

FCC Test Firm Registration Number: 171131  
Industry Canada Test Firm Number: Site# 9545A-1

Matériel testé :  
*Equipment under test:*

**HOTSPOT Radio module**

Constructeur:  
*Manufacturer:*

**TAGSYS RFID**  
785, voie Antiope, Athélia III  
13600 LA CIOTAT - France

Rapport délivré à :  
*Issued to:*

**TAGSYS RFID**  
785, voie Antiope, Athélia III  
13600 LA CIOTAT - France

Référence de la proposition :  
*Proposal number:*

032015-21359

Date de l'essai :  
*Date of test:*

May 6<sup>th</sup> & 7<sup>th</sup>, 2015

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)

FCC ID:

QHKRTLHSCORE

Lieu du test:  
*Test location:*

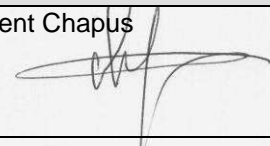
SMEE  
38 VOIRON - France

Test réalisé par :  
*Test realized by:*

Laurent CHAPUS - 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	June 25 <sup>th</sup> , 2015	Initial Edition	Jeremy Blancher	Laurent Chapus
2	July 15 <sup>th</sup> , 2015	Added info		

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## COORDONNEES

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## 1. Références Normatives / Normative references

### Standard : FCC CFR 47, PART 15, Subpart C

**ANSI C63.4 (2009)**: 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 (2009)**: American National Standard for Testing Unlicensed Wireless Devices

## 2. Synthèse des essais / Test synthesis

TEST	Paragraph number (FCC Part 15.247)	Spec. (FCC Part 15.247)	RESULTS (comments)
Conducted emissions test	15.107 / 15.207 (a)	Table 15.207 (a)	PASS
20dB Bandwidth	15.247 (a) (1)	Measurement	PASS
Carrier Frequency Separation	15.247 (a) (1)	Minimum separation 25kHz or the two-third 20dB bandwidth, whichever is greater	PASS
Number of Hopping Frequencies	15.247 (a) (1) (iii)	At least 15 channels	PASS
Time of Occupancy (Dwell Time)	15.247 (a) (1) (iii)	Maximum 400ms per channel within 400ms multiplied by the number of hopping frequencies	PASS
Maximum Peak Output Power	15.247 (b) (1)	0.125W max / 21dBm (Conducted) 0.5W max / 27dBm (EIRP)	PASS
Unwanted emissions into Non Restricted Frequency Bands	15.247 (d) /	-20dBc in any 100kHz outside frequency band.	PASS
Unwanted emissions into Restricted Frequency Bands	15.209 / 15.247 (d) / 15.205	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

### • General conclusion:

Measures and tests performed on the sample of the product HotSpot Radio module, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart C.

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

Nom /  
Identification

HotSpot Radio module

Sn: N.C

Alimentation /  
Power supply

5V dc from external power supply unit  
(Golden Profit Electronics, model GPE010H-050210-Z)

Auxiliaires /  
Auxiliaries

- External power supply unit
- RFID reader Impinj, model Speedway Revolution (R420)

Sn: 37014490080

Entrées-Sorties /  
Input / Output

	Câbles pour essai / Cables for test	Blindé / Shielded	Prévu pour >3m / Intended for >3m
MMCX to Tx antenna	0.15m	Yes	No
MMCX to Rx antenna	0.15m	Yes	No
MMCX to reader	0.30m	Yes	No
2 pins for DC supply	1.5m	No	No
11 pins for command	1.0m	No	No

Version programme /  
Firmware version

N.C

Mode de fonctionnement /  
Running mode

Equipment is able to transmit in three different frequency bands into the 2.4GHz ISM band.  
The tested sample is able to:

- Transmit hopping frequencies sequence on lowest, middle and highest bands (each band is 24.5MHz, 50 channels, 500kHz of separation)
- Different modulation types are available
- Be in standby mode (no transmission)

The RF input of the module is connected to a UHF RFID reader IMPINJ R420

Programme de test /  
Test program /

N.C

### • Equipment information:

- Frequency band: 2400 to 2483.5 MHz (Transmit)
- Antenna type: Flexible Dipole antenna (2.2dBi max gain, SMA connector, with cable to MMCX connector)
- Receive Frequency band: 902 to 928 MHz
- FHSS equipment, 0.125mW rated output power
- Equipment intended for use as a fixed station
- Equipment designed for continuous operation
- Normal power source: 5V DC from external power supply

## 4. Conditions pendant les essais / Test conditions

Humidité relative / Relative Humidity : 55%  
Température / Temperature : 20°C

Tension d'alimentation / Power supply voltage:

Equipment sous test / Equipment under test : 5V DC from external power supply  
Tension secteur / AC mains : 110V/60Hz

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

None

## 6. Conducted Emission Measurement (150kHz-30MHz)

TEST: Limits for conducted disturbance 150kHz – 30MHz / FCC part 15.107 – 15.207				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. The measurements are performed while the equipment is transmitting continually on the middle band.				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
		150kHz to 30MHz		AC input port (on external power supply unit)
Limits				
Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Result	Average	Result
0.15 – 0.50	66 \ 56	Pass	56 \ 46	Pass
0.50 – 5	56	Pass	46	Pass
5 – 30	60	Pass	50	Pass
Supplementary information: Test location: SMEE Test date: May 7 <sup>th</sup> , 2015 Power supply voltage: 110V / 60Hz				

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Attenuator / limiter	SMEE	ATT#1	ATT-101-004	2015/3	2016/3
Cable RF	Div	2m	CAB-101-007	2015/3	2016/3
LISN (50Ω / 50µH)	AFJ	LS16C	RSI-101-001	2015/3	2016/3
LISN (50Ω / 50µH)	AFJ	LS16C	RSI-101-002	2015/3	2016/3
Measuring receiver	Rohde & Schwarz	ESL3	REC-101-001	2012/6	2015/6
Ref. Comb generator	SMEE	EMC-250K	REF-111-001	-	-

## Photo of test setup for Mains Terminal Disturbance Voltage



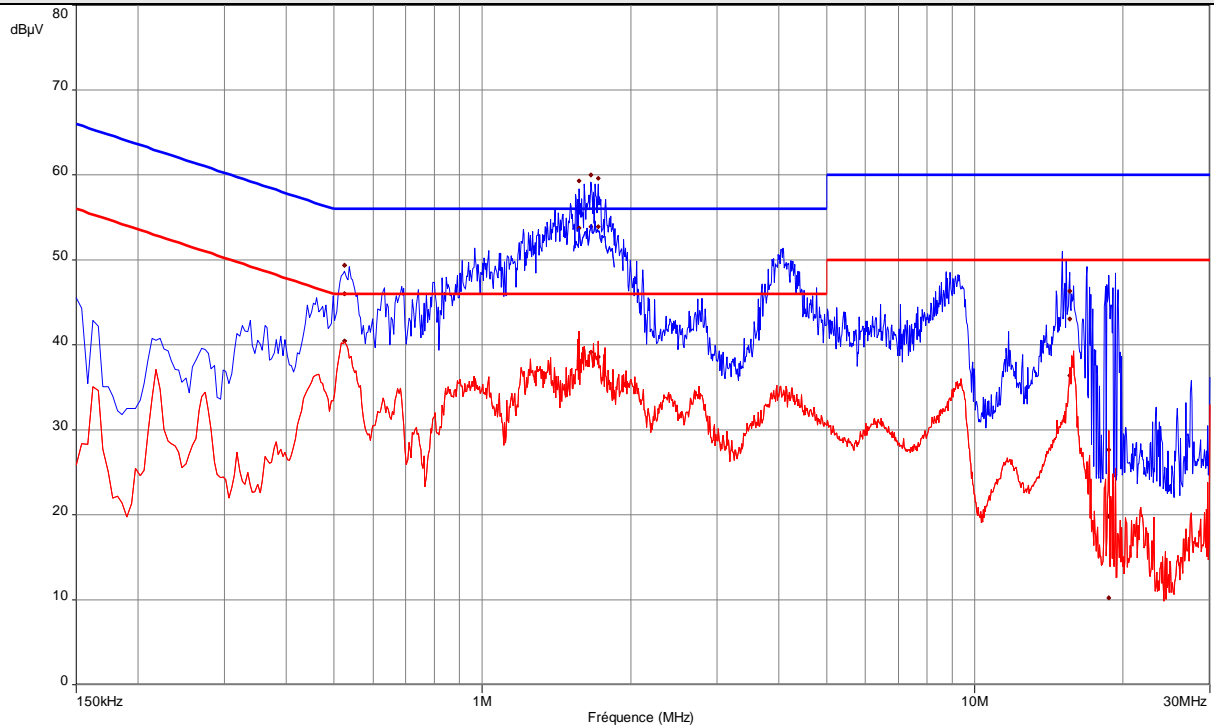
## Tabulated Results for Mains Terminal Disturbance Voltage on AC port

