

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

Matériel testé :
Equipment under test:

JOY / OCTOPUS WATCH (O2R2)
(Trademark / Marketing name or product reference)

Constructeur:
Manufacturer: **JOY**
5 Allée du Belvédère
74940 Annecy-le-Vieux – France

Rapport délivré à :
Issued to: **JOY**
M. Jean-Yves Bitterlich
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Référence de la proposition :
Proposal number: 042018-23011

Date de l'essai :
Date of test: Du 5 au 6 Juillet 2018 / 4 septembre 2018
July 5th to 6th, 2018 / September 4th, 2018

Objectif des essais :
Test purpose: EMC qualification accordingly to following standards:
- CFR 47, FCC Part 15, Subpart B & C
(Chapter 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz)
- Industry Canada ICES-003 Issue 6 & RSS-247, Issue 2
(Digital Transmission Systems Operating in the Bands 2400-2483.5 MHz)

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

Test réalisé par :
Test realized by: Laurent CHAPUS

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

Ed.	Date	Modifications / Pages	Written by : Visa	Approved by: Visa
1	July 30 th , 2018	Initial Edition	Laurent CHAPUS	Régis ANCEL
2	September 4, 2018	TCB review (ATCB023002)		

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COORDONNEES

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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 15.107 / 15.109 / 15.207 / 15.209 / 15.247

Industry Canada qualification according to:		
Standards	Applied	Title
ICES-003 (Issue 6/2016)	X	Information Technology Equipment (ITE) – Limits and methods of measurement
RSS-Gen (Issue 5/2018)	X	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 (Issue2/2017)	X	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Note: Following guidance are used

- DTS Measurement Guidance 558074 D01 v04
- Determining ERP and EIRP Guidance 412172 D01 v01r01

2. Test synthesis

TEST	Paragraph number FCC Part 15 / IC RSS-247 / RSS-GEN	Spec. FCC Part 15 / IC RSS-247 / RSS-GEN	RESULTS (comments)
Conducted emissions test	15.207 (a) RSS-Gen § 8.8	Table 15.107 (a) Table 4 / RSS-Gen	PASS [1]
Radiated emission test	15.209 (a) ICES-003	Table 15.209 (a) Table 5 , § 6.2	PASS [1]
6dB Bandwidth	15.247 (a) (2) RSS-247 § 5.2 (a)	At least 500kHz	PASS
Maximum Peak Output Power	15.247 (b) (3) RSS-247 § 5.4 (d)	1W max / 30dBm (Conducted) 4W max / 36dBm (EIRP)	PASS
Maximum Power Spectral Density	15.247 (e) RSS-247 § 5.2 (b)	8dBm in a 3kHz band segment	PASS
Unwanted emissions into Non Restricted Frequency Bands	15.247 (d) / RSS-247 § 5.5	-20dBc in any 100kHz outside frequency band.	PASS
Unwanted emissions into Restricted Frequency Bands	15.209 (a) / 15.247 (d) / 15.205 (a) RSS-GEN § 7.1, §8.9, § 8.10 / RSS-247 § 5.5	<u>Measure at 300m</u> 9-490kHz: 2400µV/m/F(kHz) <u>Measure at 30m</u> 0.490-1.705: 24000µV/m/F(kHz) 1.705-30MHz: 30µV/m <u>Measure at 3m</u> 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

N/A: Not Applicable

[1]: For battery charging mode only

- General conclusion:**

Measures and tests performed on the sample of the product *OCTOPUS O2R2 watch*, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart B & C and Industry Canada ICES-003, RSS-Gen & RSS-247.

3. Equipment Under Test (EUT)

Nom /
Identification

OCTOPUS WATCH (O2R2)

Sn: N.C

FCC ID: 2AKSXO2R2
IC ID : 22301-O2R2
Model : O2R2

Auxiliaires /
Auxiliaries

For battery charging mode:
- Companion device (JOY equipment)
- Standard power adapter Dong Guan AoHai Power Technology Co. Ltd,
model A18A-050100U-US2 (AC Mains to USB output)

Entrées-Sorties /
Input / Output

	Câbles pour essai / Cables for test	Blindé / Shielded	Prévu pour >3m / Intended for >3m
USB cable (Companion) *	USB 2.0, 1.8m	Yes	No

* Note: Cable for battery charging only (no data transfer possible)

Version programme /
Firmware version

N.C

Mode de fonctionnement /
Running mode

The tested sample is able to:

- Transmit a carrier frequency on low, middle and high channels (Bluetooth Low Energy) without battery charging mode
- Transmit a carrier frequency on low, middle and high channels (Bluetooth Low Energy) with battery charging mode on the Companion nightlight station
- Be in Receiver mode (no transmission)
- Be in standby mode (no transmission)

Programme de test /
Test program /

N.C

• **Equipment information:**

- ISM Frequency band: 2400 to 2483.5 MHz (Tx & Rx, Wideband Data Transmission systems)
- Power Setting: Power is set at its maximum (+4dBm)
- Modulation: Bluetooth Low Energy
- Data rate: 250kb/s, 1Mb/s
- Antenna type: Integral (SMD ceramic, 0dBi peak gain)
- Powered by 3.7V DC from internal battery
- Equipment intended for use as a portable station
- Equipment designed for continuous operation

4. Test conditions

Power supply voltage:

Equipment under test: 3.7V DC from Li-battery (Fully charged)
5V DC from standard power adapter (Charging stand)

5. Modifications of the EUT

None

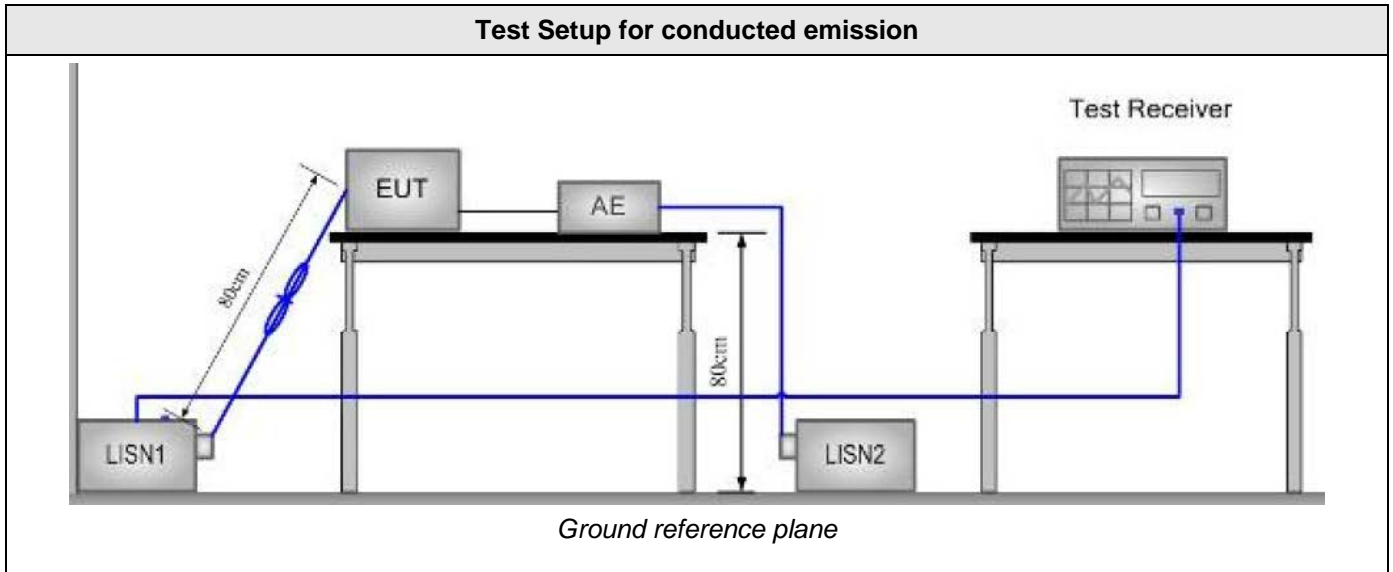
6. Special accessory

None

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

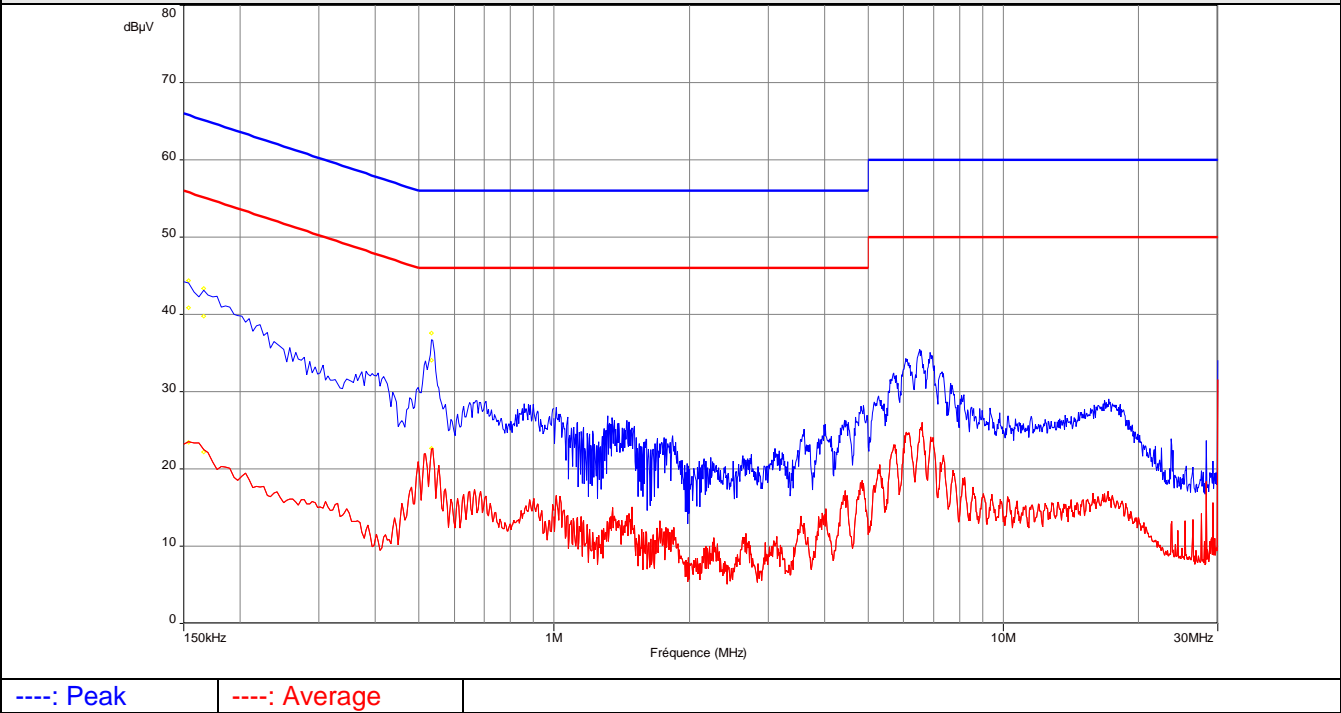
TEST: Limits for conducted disturbance 150kHz – 30MHz				Verdict	
<p>Method: The LISN is placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane. This distance was between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment 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.</p>				Pass	
Laboratory Parameters:		Required prior to the test		During the test	
Ambient Temperature		10 to 40 °C		23°C ± 2	
Relative Humidity		10 to 90 %		58% ± 5	
Fully configured sample scanned over the following frequency range		Frequency range on each side of line		Measurement Point	
		150kHz to 30MHz		AC input ports (110V on standard power adapter)	
Running mode		Battery Charging mode (On Companion device)			
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: July 6 th , 2018. Tested by L. CHAPUS					
Power supply voltage: 110V/60Hz to power adapter					

Test Equipment Used					
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	2017/4	2018/4
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	-	-

