

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

Matériel testé :
Equipment under test:

MEMS8 Reader

Constructeur:
Manufacturer: **WestRock Switzerland Ltd.**
Av de la Gare 29
CH-1950 Sion - Switzerland

Rapport délivré à :
Issued to: **WestRock Switzerland Ltd.**
Mr Nicolas Tille
Av de la Gare 29
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Référence de la proposition : 092015-21615
Proposal number:

Date de l'essai : Du 13 au 18 octobre 2016
Date of test: **October 13th to 18th, 2016**

Objectif des essais : EMC qualification accordingly to following standards:
Test purpose: - CFR 47, FCC Part 15, Subpart B and Subpart C
(Chapter 15.225 - Operation within the band 13.110-14.010 MHz)
- Industry Canada, RSS-Gen Issue 4 & RSS-210 Issue 9, section B.6
(Bands 13.110-14.010 MHz)

FCC ID: 2AJUO2070-20-1
IC ID : 21950-2070201
Model : MEMS8 Reader

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

Test réalisé par : Jérémy BLANCHER
Test realized by:

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

Ed.	Date	Modifications Pages	Written by:	Approved by: Visa
1	December 15 th , 2016	Initial Edition	Jeremy Blancher	Laurent Chapus
2	January 16 th , 2017	TCB review		

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COORDONNEES

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SAS au capital de 50 000 € / RC Grenoble B534 796 453 / SIRET 534 796 453 00015 / code APE 7490B / n° TVA : FR 59 534 796 453

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1. Normatives References

FCC qualification following:		
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 / 15.225

Industry Canada qualification following:		
Standards	Applied	Title
RSS-Gen (Issue 4/2014)	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.6: Band 13.110-14.010MHz

2. Test synthesis

TEST	Paragraph number FCC Part 15 IC RSS-210	Spec. FCC Part 15 IC RSS-210	RESULTS (comments)
Conducted emissions test	15.107 (a) / 15.207 (a) RSS-Gen: Issue 4, §8.8	Table 15.107 (a) / 15.207 (a) Table 3, §8.8	PASS
Field Strength of fundamental	15.225 (a) (b) (c) RSS-210: Issue 9, §B.6 (a) (b) (c)	Measure at 30m 13.110-13.410 MHz: 40.5dBμV/m 13.410-13.553 MHz: 50.5dBμV/m 13.553-13.567 MHz: 84.0dBμV/m 13.567-13.710 MHz: 50.5dBμV/m 13.710-14.010 MHz: 40.5dBμV/m	PASS
Fundamental frequency tolerance	15.225 (e) RSS-210: Issue 9, §B.6	shall be maintained to ±0.01% (±100 ppm)	PASS
Unwanted emissions outside the specified frequency band	15.109 / 15.209 / 15.225 (d) RSS-210: Issue 9, §B.6 (d) / RSS-Gen: Issue 4, §8.9	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	15.215 (c) RSS-Gen: Issue 4, §6.6	BW at -20dB BW at 99%	PASS

N/A: Not Applicable

• General conclusion:

Measures and tests performed on the sample of the products *MEMS8 Reader*, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart B and C and Industry Canada RSS-Gen & RSS-210.

3. Equipment Under Test (EUT)

**Nom /
Identification**

MEMS8 Reader

Sn: 0X10

**Alimentation /
Power supply**

5V DC from USB port

**Auxiliaires /
Auxiliaries**

- Laptop ASUS, model F200M and its power supply
- MEMS8 X012 Tag
- MEMS8 X020 Tag
- EDP8 X005 Tag

**Entrées-Sorties /
Input / Output**

	Câbles pour essai / Cables for test	Blindé / Shielded	Prévu pour >3m / Intended for >3m
USB 2.0	1m	Yes	No

**Version programme /
Firmware version**

V1.0

**Mode de fonctionnement /
Running mode**

Equipment is wired and powered by ancillary laptop via USB cable.
The tested sample is able to:
- transmit a modulated carrier at 13.56MHz (TAG reading)

**Programme de test /
Test program /**

ContinuousRead.exe test program

• Equipment information:

- Frequency band: 13.110-14.010 MHz (13.56MHz reader)
- Antenna type: PCB loop antenna
- Powered by 5V DC (from USB)
- Equipment intended for use as a fixed station
- Equipment designed for continuous operation

4. Test conditions

Relative Humidity : 55%
Temperature : 20°C

Power supply voltage:

Equipment under test : 5V DC from USB power port

5. Modifications of the EUT

A ferrite (WURTH ELEKTRONIK, model 742 711 11S) is added on USB cable on PC's side.



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

TEST: Limits for conducted disturbance 150kHz – 30MHz / FCC part 15.107 / 15.207 - RSS-Gen				Verdict
<u>Method:</u> 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		10 to 40 °C		20°C
Relative Humidity		10 to 90 %		55%
Fully configured sample scanned over the following frequency range		Frequency range on each side of line		Measurement Point
		150kHz to 30MHz		AC input port (110V on laptop power supply)
Running mode		Transmit on each available tag		
Limits – FCC Part 15.107 / 15.207 (a) / RSS-Gen §8.8				
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 – CE Mesures Test date: October 17 th , 2016 Power supply voltage: 110V / 60Hz for ancillary power supply / 5V DC via USB port for EUT				

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Attenuator / limiter	SMEE	ATT#1	ATT-101-004	2016/3	2017/3
Cable RF	Div	2m	CAB-101-007	2016/3	2017/3
LISN (50Ω / 50µH)	AFJ	LS16C	RSI-101-001	2016/3	2017/3
LISN (50Ω / 50µH)	AFJ	LS16C	RSI-101-002	2016/3	2017/3
Measuring Rec	Rohde&Schwarz	ESRP	REC-151-021	2015/7	2018/7
Ref. Comb generator	SMEE	EMC-250K	REF-111-001	-	-

Tabulated Results for Mains Terminal Disturbance Voltage on AC port

With MEMS8 X012 TAG

FREQ (MHz)	Meas. PK (dBμV)	Mes. QP (dBμV)	LIMIT QP (dBμV)	Margin QP (dB)	Mes. AV (dBμV)	LIMIT AV (dBμV)	Margin AV (dB)	Line
0.154	55.0	52.0	65.8	-13.8	35.5	55.8	-20.3	Line 1
0.198	47.3	42.5	63.7	-21.2	30.7	53.7	-23.0	Line 1
0.246	40.6	35.2	61.8	-26.6	25.7	51.8	-26.0	Line 1
0.490	41.2	38.7	56.2	-17.5	26.1	46.2	-20.1	Line 1
13.560	47.4	45.9	60.0	-14.1	45.0	50.0	-5.0	Line 1
27.120	39.0	38.0	60.0	-22.0	37.4	50.0	-12.6	Line 1
0.154	54.3	50.7	65.8	-15.1	31.3	55.8	-24.5	Neutral
0.19	47.0	44.3	63.9	-19.5	32.6	53.9	-21.3	Neutral
0.234	45.9	41.9	62.2	-20.3	28.1	52.2	-24.1	Neutral
0.442	45.1	42.6	57.1	-14.5	30.2	47.1	-16.9	Neutral
13.56	46.7	45.2	60.0	-14.8	44.3	50.0	-5.8	Neutral
27.12	38.6	37.5	60.0	-22.5	36.7	50.0	-13.3	Neutral

With MEMS8 X020 TAG

FREQ (MHz)	Meas. PK (dBμV)	Mes. QP (dBμV)	LIMIT QP (dBμV)	Margin QP (dB)	Mes. AV (dBμV)	LIMIT AV (dBμV)	Margin AV (dB)	Line
0.150	56.0	49.6	66.0	-16.4	27.7	56.0	-28.3	Line 1
0.190	48.3	43.8	64.0	-20.2	31.6	54.0	-22.4	Line 1
0.238	40.6	36.4	62.2	-25.8	26.4	52.2	-25.7	Line 1
0.470	42.0	40.0	56.5	-16.6	28.3	46.5	-18.2	Line 1
4.564	36.7	30.2	56.0	-25.8	22.0	46.0	-24.0	Line 1
13.560	46.9	45.5	60.0	-14.5	44.3	50.0	-5.7	Line 1
27.120	33.2	31.9	60.0	-28.1	30.7	50.0	-19.3	Line 1
0.182	49.8	45.1	64.4	-19.3	29.6	54.4	-24.8	Neutral
0.226	44.9	39.7	62.7	-23.1	27.0	52.7	-25.8	Neutral
0.274	43.9	37.6	61.1	-23.5	24.6	51.1	-26.6	Neutral
0.450	46.7	44.0	56.8	-12.8	32.7	46.8	-14.1	Neutral
13.560	46.5	45.0	60.0	-15.0	44.1	50.0	-5.9	Neutral
27.120	33.4	31.8	60.0	-28.2	30.6	50.0	-19.4	Neutral

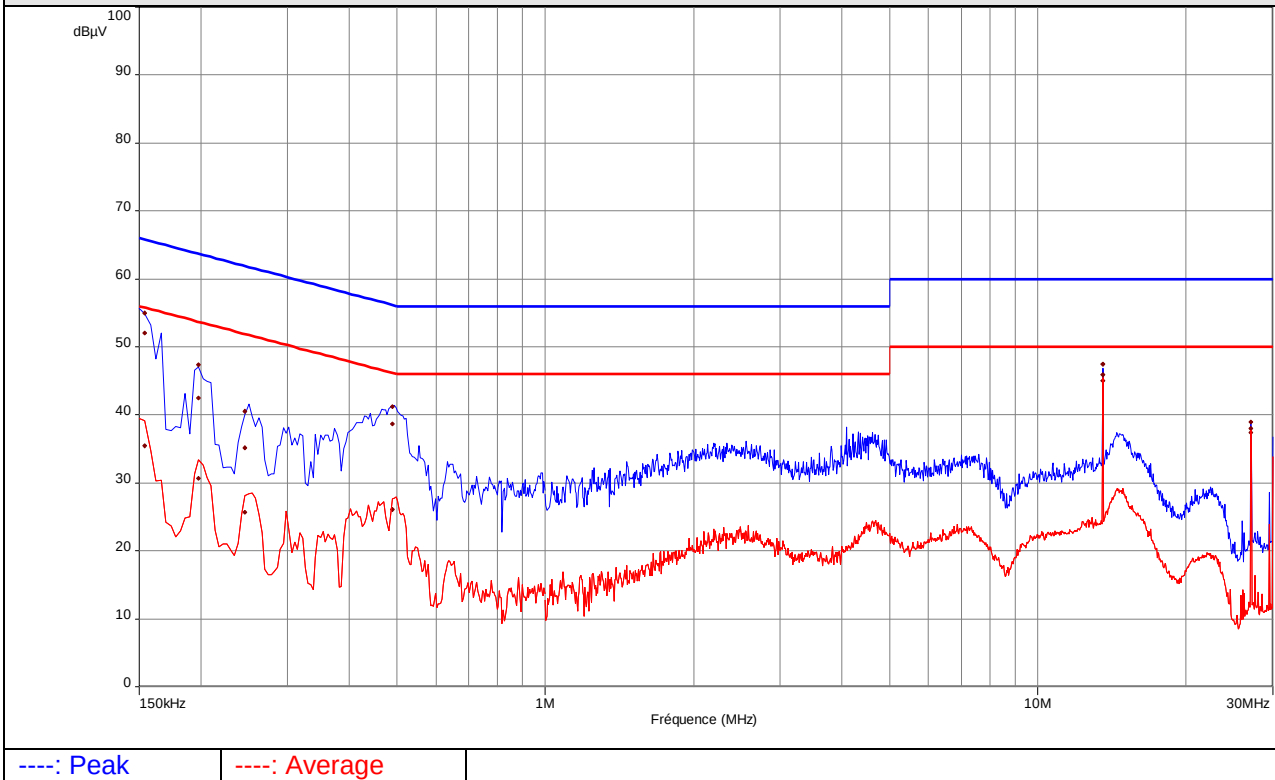
Frequency band investigated:	150kHz-30MHz
RBW:	9kHz
Voltage:	110V / 60Hz
Limit:	FCC Part 15.207 / RSS-Gen
Final measurement detector:	Quasi-Peak and Average
Wide Measurement Uncertainty:	± 3.6dB (k=2)
RESULT:	PASS
Measured value calculation:	The measured value (level) is calculated by adding the Cable 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

