Rapport d'essais / *Test Report*

N° : **21567-FCC/IC-1**

Test Firm Registration Number: 171131
IC Company Number: 9545A (Test site)

Matériel testé : *Equipment under test*:	**MUZIK Smart On Ear (Wireless headphones) / MZHP1 v1.1**

Constructeur:
Manufacturer:
Muzik LLC
404 Washington Ave. #700
Miami Beach, FL 33139 – USA

Rapport délivré à :
Issued to:
Muzik LLC
404 Washington Ave. #700
Miami Beach, FL 33139 – USA

Référence de la proposition :
Proposal number:
082015-21567

Date de l'essai :
Date of test:
Du 23 au 25 novembre 2015
November 23rd to 25th, 2015

Objectif des essais :
Test purpose:
EMC qualification accordingly to following standards:
- CFR 47, FCC Part 15, Subpart B & C
(Chapter 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz)
- Industry Canada ICES-003 Issue 5, RSS-Gen Issue 4 & RSS-247, Issue 1
(Frequency Hopping Systems (FHSs))

FCC ID:
IC:
2AASD-MZHP1
11314A-MZHP1

Lieu du test:
Test location:
SMEE CE-Mesures
38 VOIRON - France

Test réalisé par :
Test realized by:
Jérémy BLANCHER

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:	Approved by: Visa
1	December 9th, 2015	Initial Edition	Jeremy Blancher	Laurent Chapus

Sommaire / *Contents*

1. Références Normatives / Normative references

Standard : FCC CFR 47, PART 15, Subpart B & Subpart C

ANSI C63.4 (2014): 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): American National Standard for Testing Unlicensed Wireless Devices

Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems DA 00-705

Determining ERP and EIRP Guidance 412172 D01

Industry Canada ICES-003 (Issue 5/2014) - Information Technology Equipment (ITE) – Limits and methods of measurement

Industry Canada RSS-GEN (Issue 4/2014) - General Requirements and Information for the Certification of Radio Apparatus

Industry Canada RSS-247 (Issue 1/2015) - Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

2. Synthèse des essais / *Test synthesis*

TEST	Paragraph number FCC Part 15 / IC RSS-247	Spec. FCC Part 15 / IC RSS-247	RESULTS (comments)
Conducted emissions test	15.107 (a) ICES-003 § 6.1	Table 15.107 (a)	(1)
Radiated emission test	15.109 (a) ICES-003 § 6.2	Table 15.109 (a)	**PASS**
20dB Bandwidth	15.247 (a) (1) RSS-247 § 5.1 (1)	No restriction	(1)
Hopping channel separation	15.247 (a) (1) RSS-247 § 5.1 (2)	Minimum separation 25kHz or the two-third 20dB bandwidth whichever is greater	(1)
Number of hopping frequencies	15.247 (a) (1) (iii) RSS-247 § 5.1 (4)	Minimum 15 channels used	(1)
Time of occupancy	15.247 (a) (1) (iii) RSS-247 § 5.1 (4)	Maximum 400ms per channel within 31.6s	(1)
Maximum Peak Output Power	15.247 (b) (1) (4) RSS-247 § 5.4 (2)	0.125W max / 21dBm (Conducted) 0.5W max / 27dBm (EIRP)	**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 / 15.247 (d) / 15.205 RSS-Gen 6.13 / 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**
Receiver Emission Limits	RSS-Gen 7.1	Radiated, 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 Conducted (for detachable antenna) 30MHz-1GHz : -57dBm Above 1GHz : -53dBm	(1)
Occupied Bandwidwth	RSS-Gen: 2010 § 6.6	BW at 99%	(1)

N/A: Not Applicable
(1): See test report *20721-FCC-1*

- **General conclusion:**

Measures and tests performed on the sample of the product MZHP1 v1.1, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart B & C and Industry Canada ICES-003, RSS-Gen & RSS-247.

3. Equipement Sous Test (EST) / *Equipment Under Test* (EUT)

Nom /
Identification

MUZIK Smart On Ear
(Wireless headphones) / MZHP1 v1.1

Sn: Sample #1
Sn: Sample #2
Sn: Sample #3

Alimentation /
Power supply

- 3.7V dc from a Lithium battery (normal used mode)
- 5V DC from standard AC/DC power adapter (charge mode)

Auxiliaires /
Auxiliaries

- Smart Cable (4 wires, 1.5m)
- Motorola XT890 (Android smartphone)
- USB charger PHIHONG PSM03A-050Q
(100-240V 50-60Hz // 5V dc / 500mA)

Entrées-Sorties /
Input / Output

	Câbles pour essai / *Cables for test*	Blindé / *Shielded*	Prévu pour >3m / *Intended for >3m*
DC input (5V/0.5A) Micro USB connector	USB2.0 / 0.5m	Yes	No
3.5mm INPUT JACK	Smart cable	No	No

Version programme /
Firmware version

N.C

Mode de fonctionnement /
Running mode

The tested samples can be set in following modes:
- Bluetooth transmit mode to a smartphone (Normal operation, sample #1)
- Audio file listening on headphones with smart cable (Direct audio, sample #1)
- Battery charging with 5VDC power adapter (Normal operation, sample #1)

A special connection to sample #2 (radiated measurement) and sample #3 (conducted measurement) permits to set the EUT in following modes:
- Transmit on selectable channel (low, mid, high)
- Choice of modulation type, packet type, packet size
- Output Tx power set at its maximum nominal value

Programme de test /
Test program /

BlueTest3 (to configure wanted mode on samples #2 and #3)

Information sur l'équipement /
Equipment information

- Frequency hopping from 2402 MHz to 2480 MHz
- Antenna type: PIFA on PCB (Peak gain < 2.5dBi), single antenna
- Modulations: GFSK (DH5)
π/4DQPSK (2-DH5)
8DPSK (3-DH5)
- Battery type Lithium-ion 3.7V-700mH
- Bluetooth module BTM720 with CSR BlueCore5
- Low channel: 2402MHz / Mid channel: 2441MHz / High channel: 2480MHz
- Equipment intended for use as a mobile station
- Equipment designed for continuous operation

4. Conditions pendant les essais / *Test conditions*

Humidité relative / *Relative Humidity* : 40 - 55%
Température / *Temperature* : 10 - 20°C

Tension d'alimentation / *Power supply voltage*:
Equipment sous test / *Equipment under test* : 3.7V DC from Li-battery
5V DC from AC/DC power adapter (for charging mode)
Tension secteur / AC mains : 110V/60Hz

5. Modifications de l'EST / *Modifications of the EUT*

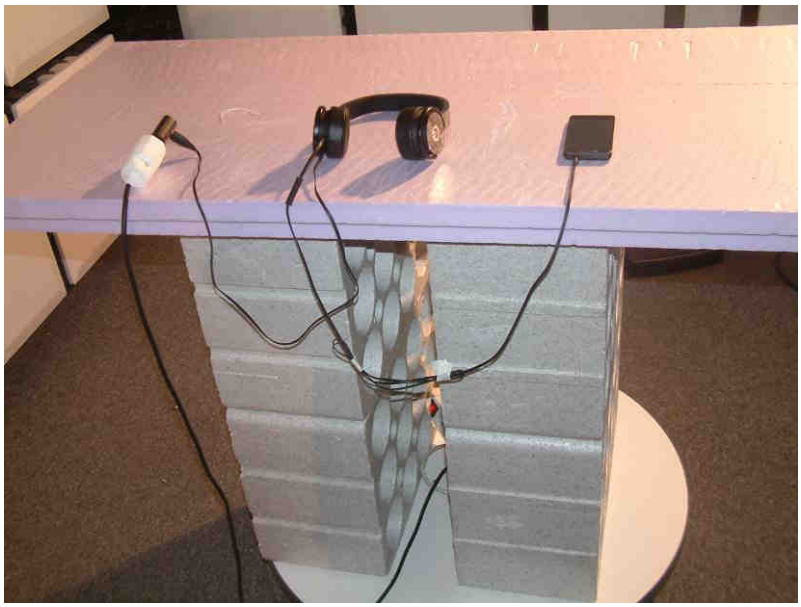
None

6. Radiated Emission Measurement (30MHz-1GHz)

TEST: Limits for radiated disturbance 30 MHz – 1 GHz			**Verdict**
Method: Measurements were made in a 3-meter Open Area Test Site (OATS) that complies to ANSI C63.4. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meters. 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) 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. A pre-scan frequency identification of the EUT has been performed in full anechoic chamber. The measured radiated field of the EUT is realised at 3-meters of distance. Antenna is 1.25-meters high. The pre-characterization graphs are obtained in PEAK detection.			**PASS**
Laboratory Parameters:	Required prior to the test		During the test
Ambient Temperature	10 to 40 °C		20°C
Relative Humidity	10 to 90 %		55%
Fully configured sample scanned over the following frequency range	Frequency range on each side of line		Measurement Point
	30MHz – 1GHz		3 m measurement distance
Running mode	Battery Charging mode, with audio cable (1kHz sound file)		
Limits			
Frequency (MHz)	Limit at 3m (dBµV/m)		
	Level / Detector		Results
30 to 88	40.0 (QP)		**Pass**
88 to 216	43.5 (QP)		**Pass**
216 to 960	46.0 (QP)		**Pass**
960 to 1000	54.0 (QP)		**Pass**
Above 1GHz	54.0 (AV) 74.0 (PK)		**Pass**
Supplementary information: Test location: SMEE Test date: November 24th, 2015 Power supply voltage: 5V DC from AC/DC power adapter			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2015/8	2016/8
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2015/8	2016/8
BiConiLog antenna	EMCO	3142B	ANT-101-010	2014/8	2015/8
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2015/7	2018/7
RF cable	Div	2m	CAB-101-011	2015/3	2016/3
RF cable	Div	OATS/25m	CAB-101-019	2015/3	2016/3
RF cable	Div	OATS/10m	CAB-101-020	2015/3	2016/3
RF cable	Pasternack	PE302-120	CAB-141-024	2015/3	2016/3
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2015/3	2016/3
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2015/3	2016/3
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2015/3	2016/3
Anechoic chamber	COMTEST	214263	CAG-141-001	-	-
OATS	Div	10m	SIT-101-001	2015/5	2016/5
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-
Measuring Rec	Rohde&Schwarz	ESRP	REC-151-002	2015/7	2018/7
Ref. Comb generator	SMEE	EMR-10M	REF-111-002	-	-