FREQ (MHz)	Meas. PK (dBμV)	Mes. QP (dBμV)	LIMIT QP (dBμV)	Margin QP (dB)	Mes. AV (dBμV)	LIMIT AV (dBμV)	Margin AV (dB)	Line
0,526	49,4	46,0	56,0	<b>-10,0</b>	40,4	46,0	<b>-5,6</b>	Line L1
1,574	59,3	53,7	56,0	<b>-2,3</b>	38,2	46,0	<b>-7,8</b>	Line L1
1,662	60,0	53,9	56,0	<b>-2,1</b>	39,2	46,0	<b>-6,8</b>	Line L1
1,722	59,6	53,9	56,0	<b>-2,1</b>	38,6	46,0	<b>-7,4</b>	Line L1
15,604	46,3	43,1	60,0	<b>-16,9</b>	36,4	50,0	<b>-13,6</b>	Line L1
18,728	27,6	19,9	60,0	<b>-40,2</b>	10,2	50,0	<b>-39,8</b>	Line L1
0,526	57,2	51,6	56,0	<b>-4,4</b>	40,5	46,0	<b>-5,5</b>	Neutral
0,950	56,8	50,9	56,0	<b>-5,1</b>	38,7	46,0	<b>-7,3</b>	Neutral
1,570	59,7	53,6	56,0	<b>-2,4</b>	40,7	46,0	<b>-5,3</b>	Neutral
1,634	60,7	55,4	56,0	<b>-0,6</b>	42,3	46,0	<b>-3,7</b>	Neutral
1,710	60,3	54,6	56,0	<b>-1,4</b>	41,7	46,0	<b>-4,3</b>	Neutral
9,346	49,9	44,1	60,0	<b>-15,9</b>	35,9	50,0	<b>-14,1</b>	Neutral
15,818	49,3	47,2	60,0	<b>-12,8</b>	42,1	50,0	<b>-7,9</b>	Neutral
<b>Frequency band investigated:</b>		150kHz-30MHz						
<b>RBW:</b>		9kHz						
<b>Voltage:</b>		110V / 60Hz						
<b>Limit:</b>		15.107 / 15.207						
<b>Final measurement detector:</b>		Quasi-Peak and Average						
<b>Wide Measurement Uncertainty:</b>		± 3.6dB (k=2)						
<b>RESULT:</b>		PASS						

Supplementary information:

Worst case result for lowest, middle and highest channel

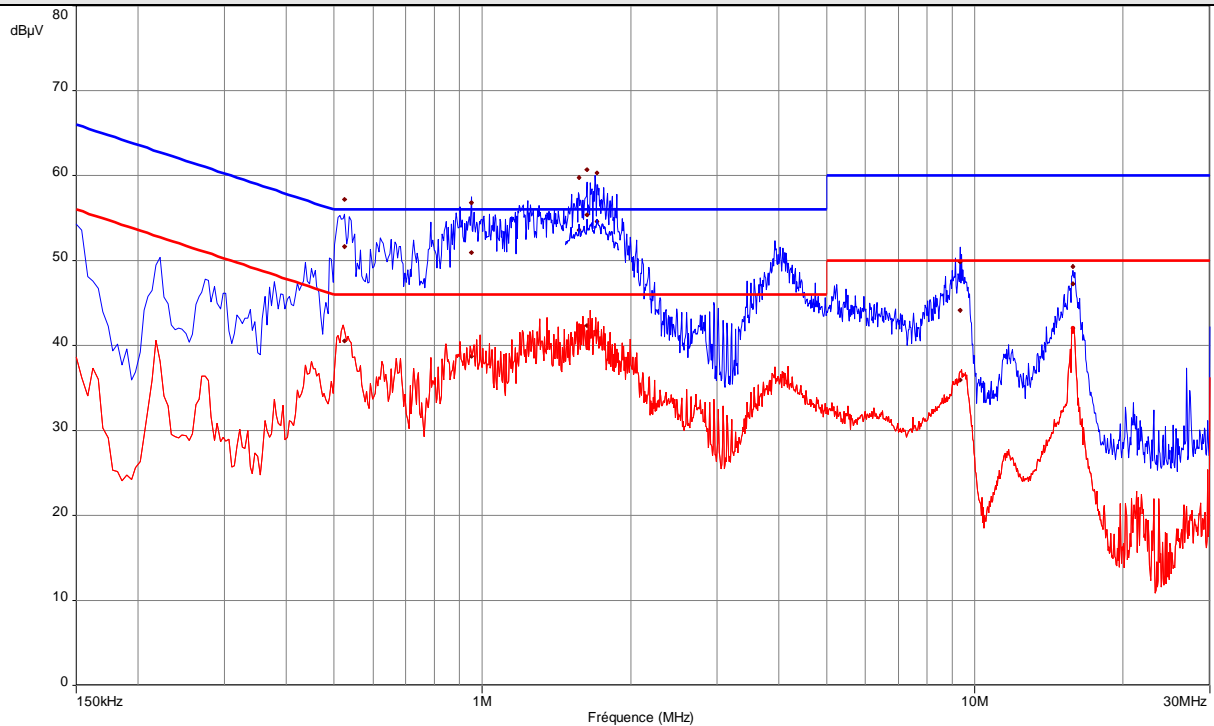
## Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line L1



----: Peak

----: Average

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



----: Peak

----: Average

## 7. 20dB Bandwidth

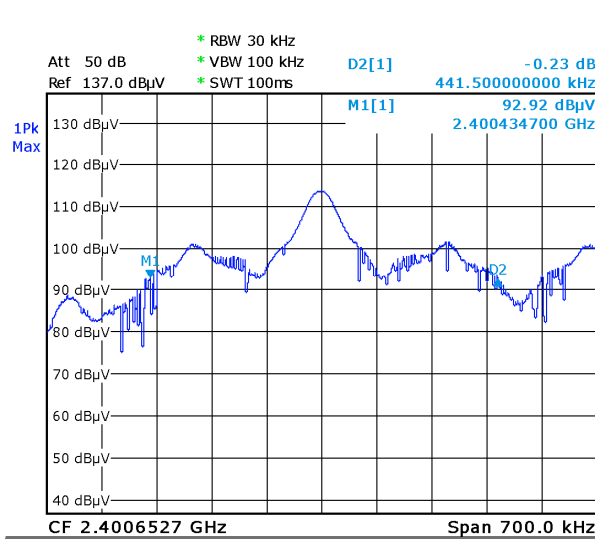
TEST: 20dB Bandwidth / FCC part 15.247			Verdict
<u>Method:</u> The Equipment under test is connected to the measuring receiver with suitable mean. RBW on spectrum analyser shall be 1-5% of the Equipment Bandwidth (EBW); RBW is adjust for RBW/EBW ratio is 1-5% The tested equipment is set to transmit operation with worst case modulations on lowest, middle and highest channel.			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%	
Limits – FCC Part 15.247 (a)(1)			
Frequency (MHz)	Level for Bandwidth	Limit	
2400.4	20dB below the maximum output power	None	
2441.7			
2472.9			
Supplementary information: Test location: SMEE / Test date: May 6 <sup>th</sup> , 2015 Power supply voltage: 5V dc			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESL3	REC-101-001	2012/6	2015/6
Cable	Pasternack	PE354-150	CAB-131-025	2015/3	2016/3

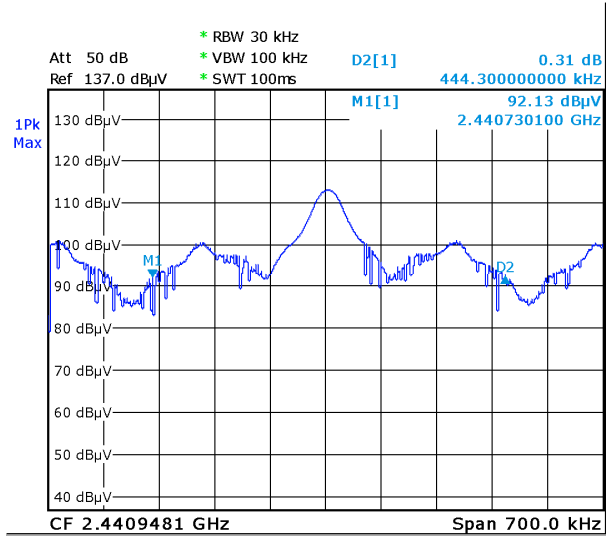
Tabulated Results for 20dB Occupied Bandwidth (Conducted measurement)		
Modulation	Frequency (MHz)	20dB Bandwidth (kHz)
Auto Set Single Reader (worst case)	2400.4	441.5 kHz
	2441.7	444.3 kHz
	2472.9	435.9 kHz



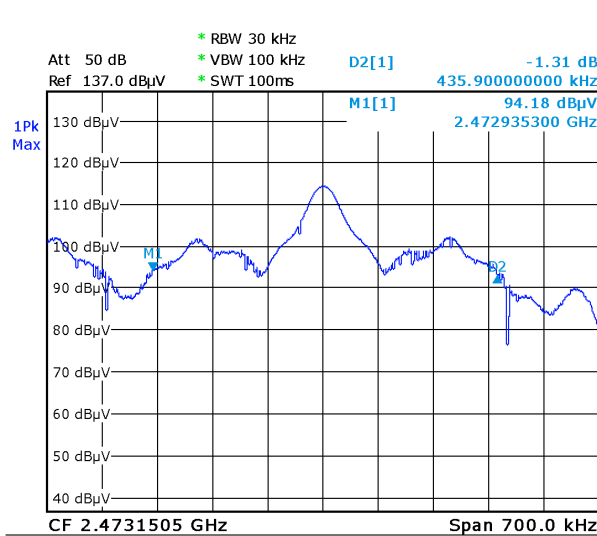
## Graphical representation of 20dB Bandwidth



Low channel



Mid channel



High channel

Note: above plots may show images of the transmitter in adjacent channels.