Tabulated Results for Mains Terminal Disturbance Voltage on AC port

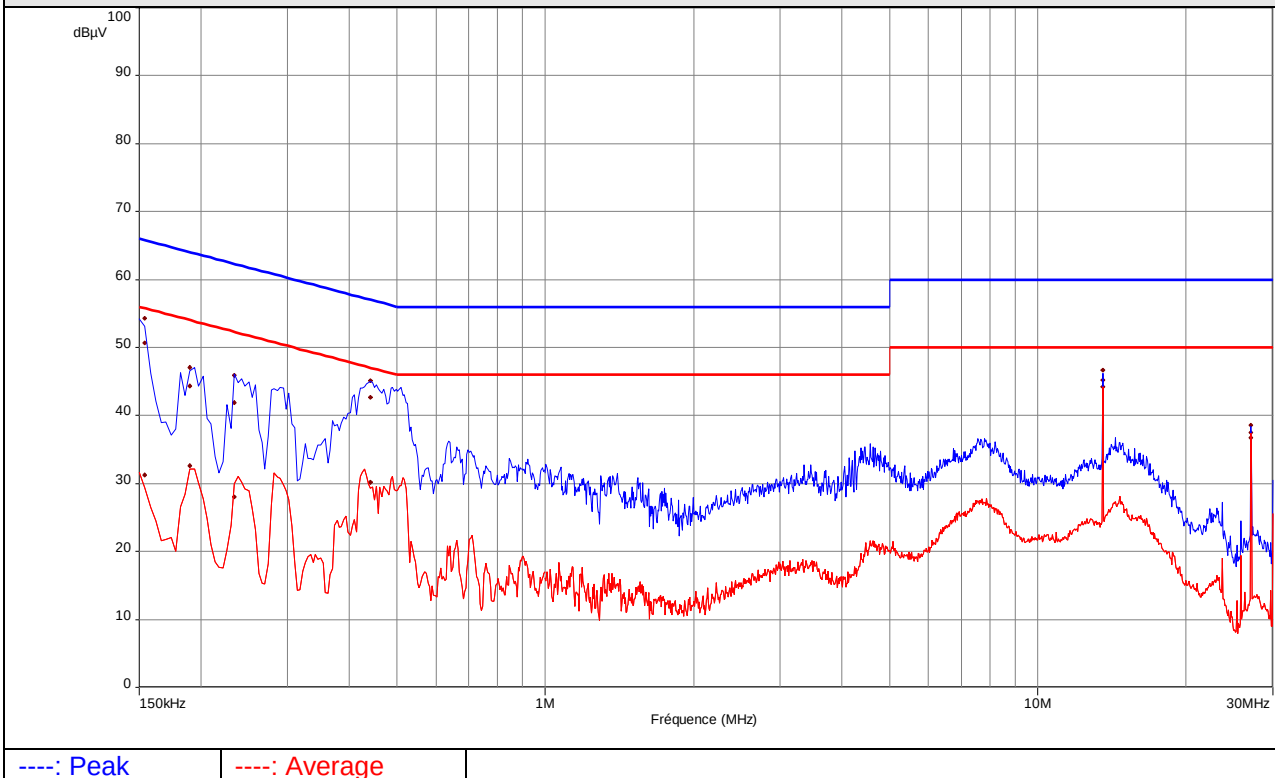
With EDP8 X005 TAG

FREQ (MHz)	Meas. PK (dBμV)	Mes. QP (dBμV)	LIMIT QP (dBμV)	Margin QP (dB)	Mes. AV (dBμV)	LIMIT AV (dBμV)	Margin AV (dB)	Line
0.174	50.1	46.5	64.6	-18.1	32.8	54.6	-21.8	Line 1
0.462	43.0	40.6	56.7	-16.1	28.7	46.7	-18.0	Line 1
13.56	45.2	43.5	60.0	-16.5	42.5	50.0	-7.5	Line 1
0.174	50.2	45.9	65.0	-19.1	29.7	55.0	-25.3	Neutral
0.458	47.1	44.2	56.8	-12.6	32.9	46.8	-13.9	Neutral
13.56	44.7	43.0	60.0	-17.0	41.8	50.0	-8.2	Neutral
Frequency band investigated:		150kHz-30MHz						
RBW:		9kHz						
Voltage:		110V / 60Hz						
Limit:		FCC Part 15.207 / RSS-Gen						
Final measurement detector:		Quasi-Peak and Average						
Wide Measurement Uncertainty:		± 3.6dB (k=2)						
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						

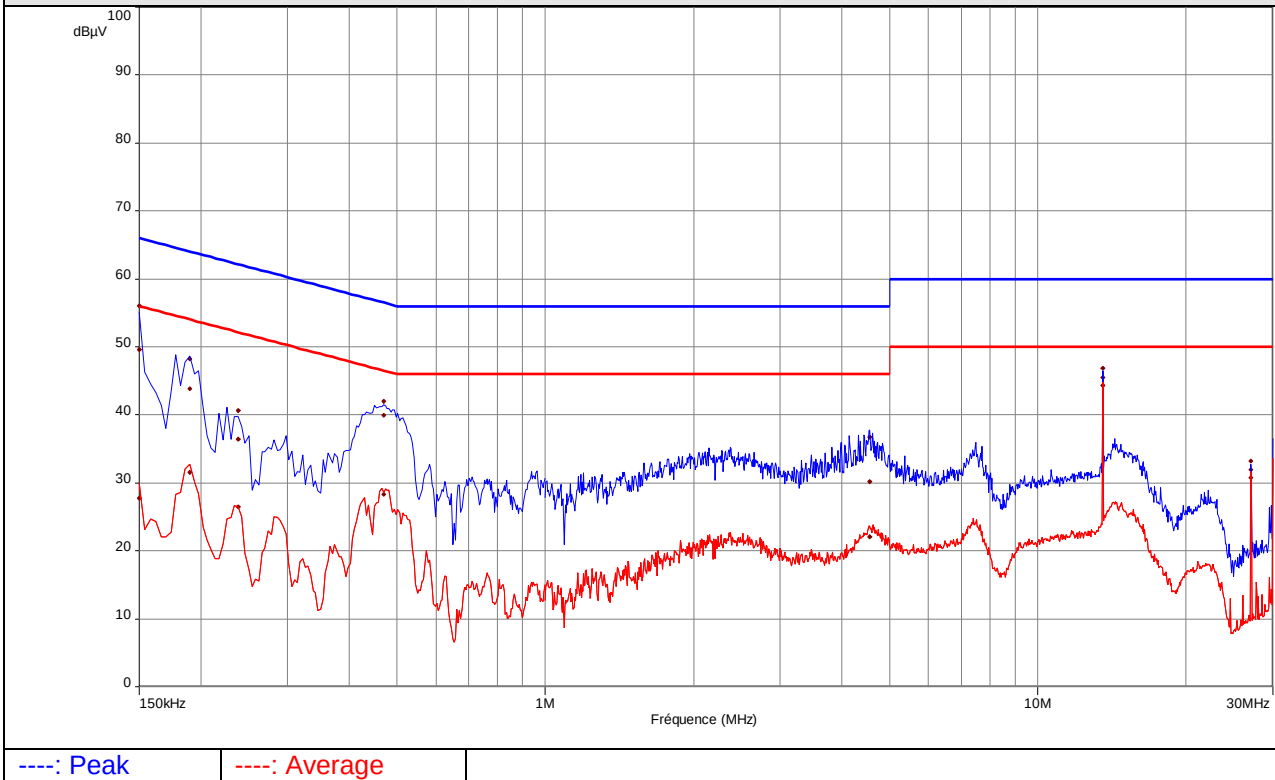
Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line L1 – With MEMS8 X012 TAG



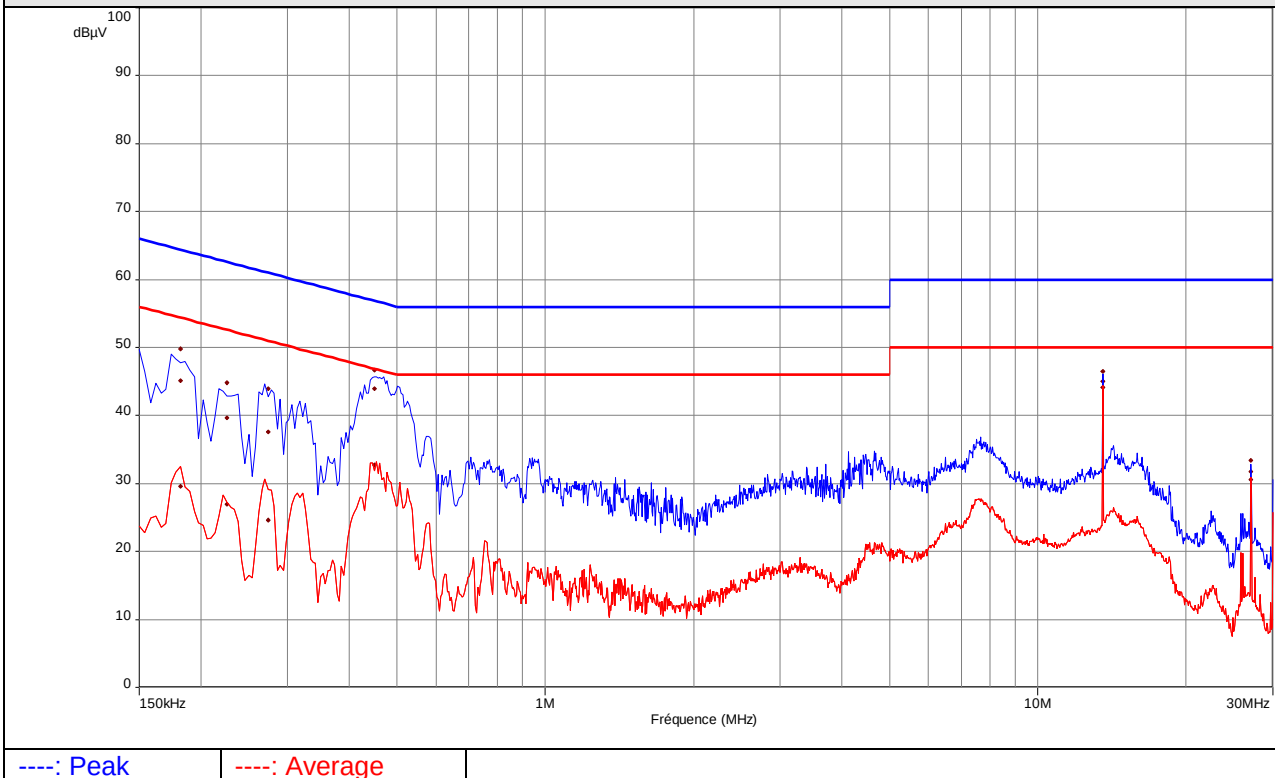
Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line Neutral – With MEMS8 X012 TAG