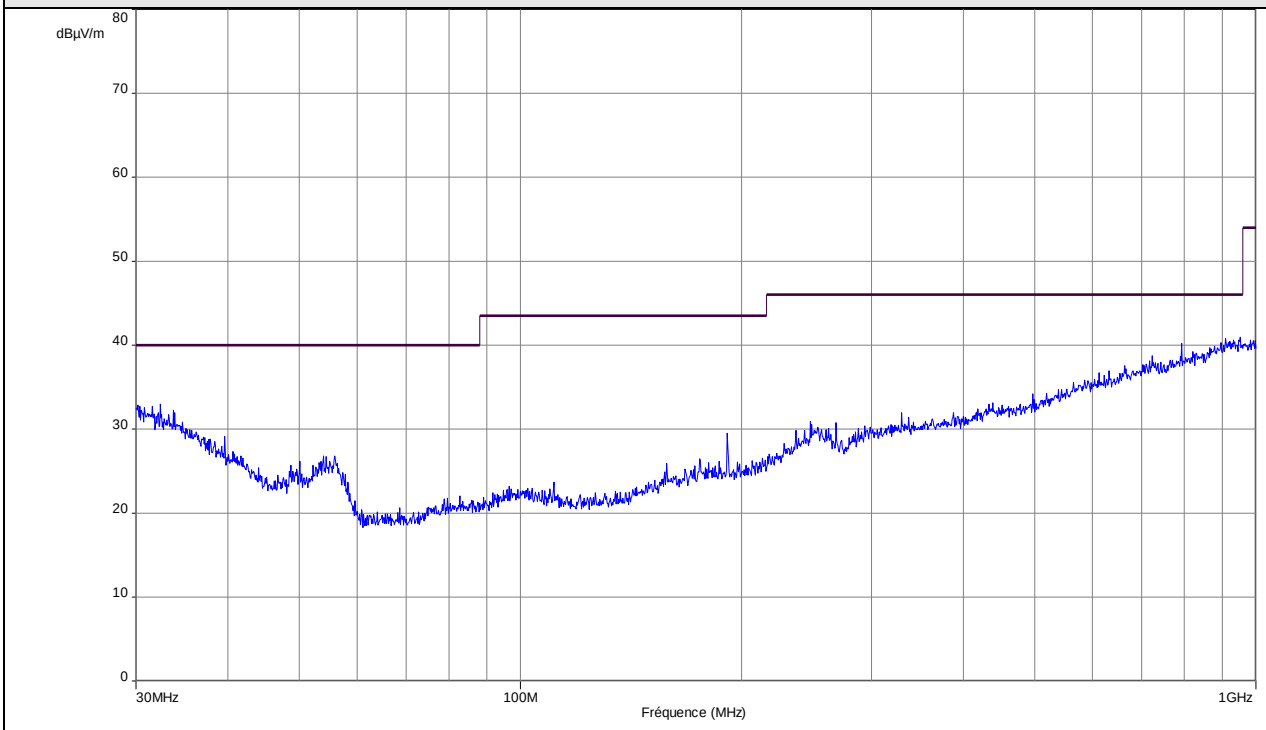
Photo of test setup for Radiated Disturbance pre-scan



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
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 15.109 / ICES-003
Final measurement detector:	Quasi-Peak
Wide Measurement Uncertainty:	± 5.2dB (k=2)
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

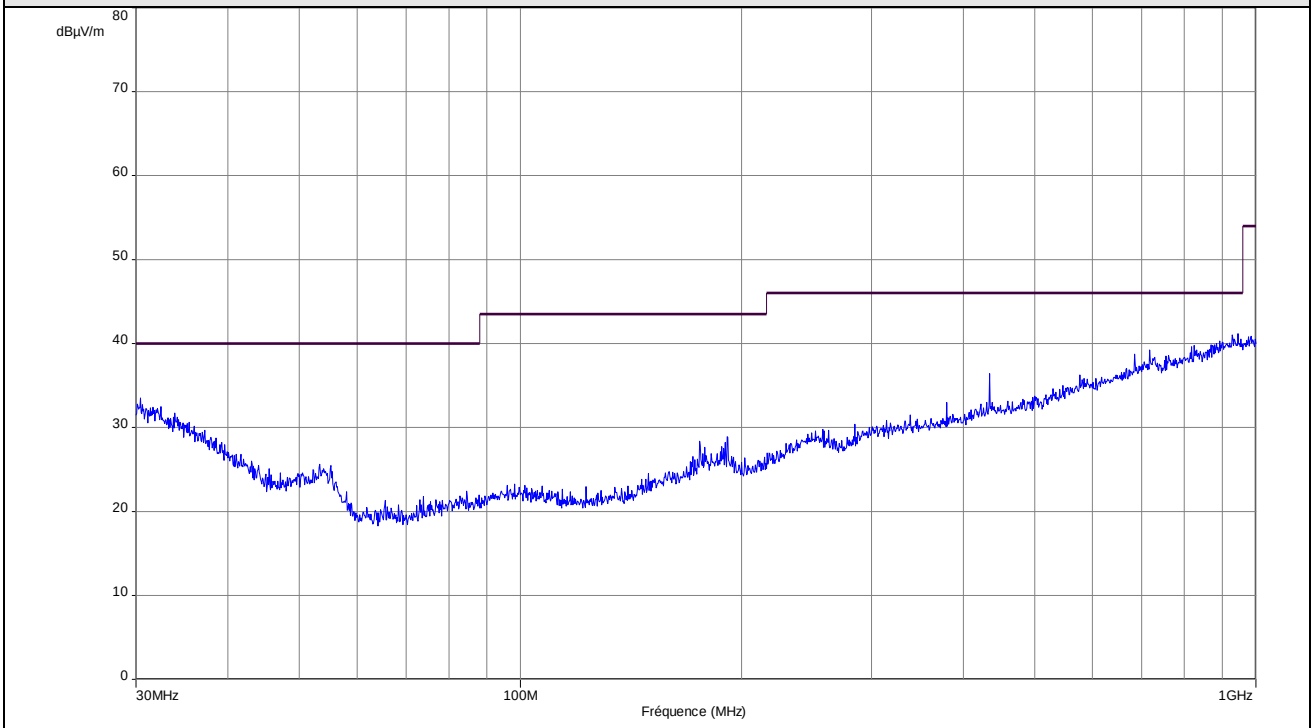
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal)



Note: Pre-scan graph only for identification purpose.

------ : Peak measure	------ : Class B limit (3m)	

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



Note: Pre-scan graph only for identification purpose.

------ : Peak measure	------ : Class B limit (3m)	

7. Maximum Peak Output power

TEST: Maximum peak conducted output power / FCC part 15.247 – RSS-247		**Verdict**
Method: Measurements were performed with peak detector using a 1MHz RBW. The VBW is set to 3MHz. The spectrum analyzer is connected via suitable means to the RF output of the tested equipment. (Conducted measurement). For field strength, the measure is performed on a 3m Open Area Test Site. The tested equipment is set to transmit operation with modulations on lowest, middle and highest channel.		**Pass**
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	12°C
Relative Humidity	10 to 90 %	45%

Limits – FCC Part 15.247 (b) / RSS-247: 2015 (§ 5.4)		
Frequency (MHz)	Limits (dBµV/m)	
	Level	Results
2400 to 2483.5	27 dBm (EIRP)	**Pass**
2400 to 2483.5	21 dBm (Conducted)	**Pass**

Supplementary information:
Test location: SMEE – CE Mesures / Test date: November 24th, 2015
Power supply voltage: 3.7V from battery (fully charged)

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESRP	REC-151-002	2015/7	2018/7
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2015/7	2018/7
RF cable	Div	OATS/25m	CAB-101-017	2015/3	2016/3
OATS	Div	3 / 10m	SIT-101-001	2015/8	2016/8
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-

Tabulated Results for Maximum peak output power (Conducted measurement)			
Modulation DH5 / GFSK			
FREQ	**Peak Power conducted**	**Limit**	**Result**
(MHz)	(dBm)	(dBm)	
2402	5,1	21.0	PASS
2441	4,3	21.0	PASS
2480	3,1	21.0	PASS
Modulation 2-DH5 / π/4DQPSK			
FREQ	**Peak Power conducted**	**Limit**	**Result**
(MHz)	(dBm)	(dBm)	
2402	3,3	21.0	PASS
2441	2,2	21.0	PASS
2480	0,4	21.0	PASS
Modulation 3-DH5 / 8DPSK			
FREQ	**Peak Power conducted**	**Limit**	**Result**
(MHz)	(dBm)	(dBm)	
2402	3,4	21.0	PASS
2441	2,2	21.0	PASS
2480	0,5	21.0	PASS

RBW:	1MHz
Limit:	FCC Part 15.247 (b) / RSS-247: 2015 (§ 5.4)
Final measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.2dB (k=2)
RESULT:	**PASS**
Note:	Worst case is with 1-DH5 / GFSK modulation

Tabulated Results for Maximum peak output power (Radiated measurement)				
FREQ	**Field Strength 3m**	**Calculated EIRP**	**Limit**	**Result**
(MHz)	(dBµV/m)	(dBm)	(dBm)	
2402	101,6	**6.4**	27.0	PASS
2440	101,9	**6.7**	27.0	PASS
2480	100,8	**5.6**	27.0	PASS

RBW:	1MHz
Measurement distance:	3m
Limit:	FCC Part 15.247 (b) / RSS-247: 2015 (§ 5.4)
Final measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.2dB (k=2)
RESULT:	**PASS**
Note:	Field strength is measured on the Open Area Test Site at a distance of 3m. Three orthogonal axis measurements are performed for both horizontal and vertical antenna (measure) polarization in order to obtain the maximum peak field strength. Test is performed with and without audio or DC cable in order to maximize radiated field. The power (EIRP) was calculated using the following equation: **EIRP = (E x d)²/30** Where D is the distance in meters from which the field strength was measured E is the maximum field strength in V/m Test performed with 1-DH5 / GFSK modulation (worst case)