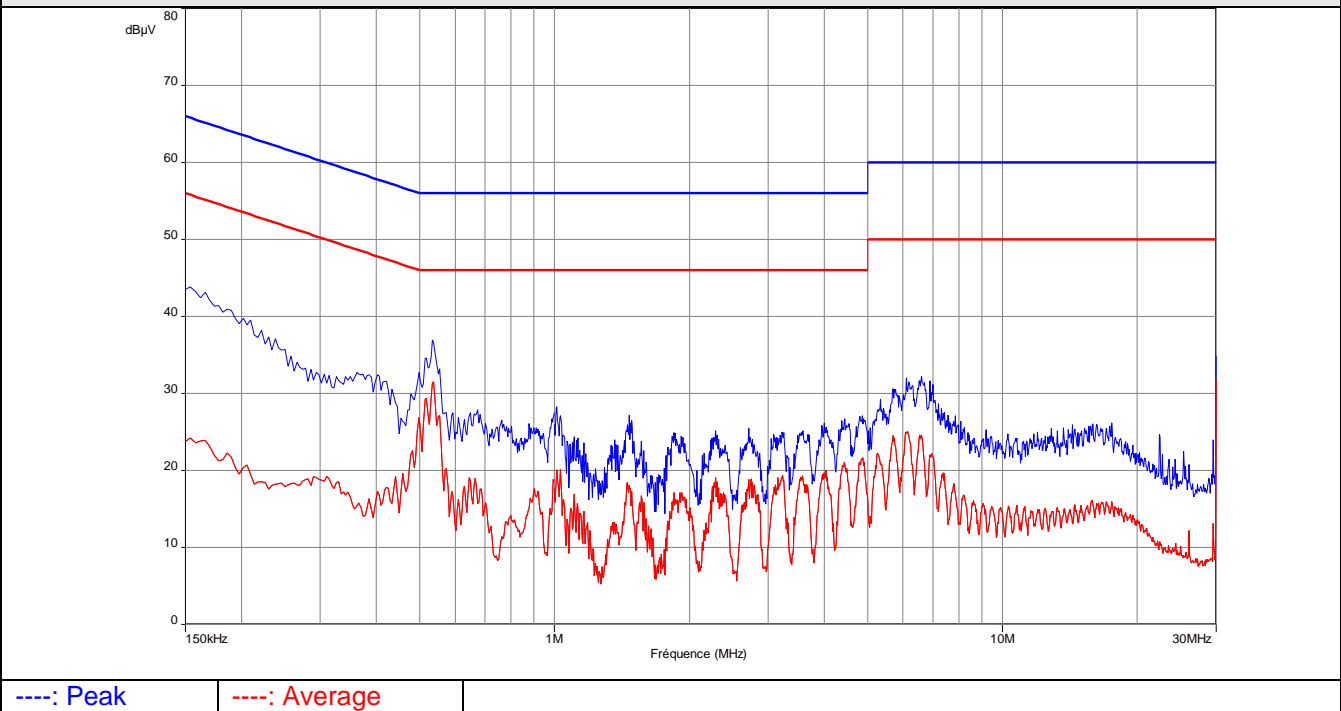


Tabulated Results for Mains Terminal Disturbance Voltage on AC port								
FREQ	Meas. PK	Mes. QP	LIMIT QP	Margin QP	Mes. AV	LIMIT AV	Margin AV	Line
(MHz)	(dBμV)	(dBμV)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
Levels are at least 20dB below limits								Line L1
Levels are at least 20dB below limits								Neutral
Frequency band investigated:		150kHz-30MHz						
RBW:		9kHz						
Voltage:		110V / 60Hz						
Limit:		FCC Part 15.107 / 15.207 / ICES-003						
Final measurement detector:		Quasi-Peak and Average						
Wide Measurement Uncertainty:		± 3.5dB (k=2)						
RESULT:		PASS						
Measured value calculation:		<p>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:</p> $\text{Meas.} = \text{RA} + \text{CF} + \text{ATT}_{\text{TRAN}} + \text{ATT}_{\text{LISN}}$ <p>Where Meas. = Level (dBμV)</p> <ul style="list-style-type: none"> RA = Receiver Amplitude CF = Cable Factor ATT_{TRAN} = Transient suppressor attenuation ATT_{LISN} = LISN attenuation <p>Margin value = Emission level – Limit value</p>						

**Graphical representation of Conducted Disturbance Measurement (Peak and Average detection)
AC port, Line L1 – Companion device with watch (Battery charging)**



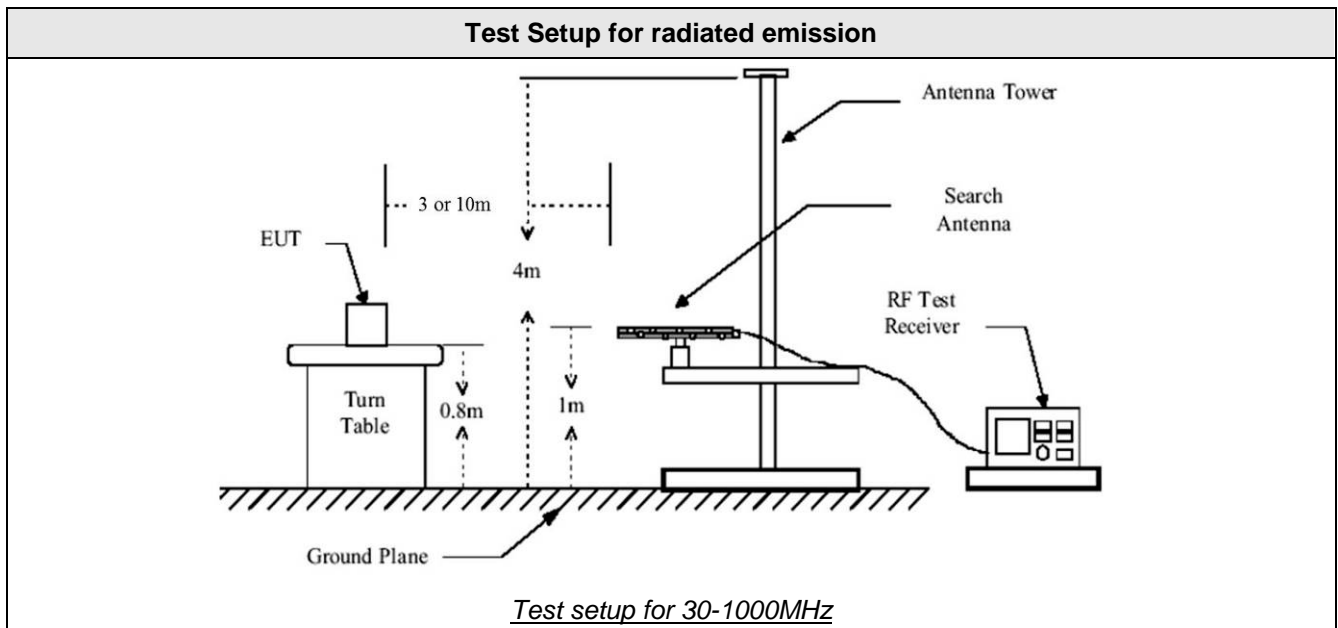
**Graphical representation of Conducted Disturbance Measurement (Peak and Average detection)
AC port, Line Neutral – Companion device with watch (Battery charging)**



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

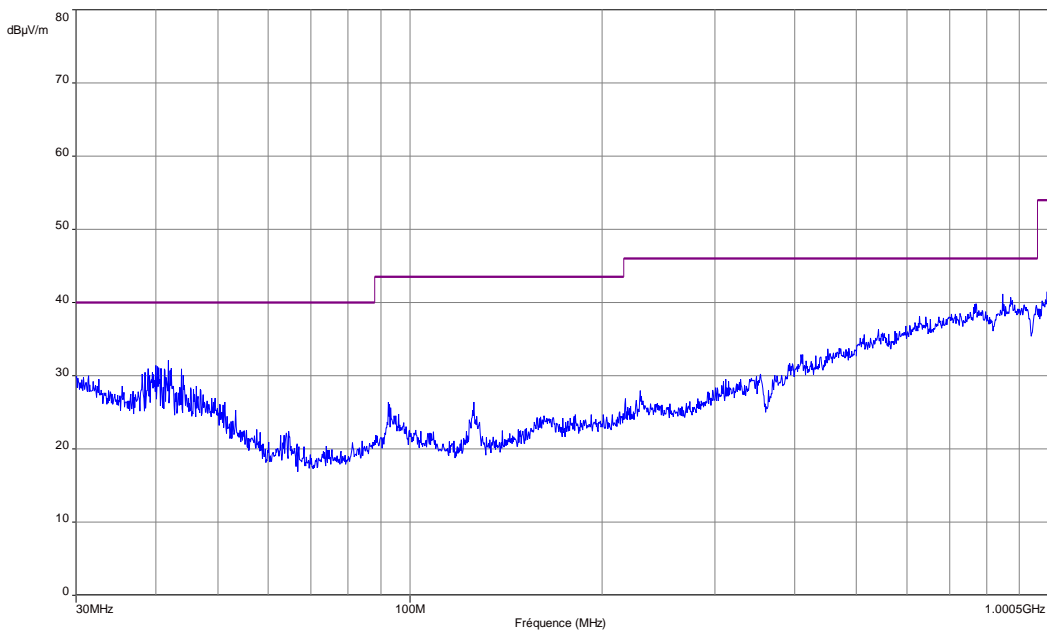
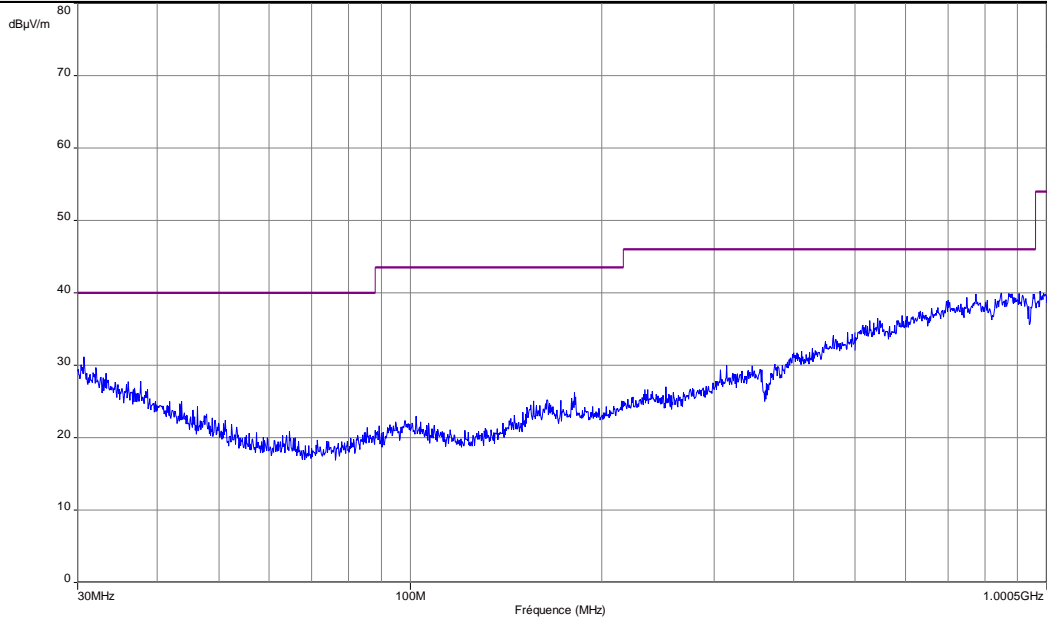
TEST: Limits for radiated disturbance 30 MHz – 1 GHz		Verdict
<p><u>Method:</u> Final measurements were made in a 3-meter Open Area Test Site (OATS). Measurements were performed at an antenna to EUT separation distance of 3 meters. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak, Quasi-peak) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.</p> <p>A pre-scan frequency identification of the EUT has been performed in a 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 with 360° continuous rotation of the device under test.</p>		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 %	58% ± 5
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point
	30MHz – 1GHz	3 m measurement distance
Running mode	Battery Charging mode (On Companion device)	
Limits		
Frequency (MHz)	Limit at 3m (dBµV/m)	
	Level / Detector	Results
30 to 88	40.0 (QP)	Pass
88 to 216	43.5 (QP)	Pass
216 to 960	46.0 (QP)	Pass
960 to 1000	54.0 (QP)	Pass
Above 1GHz	54.0 (AV) 74.0 (PK)	Pass
Supplementary information: Test location: SMEE. Test date: July 5 th , 2018. Tested by L. CHAPUS		