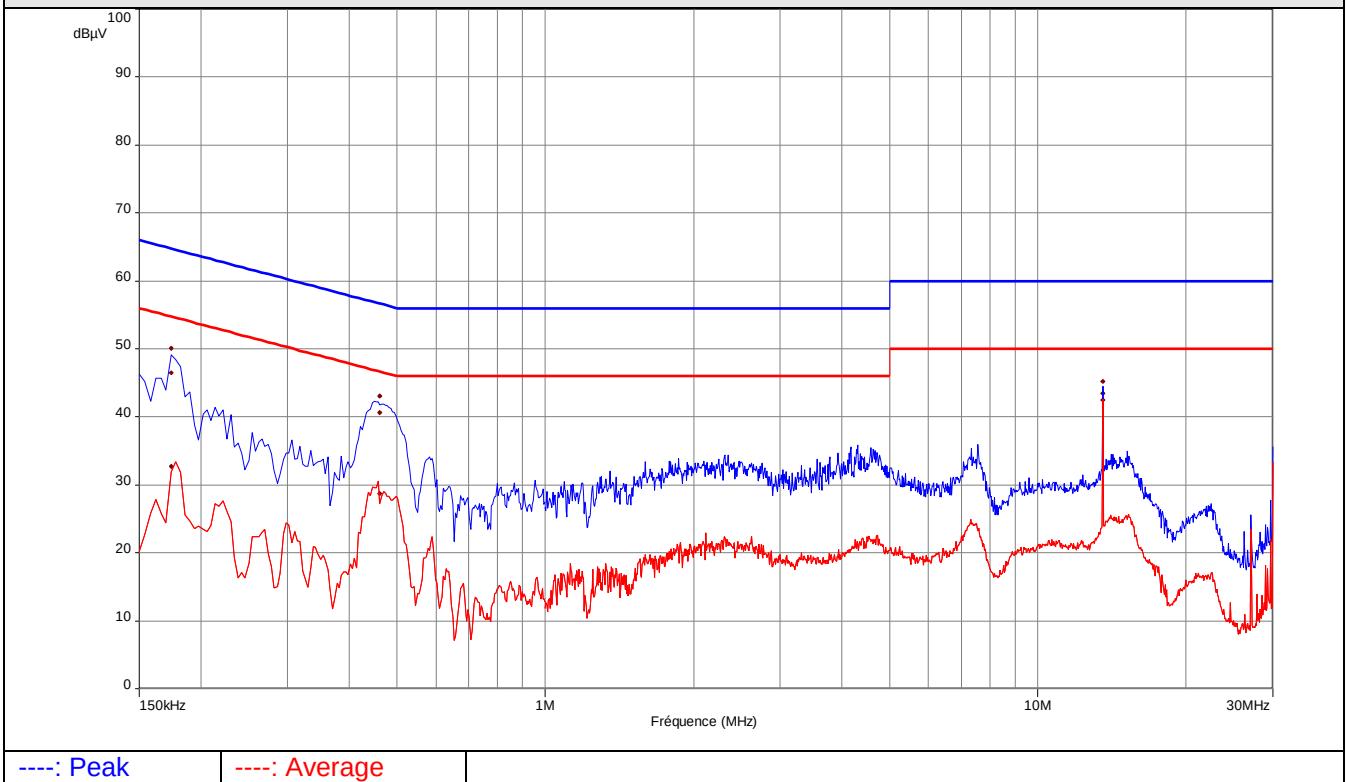
Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line L1 – With MEMS8 X020 TAG



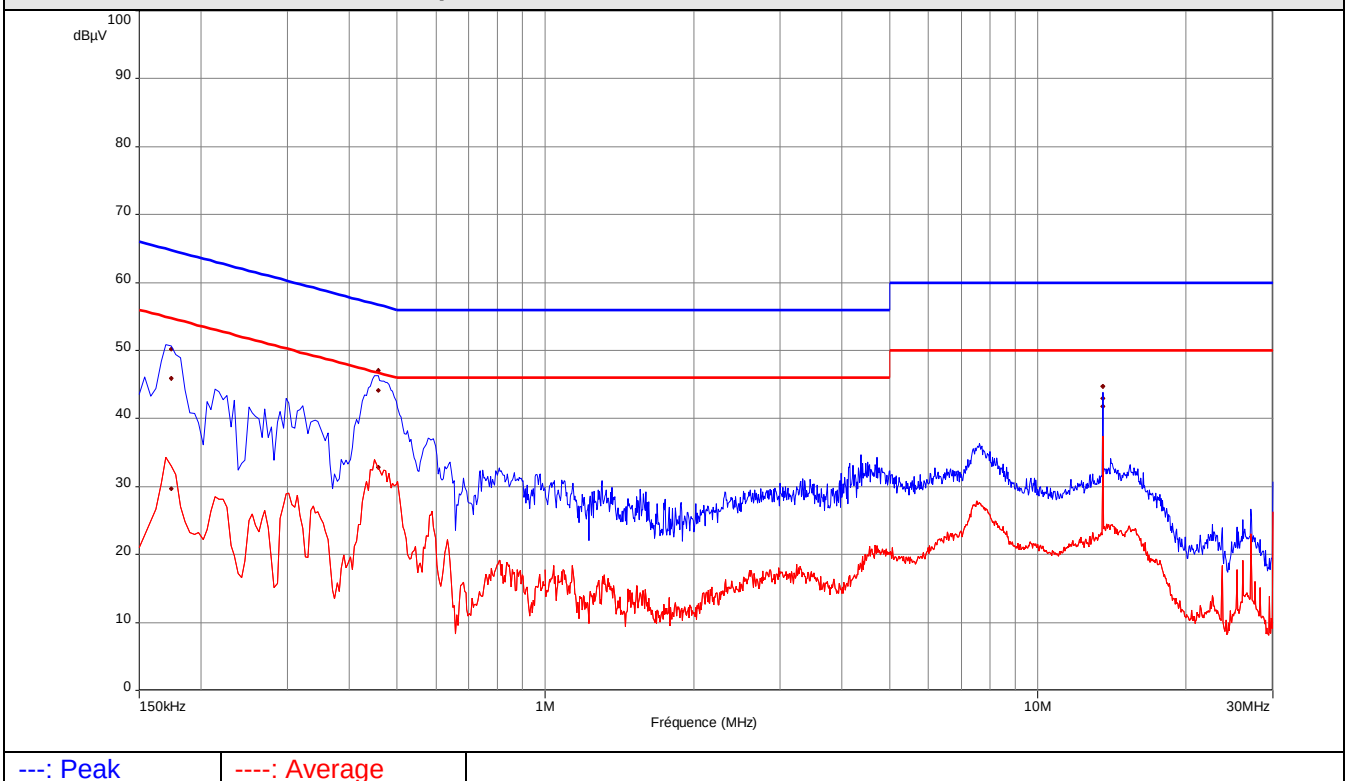
Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line Neutral – With MEMS8 X020 TAG



Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line L1 – With EDP8 X005 TAG



Graphical representation of Conducted Disturbance Measurement (Peak and Average detection) AC port, Line Neutral – With EDP8 X005 TAG



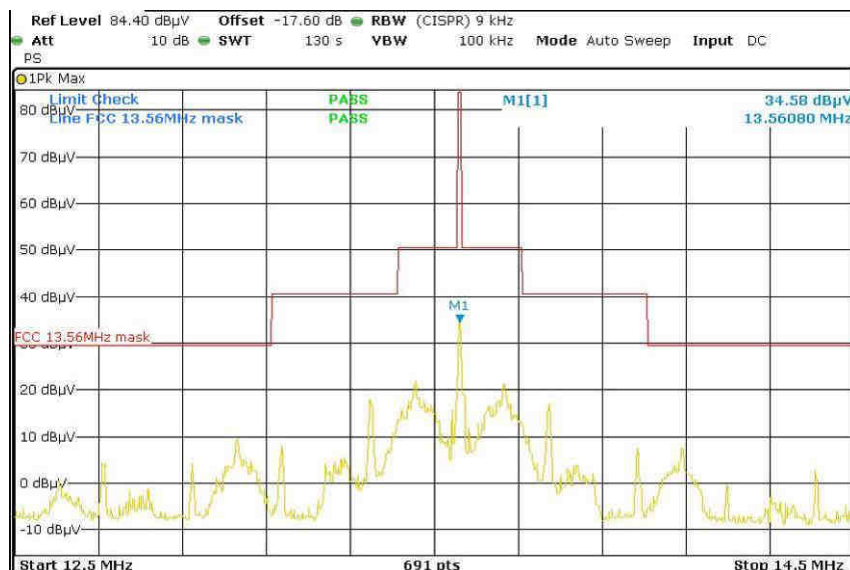
7. Field Strength of fundamental

TEST: Field strength of fundamental / FCC part 15.225 – RSS 210 §B.6			Verdict
Method: Measurements were made in a 10-meter Open Area Test Site (OATS) that complies to ANSI C63.4 and RSS-Gen. Measurements were performed with peak detector using a 9kHz RBW. The VBW is set to 100kHz. The EUT was rotated 360° about its azimuth with the receive antenna located at 1-meter in horizontal and vertical polarities. Final measurements (Peak) were then performed by rotating the EUT 360°. The tested equipment is set to transmit operation with modulations. Three orthogonal axis measurements on EUT are performed to obtain the maximum peak field strength.			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	20°C	
Relative Humidity	10 to 90 %	55%	
Limits – FCC Part 15.225 (a) (b) (c) / RSS-210 §B.6 (a) (b) (c) Operation within the band 13.110-14.010 MHz			
Frequency (MHz)	Limits (dBµV/m)		
	Level / Distance	Results	
13.553-13.567 MHz	84.0dBµV/m / 30m	Pass	
13.410-13.553 / 13.567-13.710	50.5dBµV/m / 30m	Pass	
13.110-13.410 / 13.710-14.010	40.5dBµV/m / 30m	Pass	
Outside 13.110 to 14.010 MHz	29.5dBµV/m / 30m	See chapter 9.	
Supplementary information: Test location: SMEE – CE Mesures / Test date: October 13 th , 2016 Power supply voltage: 5V DC via USB port			

