

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

Matériel testé :
Equipment under test:

IOTIZE / TnLFIW10
(Trademark / Marketing name or product reference)
(WIFI communication media)

Client / Demandeur:
Customer / Applicant : **IOTIZE**
960 chemin de la Croix Verte
38330 Montbonnot - FRANCE

Rapport délivré à :
Issued to: **IOTIZE**
960 chemin de la Croix Verte
38330 Montbonnot - FRANCE

Numéro d'affaire :
Work number : 12895

Référence de la proposition :
Proposal number: 072018-23140-1

Date de l'essai :
Date of test: 11 au 15 novembre 2019
November 11th to 15th, 2019

Objectif des essais :
Test purpose: EMC qualification according 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)
- ISED ICES-003 Issue 6 & RSS-247, Issue 2 (Digital Transmission Systems Operating in the Bands 2400-2483.5 MHz)
Measurement standards : ANSI C63.10 (2013)

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

Test réalisé par :
Test realized by: Laurent CHAPUS

Conclusion :
Conclusion: L'équipement satisfait aux prescriptions et essais des normes citées en référence.
The appliance complies with requirements and tests of above mentioned standards.

Ed.	Date	Modifications Pages	Written by : Visa	Approved by: Visa
1	March 25 th , 2020	Initial Edition	Laurent CHAPUS Technical Manager  Signature numérique de Chapus Laurent	Regis ANCEL General Manager  Signature numérique de Ancel Régis

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COORDONNEES

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Contents

1. NORMATIVES REFERENCES	3
2. TEST SYNTHESIS.....	4
3. EQUIPMENT UNDER TEST (EUT).....	5
4. TEST CONDITIONS.....	6
5. MODIFICATIONS OF THE EUT.....	6
6. SPECIAL ACCESSORY	6
7. MEASUREMENT UNCERTAINTY	6
8. FIELD STRENGTH CALCULATION.....	6
9. CONDUCTED EMISSION MEASUREMENT (150KHZ-30MHZ).....	7
10. DTS BANDWIDTH.....	10
11. MAXIMUM PEAK OUTPUT POWER.....	16
12. MAXIMUM POWER SPECTRAL DENSITY LEVEL IN THE FUNDAMENTAL EMISSION.....	20
13. UNWANTED EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS.....	27
14. UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS.....	33
15. OCCUPIED BANDWIDTH (99%).....	46

1. Normatives References

FCC qualification according to:		
Standards	Applied	Title
ANSI C63.10 (2013)	X	American National Standard for Testing Unlicensed Wireless Devices
CFR47, Part 15	X	Telecommunication – Federal Communication Commission – Radio frequency devices, Sections 15.109 / 15.209 / 15.247

ISED qualification according to:		
Standards	Applied	Title
RSS-Gen (Issue 5/2018)	X	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 (Issue2/2017)	X	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Note: Following guidance are used

- DTS Measurement Guidance 558074 D01 v05r02
- Determining ERP and EIRP Guidance 412172 D01 v01r01

Deviation from standard: None

2. Test synthesis

TEST	Paragraph number FCC Part 15 / ISED ICES & RSS	Spec. FCC Part 15 / ISED ICES & RSS	RESULTS (comments)
Conducted emissions test	15.107 (a) / 207 (a) RSS-Gen § 8.8	Table 15.107 (a) / 15.207 (A) Table 4 / RSS-Gen	PASS
Radiated emission test	15.109 (a) / 15.209 (a) RSS-Gen § 8.9	Table 15.109 (a) / 15.209 (a) Table 5 & 6 / RSS-Gen	PASS
6dB Bandwidth	15.247 (a) (2) RSS-247 § 5.2 (a)	At least 500kHz	PASS
Maximum Peak Output Power	15.247 (b) (3) & (4) RSS-247 § 5.4 (d)	1W max / 30dBm (Conducted) 4W max / 36dBm (EIRP)	PASS
Maximum Power Spectral Density	15.247 (e) RSS-247 § 5.2 (b)	8dBm in a 3kHz band segment	PASS
Unwanted emissions into Non Restricted Frequency Bands	15.247 (d) / RSS-247 § 5.5	-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 §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

- General conclusion:**

Measures and tests performed on the sample of the product *IOTIZE / TnLFIW10*, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart C and ISED RSS-Gen & RSS-247.

3. Equipment Under Test (EUT)

Nom / Identification

IOTIZE / TnLFIW10
(Trademark / Marketing name or product reference)
(WIFI communication media)

Sn: IoTize004100000010

FCC ID:

2APCX-TNLFIW10

IC:

23741-TNLFIW10

Model / HVIN:

TnLFIR10

Alimentation / Power supply

Module is powered by 3.3V DC from the MCU target board
(Nominal voltage range is 2.3V to 3.6V)

Auxiliaires / Auxiliaries

- Laptop ASUS, model F200M with its power supply unit
- Serial communication board (FTDI232)
- TapNPass expansion board

Entrées-Sorties / Input / Output

	Câbles pour essai / Cables for test	Blindé / Shielded	Prévu pour >3m / Intended for >3m
Debug connector (J1/J3)	None	No	No
P1 extension connector	Direct plugin	-	-
Auxiliary ports:			
- USB (Target board, COM port + DC)	1m	Yes	No

Version programme embarqué / Firmware version

ESP32_RF_TEST_BIN_V1.3.9

Mode de fonctionnement / Running mode

The tested sample is able to:

- Transmit a carrier frequency on low, middle and high channels (WIFI 802.11 b/g/n-20MHz and 802.11n-40MHz)

The module is plugged onto the expansion board.
The serial communication wire is only used for board programming.

Programme de test / Test program /

EspRfTestTool running on the PC.

Information sur l'équipement / Equipment information

Declaration of the applicant:

- Frequency band: 2400 to 2483.5 MHz (Tx & Rx, Wideband Data Transmission systems)
- Antenna type: CMS chip antenna (Peak antenna gain is 0.5dBi)
- Equipment intended for use as a mobile station
- Equipment designed for continuous operation

WIFI modes of operation:

- 802.11b (1 to 11Mbps data rate, DSSS modulation, 20MHz BW)
- 802.11g (6 to 54 Mbps data rate, OFDM modulation, 20MHz BW)
- 802.11n (7.2 to 72.2 Mbps data rate, OFDM modulation, 20MHz BW)
- 802.11n (15 to 150 Mbps data rate, OFDM modulation, 40MHz BW)
- WIFI channels: 2412 to 2462MHz (N°1 to 11) in 20MHz BW
- WIFI channels: 2422MHz to 2462MHz (N°3 to 11) in 40MHz BW

Rated power (Conducted):

- 802.11b: 11dBm (Tolerance +0.5dB max)
- 802.11g: 16dBm (Tolerance +1dB max)
- 802.11n: 14dBm (Tolerance +1dB max)

Dimensions de l'EST / Dimensions of EUT

Module: 28 x 38 x 3 mm

4. Test conditions

Power supply voltage:
 Equipment under test: 3.3V for RF module
 Auxiliaries (AC mains): 230V/50Hz (Radiated emission)
 110V/60Hz (Conducted emission)

5. Modifications of the EUT

None

6. Special accessory

None

7. Measurement Uncertainty

Test Description	Expanded uncertainty
Conducted emissions test (150k-30MHz, AC mains)	± 3.5dB
Radiated emission test (9kHz-30MHz, electric field)	± 4.0dB
Radiated emission test (30-300MHz, 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

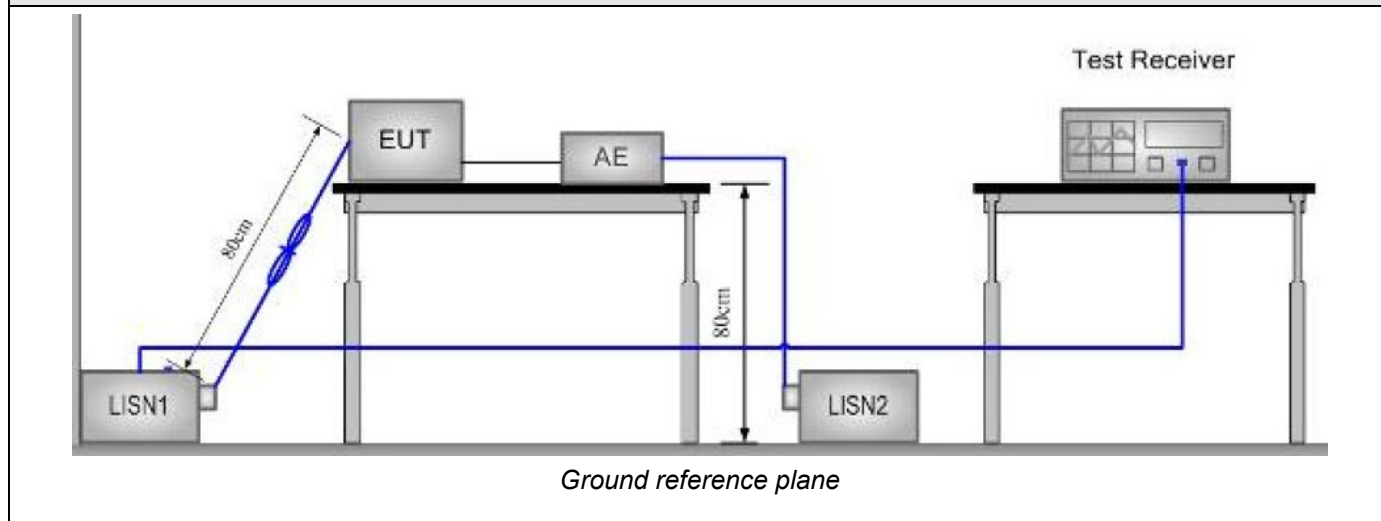
→ Field level: 19.0dBμV/m (-21.0dB for margin if limit is 40dBμV/m)

9. Conducted Emission Measurement (150kHz-30MHz)

TEST: Limits for conducted disturbance 150kHz – 30MHz				Verdict
Method: The LISN is placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane. This distance was between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment were at least 0,8 m from the AMN. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on lines were made at the output of the LISN. The EUT is 80cm above the ground reference plane and 40cm from the vertical ground plane. The AC power cable is 1m length.				Pass
Laboratory Parameters:		Required prior to the test		During the test
Ambient Temperature		20 to 30 °C		23°C ± 2
Relative Humidity		25 to 70 %		42% ± 5
Fully configured sample scanned over the following frequency range		Frequency range on each side of line		Measurement Point
		150kHz to 30MHz		AC input port (110V) Personal Computer
Limits				
Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Result	Average	Result
0.15 – 0.50	66 \ 56	PASS	56 \ 46	PASS
0.50 - 5	56	PASS	46	PASS
5 – 30	60	PASS	50	PASS
Supplementary information: Test location: SMEE Test date: November 14th, 2019. Tested by L. CHAPUS Power supply voltage: 3.3V (Module) from PC (AC mains 110V/60Hz)				

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
AC power supply	PACIFIC POWER	AMX-125	ALI-101-002	-	-
Attenuator / limiter	SMEE	ATT#2	ATT-171-010	2019/6	2020/6
Cable RF	Div	1m	CAB-101-021	2019/4	2020/4
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2019/9	2021/9
LISN (50Ω / 50µH) (Meas.)	AFJ	LS16C	RSI-101-001	2019/6	2021/6
EMC Software	NEXIO	BAT EMC V3.18	SOF-101-001	-	-

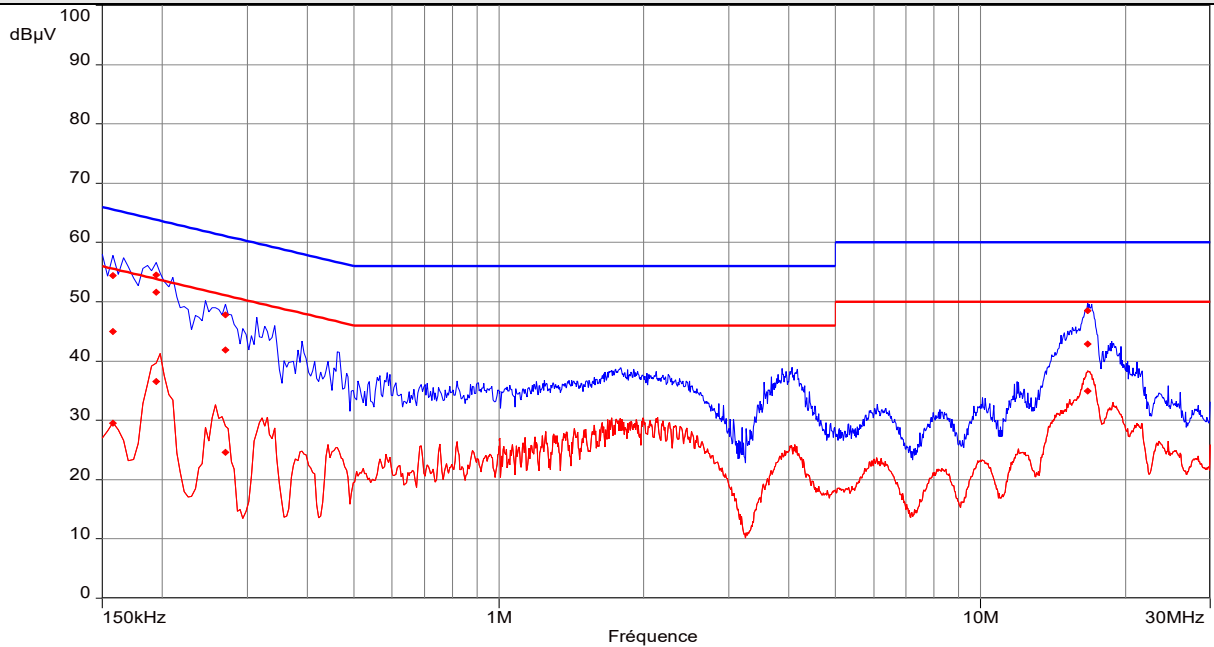
Test Setup for conducted emission



Tabulated Results for Mains Terminal Disturbance Voltage on AC port

FREQ (MHz)	Meas. PK (dBμV)	Mes. QP (dBμV)	LIMIT QP (dBμV)	Margin QP (dB)	Mes. AV (dBμV)	LIMIT AV (dBμV)	Margin AV (dB)	Line
0.158	54.5	45.0	65.6	-20.6	29.5	55.6	-26.1	L1
0.194	54.5	51.6	63.9	-12.3	36.6	53.9	-17.3	L1
0.270	47.8	41.9	61.1	-19.3	24.6	51.1	-26.6	L1
16.708	48.5	42.9	60.0	-17.1	34.9	50.0	-15.1	L1
0.154	54.7	45.1	65.8	-20.7	26.3	55.8	-29.5	N
0.186	54.7	49.8	64.2	-14.4	34.6	54.2	-19.6	N
0.266	48.5	44.8	61.2	-16.5	33.2	51.2	-18.1	N
Frequency band investigated:			150kHz-30MHz					
RBW:			9kHz					
Voltage:			110V/60Hz					
Limit:			15.207 / RSS-GEN §8.8					
Final measurement detector:			Quasi-Peak and CISPR Average (AV)					
RESULT:			PASS					
Measured value calculation:			The measured value (level) is calculated by adding the Cable Factor, the Transient suppressor attenuation and LISN attenuation from the receiver amplitude reading. The basic equation is as follow: $\text{Meas.} = \text{RA} + \text{CF} + \text{ATT}_{\text{TRAN}} + \text{ATT}_{\text{LISN}}$ Where - Meas. = Level (dBμV) - RA = Receiver Amplitude - CF = Cable Factor - ATT_{TRAN} = Transient suppressor attenuation - ATT_{LISN} = LISN attenuation Margin value = Emission level – Limit value (A negative margin shows compliance to limit)					