Photo of test setup for Radiated Disturbance

8. Unwanted emissions in Non-Restricted Frequency bands (Radiated / Conducted)

<table>
<tr><td colspan="3">TEST: Unwanted emissions in Non-Restricted Frequency Bands / FCC part 15.247 – RSS-247</td><td>Verdict</td></tr>
<tr><td colspan="3">Method: For radiated test, measurements were made in a 3-meter Open Area Test Site (OATS) that complies to ANSI C63.4. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meters. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements 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.
A pre-scan frequency identification of the EUT has been performed in full anechoic chamber. The measured radiated field of the EUT is realised at 3-meters of distance. Antenna is 1.25-meters high. The pre-characterization graphs are obtained in PEAK detection.
For conducted test, measurements were performed with peak detector using a 100kHz RBW. The VBW is set to 300kHz. The spectrum analyzer is connected via suitable means to the RF output of the tested equipment.</td><td>Pass</td></tr>
<tr><td>Laboratory Parameters:</td><td>Required prior to the test</td><td colspan="2">During the test</td></tr>
<tr><td>Ambient Temperature</td><td>10 to 40 °C</td><td colspan="2">12°C</td></tr>
<tr><td>Relative Humidity</td><td>10 to 90 %</td><td colspan="2">45%</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 colspan="2">Measurement Point</td></tr>
<tr><td>30MHz – 25GHz</td><td colspan="2">3 m measurement distance (Radiated)
RF coaxial connector (Added on antenna trace for conducted measurement)</td></tr>
<tr><td colspan="4">Limits – FCC Part 15.247 (d) / RSS-247: 2015 (§ 5.5)</td></tr>
<tr><td rowspan="2">Frequency (MHz)</td><td colspan="3">Limits</td></tr>
<tr><td>Detector / Analyser RBW</td><td>Limit</td><td>Results</td></tr>
<tr><td>30 to 25000</td><td>Pk / 100kHz</td><td>20dB below the maximum Peak level</td><td>Pass</td></tr>
<tr><td colspan="4">Supplementary information:
Test location: SMEE – CE Mesures / Test date: November 24th, 2015
Power supply voltage: 3.7V from battery (fully charged)</td></tr>
</table>

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2015/8	2016/8
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2015/8	2016/8
BiConiLog antenna	EMCO	3142B	ANT-101-010	2015/8	2016/8
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2015/7	2018/7
RF cable	Div	OATS/25m	CAB-101-019	2015/3	2016/3
RF cable	Pasternack	PE302-120	CAB-131-024	2015/3	2016/3
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2015/3	2016/3
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2015/3	2016/3
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2015/3	2016/3
High-pass filter	Mini-Circuit	VHF-3100+	FIL-151-006	2015/3	2016/3
Pre-amplifier	PE	PE1524	PRE-101-002	2015/3	2016/3
Anechoic chamber	COMTEST	214263	CAG-141-001	-	-
OATS	Div	10m	SIT-101-001	2015/8	2016/8
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	2015/7	2018/7
Spectrum analyzer	AGILENT HP	8563E	ASP-111-003	2013/9	2016/9

Photo of test setup for Radiated Disturbance

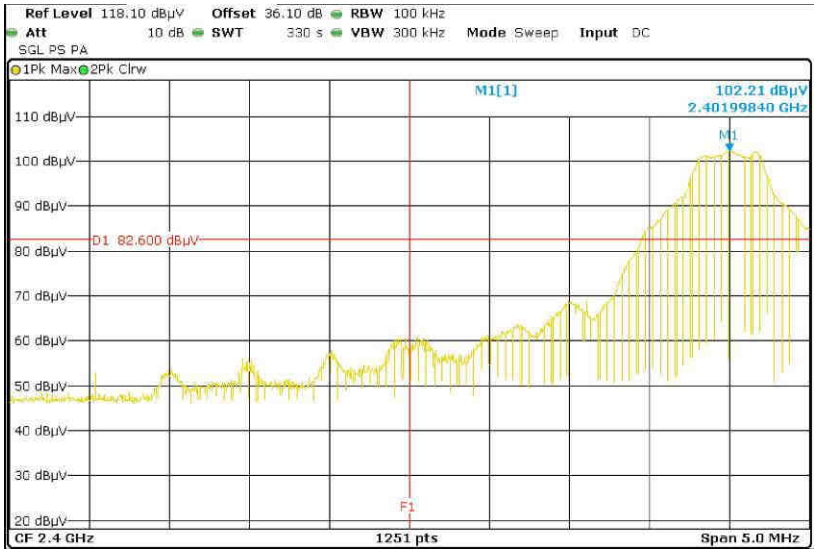
Tabulated Results for Peak Output Power Reference level (Radiated)	
FREQ	**Field Strength 3m**
(MHz)	(dBµV/m)
2402.0	101,5
2440.0	101,8
2480.0	100,7
RBW:	100kHz
Measurement distance:	3m
Limit:	Ref. level only – For 15.247 (d) / RSS-247: 2016 (§ 5.5)
Final measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.2dB (k=2)
Note:	Only for identification of limit in non-restricted band (1): Limit is **80.7 dBµV/m** Peak for radiated out-of-band frequencies in Non-Restricted bands (2): Test performed with 1-DH5 / GFSK modulation (Worst case) (3): Test is performed with and without audio or DC cables in order to maximize radiated field on three orthogonal axis.

Tabulated Results for Peak Output Power Reference level (Conducted)	
FREQ	**Peak Power**
(MHz)	(dBm)
2402.0	4.9
2440.0	4.2
2480.0	2.8
RBW:	100kHz
Limit:	Ref. level only – For 15.247 (d) / RSS-247: 2016 (§ 5.5)
Final measurement detector:	Peak
Wide Measurement Uncertainty:	± 3.2dB (k=2)
Note:	Only for identification of limit in non-restricted band (1): Limit is **-17.2dBm** Peak for conducted out-of-band frequencies (2): Test performed with 1-DH5 / GFSK modulation (Worst case)

Tabulated Results for Unwanted emissions in Non-Restricted bands (Radiated) 30MHz-25GHz			
FREQ	**Field Strength 3m**	**Limit**	**Result**
(MHz)	(dBµV/m)	(dBµV/m)	
Margin > 20dB			

RBW:	100kHz
Measurement distance:	3m
Limit:	15.247 (d) / RSS-247: 2015 (§ 5.5)
Final measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.2dB (k=2)
RESULT:	PASS
Note:	See low band-edge compliance graph below

Graphical representation of Band-edge compliance (Radiated)



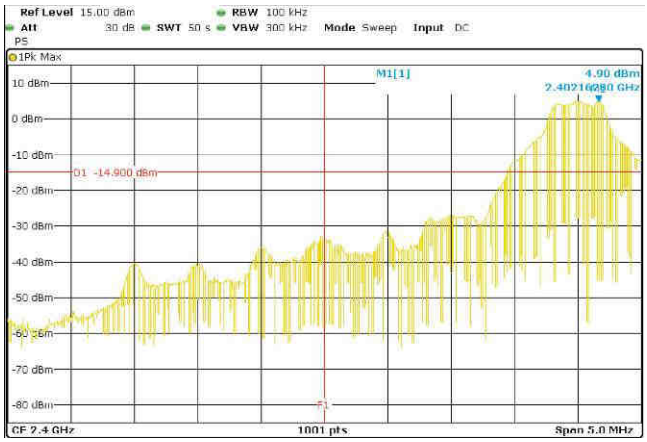
Low bandedge compliance

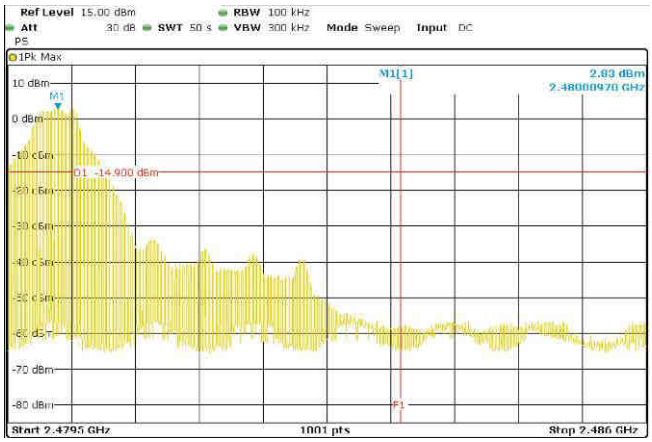
F1 = 2400MHz
Peak level below 2400MHz is 60.8dBµV/m max.
RESULT: PASS
Note: Radiated measurement

Tabulated Results for Unwanted emissions (Conducted) 30MHz-25GHz			
FREQ	**Peak level**	**Limit**	**Result**
(MHz)	(dBm)	(dBm)	
4804	-37.8	-17.2	**Pass**
4882	-40.8	-17.2	**Pass**
4960	-44.0	-17.2	**Pass**

RBW:	100kHz
Limit:	15.247 (d) / RSS-247: 2015 (§ 5.5)
Final measurement detector:	Peak
Wide Measurement Uncertainty:	± 3.2dB (k=2)
RESULT:	PASS
Note:	(1): Test performed with 1-DH5 / GFSK modulation (2): See graphs page 22/23/24 (3): See Band-edge compliance on graphs below

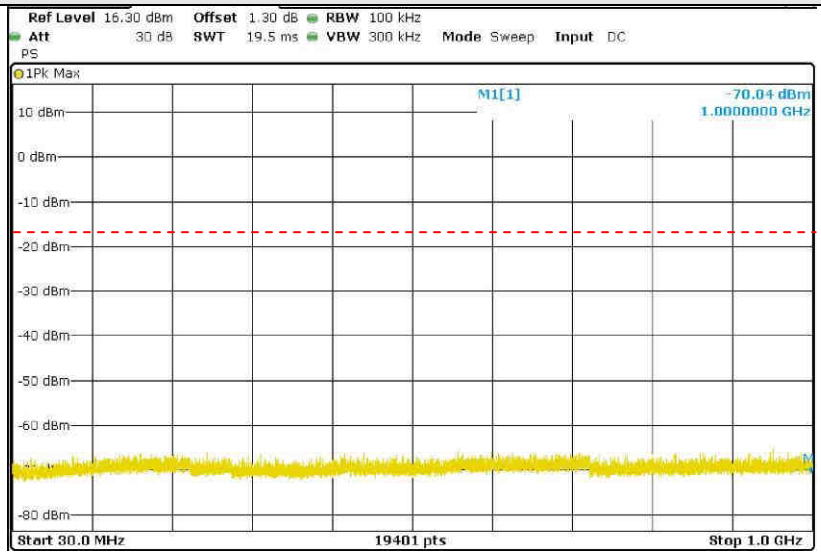
Graphical representation of Band-edge compliance (Conducted)