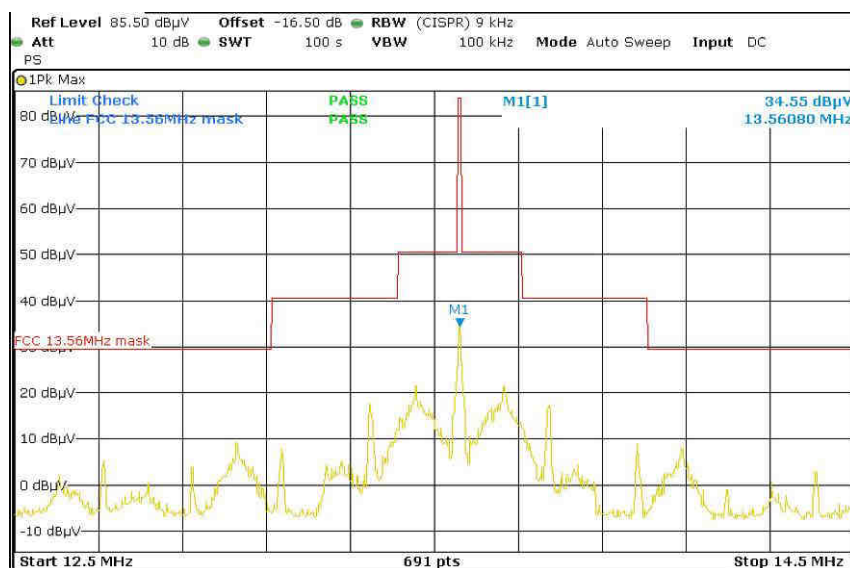
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESRP	REC-151-002	2015/7	2018/7
Loop antenna	EMCO	6502	ANT-101-009	2015/3	2017/3
RF cable	Div	OATS/25m	CAB-101-017	2016/3	2017/3
OATS	Div	3 / 10m	SIT-101-001	2016/8	2017/8
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-

Tabulated Results for Field Strength of fundamental						
With MEMS8 X012 TAG						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	dBμV/m	dBμV/m	dB	Degree	Degree	dB
13.56	34.5	84.0	-49.5	H / 110°	90	11.6
With MEMS8 X020 TAG						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	dBμV/m	dBμV/m	dB	Degree	Degree	dB
13.56	34.5	84.0	-49.5	H / 110°	90	11.6
With EDP8 X005 TAG						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	dBμV/m	dBμV/m	dB	Degree	Degree	dB
13.56	32.5	84.0	-51.5	H / 110°	90	11.6
Without TAG						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	dBμV/m	dBμV/m	dB	Degree	Degree	dB
13.56	36.1	84.0	-47.9	H / 110°	90	11.6
RBW:		200Hz (9kHz-150kHz)				
		9kHz (150kHz-30MHz)				
Measurement distance:		10m				
Limit:		FCC Part 15.225 (a) (b) (c) / RSS-210 §B.6				
Final measurement detector:		Quasi-Peak				
Wide Measurement Uncertainty:		± 5.2dB (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): Three axis measurement performed for equipment under test (3): Measure have been done at 10m distance and corrected according to requirements of 15.209.e) $M_{30m} = M_{10m} - 19.1dB$				

Graphical representation of Radiated E-field Band Edge compliance within the band 13.110-14010 MHz



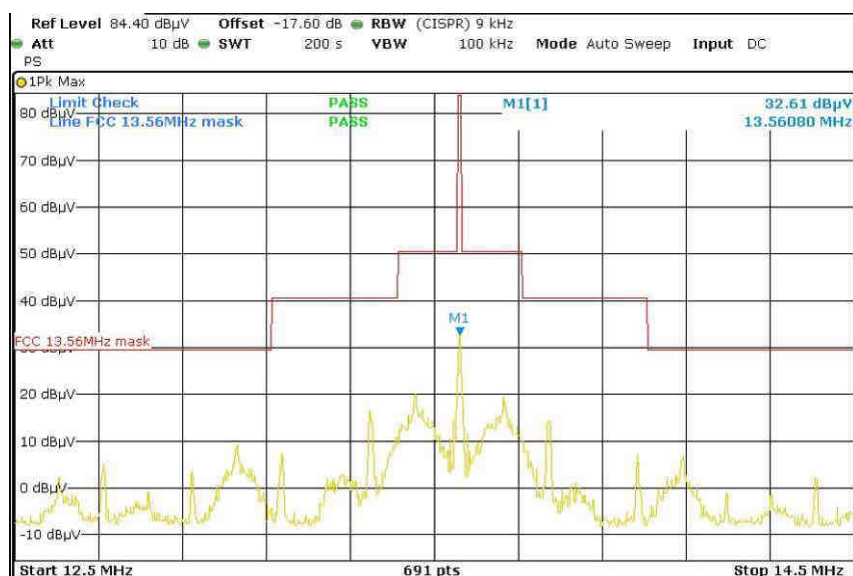
With MEMS8 X012 TAG



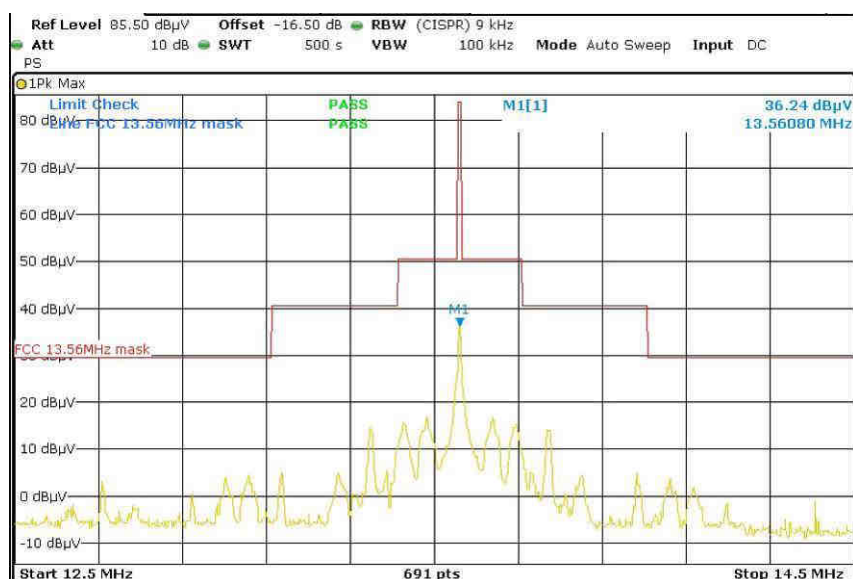
With MEMS8 X020 TAG

Frequency band investigated:	12.5MHz to 14.5MHz
Unit :	dBμV/m
RBW :	9kHz
Voltage:	5V DC
Limit:	FCC Part 15.225 (a) (b) (c) (d)
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5 dB (k=2)

Graphical representation of Radiated E-field Band Edge compliance within the band 13.110-14010 MHz



With EDP8 X005 TAG



Without TAG

Frequency band investigated:	12.5MHz to 14.5MHz
Unit :	dBμV/m
RBW :	9kHz
Voltage:	5V DC
Limit:	FCC Part 15.225 (a) (b) (c) (d)
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5 dB (k=2)

8. Fundamental frequency tolerance

TEST: Fundamental frequency tolerance / FCC part 15.225 – RSS-210 §B.6			Verdict
<u>Method:</u> The frequency tolerance of the carrier signal shall be maintained within ± 0.01% of the operating frequency when the temperature is varied from -30°C to +50°C at the nominal power voltage and the primary power voltage is varied from 85% to 115% of the rated supply voltage at 20°C. The equipment is placed in a climatic chamber. Carrier level and frequency are measured using a test fixture.			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	20°C	
Relative Humidity	10 to 90 %	55%	
Fully configured sample scanned over the following frequency range			
Carrier Signal :	13.56MHz		
Normal test temperature :	20°C		
Normal power voltage :	5V DC from USB port		
Extreme Temperature variation :	-30°C to +55°C		
Extreme Voltage variation :	4.75V to 5.25V DC (Basic USB extreme variations)		
Limits – FCC Part 15.225 (e) / RSS-210 §B.6 (e)			
Frequency (MHz)	Limits	Results	
13.56MHz	0.01% / 1.356kHz	Pass	
Supplementary information: Test location: SMEE – CE Mesures / Test date: October 18 th , 2016 Power supply voltage: 5V DC via USB port			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Loop antenna	EMCO	6502	ANT-101-009	2015/3	2017/3
RF cable	Pasternack	PE302-120	CAB-131-024	2016/3	2017/3
Climatic chamber	VÖTSCH	VT 3050	CLI-101-001	2015/9	2018/9
Measuring Rec	Rohde&Schwarz	ESRP	REC-151-002	2015/7	2018/7

Tabulated Results for fundamental frequency tolerance			
Frequency Drift			
Temperature	-30°C	20°C	$+55^{\circ}\text{C}$
5.00V DC	-140Hz	13.56007MHz (REF)	-120Hz
4.75V DC	-70Hz	0Hz	+30Hz
5.25V DC	-570Hz	-570Hz	-520Hz

9. Unwanted emissions

TEST: Unwanted emissions outside the specified frequency band / FCC part 15.109, 15.209, 15.225 - RSS-210 §B.6 / RSS-Gen §8.9		Verdict
<u>Method:</u> Measurements were made in a 10 or 3-meter Open Area Test Site (OATS) that complies to ANSI C63.4. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meter. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak, Quasi-peak, Average) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable. A pre-scan frequency identification of the EUT has been performed in full anechoic chamber. The measured radiated field of the EUT is realised at 3-meters of distance. Antenna is 1.25-meters high.		Pass
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	20°C
Relative Humidity	10 to 90 %	55%
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point
	9kHz – 30MHz	10 m measurement distance
	30MHz – 1GHz	3 m measurement distance
Limits – FCC Part 15.109, 15.209, 15.225 (d) / RSS-Gen §8.9, RSS-210 §B.6 (d)		
Frequency (MHz)	Limits (dBµV/m)	
	Level / Detector / Distance	Results
0.009 to 0.490	107.6 to 72.9 / QP / 10m	Pass
0.490 to 1.705	52.9 to 42.1 / QP / 10m	Pass
1.705 to 30	48.6 / QP / 10m	Pass
30 to 88	40.0 / QP / 3m	Pass
88 to 216	43.5 / QP / 3m	Pass
216 to 960	46.0 / QP / 3m	Pass
960-1000	54.0 / QP / 3m	Pass
Supplementary information: Test location: SMEE – CE Mesures / Test date: October 13th, 2016 Power supply voltage: 5V DC via USB port		

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Log-periodic antenna	TDK	PLP3003	ANT-101-001	2016/8	2017/8
Biconnic antenna	COM-POWER	AB- 900	ANT-101-003	2016/8	2017/8
Loop antenna	EMCO	6502	ANT-101-009	2015/3	2017/3
BiConiLog antenna	EMCO	3142B	ANT-101-010	2016/8	2017/8
RF cable	Div	OATS/25m	CAB-101-019	2016/3	2017/3
RF cable	Pasternack	PE302-120	CAB-131-024	2016/3	2017/3
RF cable	HUBER+SUHNER	RG214U	CAB-141-026	2016/3	2017/3
RF cable	HUBER+SUHNER	RG214U	CAB-141-029	2016/3	2017/3
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2016/3	2017/3
Anechoic chamber	COMTEST	214263	CAG-141-001	-	-
OATS	Div	10m	SIT-101-001	2016/8	2017/8
Antenna mast	Innco- Systems	MA4000EP	MAT-101-001	-	-
Turntable	Innco- Systems	DS1200S	PLA-101-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-
Measuring Rec	Rohde&Schwarz	ESRP	REC-151-002	2015/7	2018/7

