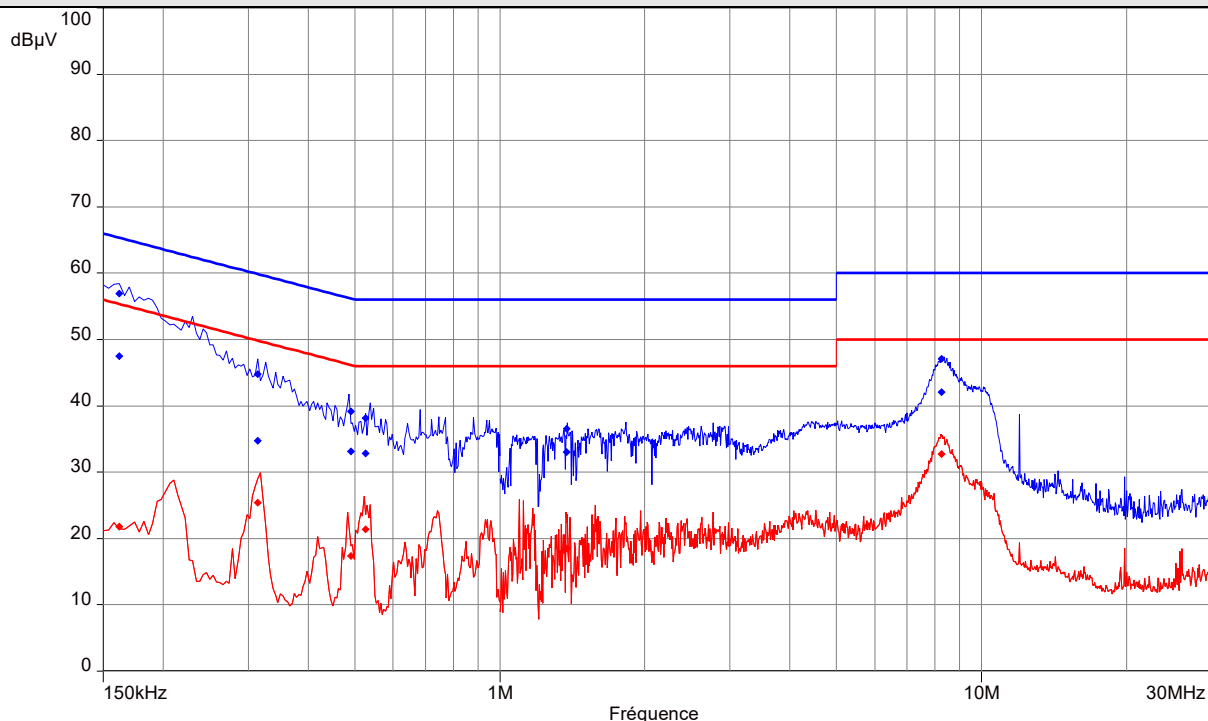
Test Setup for conducted emission



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
0.162	56.97	47.54	65.36	-17.82	21.83	55.36	-33.53	L1
0.314	44.81	34.75	59.86	-25.12	25.43	49.86	-24.44	L1
0.49	39.12	33.16	56.17	-23	17.39	46.17	-28.78	L1
0.526	38.13	32.89	56	-23.11	21.43	46	-24.57	L1
1.376	36.57	32.99	56	-23.01	18.5	46	-27.5	L1
8.268	47.09	42.1	60	-17.9	32.71	50	-17.29	L1
0.158	57.78	47.88	65.57	-17.69	21.55	55.57	-34.01	N
0.318	47.74	43.17	59.76	-16.59	33.95	49.76	-15.81	N
0.526	45.45	42.83	56	-13.17	31.43	46	-14.57	N
0.986	45.44	40.92	56	-15.08	17.61	46	-28.39	N
1.132	45.15	41.72	56	-14.28	24.26	46	-21.74	N
2.644	44.81	40.61	56	-15.39	25.13	46	-20.87	N
8.264	49	43.74	60	-16.26	34.04	50	-15.96	N
0.158	57.78	47.88	65.57	-17.69	21.55	55.57	-34.01	N
Frequency band investigated:			150kHz-30MHz					
RBW:			9kHz					
Voltage:			110V/60Hz					
Limit:			FCC Part 15.207 / RSS-Gen §8.8					
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)					

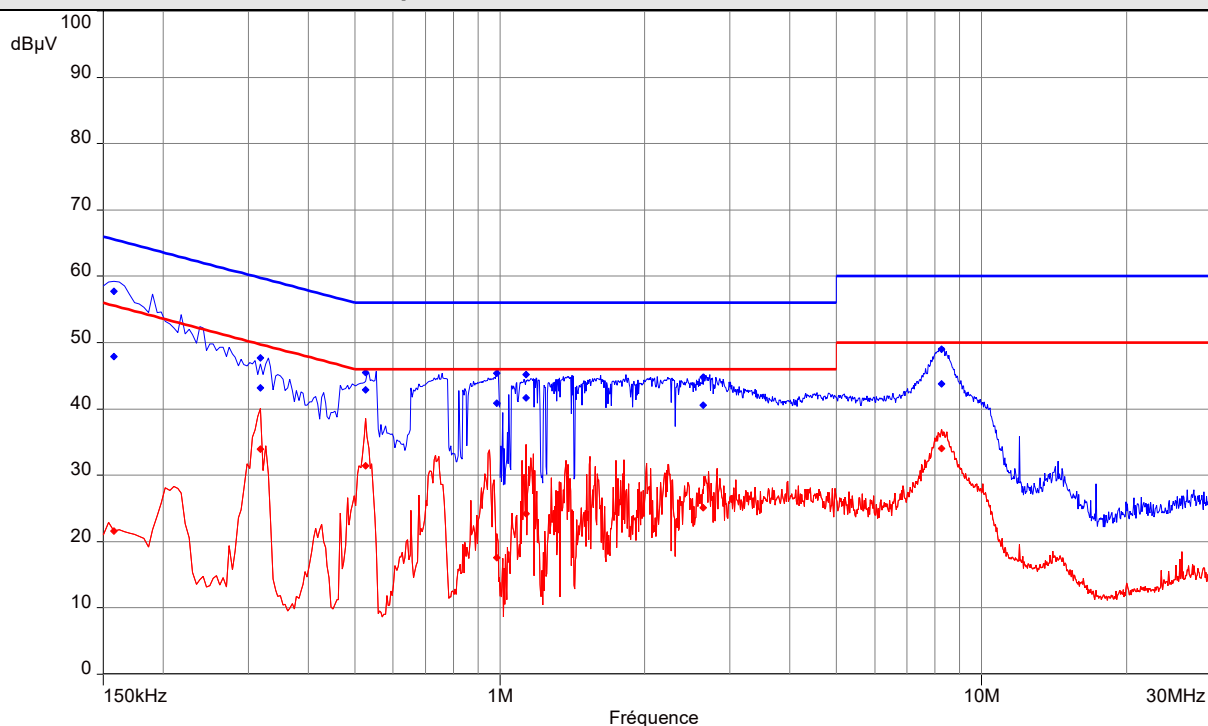
Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line L1 – Connected to PC