Low band-edge compliance	*High band-edge compliance*
F1 = 2400MHz Peak level below 2400MHz is -32.3dBm max. (limit is -17.2dBm) RESULT: PASS Note: Conducted measurement	F1 = 2483.5MHz Peak level above 2483.5 MHz is -58dBm max (limit is -17.2dBm) RESULT: PASS Note: Conducted measurement

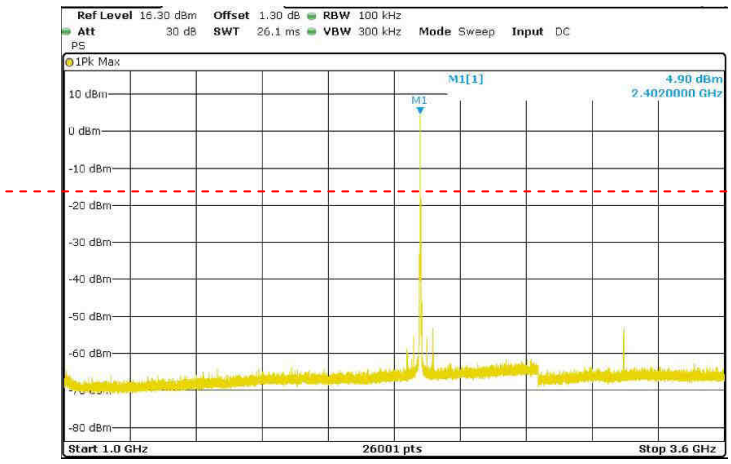
Graphical representation of Conducted unwanted emissions (30MHz-1GHz)



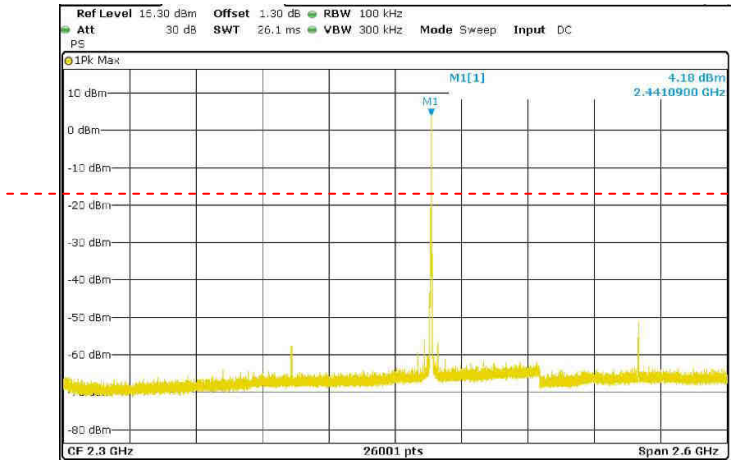
Middle Channel

Note: Worst case result for low, middle and high channels. Limit is -17.2dBm

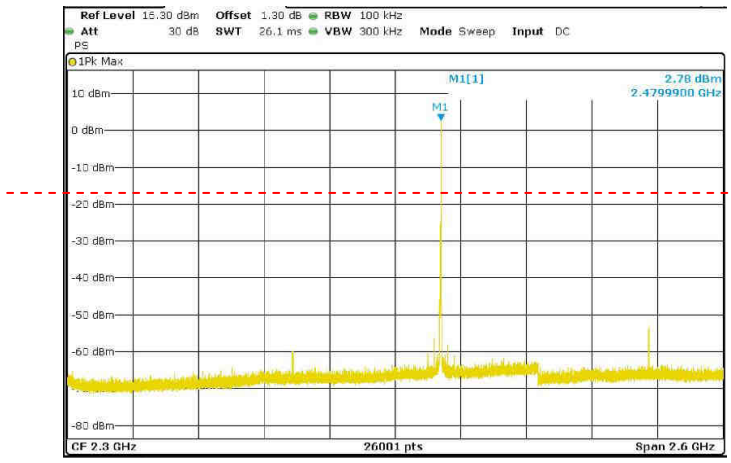
Graphical representation of Conducted unwanted emissions (1GHz-3.6GHz)



Low channel

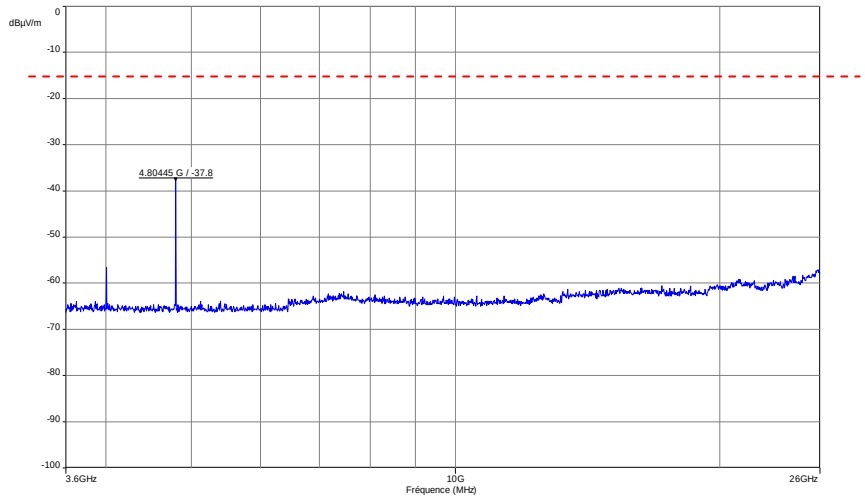


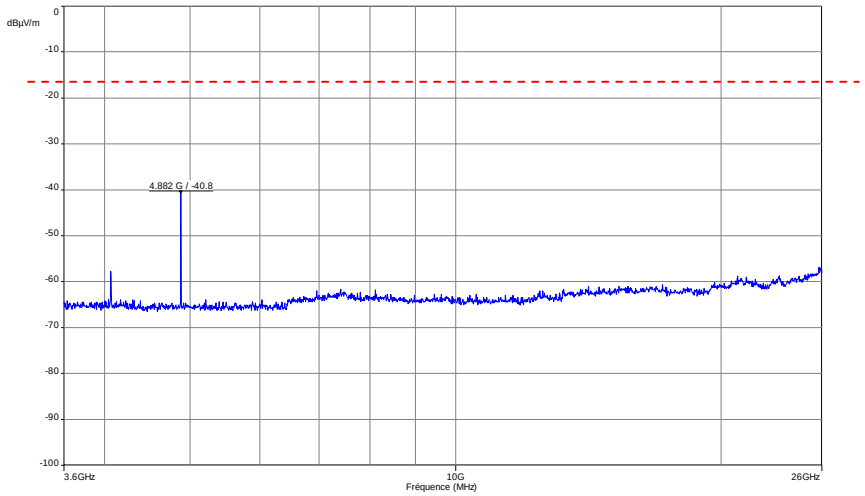
Middle channel

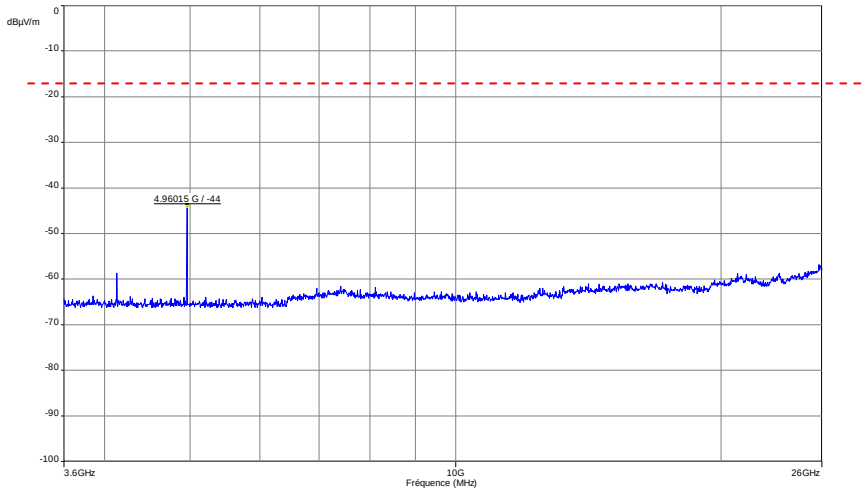


High channel

Graphical representation of Conducted unwanted emissions (3.6GH-25GHz)







Low, Middle, High channels

9. Unwanted emissions in Restricted Frequency bands

TEST: Unwanted emissions into Restricted Frequency Bands / FCC part 15.205, 15.209, 15.247 – RSS-GEN, RSS-247			**Verdict**
Method: Measurements were made in a 10 or 3-meter Open Area Test Site (OATS) that complies to ANSI C63.4. 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. A pre-scan frequency identification of the EUT has been performed in full anechoic chamber. The measured radiated field of the EUT is realised at 3-meters of distance. Antenna is 1.25-meters high. The pre-characterization graphs are obtained in PEAK detection.			**Pass**
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	12°C	
Relative Humidity	10 to 90 %	45%	
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, 15.247 / RSS-GEN, RSS-247			
Frequency (MHz)	Limits (dBµV/m)		
	Level / Detector / Distance	Results	
0.009 to 0.490	107.6 to 72.9 / QP / 10m	**Pass**	
0.490 to 1.705	52.9 to 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 to 1GHz	54.0 / QP / 3m	**Pass**	
1GHz to 25GHz	74 / Pk / 3m 54 / Av / 3m	**Pass**	
Supplementary information: Test location: SMEE – CE Mesures / Test date: November 24th, 2015 Power supply voltage: 3.7V from battery (fully charged)			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2015/8	2016/8
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2015/8	2016/8
BiConiLog antenna	EMCO	3142B	ANT-101-010	2015/8	2016/8
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2015/7	2018/7
RF cable	Div	OATS/25m	CAB-101-019	2015/3	2016/3
RF cable	Pasternack	PE302-120	CAB-131-024	2015/3	2016/3
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2015/3	2016/3
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2015/3	2016/3
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2015/3	2016/3
High-pass filter	Mini-Circuit	VHF-3100+	FIL-151-006	2015/3	2016/3
Pre-amplifier	PE	PE1524	PRE-101-002	2015/3	2016/3
Anechoic chamber	COMTEST	214263	CAG-141-001	-	-
OATS	Div	10m	SIT-101-001	2015/8	2016/8
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	2015/7	2018/7
Spectrum analyzer	AGILENT HP	8563E	ASP-111-003	2013/9	2016/9