Tabulated Results for Unwanted emissions (9kHz-30MHz)						
FREQ	RF field @ 30m	Limit @ 30m	Margin	Antenna angle	Table angle	Correc. Fact. (CF)
MHz	(QP) dBμV/m	(QP) dBμV/m	dB	Degree	Degree	dB
Margin > 20dB						
Supplementary information:						
Frequency list measured on the Open Area Test Site has been created with pre-scan results.						
Frequency band investigated:		9kHz-30MHz				
RBW:		200Hz (9kHz-150kHz)				
		9kHz (150kHz-30MHz)				
Measurement distance:		10m				
Limit:		FCC Part 15.209 – 15.225 / RSS-Gen §8.9 – RSS-210 §B.6 (d)				
Final measurement detector:		Quasi-Peak				
Wide Measurement Uncertainty:		± 5 dB (k=2)				
Note:		CF: Correction factor = Antenna factor + Cable loss * ¹ : Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)				

Tabulated Results for Unwanted emissions (30MHz-1GHz)

With MEMS8 X012 TAG

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
36,000	25,2	35,2	12,0	37,2	47,2	V	100	0	40	-2,8
48,000	17,5	27,2	11,6	29,1	38,8	V	101	90	40	-10,9
54,240	15,5	19,3	11,4	26,9	30,7	V	102	290	40	-13,1
81,360	14,8	23,3	7,5	22,3	30,8	V	103	120	40	-17,7
84,000	15,0	25,1	8	23,0	33,1	V	104	205	40	-17,0
325,449	13,0	16,6	18,3	31,3	34,9	H	100	0	46	-14,7

With MEMS8 X020 TAG

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
36,000	23,9	33,7	12,0	35,9	45,7	V	100	0	40	-4,1
325,449	10,7	15,3	18,3	29,0	33,6	H	100	0	46	-17,0

With EDP8 X005 TAG

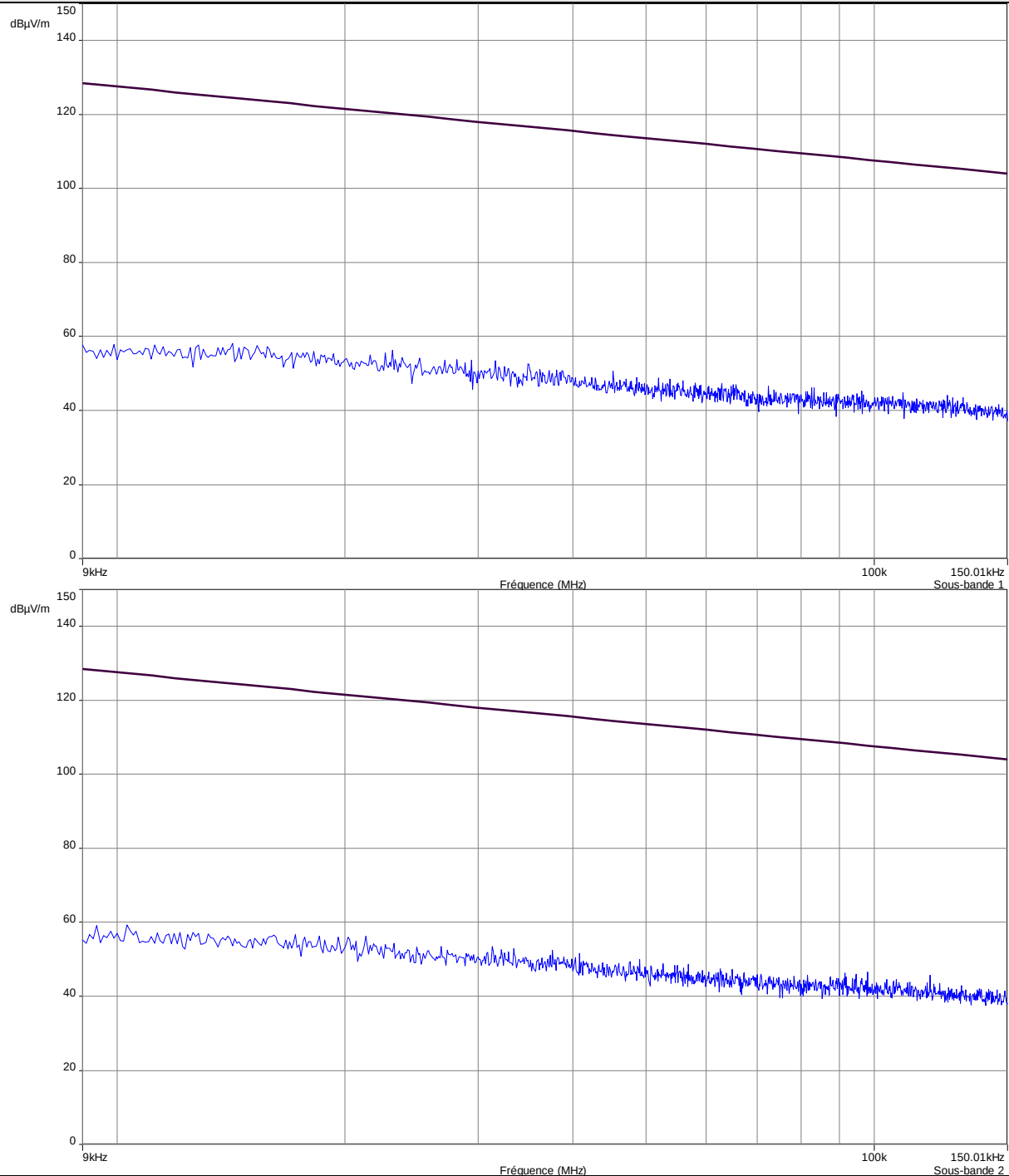
FREQ	Meter reading	Meter reading	Total factor	Field level	Field level	Pol	Antenna height	Table angle	Limit	Margin
MHz	(QP) dBμV	(Pk) dBμV	dB	(QP) dBμV/m	(Pk) dBμV/m		cm	Degré	(QP) dBμV/m	dB
33,270	22,0	30,9	13,0	35,0	43,9	V	100	0	40	-5,0
36,000	23,8	33,5	12,0	35,8	45,5	V	100	0	40	-4,2
60,000	15,7	23,3	11,4	27,1	34,7	V	100	230	40	-12,9
325,449	18,1	20,5	18,3	36,4	38,8	H	100	0	46	-9,6
786,480	10,2	14,5	26,5	36,7	41,0	H	220	60	46	-9,3
840,720	10,6	15,2	27,8	38,4	43,0	H	220	0	46	-7,6

Supplementary information:

Frequency list measured on the Open Area Test Site has been created with pre-scan results.

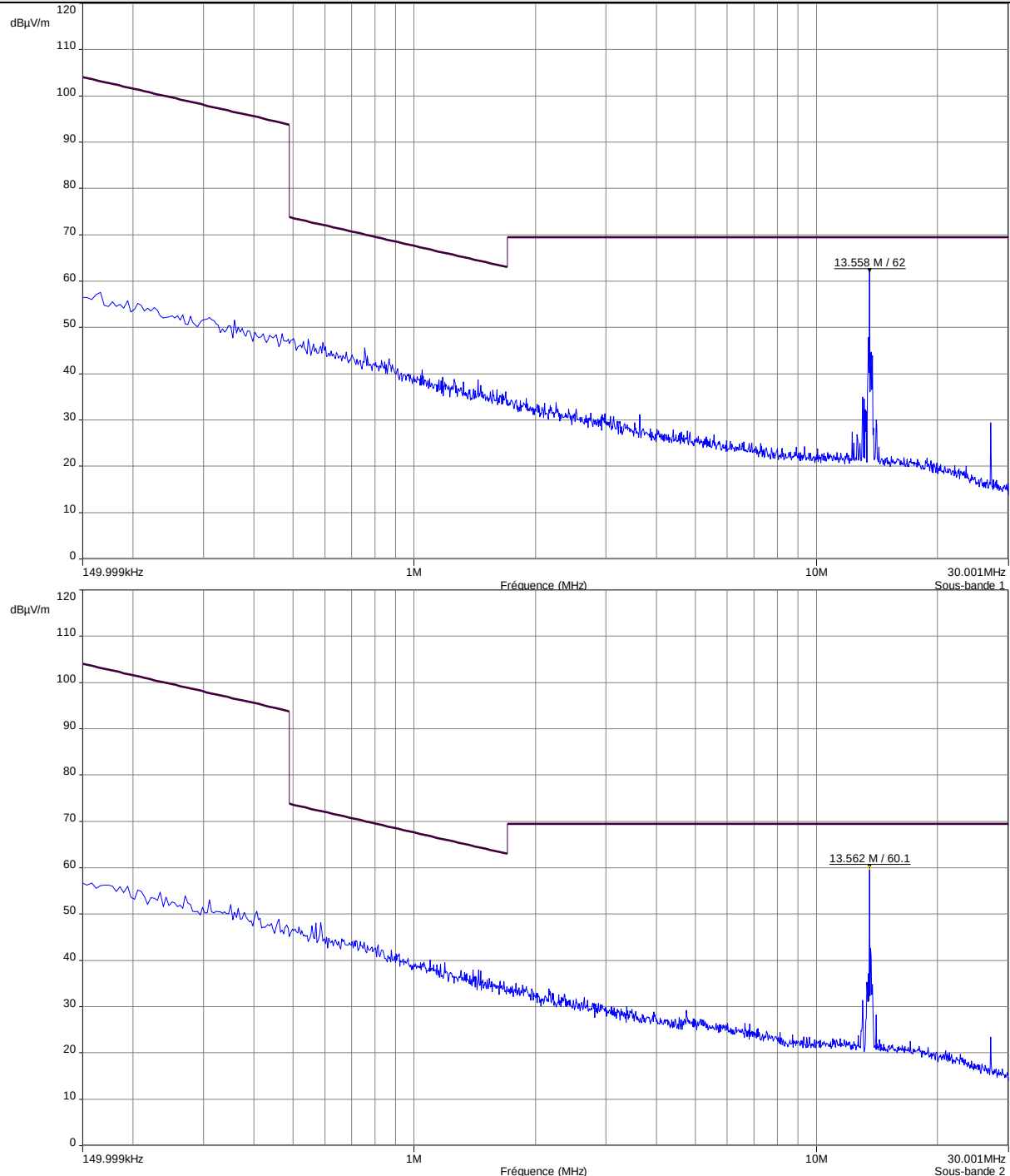
Frequency band investigated:	30MHz-1GHz
RBW:	120kHz
Measurement distance:	3m
Limit:	FCC Part 15.209 – 15.225 / RSS-Gen §8.9 – RSS-210 §B.6 (d)
Final measurement detector:	Quasi-Peak
Wide Measurement Uncertainty:	± 5.2dB (k=2)
RESULT:	PASS
Notes:	The field strength (level) is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follow: $FS = RA + AF + CF - AG$ Where FS = Field Strength RA = Receiver Amplitude AF = Antenna Factor CF = Cable Factor AG = Amplifier Gain Total factor (dB) is AF + CF – AG Margin value = Emission level – Limit value