Modulation:	Auto Set Single Reader (Worst case)
Frequency band investigated:	2400MHz to 2483.5MHz
RBW :	30kHz
Measurement detector:	Peak

## 8. Carrier Frequency Separation

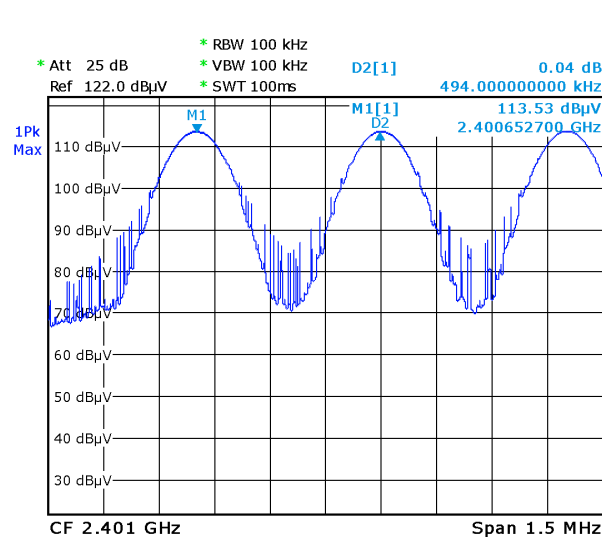
TEST: Channel Separation / FCC part 15.247			Verdict
<u>Method:</u> The Equipment under test is connected to the measuring receiver with suitable mean. SPAN is adjusted to capture two peaks of two adjacent channels. RBW on spectrum analyser shall be > 1% of the SPAN. The tested equipment is set to transmit hopping sequences on lowest, middle and highest channel.			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%	
Limits – FCC Part 15.247 (a)(1)			
Frequency (MHz)	Minimum Channel Separation	Result	
2400.4	25kHz or the two-third 20dB bandwidth, whichever is greater	Pass	
2441.7			
2472.9			
Supplementary information: Test location: SMEE / Test date: May 6 <sup>th</sup> , 2015 Power supply voltage: 5V dc			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESL3	REC-101-001	2012/6	2015/6
Cable	Pasternack	PE354-150	CAB-131-025	2015/3	2016/3

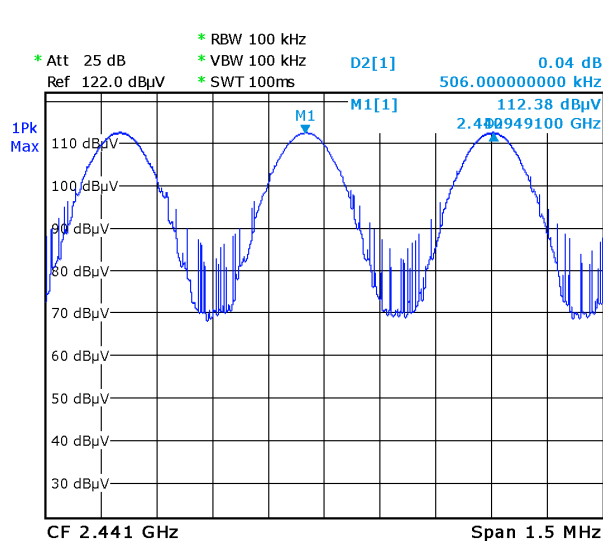
Tabulated Results for Hopping Channel Separation (Conducted measurement)				
Channel frequency (MHz)	Adjacent channel separation (MHz)	Max. 20dB Bandwidth (MHz)	Minimum limit (MHz)	Result
2400.4	<b>0.507</b>	0.4415	0.297	PASS
2441.7	<b>0.506</b>	0.4443	0.297	PASS
2472.9	<b>0.494</b>	0.4359	0.297	PASS

Note: Test performed with Auto Set Single Reader

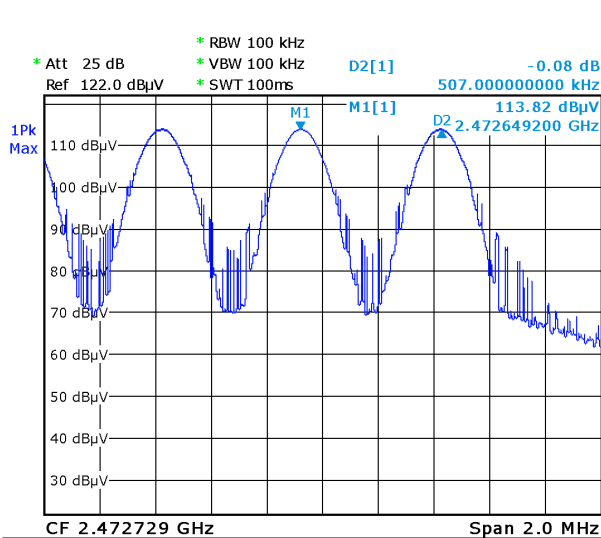
## Graphical representation of Channel Separation



