

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

Matériel testé :  
*Equipment under test:*

**IOTIZE / TapNLink TnL-FIR10 (BLE, NFC)**  
(Trademark / Marketing name or product reference)

Client / Demandeur:  
*Customer / Applicant :*

**IOTIZE**  
M. Francis Lamotte  
17 av. Jean Kuntzmann  
38330 Montbonnot - FRANCE

Fabricant :  
*Manufacturer:*

**IOTIZE**  
17 av. Jean Kuntzmann  
38330 Montbonnot - FRANCE

Numéro d'affaire :  
*Work number :*

12478

Référence de la proposition :  
*Proposal number:*

062018-22897

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

Le 16 mai 2018 /  
May 16<sup>th</sup>, 2018

Objectif des essais :  
*Test purpose:*

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

Lieu du test:  
*Test location:*

SMEE, Rue de Taille  
38500 VOIRON - France

Test réalisé par :  
*Test realized by:*

Laurent CHAPUS

Conclusion :  
*Conclusion:*

L'équipement satisfait aux prescriptions des normes citées en référence.  
*The appliance complies with requirements of above mentioned standards.*

Ed.	Date	Modifications / Pages	Written by : Visa	Approved by: Visa
1 2	July 26 <sup>th</sup> , 2018 September 5 <sup>th</sup> , 2018	Initial Edition TCB review (ATCB022986)	Laurent Chapus	Régis ANCEL

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## 1. Normatives References

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

Industry Canada qualification according to:		
Standards	Applied	Title
RSS-Gen (Issue 5/2018)	X	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 (Issue9/2016)	X	Licence-exempt Radio Apparatus: Category I Equipment, Section B.10: Devices Operating in Frequency Bands for Any Application, Band 2400-2483.5MHz.

Deviation from standards: None.

## 2. Test synthesis

TEST	Paragraph number FCC Part 15 IC RSS-210	Spec. FCC Part 15 IC RSS-210	RESULTS (comments)
Conducted emissions test	15.207 (a) RSS-Gen: Issue 5, §8.8	15.207 (a) Table 4, §8.8	<b>PASS</b>
Field Strength of fundamental	15.249 (a) (c) RSS-210: Issue 9, §B.10 (a)	94dB $\mu$ V/m @3m (50mV/m @ 3m)	<b>PASS</b>
Field Strength of harmonics	15.249 (a) (c) (e) RSS-210: Issue 9, §B.10 (a)	54dB $\mu$ V/m @3m (0.5mV/m @ 3m)	<b>PASS</b>
Unwanted emissions outside the specified frequency band and harmonics	15.209 / 15.249 (d) (e) RSS-210: Issue 9, §B.10 (b) / RSS-Gen: Issue 5, §8.9	Whichever is less stringent, either: - 50dB below level of fundamental, or; - General field strength limits, as follow: <u>Measure at 300m</u> 9-490kHz: 2400 $\mu$ V/m/F(kHz) <u>Measure at 30m</u> 0.490-1.705: 24000 $\mu$ V/m/F(kHz) 1.705-30MHz: 30 $\mu$ V/m <u>Measure at 3m</u> 30MHz-88MHz : 40 dB $\mu$ V/m 88MHz-216MHz : 43.5 dB $\mu$ V/m 216MHz-960MHz : 46.0 dB $\mu$ V/m Above 960MHz : 54.0 dB $\mu$ V/m	<b>PASS</b>
Occupied Bandwidwth	RSS-Gen: Issue 5, §6.7	BW at 99%	<b>PASS</b>

- **General conclusion:**

Measures and tests performed on the sample of the product *OTIZE / TnL-FIR10 (BLE, NFC)*, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart C and Industry Canada RSS-Gen & RSS-210.

### 3. Equipment Under Test (EUT)

**Nom /  
Identification**
**TapNLink TnL-FIR10 (BLE, NFC)**

Sn: IOTzPr004100001621

**FCC ID:** 2APCX-TNLFIR10  
**IC:** 23741-TNLFIR10  
**Model:** TnLFIR10

**Alimentation /  
Power supply** 5V DC (ADP\_Debug board)  
3V for module

**Auxiliaires /  
Auxiliaries**  
- Laptop ASUS, model F200M  
- Battery pack 5V (USB output)  
- ADP\_DEBUG V1.0 board

**Entrées-Sorties /  
Input / Output**

	Câbles pour essai / Cables for test	Blindé / Shielded	Prévu pour >3m / Intended for >3m
Debug connector (J1/J3)	-	-	-
P1 extension connector	None		
Auxiliary ports: - USB / DC (Debug board)	0.2m	Yes	No

**Version programme /  
Firmware version** N.C

**Mode de fonctionnement /  
Running mode** The tested sample is able to:  
- Transmit a modulated carrier frequency on low, middle and high channels (Bluetooth Low Energy)

**Information sur l'équipement /  
Equipment information**  
ISM Frequency band: 2400 to 2483.5 MHz (Tx & Rx, Wideband Data Transmission systems)  
- Antenna type: Chip antenna (Integral, 0.5 dBi antenna gain)  
- Bluetooth Low Energy communication (BLE 4.1)  
- Input voltage 2.3V to 3.6V (Powered for test at 3V)  
- Output BLE power: +3dBm (output of BLE SoC)

### 4. Modifications of the EUT

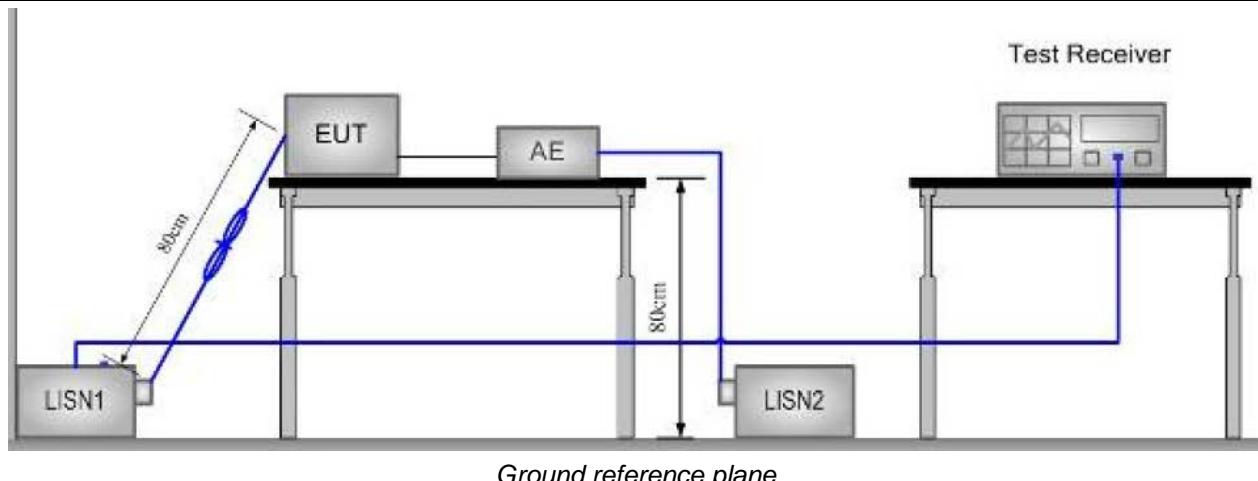
None

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

<b>TEST: Limits for conducted disturbance 150kHz – 30MHz</b>			<b>Verdict</b>		
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		
<b>Laboratory Parameters:</b>		Required prior to the test	During the test		
Ambient Temperature		20 to 30 °C	20°C ± 2		
Relative Humidity		25 to 65 %	50% ±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) Power adapter of PC		
<b>Limits</b>					
Frequency (MHz)	Limit dB (µV)				
	Quasi-Peak	Result	Average	Result	
0.15 – 0.50	66 \ 56	<b>PASS</b>	56 \ 46	<b>PASS</b>	
0.50 - 5	56	<b>PASS</b>	46	<b>PASS</b>	
5 – 30	60	<b>PASS</b>	50	<b>PASS</b>	
Supplementary information: Test location: SMEE Test date: May 16 <sup>th</sup> , 2018. Tested by L. Chapus Power supply voltage: 110V/60Hz (Power adapter of the PC)					

<b>Test Equipment Used</b>					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Attenuator / limiter	SMEE	ATT#2	ATT-171-010	2017/6	2018/6
Cable RF	Div	1m	CAB-101-021	2018/4	2019/4
LISN (50Ω / 50µH) (Meas.)	AFJ	LS16C	RSI-101-001	2017/6	2019/6
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2017/3	2019/3
EMC Software	NEXIO	BAT EMC V3.8	SOF-101-001	-	-
AC power supply	PACIFIC POWER	AMX-125	101-002	-	-

