

FCC Test Firm Designation Number: FR0014
Industry Canada Test Firm Number: Site# 9545A-1 / 9545A-2

Matériel testé :
Equipment under test:

RIIOT LABS SA / BLUE CONNECT (BLUE V2)
(Trademark / Marketing name or product reference)

Client / Demandeur:
Customer / Applicant :

Riiot Labs
M. Julien Delarbre
Boulevard de l'Ourthe, 16
44032 Chênée- Belgium

Fabricant :
Manufacturer:

Riiot Labs
Boulevard de l'Ourthe, 16
44032 Chênée- Belgium

Numéro d'affaire :
Work number :

12199

Référence de la proposition :
Proposal number:

102017-22693

Date de l'essai :
Date of test:

17 mai 2018
May 17th, 2018

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 2400-2483.5 MHz)

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 des normes citées en référence.
The appliance complies with requirements of above mentioned standards.

Ed.	Date	Modifications Pages	Written by : Visa	Approved by: Visa
1	March 6 th , 2019	Initial Edition	Laurent Chapus  Signature numérique de Chapus Laurent	Régis ANCEL  Signature numérique de Ancel Régis
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COORDONNEES

SMEE
Rue de Taille – ZI Des Blanchisseries
38500 VOIRON - France

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

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

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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 15.109 / 15.209 / 15.247

ISED qualification according to:		
Standards	Applied	Title
ICES-003 (Issue 6/2016)	X	Information Technology Equipment (ITE) – Limits and methods of measurement
RSS-Gen (Issue 5/2018)	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 v05
- Determining ERP and EIRP Guidance 412172 D01 v01r01

Deviation from standard: None

2. Test synthesis

TEST	Paragraph number FCC Part 15 / IC RSS-247 / RSS-GEN	Spec. FCC Part 15 / IC RSS-247 / RSS-GEN	RESULTS (comments)
Conducted emissions test	15.207 (a) RSS-Gen § 8.8	Table 15.107 (a) Table 4 / RSS-Gen	N/A (1)
6dB Bandwidth	15.247 (a) (2) RSS-247 § 5.2 (a)	At least 500kHz	PASS
Maximum Peak Output Power	15.247 (b) (3) 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	-20dBc in any 100kHz outside frequency band.	PASS
Unwanted emissions into Restricted Frequency Bands	15.209 (a) / 15.247 (d) / 15.205 (a) RSS-GEN § 7.1, §8.9, § 8.10 / RSS-247 § 5.5	Measure at 300m 9-490kHz: 2400µV/m/F(kHz) Measure at 30m 0.490-1.705: 24000µV/m/F(kHz) 1.705-30MHz: 30µV/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

(1): No connection to AC mains possible (Non rechargeable battery)

• General conclusion:

Measures and tests performed on the sample of the product **BLUE V2**, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart C and ISSED RSS-Gen & RSS-247.

3. Equipment Under Test (EUT)

Nom /
Identification

BLUE CONNECT (BLUE V2)

Sn: 42174720232

FCC ID:

2A007-BLUEV2

IC:

23490-BLUEV2

Model:

BLUE V2

Alimentation /
Power supply

3.6V DC from internal battery (Non rechargeable)

Auxiliaires /
Auxiliaries

None

Entrées-Sorties /
Input / Output

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

Version programme /
Firmware version

NC

Mode de fonctionnement /
Running mode

The tested sample is able to:

- Transmit a modulated carrier frequency on low, middle and high channels (Bluetooth Low Energy)
- Be in standby mode (no transmission)
- Be in normal (measuring) mode with RF function disable

Programme de test /
Test program /

None

Information sur l'équipement /
Equipment information

Bluetooth Low Energy

- ISM frequency band: 2400 to 2483.5 MHz
- Type of technology: Digital Transmission System
- Frequency band : 2402-2480MHz
- Number of channels: 40
- Occupied Channel Bandwidth: 1MHz
- Channel spacing: 2MHz
- Tx power setting: +3dBm
- Antenna type: PCB antenna
- Antenna Gain: 0dBi max.
- Powered by two 3.6V DC Li-SOCl₂ batteries
- Equipment intended for use as a mobile station
- Equipment designed for continuous operation
- Extreme temperature range: 5°C and +45°C

4. Test conditions

Power supply voltage:

Equipment under test:

Auxiliaries:

3.6V DC (Fully charged battery)

NA

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, 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)

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

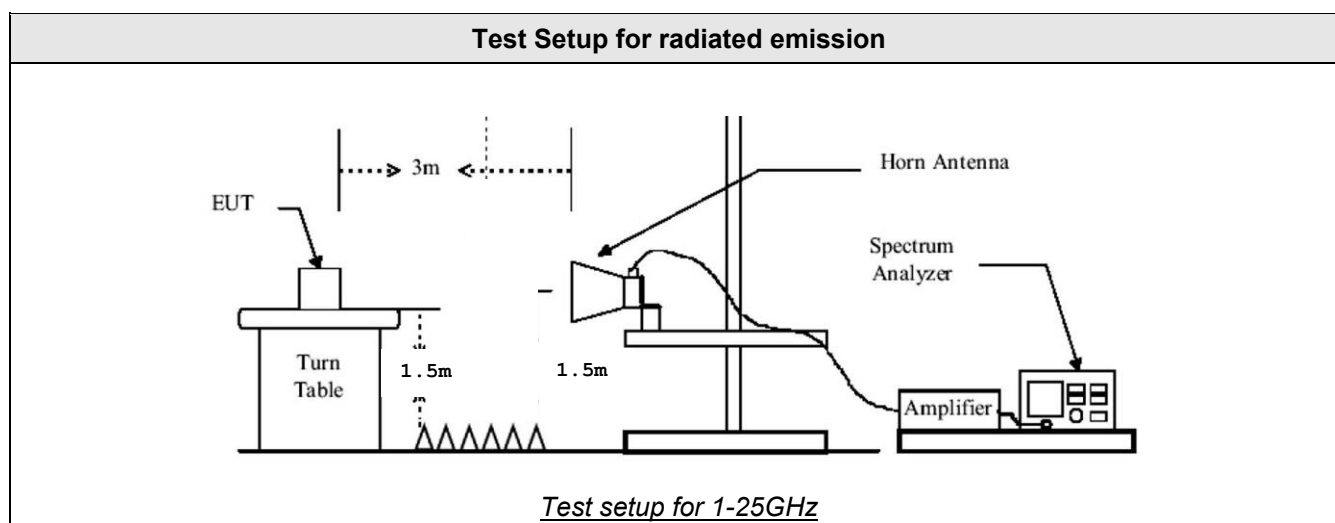
→ Total factor: 5dBm⁻¹

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

9. 6dB Bandwidth

TEST: 6dB Bandwidth		Verdict	
<u>Method:</u> The setup is in an anechoic chamber. The spectrum analyzer is connected to the measuring antenna. A radiated measurement is performed. The RBW is 100kHz, with VBW ≥ 3 x RBW. The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. Automatic function of the spectrum analyser is used. 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	20 to 30 °C		22°C ± 2
Relative Humidity	25 to 70 %		58% ± 5
Limits – FCC Part 15.247 (a) / RSS-247 §5.2 (a)			
Frequency (MHz)	Level for Bandwidth	Limit	
2402.0	6dB below the maximum output power	At least 500kHz	
2440.0			
2480.0			
Supplementary information: Test location: SMEE. Test date: May 17 th , 2018. Tested by L. CHAPUS			

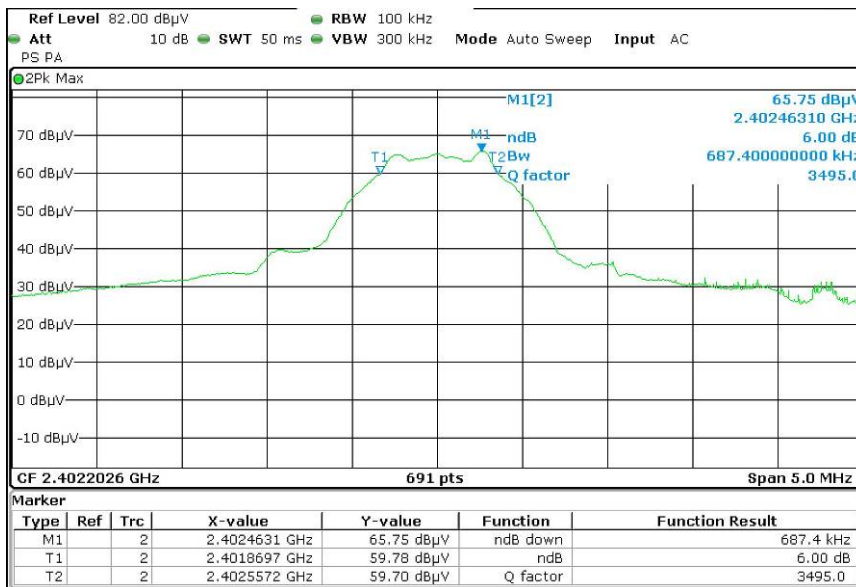
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2017/5	2019/5



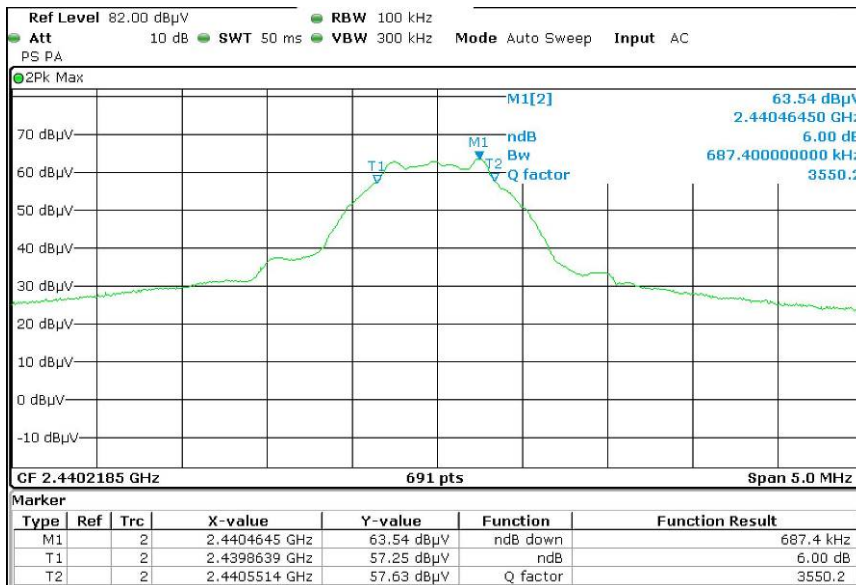
Tabulated Results for Occupied Bandwidth

Frequency (MHz)	6dB Bandwidth (kHz)	Result
2402.0	687.4 kHz	Pass
2440.0	687.4 kHz	Pass
2480.0	680.2 kHz	Pass