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2017/5	2019/5
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2017/5	2019/5
BiConiLog antenna	EMCO	3142B	ANT-101-010	2017/7	2019/7
RF cable	Div	OATS/25m	CAB-101-017	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
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001		
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2017/3	2019/3
OATS	Div	10m	SIT-101-001	2017/7	2020/7
EMC Software	NEXIO	BAT EMC V3.8	SOF-101-001	-	-



Tabulated Results for Radiated Disturbance (3m measurement on Open Area Test Site, 30MHz-1GHz)										
With Companion device										
FREQ	Meter reading	Meter reading	Total Factor	Field level	Field level	Pol	Antenna height	Table angle	Limit	Margin
MHz	(QP) dB μ V	(Pk) dB μ V	dB	(QP) dB μ V/m	(Pk) dB μ V/m		cm	Degré	(QP) dB μ V/m	dB
Levels are at least 10dB below limits										
Supplementary information: Frequency list measured on the Open Area Test Site is created with pre-scan results.										
Frequency band investigated:				30MHz-1GHz						
RBW:				120kHz						
Measurement distance:				3m						
Limit:				FCC Part 15.109 / 15.209 / ICES-003						
Final measurement detector:				Quasi-Peak						
Wide Measurement Uncertainty:				± 5.6 dB (k=2)						
RESULT:				PASS						
Field Strength Calculation:				<p>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:</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>						

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal & Vertical) – Companion with Octopus watch (Battery charging)



Note: Pre-scan graph only for identification purpose.

----- : Peak measure

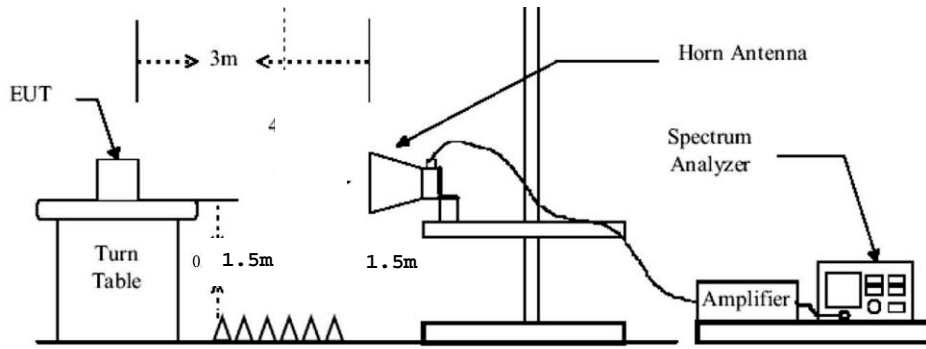
----- : Class B limit (3m)

9. 6dB Bandwidth

TEST: 6dB Bandwidth		Verdict
<p>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 100kHz, with VBW $\geq 3 \times$ RBW. The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. The tested equipment is set to transmit operation with modulation on low, mid and high channels.</p>		Pass
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	23°C \pm 2
Relative Humidity	10 to 90 %	58% \pm 5
Limits – FCC Part 15.247 (a) / RSS-247 §5.2 (a)		
Frequency (MHz)	Level for Bandwidth	Limit
2402.0	6dB below the maximum output power	At least 500kHz
2440.0		
2480.0		
Supplementary information: Test location: SMEE. Test date: July 5 th , 2018. Tested by L. CHAPUS		

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Turntable	Innco- Systems	CT0800	PLA-141-001		
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2017/3	2019/3

Test Setup for radiated emission

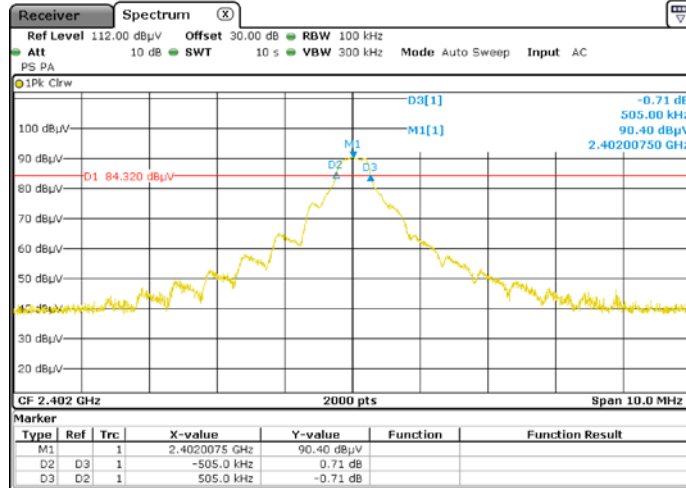


Test setup for 1-25GHz

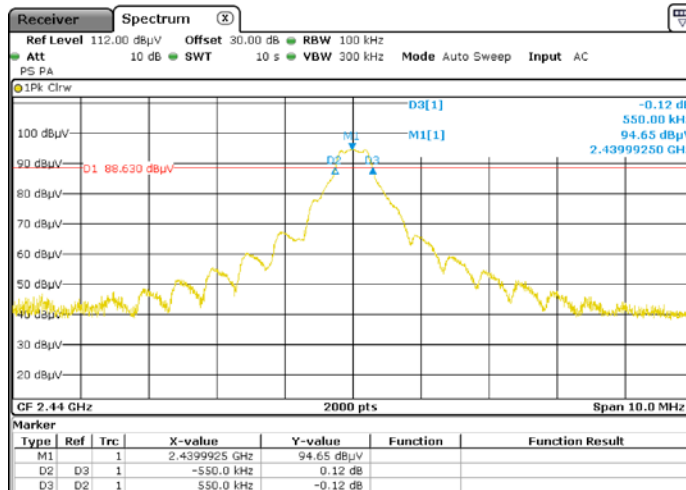
Tabulated Results for Occupied Bandwidth

Frequency (MHz)	6dB Bandwidth (kHz)	Result
2402.0	505	Pass
2440.0	550	Pass
2480.0	580	Pass

Graphical representation of 6dB Bandwidth

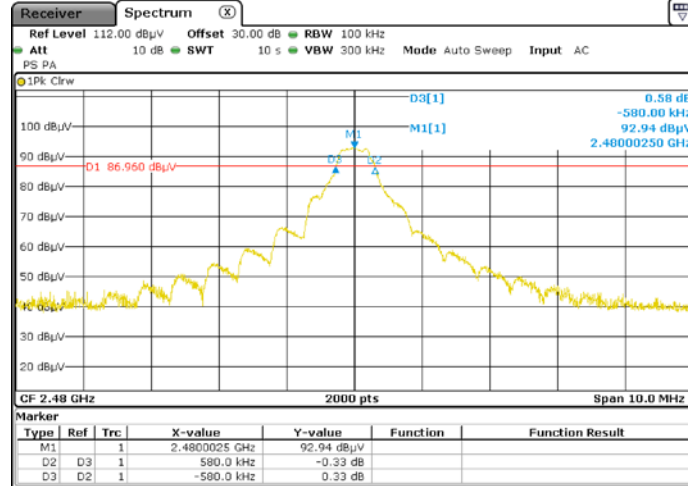


Low channel



Mid channel

Graphical representation of 6dB Bandwidth



High channel

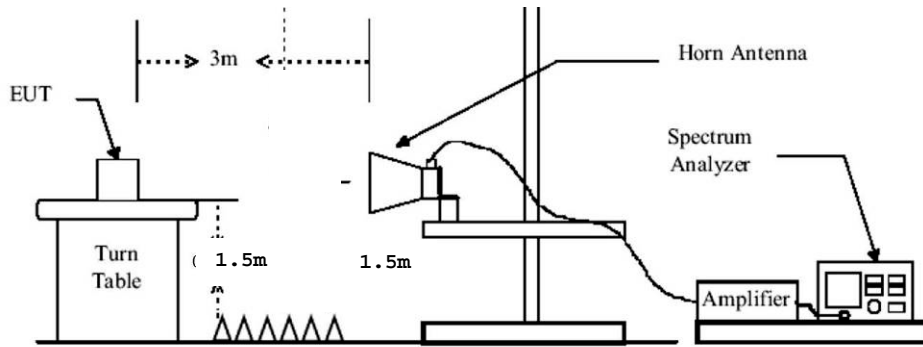
Frequency band investigated:	2400MHz to 2483.5MHz
RBW :	100kHz
Measurement detector :	Peak
Note :	Worst case measurement for standalone watch or Companion + watch

10. Maximum Peak Output power

TEST: Maximum peak conducted output power		Verdict
<p>Method: A radiated measurement is performed. The RBW is wide enough to capture the maximum amplitude level (1MHz). The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. Radiated field strength of RF Output Power is measured at 3m in a Full Anechoic Chamber (FAC) that complies with ANSI C63.10. Maximum field strength (Peak) is performed by rotating the EUT 360°. All frequencies were investigated in both horizontal and vertical antenna polarity. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength, with a 60° rotation on each axis. (Clause 6.6.5 of ANSI C63.10). The tested equipment is set to transmit operation with modulation on low, mid and high channels.</p>		Pass
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	23°C ± 2
Relative Humidity	10 to 90 %	58% ± 5
Limits – FCC Part 15.247 (b) / RSS-247 §5.4 (d)		
Frequency (MHz)	Limits (dBµV/m)	
	Level / Detector	Results
2400 to 2483.5	36 dBm / Pk / 3m (Radiated)	Pass
2400 to 2483.5	30 dBm / Pk (Conducted)	Pass
Supplementary information: Test location: SMEE. Test date: July 5 th , 2018. Tested by L. CHAPUS		

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Turntable	Innco- Systems	CT0800	PLA-141-001		
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2017/3	2019/3

Test Setup for radiated emission



Test setup for 1-25GHz

Tabulated Results for Maximum peak output power (Radiated measurement)

Normal mode (Standalone)

FREQ (MHz)	Field Strength 3m (dBµV/m)	Calculated EIRP (dBm)	Limit (dBm)	Result
2402	91.6	-3.7	36.0	Pass
2440	96.2	0.9	36.0	Pass
2480	94.4	-0.9	36.0	Pass

Charge mode (Companion)

FREQ (MHz)	Field Strength 3m (dBµV/m)	Calculated EIRP (dBm)	Limit (dBm)	Result
2402	90.8	-4.5	36.0	Pass
2440	96.0	0.7	36.0	Pass
2480	94.5	-0.8	36.0	Pass

RBW:	1MHz
Measurement distance:	3m
Limit:	FCC Part 15.247 / RSS-247
Final measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)
RESULT:	PASS

Note:

(1): The field strength (level) is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follow:

$$FS = RA + AF + CF - AG$$
Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain
Total factor (dB) is AF + CF - AG
Margin value = Emission level - Limit value

(2): EIRP is calculated using the following equation:

$$EIRP = E + 20 \times \log(D) - 104.8 - GR$$
Where EIRP = Equivalent Isotropic Radiated Power in dBm
E = Electric field strength in dBµV/m
D = Measuring distance in meter
GR = Ground reflection in dB (0dB above 1GHz)

Tabulated Results for Maximum peak output power (Conducted)			
FREQ (MHz)	Conducted power (dBm)	Limit (dBm)	Result
2402	-3.7	30.0	Pass
2440	0.9	30.0	Pass
2480	-0.8	30.0	Pass
RBW:	1MHz		
Limit:	FCC Part 15.247 / IC RSS-247		
Final measurement detector:	Peak		
RESULT:	PASS		
Note:	<p>(1): Maximum conducted Peak output power is calculated as follow: $P_c = EIRP - G$ Where P_c = Conducted power dBm $EIRP$ = Equivalent Isotropic Radiated Power in dBm G = Antenna gain in dBi (0dBi, as declared by the manufacturer)</p> <p>(2): Worst case measurement for standalone watch and Companion + watch</p>		