## Test Setup for conducted emission



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

FREQ (MHz)	Meas. PK (dB $\mu$ V)	Mes. QP (dB $\mu$ V)	LIMIT QP (dB $\mu$ V)	Margin QP (dB)	Mes. AV (dB $\mu$ V)	LIMIT AV (dB $\mu$ V)	Margin AV (dB)	Line
0.154	53.4	47.1	65.8	<b>-18.7</b>	27.5	55.8	<b>-28.2</b>	L1
0.162	54.2	50.1	65.6	<b>-15.4</b>	26.7	55.6	<b>-28.9</b>	L1
0.175	48.7	45.0	64.8	<b>-19.8</b>	33.2	54.8	<b>-21.5</b>	L1
0.463	41.9	39.3	56.7	<b>-17.4</b>	29.6	46.7	<b>-17.1</b>	L1
0.487	42.3	40.6	56.4	<b>-15.8</b>	28.8	46.4	<b>-17.6</b>	L1
0.155	54.8	50.4	65.8	<b>-15.4</b>	33.8	55.8	<b>-22.0</b>	N
0.184	51.8	48.9	64.6	<b>-15.7</b>	38.3	54.6	<b>-16.3</b>	N
0.191	50.9	46.9	64.0	<b>-17.1</b>	32.5	54.0	<b>-21.6</b>	N
0.477	45.4	42.7	56.4	<b>-13.8</b>	34.5	46.4	<b>-12.0</b>	N
0.495	45.7	43.1	56.2	<b>-13.2</b>	34.5	46.2	<b>-11.7</b>	N

### Frequency band investigated:

150kHz-30MHz

RBW

9kHz

## Voltage:

110V/60Hz

### Limit:

FCC Part 15.209 a) / RSS-Gen: Issue

### Final measurement detector:

## Quasi-Peak a

## Wide Mea

$\pm 3.5\sigma$

## RESULT:

**PASS**  
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:

$$\text{Meas.} = \text{RA} + \text{CF} + \text{ATT}_{\text{TRAN}} + \text{ATT}_{\text{REF}}$$

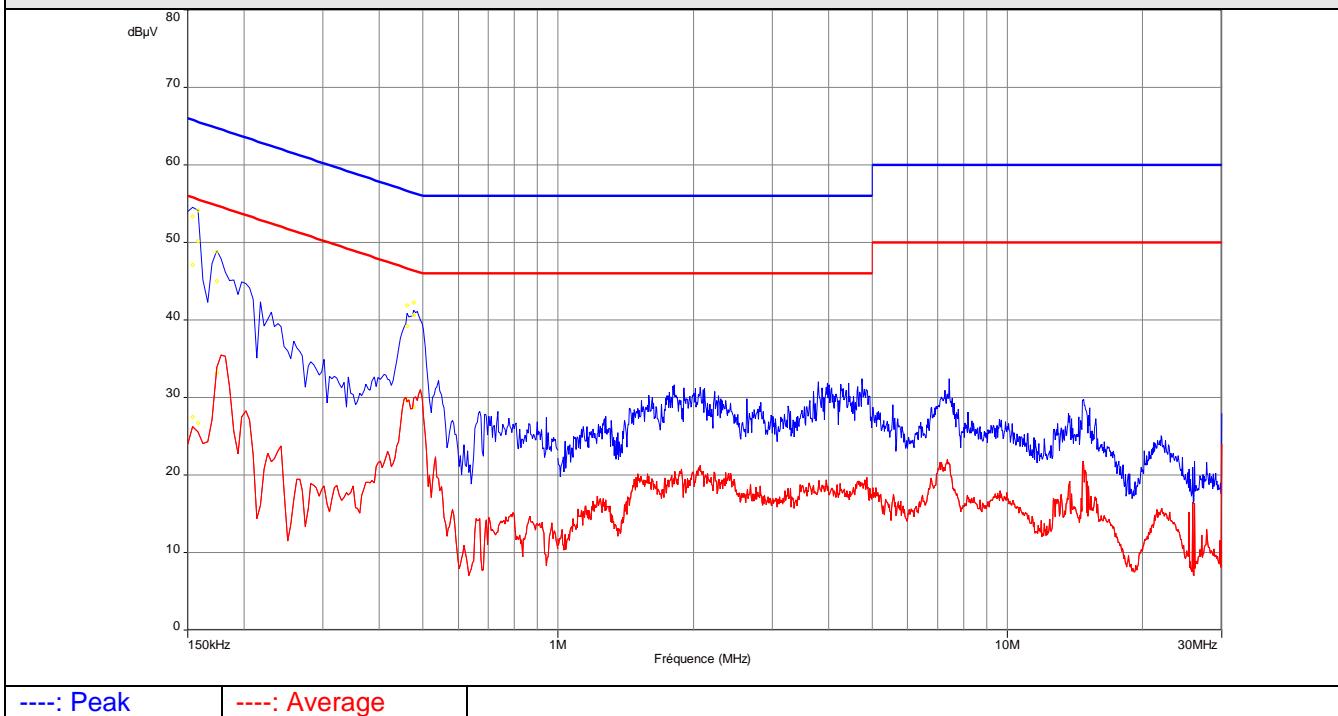
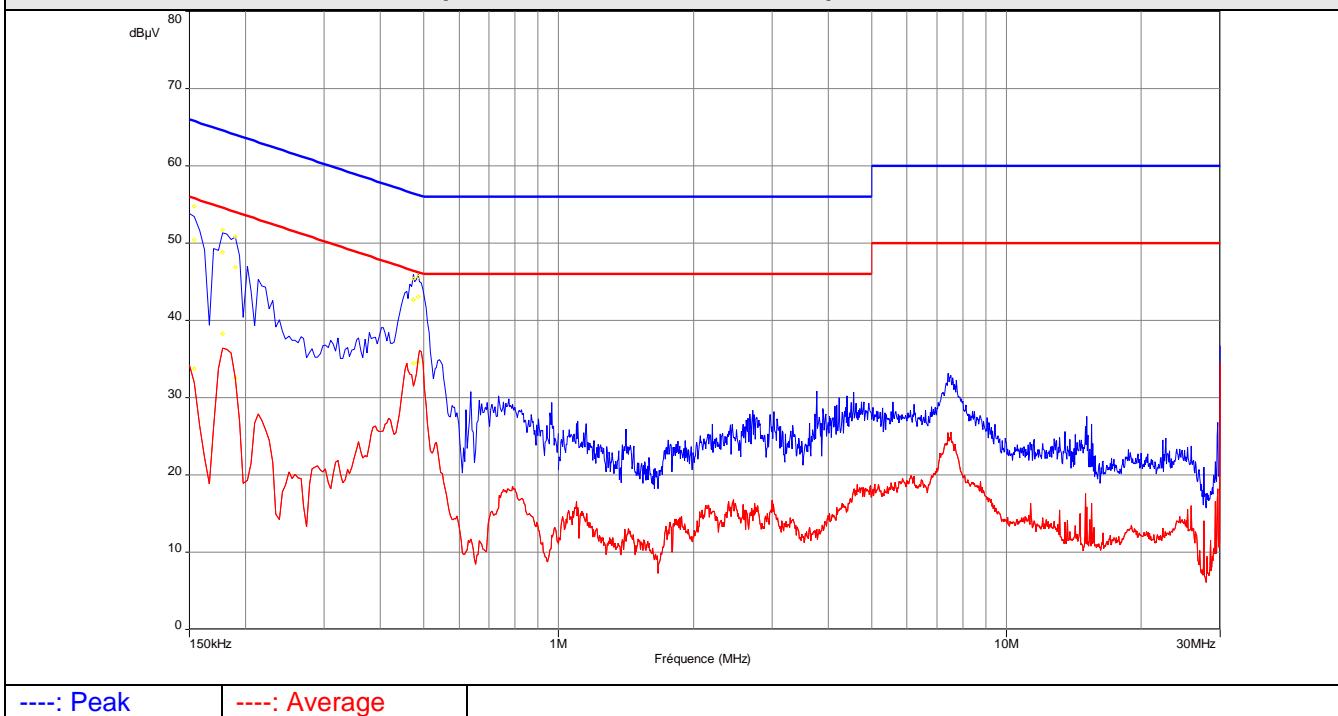
Meas. = Level (dB $\mu$ V)

RA = Receiver Am

CF = Cable Factor

ATT<sub>TRAN</sub> = Transient suppression factor.