Graphical representation of 6dB Bandwidth

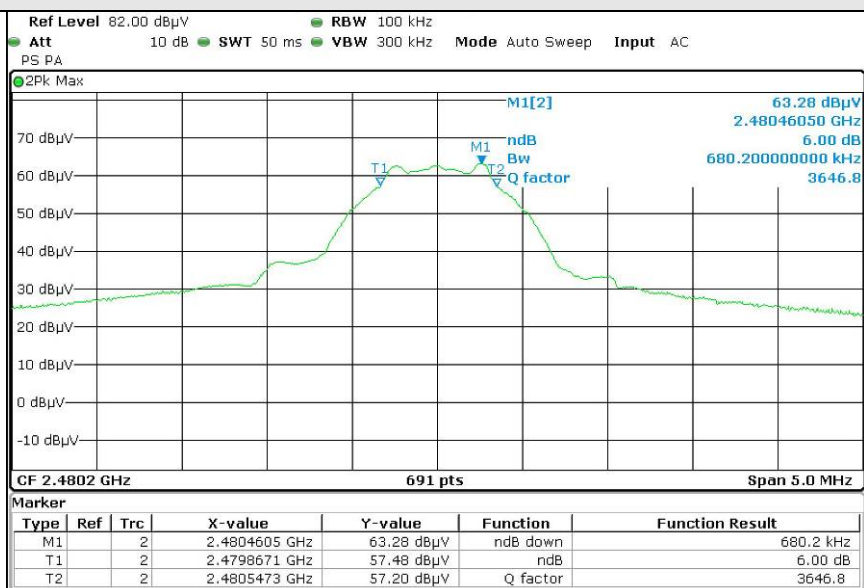


Low channel



Mid channel

Graphical representation of 6dB Bandwidth



High channel

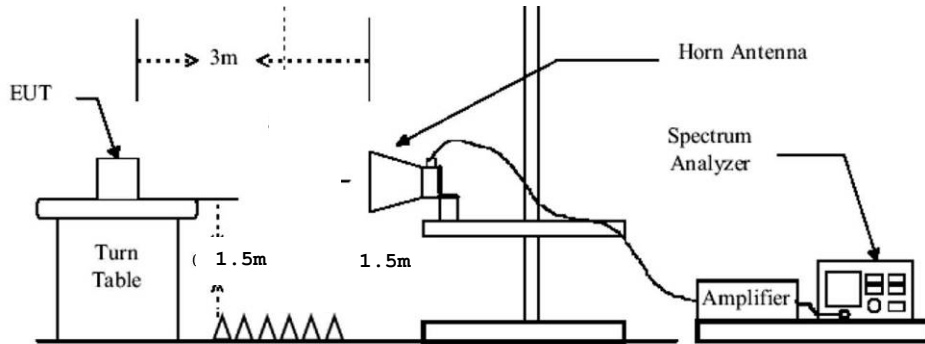
Frequency band investigated:	2400MHz to 2483.5MHz
RBW :	100kHz
Measurement detector :	Peak

10. Maximum Peak Output power

TEST: Maximum peak conducted output power			Verdict
<u>Method:</u> A radiated measurement is performed. The RBW is wide enough to capture the maximum amplitude level (1MHz). The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. Radiated field strength of RF Output Power is measured at 3m in a Full Anechoic Chamber (FAC) that complies with ANSI C63.10. Maximum field strength (Peak) is performed by rotating the EUT 360°. All frequencies were investigated in both horizontal and vertical antenna polarity. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength, with a 60° rotation on each axis. (Clause 6.6.5 of ANSI C63.10). 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	20 to 30 °C	22°C ± 2	
Relative Humidity	25 to 70 %	58% ± 5	
Limits – FCC Part 15.247 (b) / RSS-247 §5.4 (d)			
Frequency (MHz)	Limits (dBµV/m)		
	Level / Detector	Results	
2400 to 2483.5	36 dBm / Pk / 3m (Radiated)	Pass	
2400 to 2483.5	30 dBm / Pk (Conducted)	Pass	
Supplementary information: Test location: SMEE. Test date: May 17 th , 2018. Tested by L. CHAPUS			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2017/5	2019/5

Test Setup for radiated emission



Test setup for 1-25GHz

Tabulated Results for Maximum peak output power (Radiated measurement)

FREQ (MHz)	Field Strength 3m (dBμV/m)	Calculated EIRP (dBm)	Limit (dBm)	Result
2402	97.9	2.6	36.0	Pass
2441	97.3	2.1	36.0	Pass
2480	97.1	1.9	36.0	Pass
RBW:		1MHz		
Measurement distance:		3m		
Limit:		FCC Part 15.247 / RSS-247		
Final measurement detector:		Peak		
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 (2): EIRP is calculated using the following equation: $EIRP = E + 20 \times \log(D) - 104.8 - GR$ Where EIRP = Equivalent Isotropic Radiated Power in dBm E = Electric field strength in dBμV/m D = Measuring distance in meter GR = Ground reflection in dB (0dB above 1GHz)		

Tabulated Results for Maximum peak output power (Conducted)			
FREQ	Conducted power	Limit	Result
(MHz)	(dBm)	(dBm)	
2402	2.6	30.0	Pass
2440	2.1	30.0	Pass
2480	1.9	30.0	Pass
RBW:	1MHz		
Limit:	FCC Part 15.247 / IC RSS-247		
Final measurement detector:	Peak		
RESULT:	PASS		
Note:	(1): Maximum conducted Peak output power is calculated as follow: $P_c = EIRP - G$ Where P_c = Conducted power dBm $EIRP$ = Equivalent Isotropic Radiated Power in dBm G = Antenna gain in dBi (0dBi, as declared by the manufacturer)		

11. Maximum Power Spectral Density Level in the fundamental emission

TEST: Maximum Peak Power Spectral Density			Verdict
<u>Method:</u> A radiated measurement is performed. The SPAN is wide enough to capture all products of the modulation process. Radiated field strength of RF Output Power is measured at 3m in a Full Anechoic Chamber (FAC) that complies with ANSI C63.10. Maximum field strength is performed by rotating the EUT 360°. All frequencies were investigated in both horizontal and vertical antenna polarity. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength, with a 60° rotation on each axis. (Clause 6.6.5 of ANSI C63.10). 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	20 to 30 °C	22°C ± 2	
Relative Humidity	25 to 70 %	58% ± 5	
Limits – FCC Part 15.247 (e) / RSS-247 §5.2 (b)			
Frequency (MHz)	Level (Detector)	Limit	
2441.75	8 dBm/3kHz (Pk)		Pass
Supplementary information: Test location: SMEE. Test date: May 17th, 2018. Tested by L. CHAPUS			

Tabulated Results for Maximum Power Spectral Density			
Frequency (MHz)	PSD (dBm/3kHz)	Limit	Result
2402	2.6 [1]	8dBm/3kHz	Pass
2440	2.1 [1]	8dBm/3kHz	Pass
2480	1.9 [1]	8dBm/3kHz	Pass
RBW:	1MHz		
Limit:	FCC Part 15.247 / RSS-247		
Final measurement detector:	Peak		
RESULT:	PASS		

[1]: Measured output power reported. Maximum Peak Output power complies with the PSD limit.
See Clause 11.10.1 of ANSI C63.10 (2013).

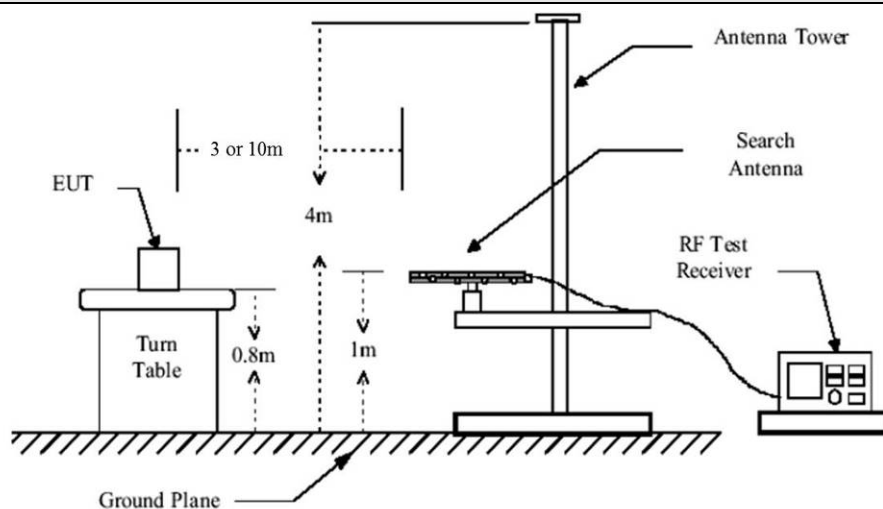
12. Unwanted emissions in Non-Restricted Frequency bands

TEST: Unwanted emissions in Non-Restricted Frequency Bands			Verdict
<u>Method:</u> Measurements were performed on a 3-meter Open Area Test Site (OATS) for frequency below 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) were then performed by rotating the EUT on 360° and adjusting the receive antenna height from 1 to 4 m For frequency above 1GHz, final measurements were made at 3m 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 1.25-meters high. The pre-characterization graphs are obtained in PEAK detection with 360° continuous rotation of the device under test.			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	20 to 30 °C	22°C ± 2	
Relative Humidity	25 to 70 %	58% ± 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 15.247 (d) / RSS-247 § 5.5			
Frequency (MHz)	Limits (dBµV/m)		
	Detector / Analyser RBW	Limit	Results
30 to 25000	Pk / 100kHz	20dB below the maximum Peak level	Pass
Supplementary information: Test location: SMEE. Test date: May 17 th , 2018. Tested by L. CHAPUS			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2017/5	2019/5
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2017/5	2019/5
Loop antenna	EMCO	6502	ANT-101-009	2017/8	2019/8
BiConiLog antenna	EMCO	3142B	ANT-101-010	2017/7	2019/7
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2017/12	2022/12
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2017/5	2019/5
RF cable	Div	OATS/25m	CAB-101-017	2018/4	2019/4
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2018/4	2019/4

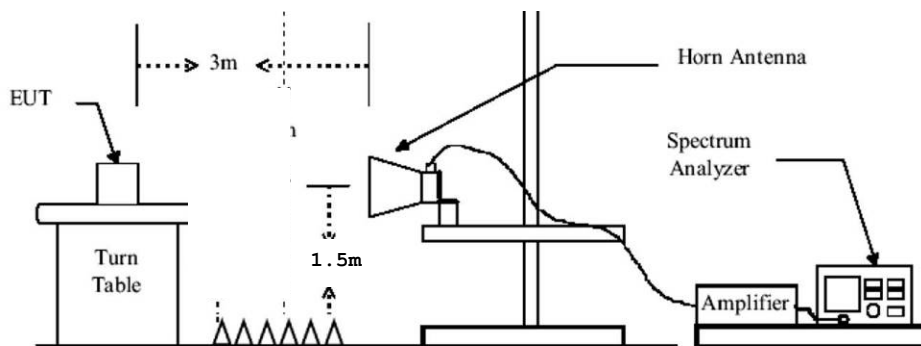
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2017/5	2019/5
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-035	2017/5	2019/5
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	2018/4	2019/4
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2017/12	2019/12
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2017/5	2019/5
OATS	Div	10m	SIT-101-001	2017/7	2020/7
EMC Software	NEXIO	BAT EMC V3.8	SOF-101-001	-	-