11. Maximum Power Spectral Density Level in the fundamental emission

TEST: Maximum Peak Power Spectral Density		Verdict
Method: The PSD is derived from maximum peak output power (Conducted). See chapter 10 for results.		Pass
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	23°C ± 2
Relative Humidity	10 to 90 %	58% ± 5
Limits – FCC Part 15.247 (e) / RSS-247 §5.2 (b)		
Frequency (MHz)	Level (Detector)	Limit
2441.75	8 dBm/3kHz (Pk)	Pass
Supplementary information: Test location: SMEE. Test date: July 5 th , 2018. Tested by L. CHAPUS		

Tabulated Results for Maximum Power Spectral Density			
Frequency (MHz)	PSD (dBm/3kHz)	Limit	Result
2402	-3.7 [1]	8dBm/3kHz	Pass
2440	0.9 [1]	8dBm/3kHz	Pass
2480	-0.8 [1]	8dBm/3kHz	Pass
RBW:	100kHz		
Limit:	FCC Part 15.247 / RSS-247		
Final measurement detector:	Peak		
RESULT:	PASS		
Note:			

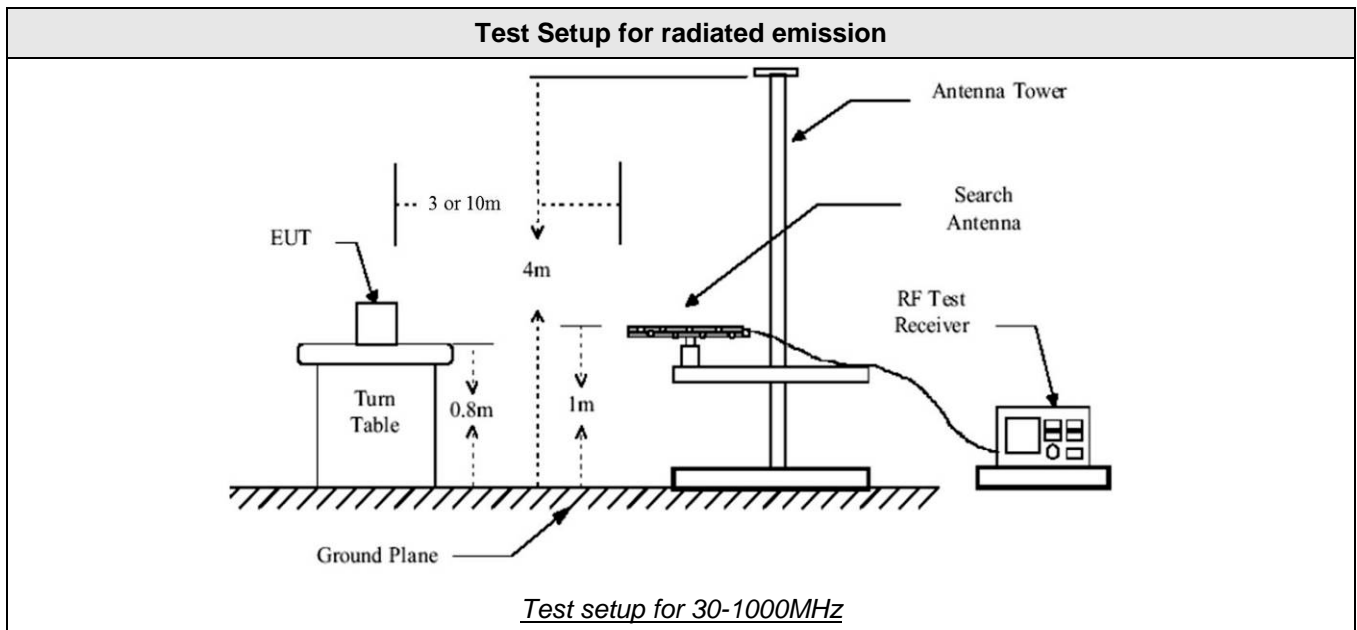
[1]: Measured output power reported. Maximum Peak Output power complies with the PSD limit.
See Clause 11.10.1 of ANSI C63.10 (2013).

12. Unwanted emissions in Non-Restricted Frequency bands

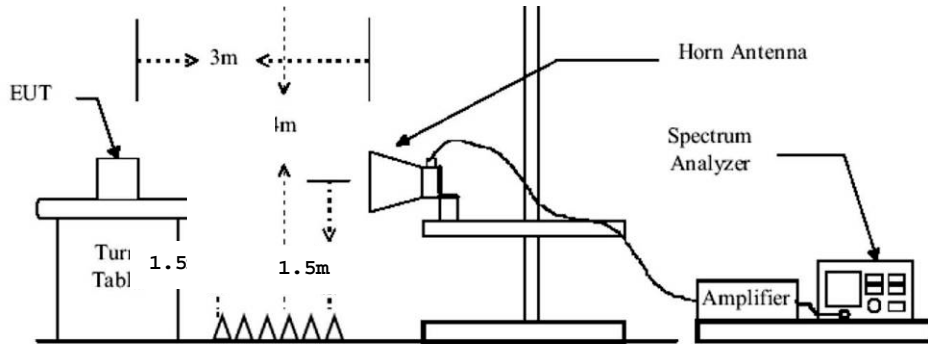
TEST: Unwanted emissions in Non-Restricted Frequency Bands			Verdict
<p>Method: Measurements were performed on a 3-meter Open Area Test Site (OATS) for frequency below 1GHz. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak) were then performed by rotating the EUT on 360° and adjusting the receive antenna height from 1 to 4 m</p> <p>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.</p> <p>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).</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 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.</p>			Pass
Laboratory Parameters:			
	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	23°C ± 2	
Relative Humidity	10 to 90 %	58% ± 5	
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point	
	30MHz – 25GHz	3 m measurement distance	
Limits – FCC Part 15.247 (d) / RSS-247 § 5.5			
Frequency (MHz)	Limits (dBµV/m)		
	Detector / Analyser RBW	Limit	Results
30 to 25000	Pk / 100kHz	20dB below the maximum Peak level	Pass
Supplementary information:			
Test location: SMEE.			
Test date: July 5 th , 2018. Tested by L. CHAPUS			

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

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2017/5	2019/5
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-034	2017/5	2019/5
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001		
Pre-amplifier	PE	1524	PRE-101-002	2017/6	2018/6
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2017/12	2018/12
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2017/3	2019/3
OATS	Div	10m	SIT-101-001	2017/7	2020/7
EMC Software	NEXIO	BAT EMC V3.8	SOF-101-001	-	-



Test Setup for radiated emission



Test setup for 1-25GHz

Tabulated Results for Peak Output Power Reference level

Normal mode (Standalone)

FREQ (MHz)	Field Strength 3m (dB μ V/m)
2402.0	90.7
2440.0	95.3
2480.0	93.5

Charge mode (Companion)

FREQ (MHz)	Field Strength 3m (dB μ V/m)
2402.0	90.9
2440.0	95.1
2480.0	93.6

RBW: 100kHz

Measurement distance: 3m

Limit: Ref. level only – For 15.247 (d) / RSS-247 § 5.5

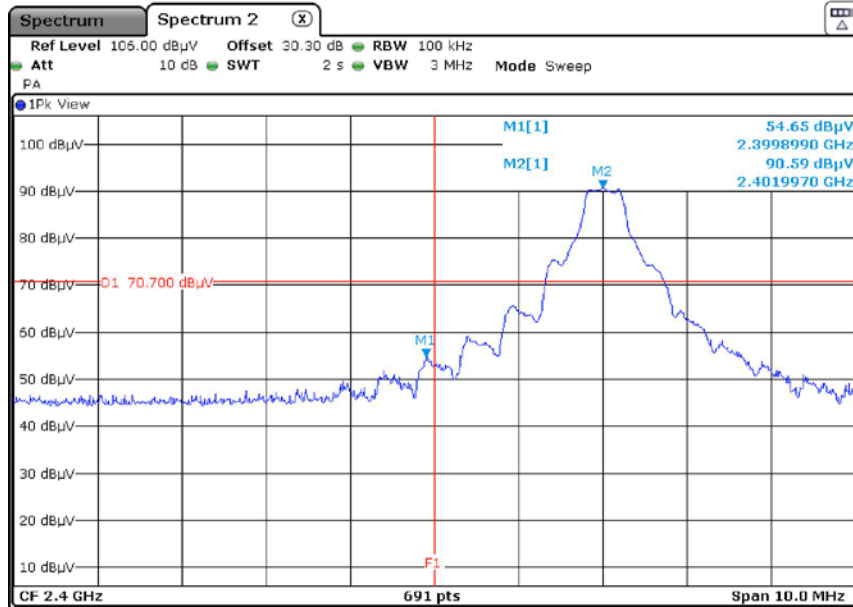
Final measurement detector: Peak

Wide Measurement Uncertainty: ± 5.6 dB (k=2)

Note: (1): Only for identification of limit in non-restricted band
Limit is **70.7 dB μ V/m** Peak for out-of-band frequencies in Non-Restricted bands (with a 100kHz RBW on the spectrum analyser)

Tabulated Results for Unwanted emissions in Non-Restricted bands				
FREQ (MHz)	Field Strength 3m (dBµV/m)	Limit (dBµV/m)	Margin (dBµV/m)	Result (dBµV/m)
2399.899	54.7	70.7	-16.0	Pass
4804.0	57.3	70.7	-13.4	Pass
4880.5	57.1	70.7	-13.6	Pass
4960.5	57.9	70.7	-12.8	Pass
7206.6	55.8	70.7	-14.9	Pass
7320.0	56.3	70.7	-14.4	Pass
9607.2	59.9	70.7	-10.8	Pass
9921.0	60.0	70.7	-10.7	Pass
12010.8	60.8	70.7	-9.9	Pass
RBW:	100kHz			
Measurement distance:	3m			
Limit:	15.247 / RSS-247			
Final measurement detector:	Peak			
Wide Measurement Uncertainty:	± 5.6dB (k=2)			
RESULT:	PASS			
Note:	<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: $FS = RA + AF + CF - AG$ 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</p> <p>(2): Peak pre-scans not performed at 3-meters distance are corrected as follow: $M@3m = M@D_m + 20 \times \log(D_m / 3m)$ Where D is the measurement distance in meter</p> <p>(3): All frequencies not specified have margin < -10dB (4): Worst case between charge mode and normal used mode (5): 3-axis measurement performed for device under test.</p>			

Graphical representation of Band-edge compliance (LOW)



Low bandedge compliance

Radiated Peak level is 54.7dBμV/m (limit 70.7dBμV/m)