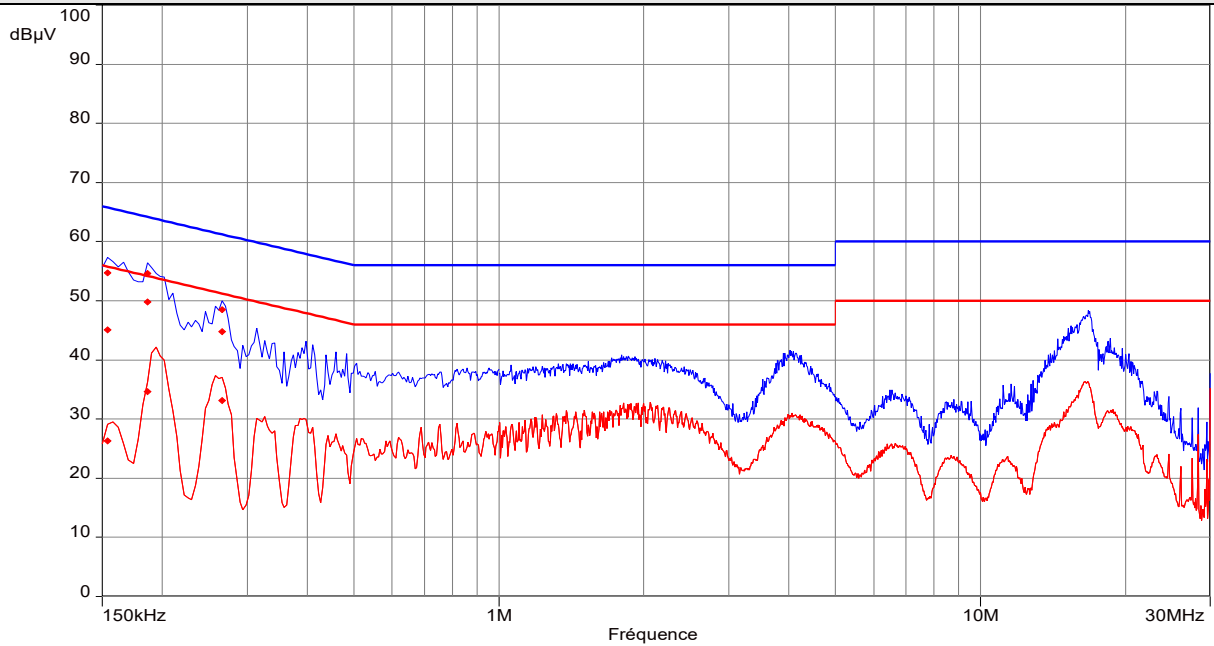
Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line L1



----: Peak

----: Average

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



----: Peak

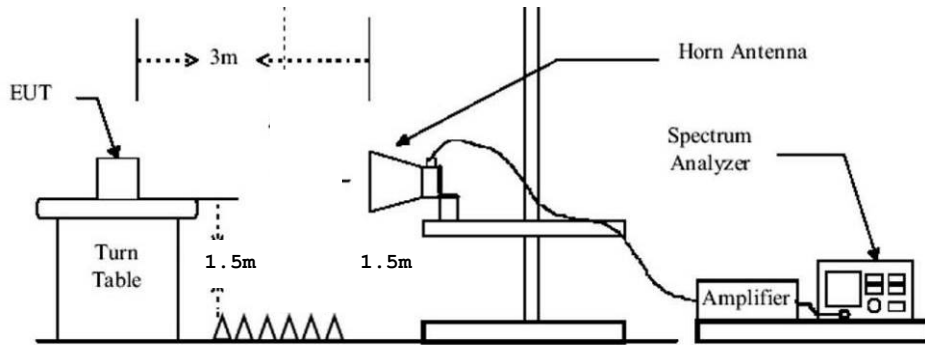
----: Average

10. DTS Bandwidth

TEST: DTS 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		23°C ± 2
Relative Humidity	25 to 70 %		42% ± 5
Limits – FCC Part 15.247 (a) / RSS-247 §5.2 (a)			
Frequency (MHz)	Level for Bandwidth	Limit	
Low channel 2412 or 2422	6dB below the maximum output power	At least 500kHz	
Mid channel 2437 or 2442			
High channel 2462			
Supplementary information: Test location: SMEE Test date: November 11th, 2019. Tested by L. CHAPUS Power supply voltage: 3.3V (Module) from PC			

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

Test Setup for radiated emission

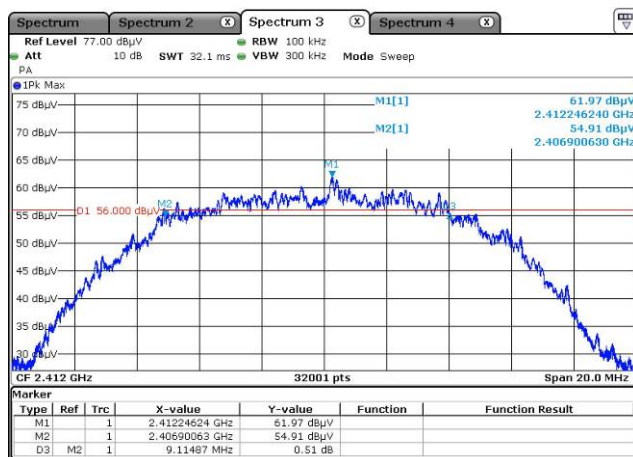


Test setup for 1-25GHz

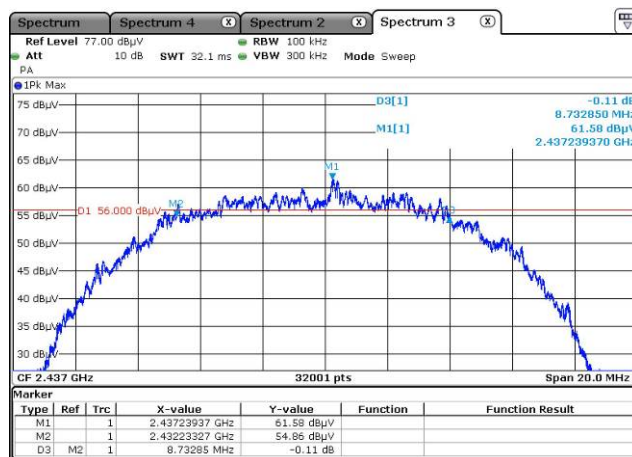
Tabulated Results for Occupied Bandwidth

Frequency (MHz)	6dB Bandwidth (MHz)	Result
802.11b		
2412.0	9.115	Pass
2437.0	8.733	Pass
2462.0	9.273	Pass
802.11g		
2412.0	16.381	Pass
2437.0	16.404	Pass
2462.0	16.414	Pass
802.11n-20MHz		
2412.0	17.306	Pass
2437.0	17.321	Pass
2462.0	17.296	Pass
802.11n-40MHz		
2422.0	35.991	Pass
2442.0	36.345	Pass
2462.0	36.389	Pass

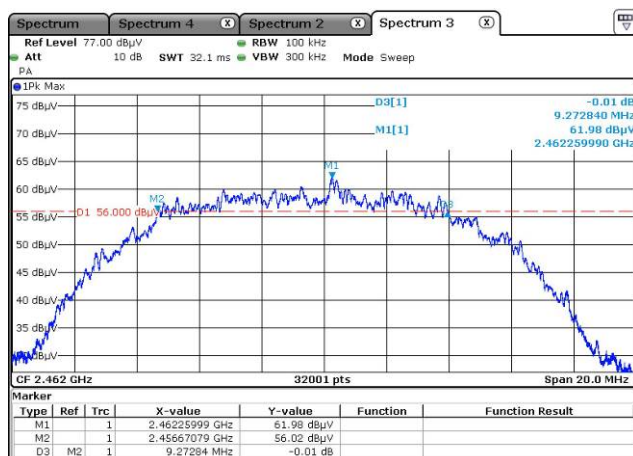
Graphical representation of 6dB Bandwidth (802.11b)



Low channel



Mid channel



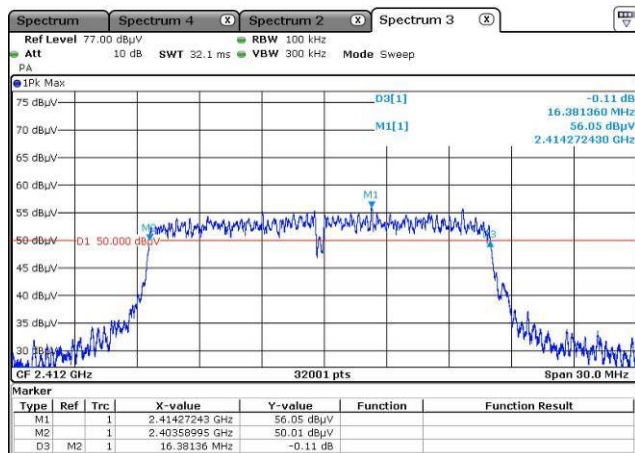
High channel

Frequency band investigated: 2400MHz to 2483.5MHz

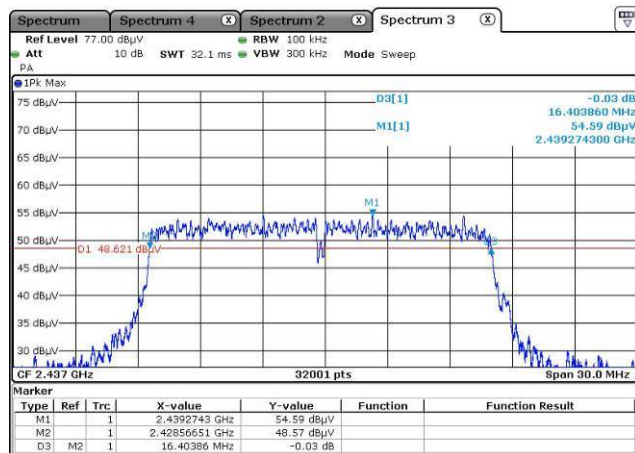
RBW : 100kHz

Measurement detector : Peak / Max hold

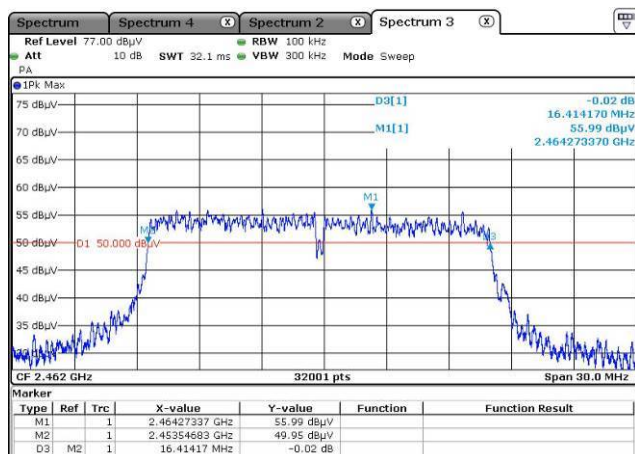
Graphical representation of 6dB Bandwidth (802.11g)



Low channel



Mid channel



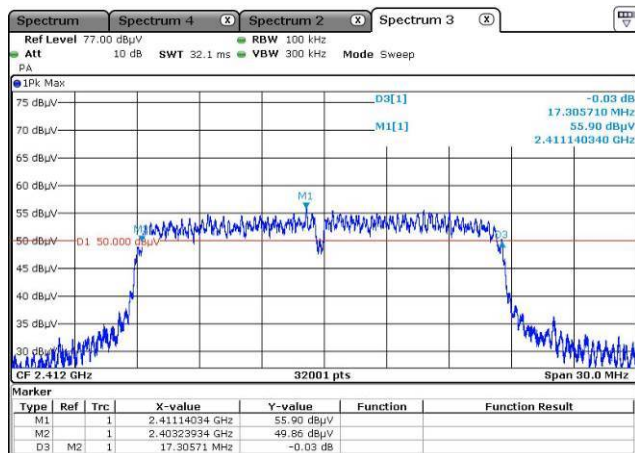
High channel

Frequency band investigated: 2400MHz to 2483.5MHz

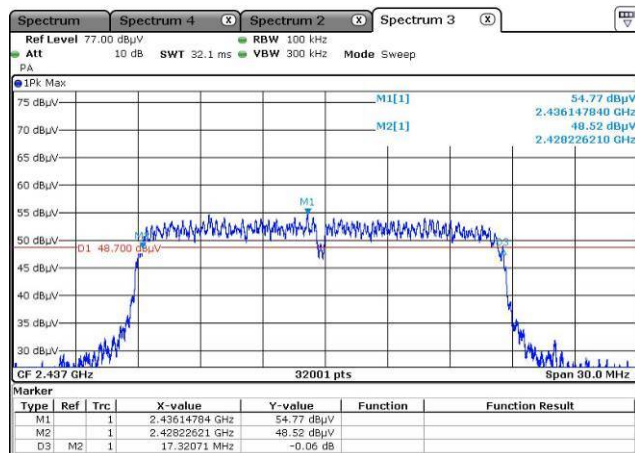
RBW : 100kHz

Measurement detector : Peak / Max hold

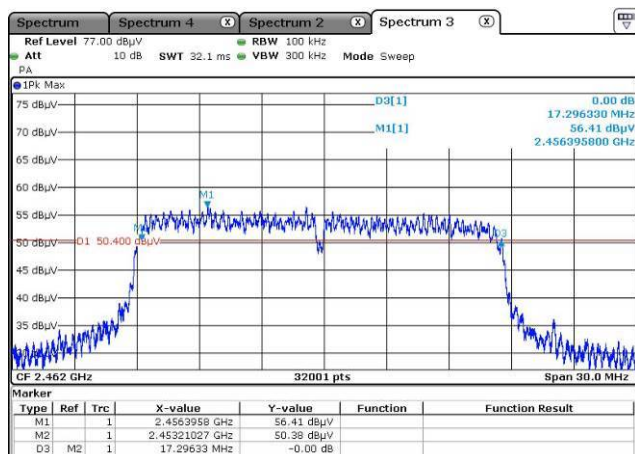
Graphical representation of 6dB Bandwidth (802.11n-20MHz)