Low channel



Mid channel



High channel

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

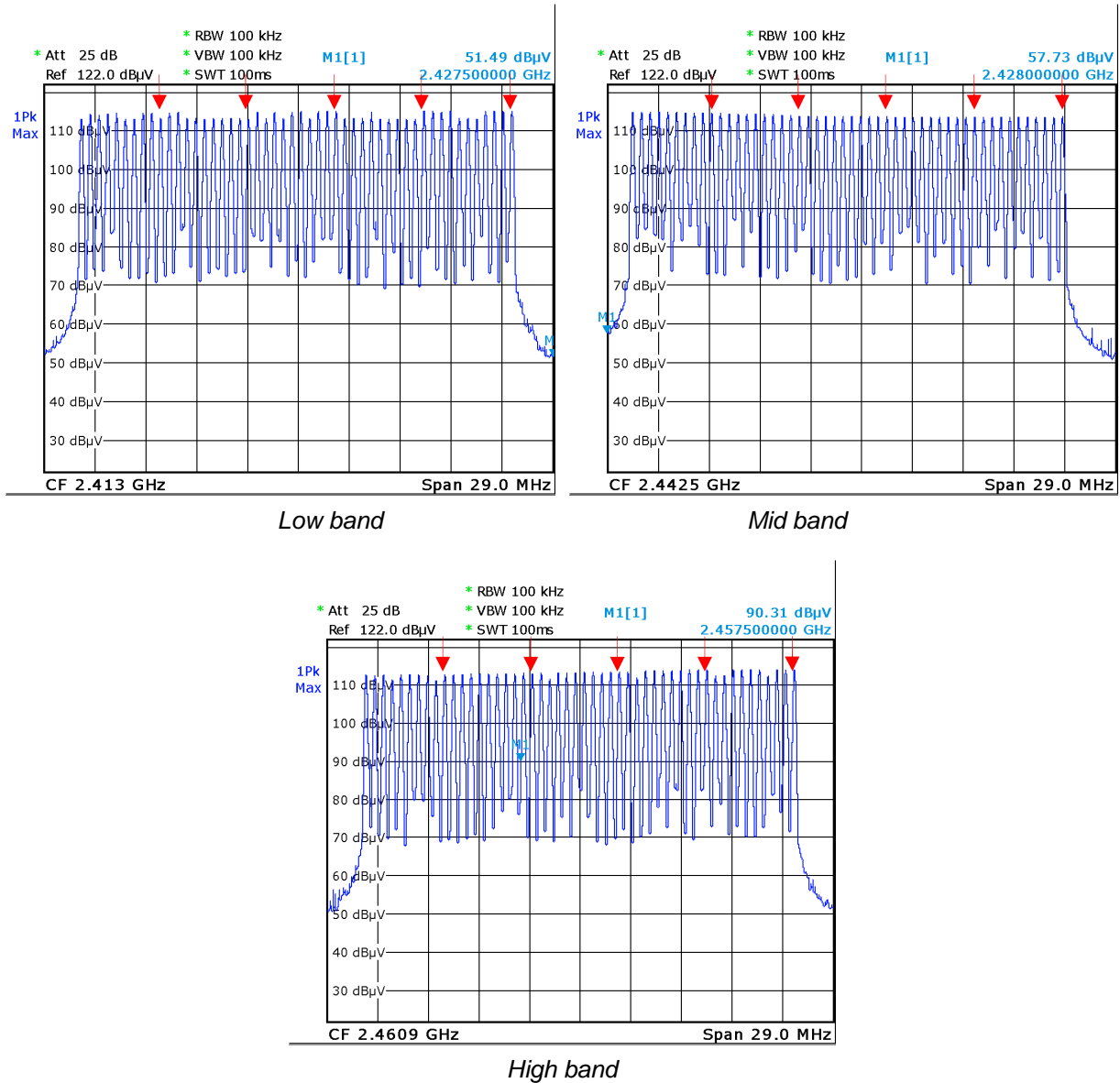
## 9. Number of Hopping frequencies

TEST: Number of channels / FCC part 15.247			Verdict
Method: The Equipment under test is connected to the measuring receiver with suitable mean. SPAN is adjusted to capture the frequency band of operation. RBW on spectrum analyser shall be > 1% of the SPAN. The tested equipment is set to transmit hopping sequences on the three (3) bands available.			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%	
Limits – FCC Part 15.247 (a)(1)(iii)			
Frequency bands (MHz)	Minimum number of channels	Result	
2400.4	At least 15 channels	Pass	
2441.7			
2472.9			
Supplementary information: Test location: SMEE / Test date: May 6 <sup>th</sup> , 2015 Power supply voltage: 5V dc			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESL3	REC-101-001	2012/6	2015/6
Cable	Pasternack	PE354-150	CAB-131-025	2015/3	2016/3

Tabulated Results for Number of Hopping Frequencies (Conducted measurement)			
Frequency band (MHz)	Number of channels measured	Minimum required	Result
2400.4	50	15	PASS
2441.7	50	15	PASS
2472.9	50	15	PASS

## Graphical representation of Number of Hopping Frequencies



Note: Interval between two pointers corresponds to 10 hopping channels

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

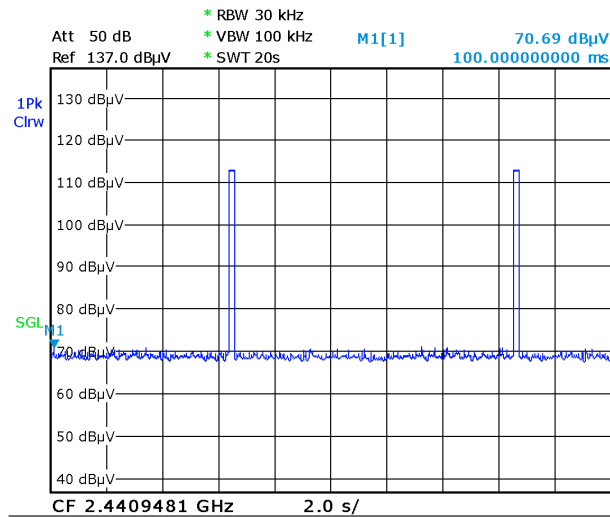
## 10. Time of Occupancy (Dwell time)

TEST: Dwell Time / FCC part 15.247			Verdict
<u>Method:</u> The Equipment under test is connected to the measuring receiver with suitable mean. SPAN is centred on a hopping channel. Zero SPAN is used. The sweep time is adjusted to observe the time of occupancy of a channel. The tested equipment is set to transmit hopping sequences.			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%	
Limits – FCC Part 15.247 (a)(1)(iii)			
Observation time	Maximum time of occupancy per channel	Result	
Number of Hopping channels x 0,4s	0,4s	PASS	
Supplementary information: Test location: SMEE / Test date: May 6 <sup>th</sup> , 2015 Power supply voltage: 5V dc			

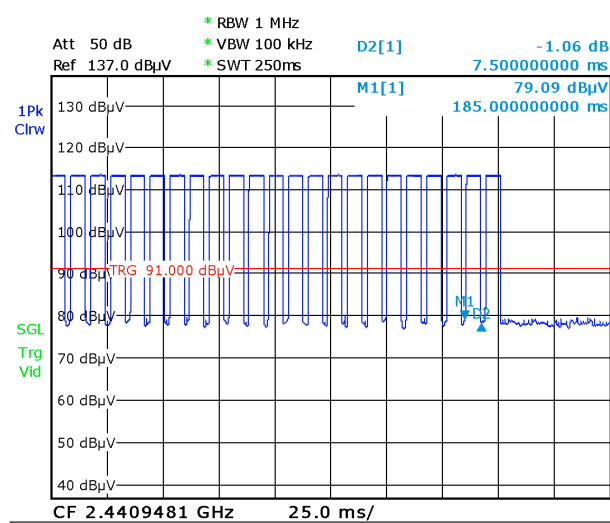
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESL3	REC-101-001	2012/6	2015/6
Cable	Pasternack	PE354-150	CAB-131-025	2015/3	2016/3
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-

Tabulated Results for Dwell Time (Conducted measurement)					
Number of transmit time per 20s	Number of pulse per transmit time	Length of 1 pulse (ms)	Time of occupancy (ms)	Limit (ms)	Result
2	23	7.5ms	345ms	400ms	PASS
<p>Additional information:</p> <p>Period of 20s (0.4s x 50 channels)</p>					

## Graphical representation of Time of Occupancy



20s observation time



250ms observation time (One transmit pulse)

Frequency band investigated:	2400MHz to 2483.5MHz
Measurement detector:	Peak

## 11. Maximum Peak Output power

TEST: Maximum peak conducted output power / FCC part 15.247			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	20°C	
Relative Humidity	10 to 90 %	55%	
Limits – FCC Part 15.247 (b)			
Frequency (MHz)	Limits (dBµV/m)		
	Level / Detector / Distance	Results	
2400 to 2483.5	21 dBm / Pk / 3m (Conducted)	Pass	
2400 to 2483.5	27 dBm / Pk / 3m (Radiated)	Pass	
Supplementary information: Test location: SMEE / Test date: May 6 <sup>th</sup> , 2015 Power supply voltage: 5V dc			

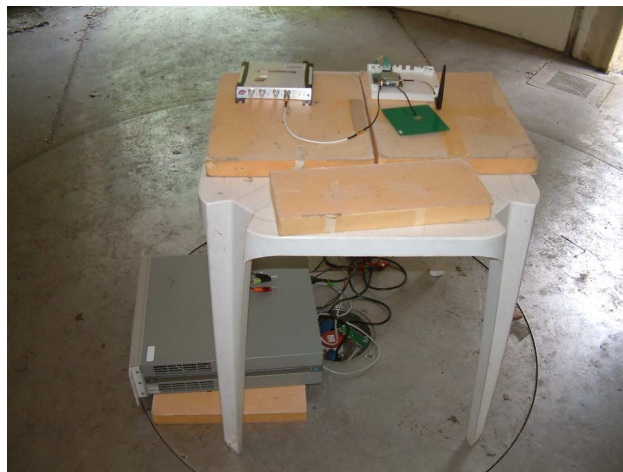
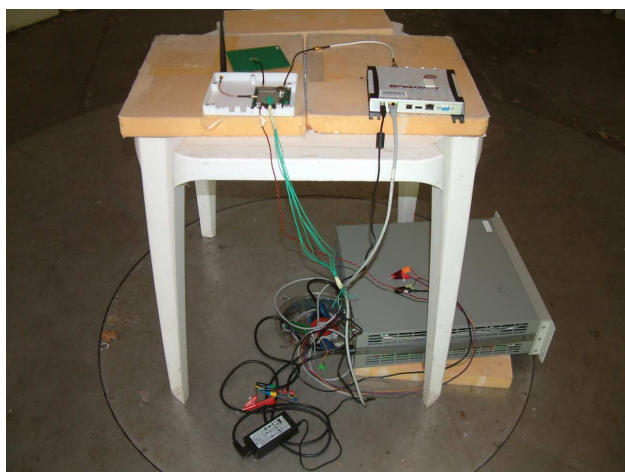
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESL3	REC-101-001	2012/6	2015/6
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2017/3
RF cable	Div	OATS/25m	CAB-101-017	2015/3	2016/3
OATS	Div	3 / 10m	SIT-101-001	2014/5	2015/6
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-

Tabulated Results for Maximum peak output power (Conducted measurement)			
FREQ (MHz)	Peak Power conducted (dBm)	Limit (dBm)	Result
2400.4	<b>19.2</b>	21.0	<b>Pass</b>
2441.7	<b>20.5</b>	21.0	<b>Pass</b>
2472.9	<b>19.8</b>	21.0	<b>Pass</b>
<b>RBW:</b>		1MHz	
<b>Measurement distance:</b>		Conducted measurement	
<b>Limit:</b>		FCC Part 15.247 (b)	
<b>Final measurement detector:</b>		Peak	
<b>RESULT:</b>		PASS	