RESULT: PASS

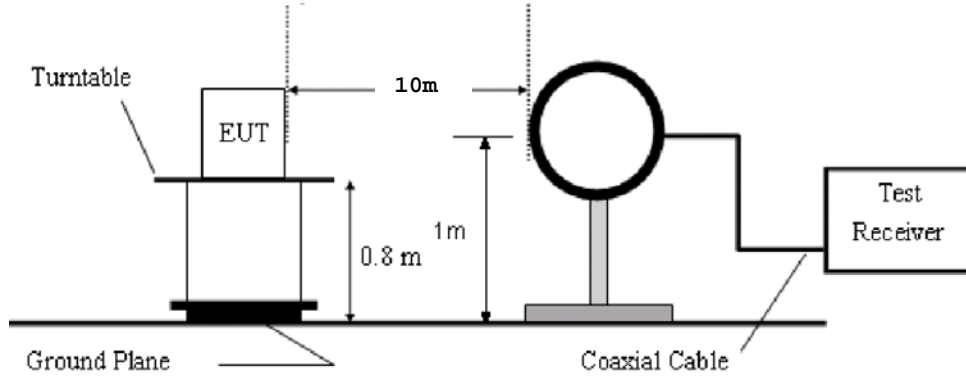
Note: radiated measurement

13. Unwanted emissions in Restricted Frequency bands

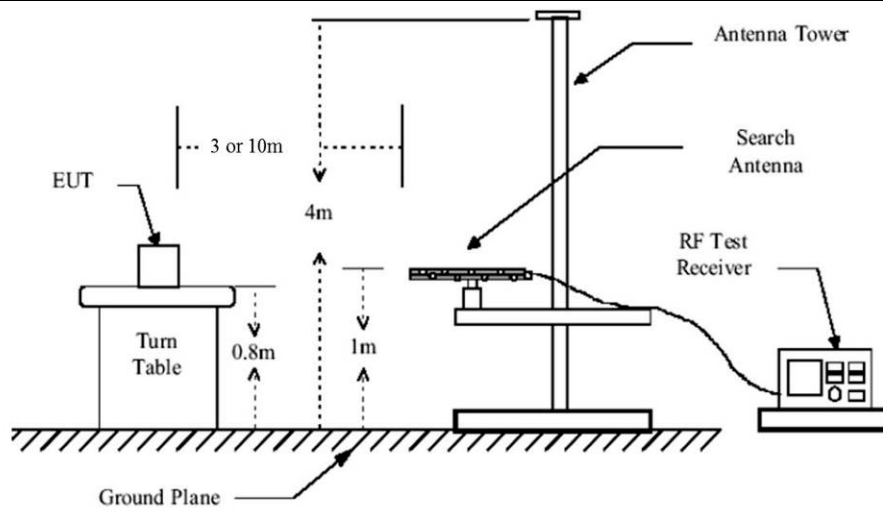
TEST: Unwanted emissions into Restricted Frequency Bands		Verdict
<p>Method: Measurements were performed on a 3-meter Open Area Test Site (OATS) for frequency below 1GHz. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak) were then performed by rotating the EUT on 360° and adjusting the receive antenna height from 1 to 4 m</p> <p>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.</p> <p>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).</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 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.</p>		Pass
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	23°C ± 2
Relative Humidity	10 to 90 %	58% ± 5
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point
	9kHz – 30MHz	10 m measurement distance
	30MHz – 25GHz	3 m measurement distance
Limits – FCC Part 15.205, 15.209 (a), 15.247 (d) / RSS-GEN §8.9, §8.10, RSS-247 §5.5		
Frequency (MHz)	Limits (dBµV/m)	
	Level / Detector / Distance	Results
0.009 to 0.090	107.6 – 87.6 / AV / 10m 127.6 – 107.6 / PK / 10m	Pass
0.090 to 0.110	87.6 – 85.9 / QP / 10m	Pass
0.110 to 0.490	85.7 – 72.9 / AV / 10m 105.7 – 92.9 / PK / 10m	Pass
0.490 to 1.705	52.9 – 42.1 / QP / 10m	Pass
1.705 to 30	48.6 / QP / 10m	Pass
30 to 88	40.0 / QP / 3m	Pass
88 to 216	43.5 / QP / 3m	Pass
216 to 960	46.0 / QP / 3m	Pass
960-1000	54.0 / QP / 3m	Pass
Above 1GHz	54.0 / AV / 3m 74.0 / PK / 3m	Pass
Supplementary information: Test location: SMEE. Test date: July 5 th , 2018. Tested by L. CHAPUS		

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2017/5	2019/5
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2017/5	2019/5
Loop antenna	EMCO	6502	ANT-101-009	2017/8	2019/8
BiConiLog antenna	EMCO	3142B	ANT-101-010	2017/7	2019/7
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2017/12	2022/12
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2017/5	2019/5
RF cable	Div	OATS/25m	CAB-101-017	2018/4	2019/4
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2018/4	2019/4
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2017/5	2019/5
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-034	2017/5	2019/5
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001		
Pre-amplifier	PE	1524	PRE-101-002	2017/6	2018/6
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2017/12	2018/12
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2017/3	2019/3
OATS	Div	10m	SIT-101-001	2017/7	2020/7
EMC Software	NEXIO	BAT EMC V3.8	SOF-101-001	-	-

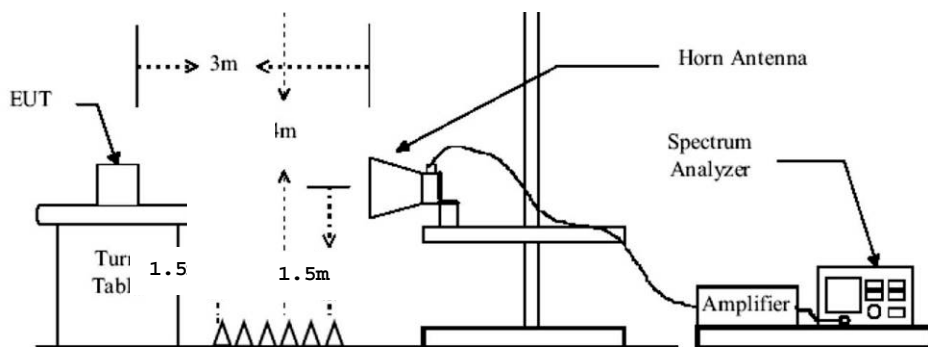
Test Setup for radiated emission



Test setup for 9k-30MHz



Test setup for 30-1000MHz



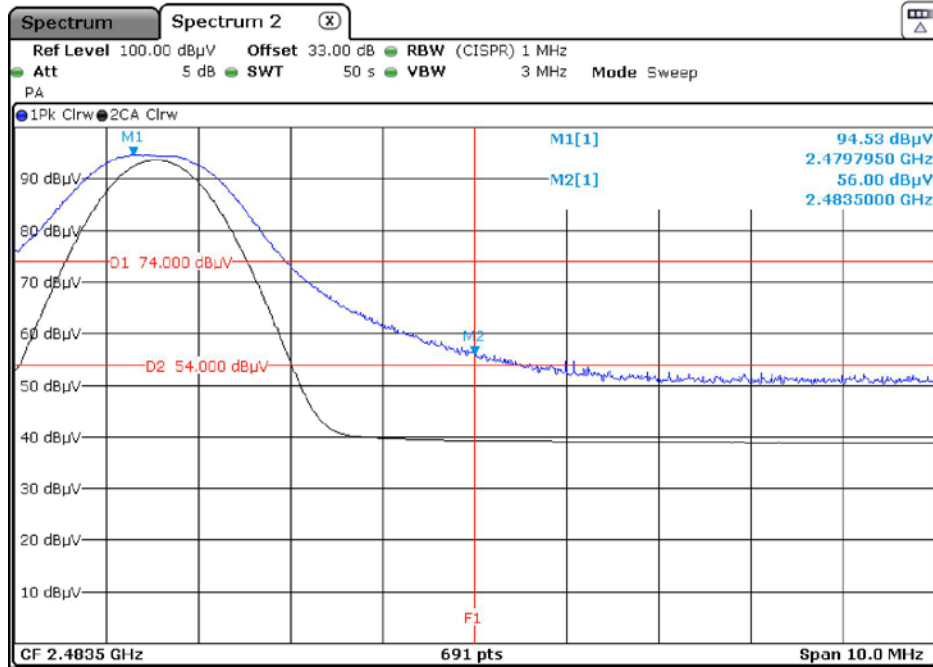
Test setup for 1-25GHz

Tabulated Results for Unwanted emissions (9kHz-30MHz)						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	(QP) dBµV/m	(QP) dBµV/m	dB	Degree	Degree	dB
Margin < -10dB						
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results.						
Frequency band investigated:		9kHz-30MHz				
RBW:		200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)				
Measurement distance:		10m				
Limit:		FCC Part 15.205 - 15.209 / RSS-GEN				
Final measurement detector:		Peak / Quasi-Peak / Average				
Wide Measurement Uncertainty:		± 3.5 dB (k=2)				
Note:		CF: Correction factor = Antenna factor + Cable loss *1: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)				

Tabulated Results for Unwanted emissions (30MHz-1GHz)										
FREQ	Meter reading	Meter reading	Total factor	Field level	Field level	Pol	Antenna height	Table angle	Limit	Margin
MHz	(QP) dBµV	(Pk) dBµV	dB	(QP) dBµV/m	(Pk) dBµV/m		cm	Degré	(QP) dBµV/m	dB
Margin < -10dB										
Supplementary information: Frequency list measured on the Open Area Test Site has been created with pre-scan results.										
Frequency band investigated:		30MHz-1GHz								
RBW:		120kHz								
Measurement distance:		3m								
Limit:		FCC Part 15.205 - 15.209 / RSS-GEN								
Final measurement detector:		Quasi-Peak								
Wide Measurement Uncertainty:		± 5.2dB (k=2)								
RESULT:		PASS								
Field Strength Calculation:		<p>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:</p> $FS = RA + AF + CF - AG$ <p>Where FS = Field Strength RA = Receiver Amplitude 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-26GHz)					
FREQ (MHz)	Field Strength 3m (dB μ V/m)	Detector	Limit (dB μ V/m)	Margin (dB μ V/m)	Result
2483.5	56.0	Pk	74	-18.0	Pass
2483.5	39.3	Avg	54	-14.7	Pass
4804.0	57.3	Pk	74	-16.7	Pass
4804.0	44.2	Avg	54	-9.8	Pass
4880.0	57.3	Pk	74	-16.7	Pass
4880.0	43.3	Avg	54	-10.7	Pass
4960.0	58.0	Pk	74	-16.0	Pass
4960.0	44.7	Avg	54	-9.3	Pass
9608.0	58.9	Pk	74	-5.1	Pass
9608.0	46.3	Avg	54	-7.7	Pass
9760.0	58.2	Pk	74	-5.8	Pass
9760.0	44.6	Avg	54	-9.4	Pass
9920.0	59.5	Pk	74	-14.5	Pass
9920.0	46.2	Avg	54	-7.8	Pass
RBW / VBW		1MHz / 3MHz (Peak) 1MHz / 10Hz (AV)			
Measurement distance:		3m			
Limit:		FCC Part 15.205, 15.209, 15.247 / RSS-Gen, RSS-247			
Final measurement detector:		Peak / Average			
Wide Measurement Uncertainty:		± 5.2 dB (k=2)			
RESULT:		PASS			
Notes:		<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: $FS = RA + AF + CF - AG$ 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</p> <p>(2): Peak pre-scans not performed at 3-meters distance are corrected as follow: $M@3m = M@Dm + 20 \times \log(Dm / 3m)$ Where D is the measurement distance in meter</p> <p>(3): All frequencies not specified have margin < -10dB (for peak and average detector)</p> <p>(4): Worst case between charge mode and normal used mode</p> <p>(5): 3-axis measurement performed for device under test.</p>			

Graphical representation of Band-edge compliance (HIGH)