Low channel



Mid channel



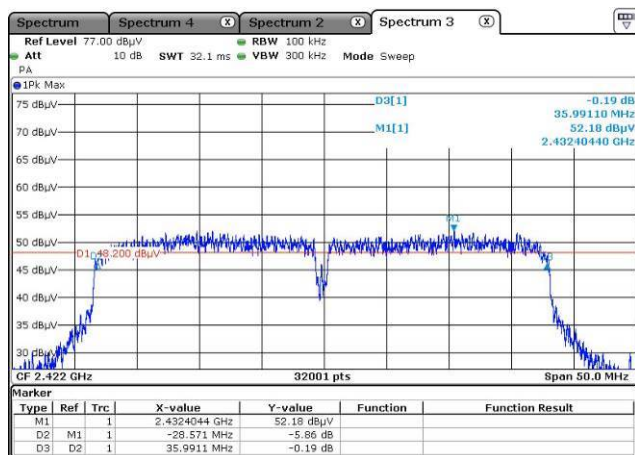
High channel

Frequency band investigated: 2400MHz to 2483.5MHz

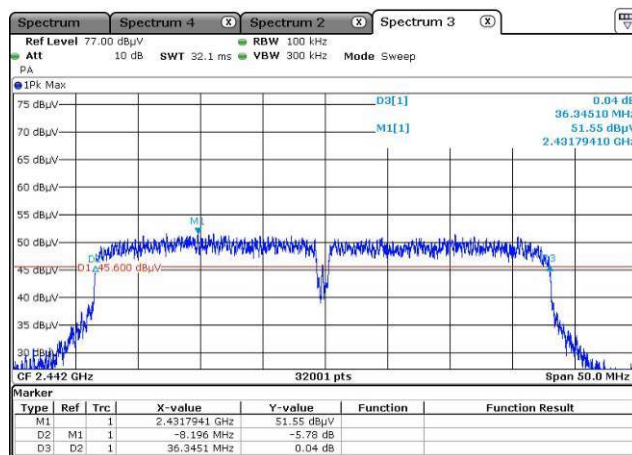
RBW : 100kHz

Measurement detector : Peak / Max hold

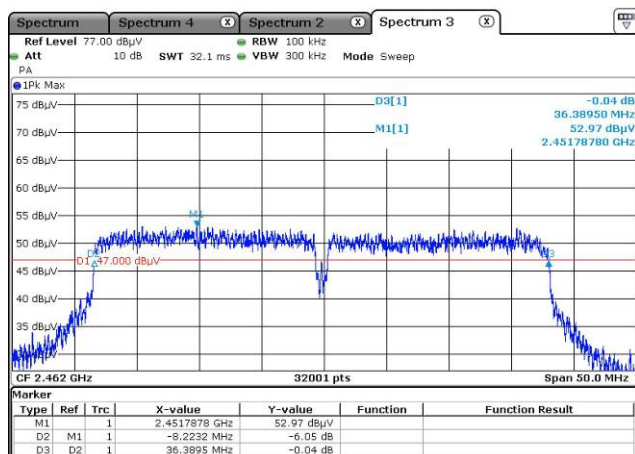
Graphical representation of 6dB Bandwidth (802.11n-40MHz)



Low channel



Mid channel



High channel

Frequency band investigated: 2400MHz to 2483.5MHz

RBW : 100kHz

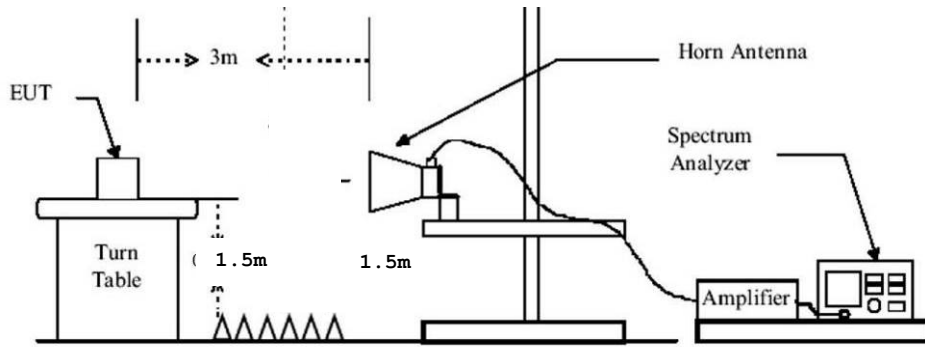
Measurement detector : Peak / Max hold

11. Maximum Peak Output power

TEST: Maximum Peak conducted output power			Verdict
Method: A radiated measurement is performed. A MaxHold Peak detector is used. The RBW and VBW are greater than the DTS bandwidth. 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	23°C ± 2	
Relative Humidity	25 to 70 %	42% ± 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: November 11th, 2019. Tested by L. CHAPUS Power supply voltage: 3.3V (Module) from PC			

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

Test Setup for radiated emission



Test setup for 1-25GHz

Tabulated Results for Maximum peak output power (Radiated measurement)				
FREQ	Field Strength 3m	Calculated EIRP	Limit	Result
(MHz)	(dBμV/m)	(dBm)	(dBm)	
802.11b (1Mbps)				
2412.0	101.4	6.2	36.0	Pass
2437.0	102.0	6.8	36.0	Pass
2462.0	102.1	6.9	36.0	Pass
802.11b (11Mbps)				
2412.0	101.6	6.4	36.0	Pass
2437.0	101.1	5.9	36.0	Pass
2462.0	102.1	6.9	36.0	Pass
802.11g (6Mbps)				
2412.0	107.3	12.1	36.0	Pass
2437.0	108.0	12.8	36.0	Pass
2462.0	107.7	12.5	36.0	
802.11g (54Mbps)				
2412.0	105.1	9.9	36.0	Pass
2437.0	106.0	10.8	36.0	Pass
2462.0	105.2	10.0	36.0	Pass
802.11n-20MHz (MCS0)				
2412.0	107.0	11.8	36.0	Pass
2437.0	108.1	12.9	36.0	Pass
2462.0	107.8	12.6	36.0	Pass
802.11n-20MHz (MCS7)				
2412.0	104.8	9.6	36.0	Pass
2437.0	105.8	10.6	36.0	Pass
2462.0	105.0	9.8	36.0	Pass
802.11n-40MHz (MCS0)				
2422.0	107.0	11.8	36.0	Pass
2442.0	108.0	12.8	36.0	Pass
2462.0	107.9	12.7	36.0	Pass
802.11n-40MHz (MCS7)				
2422.0	104.4	9.2	36.0	Pass
2442.0	105.2	10.0	36.0	Pass
2462.0	104.9	9.7	36.0	Pass
Measurement distance:		3m		
Limit:		FCC Part 15.247 / RSS-247		
RESULT:		PASS		
Note:		(1): EIRP is calculated using the following equation: $EIRP = E + 20 \log(D) - 104.8 - GR$ 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)		

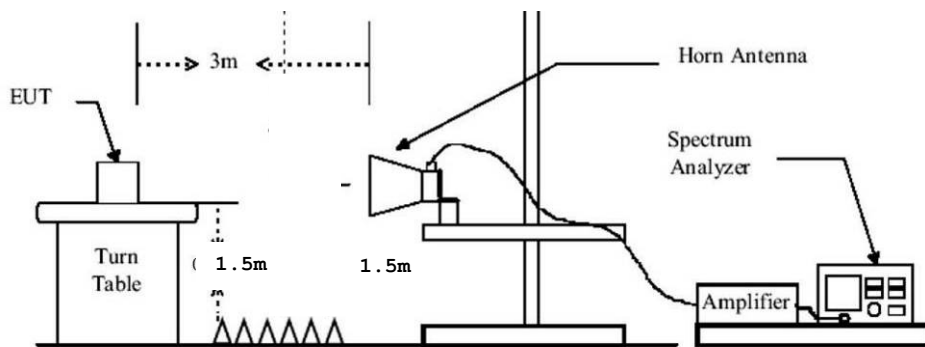
Tabulated Results for Maximum peak output power (Conducted)			
FREQ (MHz)	Conducted power (dBm)	Limit (dBm)	Result
802.11b (1Mbps)			
2412.0	5.7	30.0	Pass
2437.0	6.3	30.0	Pass
2462.0	6.4	30.0	Pass
802.11b (11Mbps)			
2412.0	5.9	30.0	Pass
2437.0	5.4	30.0	Pass
2462.0	6.4	30.0	Pass
802.11g (6Mbps)			
2412.0	11.6	30.0	Pass
2437.0	12.3	30.0	Pass
2462.0	12.0	30.0	Pass
802.11g (54Mbps)			
2412.0	9.4	30.0	Pass
2437.0	10.3	30.0	Pass
2462.0	9.5	30.0	Pass
802.11n-20MHz (MCS0)			
2412.0	11.3	30.0	Pass
2437.0	12.4	30.0	Pass
2462.0	12.1	30.0	Pass
802.11n-20MHz (MCS7)			
2412.0	9.1	30.0	Pass
2437.0	10.1	30.0	Pass
2462.0	9.3	30.0	Pass
802.11n-40MHz (MCS0)			
2422.0	11.3	30.0	Pass
2442.0	12.3	30.0	Pass
2462.0	12.2	30.0	Pass
802.11n-40MHz (MCS7)			
2422.0	8.7	30.0	Pass
2442.0	9.5	30.0	Pass
2462.0	9.2	30.0	Pass
Limit:		FCC Part 15.247 / IC RSS-247	
RESULT:		PASS	
Note:		(1): Maximum conducted average 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 (0.5dBi, as declared by the manufacturer)	

12. Maximum Power Spectral Density Level in the fundamental emission

TEST: Maximum Peak Power Spectral Density			Verdict
Method: 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	23°C ± 2	
Relative Humidity	25 to 70 %	42% ± 5	
Limits – FCC Part 15.247 (e) / RSS-247 §5.2 (b)			
Frequency (MHz)	Level (Detector)	Limit	
Low channel 2412 or 2422	8 dBm/3kHz (Pk)	Pass	
Mid channel 2437 or 2442	8 dBm/3kHz (Pk)	Pass	
High channel 2462	8 dBm/3kHz (Pk)	Pass	
Supplementary information: Test location: SMEE Test date: November 11th, 2019. Tested by L. CHAPUS Power supply voltage: 3.3V (Module) from PC			

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

Test Setup for radiated emission



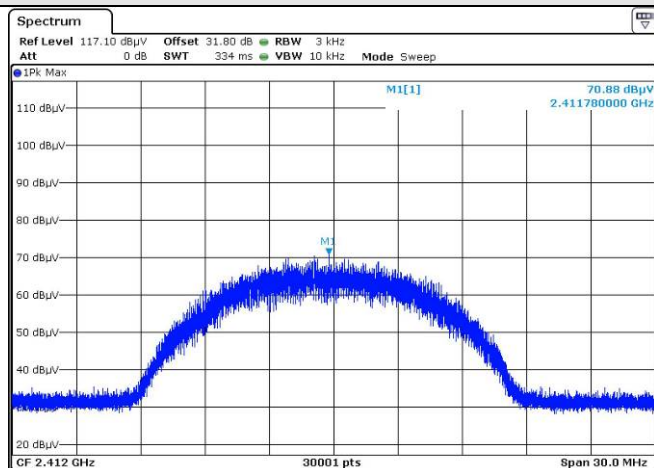
Test setup for 1-25GHz

Tabulated Results for Maximum Spectral Density (Radiated measurement)

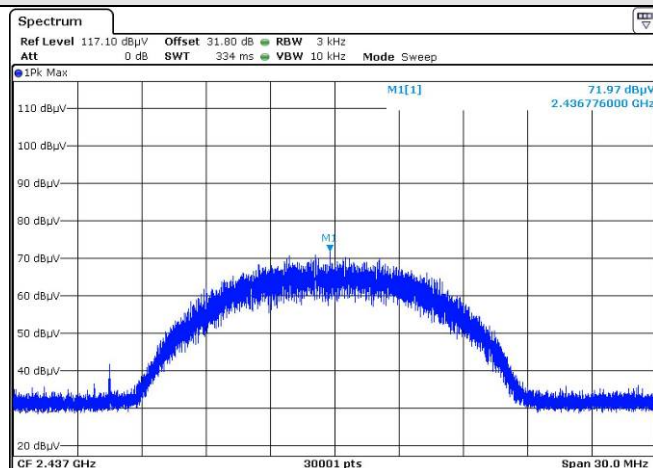
FREQ	Field Strength 3m	Calculated Radiated PSD (EIRP)	Limit	Result
(MHz)	(dBμV/m)	(dBm)	(dBm)	
802.11b (11Mbps)				
2412.0	70.9	-24.3	-	-
2437.0	72.0	-23.2	-	-
2462.0	70.2	-25.0	-	-
802.11g (6Mbps)				
2412.0	69.4	-25.8	-	-
2437.0	69.9	-25.3	-	-
2462.0	70.4	-24.8	-	-
802.11n-20MHz (MCS0)				
2412.0	70.0	-25.2	-	-
2437.0	70.1	-25.1	-	-
2462.0	70.8	-24.4	-	-
802.11n-40MHz (MCS0)				
2422.0	67.9	-27.3	-	-
2442.0	67.6	-27.6	-	-
2462.0	68.5	-26.7	-	-
RBW:		3kHz		
Measurement distance:		3m		
Limit:		FCC Part 15.247 / RSS-247		
Final measurement detector:		Peak		
Note:		(1): EIRP/PSD is calculated using the following equation: EIRP = E + 20xlog (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) (2): Method used is PKPSD		

Tabulated Results for Maximum Conducted Power Spectral Density			
Frequency (MHz)	PSD (dBm/3kHz)	Limit	Result
802.11b (11Mbps)			
2412	-24.8	8dBm/3kHz	Pass
2437	-23.7	8dBm/3kHz	Pass
2462	-25.5	8dBm/3kHz	Pass
802.11g (6Mbps)			
2412	-26.3	8dBm/3kHz	Pass
2437	-25.8	8dBm/3kHz	Pass
2462	-25.3	8dBm/3kHz	Pass
802.11n-20MHz (7Mbps)			
2412	-25.7	8dBm/3kHz	Pass
2437	-25.6	8dBm/3kHz	Pass
2462	-24.9	8dBm/3kHz	Pass
802.11n-40MHz (MCS0)			
2422.0	-27.8	8dBm/3kHz	Pass
2442.0	-28.1	8dBm/3kHz	Pass
2462.0	-27.2	8dBm/3kHz	Pass
RBW:	3kHz		
Limit:	FCC Part 15.247 / RSS-247		
Final measurement detector:	RMS		
RESULT:	PASS		
Note:	(1): Maximum conducted power spectral density is calculated as follow: $P_{SD} = EIRP - G$ Where P_{SD} = Conducted power spectral density EIRP = Equivalent Isotropic Radiated Power in dBm G = Antenna gain in dBi (0.5dBi, as declared by the manufacturer)		