Tabulated Results for Maximum peak output power (Radiated measurement)				
FREQ (MHz)	Field Strength 3m (dBμV/m)	Calculated EIRP (dBm)	Limit (dBm)	Result
2400.4	118.3	<b>23.1</b>	27.0	<b>Pass</b>
2441.7	118.5	<b>23.3</b>	27.0	<b>Pass</b>
2472.9	118.3	<b>23.1</b>	27.0	<b>Pass</b>
RBW:		1MHz		
Measurement distance:		3m		
Limit:		FCC Part 15.247 (b)		
Final measurement detector:		Peak		
Wide Measurement Uncertainty:		± 5.2dB (k=2)		
RESULT:		PASS		
Notes:		<p>(1): 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.</p> <p>The power (EIRP) was calculated using the following equation:  <b><math>EIRP = (E \times d)^2/30</math></b>            Where D is the distance in meters from which the field strength was measured            E is the maximum field strength in V/m</p>		

## Photo of test setup for Radiated Disturbance



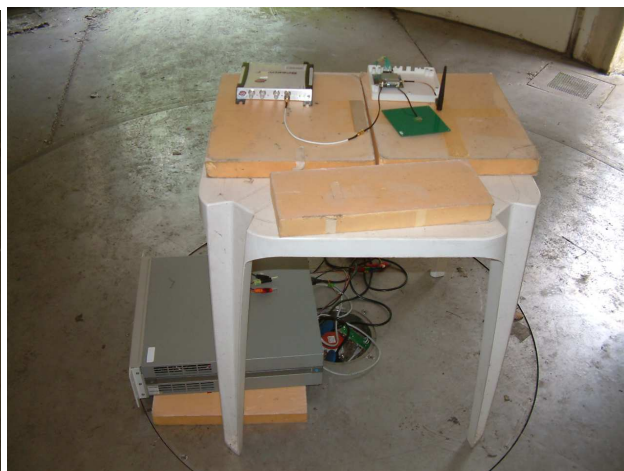
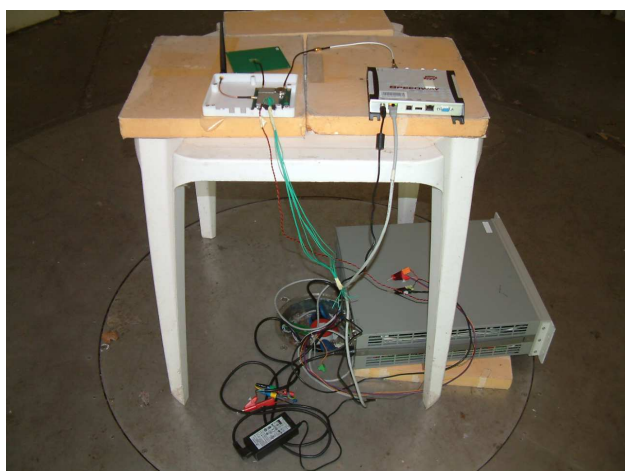
## 12. Radiated (Non-Restricted Frequency bands) & Conducted Unwanted emissions

TEST: Unwanted emissions (Radiated / Conducted) / FCC part 15.247 (d)			Verdict
<p><u>Method:</u> Radiated 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 3 meter (Freq &gt; 30MHz). 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.</p> <p>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.</p> <p>Conducted measurement was performed with peak detector using a 100kHz RBW. The spectrum analyzer was connected via suitable means to the RF output of the tested equipment. The SPAN was wide enough to capture peak level from lower frequency of the equipment to the 10<sup>th</sup> harmonic.</p>			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 Points	
	30MHz – 25GHz	3 m measurement distance / Conducted measurement	
Limits – FCC Part 15.247 (d)			
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 6 <sup>th</sup> , 2015 Power supply voltage: 5V dc			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2014/5	2015/6
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2014/5	2015/6
BiConiLog antenna	EMCO	3142B	ANT-101-010	2014/11	2015/11
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2017/3
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-131-023	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

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
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	2014/5	2015/6
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	ESL3	REC-101-001	2012/6	2015/6
Spectrum analyzer	AGILENT HP	8563E	ASP-111-003	2013/9	2016/9

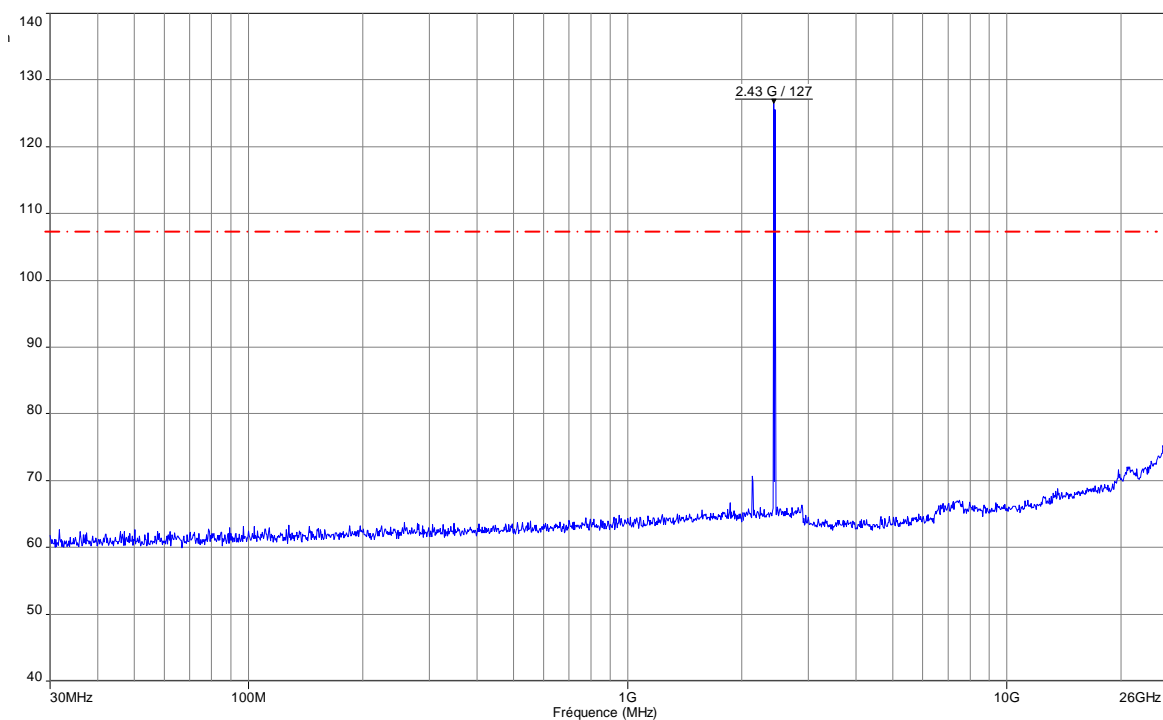
Photo of test setup for Radiated Disturbance



Tabulated Results for Peak Output Power Reference level (Radiated)	
FREQ (MHz)	Field Strength 3m (dBμV/m)
2401 / 2441 / 2473	118.0
<b>RBW:</b>	100kHz
<b>Measurement distance:</b>	3m
<b>Limit:</b>	Ref. level only – For 15.247 (d)
<b>Final measurement detector:</b>	Peak
<b>Wide Measurement Uncertainty:</b>	± 5.2dB (k=2)
<b>Note:</b>	Only for identification of limit in non-restricted band  Limit is <b>98.0 dBμV/m</b> Peak for out-of-band frequencies in Non-Restricted bands radiated emissions (with a 100kHz RBW on the spectrum analyser)

Tabulated Results for Unwanted emissions in Non-Restricted bands (Radiated measurement)			
FREQ (MHz)	Field Strength 3m (dBμV/m)	Limit (dBμV/m)	Result (dBμV/m)
912.000	<b>70.4</b>	98.0	<b>Pass</b>
2400.000 (Band Edge)	<b>67.0</b>	98.0	<b>Pass</b>
3053.300	<b>55.9</b>	98.0	<b>Pass</b>
6106.700	<b>58.1</b>	98.0	<b>Pass</b>
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results. (Worst case result for lowest, middle and highest channel) Band edge measured with hopping sequence activated			
<b>RBW:</b>	100kHz		
<b>Measurement distance:</b>	3m		
<b>Limit:</b>	15.247 (d)		
<b>Final measurement detector:</b>	Peak		
<b>Wide Measurement Uncertainty:</b>	± 5.2dB (k=2)		
<b>RESULT:</b>	PASS		
<b>Note:</b>	See chapter 13. for graphical representation of radiated spurious		
<b>Field Strength Calculation:</b>	<p>The field strength 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:</p> $FS = RA + AF + CF - AG$ <p>Where FS = Field Strength (Level)  RA = Receiver Amplitude (Meter reading)  AF = Antenna Factor  CF = Cable Factor  AG = Amplifier Gain</p> <p>Total factor (dB) is AF + CF – AG</p>		

## Graphical representation of Conducted Disturbance Measurement (Peak detection, 30MHz-26GHz / Transmit mode)



--- : Limit for conducted spurious emissions (107.5dBμV)

Note: No conducted spurious observed. Worst case plot for lowest, middle and highest channel.