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 9kHz-150kHz / 3m / Polarization 1 & 2 / With MEMS8 X012 TAG)



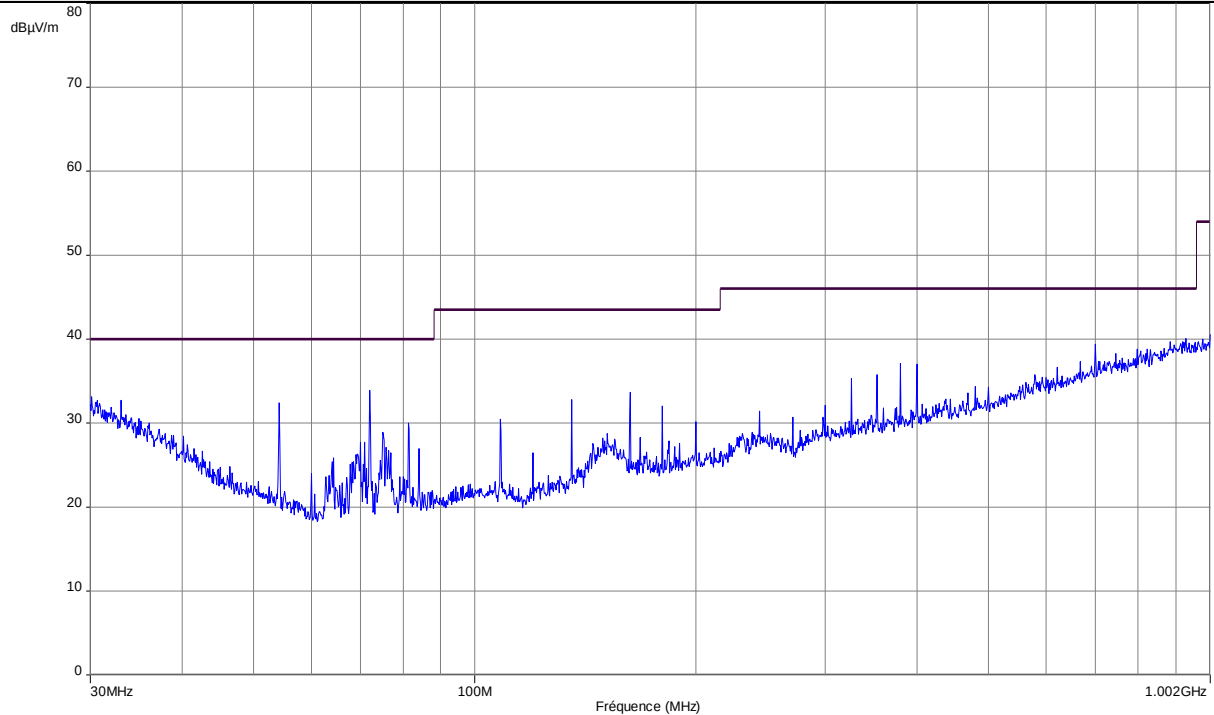
Frequency band investigated:	9kHz-150kHz
Unit :	dBμV/m
RBW :	200Hz
Antenna polarization :	Polarization 1 & 2
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 150kHz-30MHz / 3m / Polarization 1 & 2 / With MEMS8 X012 TAG)



Frequency band investigated:	150kHz-30MHz
Unit :	dBμV/m
RBW :	9kHz
Antenna polarization :	Polarization 1 & 2
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal / With MEMS8 X012 TAG)

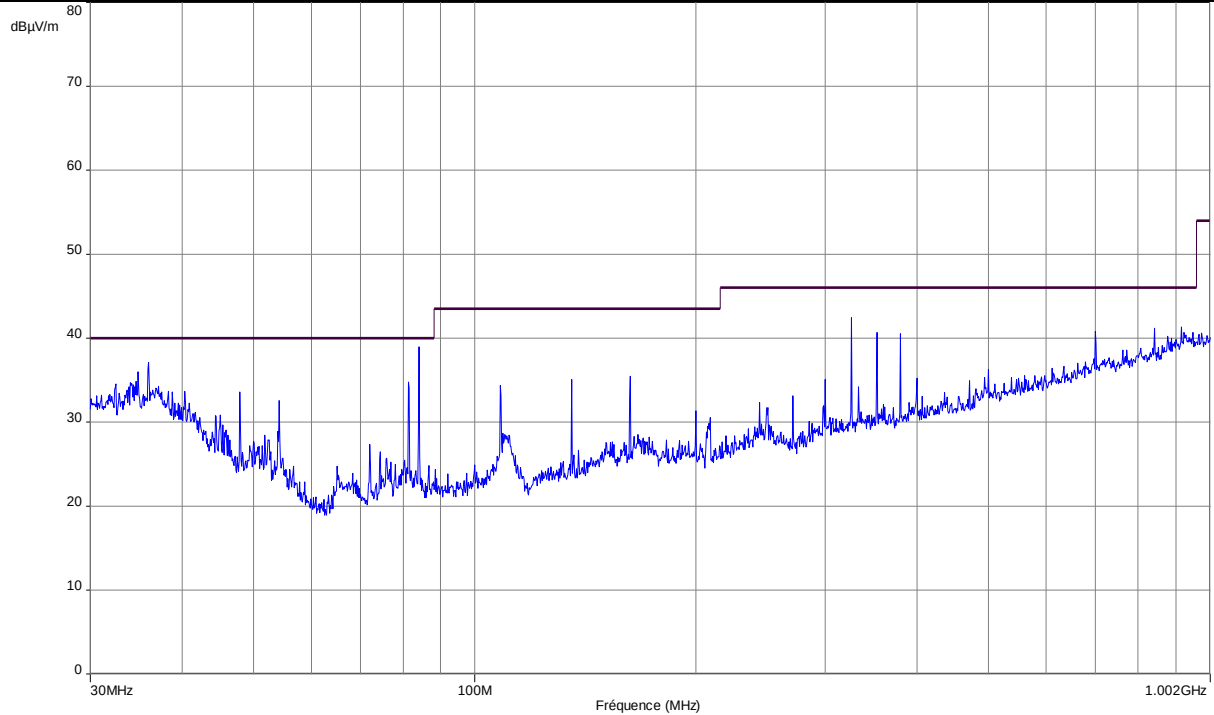


Frequency (MHz)	Peak Level (dBμV/m)
33.031	32.7
54.250	32.5
71.953	33.9

Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	30MHz-1GHz
Unit :	dBμV/m
RBW :	100kHz
Antenna polarization :	Horizontal
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Vertical / With MEMS8 X012 TAG)

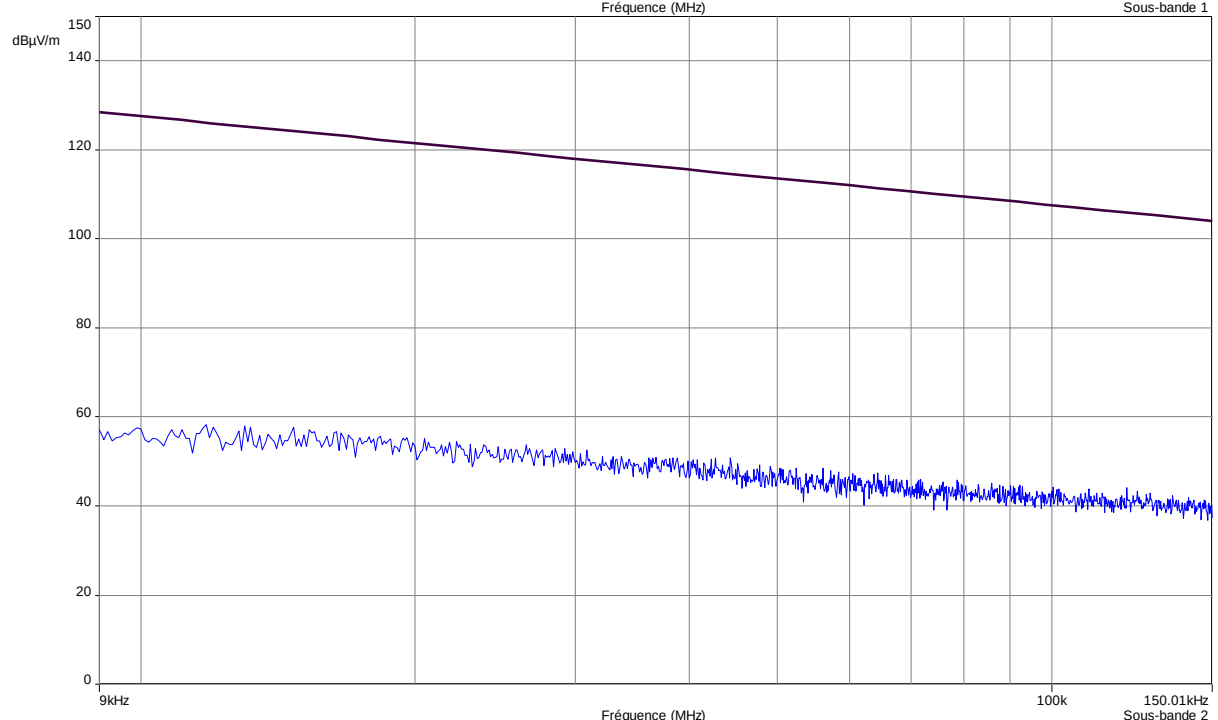
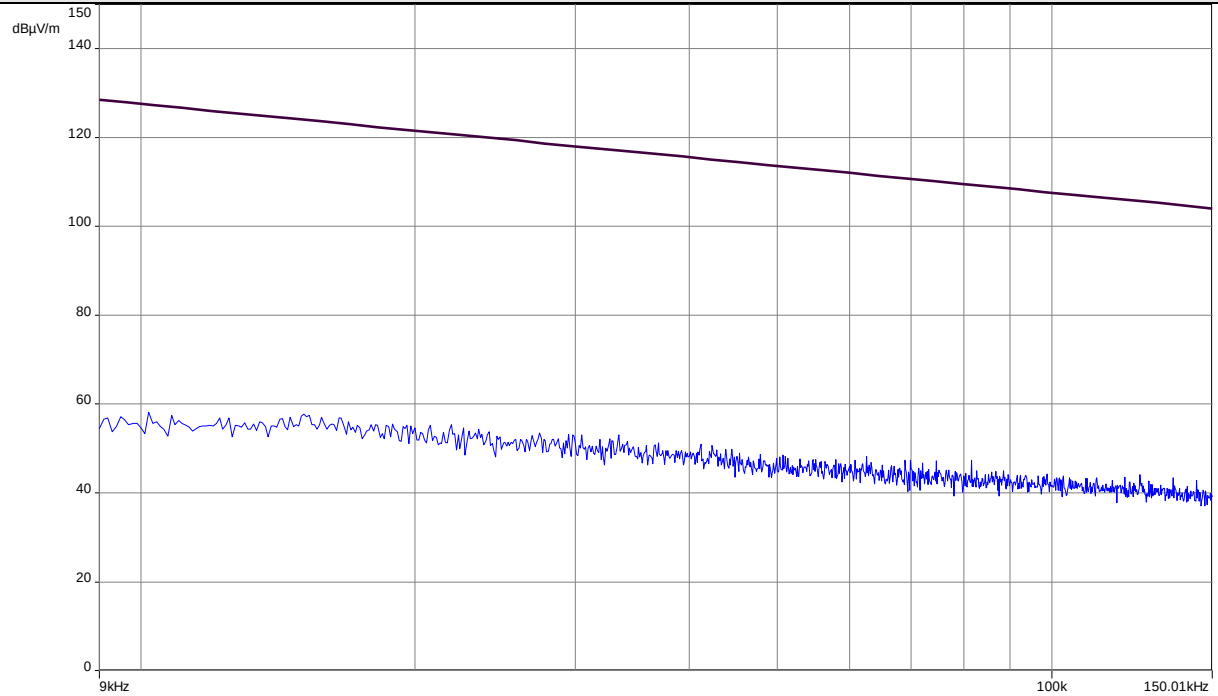


Frequency (MHz)	Peak Level (dBμV/m)
36.016	37.1
47.942	33.6
54.215	32.6
81.369	34.8
84.016	39.0
352.573	40.7
379.677	40.6

Note: Pre-scan graph only for identification purpose.