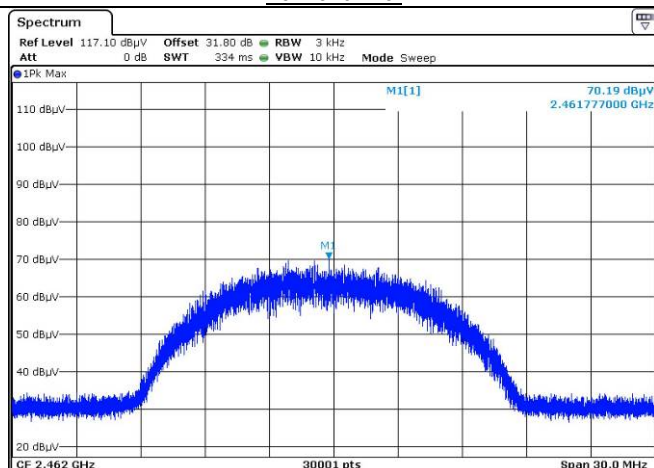
Graphical representation for Maximum Power Spectral Density (802.11b)



Low channel



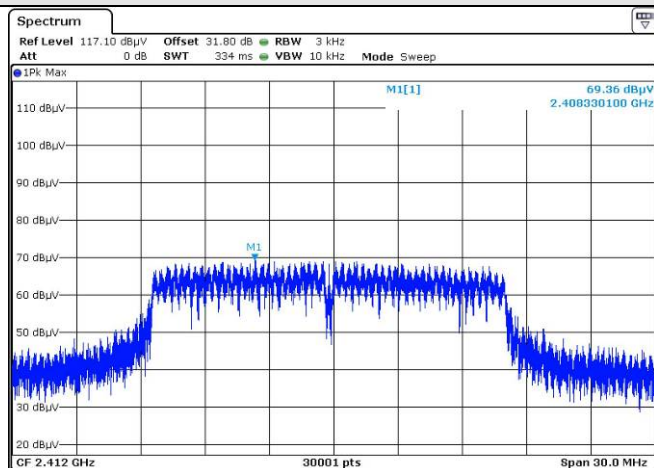
Mid channel



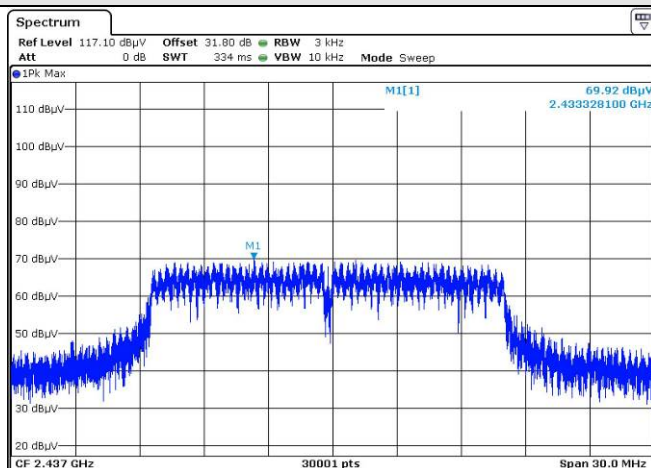
High channel

RBW:	3kHz
Limit:	FCC Part 15.247 / RSS-247
RESULT:	PASS

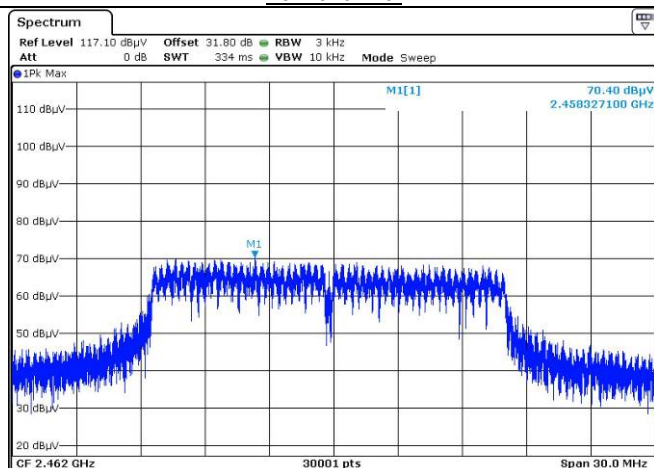
Graphical representation for Maximum Power Spectral Density (802.11g)



Low channel



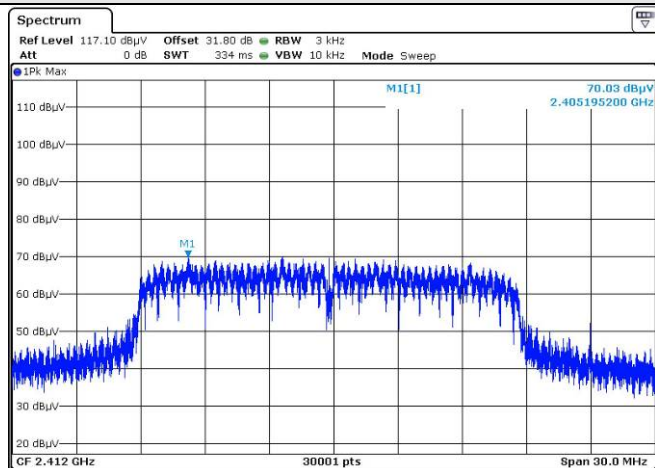
Mid channel



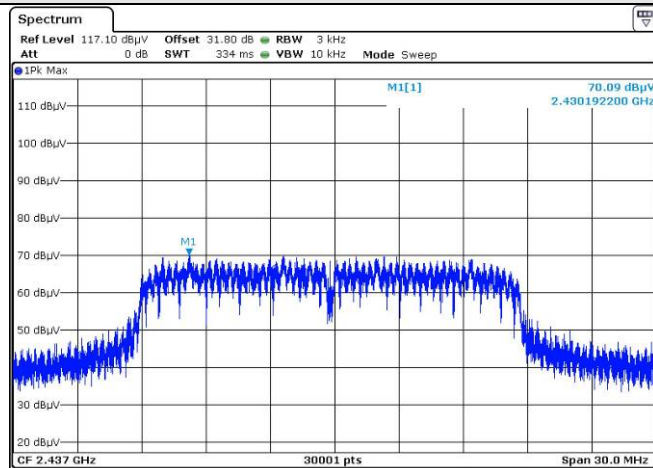
High channel

RBW:	3kHz
Limit:	FCC Part 15.247 / RSS-247
RESULT:	PASS

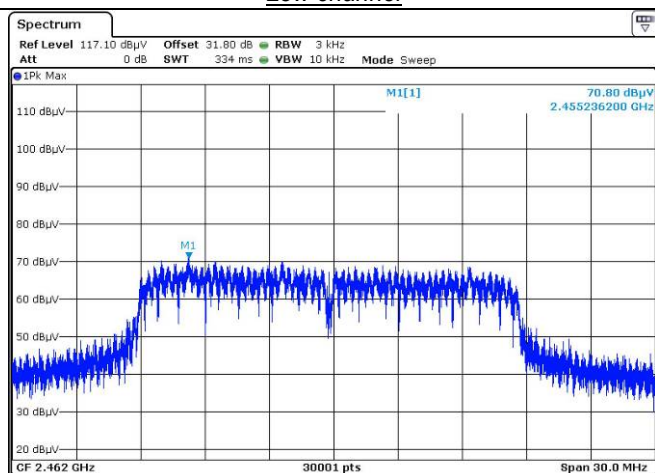
Graphical representation for Maximum Power Spectral Density (802.11n-20MHz)



Low channel



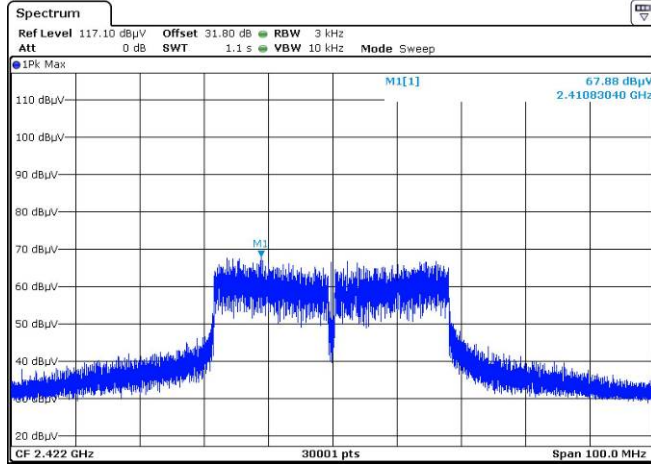
Mid channel



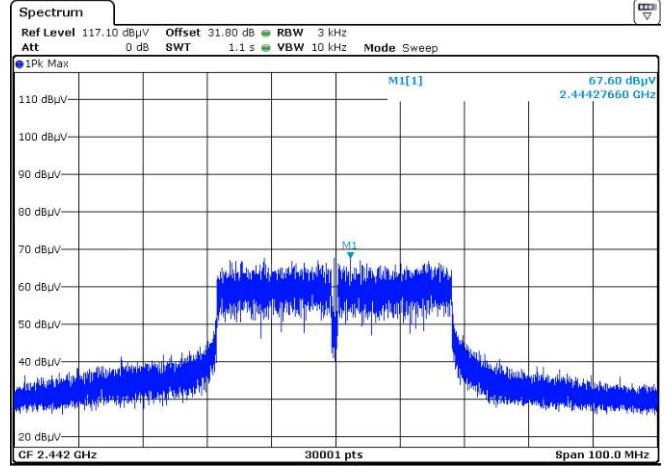
High channel

RBW:	3kHz
Limit:	FCC Part 15.247 / RSS-247
RESULT:	PASS

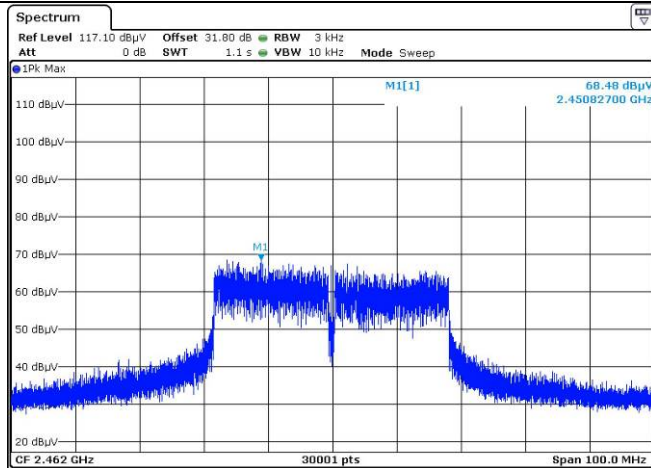
Graphical representation for Maximum Power Spectral Density (802.11n-40MHz)



Low channel



Mid channel



High channel

RBW:	3kHz
Limit:	FCC Part 15.247 / RSS-247
RESULT:	PASS

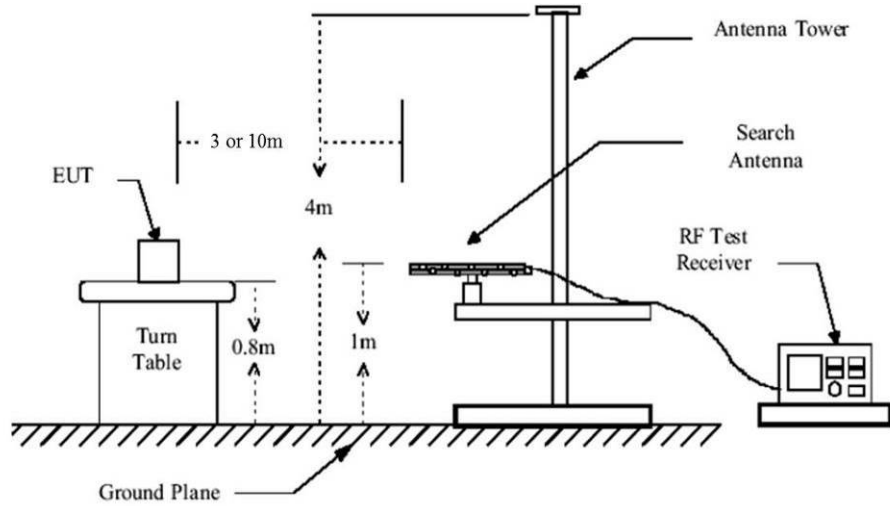
13. Unwanted emissions in Non-Restricted Frequency bands

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	23°C ± 2	
Relative Humidity	25 to 70 %	42% ± 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: November 12th, 2019. Tested by L. CHAPUS Power supply voltage: 3.3V (Module) from PC			

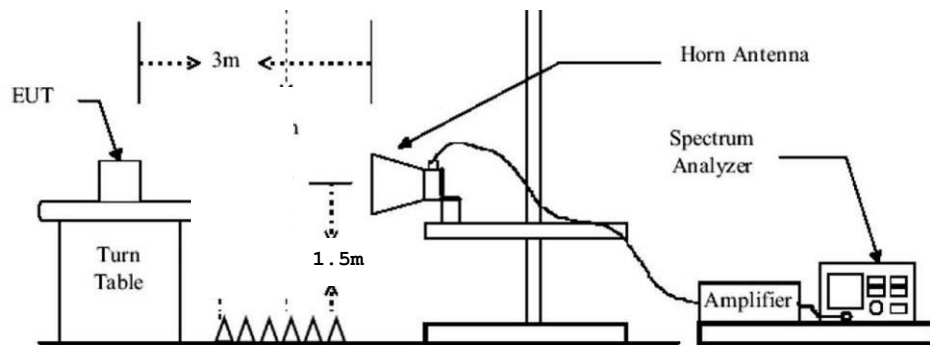
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	EMCO	3146	ANT-191-019	2019/6	2021/6
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2019/6	2021/6
BiConiLog antenna	EMCO	3142B	ANT-101-010	2019/8	2021/8
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2018/10	2021/10
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2017/12	2022/12
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2019/8	2021/8
RF cable	Div	OATS/25m	CAB-101-017	2019/4	2020/4
RF cable	Pasternack RF	PE302-120	CAB-131-024	2019/4	2020/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2019/4	2020/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2019/4	2020/4

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2019/4	2020/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2019/4	2020/4
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-034	2019/4	2020/4
Pre-amplifier	Pasternack RF	PE1524	PRE-101-002	2019/6	2020/6
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2017/12	2019/12
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
OATS	Div	10m	SIT-101-001	2017/7	2020/7
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-
Measuring Rec	Rohde&Schwarz	ESRP	REC-151-002	2019/9	2021/9
EMC Software	NEXIO	BAT EMC V3.9	SOF-101-001	-	-