Frequency band investigated:	30MHz-26GHz
Unit :	dBμV
RBW :	100kHz
Measurement method	Conducted
Voltage:	5V DC
Limit:	15.247 (d)
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

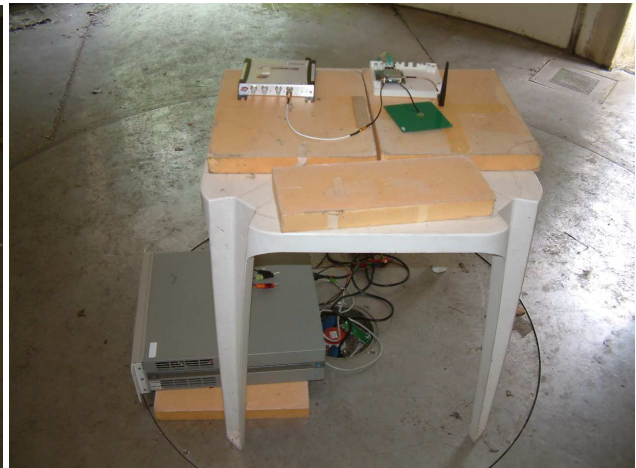
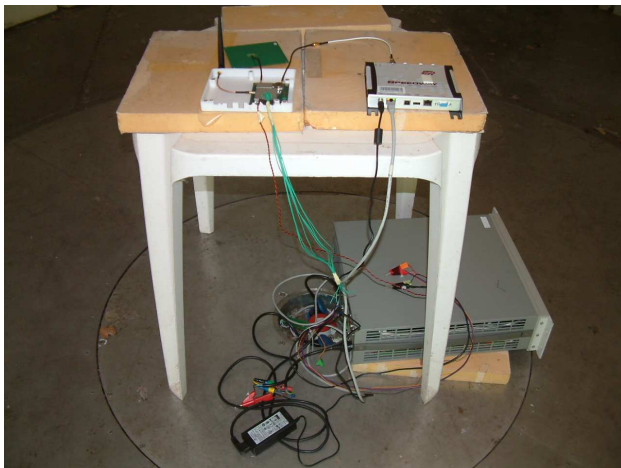
## 13. Unwanted emissions in Restricted Frequency bands

TEST: Unwanted emissions into Restricted Frequency Bands / FCC part 15.205, 15.209, 15.247		Verdict
<p><b>Method:</b> 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 10 meter (Freq &lt; 30MHz) or 3 meter (Freq &gt; 30MHz). 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.</p> <p>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 frequency above 10GHz, a manual search is performed at a distance of 1m or less in order to identify any frequency radiated by the equipment under test.</p>		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
	9kHz – 30MHz	10 m measurement distance
	30MHz – 25GHz	3 m measurement distance
Limits – FCC Part 15.205, 15.209, 15.247		
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 1000	54.0 / QP / 3m	Pass
Above 1GHz	54.0 / AV / 3m 74.0 / PK / 3m	Pass
<p>Supplementary information:  Test location: SMEE / Test date: May 6<sup>th</sup>, 2015  Power supply voltage: 5V dc</p>		



Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2014/5	2015/6
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2014/5	2015/6
BiConiLog antenna	EMCO	3142B	ANT-101-010	2014/11	2015/11
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2017/3
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-131-023	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
Anechoic chamber	COMTEST	214263	CAG-141-001	-	-
OATS	Div	10m	SIT-101-001	2014/5	2015/6
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	ESL3	REC-101-001	2012/6	2015/6
Spectrum analyzer	AGILENT HP	8563E	ASP-111-003	2013/9	2016/9

## Photo of test setup for Radiated Disturbance



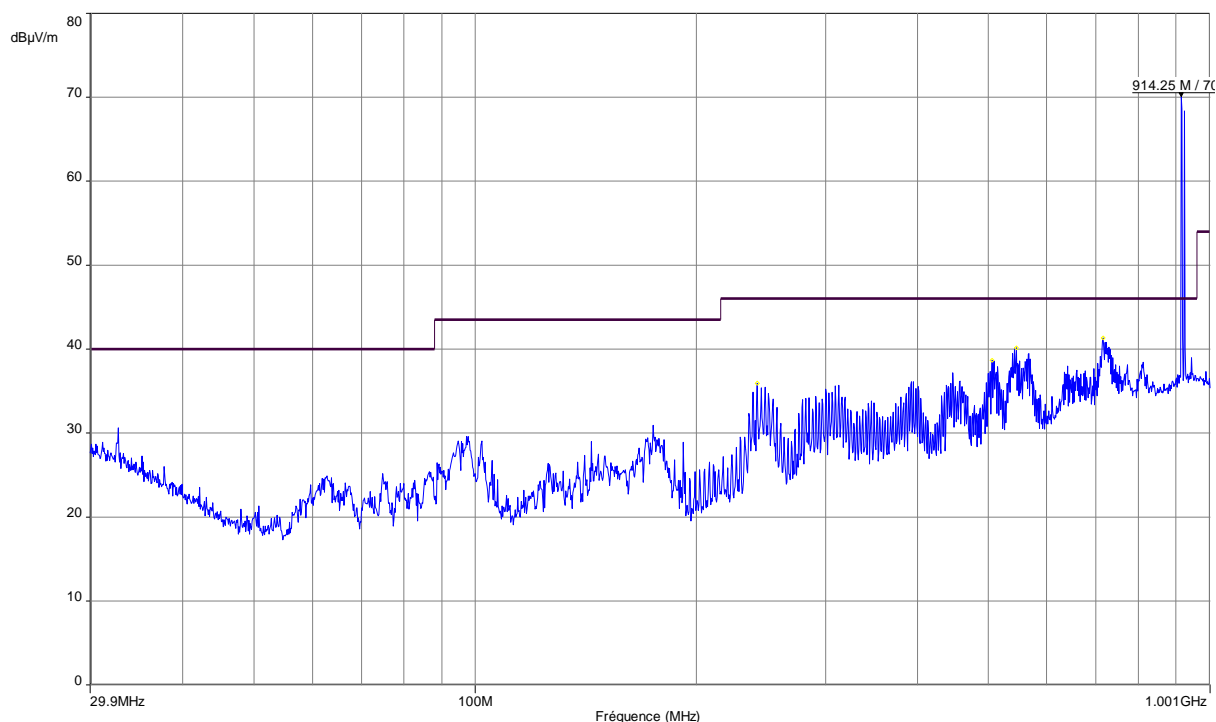
Tabulated Results for Unwanted emissions (9kHz-30MHz)						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	(QP) dBμV/m	(QP) dBμV/m	dB	Degree	Degree	dB
No frequency observed						
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results. (Worst case result for lowest, middle and highest channel)						
<b>Frequency band investigated:</b>		9kHz-30MHz				
<b>RBW:</b>		200Hz (9kHz-150kHz)				
		9kHz (150kHz-30MHz)				
<b>Measurement distance:</b>		10m (Open Area Test Site)				
<b>Limit:</b>		FCC Part 15.205 - 15.209				
<b>Final measurement detector:</b>		Quasi-Peak				
<b>Wide Measurement Uncertainty:</b>		± 5 dB (k=2)				
<b>Note:</b>		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. (Worst case result for lowest, middle and highest channel)										
<b>Frequency band investigated:</b>		30MHz-1GHz								
<b>RBW:</b>		120kHz								
<b>Measurement distance:</b>		3m (Open Area Test Site)								
<b>Limit:</b>		FCC Part 15.205 - 15.209								
<b>Final measurement detector:</b>		Quasi-Peak								
<b>Wide Measurement Uncertainty:</b>		± 5.2dB (k=2)								
<b>RESULT:</b>		PASS								
<b>Field Strength Calculation:</b>		<p>The field strength 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:</p> $FS = RA + AF + CF - AG$ <p>Where FS = Field Strength (Level)  RA = Receiver Amplitude (Meter reading)  AF = Antenna Factor  CF = Cable Factor  AG = Amplifier Gain</p> <p>Total factor (dB) is AF + CF - AG  Margin value = Emission level - Limit value</p>								