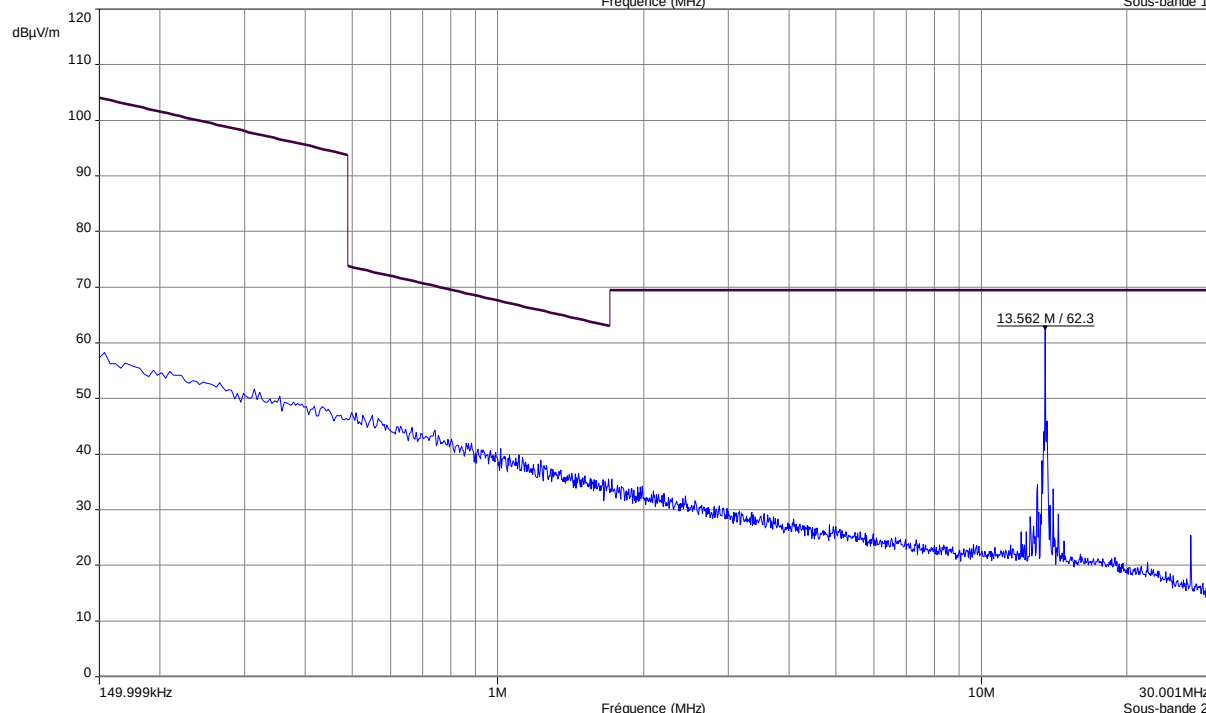
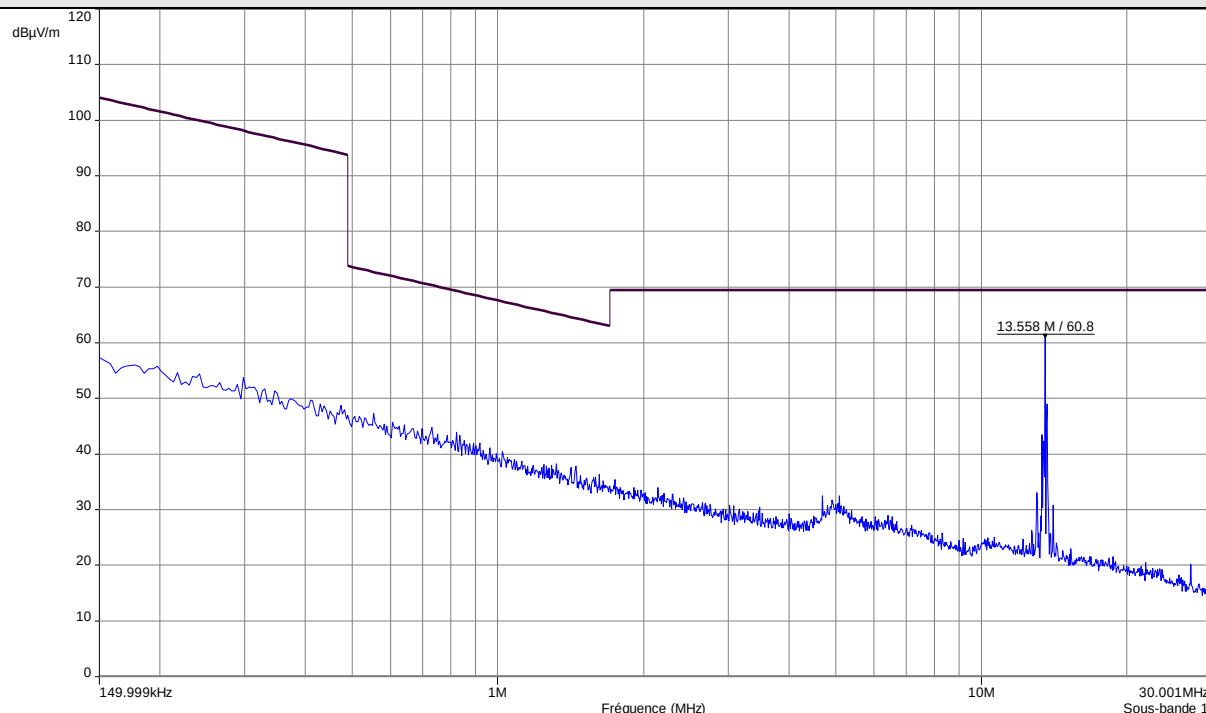
Frequency band investigated:	30MHz-1GHz
Unit :	dBμV/m
RBW :	100kHz
Antenna polarization :	Vertical
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 9kHz-150kHz / 3m / Polarization 1 & 2 / With MEMS8 X020 TAG)



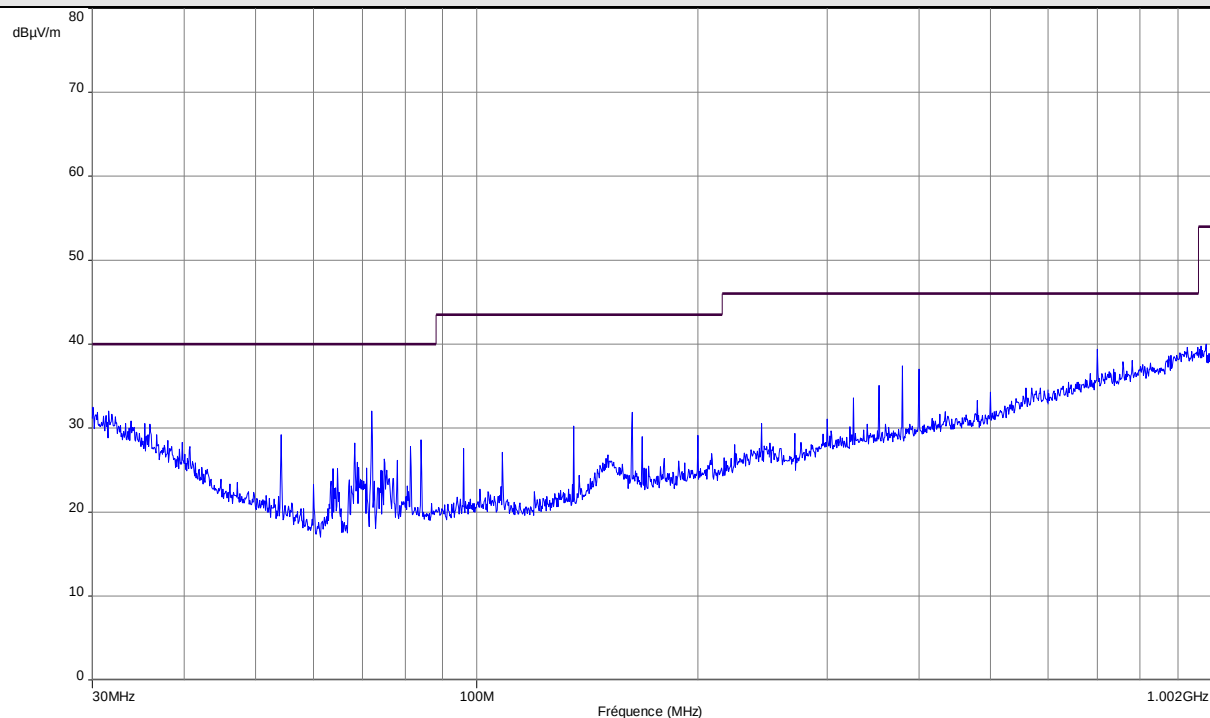
Frequency band investigated:	9kHz-150kHz
Unit :	dBμV/m
RBW :	200Hz
Antenna polarization :	Polarization 1 & 2
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 150kHz-30MHz / 3m / Polarization 1 & 2 / With MEMS8 X020 TAG)



Frequency band investigated:	150kHz-30MHz
Unit :	dBμV/m
RBW :	9kHz
Antenna polarization :	Polarization 1 & 2
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal / With MEMS8 X020 TAG)