----: Peak

----: Average

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



----: Peak

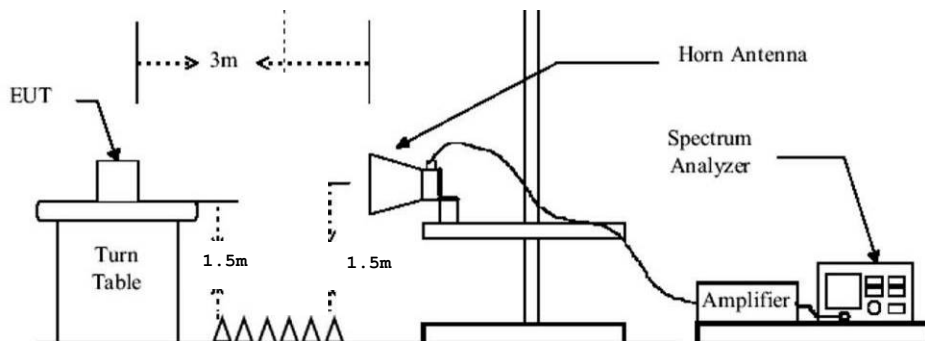
----: Average

9. Field Strength of fundamental

TEST: Field strength of fundamental / FCC part 15.249 – RSS 210 §B.10			Verdict
Method: Final measurements are made in a Full Anechoic Chamber (FAC) that complies with ANSI C63.10. 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 in horizontal and vertical polarities. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength, with 60° rotation on each axis. (Clause 6.6.5 of ANSI C63.10).			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	23°C ± 2	
Relative Humidity	10 to 90 %	55% ± 5	
Limits – FCC Part 15.249 (a) (c) / RSS-210 §B.10 (a)			
Frequency (MHz)	Limits (dBµV/m)		
	Level / Detector / Distance	Results	
2402 to 2479 MHz	94dBµV/m / Average / 3m 114dBµV/m / Peak / 3m	Pass	
Supplementary information: Test location: SMEE Test date: November 4 th , 2019. Tested by L. Chapus			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2018/10	2021/10
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2019/4	2020/4
RF cable	Pasternack	PE302-120	CAB-131-024	2019/4	2020/4
Anechoic chamber	COMTEST	214263	CAG-141-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-002	-	-
Measuring Receiver	Rohde&Schwarz	ESRP	REC-151-002	2019/9	2021/9

Test Setup for radiated emission



Test setup

Tabulated Results for Field Strength of fundamental

FREQ (MHz)	Field Strength @ 3m (dBμV/m)	Detector	Limit (dBμV/m)	Margin dBm	Result
2402.0	93.9	Pk	114	-20.1	Pass
2402.0	93.5	Av	94	-0.5	Pass
2440.0	91.5	Pk	114	-22.5	Pass
2440.0	91.1	Av	94	-2.9	Pass
2479.0	91.6	Pk	114	-22.4	Pass
2479.0	91.2	Av	94	-2.8	Pass

RBW: 1MHz

Measurement distance: 3m

Limit: FCC Part 15.249 (a) (c) / RSS-210 §B.10

Final measurement detector: Peak / CISPR Average

RESULT: PASS

Note: (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

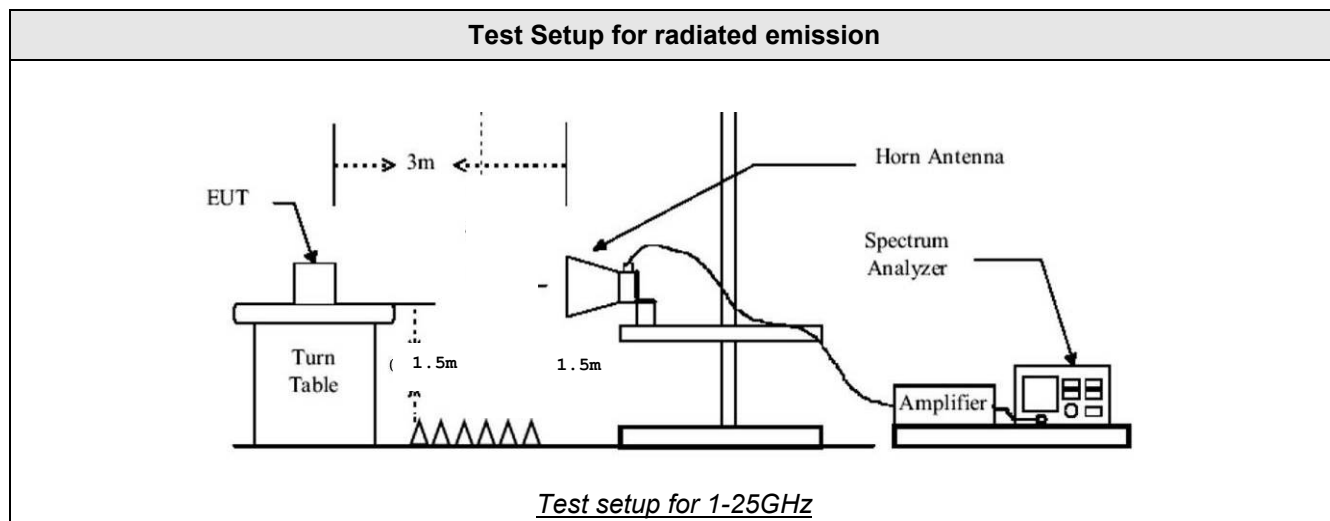
Total factor (dB) is AF + CF – AG

Margin value = Emission level – Limit value

10. Field Strength of harmonics

TEST: Field Strength of harmonics / FCC part 15.249 – RSS-210 §B.10			Verdict
<u>Method:</u> For frequency above 1GHz, final measurements are made in a Full Anechoic Chamber (FAC) that complies with ANSI C63.10. 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 in horizontal and vertical polarities. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength, with 60° rotation on each axis.(Clause 6.6.5 of ANSI C63.10). A pre-scan frequency identification of the EUT has been performed in full anechoic chamber. The measured radiated field of the EUT is performed (or corrected) at 3-meters of distance. Antenna is 1.5-meters high. The pre-characterization graphs are obtained in PEAK and Average detection with 360° continuous rotation of the device under test.			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	23°C ± 2	
Relative Humidity	10 to 90 %	55% ± 5	
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point	
	30MHz – 25GHz	3 m measurement distance	
Limits – FCC Part 15.249 (a) (c) (e) / RSS-210 §B.10 (a)			
Frequency bands for harmonics (MHz)	Limits (dBµV/m)		
	Level / Detector / Distance	Results	
4800 to 4967	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
7200 to 7450.5	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
9600 to 9934	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
12000 to 12417.5	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
14400 to 14901	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
16800 to 17384.5	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
19200 to 19868	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
21600 to 22351.5	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
24000 to 24835	54.0 / AV / 3m 74.0 / PK / 3m	Pass	
Supplementary information: Test location: SMEE Test date: November 4 th , 2019. Tested by L. Chapus			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2018/10	2021/10
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2017/12	2022/12
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2019/8	2021/8
RF cable	Pasternack RF	PE302-120	CAB-131-024	2019/4	2020/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2019/4	2020/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2019/4	2020/4
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-035	2019/4	2020/4
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001		
Pre-amplifier	PE	1524	PRE-101-002	2019/6	2020/6
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2017/12	2019/12
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2019/9	2021/9
EMC Software	NEXIO	BAT EMC V3.9	SOF-101-001	-	-



Tabulated Results for Field strength of harmonics (1GHz-25GHz)					
FREQ (MHz)	Field Strength 3m (dBμV/m)	Detector	Limit (dBμV/m)	Margin (dBμV/m)	Result
Levels are at least 10dB below limits					
Supplementary information: Frequency list has been created with pre-scan results. See pre-scan graphs in §12.					
RBW:		1MHz (CISPR)			
Measurement distance:		3m			
Limit:		FCC Part 15.249 (a) (c) (e) / RSS-210 §B.10 (a)			
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): Peak pre-scans not performed at 3-meters distance are corrected as follow: $M@3m = M@Dm + 20 \times \log (Dm / 3m)$ Where D is the measurement distance in meter (3): All frequencies not specified have margin < -10dB (for peak and average detector)			