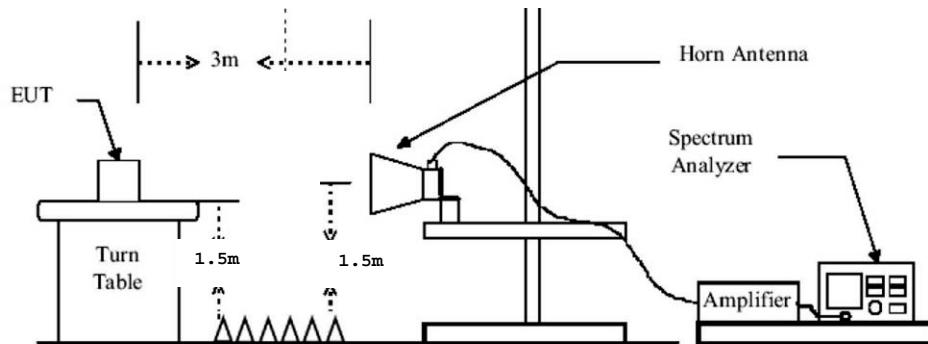
Margin value = Emission level – Limit value (A negative margin shows compliance to limit)

**Graphical representation of Conducted Disturbance Measurement (Peak and Average detection)  
AC port, Line L1 – Power adapter of PC**

**Graphical representation of Conducted Disturbance Measurement (Peak and Average detection)  
AC port, Line Neutral – Power adapter of PC**


## 6. Field Strength of fundamental

<b>TEST: Field strength of fundamental / FCC part 15.249 – RSS 210 §B.10</b>			<b>Verdict</b>
Method: Measurements were made in a 3-meter Full Anechoic Chamber (FAC) that complies to ANSI C63.10.			
The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak/Average) were then performed by rotating the EUT 360° and adjusting the receive antenna height.			<b>Pass</b>
The tested equipment is set to transmit operation with modulations on lowest, middle and highest channel. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength.			
Laboratory Parameters:	Required prior to the test		During the test
Ambient Temperature	10 to 40 °C		20°C ± 2
Relative Humidity	10 to 90 %		50% ±5
<b>Limits – FCC Part 15.249 (a) (c) / RSS-210 §B.10 (a)</b>			
Frequency (MHz)	Limits (dB $\mu$ V/m)		
	Level / Detector / Distance	Results	
2402 to 2480 MHz	94dB $\mu$ V/m / Average / 3m 114dB $\mu$ V/m / Peak / 3m	<b>Pass</b>	
Supplementary information: Test location: SMEET Test date: May 16 <sup>th</sup> , 2018. Tested by L. Chapus			

<b>Test Equipment Used</b>					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Receiver	Rohde&Schwarz	ESRP	REC-151-002	2017/3	2019/3
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
RF cable	Pasternack	PE302-120	CAB-131-024	2018/4	2019/4
Turntable	Innco- Systems	CT0800	PLA-141-002	-	-
Controller	Innco- Systems	CO 3000	ACC-141-025	-	-
Ref. Comb generator	SMEET	EMR-10M	REF-141-003	-	-
Anechoic chamber	COMTEST	214263	CAG-141-001	-	-

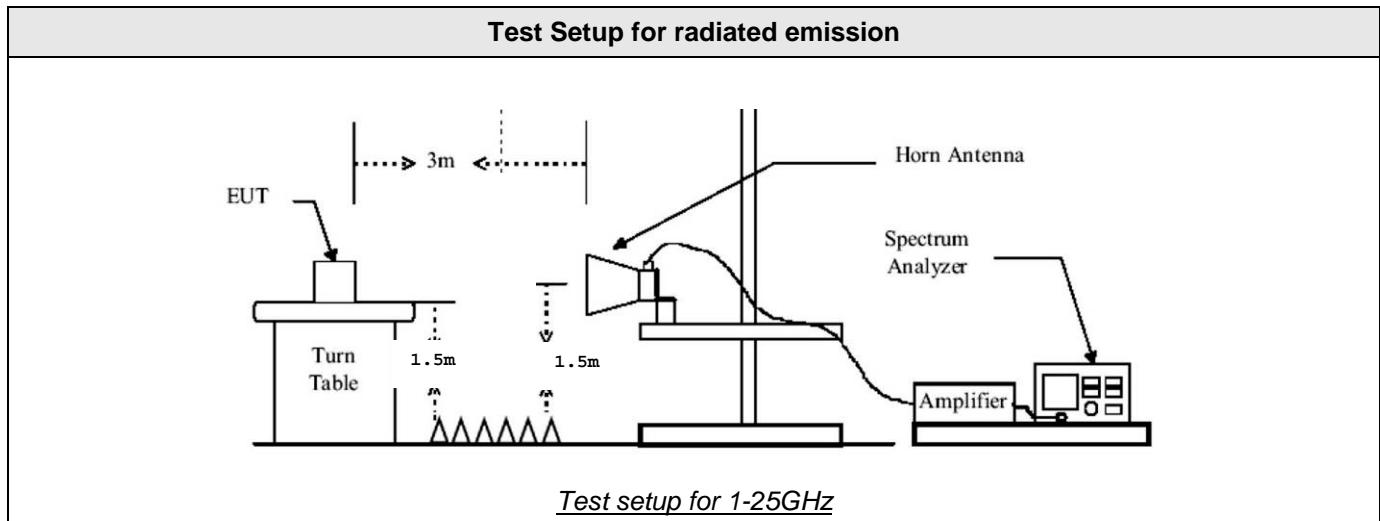
**Test Setup for radiated emission**

Test setup
**Tabulated Results for Field Strength of fundamental**

FREQ (MHz)	Field Strength @ 3m (dB $\mu$ V/m)	Detector	Limit (dB $\mu$ V/m)	Margin	Result
2402.0	91.0	Pk	114	-23.0	<b>Pass</b>
2402.0	78.8	Av	94	-15.2	<b>Pass</b>
2440.0	92.7	Pk	114	-21.3	<b>Pass</b>
2440.0	81.4	Av	94	-12.6	<b>Pass</b>
2480.0	90.9	Pk	114	-23.1	<b>Pass</b>
2480.0	79.5	Av	94	-14.5	<b>Pass</b>
<b>RBW:</b>	1MHz				
<b>Measurement distance:</b>	3m				
<b>Limit:</b>	FCC Part 15.249 (a) (c) / RSS-210 §B.10				
<b>Final measurement detector:</b>	Peak / Average				
<b>Wide Measurement Uncertainty:</b>	$\pm 5.6\text{dB}$ ( $k=2$ )				
<b>RESULT:</b>	<b>PASS</b>				
<b>Note:</b>	(1): The field strength (level) is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follow: $FS = RA + AF + CF - AG$ Where $FS$ = Field Strength $RA$ = Receiver Amplitude $AF$ = Antenna Factor $CF$ = Cable Factor $AG$ = Amplifier Gain Total factor (dB) is $AF + CF - AG$ Margin value = Emission level – Limit value				

## 7. Field Strength of harmonics

<b>TEST: Field Strength of harmonics / FCC part 15.249 – RSS-210 §B.10</b>			<b>Verdict</b>
<b>Method:</b> Measurements were made in a 3-meter Full Anechoic Chamber (FAC) that complies to ANSI C63.10. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak/Average) were then performed by rotating the EUT 360° and adjusting the receive antenna height. The tested equipment is set to transmit operation with modulations on lowest, middle and highest channel. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength. A pre-scan frequency identification of the EUT has been performed in full anechoic chamber. The measured radiated field of the EUT is realised at 1.6-meters of distance. Antenna is 1.5-meters high in front of EUT.			<b>Pass</b>
<b>Laboratory Parameters:</b> Required prior to the test Ambient Temperature: 10 to 40 °C Relative Humidity: 10 to 90 % <b>Fully configured sample scanned over the following frequency range</b> Frequency range on each side of line 30MHz – 25GHz			During the test 22°C ± 2 45% ±5 Measurement Point 3 m measurement distance
<b>Limits – FCC Part 15.249 (a) (c) (e) / RSS-210 §B.10 (a)</b>			
Frequency bands for harmonics (MHz)	Limits (dB $\mu$ V/m)		
	Level / Detector / Distance		Results
4800 to 4967	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
7200 to 7450.5	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
9600 to 9934	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
12000 to 12417.5	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
14400 to 14901	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
16800 to 17384.5	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
19200 to 19868	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
21600 to 22351.5	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
24000 to 24835	54.0 / AV / 3m 74.0 / PK / 3m		<b>Pass</b>
Supplementary information: Test location: SMEET Test date: May 16 <sup>th</sup> , 2018. Tested by L. Chapus			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2017/12	2022/12
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2017/5	2019/5
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-034	2017/5	2019/5
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-
Measuring Rec	Rohde&Schwarz	ESRP	REC-151-002	2017/3	2019/3
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2017/5	2019/5