Test Setup for radiated emission



Test setup for 30-1000MHz

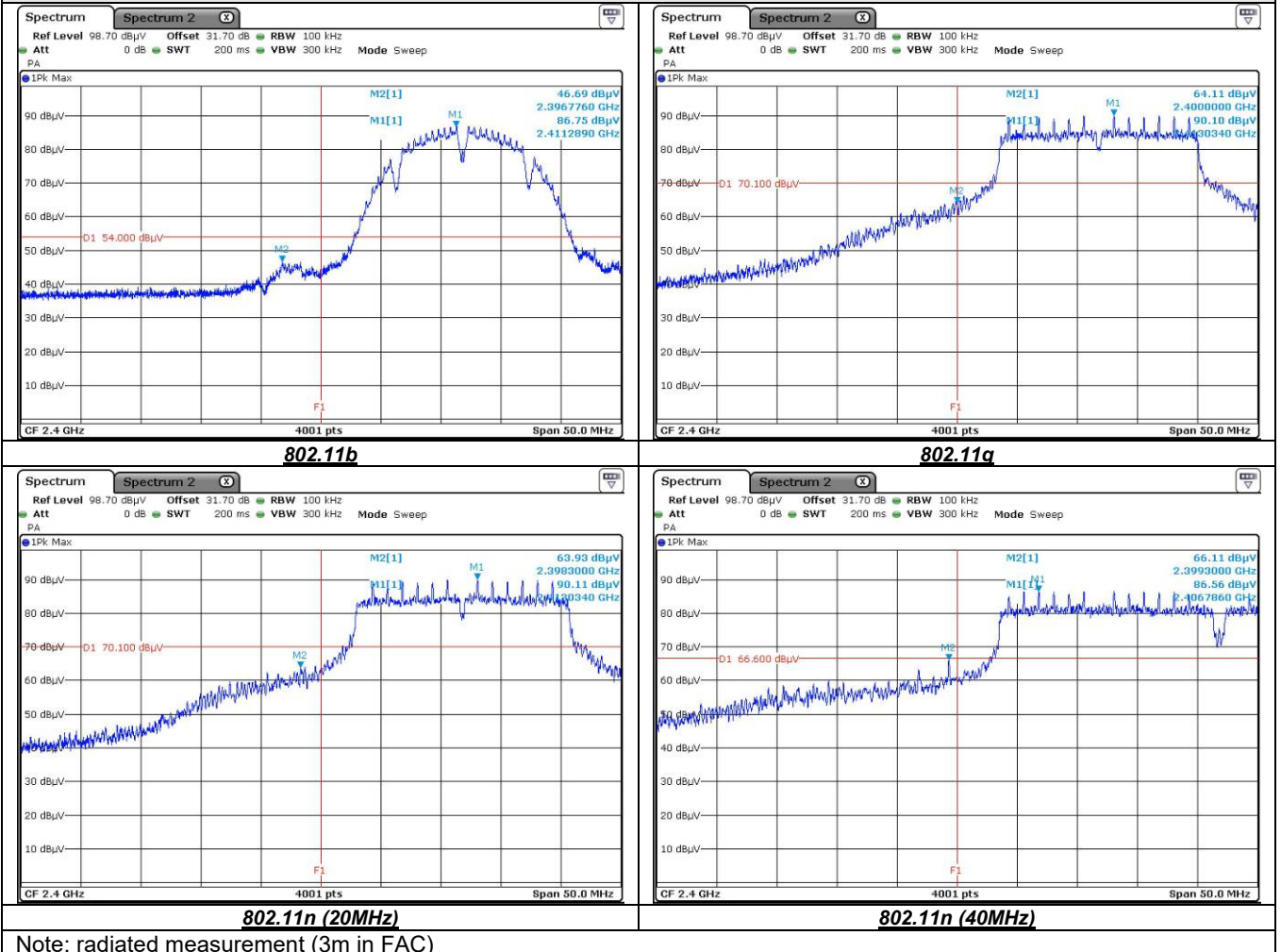


Test setup for 1-25GHz

Tabulated Results for Peak Output Power Reference level	
802.11b	
FREQ	Field Strength 3m
(MHz)	(dBμV/m)
2412.0	86.8
2432.0	87.2
2462.0	87.2
802.11g	
FREQ	Field Strength 3m
(MHz)	(dBμV/m)
2412.0	90.1
2432.0	91.0
2462.0	90.6
802.11n-20MHz	
FREQ	Field Strength 3m
(MHz)	(dBμV/m)
2412.0	90.1
2432.0	91.1
2462.0	90.6
802.11n-40MHz	
FREQ	Field Strength 3m
(MHz)	(dBμV/m)
2422.0	86.6
2442.0	87.5
2462.0	87.5
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 Peak limit 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)
802.11b				
2396.776	46.7	66.8	-20.1	Pass
802.11g				
2400.000	64.1	70.1	-6.0	Pass
802.11n-20MHz				
2398.300	63.9	70.1	-6.2	Pass
802.11n-40MHz				
2399.300	66.1	66.6	-0.5	Pass
RBW:		100kHz		
Measurement distance:		3m		
Limit:		15.247 / RSS-247		
Final measurement detector:		Peak		
RESULT:		PASS		
Note:		(1): All frequencies not specified have margin < -10dB or are below general limits. (See curves in §14) (2): Worst case between charge mode and normal used mode (3): 3-axis measurement performed for device under test.		

Graphical representation of Band-edge compliance (LOW)



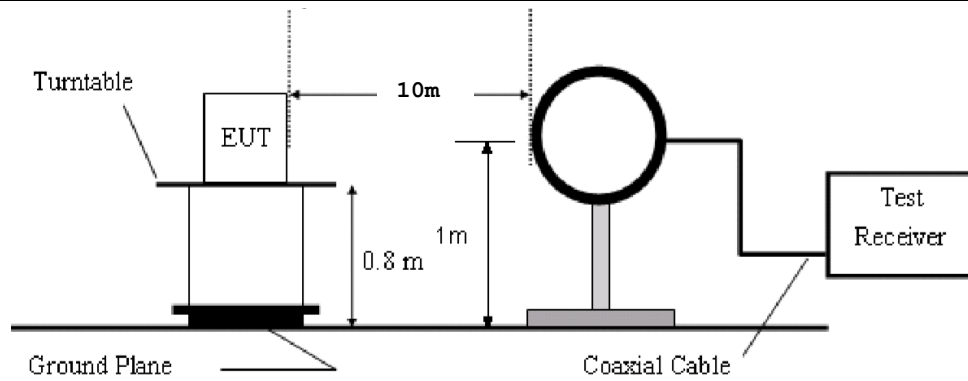
Note: radiated measurement (3m in FAC)

14. Unwanted emissions in Restricted Frequency bands

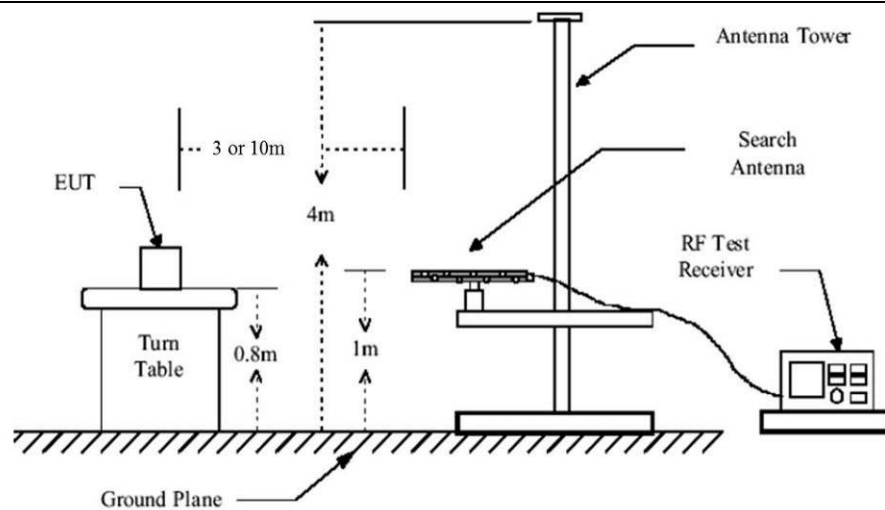
TEST: Unwanted emissions into Restricted Frequency Bands		Verdict
Method: Measurements were performed on a 3-meter Open Area Test Site (OATS) for frequency below 1GHz. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. 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	23°C ± 2
Relative Humidity	25 to 70 %	42% ± 5
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point
	9kHz – 30MHz	10 m measurement distance
	30MHz – 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: November 13th, 2019. Tested by L. CHAPUS Power supply voltage: 3.3V (Module) from PC		

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

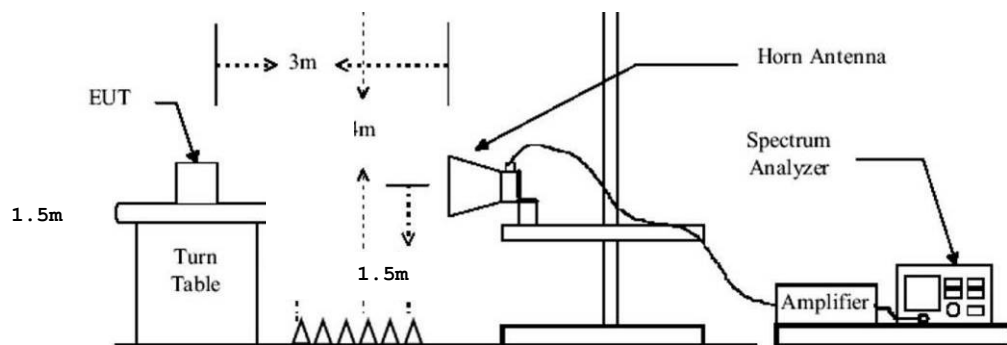
Test Setup for radiated emission



Test setup for 9k-30MHz



Test setup for 30-1000MHz



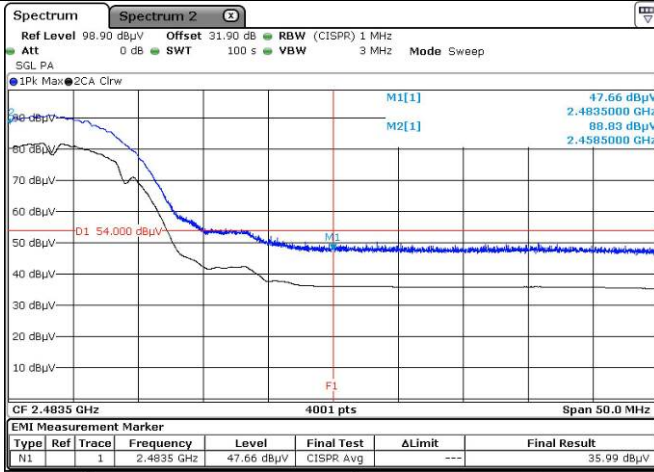
Test setup for 1-25GHz

Tabulated Results for Unwanted emissions (9kHz-30MHz)						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	(QP) dBμV/m	(QP) dBμV/m	dB	Degree	Degree	dB
Levels are at least 10dB below limits						
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results.						
Frequency band investigated:		9kHz-30MHz				
RBW:		200Hz (9kHz-150kHz)				
		9kHz (150kHz-30MHz)				
Measurement distance:		10m				
Limit:		FCC Part 15.205 - 15.209 / RSS-GEN				
Final measurement detector:		Peak / Quasi-Peak / Average				
Note:		CF: Correction factor = Antenna factor + Cable loss 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
Levels are at least 10dB below limits										
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results.										
Frequency band investigated:		30MHz-1GHz								
RBW:		120kHz								
Measurement distance:		3m								
Limit:		FCC Part 15.205 - 15.209 / RSS-GEN								
Final measurement detector:		Quasi-Peak								
RESULT:		PASS								
Note:										

Tabulated Results for Unwanted emissions (1GHz-25GHz)					
FREQ (MHz)	Field Strength 3m (dBμV/m)	Detector	Limit (dBμV/m)	Margin (dBμV/m)	Result
802.11b					
2483.5	47.7	Pk	74	-26.3	Pass
2483.5	36.0	Avg	54	-18.0	Pass
4823.5	62.4	Pk	74	-21.6	Pass
4823.5	53.3	Avg	54	-0.7	Pass
4873.5	62.9	Pk	74	-11.1	Pass
4873.5	53.4	Avg	54	-0.6	Pass
4923.5	62.8	Pk	74	-11.2	Pass
4923.5	53.3	Avg	54	-0.7	Pass
802.11g					
2483.5	63.6	Pk	74	-10.4	Pass
2483.5	45.0	Avg	54	-9.0	Pass
4823.5	63.5	Pk	74	-10.5	Pass
4823.5	48.2	Avg	54	-5.8	Pass
4873.5	63.6	Pk	74	-10.4	Pass
4873.5	48.3	Avg	54	-5.7	Pass
4923.5	62.8	Pk	74	-11.2	Pass
4923.5	47.7	Avg	54	-6.3	Pass
802.11n-20MHz					
2483.5	66.8	Pk	74	-7.2	Pass
2483.5	46.2	Avg	54	-7.8	Pass
4823.5	62.4	Pk	74	-11.6	Pass
4823.5	48.1	Avg	54	-5.9	Pass
4873.5	63.4	Pk	74	-10.6	Pass
4873.5	48.0	Avg	54	-6.0	Pass
4923.5	62.8	Pk	74	-11.2	Pass
4923.5	46.9	Avg	54	-7.1	Pass
802.11n-40MHz					
2483.5	73.4	Pk	74	-0.6	Pass
2483.5	50.5	Avg	54	-3.5	Pass
4844.0	60.9	Pk	74	-13.1	Pass
4844.0	47.0	Avg	54	-7.0	Pass
4884.0	61.1	Pk	74	-12.9	Pass
4884.0	47.5	Avg	54	-6.5	Pass
4924.0	60.2	Pk	74	-13.8	Pass
4924.0	46.9	Avg	54	-7.1	Pass
RBW:		1MHz			
Measurement distance:		3m			
Limit:		FCC Part 15.205, 15.209, 15.247 / RSS-Gen, RSS-247			
Final measurement detector:		Peak / CISPR Average			
RESULT:		PASS			
Notes:		(1): All frequencies not specified have margin < -10dB (for peak and average detector)			

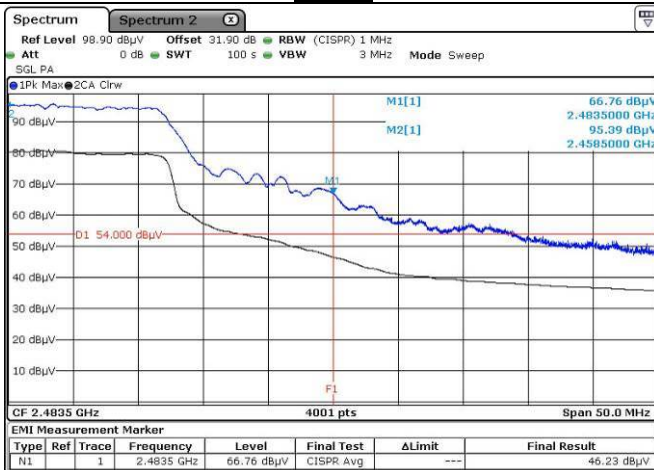
Graphical representation of Band-edge compliance (HIGH)