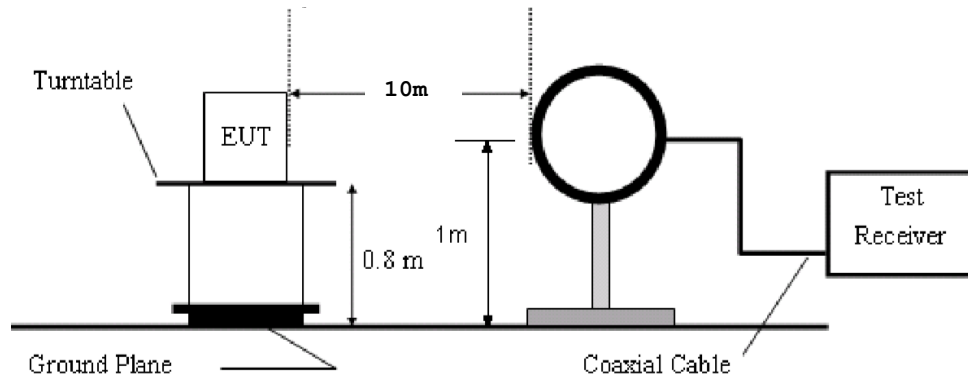
11. Unwanted emissions

TEST: Unwanted emissions outside fundamental and harmonics bands / FCC part 15.209, 15.249 - RSS-210 §B.10 / RSS-Gen §8.9		Verdict
Method: Measurements were made in a 3-meter Open Area Test Site that complies to ANSI C63.10 for frequency below 1GHz. Measurements were made in a 3-meter Full Anechoic Chamber (FAC) that complies to ANSI C63.10 for frequency above 1GHz. 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. The tested equipment is set to transmit operation with modulations on lowest, middle and highest channel. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength. A pre-scan frequency identification of the EUT has been performed in full anechoic chamber. The measured radiated field of the EUT is performed at 3-meters of distance for frequency 9k-1GHz. The measured radiated field of the EUT is performed at 1.6-meters of distance for frequency 1-25GHz. Antenna is 1.25m (Freq < 1GHz) or 1.5m (Freq < 1GHz) high in front of EUT.		Pass
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	23°C ± 2
Relative Humidity	10 to 90 %	55% ± 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 – 25GHz	3 m measurement distance
Limits – FCC Part 15.209, 15.249 (d) (e) / RSS-Gen §8.9, RSS-210 §B.10 (b)		
Whichever is less stringent, either:		
Frequency (MHz)	Limits (dBµV/m)	
	Level / Detector / Distance	Results
30 to 1000	50dB below the fundamental / QP / 3m	Not used
Above 1GHz	50dB below the fundamental / Av / 3m 30dB below the fundamental / Pk / 3m	Not used
Or		
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

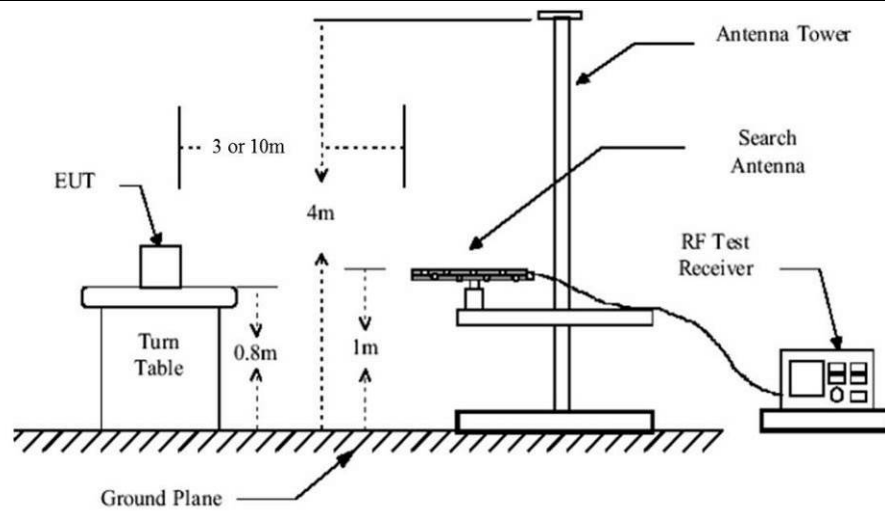
Above 1GHz	54.0 / AV / 3m 74.0 / PK / 3m	Pass
Supplementary information: Test location: SMEE Test date: November 4 th , 2019. Tested by L. Chapus		

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	EMCO	3146	ANT-191-019	2019/6	2021/6
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2019/6	2021/6
Loop antenna	EMCO	6502	ANT-101-009	2019/8	2021/8
BiConiLog antenna	EMCO	3142B	ANT-101-010	2019/8	2021/8
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2018/10	2021/10
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2017/12	2022/12
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2019/8	2021/8
RF cable	Div	OATS/25m	CAB-101-017	2019/4	2020/4
RF cable	Pasternack RF	PE302-120	CAB-131-024	2019/4	2020/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2019/4	2020/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2019/4	2020/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2019/4	2020/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2019/4	2020/4
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-034	2019/4	2020/4
Pre-amplifier	Pasternack RF	PE1524	PRE-101-002	2019/6	2020/6
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2017/12	2019/12
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
OATS	Div	10m	SIT-101-001	2017/7	2020/7
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-
Measuring Rec	Rohde&Schwarz	ESRP	REC-151-002	2019/9	2021/9
EMC Software	NEXIO	BAT EMC V3.9	SOF-101-001	-	-

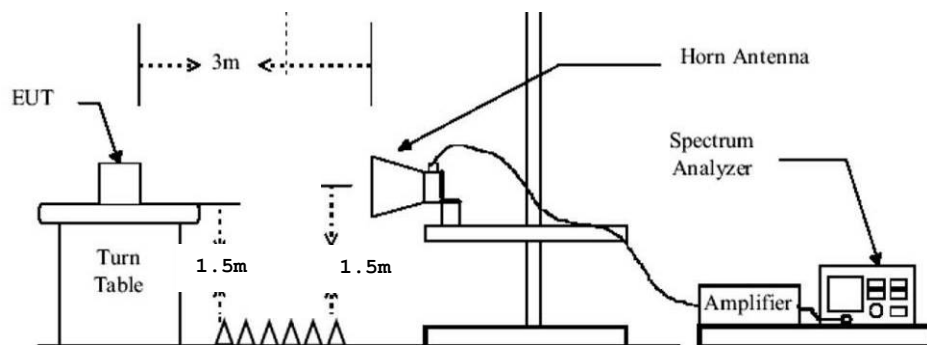
Test Setup for radiated emission



Test setup for 9k-30MHz



Test setup for 30-1000MHz



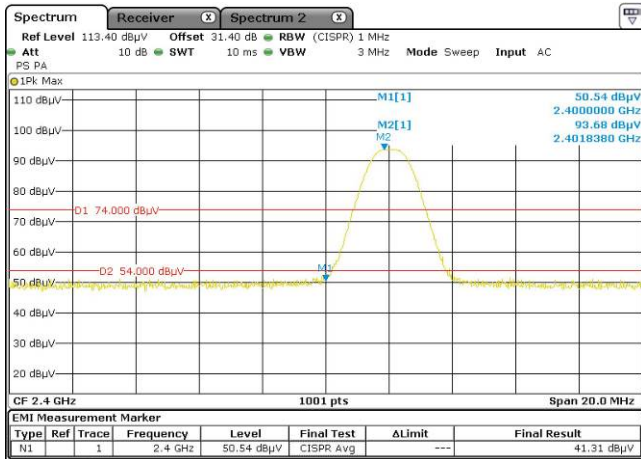
Test setup for 1-25GHz

Tabulated Results for Unwanted emissions (9kHz-30MHz)							
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna		Table angle	Correc. Fact. (CF)
MHz	(QP) dBμV/m	(QP) dBμV/m	dB	Angle (Degree)	Position	Degree	dB
Levels are at least 10dB below limits							
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results.							
Frequency band investigated:		9kHz-30MHz					
RBW:		200Hz (9kHz-150kHz)					
		9kHz (150kHz-30MHz)					
Measurement distance:		10m					
Limit:		FCC Part 15.209 – 15.249 / RSS-Gen §8.9 – RSS-210 §B.10 (b)					
Final measurement detector:		Peak / Quasi-Peak / Average					
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)					