Test Setup for radiated emission



Test setup for 30-1000MHz

Test Setup for radiated emission



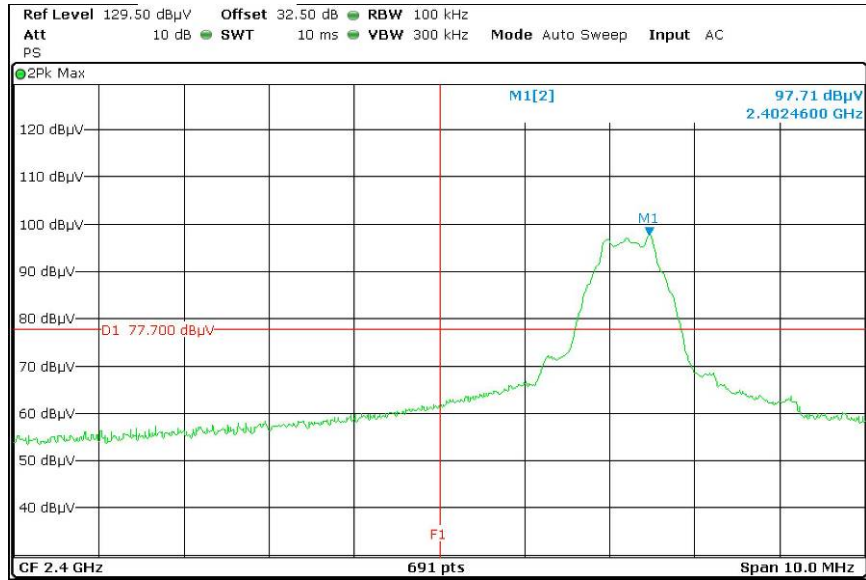
Test setup for 1-25GHz

Tabulated Results for Peak Output Power Reference level

FREQ (MHz)	Field Strength 3m (dB μ V/m)
2402.0	97.7
2440.0	97.2
2480.0	97.0
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 77.0 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)
2400.0	62.5	77.0	-14.5	Pass
RBW:		100kHz		
Measurement distance:		3m		
Limit:		15.247 / RSS-247		
Final measurement detector:		Peak		
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 (2): Peak pre-scans not performed at 3-meters distance are corrected as follow: $M@3m = M@D_m + 20 \times \log(D_m / 3_m)$ Where D is the measurement distance in meter (3): All frequencies not specified have margin < -10dB (4): Worst case between charge mode and normal used mode (5): 3-axis measurement performed for device under test.		

Graphical representation of Band-edge compliance (LOW)



Low bandedge compliance

Radiated Peak level is 60.1dBμV/m (limit 74.9dBμV/m)

F1 = 2400MHz

RESULT: PASS

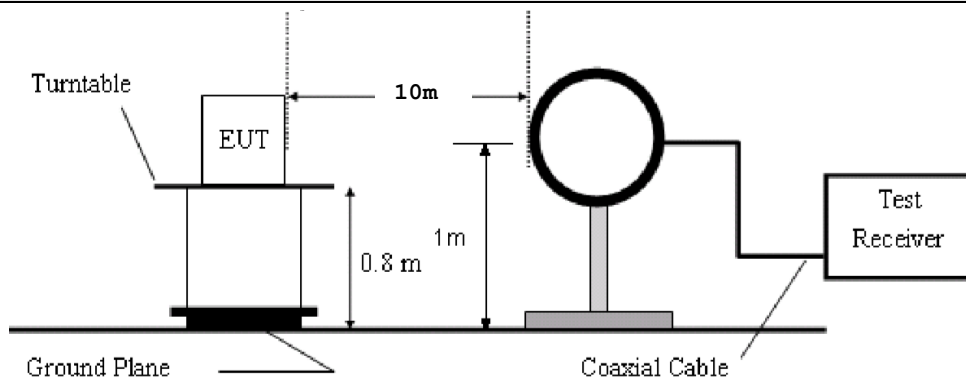
Note: radiated measurement (3m in FAC)

13. Unwanted emissions in Restricted Frequency bands

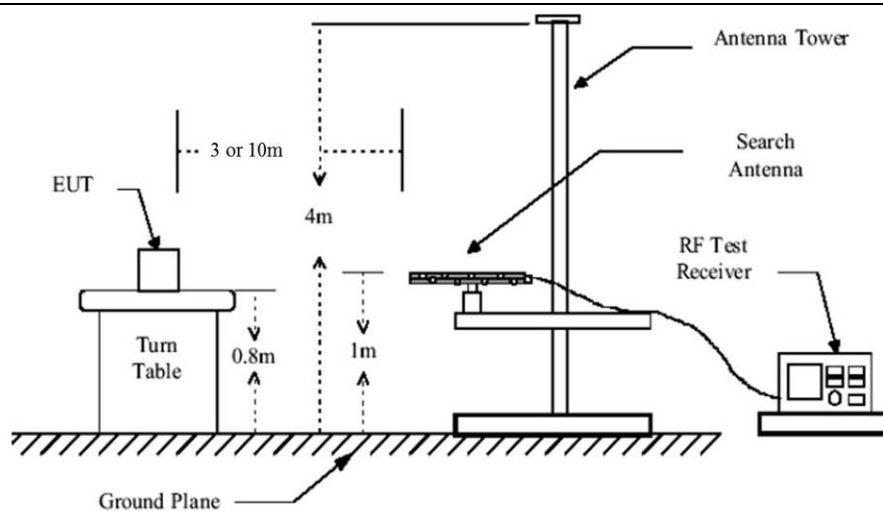
TEST: Unwanted emissions into Restricted Frequency Bands			Verdict
<u>Method:</u> Measurements were performed on a 3-meter Open Area Test Site (OATS) for frequency below 1GHz. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak) were then performed by rotating the EUT on 360° and adjusting the receive antenna height from 1 to 4 m For frequency above 1GHz, final measurements were made at 3m 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 1.25-meters high. The pre-characterization graphs are obtained in PEAK detection with 360° continuous rotation of the device under test.			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	20 to 30 °C	22°C ± 2	
Relative Humidity	25 to 70 %	58% ± 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 15.205, 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 17 th , 2018. Tested by L. CHAPUS			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2017/5	2019/5
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2017/5	2019/5
Loop antenna	EMCO	6502	ANT-101-009	2017/8	2019/8
BiConiLog antenna	EMCO	3142B	ANT-101-010	2017/7	2019/7
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2017/12	2022/12
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2017/5	2019/5
RF cable	Div	OATS/25m	CAB-101-017	2018/4	2019/4
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2018/4	2019/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2017/5	2019/5
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-034	2017/5	2019/5
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	2018/4	2019/4
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2017/12	2018/12
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2017/5	2019/5
OATS	Div	10m	SIT-101-001	2017/7	2020/7
EMC Software	NEXIO	BAT EMC V3.8	SOF-101-001	-	-

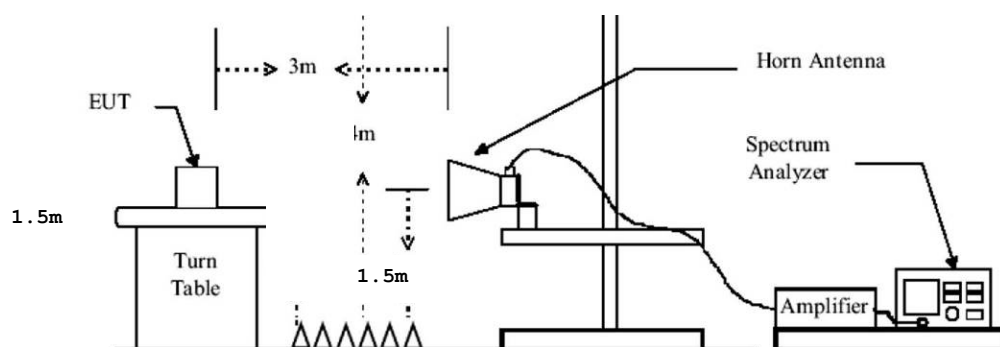
Test Setup for radiated emission



Test setup for 9k-30MHz



Test setup for 30-1000MHz



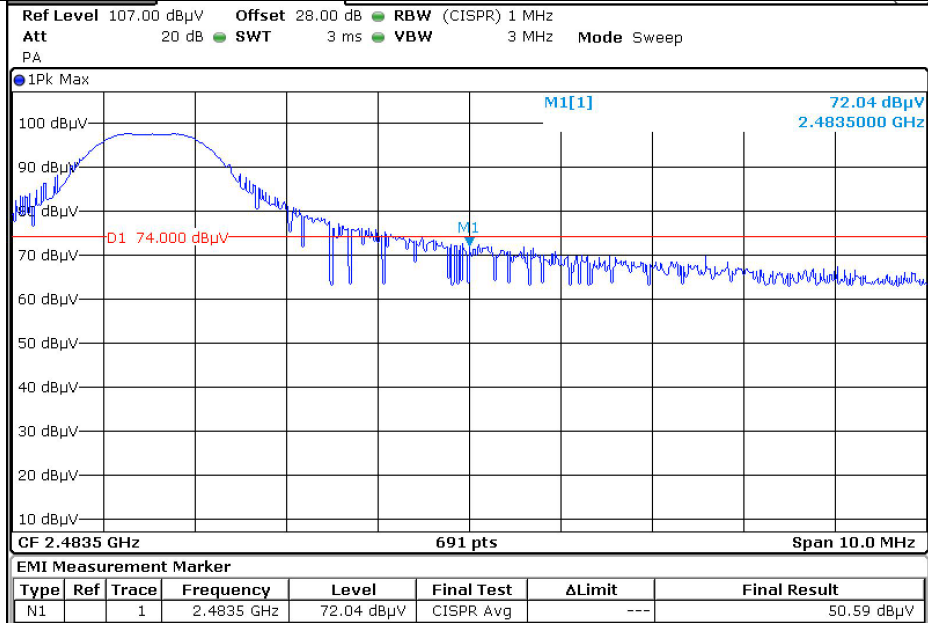
Test setup for 1-25GHz

Tabulated Results for Unwanted emissions (9kHz-30MHz)						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	(QP) dBμV/m	(QP) dBμV/m	dB	Degree	Degree	dB
Margin < -10dB						
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 15.205 - 15.209 / RSS-GEN				
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 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	Degré	(QP) dBμV/m	dB
Margin < -10dB										
Supplementary information: Frequency list measured on the Open Area Test Site 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								
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 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								