Photo of test setup for Radiated Disturbance



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 > 20dB						
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: 2014
Final measurement detector:	Quasi-Peak
Wide Measurement Uncertainty:	± 5 dB (k=2)
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)

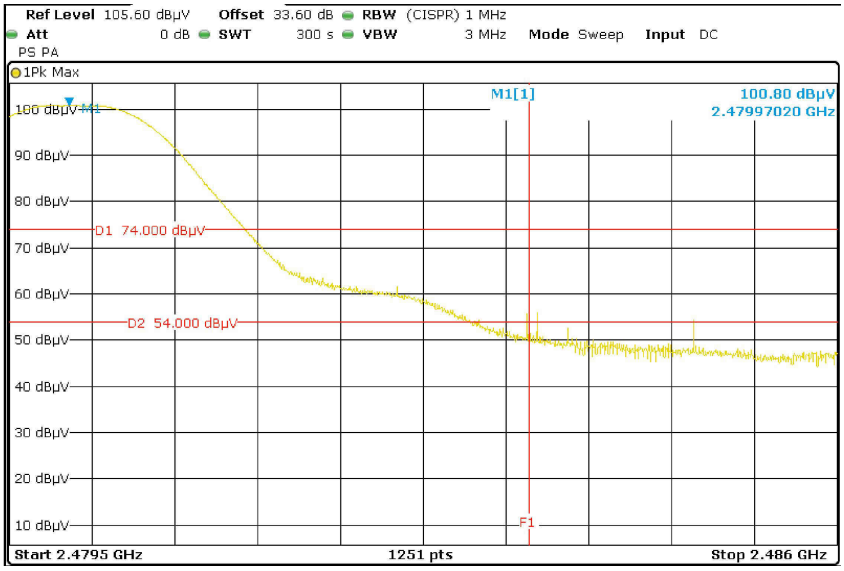
Tabulated Results for Unwanted emissions (30MHz-1GHz)										
FREQ	**Meter reading**	**Meter reading**	**CF total**	**Field level**	**Field level**	**Pol**	**Antenna height**	**Table angle**	**Limit**	**Margin**
MHz	(QP) dBµV	(Pk) dBµV	dB	(QP) dBµV/m	(Pk) dBµV/m		cm	Degré	(QP) dBµV/m	dB
Margin > 20dB										
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: 2014
Final measurement detector:	Quasi-Peak
Wide Measurement Uncertainty:	± 5.2dB (k=2)
RESULT:	PASS

Tabulated Results for Unwanted emissions (1GHz-25GHz)				
FREQ	**Field level**	**Detector**	**Limit**	**Result**
(MHz)	dBµV/m		(dBµV/m)	
2483.5	**54.3**	**Pk**	74	**Pass (3)**
2483.5	**34.5**	**Av**	54	**Pass (3)**
4804,0	**63,0**	**Pk**	74	**Pass**
4804,0	**53,4**	**Av**	54	**Pass**
4882,0	**62,4**	**Pk**	74	**Pass**
4882,0	**52,8**	**Av**	54	**Pass**
4960,0	**60,4**	**Pk**	74	**Pass**
4960,0	**50,8**	**Av**	54	**Pass**

RBW:	1MHz
Measurement distance:	3m
Limit:	FCC Part 15.205 - 15.209 / RSS-GEN: 2014
Final measurement detector:	Peak / Average
Wide Measurement Uncertainty:	± 5.2dB (k=2)
RESULT:	PASS
Note:	(1): Performed on OATS at 3m distance (2): Test performed with 1-DH5 / GFSK modulation (Worst case) (3): See graph for band-edge compliance below (4): Test is performed with and without audio or DC cables in order to maximize radiated field on three orthogonal axis.

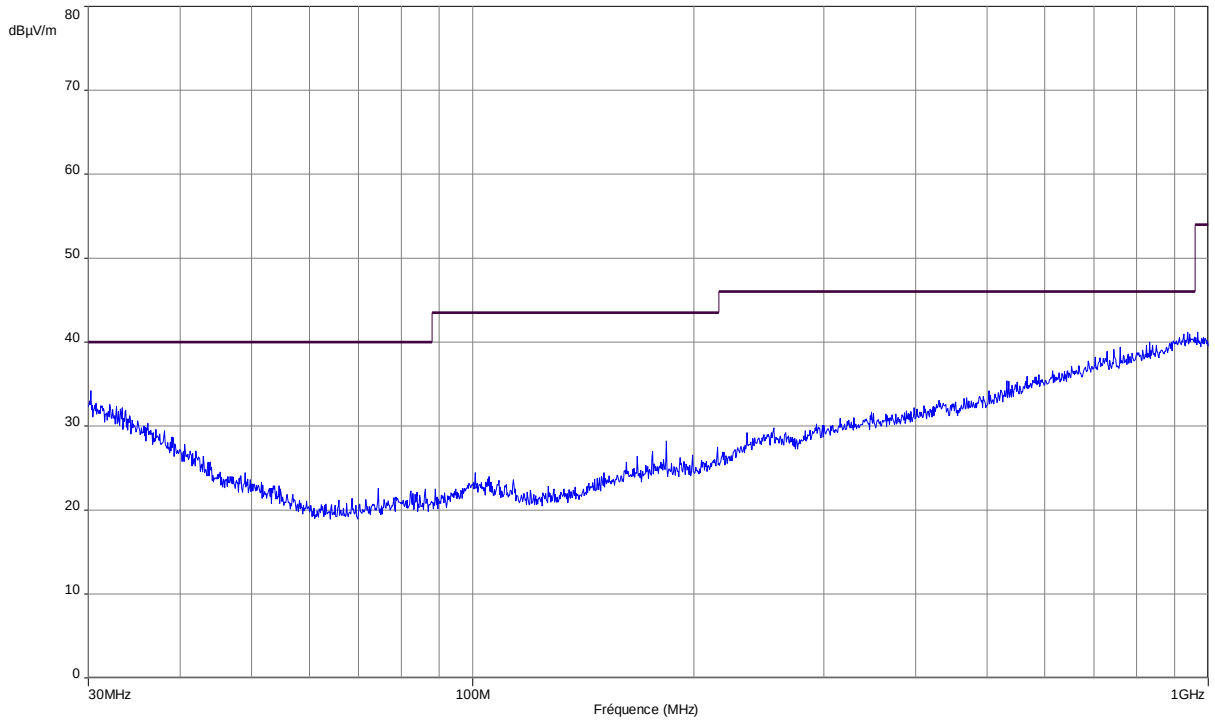
Graphical representation of Band-edge compliance



High bandedge compliance

Radiated Peak level is 54.3dBµV/m (limit 74dBµV/m)
Radiated Average level is 34.5dBµV/m (limit 54dBµV/m)
RESULT: PASS
Note: radiated measurement (3m on OATS)

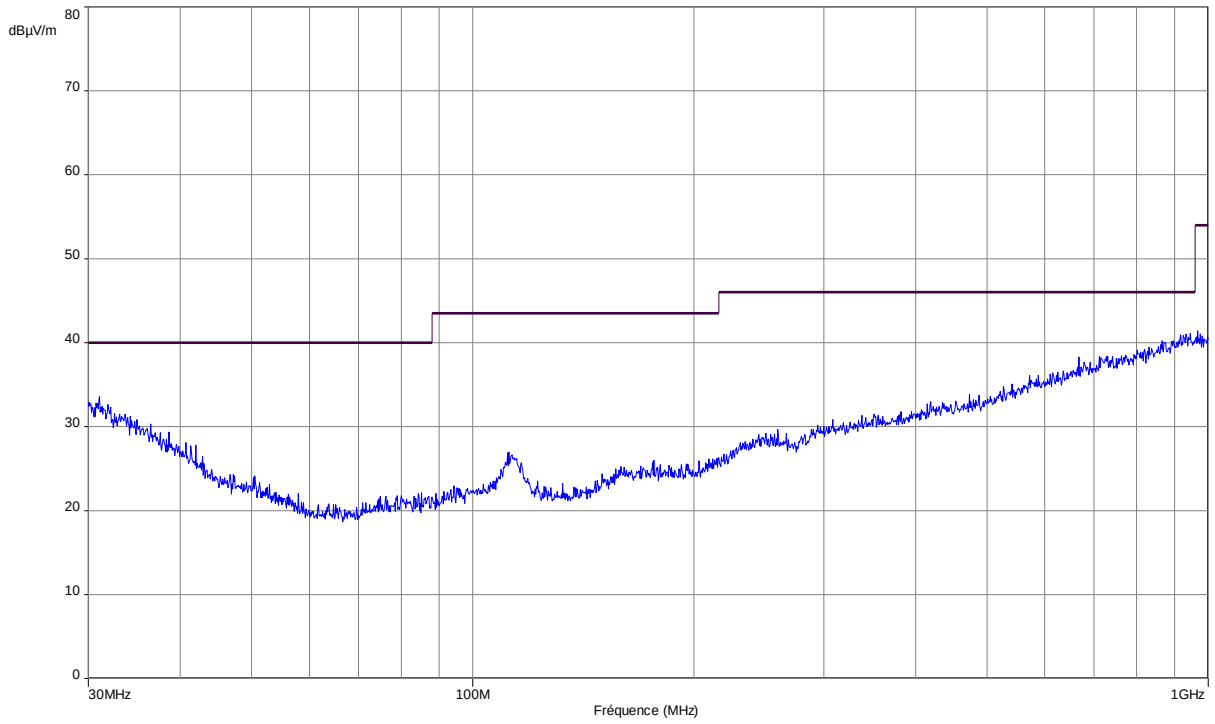
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal / Transmit mode)



Note: Pre-scan graph only for identification purpose. Same result for low, middle and high channels

Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Horizontal
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