Tabulated Results for Radiated Disturbance (3m measurement on Open Area Test Site, 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	Degré	(QP) dBμV/m	dB
38.810	26.4	32.9	10.3	36.7	43.2	V	100	30	40.0	-3.3
44.766	25.6	32.5	10.7	36.3	43.2	V	100	40	40.0	-3.7
50.800	24.1	28.1	11.0	35.1	39.1	V	100	55	40.0	-4.9
144.009	24.2	25.3	13.7	37.9	39.0	H	120	170	43.5	-5.6
156.074	25.1	25.6	14.1	39.2	39.7	H	130	235	43.5	-4.3
167.987	22.1	24.5	15.9	38.0	40.4	H	120	85	43.5	-5.5
479.973	14.1	17.3	20.9	35.0	38.2	V	150	55	46.0	-11.0
Supplementary information: Frequency list measured on the Open Area Test Site is created with pre-scan results. Worst case results for Tx continuous, USB connection to PC, ring battery charging modes.										
Frequency band investigated:		30MHz-1GHz								
RBW:		120kHz								
Measurement distance:		3m								
Limit:		FCC Part 15.209 – 15.249 / RSS-Gen §8.9 – RSS-210 §B.10 (b)								
Final measurement detector:		Quasi-Peak								
RESULT:		PASS								
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 Total factor (dB) is AF + CF – AG Margin value = Emission level – Limit value (A negative margin shows compliance to limit) Limits used are FCC part 15.209 / RSS-Gen.								

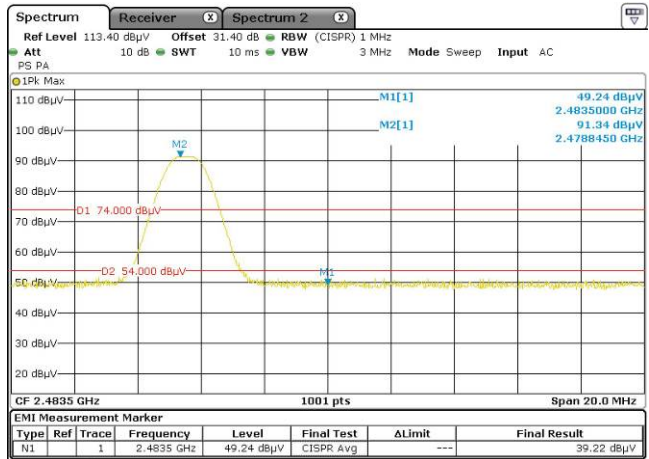
Tabulated Results for Unwanted emissions (1GHz-25GHz)				
FREQ (MHz)	Field level dBμV/m	Detector	Limit (dBμV/m)	Result
2400.000	50.5	Pk	74 Pk	Pass
2400.000	41.3	Av	54 Av	Pass
2483.274	49.2	Pk	74 Pk	Pass
2483.274	39.2	Av	54 Av	Pass
RBW		1MHz (CISPR)		
Measurement distance:		3m		
Limit:		FCC Part 15.209 – 15.249 / RSS-Gen §8.9 – RSS-210 §B.10 (b)		
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): Limits used are FCC part 15.209 / RSS-Gen §8.9 (3): Peak pre-scans not performed at 3-meters distance are corrected as follow: $M@3m = M@D_m + 20 \times \log(D_m / 3m)$ Where D is the measurement distance in meter (4): All frequencies not specified have margin < -10dB (for peak and average detector)		

Graphical representation of Band-edge compliance (Radiated)



Low band-edge compliance

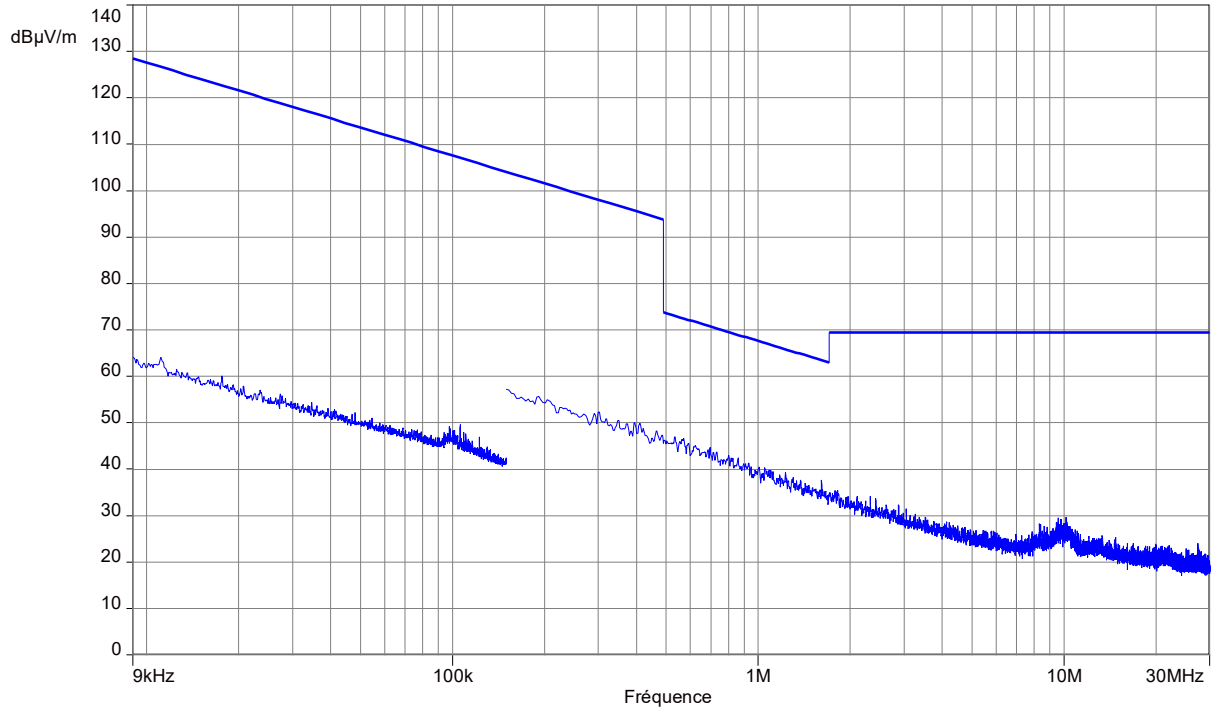
M1 = 2400MHz
 Average level at 2400MHz is 41.3dBμV/m
 (Average limit is 54dBμV/m - Peak limit is 74dBμV/m @ 3m)
 RESULT: PASS
 Note: Radiated measurement