Tabulated Results for Unwanted emissions (1GHz-25GHz)				
FREQ (MHz)	Field level dBμV/m	Detector	Limit (dBm)	Result
1526.7	46.3	Pk	74 / Pk 54 / Av	PASS
2483.5 (Band Edge)	63.5	Pk	74 / Pk	PASS
	51.0	Av	54 / Av	PASS
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results. (Worst case result for lowest, middle and highest channel) Band edge measured with hopping sequence activated				
Frequency band investigated:		1GHz-26GHz		
RBW:		1MHz (RBW) / 3MHz (VBW) for Peak measurement 1MHz (RBW) / 10Hz (VBW) for Average measurement		
Measurement distance:		3m		
Limit:		FCC Part 15.205 - 15.209		
Final measurement detector:		Peak / Average		
Wide Measurement Uncertainty:		± 5.2dB (k=2)		
RESULT:		PASS		
Field Strength Calculation:		<p>The field strength 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:</p> $FS = RA + AF + CF - AG$ <p>Where FS = Field Strength (Level)  RA = Receiver Amplitude (Meter reading)  AF = Antenna Factor  CF = Cable Factor  AG = Amplifier Gain</p> <p>Total factor (dB) is <math>AF + CF - AG</math>  Margin value = Emission level – Limit value</p>		

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

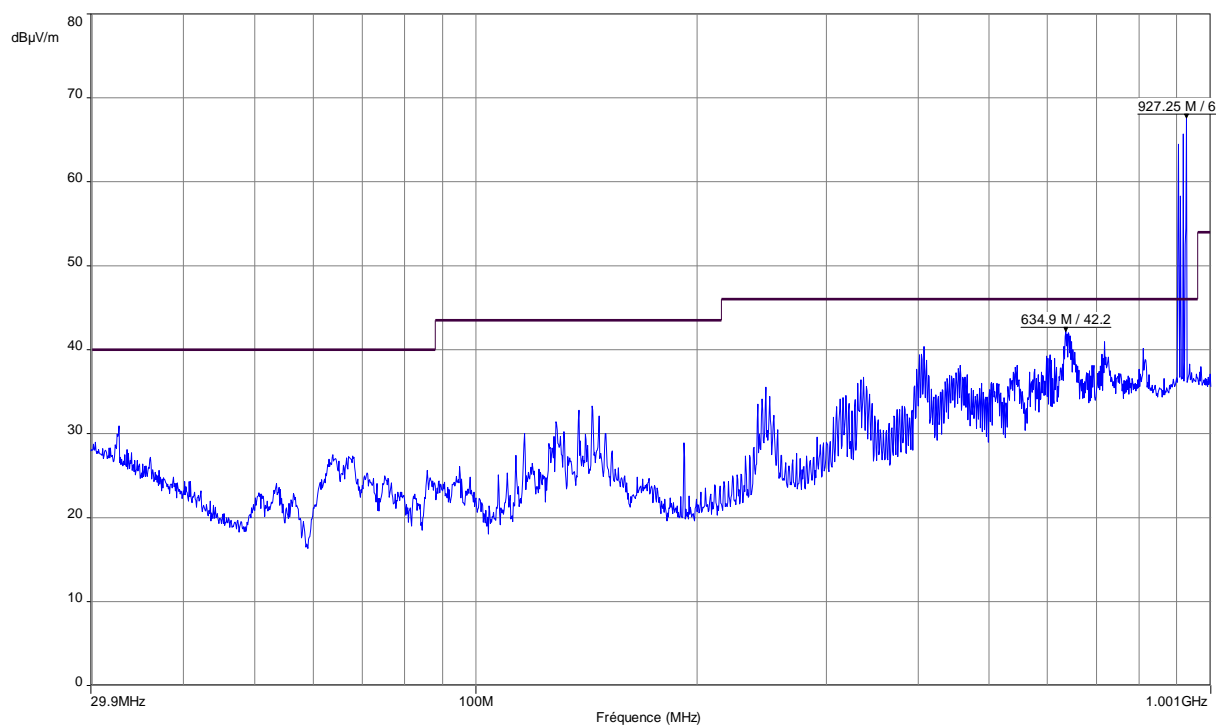


Frequency (MHz)	Peak Level (dBμV/m)	Comments
242,050	36,0	Restricted band
505,450	38,6	Not in Rest. Band (Limit: 98.0dBμV/m)
545,250	40,2	Not in Rest. Band (Limit: 98.0dBμV/m)
716,350	41,3	Not in Rest. Band (Limit: 98.0dBμV/m)

Note: Pre-scan graph only for identification purpose.  
(Worst case result for lowest, middle and highest channel)

Frequency band investigated:	30MHz-1GHz
Unit :	dBμV/m
RBW :	100kHz
Antenna polarization :	Horizontal
Voltage:	5V DC
Limit:	15.205 - 15.209
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)

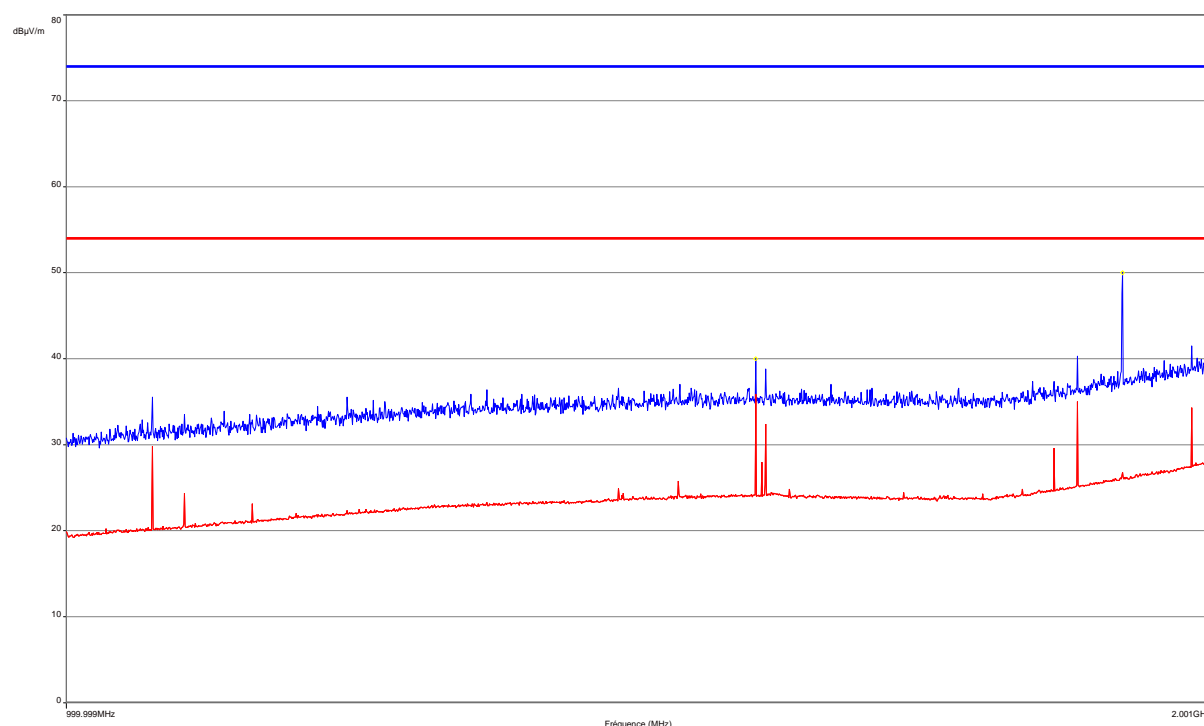


Frequency (MHz)	Peak Level (dBμV/m)	Comments
248,200	35,5	Restricted band
407,450	40,4	Restricted band
634,900	42,2	Not in Rest. Band (Limit: 98.0dBμV/m)
717,800	41,0	Not in Rest. Band (Limit: 98.0dBμV/m)
809,350	40,1	Not in Rest. Band (Limit: 98.0dBμV/m)
927,250	67,5	Not in Rest. Band (Limit: 98.0dBμV/m)

Note: Pre-scan graph only for identification purpose.  
(Worst case result for lowest, middle and highest channel)

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

## Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-2GHz / 3m / Horizontal / Transmit mode)