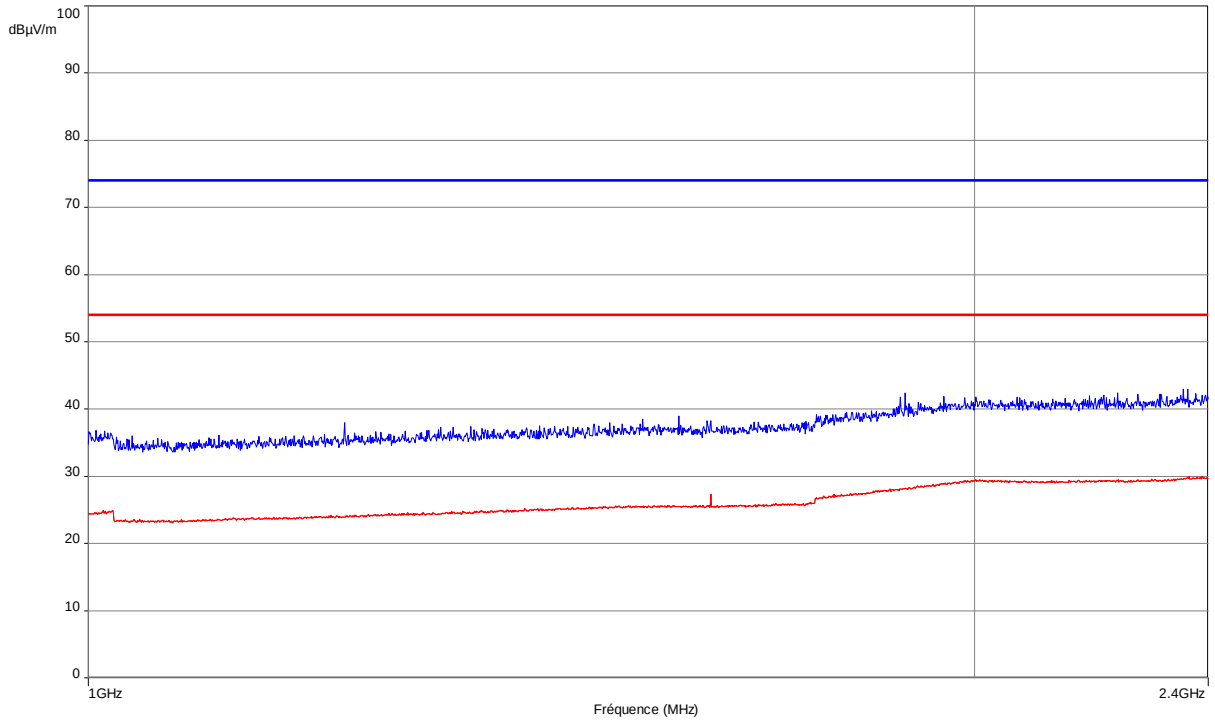
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Vertical / Transmit mode)



Note: Pre-scan graph only for identification purpose. Same result for low, middle and high channels

Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Vertical
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

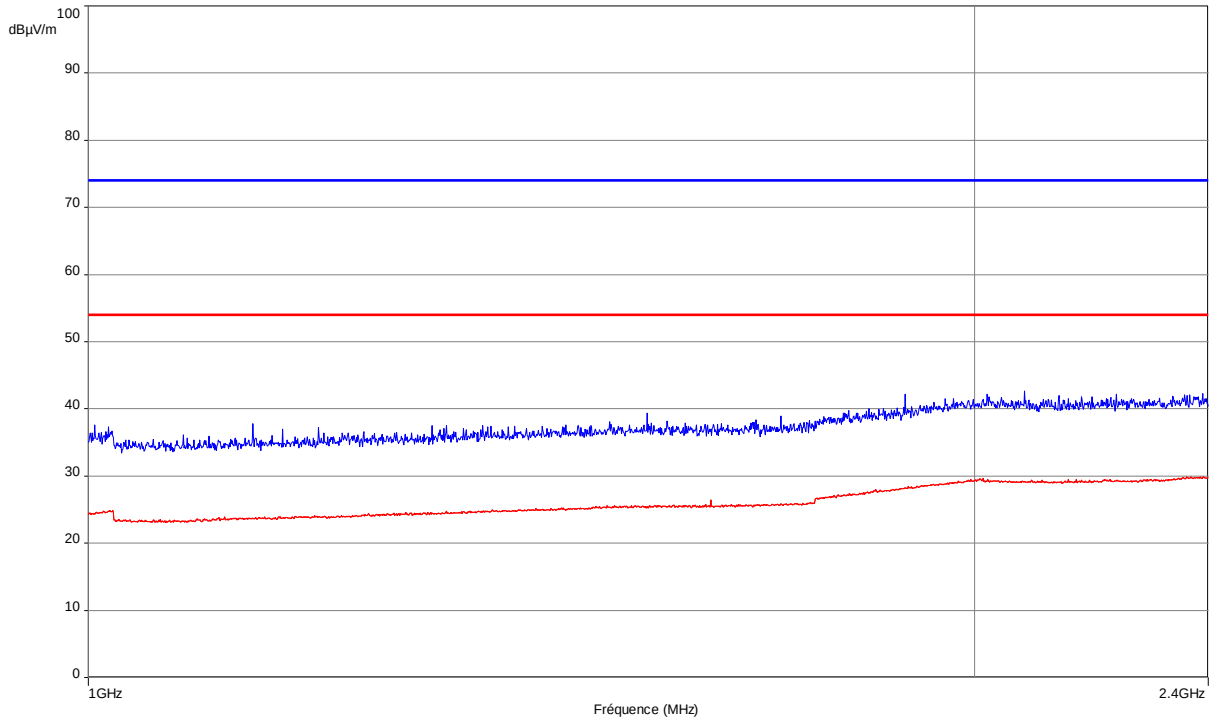
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-2.4GHz / 3m / Horizontal / Transmit mode)



Note: Pre-scan graph only for identification purpose. Same result for low, middle and high channels

------ : Peak measure	------ : Average measure
Frequency band investigated:	1GHz-2.4GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

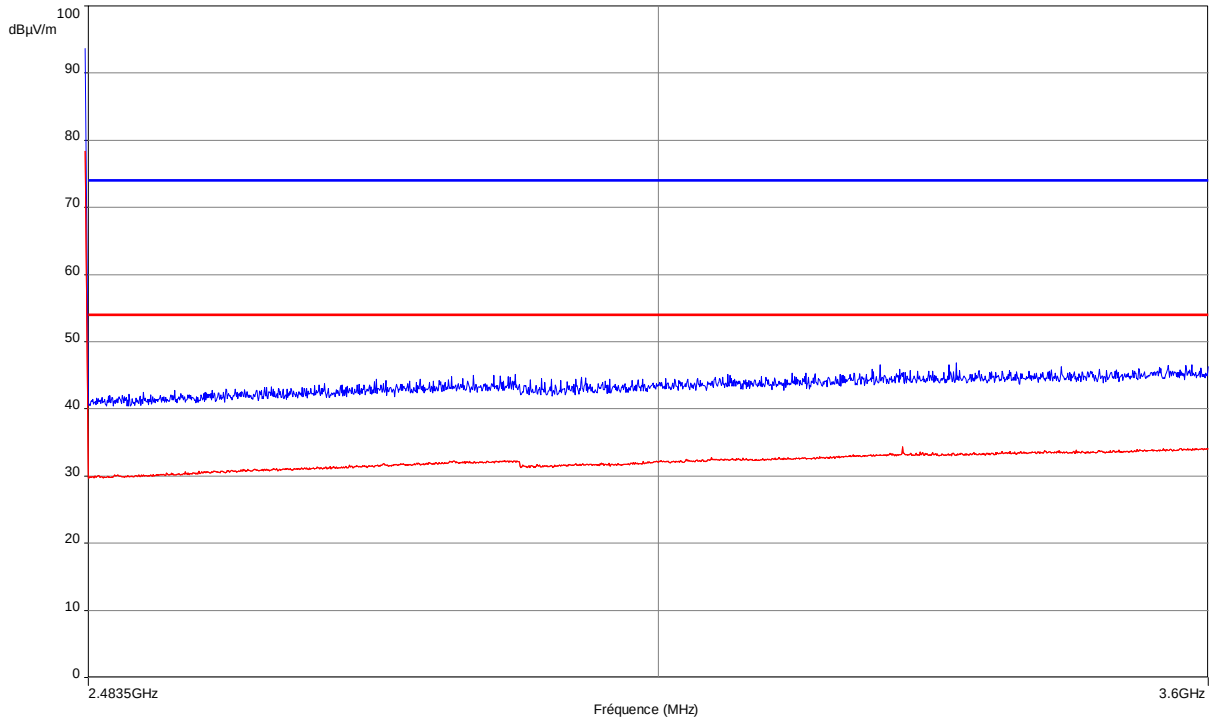
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-2.4GHz / 3m / Vertical / Transmit mode)



Note: Pre-scan graph only for identification purpose. Same result for low, middle and high channels

------ : Peak measure	------ : Average measure
Frequency band investigated:	1GHz-2.4GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

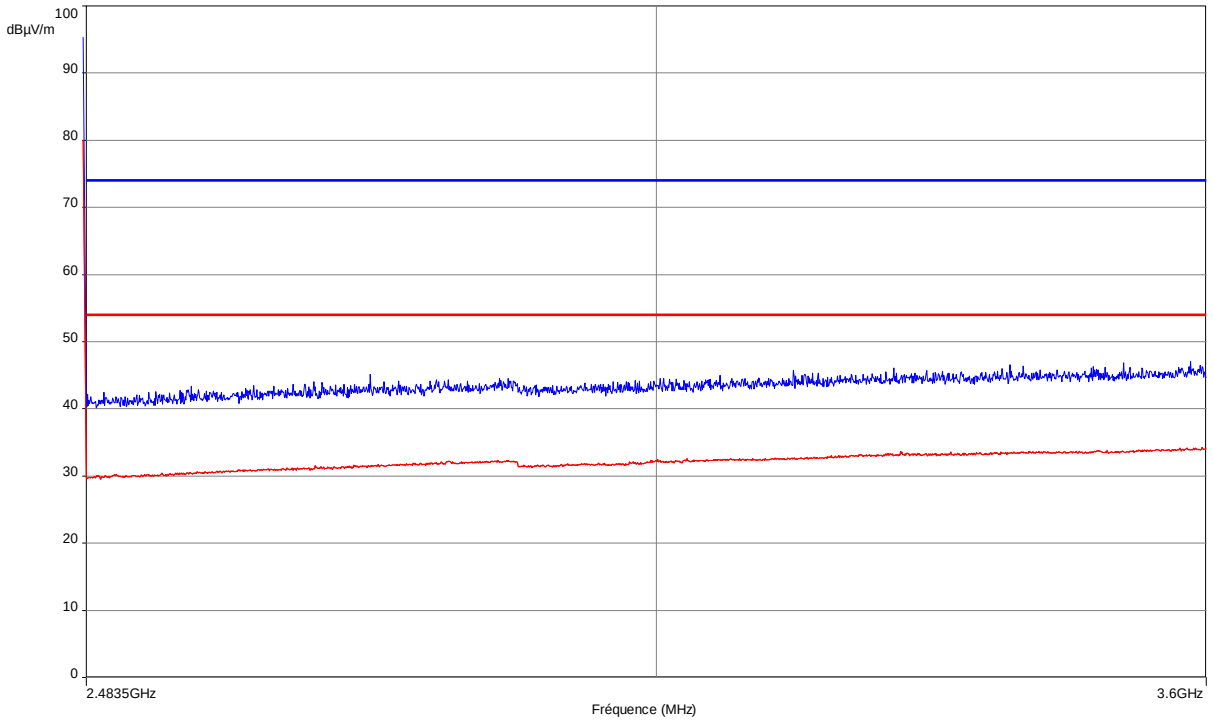
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 2.435GHz-3.6GHz / 3m / Horizontal / Transmit mode)