High bandedge compliance

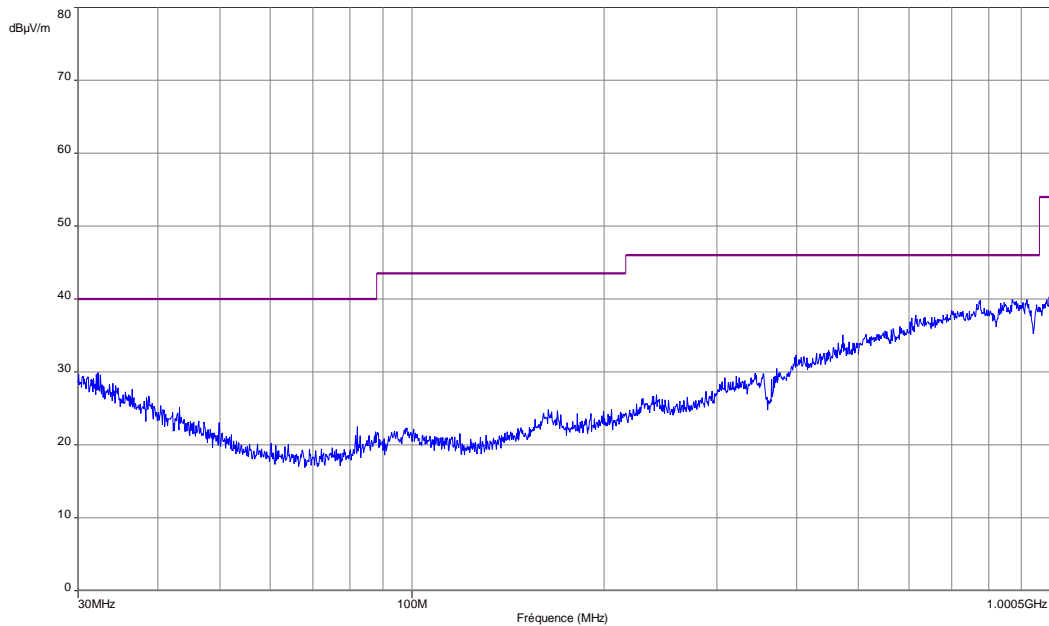
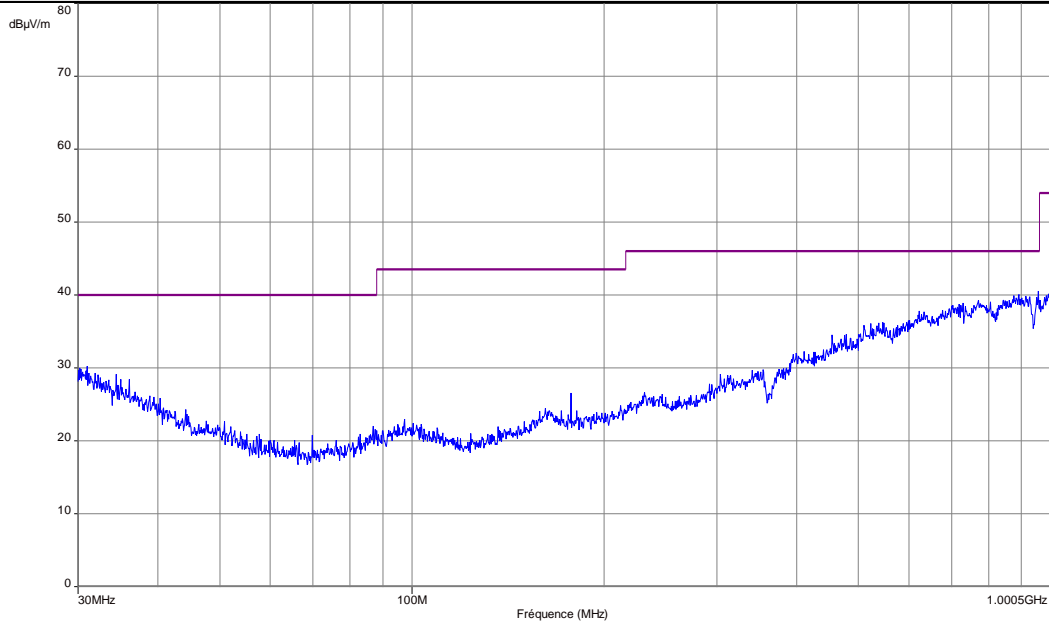
Radiated Peak level is 56.0dBµV/m (limit 74dBµV/m)

Radiated Average level is 39.3dBµV/m (limit 54dBµV/m, CISPR Average detector measurement)

RESULT: PASS

Note: radiated measurement

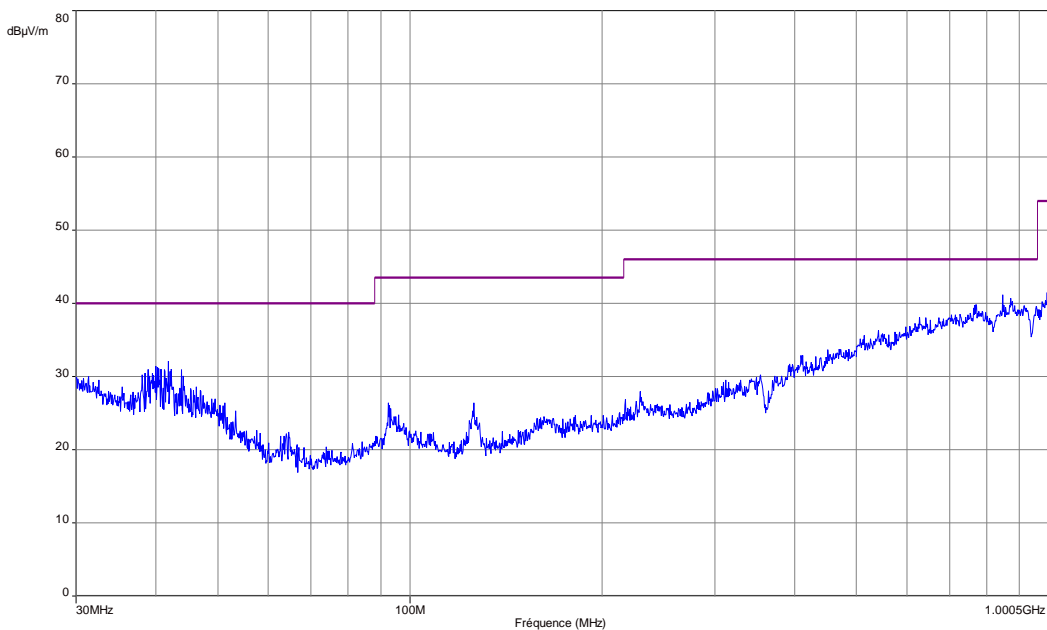
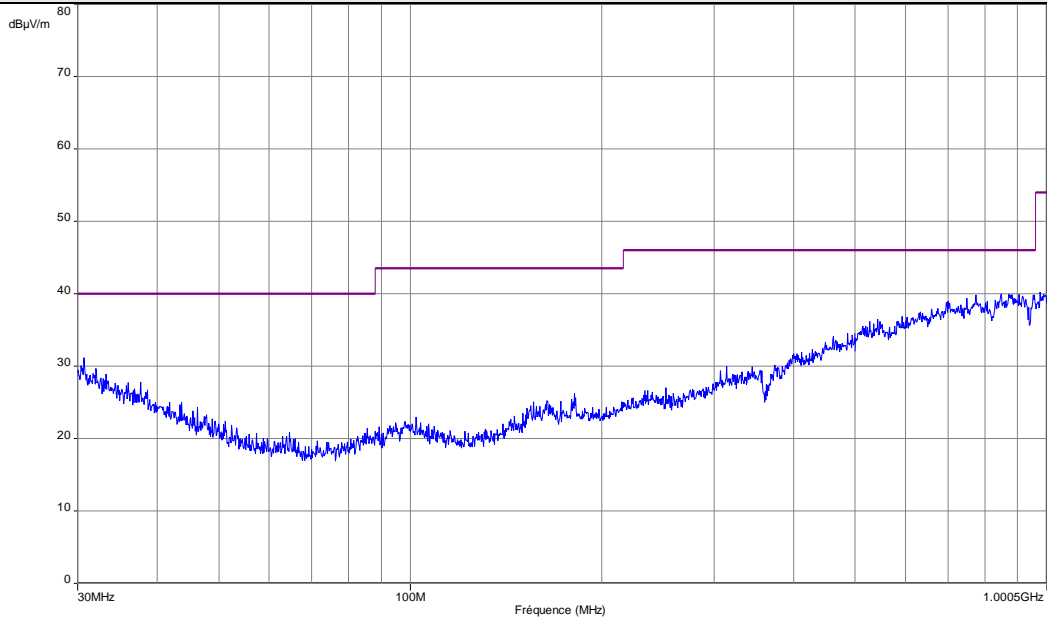
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal & Vertical/ Transmit mode) – Standalone



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

Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.7V DC (Internal battery)
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)

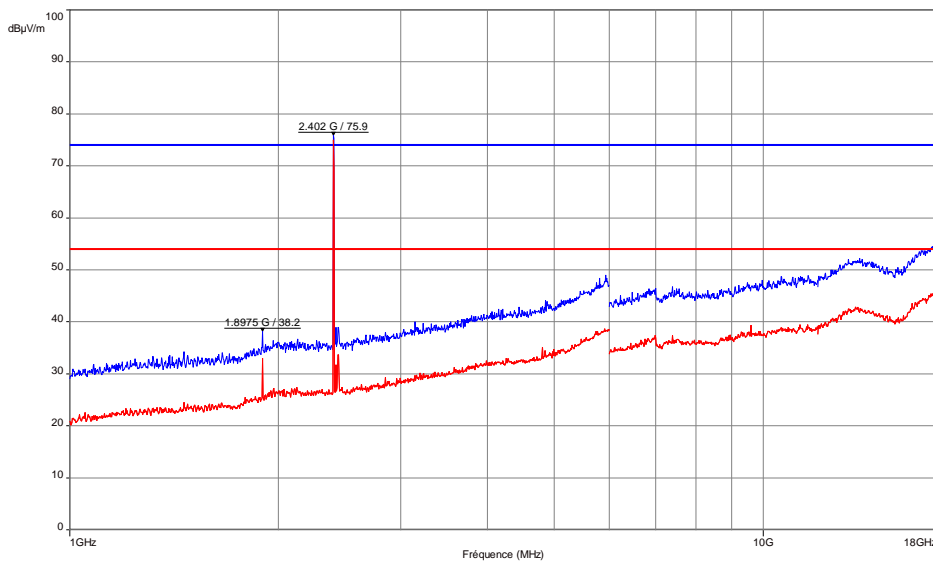
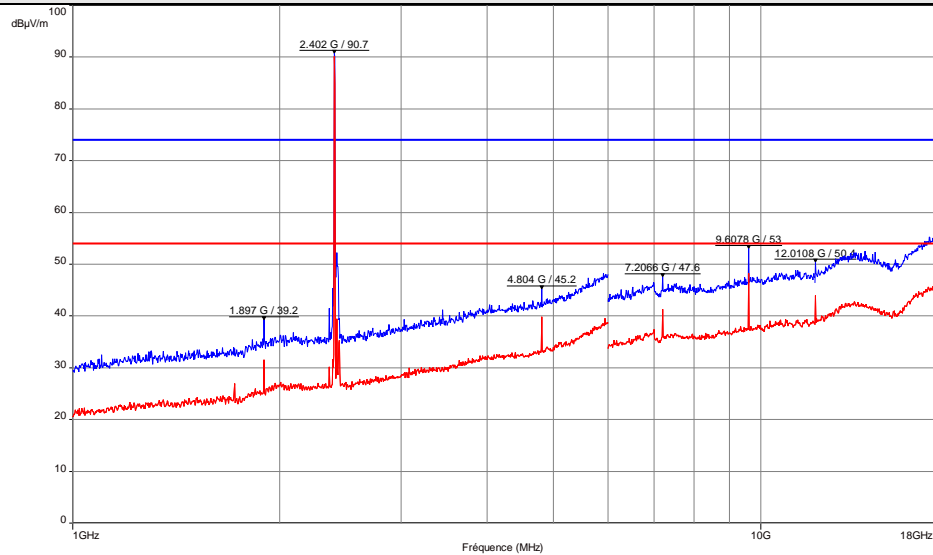
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal & Vertical / Transmit mode) – Companion



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

Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC (From power adapter)
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)