High band-edge compliance

M1 = 2483.5MHz
 Average level at 2483.5MHz is 39.2dBμV/m
 (Average limit is 54dBμV/m - Peak limit is 74dBμV/m @ 3m)
 RESULT: PASS
 Note: Radiated measurement

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

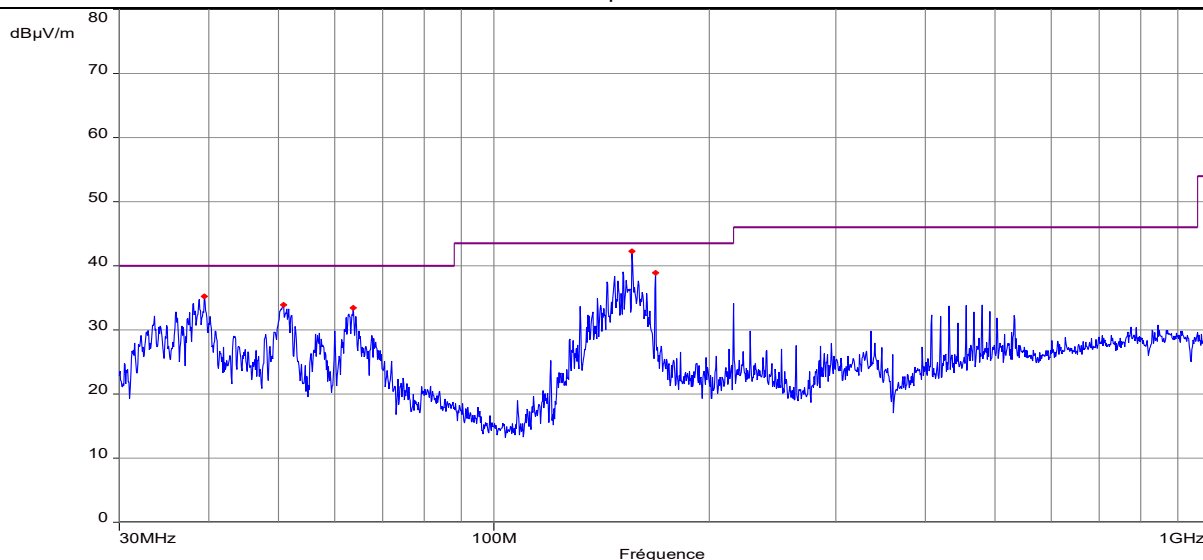


Notes: Pre-scan graph only for identification purpose.
Same result for transmit mode on all channels.

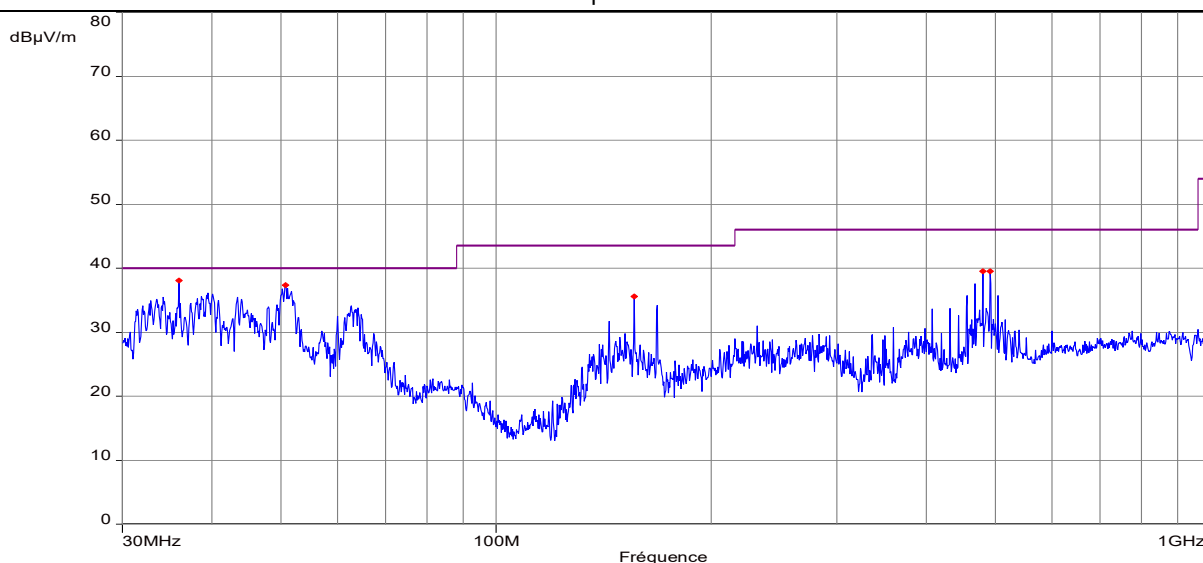
Frequency band investigated:	9kHz-30MHz
Unit :	dBμV/m
RBW :	200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)
Antenna polarization :	Parallel & Perpendicular to measurement axis
Measurement detector:	Peak

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

Horizontal polarization



Vertical polarization



----- : Peak measure

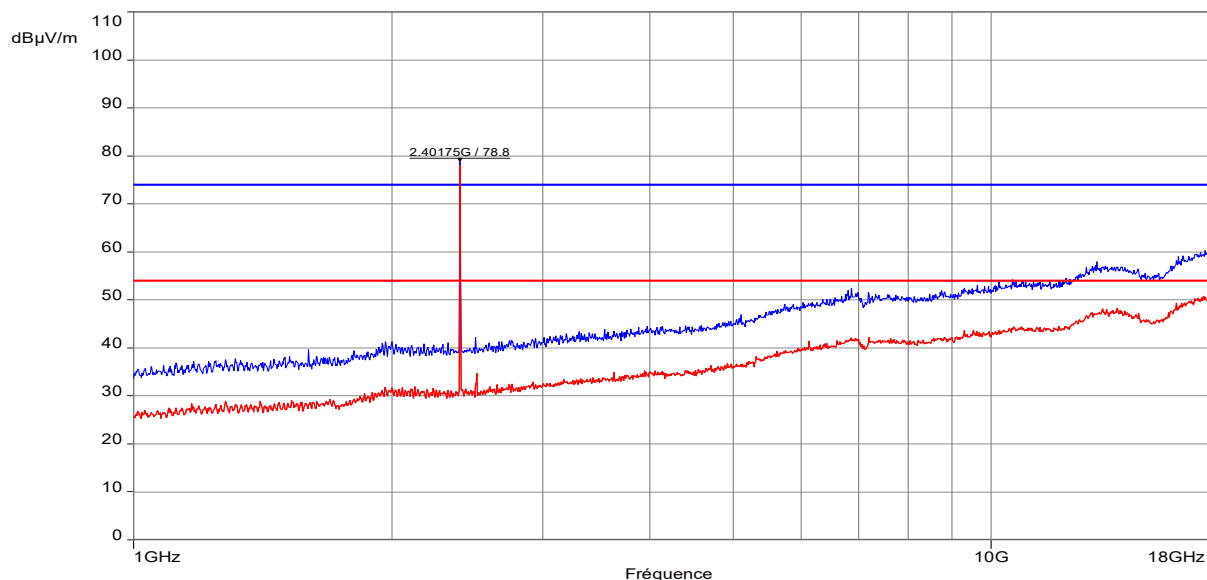
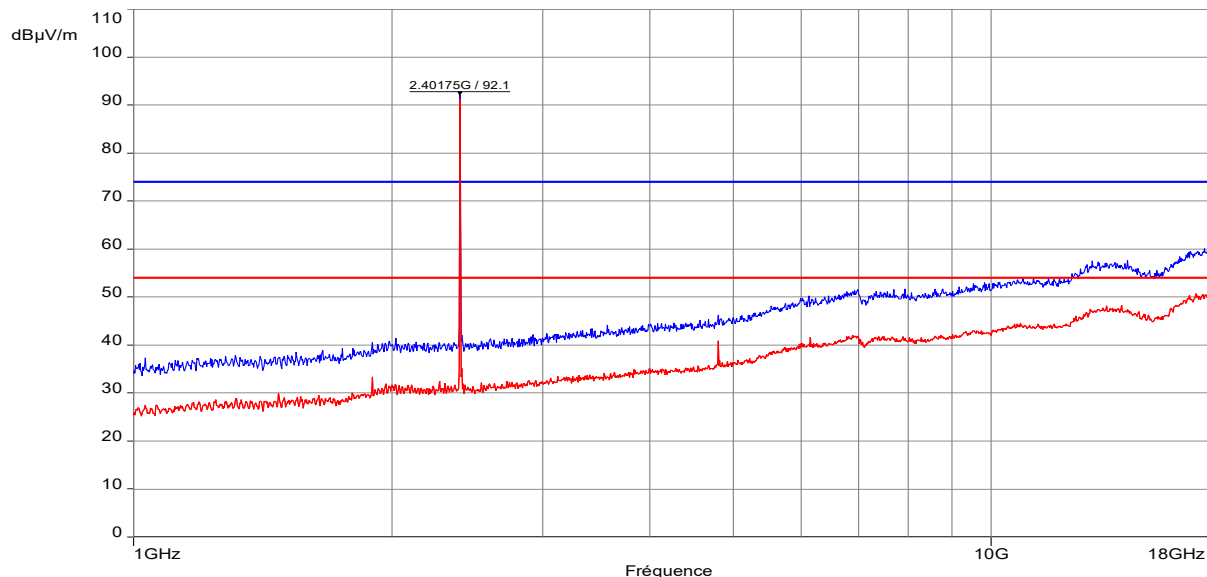
----- : QP limit (3m)