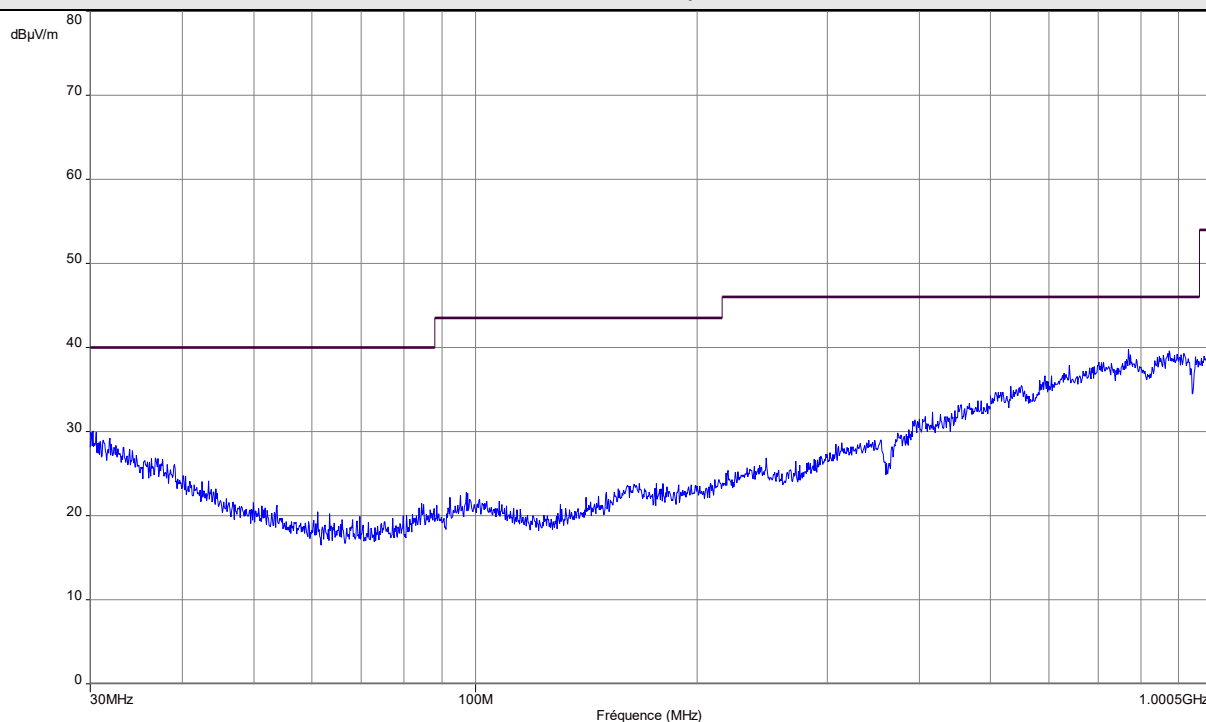
Tabulated Results for Unwanted emissions (1GHz-25GHz)					
Transmit mode					
FREQ (MHz)	Field Strength 3m (dBμV/m)	Detector	Limit (dBμV/m)	Margin (dBμV/m)	Result
2483.5	72.0	Pk	74	-2.0	Pass
2483.5	50.6	Avg	54	-3.4	Pass
4804.0	59.8	Pk	74	-14.2	Pass
4804.0	51.6	Avg	54	-2.4	Pass
4880.0	60.0	Pk	74	-14.0	Pass
4880.0	51.0	Avg	54	-3.0	Pass
4960.0	60.1	Pk	74	-13.9	Pass
4960.0	50.8	Avg	54	-3.2	Pass
7206.0	58.7	Pk	74	-15.3	Pass
7206.0	47.7	Avg	54	-6.3	Pass
7320.0	58.8	Pk	74	-15.2	Pass
7320.0	48.5	Avg	54	-5.5	Pass
7440.0	59.1	Pk	74	-14.9	Pass
7440.0	48.3	Avg	54	-5.7	Pass
Receive / Standby mode					
FREQ (MHz)	Field Strength 3m (dBμV/m)	Detector	Limit (dBμV/m)	Margin (dBμV/m)	Result
Margin < -10dB					
RBW / VBW		1MHz / 3MHz			
Measurement distance:		3m			
Limit:		FCC Part 15.205, 15.209, 15.247 / RSS-Gen, RSS-247			
Final measurement detector:		Peak / 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) (4): 3-axis measurement performed for device under test.			

Graphical representation of Band-edge compliance (HIGH)



High bandedge compliance

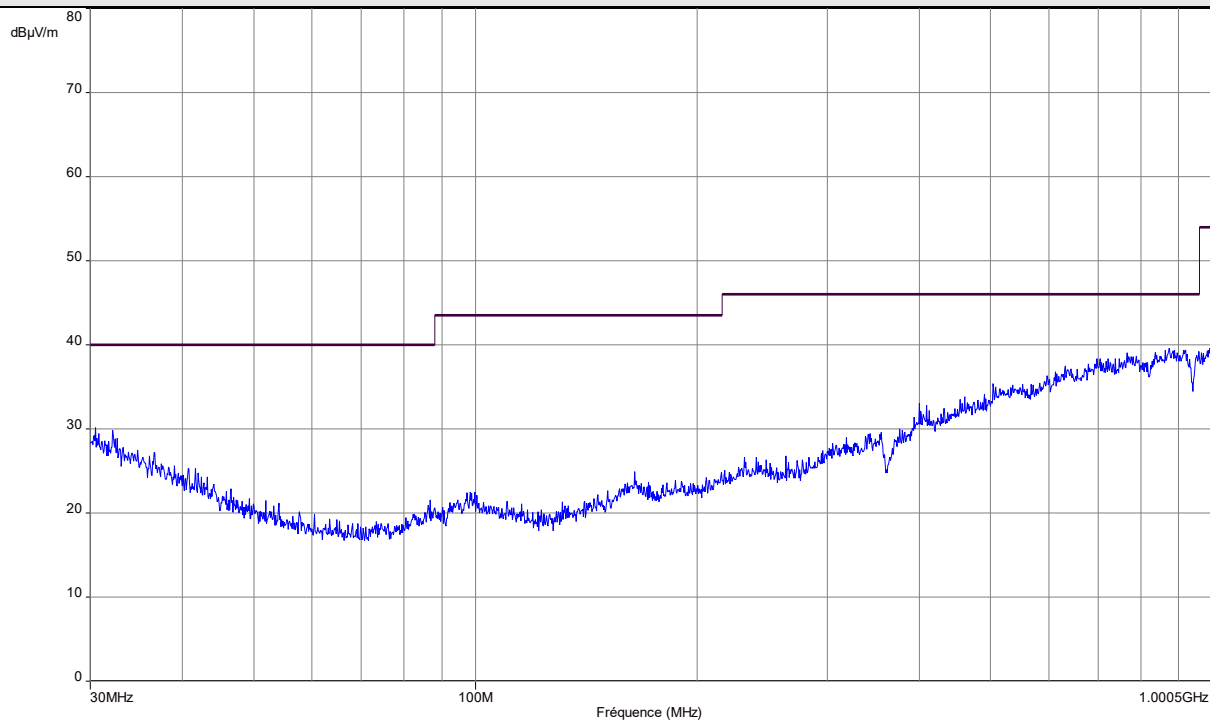
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal / Transmit mode)



Note: Pre-scan graph only for identification purpose. Worst case between low, mid and high channels.

Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak

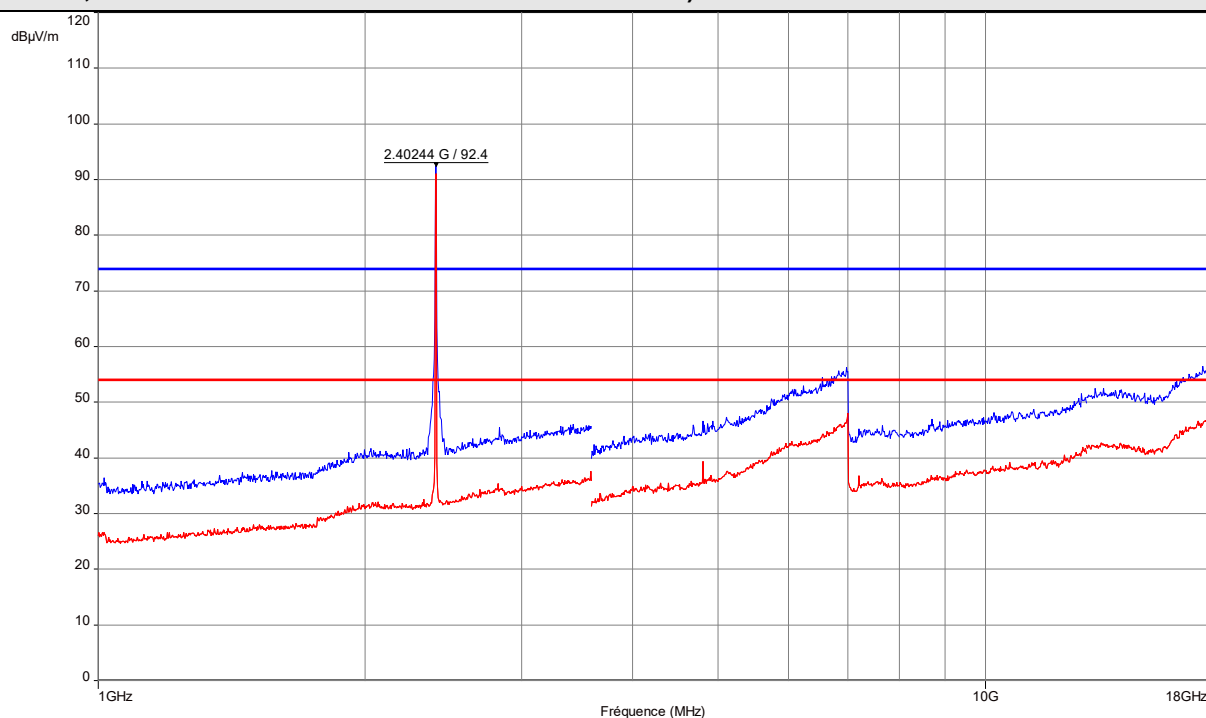
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Vertical / Transmit mode)



Note: Pre-scan graph only for identification purpose. Worst case between low, mid and high channels.

Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak

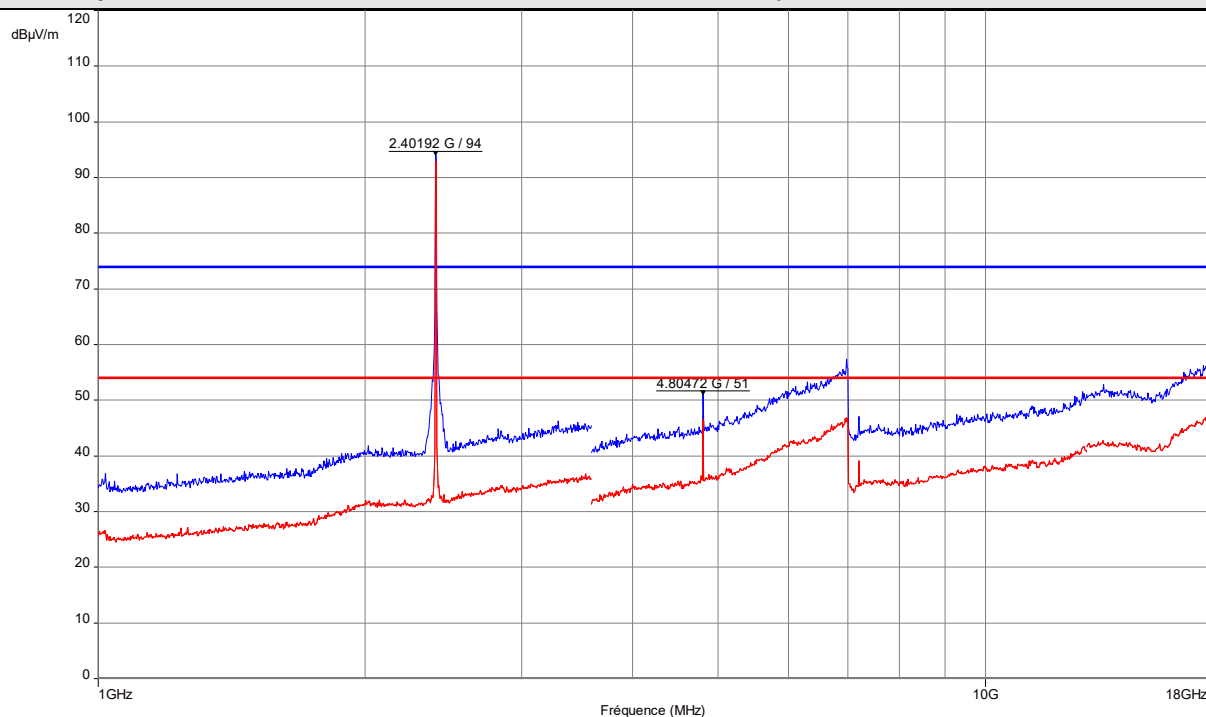
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal / Transmit mode) – Low channel