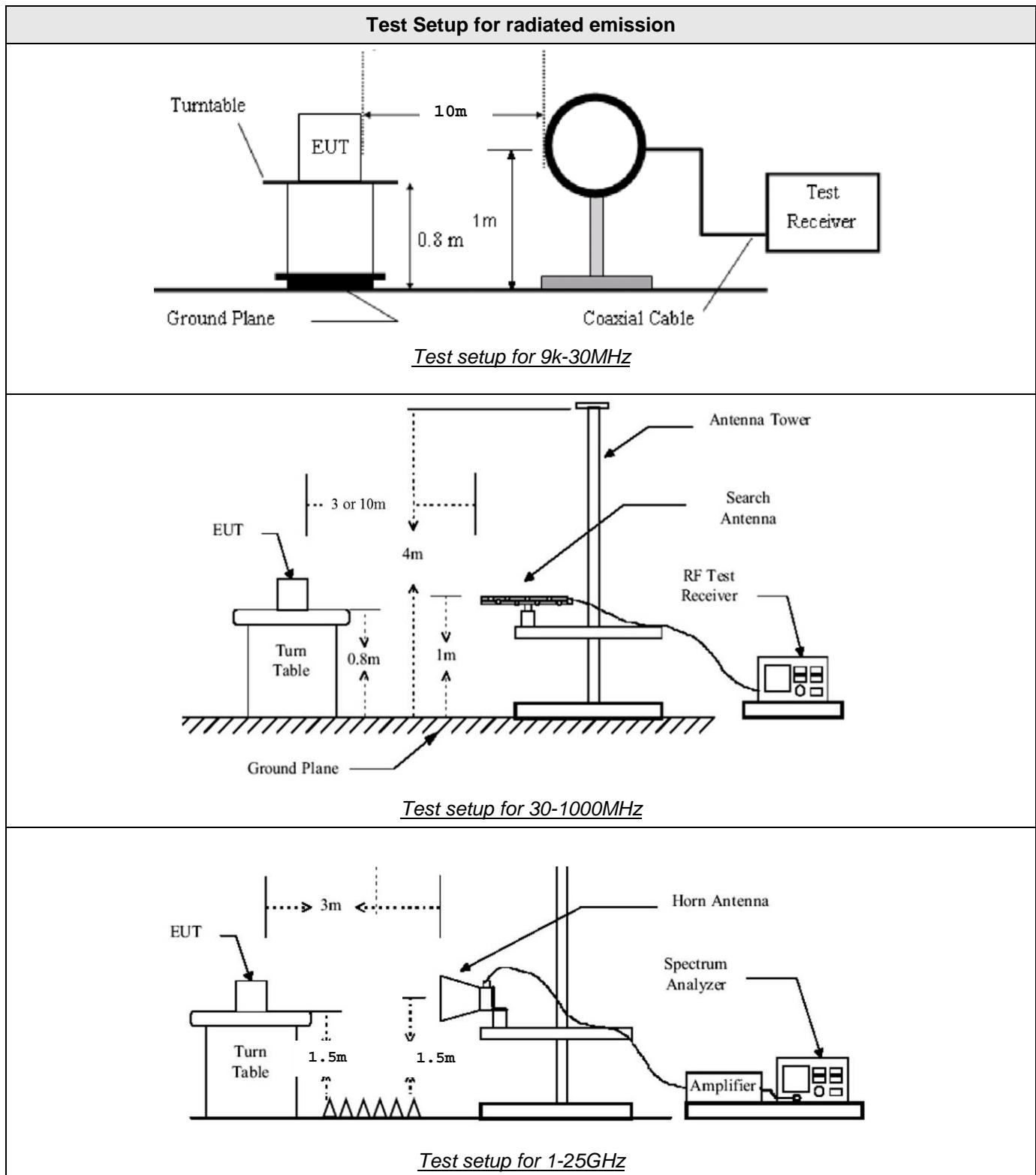


<b>Tabulated Results for Field strength of harmonics (1GHz-25GHz)</b>				
<b>FREQ</b>	<b>Field level</b>	<b>Detector</b>	<b>Limit</b>	<b>Result</b>
(MHz)	dB $\mu$ V/m		(dB $\mu$ V/m)	
4804.0	55.4	<b>Pk</b>	74 Pk	<b>Pass</b>
4804.0	43.4	<b>Av</b>	54 Av	<b>Pass</b>
4880.0	56.3	<b>Pk</b>	74 Pk	<b>Pass</b>
4880.0	44.1	<b>Av</b>	54 Av	<b>Pass</b>
4960.0	56.6	<b>Pk</b>	74 Pk	<b>Pass</b>
4960.0	44.8	<b>Av</b>	54 Av	<b>Pass</b>
12010.0	57.8	<b>Pk</b>	74 Pk	<b>Pass</b>
12010.0	46.0	<b>Av</b>	54 Av	<b>Pass</b>
12200.0	58.4	<b>Pk</b>	74 Pk	<b>Pass</b>
12200.0	46.6	<b>Av</b>	54 Av	<b>Pass</b>
12400.0	58.6	<b>Pk</b>	74 Pk	<b>Pass</b>
12400.0	47.1	<b>Av</b>	54 Av	<b>Pass</b>
14412.0	61.2	<b>Pk</b>	74 Pk	<b>Pass</b>
14412.0	49.0	<b>Av</b>	54 Av	<b>Pass</b>
14640.0	61.7	<b>Pk</b>	74 Pk	<b>Pass</b>
14640.0	49.6	<b>Av</b>	54 Av	<b>Pass</b>
14882.0	60.8	<b>Pk</b>	74 Pk	<b>Pass</b>
14882.0	48.7	<b>Av</b>	54 Av	<b>Pass</b>
<b>RBW</b>	1MHz			
<b>Measurement distance:</b>	3m			
<b>Limit:</b>	FCC Part 15.249 (a) (c) (e) / RSS-210 §B.10 (a)			
<b>Final measurement detector:</b>	Peak / CISPR Average			
<b>Wide Measurement Uncertainty:</b>	$\pm 5.6\text{dB}$ (k=2)			
<b>RESULT:</b>	<b>PASS</b>			
<b>Notes:</b>	<p>(1): The field strength (level) is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follow:  <math display="block">\text{FS} = \text{RA} + \text{AF} + \text{CF} - \text{AG}</math> 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</p> <p>(2): Peak pre-scans not performed at 3-meters distance are corrected as follow:  <math display="block">M@3m = M@D_m + 20 \times \log(D_m / 3m)</math> Where D is the measurement distance in meter</p> <p>(3): All frequencies not specified have margin &lt; -10dB (for peak and average detector)</p> <p>(4): Three axis measurement performed for equipment under test.</p>			

## 8. Unwanted emissions

<b>TEST: Unwanted emissions outside fundamental and harmonics bands / FCC part 15.209, 15.249 - RSS-210 §B.10 / RSS-Gen §8.9</b>		<b>Verdict</b>
Method: Measurements were made in a 3-meter Open Area Test Site that complies to ANSI C63.10 for frequency below 1GHz. Measurements were made in a 3-meter Full Anechoic Chamber (FAC) that complies to ANSI C63.10 for frequency above 1GHz.		
The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak/Quasi-Peak/Average) were then performed by rotating the EUT 360° and adjusting the receive antenna height.		
The tested equipment is set to transmit operation with modulations on lowest, middle and highest channel. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength. A pre-scan frequency identification of the EUT has been performed in full anechoic chamber.		<b>Pass</b>
The measured radiated field of the EUT is performed at 3-meters of distance for frequency 9K-1GHz. The measured radiated field of the EUT is performed at 1.6-meters of distance for frequency 1-25GHz. Antenna is 1.25m or 1.5m high in front of EUT.		
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	20°C ± 2
Relative Humidity	10 to 90 %	50% ±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
<b>Limits – FCC Part 15.209, 15.249 (d) (e) / RSS-Gen §8.9, RSS-210 §B.10 (b)</b>		
<b>Whichever is less stringent, either:</b>		
Frequency (MHz)	Limits (dB $\mu$ V/m)	
	Level / Detector / Distance	Results
30 to 1000	50dB below the fundamental / QP / 3m	Not used
Above 1GHz	50dB below the fundamental / Av / 3m 30dB below the fundamental / Pk / 3m	Not used
<b>Or</b>		
Frequency (MHz)	Limits (dB $\mu$ V/m)	
	Level / Detector / Distance	Results
0.009 to 0.490	107.6 to 72.9 / QP / 10m	<b>Pass</b>
0.490 to 1.705	52.9 to 42.1 / QP / 10m	<b>Pass</b>
1.705 to 30	48.6 / QP / 10m	<b>Pass</b>
30 to 88	40.0 / QP / 3m	<b>Pass</b>
88 to 216	43.5 / QP / 3m	<b>Pass</b>
216 to 960	46.0 / QP / 3m	<b>Pass</b>
960 to 1000	54.0 / QP / 3m	<b>Pass</b>
Above 1GHz	54.0 / AV / 3m 74.0 / PK / 3m	<b>Pass</b>
Supplementary information: Test location: SMEET Test date: May 16 <sup>th</sup> , 2018. Tested by L. Chapus		