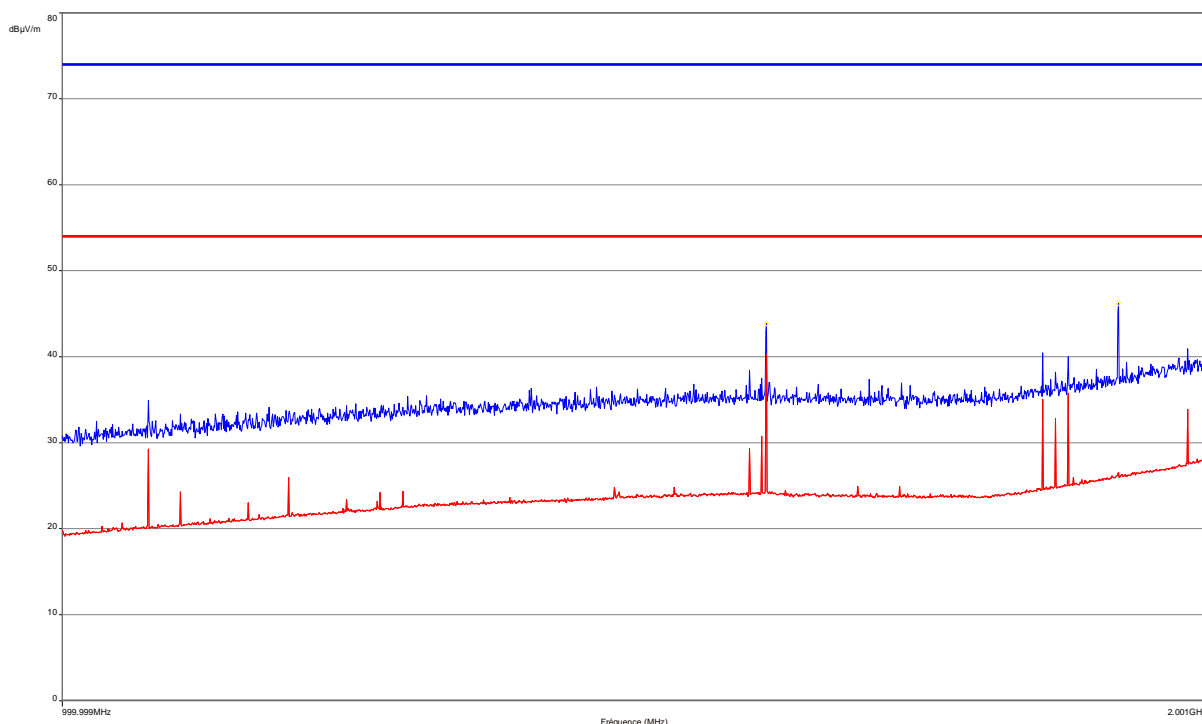


Frequency (MHz)	Peak Level (dBμV/m)	Comments
1517,600	40,0	Restricted band
1893,900	50,0	Ambient noise

Note: Pre-scan graph only for identification purpose.  
(Worst case result for lowest, middle and highest channel)

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

## Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-2GHz / 3m / Vertical / Transmit mode)

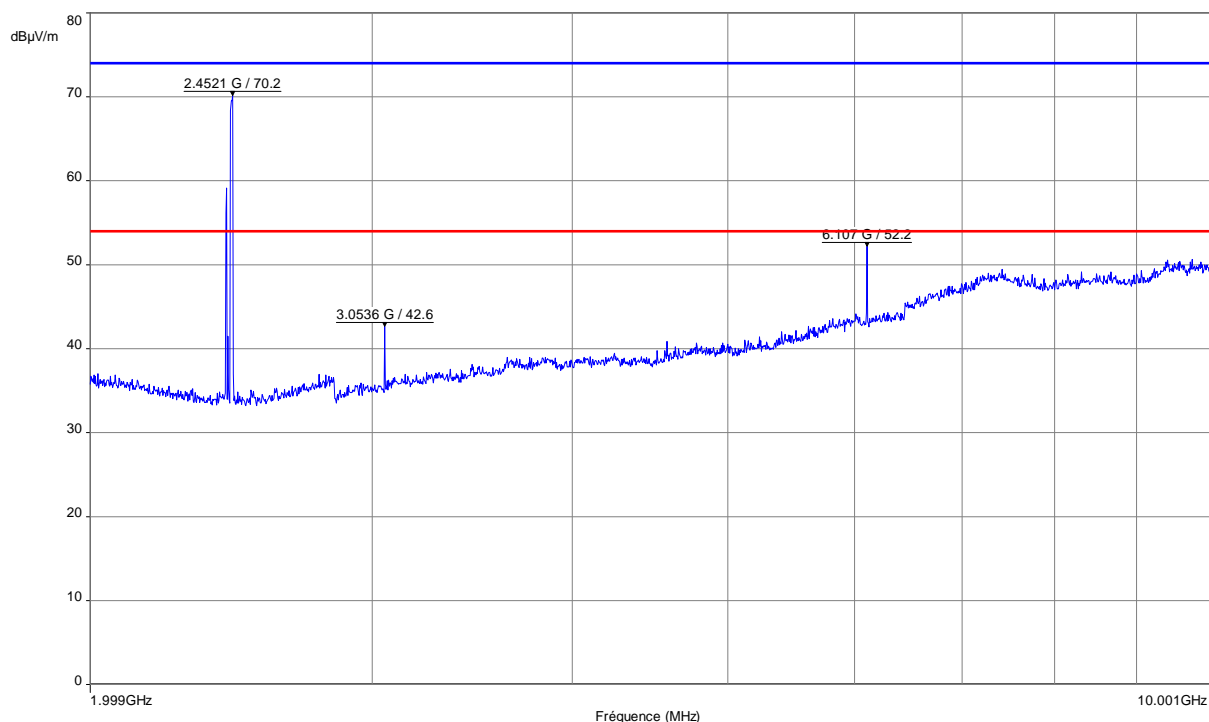


Frequency (MHz)	Peak Level (dBμV/m)	Comments
1531,100	43,9	Restricted band
1893,900	46,2	Ambient noise

Note: Pre-scan graph only for identification purpose.  
(Worst case result for lowest, middle and highest channel)

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

## Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 2GHz-10GHz / 3m / Horizontal / Transmit mode)

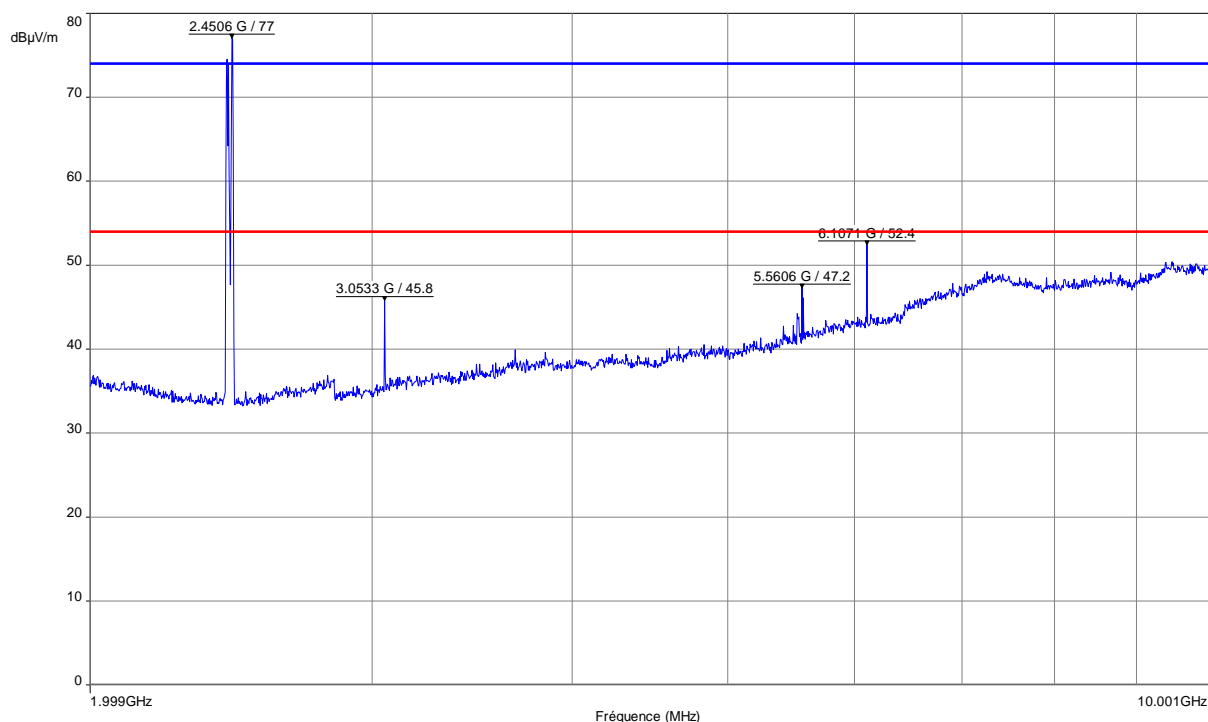


Frequency (MHz)	Peak Level (dBμV/m)	Comments
2452,1	70,2	Carrier frequency
3053,6	42,6	Not in Rest. Band (Limit: 98.0dBμV/m)
6107,0	52,2	Not in Rest. Band (Limit: 98.0dBμV/m)

Note: Pre-scan graph only for identification purpose. No frequency observed above 10GHz.  
(Worst case result for lowest, middle and highest channel)

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

## Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 2GHz-10GHz / 3m / Vertical / Transmit mode)



Frequency (MHz)	Peak Level (dBμV/m)	Comments
2450,6	77,0	Carrier frequency
3053,3	45,8	Not in Rest. Band (Limit: 98.0dBμV/m)
5560,6	47,2	Restricted band
6107,1	52,4	Not in Rest. Band (Limit: 98.0dBμV/m)

Note: Pre-scan graph only for identification purpose. No frequency observed above 10GHz.  
(Worst case result for lowest, middle and highest channel)

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