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

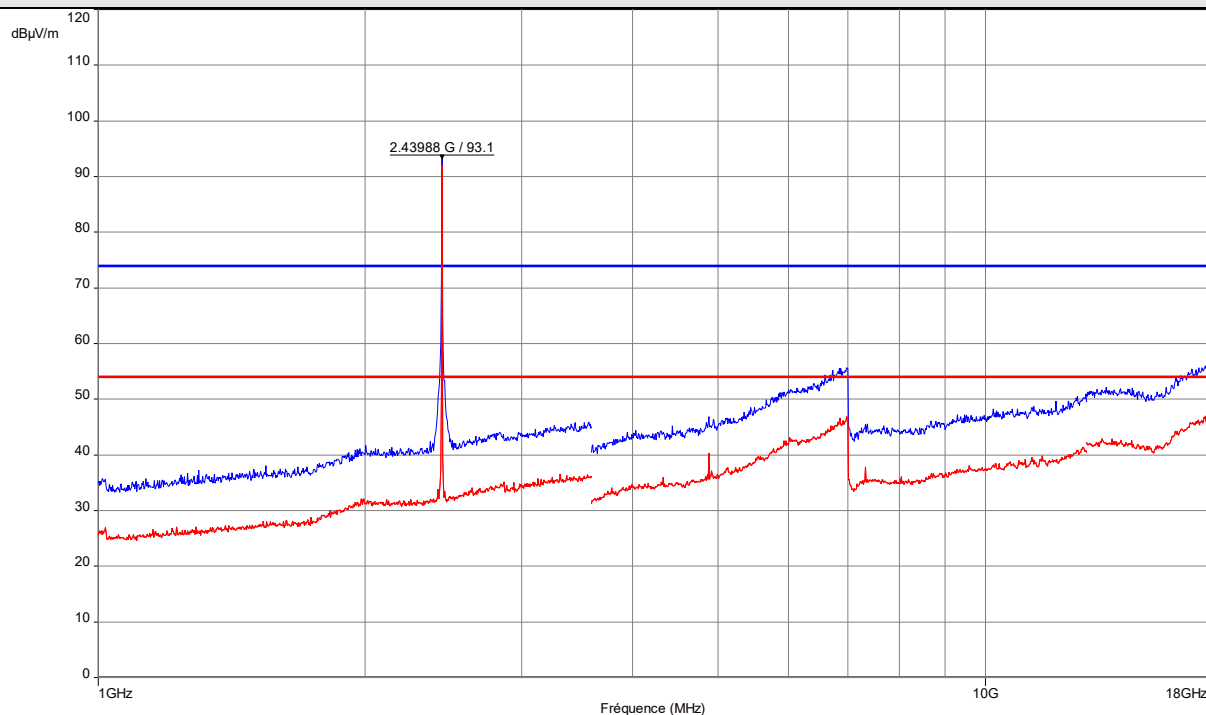
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Vertical / Transmit mode) – Low channel



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

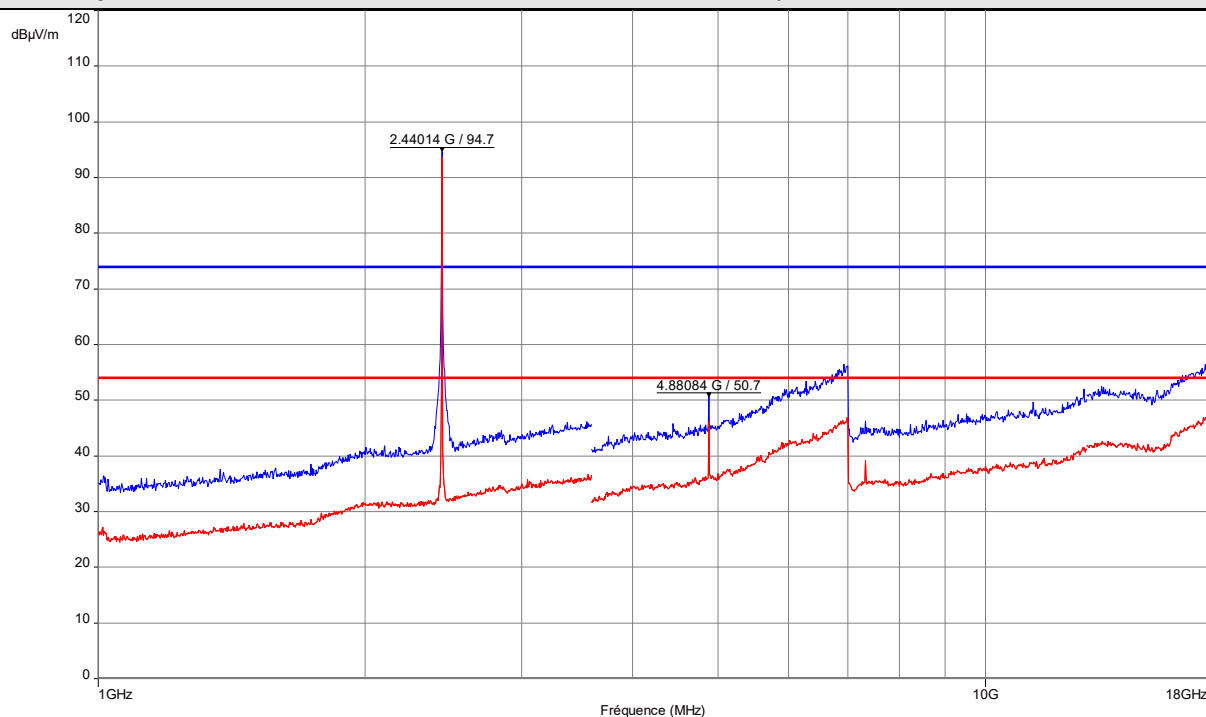
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal / Transmit mode) – Mid channel



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

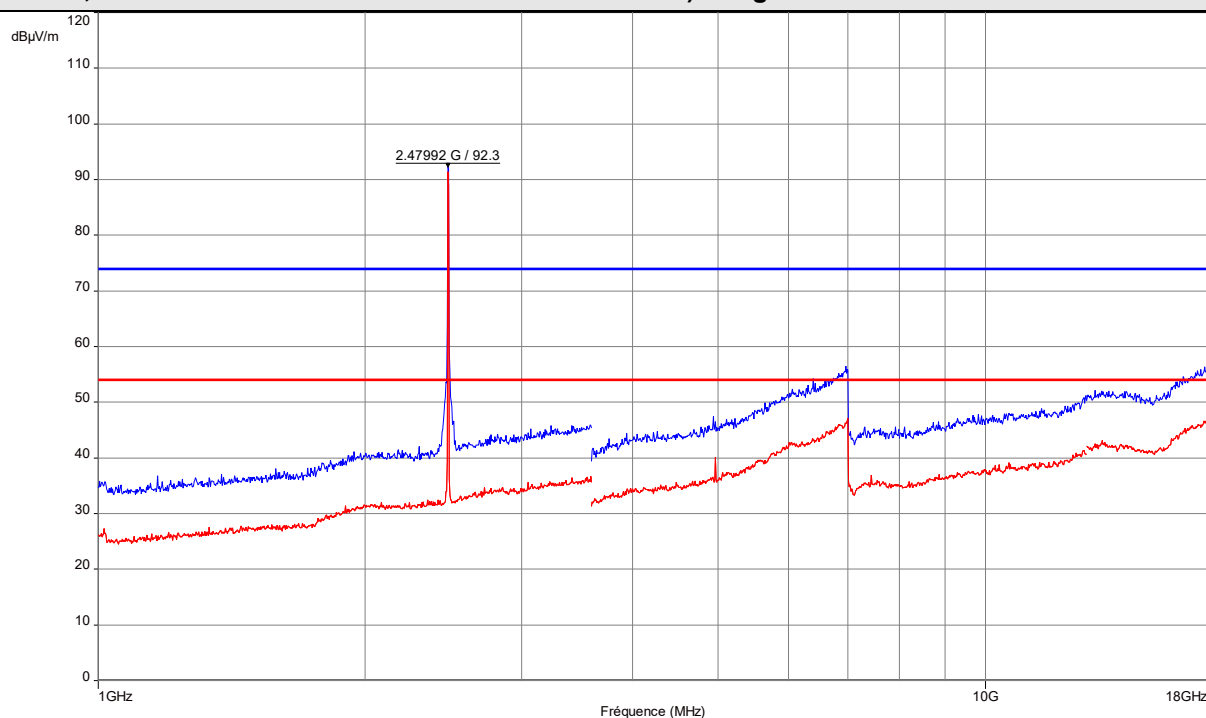
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Vertical / Transmit mode) – Mid channel



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

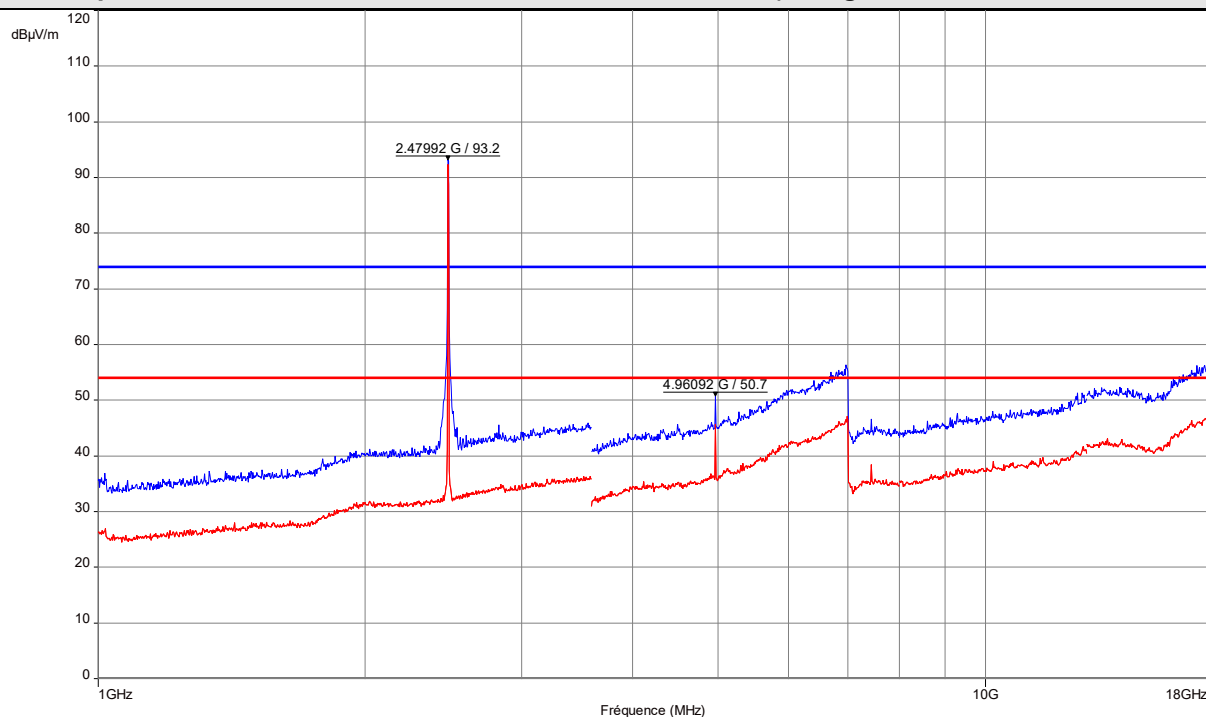
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal / Transmit mode) – High channel