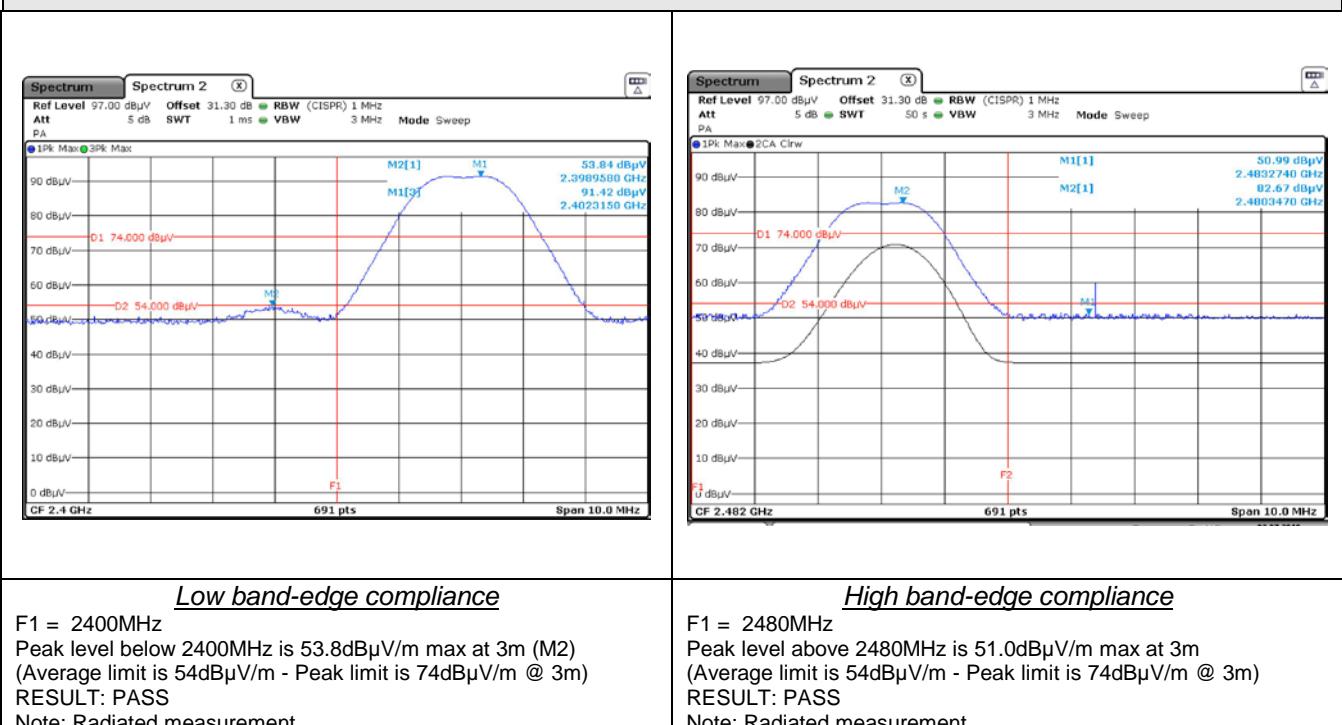
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2017/5	2019/5
Biconic antenna	COM-POWER	AB- 900	ANT-101-003	2017/5	2019/5
Loop antenna	EMCO	6502	ANT-101-009	2017/8	2019/8
BiConiLog antenna	EMCO	3142B	ANT-101-010	2017/7	2019/7
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2017/12	2022/12
RF cable	Div	OATS/25m	CAB-101-017	2018/4	2019/4
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2018/4	2019/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2017/5	2019/5
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-034	2017/5	2019/5
Pre-amplifier	Pasternack RF	PE1524	PRE-101-002	2017/6	2018/6
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2017/12	2018/12
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	2017/3	2019/3
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2017/5	2019/5

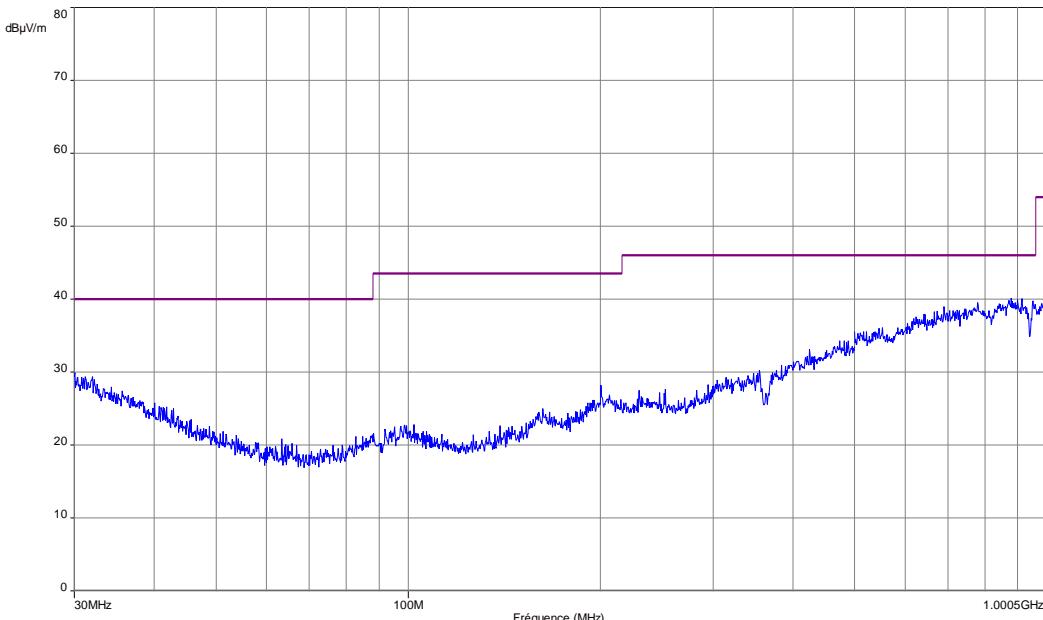
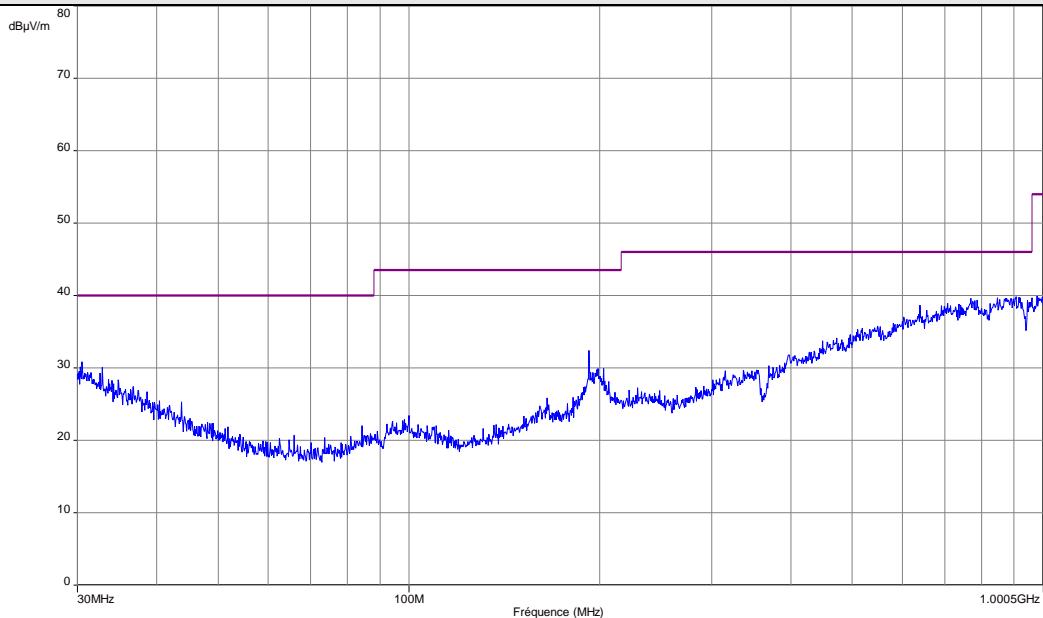


Tabulated Results for Unwanted emissions (9kHz-30MHz)							
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna		Table angle	Correc. Fact. (CF)
MHz	(QP) dB $\mu$ V/m	(QP) dB $\mu$ V/m	dB	Angle (Degree)	Position	Degree	dB
Levels are at least 10dB below limits							
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results.							
<b>Frequency band investigated:</b>		9kHz-30MHz					
<b>RBW:</b>		200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)					
<b>Measurement distance:</b>		10m					
<b>Limit:</b>		FCC Part 15.209 – 15.249 / RSS-Gen §8.9 – RSS-210 §B.10 (b)					
<b>Final measurement detector:</b>		Quasi-Peak					
<b>Wide Measurement Uncertainty:</b>		$\pm 3.5$ 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	Total factor	Field level	Limit	Margin
MHz	(QP) dB $\mu$ V	dB	(QP) dB $\mu$ V/m	(QP) dB $\mu$ V/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.					
<b>Frequency band investigated:</b>		30MHz-1GHz			
<b>RBW:</b>		120kHz			
<b>Measurement distance:</b>		3m			
<b>Limit:</b>		FCC Part 15.209 – 15.249 / RSS-Gen §8.9 – RSS-210 §B.10 (b)			
<b>Final measurement detector:</b>		Quasi-Peak			
<b>Wide Measurement Uncertainty:</b>		$\pm 5.6$ dB (k=2)			
<b>RESULT:</b>		PASS			
<b>Notes:</b>		(1): The field strength (level) is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follow: $FS = RA + AF + CF - AG$ Where FS = Field Strength RA = Receiver Amplitude AF = Antenna Factor CF = Cable Factor AG = Amplifier Gain Total factor (dB) is AF + CF – AG Margin value = Emission level – Limit value (2): Limits used are FCC part 15.209 / RSS-Gen (3): Three axis measurement performed for equipment under test			