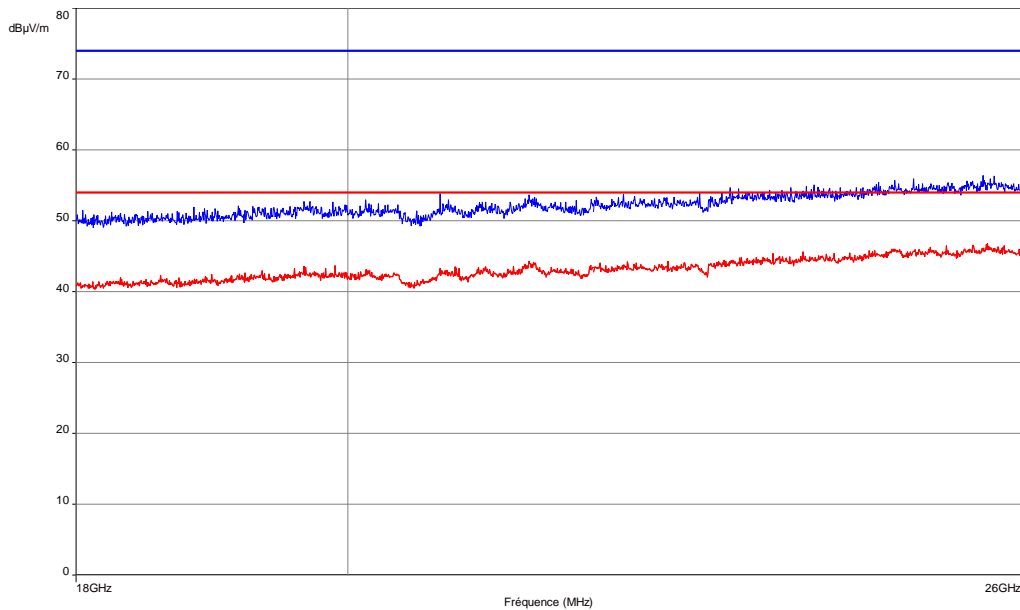
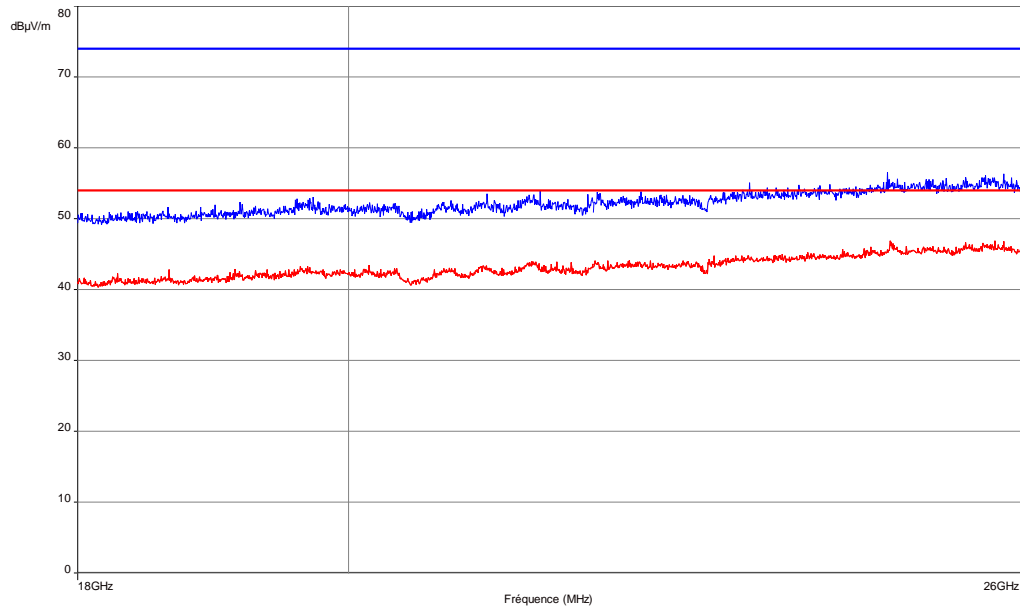
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical / Transmit mode) – Low channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-18GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.7V DC (Standalone mode) / 5V DC (Charge mode) / Worst case
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)

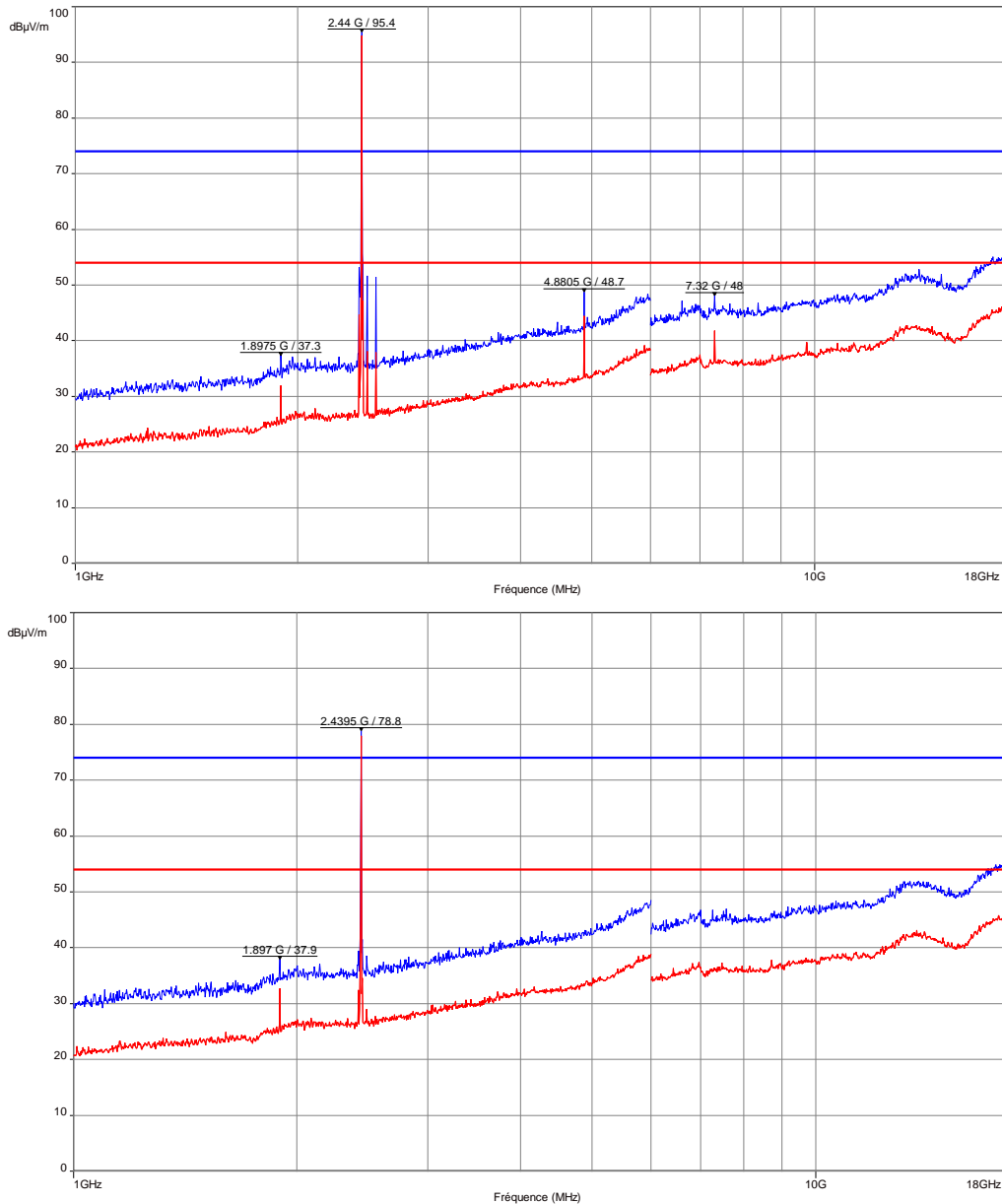
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-26GHz / 3m / Horizontal & Vertical / Transmit mode) – Low channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.7V DC (Standalone mode) / 5V DC (Charge mode) / Worst case
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)

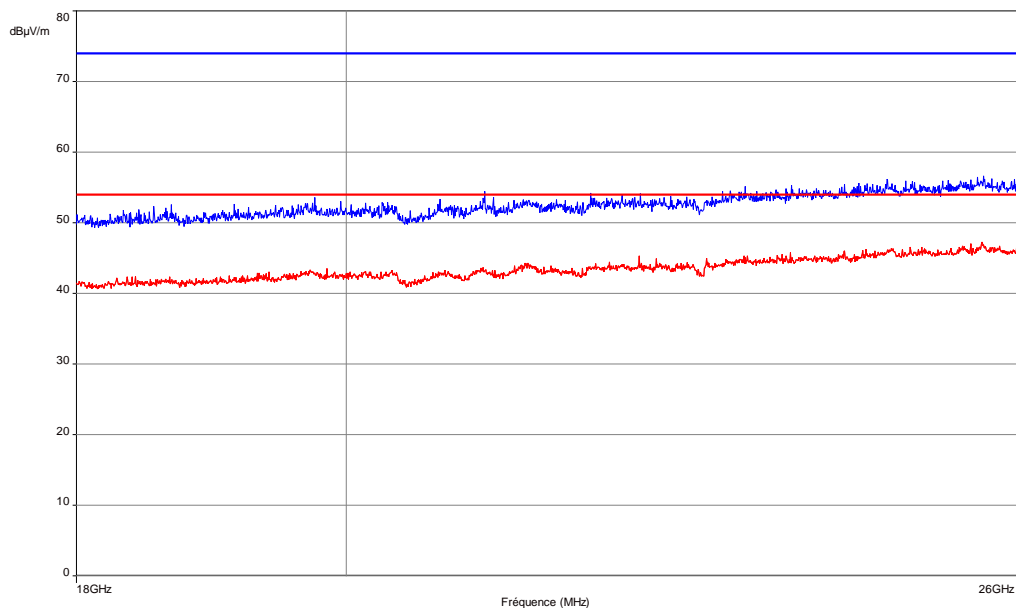
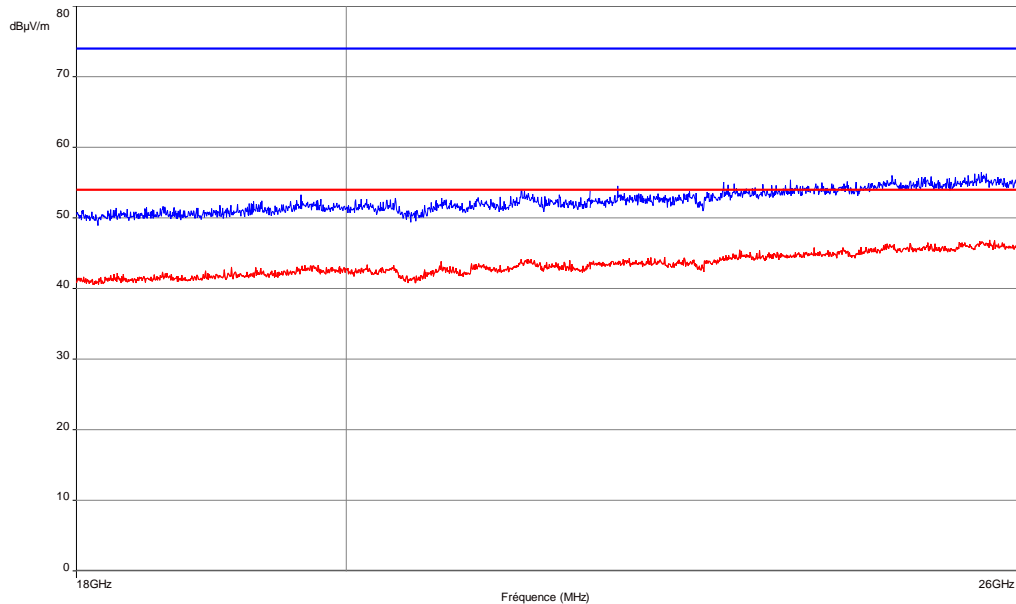
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18 GHz / 3m / Horizontal & Vertical / Transmit mode) – Mid channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-18GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.7V DC (Standalone mode) / 5V DC (Charge mode) / Worst case
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)