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

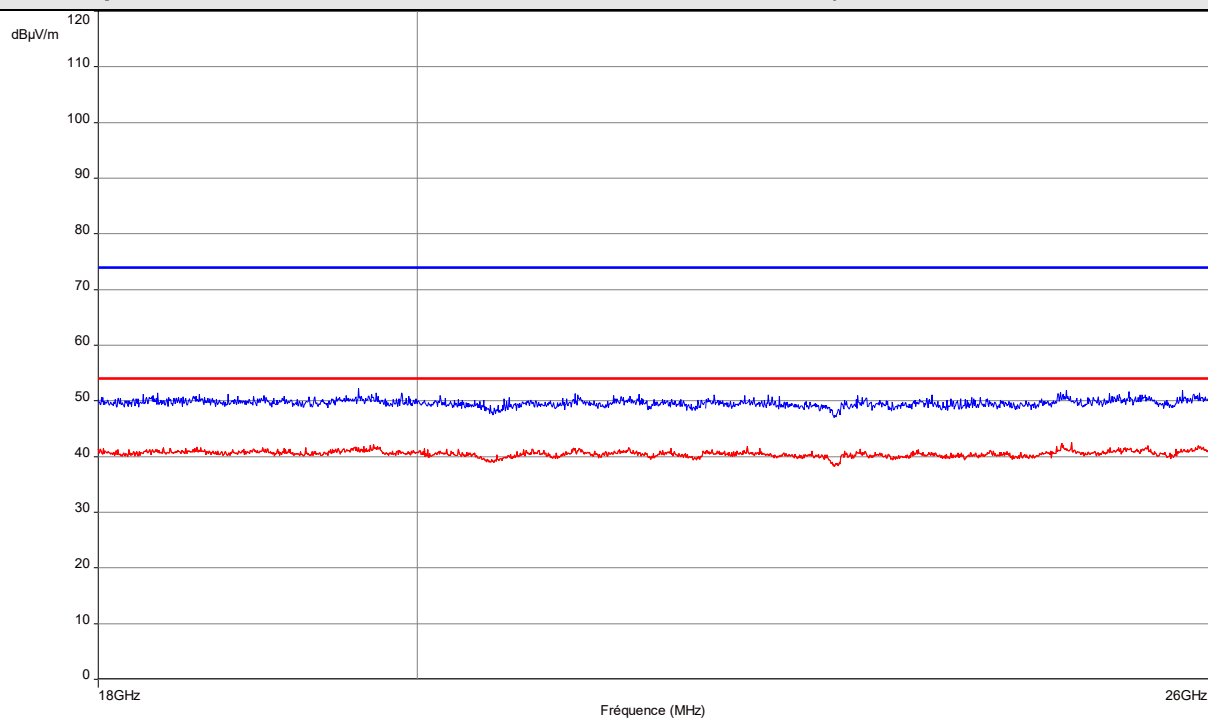
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Vertical / Transmit mode) – High channel



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

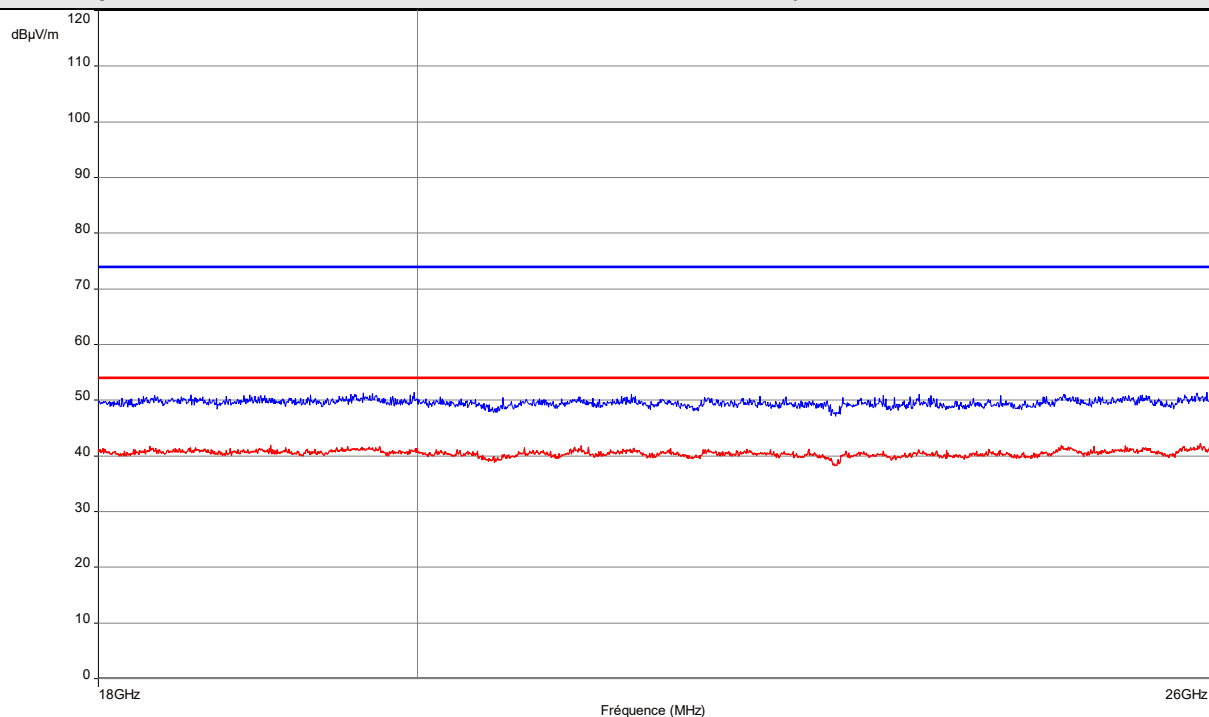
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-26GHz / 3m / Horizontal / Transmit mode) – Low channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

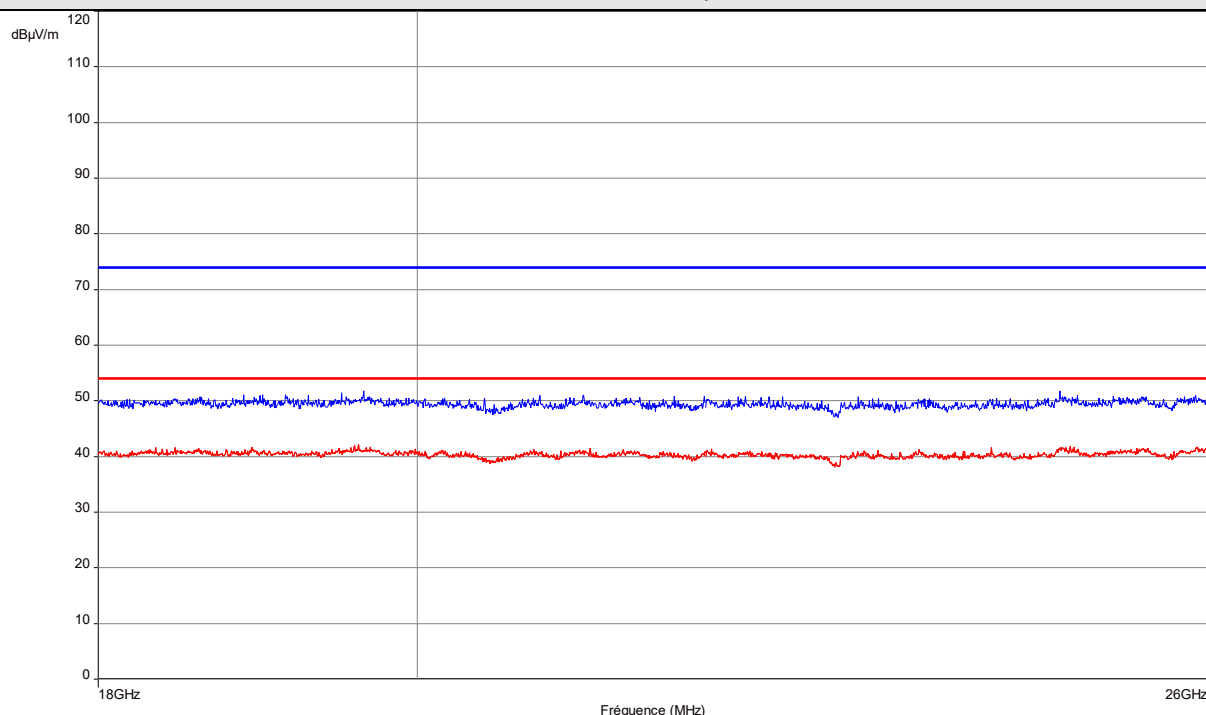
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-26GHz / 3m / Vertical / Transmit mode) – Low channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

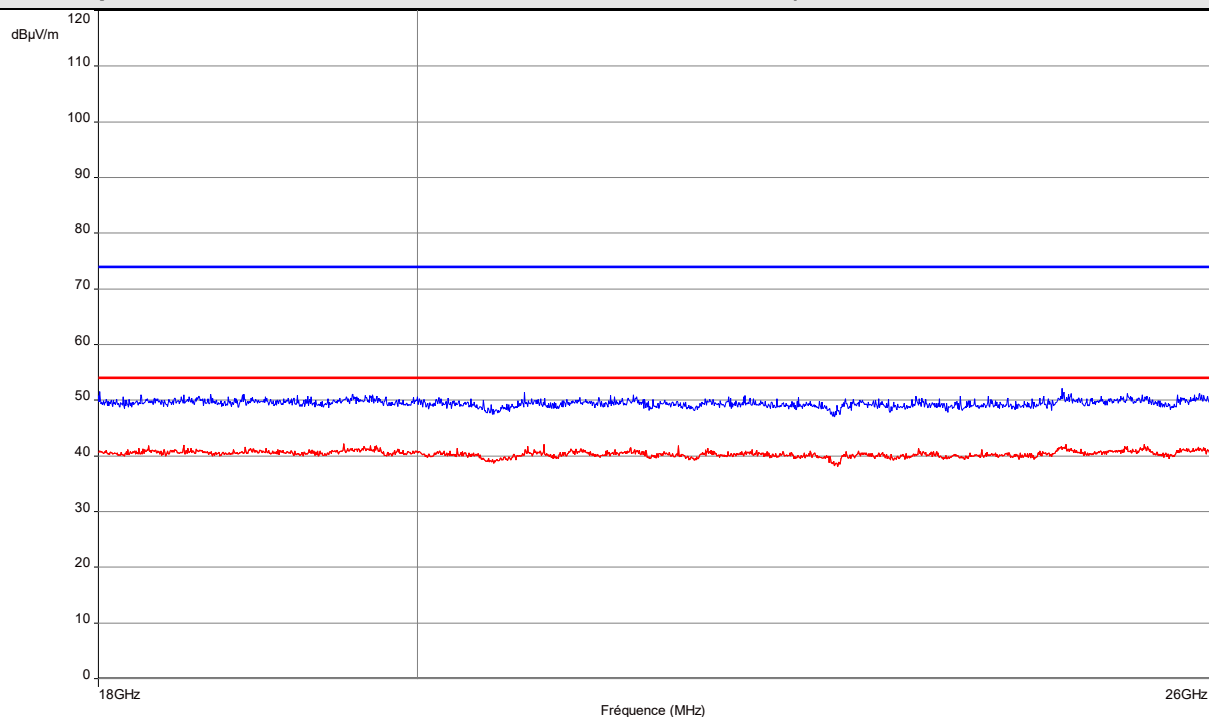
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-26GHz / 3m / Horizontal / Transmit mode) – Mid channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