Note: Pre-scan graph only for identification purpose. Worst case results for Tx continuous, USB connection to PC, ring battery charging modes.

Marker List :

Frequency (MHz)	Peak Level (dBμV/m)	Limit (dBμV/m)	Polarization
39.3972	35.27	40.0	H
50.8557	33.93	40.0	H
63.6782	33.45	40.0	H
155.922	42.29	43.5	H
168.017	38.88	43.5	H
36.0021	38.09	40.0	V
50.7344	37.37	40.0	V
156.013	35.56	43.5	V
480.033	39.55	46.0	V
492.007	39.5	46.0	V

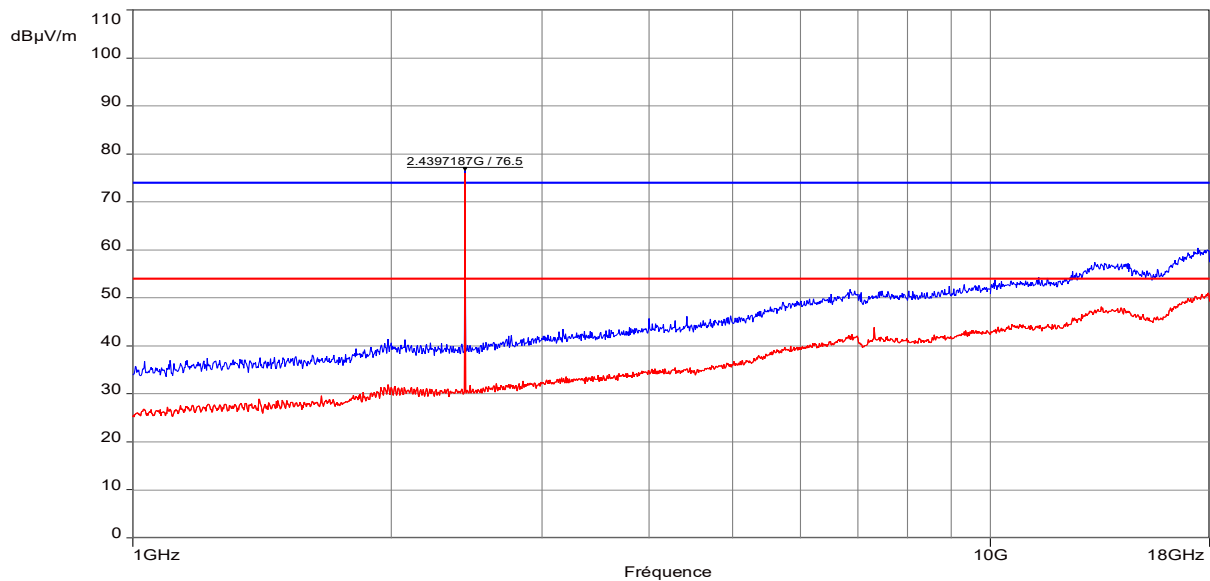
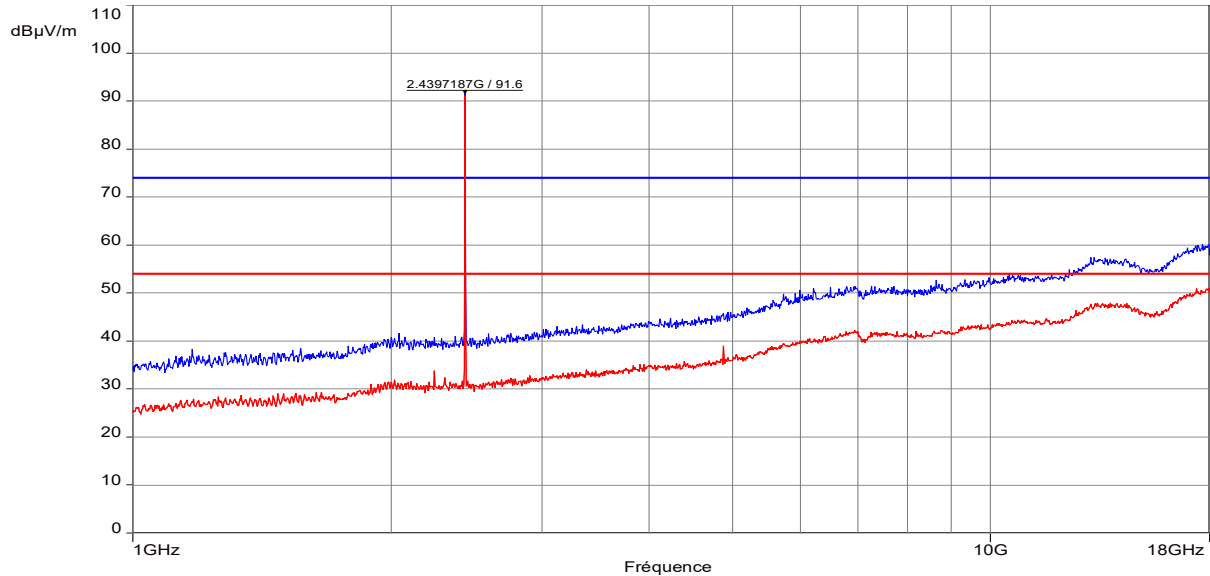
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical / Transmit mode at 2402MHz)



Notes: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.209 a) / RSS-Gen §8.9
Measurement detector:	Peak