Tabulated Results for Unwanted emissions (1GHz-25GHz)				
FREQ (MHz)	Field level dB $\mu$ V/m	Detector	Limit (dB $\mu$ V/m)	Result
2398.958	53.8	Pk	74 Pk	<b>Pass</b>
2398.958	34.7	Av	54 Av	<b>Pass</b>
2483.274	51.0	Pk	74 Pk	<b>Pass</b>
2483.274	34.2	Av	54 Av	<b>Pass</b>
<b>RBW</b>	1MHz			
<b>Measurement distance:</b>	3m			
<b>Limit:</b>	FCC Part 15.209 – 15.249 / RSS-Gen §8.9 – RSS-210 §B.10 (b)			
<b>Final measurement detector:</b>	Peak / CISPR Average			
<b>Wide Measurement Uncertainty:</b>	$\pm 5.6\text{dB}$ (k=2)			
<b>RESULT:</b>	<b>PASS</b>			
<b>Notes:</b>	<p>(1): The field strength (level) is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follow:  <math display="block">\text{FS} = \text{RA} + \text{AF} + \text{CF} - \text{AG}</math> 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</p> <p>(2): Limits used are FCC part 15.209 / RSS-Gen §8.9</p> <p>(3): Peak pre-scans not performed at 3-meters distance are corrected as follow:  <math display="block">M@3m = M@D_m + 20 \times \log(D_m / 3m)</math> Where D is the measurement distance in meter</p> <p>(4): All frequencies not specified have margin &lt; -10dB (for peak and average detector)</p>			

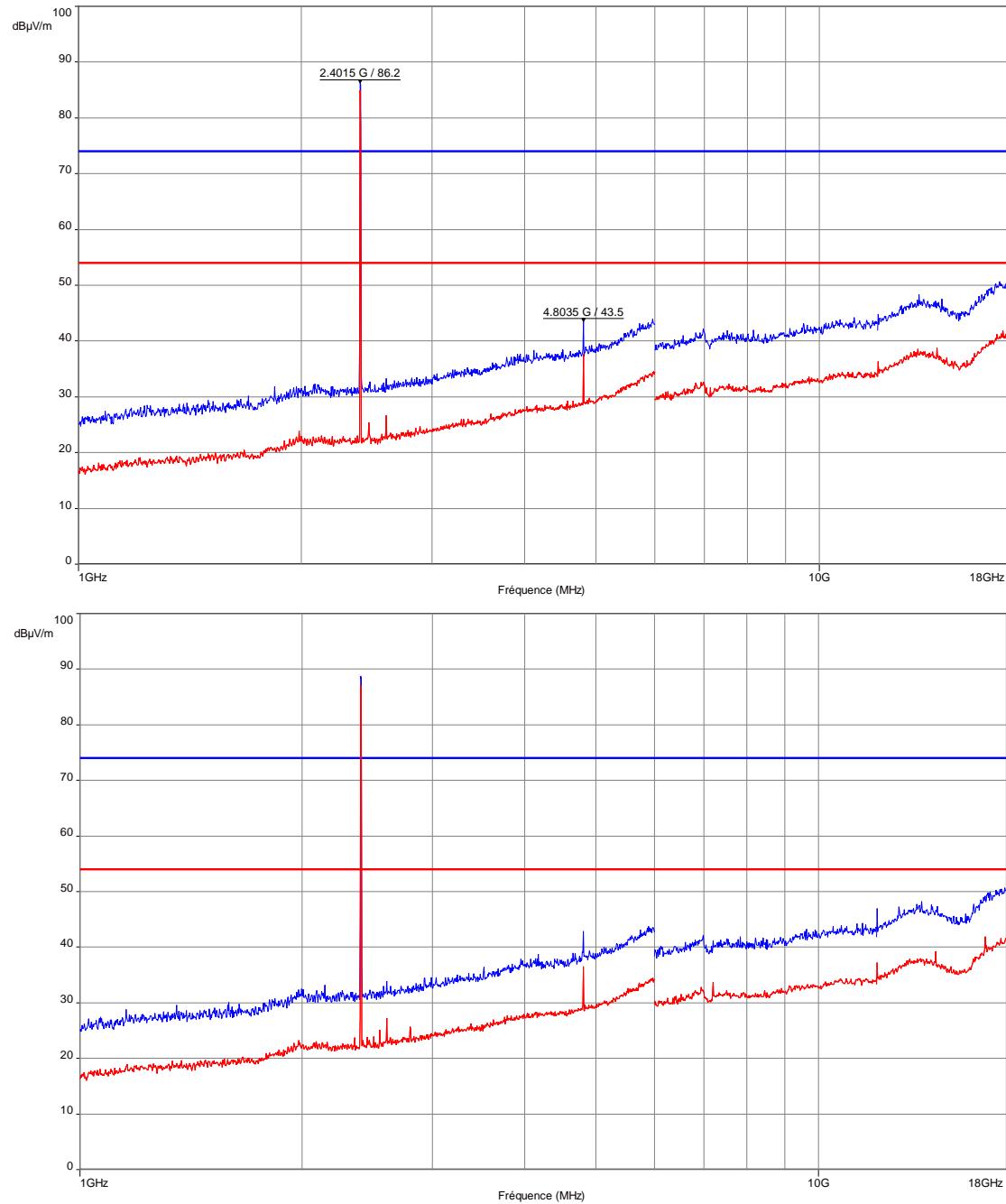
**Graphical representation of Band-edge compliance (Radiated)**


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


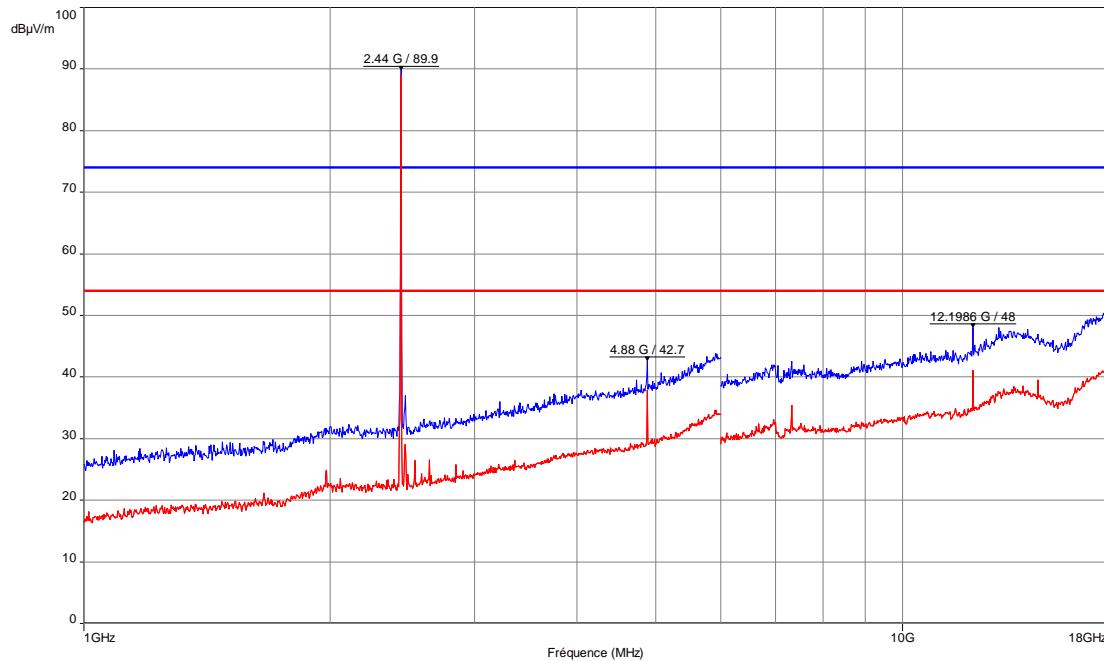
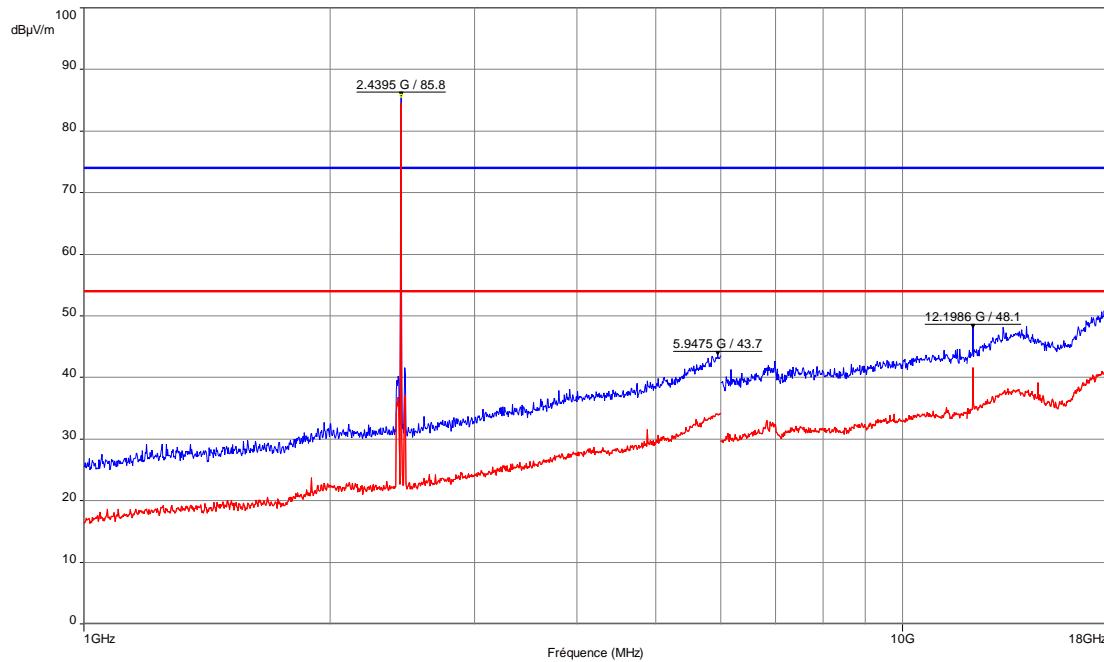
Notes: Pre-scan graph only for identification purpose.