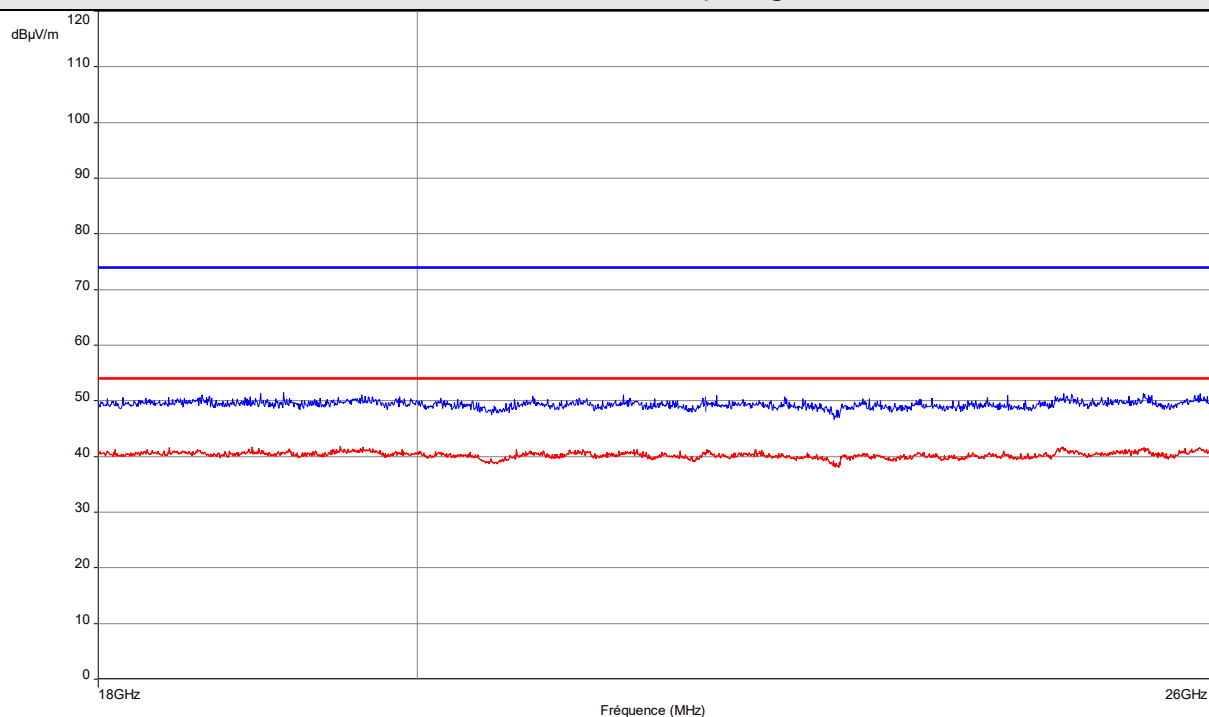
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-26GHz / 3m / Vertical / Transmit mode) – Mid channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

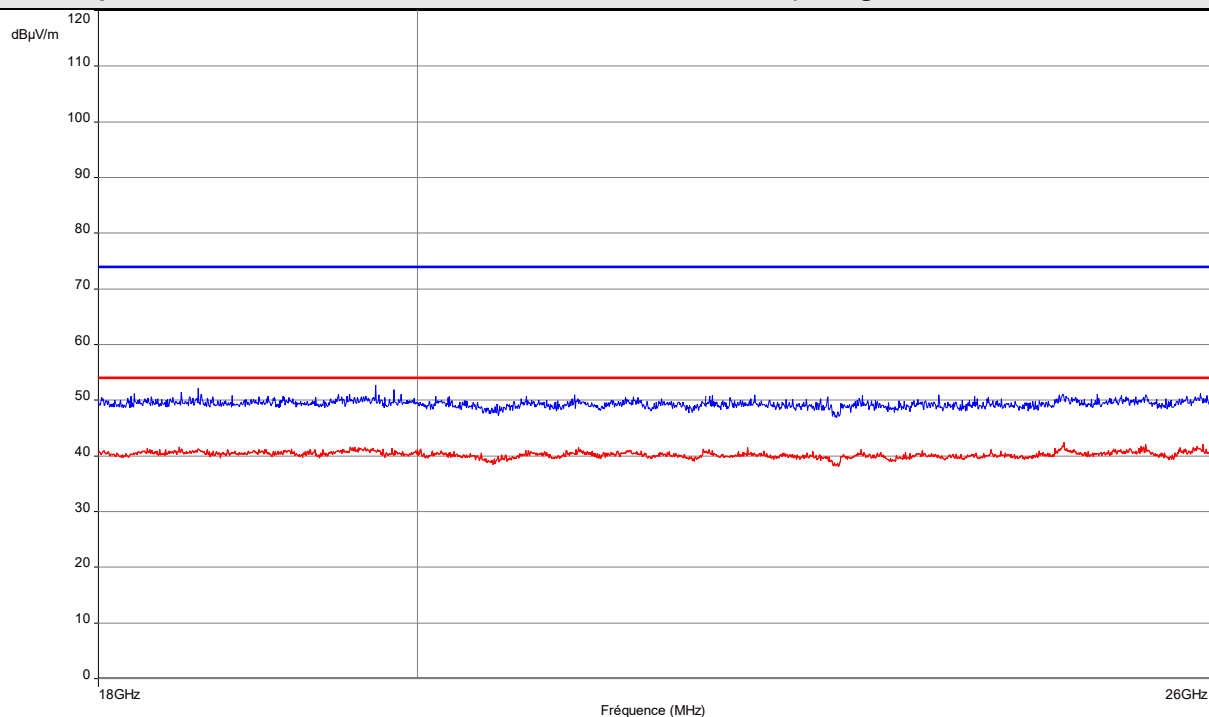
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-26GHz / 3m / Horizontal / Transmit mode) – High channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

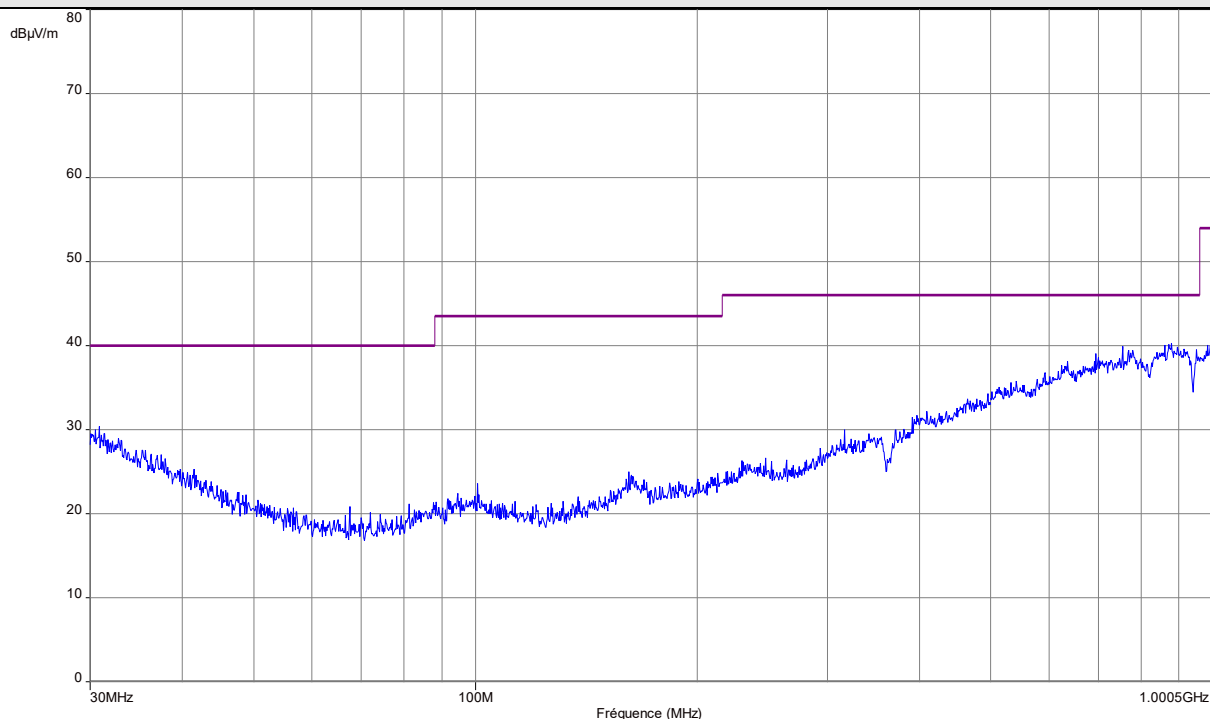
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-26GHz / 3m / Vertical / Transmit mode) – High channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

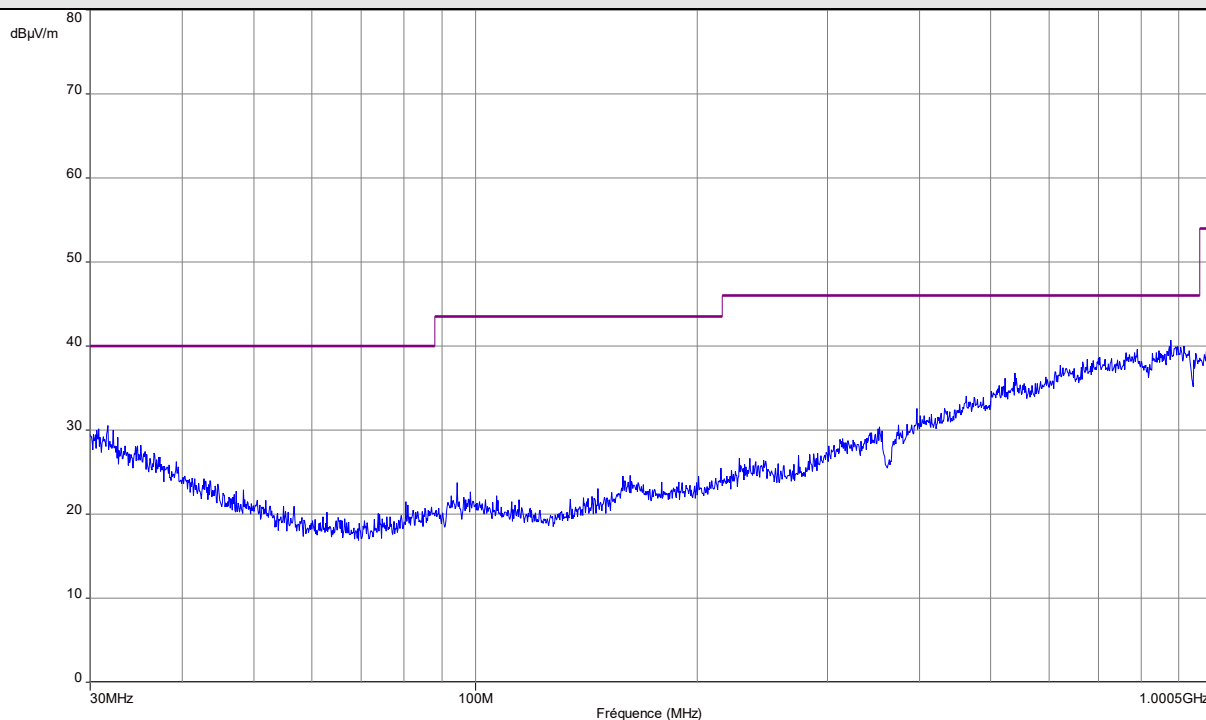
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal / Receive mode)