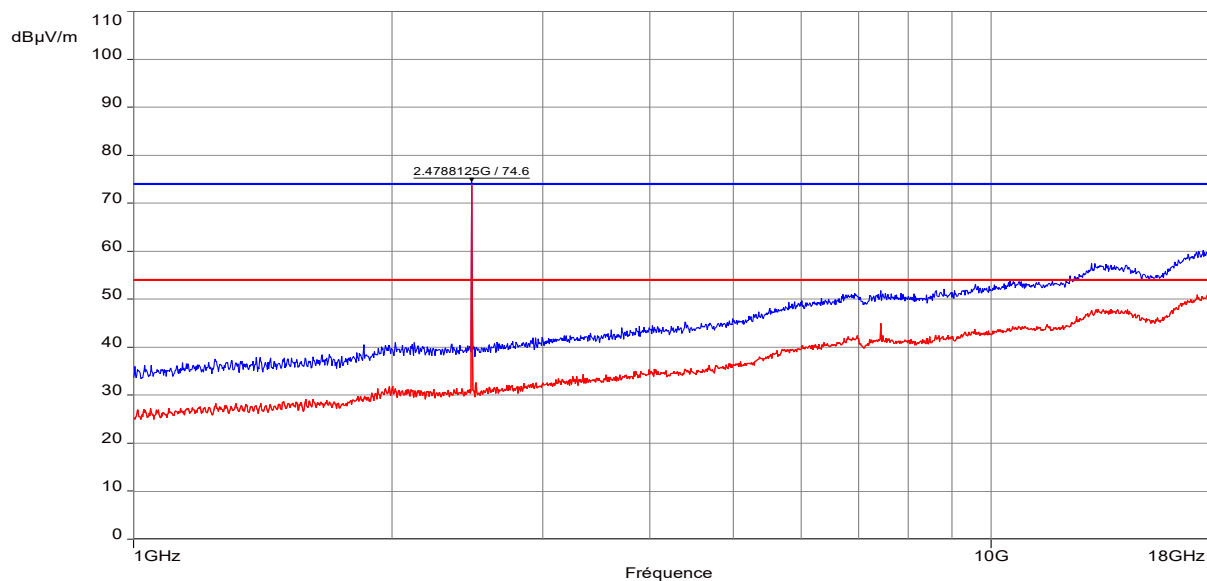
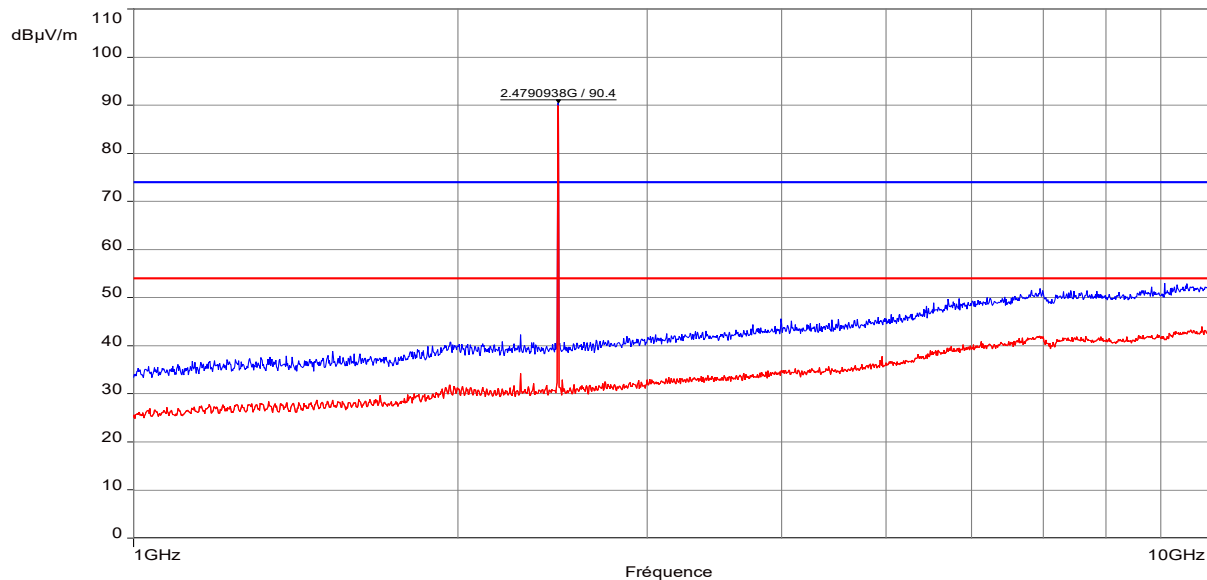
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical / Transmit mode at 2440MHz)



Notes: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.209 a) / RSS-Gen §8.9
Measurement detector:	Peak

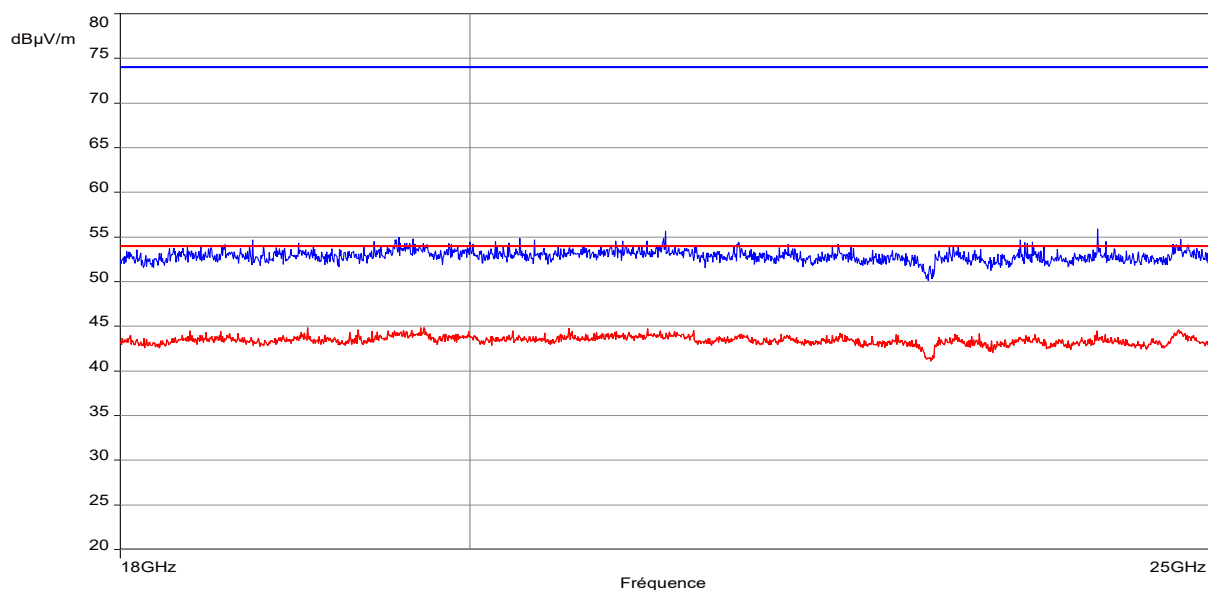
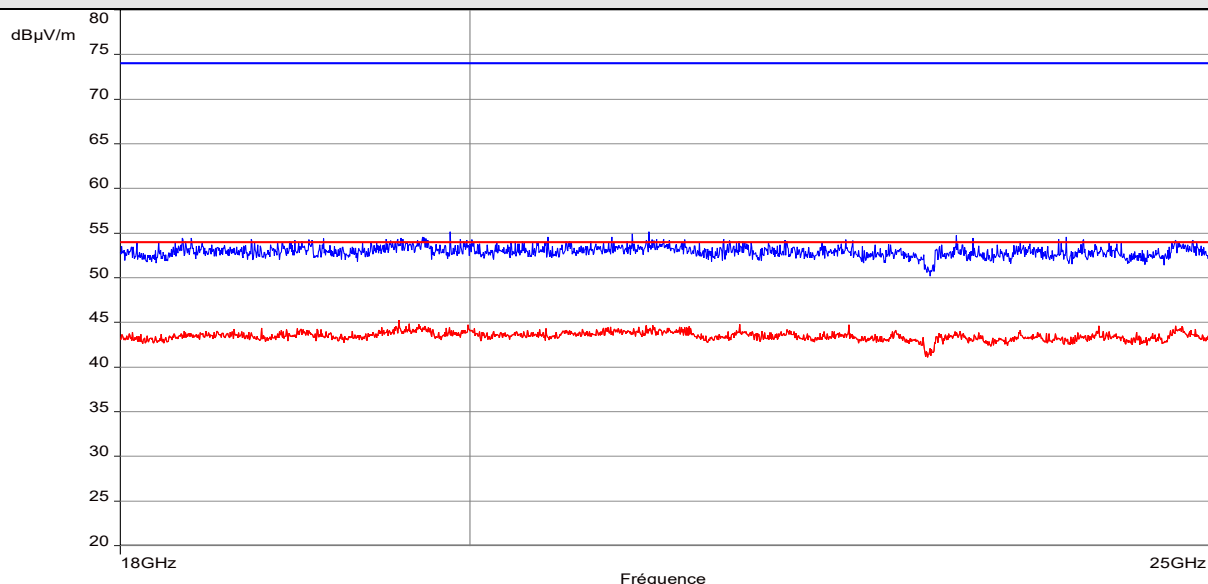
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical / Transmit mode at 2479MHz)