Note: Pre-scan graph only for identification purpose. Same result for low, middle and high channels

------ : Peak measure	------ : Average measure
Frequency band investigated:	2.435GHz-3.6GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

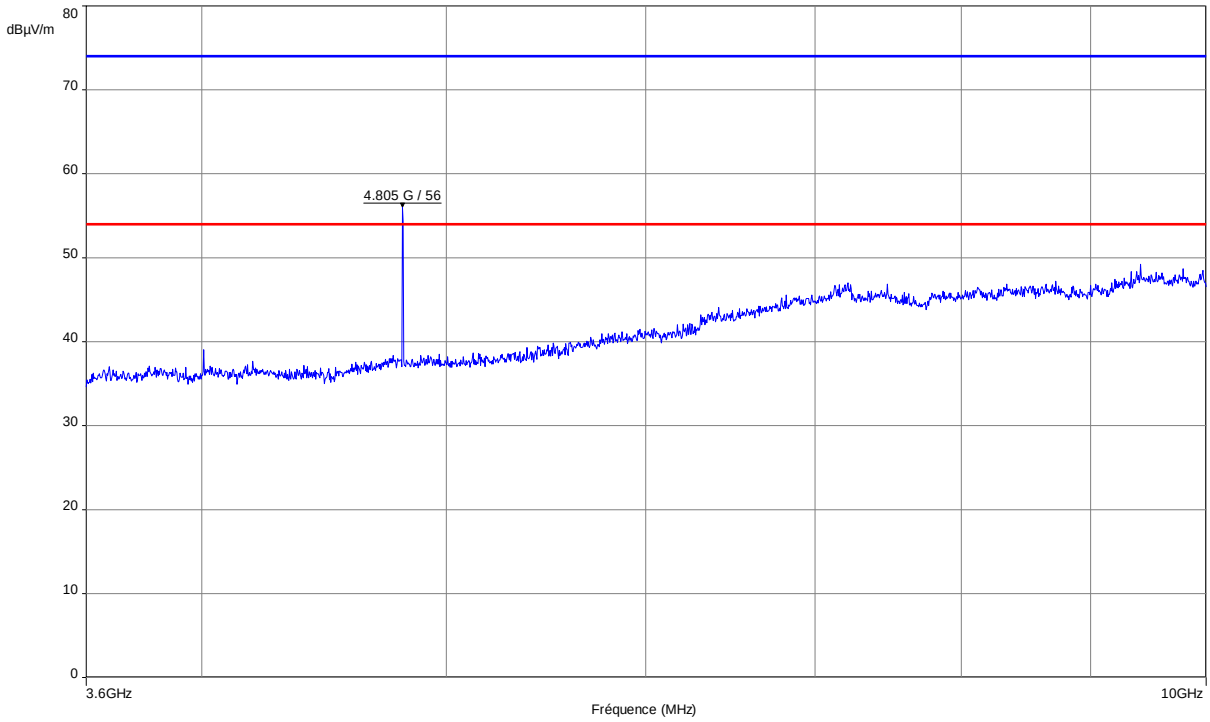
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 2.435GHz-3.6GHz / 3m / Vertical / Transmit mode)



Note: Pre-scan graph only for identification purpose. Same result for low, middle and high channels

------ : Peak measure	------ : Average measure
Frequency band investigated:	2.435GHz-3.6GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

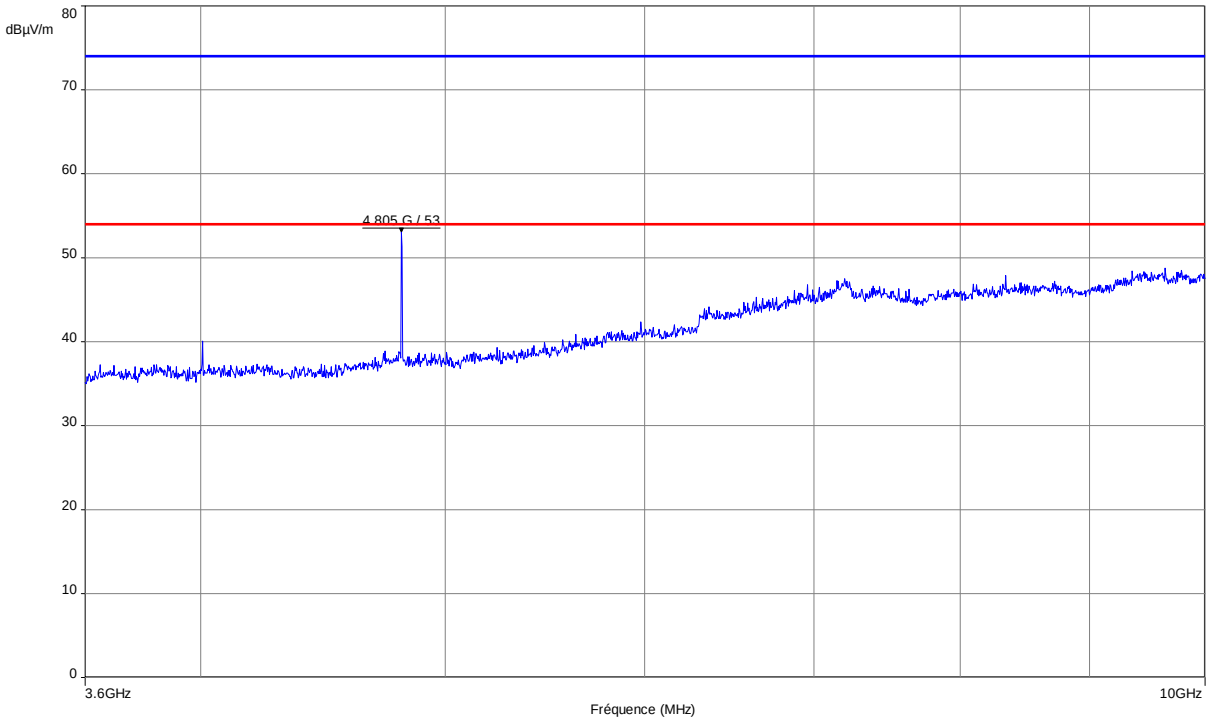
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 3.6GHz-10GHz / 3m / Horizontal / Transmit mode) – Low channel



Note: Pre-scan graph only for identification purpose.
Above 10GHz, a manual search were performed at 1m distance and corrected with the Correction Factor :
CF = 20log(1 meter / 3 meters) = -9.5dB

------ : Peak measure	------ : Average measure
Frequency band investigated:	3.6GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

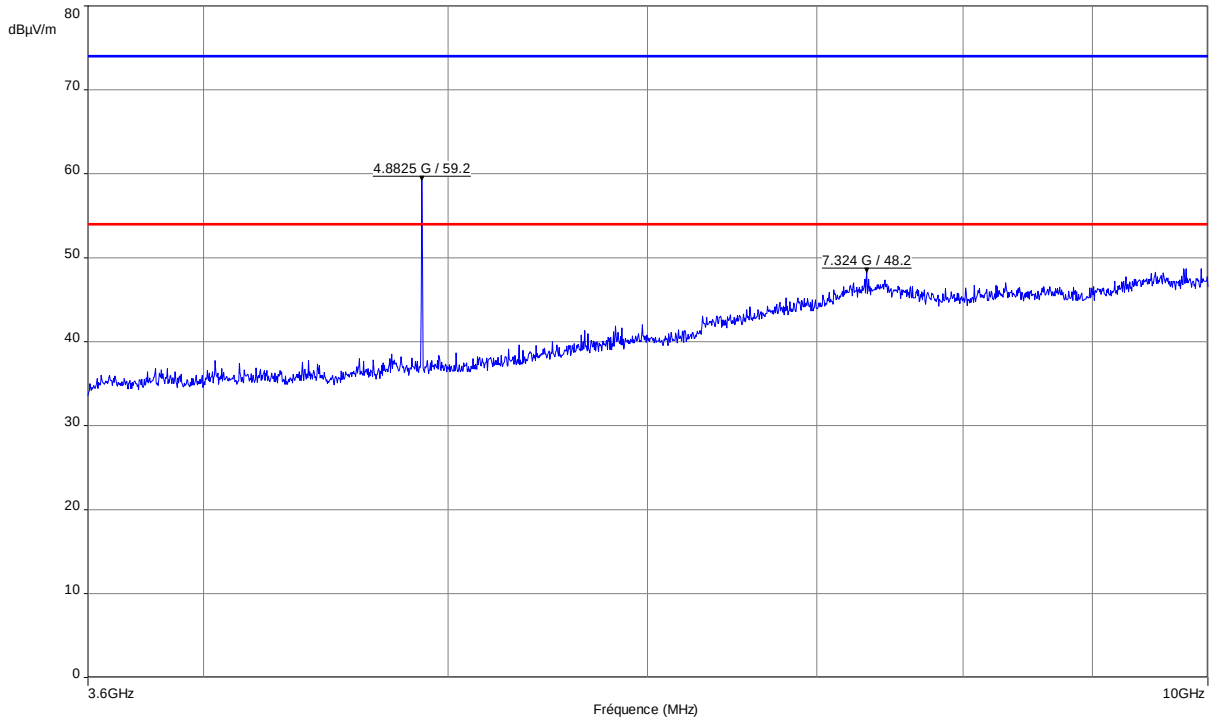
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 3.6GHz-10GHz / 3m / Vertical / Transmit mode) – Low channel