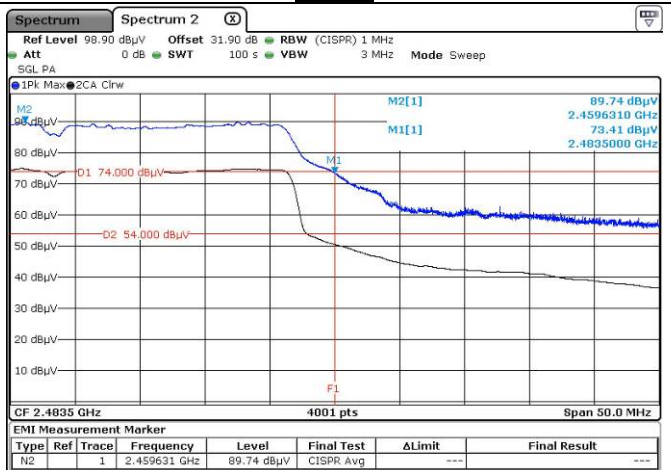
802.11b



802.11g



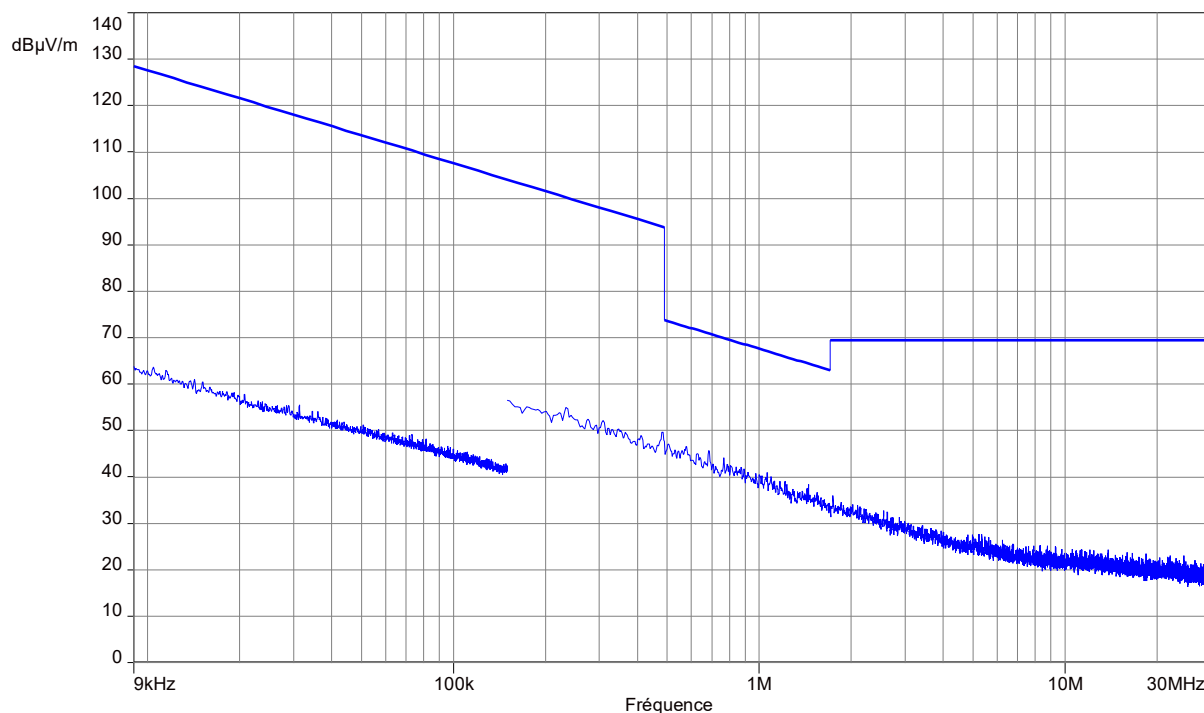
802.11n (20MHz)



802.11n (40MHz)

Note: Radiated measurement (FAC/3m)

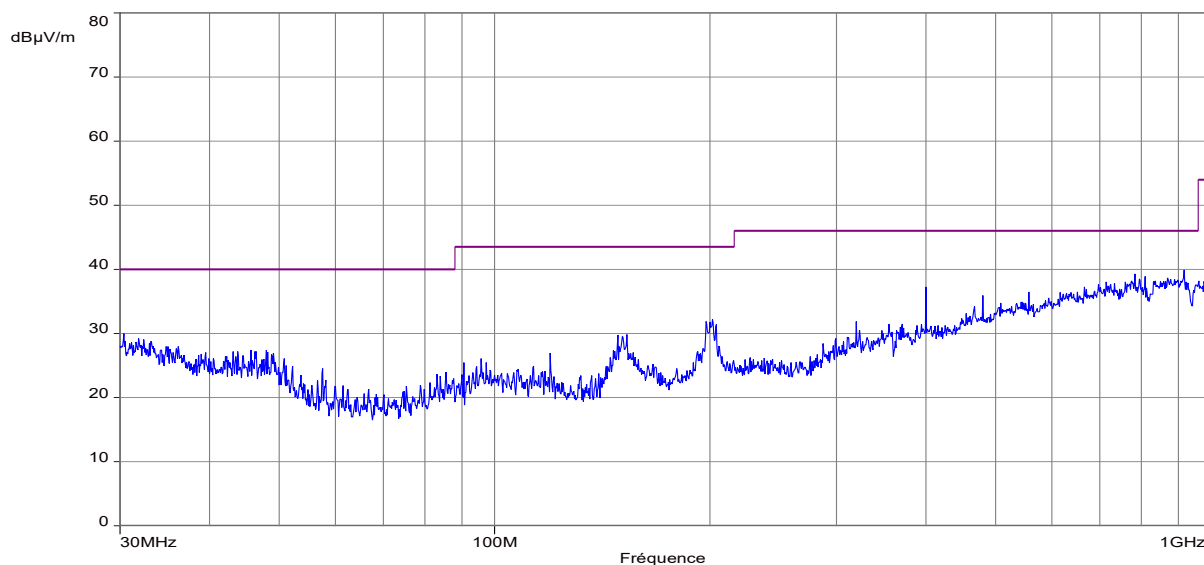
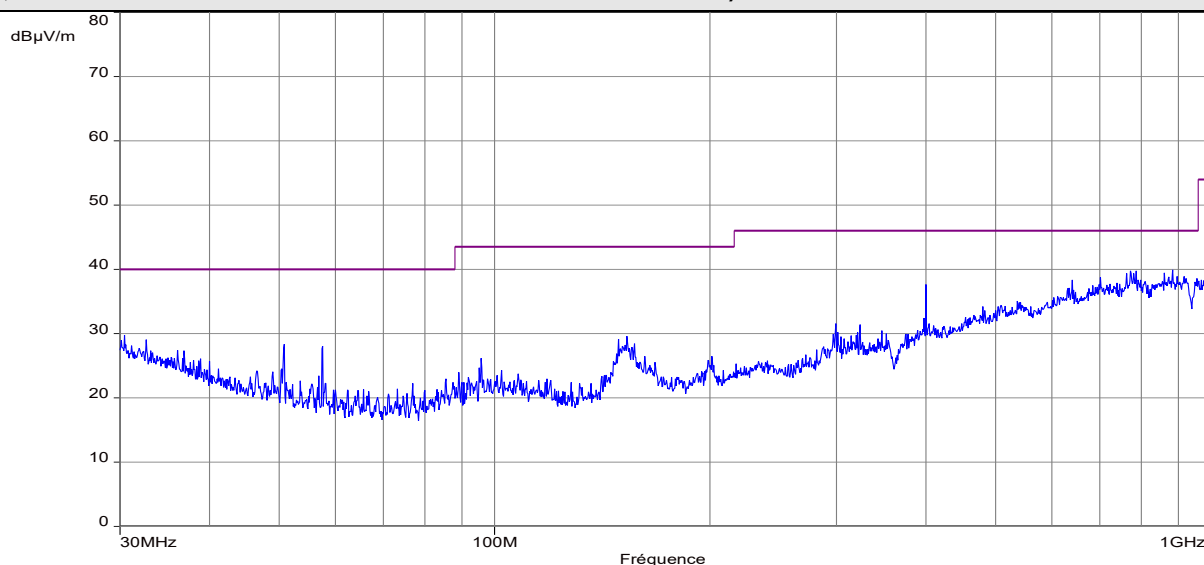
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 9kHz-30MHz / 3m / Parallel & Perpendicular antenna position / Transmit mode)



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

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

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

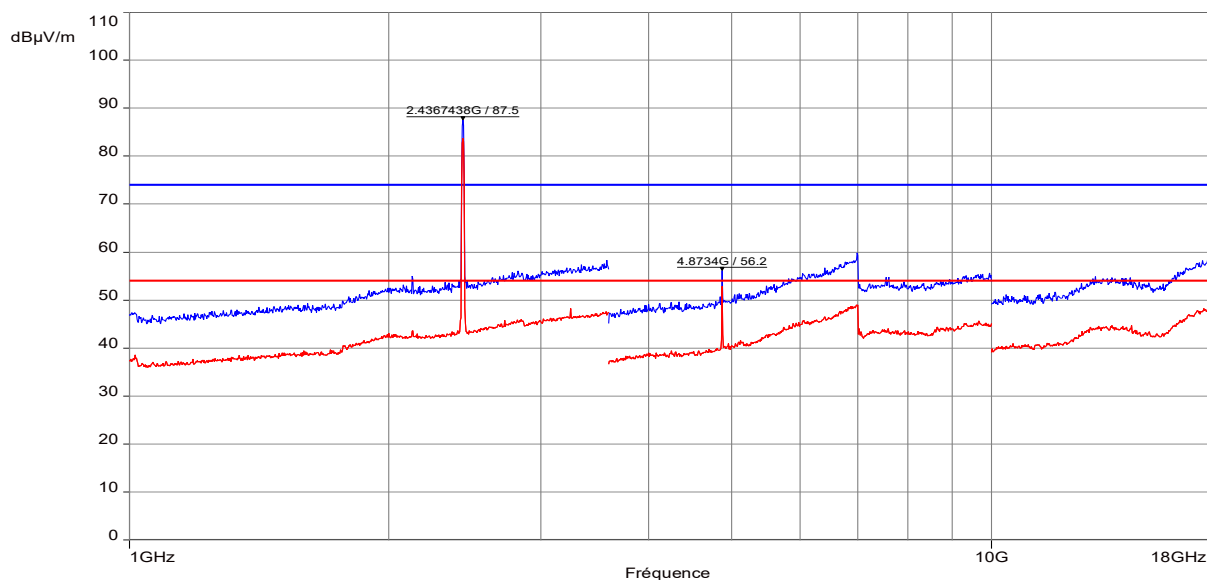
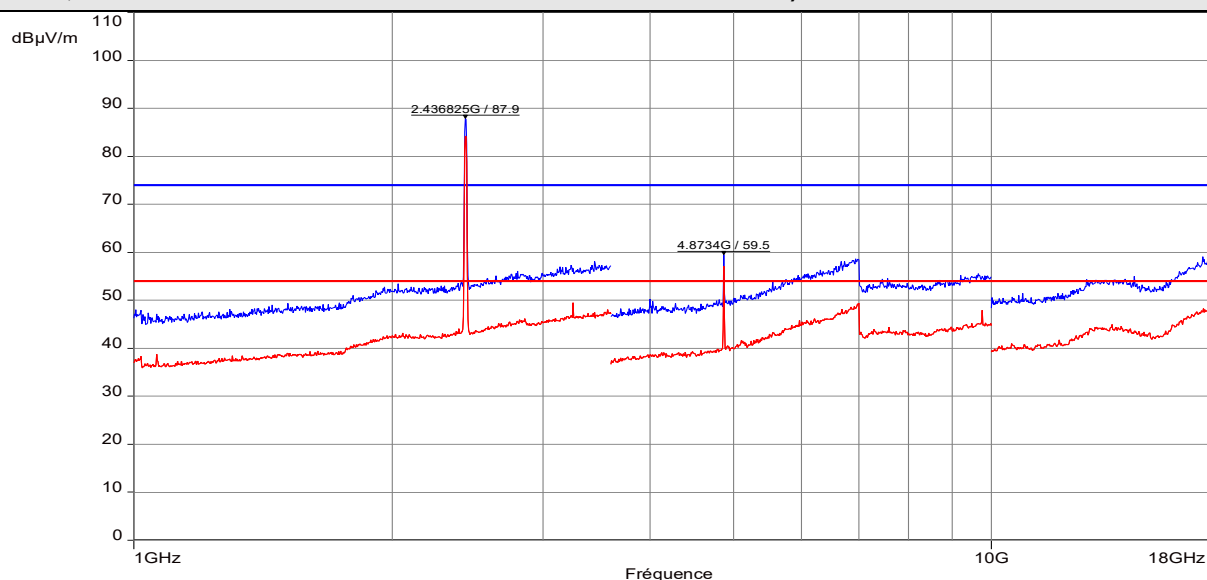


Note: Pre-scan graph only for identification purpose.

Same result for transmit mode on all channels

Frequency band investigated:		30MHz-1GHz			
Unit :		dBμV/m			
RBW :		100kHz			
Antenna polarization :		Horizontal & Vertical			
Measurement detector:		Peak			
PEAK LIST FROM PRE-SCAN					
Frequency (MHz)	Peak Level (dBμV/m)	Angle (°)	Limit (dBμV/m)	Polarization	Comments
None					

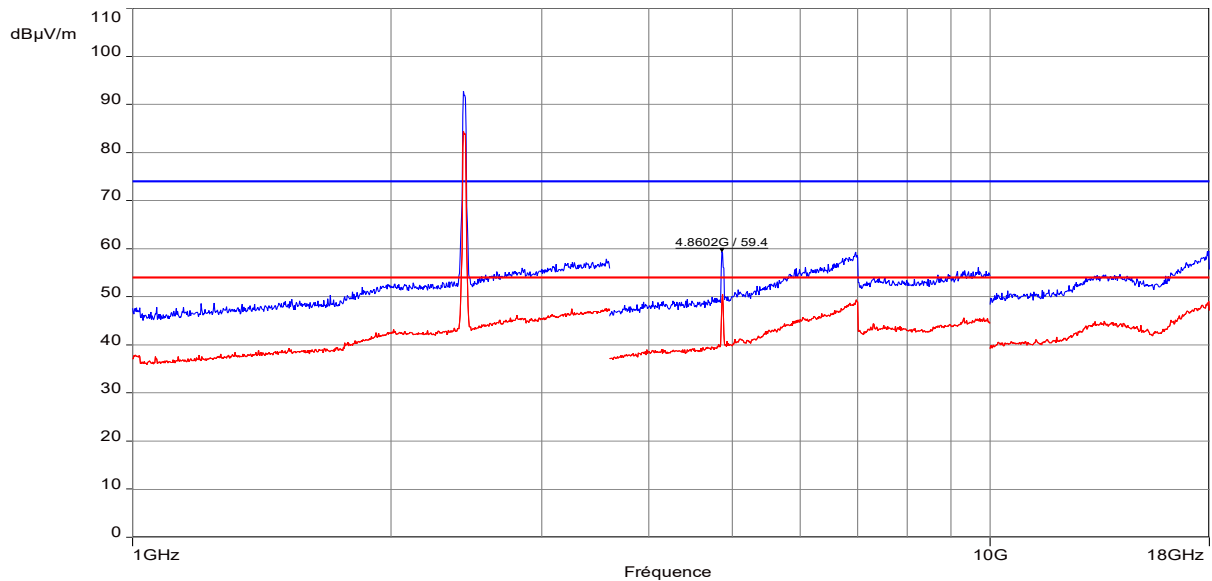
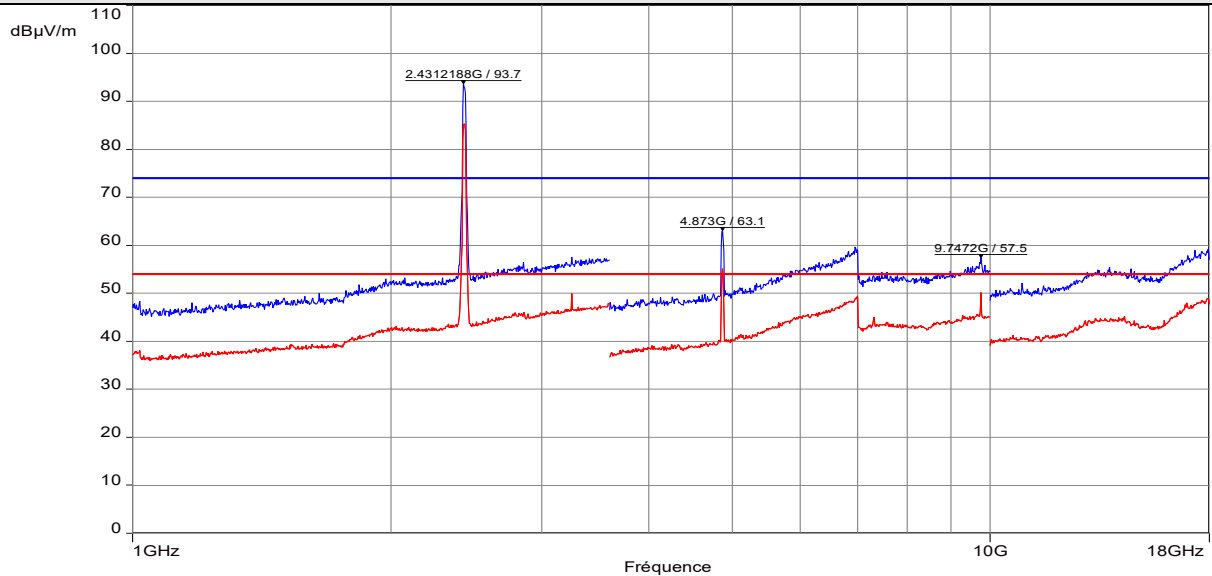
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical/ Transmit mode) – Mid channel 802.11b