Same result for transmit mode at 2402MHz, 2440MHz or 2480MHz.

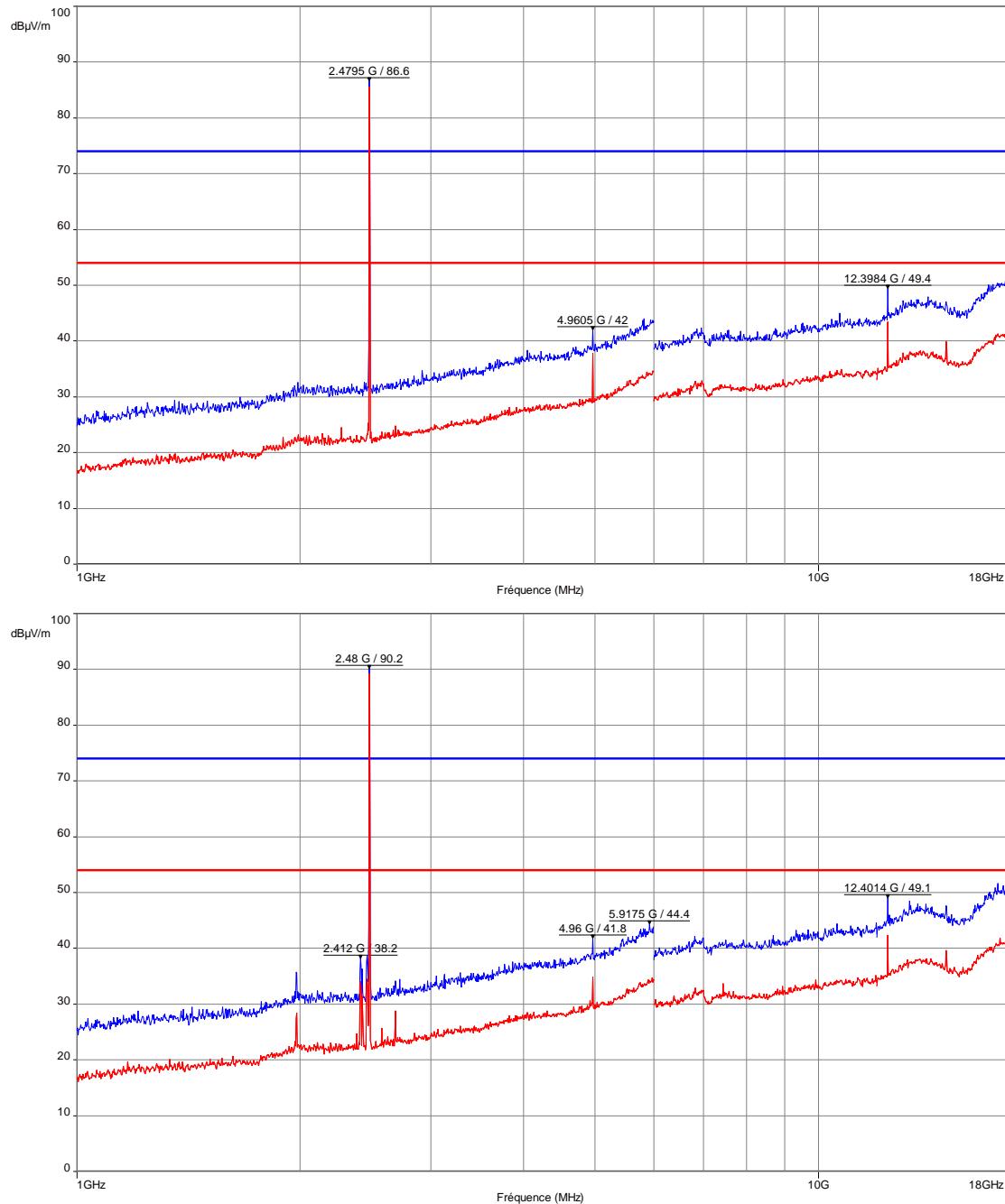
<b>Frequency band investigated:</b>	30MHz-1GHz
<b>Unit :</b>	dB $\mu$ V/m
<b>RBW :</b>	100kHz
<b>Antenna polarization :</b>	Horizontal & Vertical
<b>Voltage:</b>	5V DC
<b>Limit:</b>	FCC 15.209 a) / RSS-Gen §8.9
<b>Measurement detector:</b>	Peak

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


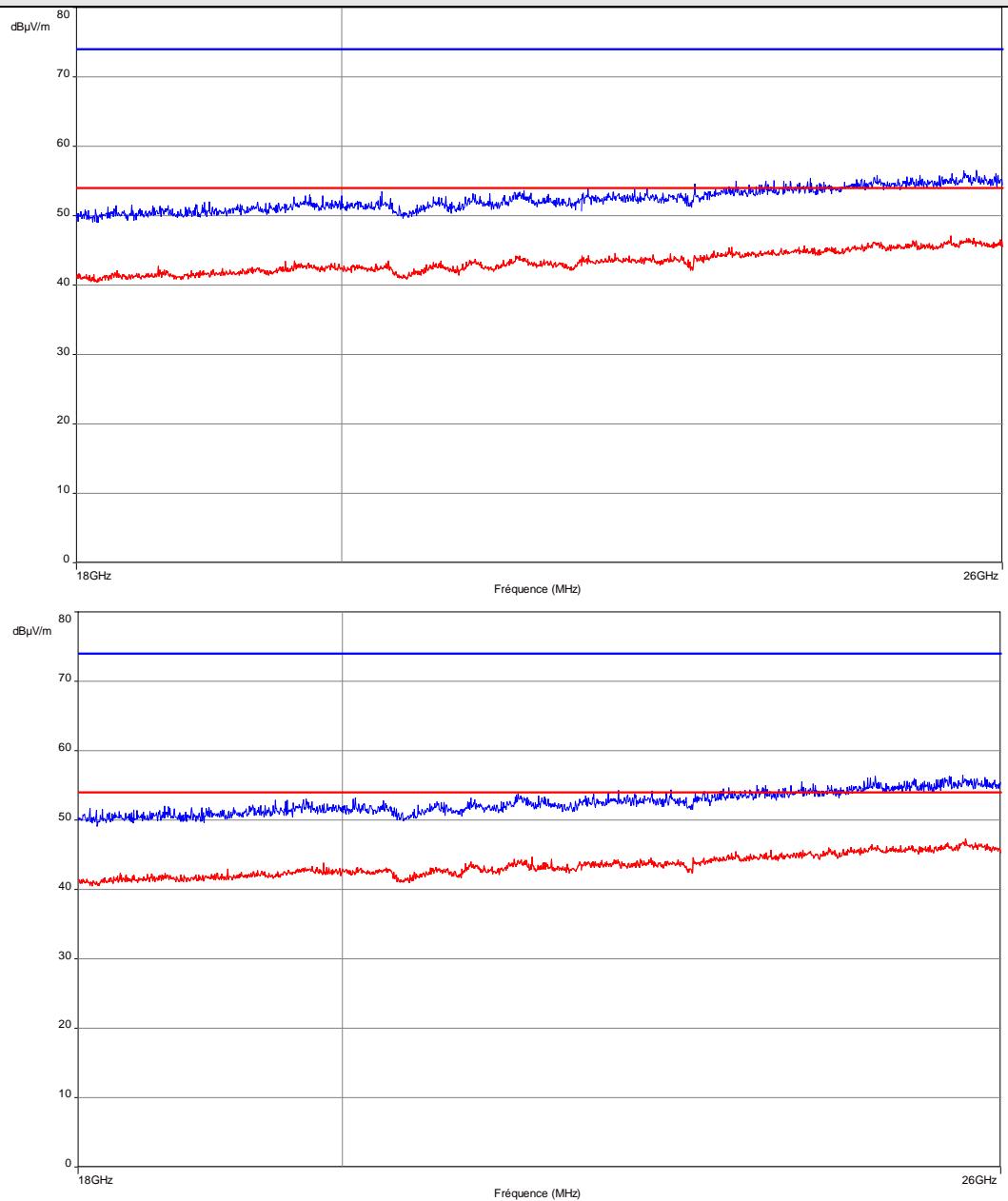
<b>Frequency band investigated:</b>	1GHz-18GHz
<b>Unit :</b>	dB $\mu$ V/m
<b>RBW :</b>	1MHz
<b>Antenna polarization :</b>	Horizontal & Vertical
<b>Voltage:</b>	5V DC
<b>Limit:</b>	FCC 15.209 a) / RSS-Gen §8.9
<b>Measurement detector:</b>	Peak