Notes: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.209 a) / RSS-Gen §8.9
Measurement detector:	Peak

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-25GHz / 3m / Horizontal & Vertical / Transmit mode)



Notes: Pre-scan graph only for identification purpose.

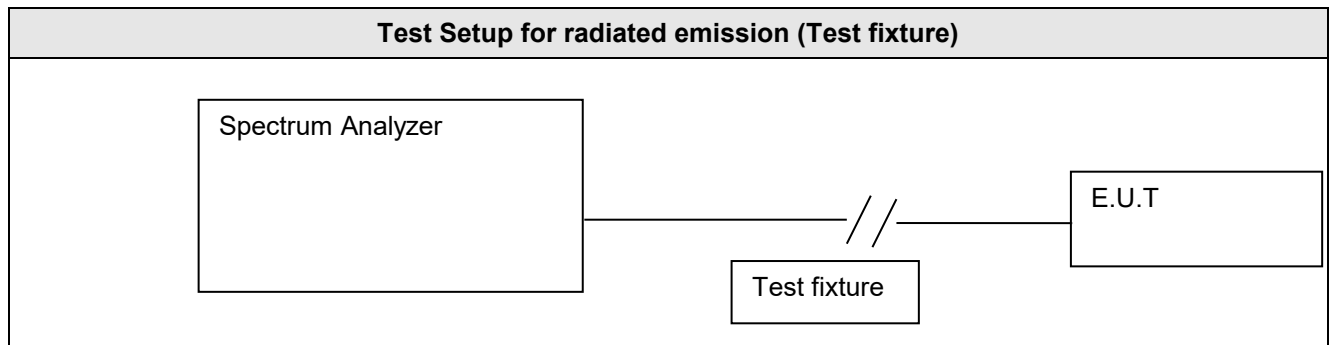
Same result for transmit mode at 2402MHz, 2440MHz or 2479MHz.

Frequency band investigated:	18GHz-25GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.209 a) / RSS-Gen §8.9
Measurement detector:	Peak and Average

12. 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 measuring antenna. A radiated measurement is performed. The RBW is set in the range of 1% to 5% of the occupied bandwidth, with VBW ≥ 3 x RBW. The SPAN is wide enough to capture all products of the modulation process. A Peak detector is used. Measure is performed with OBW 99% function of the spectrum analyser. The tested equipment is set to transmit operation with modulation on low, mid and high channels.			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	23°C ± 2	
Relative Humidity	10 to 90 %	55% ± 5	
Supplementary information: Test location: SMEE Test date: November 5 th , 2019			

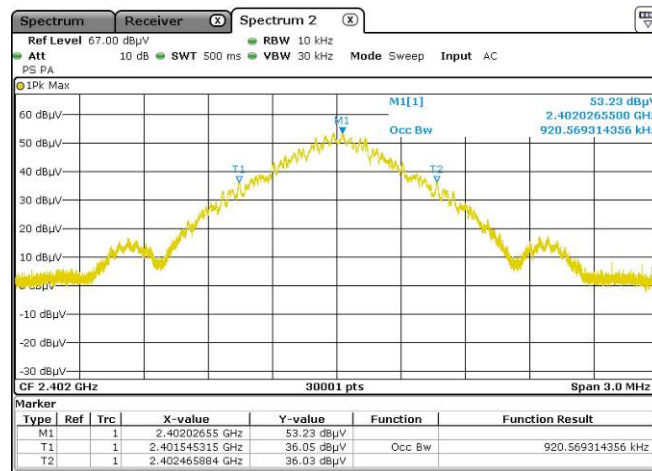
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2018/10	2021/10
RF cable	Pasternack RF	PE302-120	CAB-131-024	2019/4	2020/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2019/4	2020/4
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6



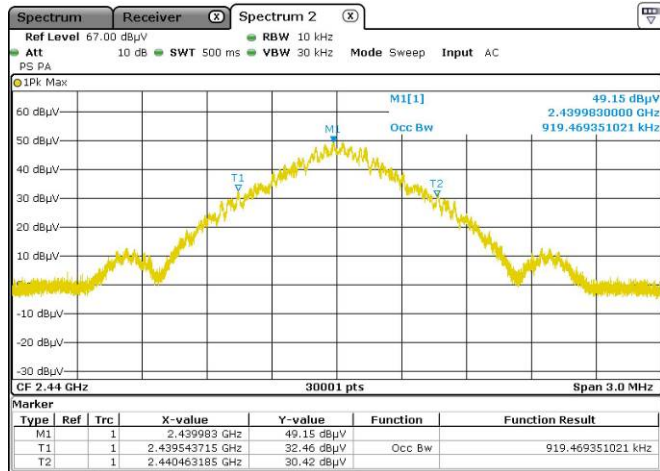
Tabulated Results for Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (kHz)
2402.0	920.57
2440.0	919.47
2479.0	921.27

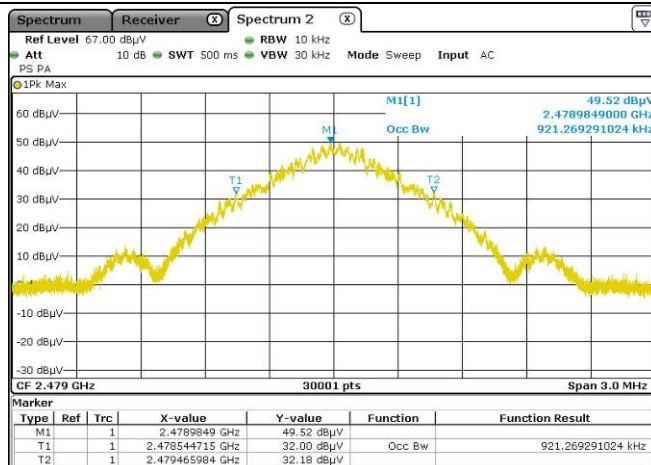
Graphical representation of Occupied Bandwidth



Low Channel



Mid Channel



High Channel

Frequency band investigated:	2400MHz to 2483.5MHz
RBW / VBW :	10kHz / 30kHz
Measurement detector:	Peak / Max hold