Note: Pre-scan graph only for identification purpose. Worst case position shown.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Measurement detector:	Peak / Average

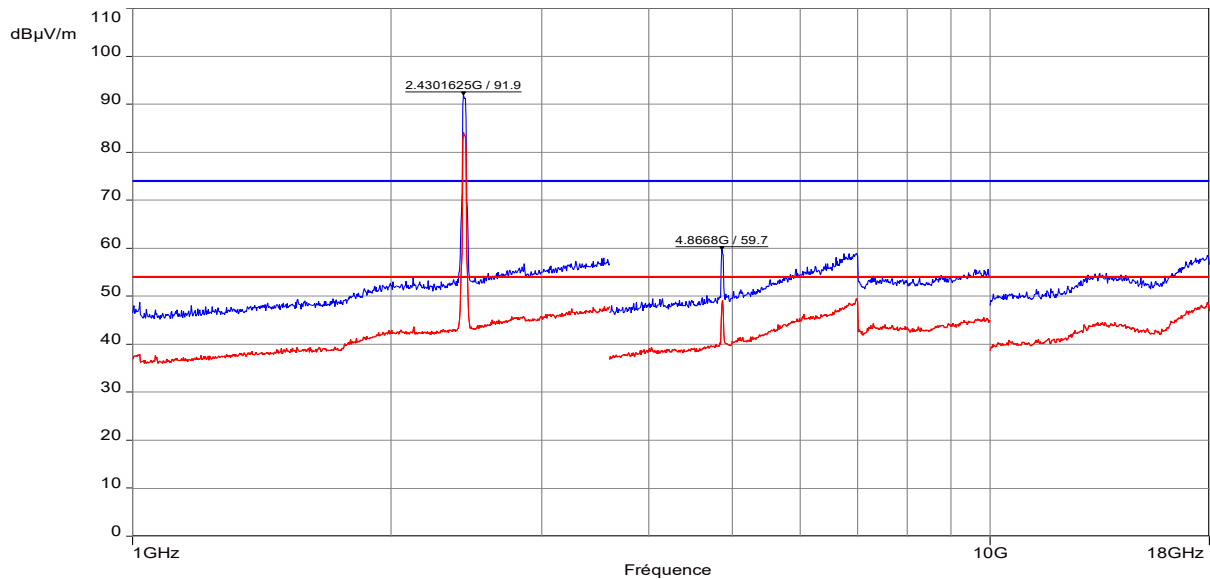
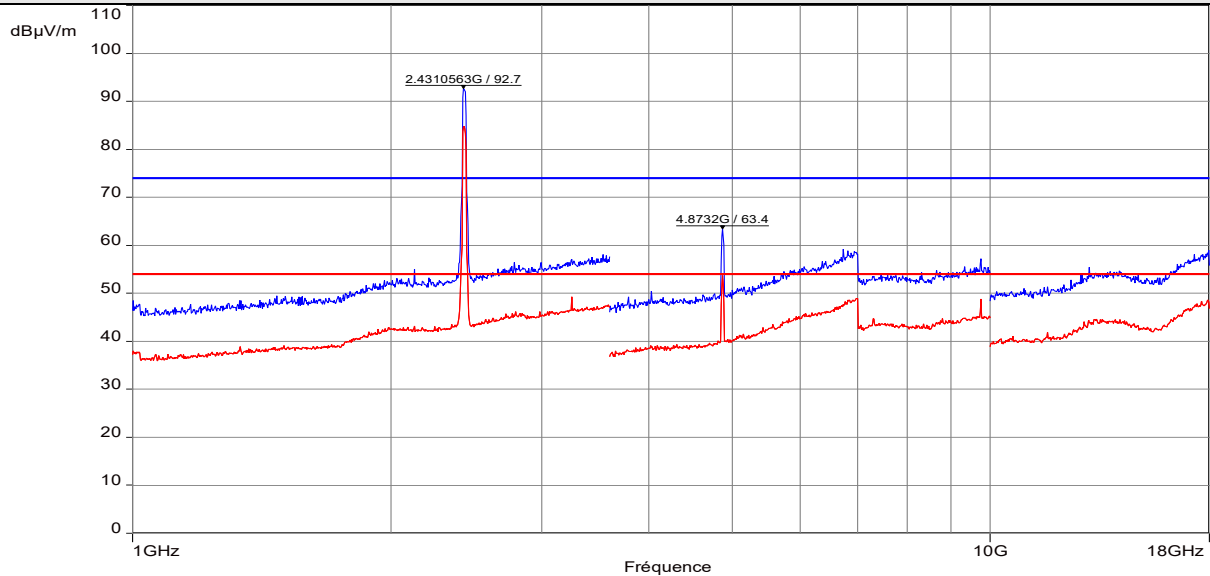
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical/ Transmit mode) – Mid channel 802.11g



Note: Pre-scan graph only for identification purpose. Worst case position shown.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Measurement detector:	Peak / Average

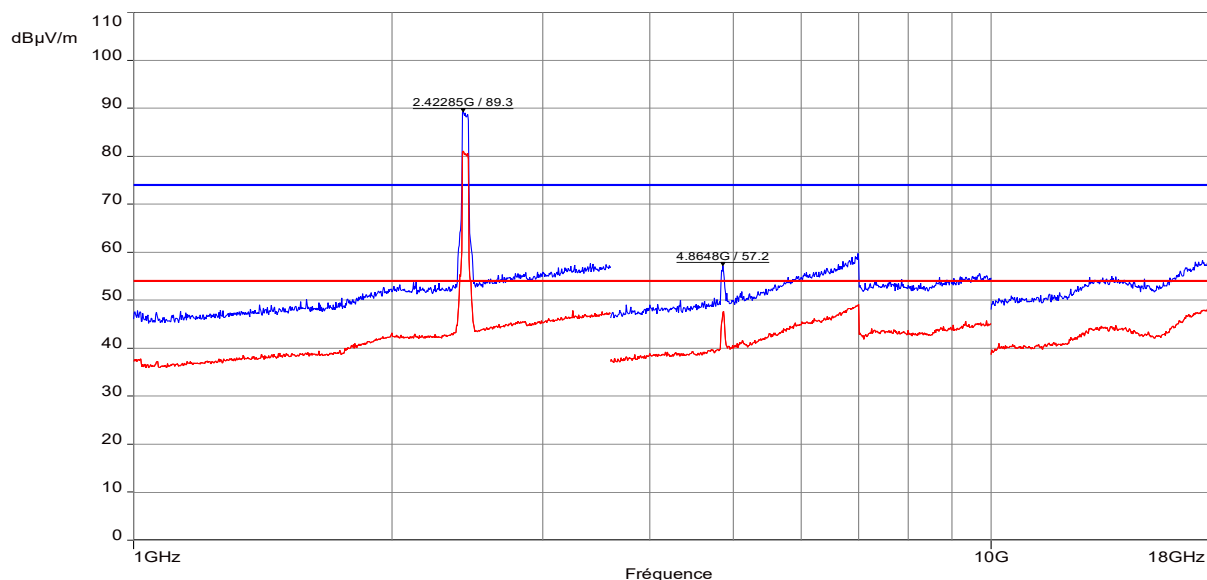
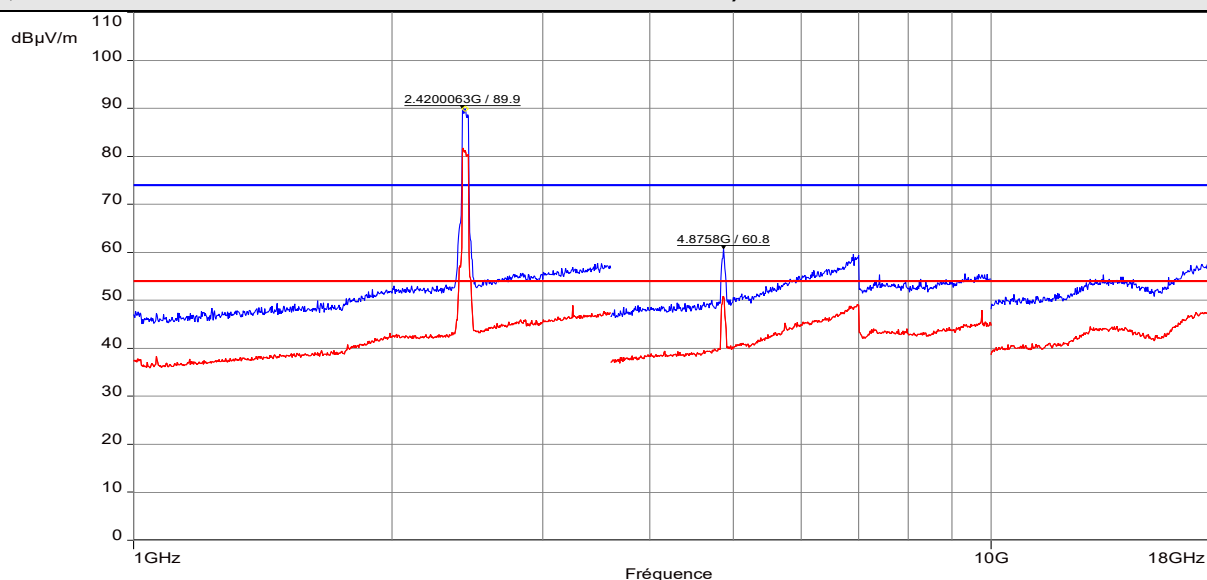
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical/ Transmit mode) – Mid channel 802.11n-20MHz



Note: Pre-scan graph only for identification purpose. Worst case position shown.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Measurement detector:	Peak / Average

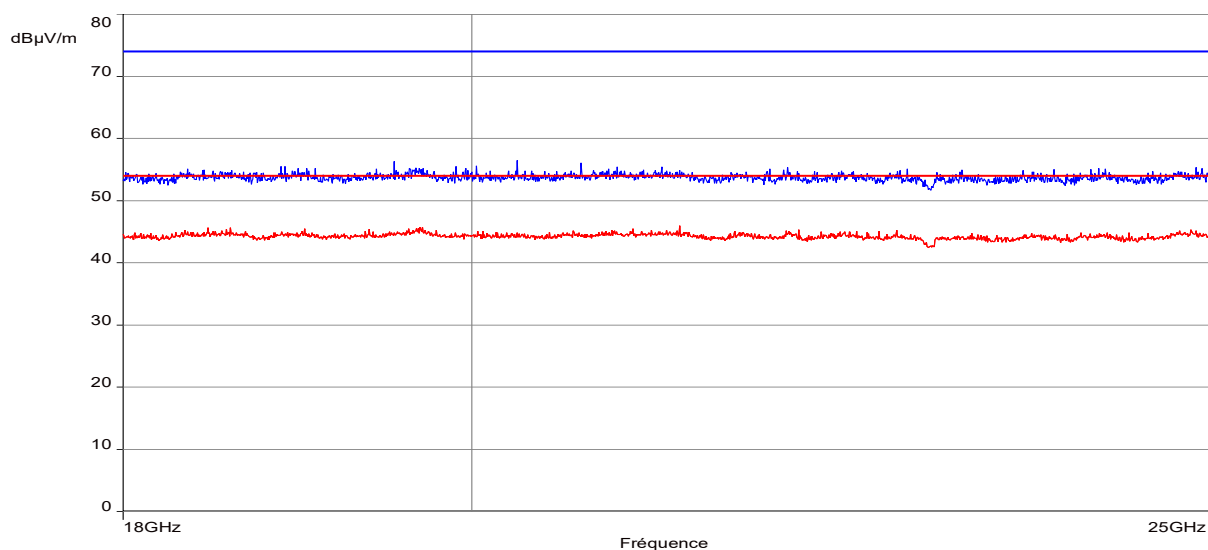
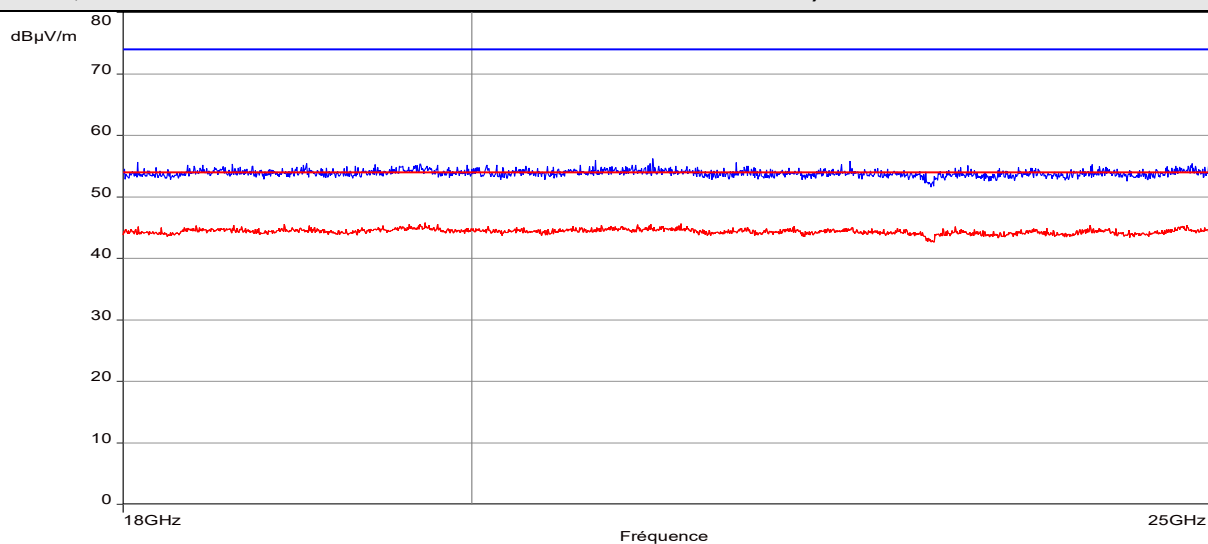
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical/ Transmit mode) – Mid channel 802.11n-40MHz