Note: Pre-scan graph only for identification purpose.
Above 10GHz, a manual search were performed at 1m distance and corrected with the Correction Factor :
CF = 20log(1 meter / 3 meters) = -9.5dB

------ : Peak measure	------ : Average measure
Frequency band investigated:	3.6GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

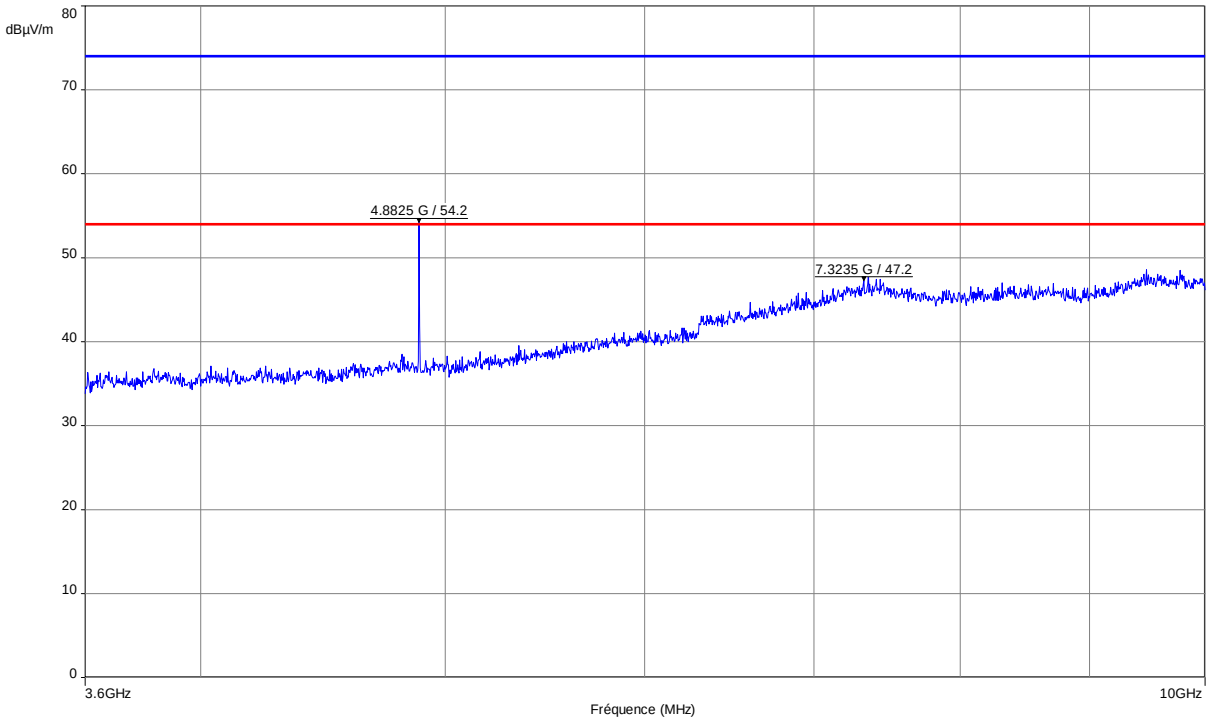
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 3.6GHz-10GHz / 3m / Horizontal / Transmit mode) – Mid channel



Note: Pre-scan graph only for identification purpose.
Above 10GHz, a manual search were performed at 1m distance and corrected with the Correction Factor :
CF = 20log(1 meter / 3 meters) = -9.5dB

------ : Peak measure	------ : Average measure
Frequency band investigated:	3.6GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

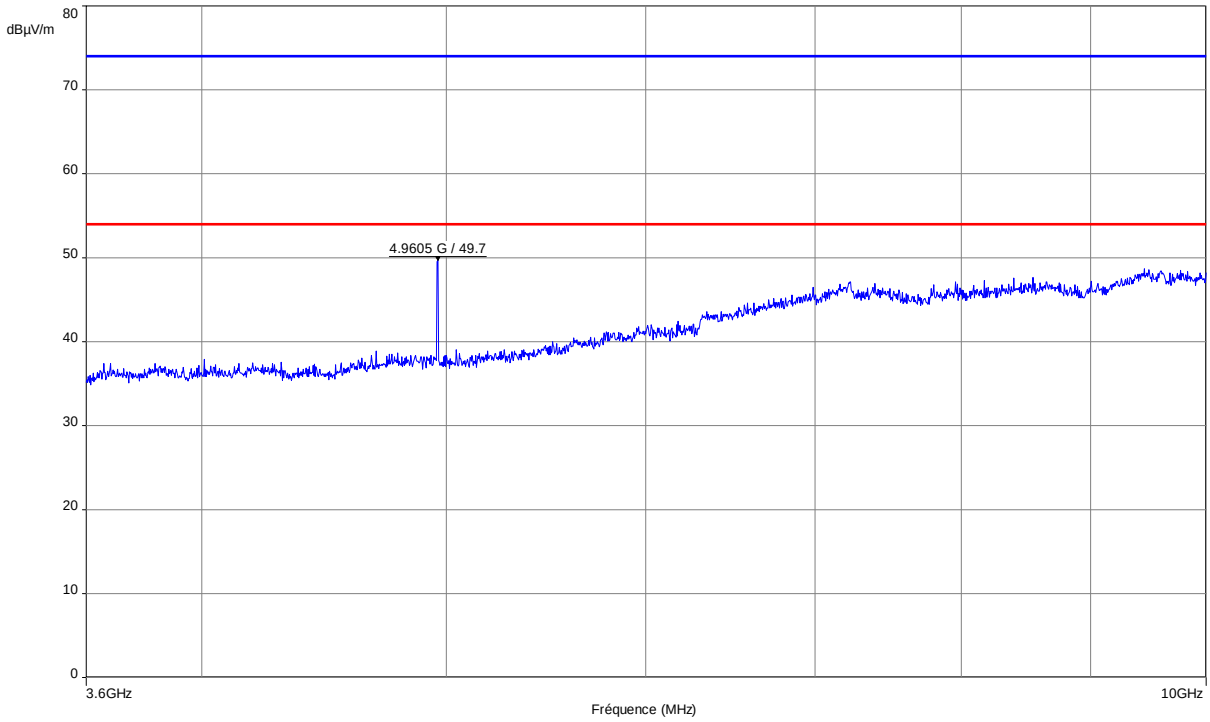
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 3.6GHz-10GHz / 3m / Vertical / Transmit mode) – Mid channel



Note: Pre-scan graph only for identification purpose.
Above 10GHz, a manual search were performed at 1m distance and corrected with the Correction Factor :
CF = 20log(1 meter / 3 meters) = -9.5dB

------ : Peak measure	------ : Average measure
Frequency band investigated:	3.6GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

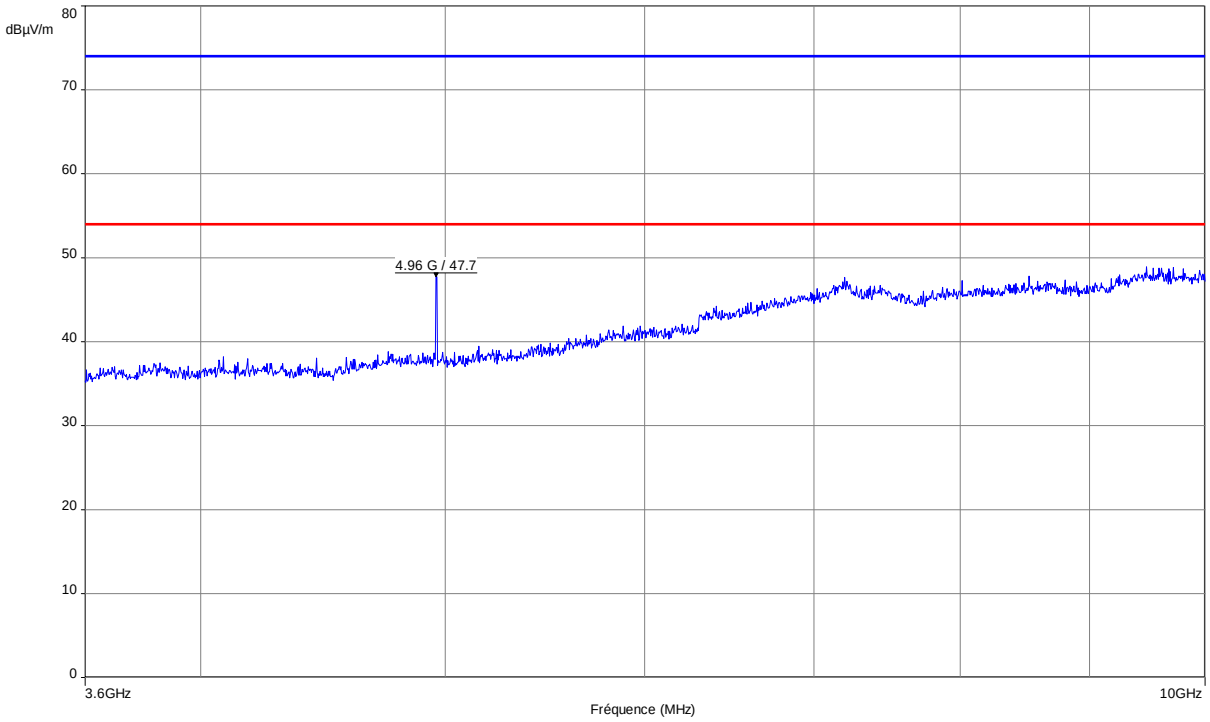
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 3.6GHz-10GHz / 3m / Horizontal / Transmit mode) – High channel



Note: Pre-scan graph only for identification purpose.
Above 10GHz, a manual search were performed at 1m distance and corrected with the Correction Factor :
CF = 20log(1 meter / 3 meters) = -9.5dB

------ : Peak measure	------ : Average measure
Frequency band investigated:	3.6GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 3.6GHz-10GHz / 3m / Vertical / Transmit mode) – High channel



Note: Pre-scan graph Above 10GHz, a manual search were performed at 1m distance and corrected with the Correction Factor :
CF = 20log(1 meter / 3 meters) = -9.5dB only for identification purpose.

------ : Peak measure	------ : Average measure
Frequency band investigated:	3.6GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Vertical
Voltage:	3.7V DC
Limit:	15.205 - 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)