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	30MHz-1GHz
Unit :	dBμV/m
RBW :	100kHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak

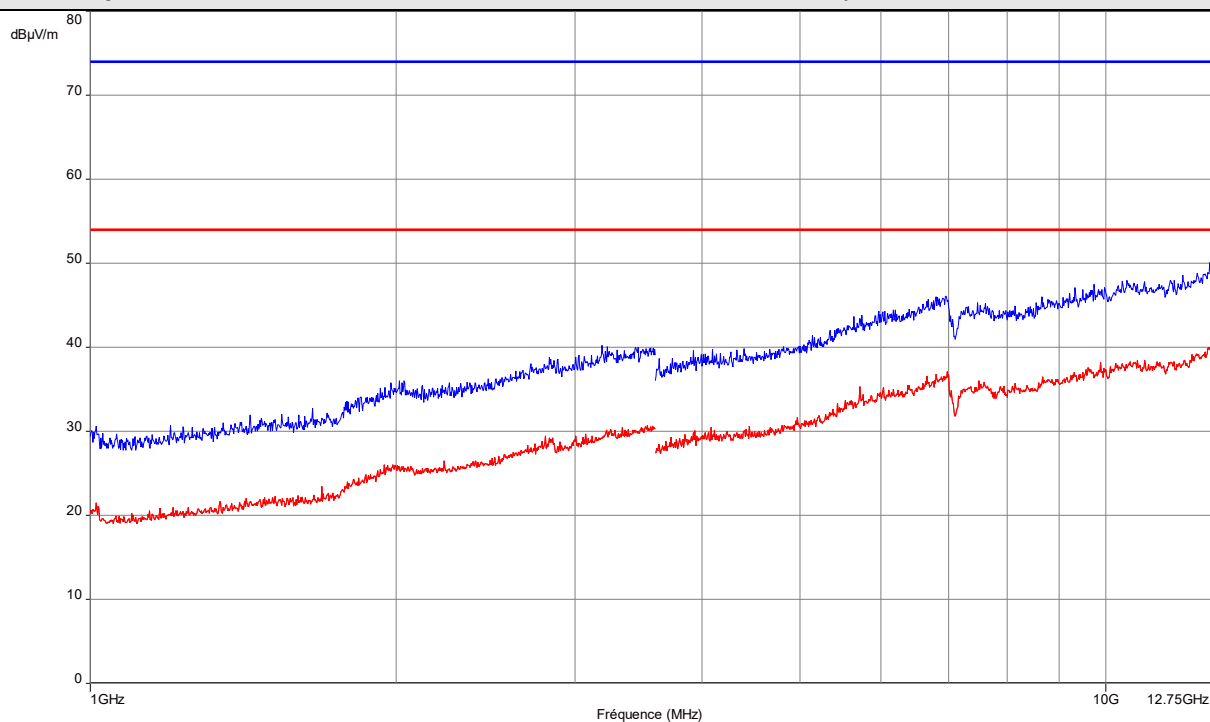
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Vertical / Receive mode)



Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak

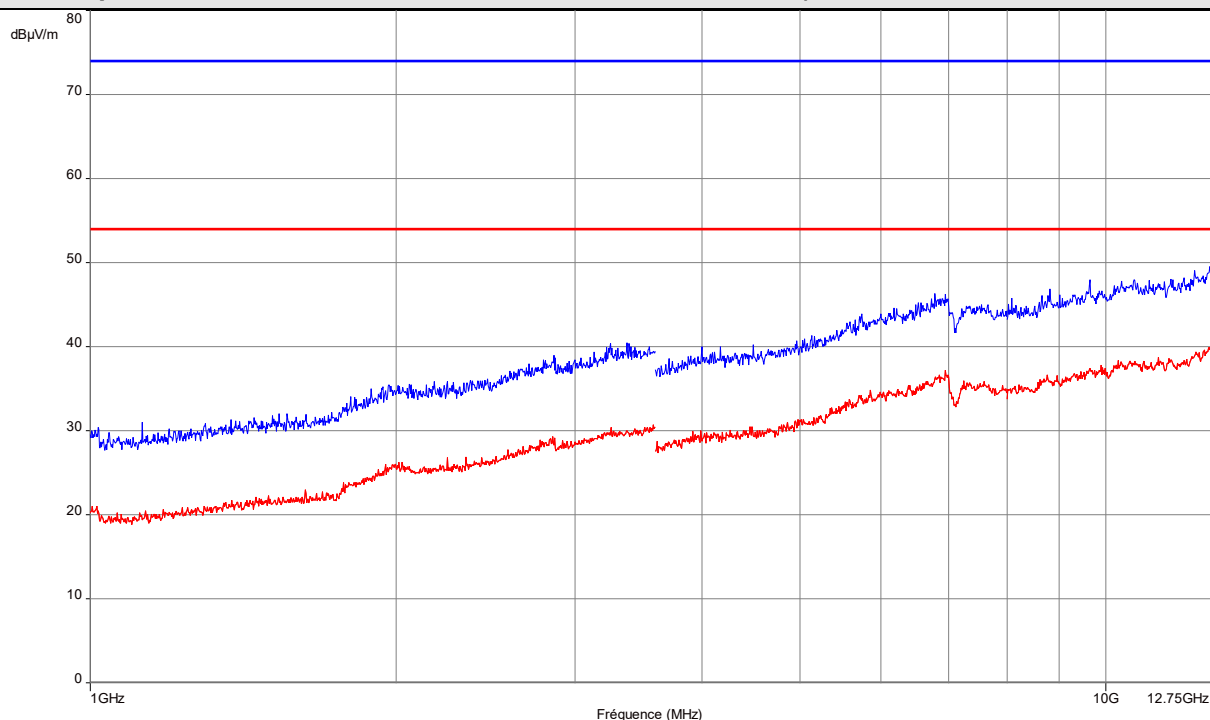
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-12.75GHz / 3m / Horizontal / Receive mode)



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-12.75GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-12.75GHz / 3m / Vertical / Receive mode)



Note: Pre-scan graph only for identification purpose.

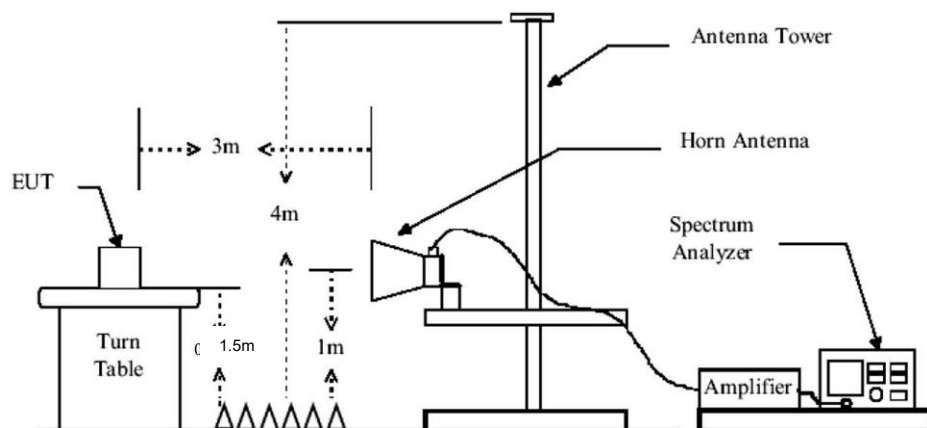
----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-12.75GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.6V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak & Average

14. Occupied bandwidth (99%)

TEST: Occupied bandwidth (99%) / RSS-GEN			Verdict
<u>Method:</u> 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 MaxHold 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	20 to 30 °C	22°C ± 2	
Relative Humidity	25 to 70 %	58% ± 5	
Supplementary information: Test location: SMEE. Test date: May 17th. 2018. Tested by L. CHAPUS			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESRP	REC-151-002	2017/5	2019/5
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2015/7	2018/7
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2017/6	2018/6
RF cable	Pasternack	PE302-120	CAB-131-024	2017/6	2018/6
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/7	2019/7
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-

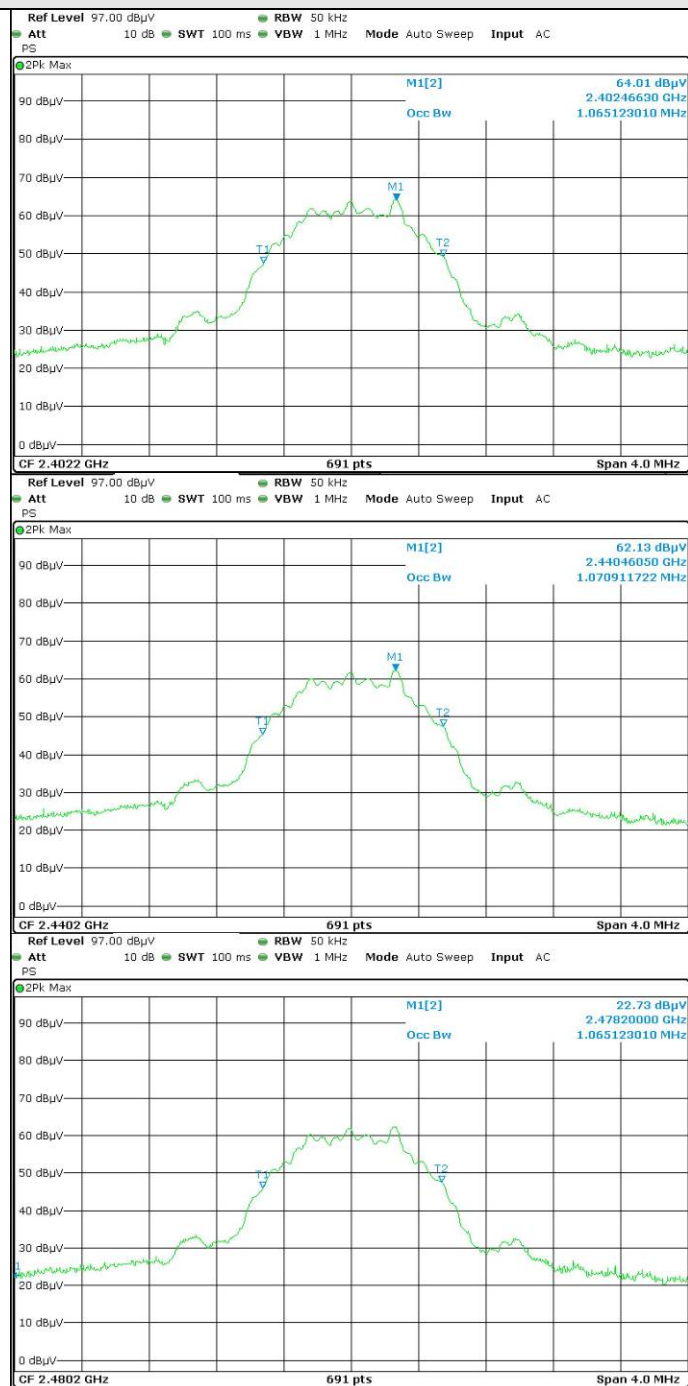
Test Setup for radiated emission



Tabulated Results for Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (MHz)
2402.0	1.065
2440.0	1.071
2480.0	1.065

Graphical representation of Occupied Bandwidth



Low channel

Mid channel

High channel

Frequency band investigated: 2400MHz to 2483.5MHz

RBW : 50kHz

Measurement detector: Peak