Note: Pre-scan graph only for identification purpose. Worst case position shown.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-18GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Measurement detector:	Peak / Average

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



Note: Pre-scan graph only for identification purpose. Pre-scan performed at 1m.
Same result for transmit mode on all channels.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-25GHz
Unit :	dBμV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Measurement detector:	Peak / Average

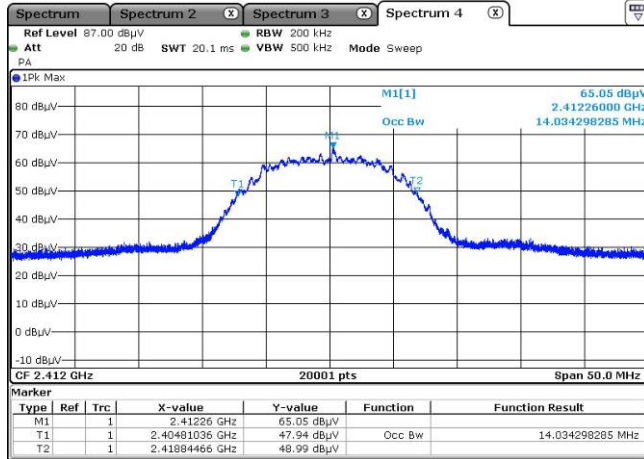
15. Occupied bandwidth (99%)

TEST: Occupied bandwidth (99%) / RSS-GEN			Verdict
Method: The setup is in an anechoic chamber. The spectrum analyzer is connected to the measuring antenna. A radiated measurement is performed. The RBW is set in the range of 1% to 5% of the occupied bandwidth, with VBW ≥ 3 x RBW. The SPAN is wide enough to capture all products of the modulation process. A 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	23°C ± 2	
Relative Humidity	25 to 70 %	42% ± 5	
Supplementary information: Test location: SMEE Test date: November 11 th , 2019. Tested by L. CHAPUS			

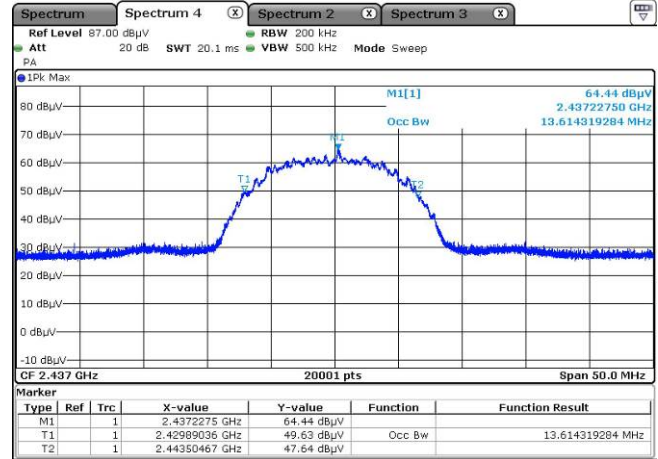
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2018/10	2021/10
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2019/4	2020/4
RF cable	Pasternack	PE302-120	CAB-131-024	2019/4	2020/4
Anechoic chamber	COMTEST	214263	CAG-141-001	-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

Tabulated Results for Occupied Bandwidth	
Frequency (MHz)	99% Occupied Bandwidth (MHz)
802.11b	
2412.0	14.034
2437.0	13.614
2462.0	14.049
802.11g	
2412.0	17.874
2437.0	17.322
2462.0	18.109
802.11n-20MHz	
2412.0	18.109
2437.0	17.719
2462.0	18.076
802.11n-40MHz	
2422.0	37.878
2442.0	38.203
2462.0	38.908

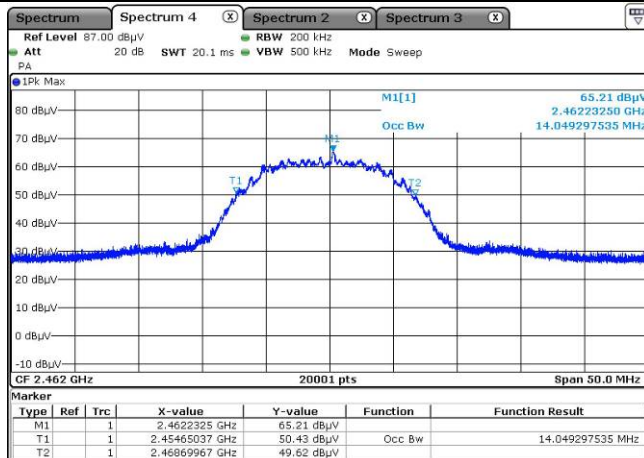
Graphical representation of Occupied Bandwidth (802.11b)



Low Channel



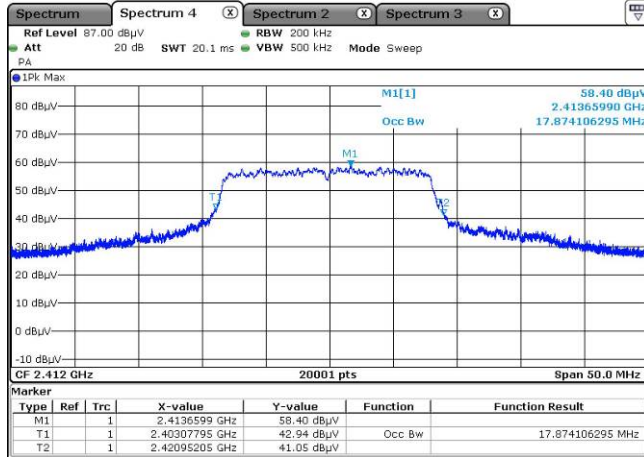
Mid Channel



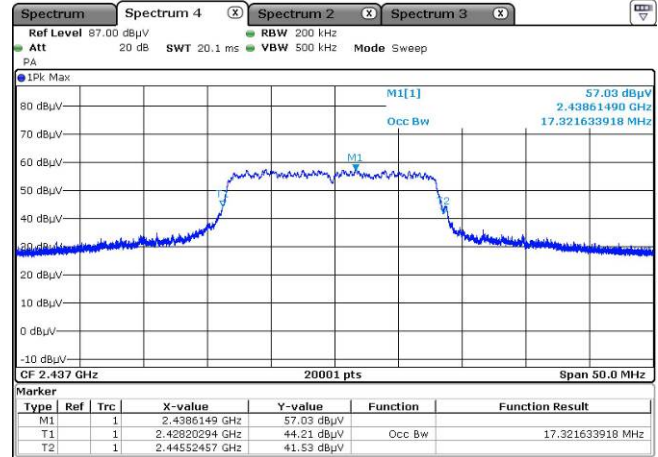
High Channel

Frequency band investigated:	2400MHz to 2483.5MHz
RBW :	200kHz
Measurement detector:	Peak

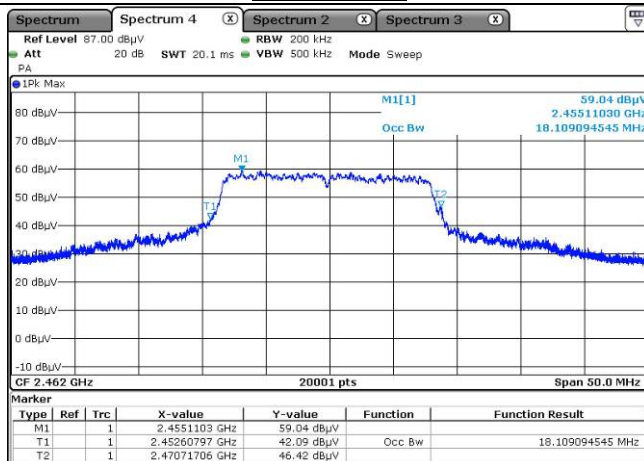
Graphical representation of Occupied Bandwidth (802.11g)



Low Channel



Mid Channel



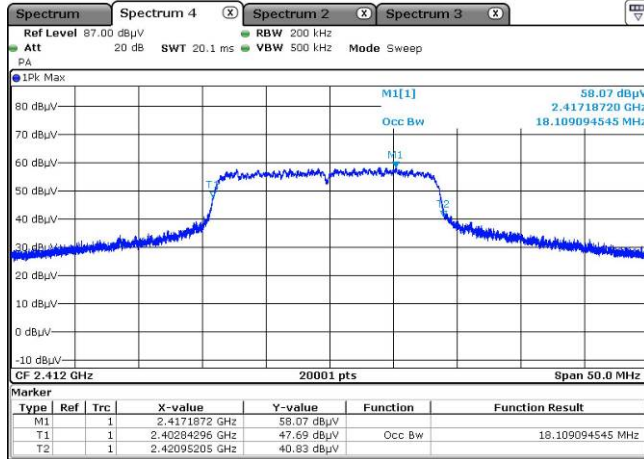
High Channel

Frequency band investigated: 2400MHz to 2483.5MHz

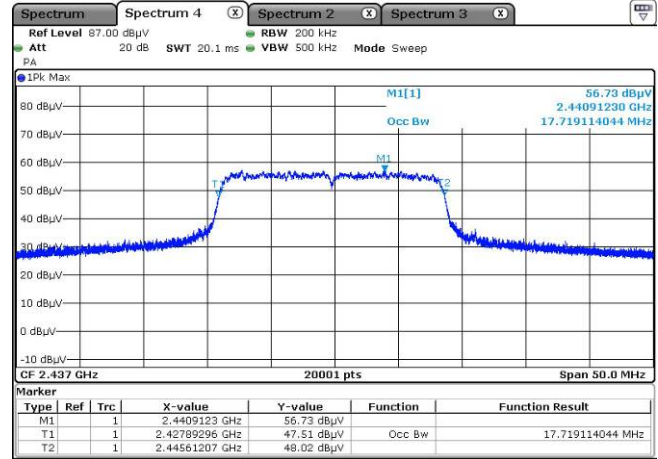
RBW : 200kHz

Measurement detector: Peak

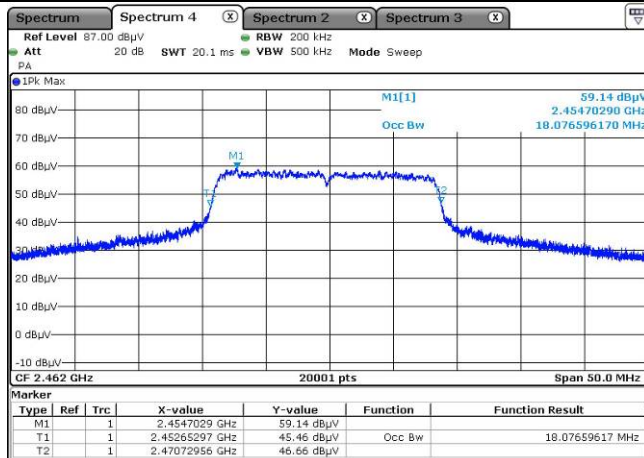
Graphical representation of Occupied Bandwidth (802.11n-20MHz)



Low Channel



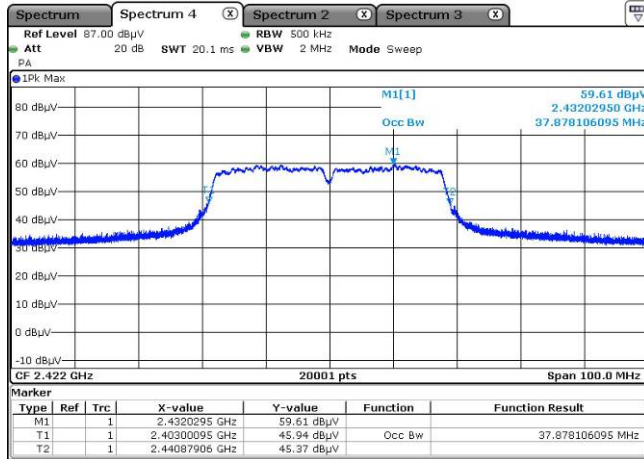
Mid Channel



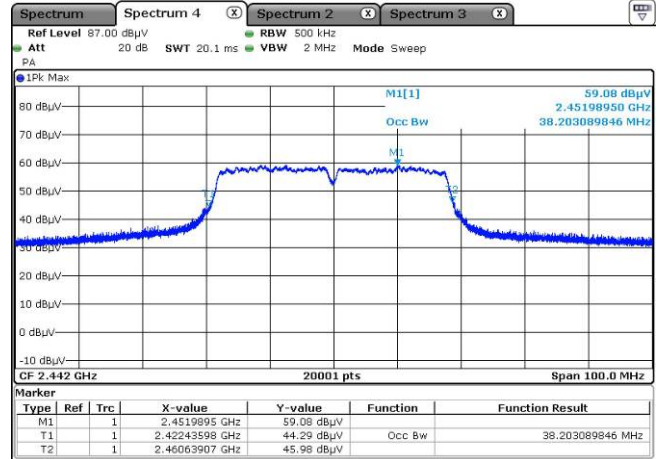
High Channel

Frequency band investigated:	2400MHz to 2483.5MHz
RBW :	200kHz
Measurement detector:	Peak

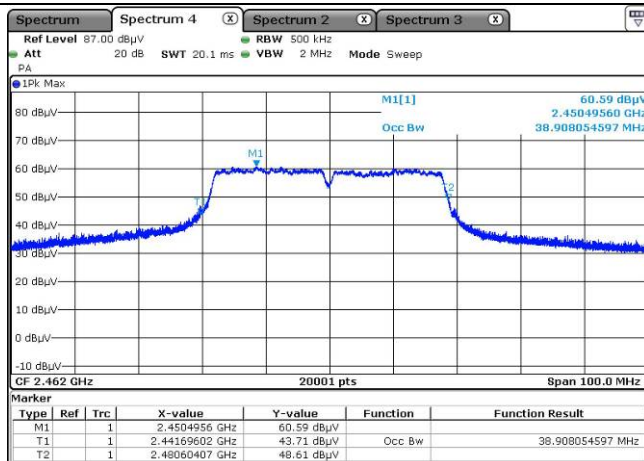
Graphical representation of Occupied Bandwidth (802.11n-40MHz)



Low Channel



Mid Channel



High Channel

Frequency band investigated:	2400MHz to 2483.5MHz
RBW :	500kHz
Measurement detector:	Peak