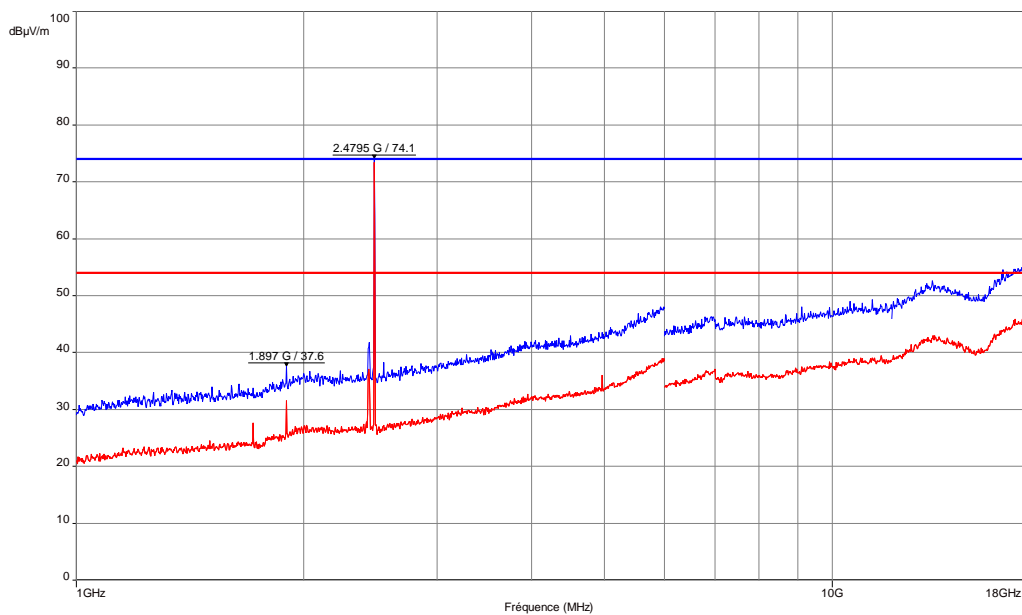
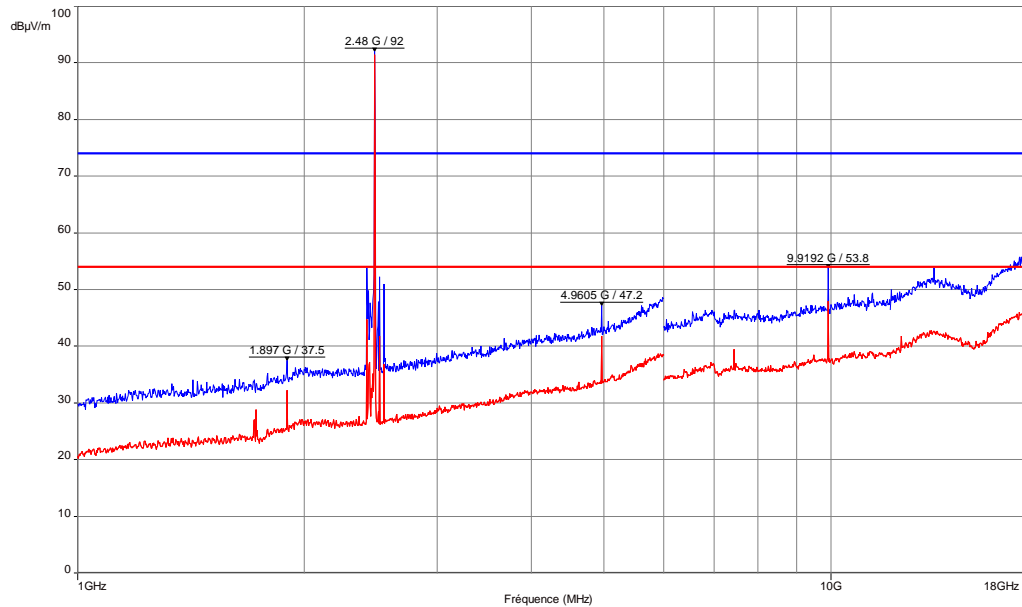
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 18GHz-26GHz / 3m / Horizontal & Vertical / Transmit mode) – Mid channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.7V DC (Standalone mode) / 5V DC (Charge mode) / Worst case
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)

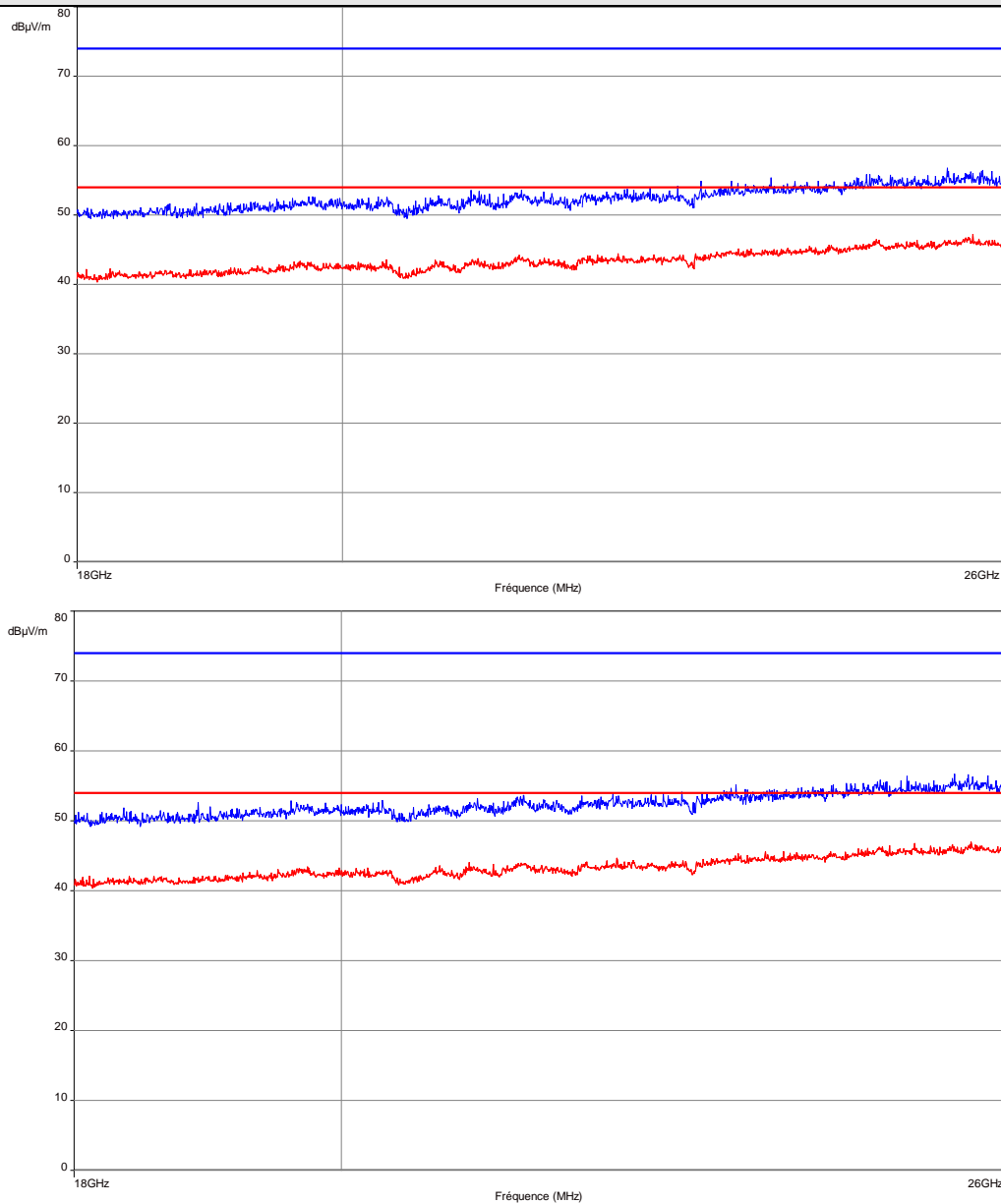
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-18GHz / 3m / Horizontal & Vertical / Transmit mode) – High channel



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	1GHz-18GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.7V DC (Standalone mode) / 5V DC (Charge mode) / Worst case
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)

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



Note: Pre-scan graph only for identification purpose.

----- : Peak measure	----- : Average measure
Frequency band investigated:	18GHz-26GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.7V DC (Standalone mode) / 5V DC (Charge mode) / Worst case
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5.6dB (k=2)

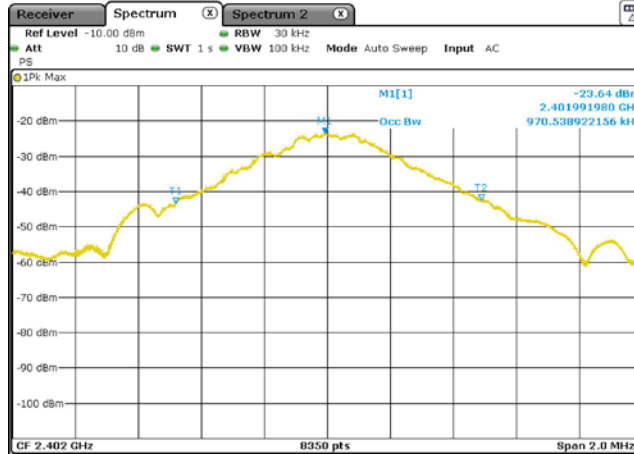
14. Occupied bandwidth (99%)

TEST: Occupied bandwidth (99%) / RSS-GEN			Verdict
<p>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 $\geq 3 \times$ 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.</p>			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	23°C \pm 2	
Relative Humidity	10 to 90 %	54% \pm 5	
Supplementary information: Test location: SMEE. Test date: September 4 th , 2018. Tested by L. CHAPUS			

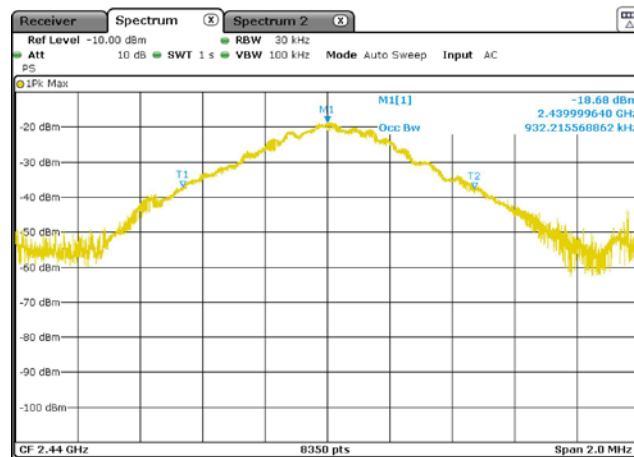
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Horn antenna	ETS-LINDGREN	3115	ANT-141-013	2014/3	2019/3
RF cable	Pasternack RF	PE302-120	CAB-131-024	2018/4	2019/4
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2018/4	2019/4
Anechoic chamber	COMTEST	214263	CAG-141-001	2017/6	2020/6
Turntable	Innco- Systems	CT0800	PLA-141-001		
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-003	2017/3	2019/3

Tabulated Results for Occupied Bandwidth	
Frequency (MHz)	99% Occupied Bandwidth (kHz)
2402.0	970.539
2440.0	932.216
2480.0	954.491

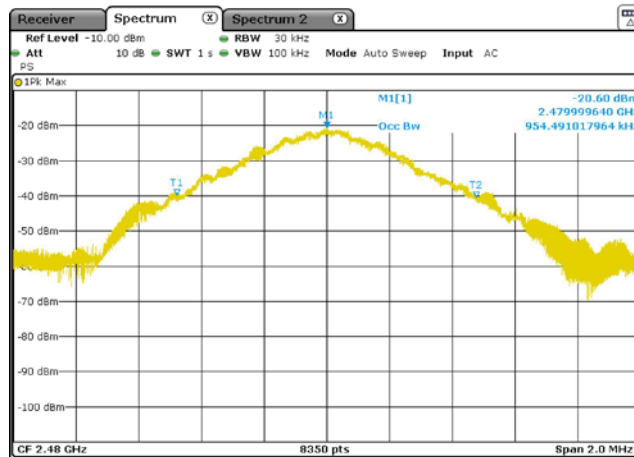
Graphical representation of Occupied Bandwidth



Low Channel



Mid Channel



High Channel

Frequency band investigated:	2400MHz to 2483.5MHz
RBW :	30kHz
Measurement detector:	Peak