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


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

**Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical / Transmit mode at 2480MHz)**


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

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


Notes: Pre-scan graph only for identification purpose.

Same result for transmit mode at 2402MHz, 2440MHz or 2480MHz.

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

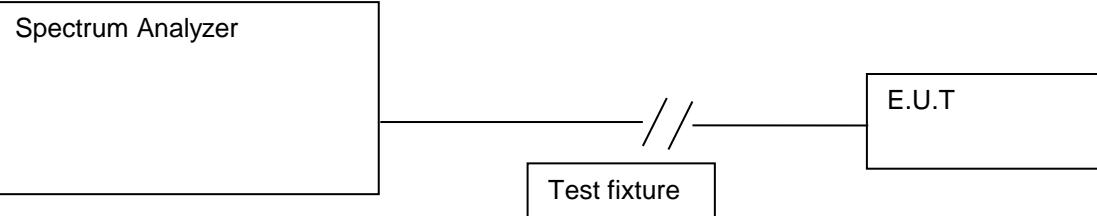
## 9. Occupied bandwidth (99%)

<b>TEST: Occupied bandwidth (99%) / RSS-GEN</b>		<b>Verdict</b>
<b>Method:</b> 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 $VBW \geq 3 \times RBW$ . The SPAN is wide enough to capture all products of the modulation process. A Peak detector is used. Measure is performed with OBW 99% function of the spectrum analyser. The tested equipment is set to transmit operation with modulation on low, mid and high channels.		<b>Pass</b>
<b>Laboratory Parameters:</b>		<b>Required prior to the test</b>
Ambient Temperature	10 to 40 °C	20°C ± 2
Relative Humidity	10 to 90 %	50% ±5
<b>Supplementary information:</b> Test location: SMEC Test date: May 16 <sup>th</sup> , 2018. Tested by L. Chapus		

### Test Equipment Used

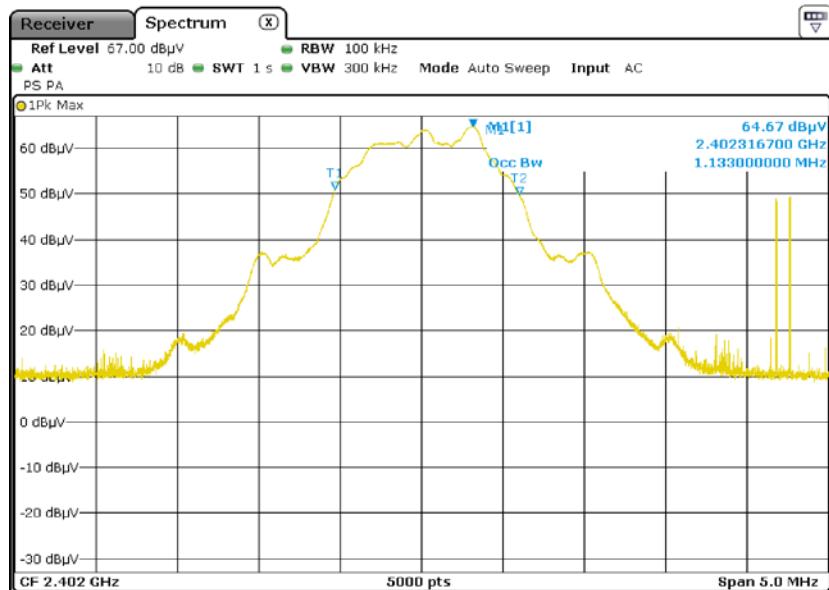
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Receiver	Rohde&Schwarz	ESRP	REC-151-002	2017/3	2019/3
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
RF cable	HUBER+SUHNER	3m	CAB-141-026	2018/4	2019/4
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6

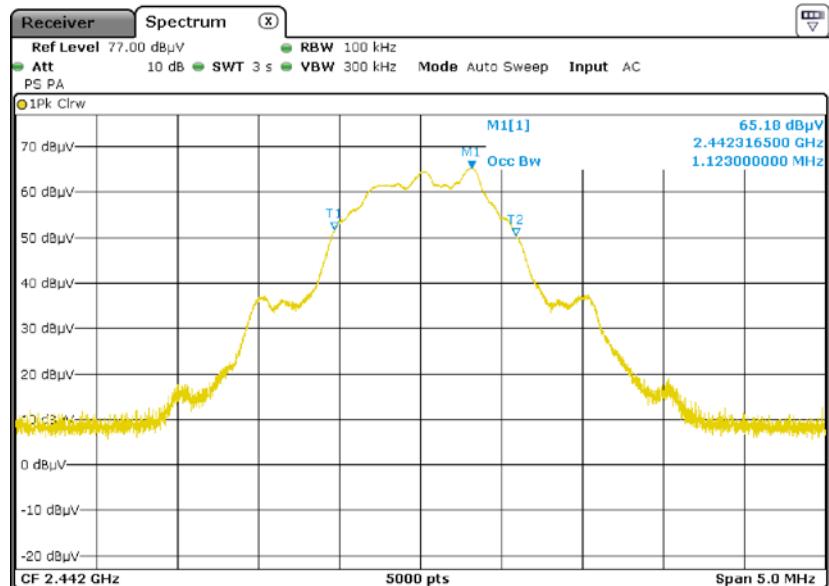
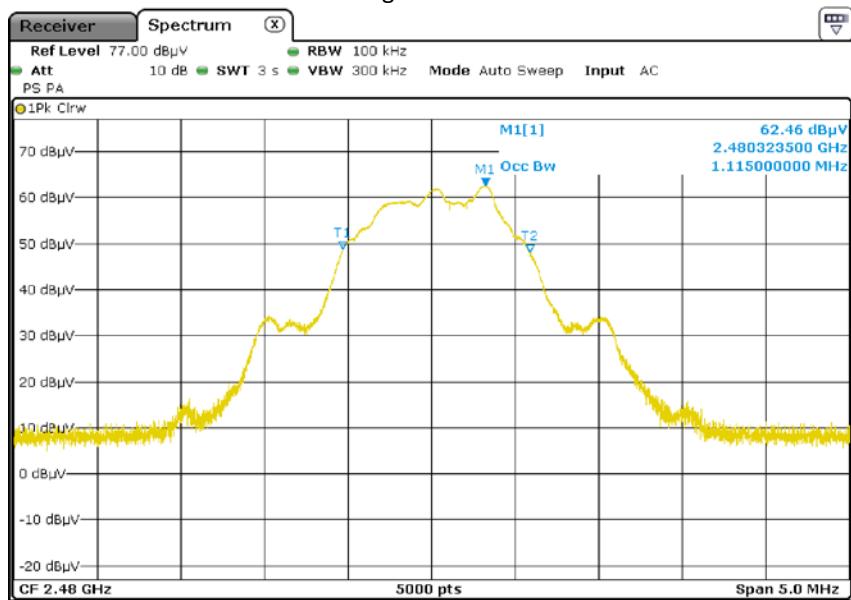
### Test Setup for conducted emission



**Tabulated Results for Occupied Bandwidth**

Frequency (MHz)	99% Occupied Bandwidth (kHz)
2402.0	1133.0
2440.0	1123.0
2480.0	1115.0

**Graphical representation of Occupied Bandwidth**
**Low Channel**


**Mid Channel**

**High Channel**


<b>Frequency band investigated:</b>	2400MHz to 2483.5MHz
<b>RBW :</b>	100kHz
<b>Measurement detector:</b>	Peak