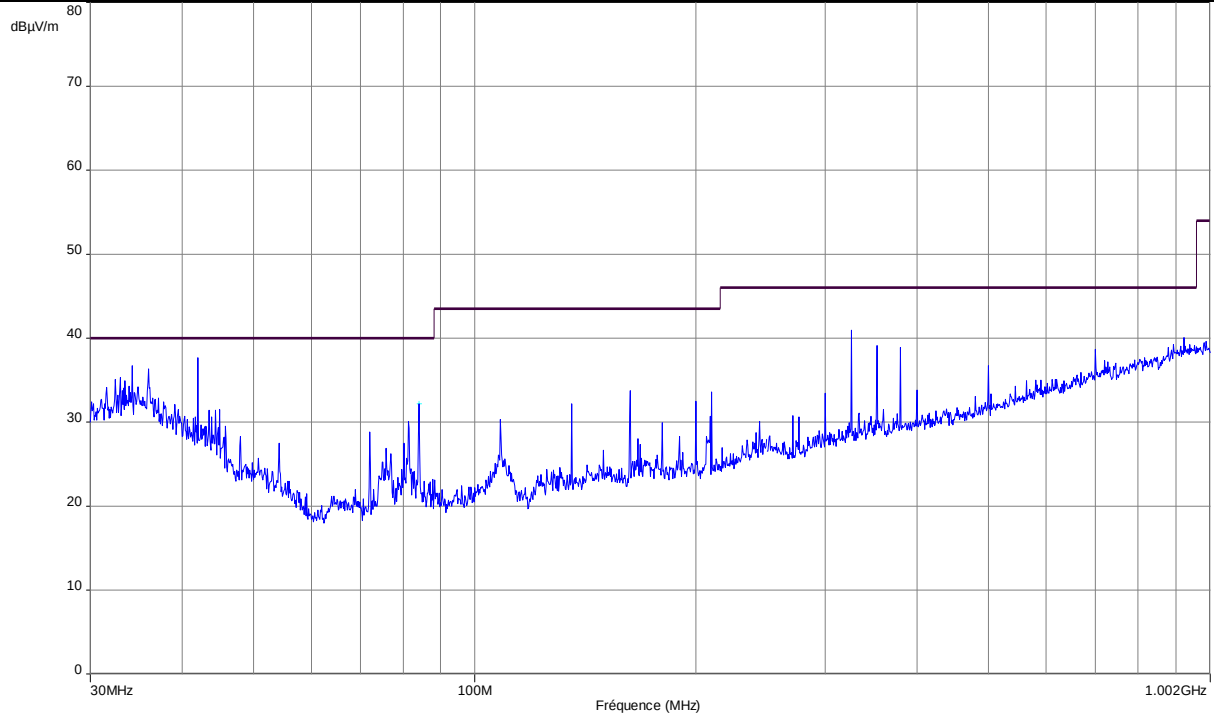


Frequency (MHz)	Peak Level (dBμV/m)
33.031	32.7
54.250	32.5
71.953	33.9

Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	30MHz-1GHz
Unit :	dBμV/m
RBW :	100kHz
Antenna polarization :	Horizontal
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Vertical / With MEMS8 X020 TAG)

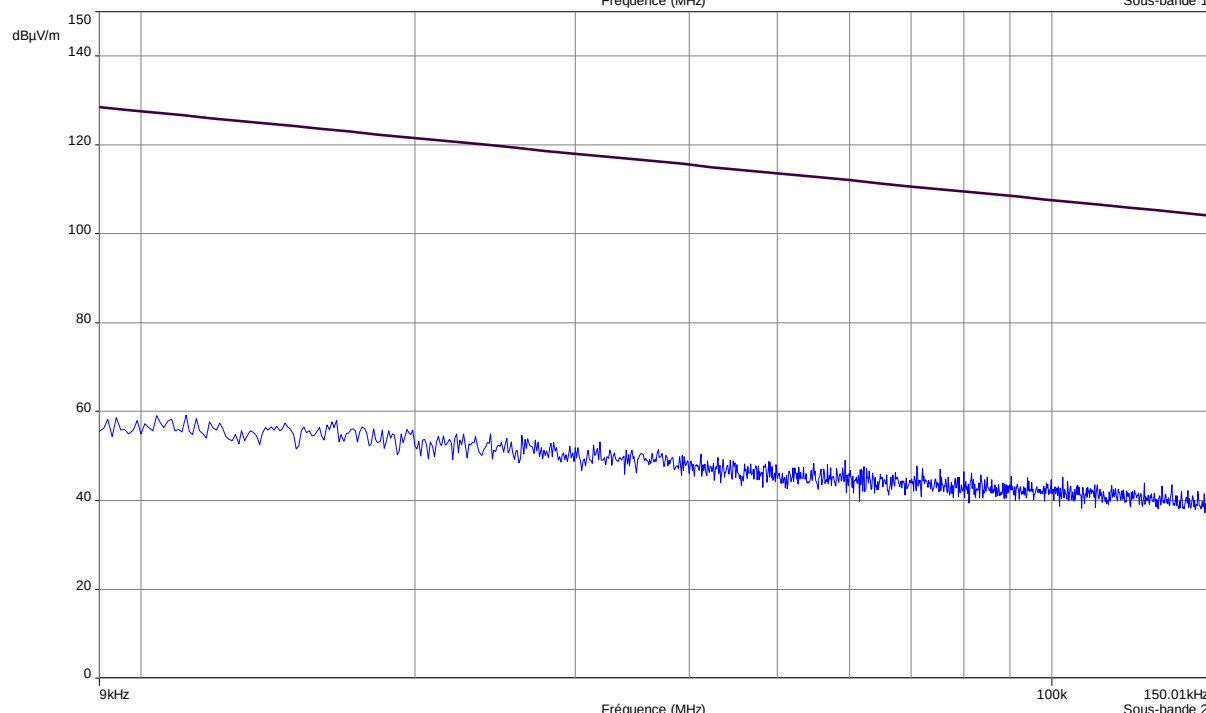
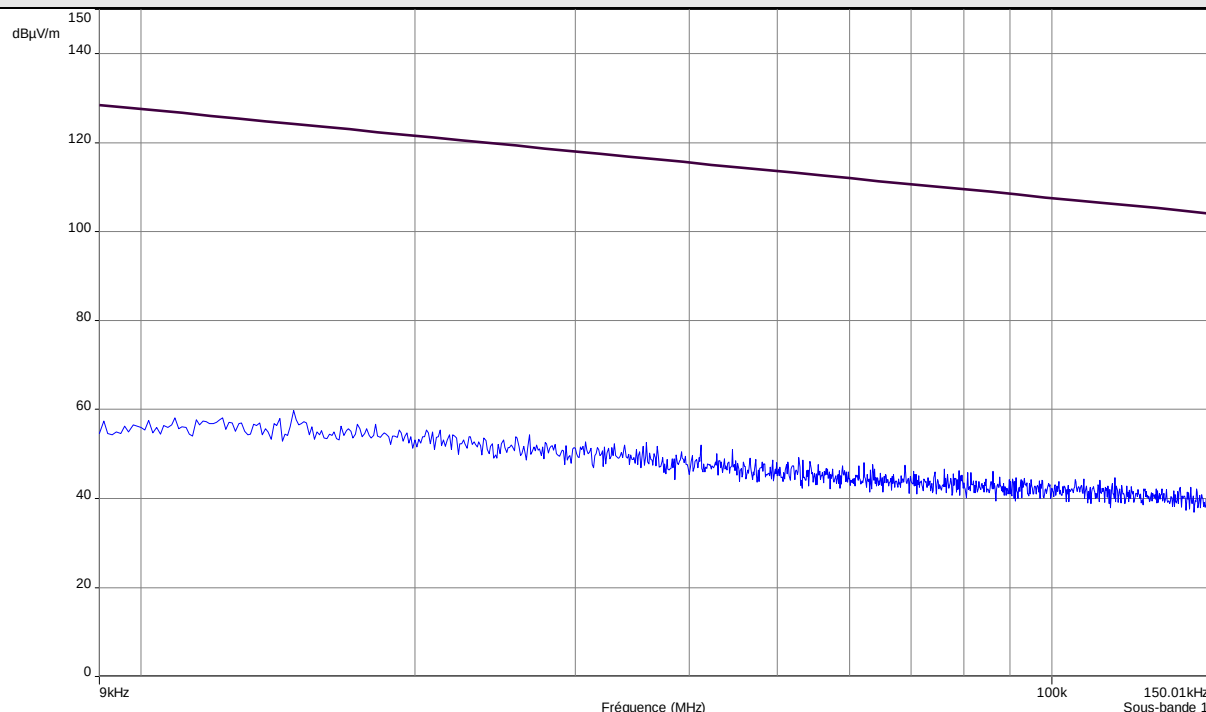


Frequency (MHz)	Peak Level (dBμV/m)
36.039	36.3
42.018	37.7
84.016	32.2
325.432	41.0

Note: Pre-scan graph only for identification purpose.

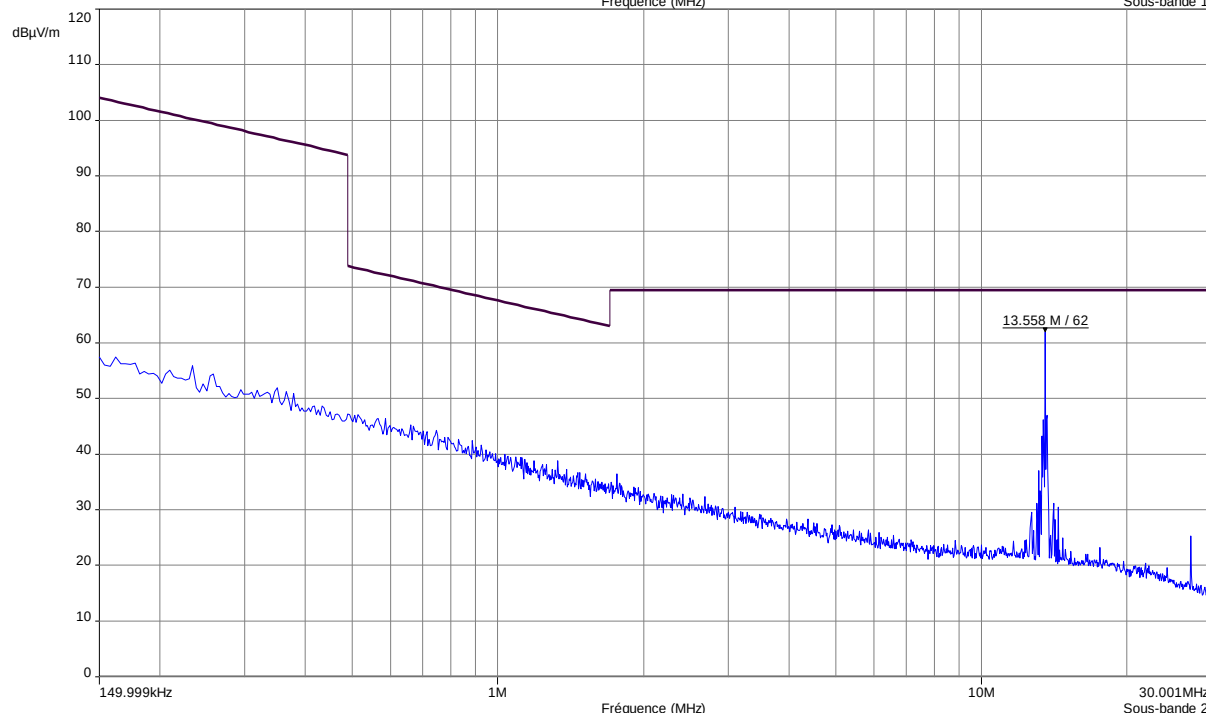
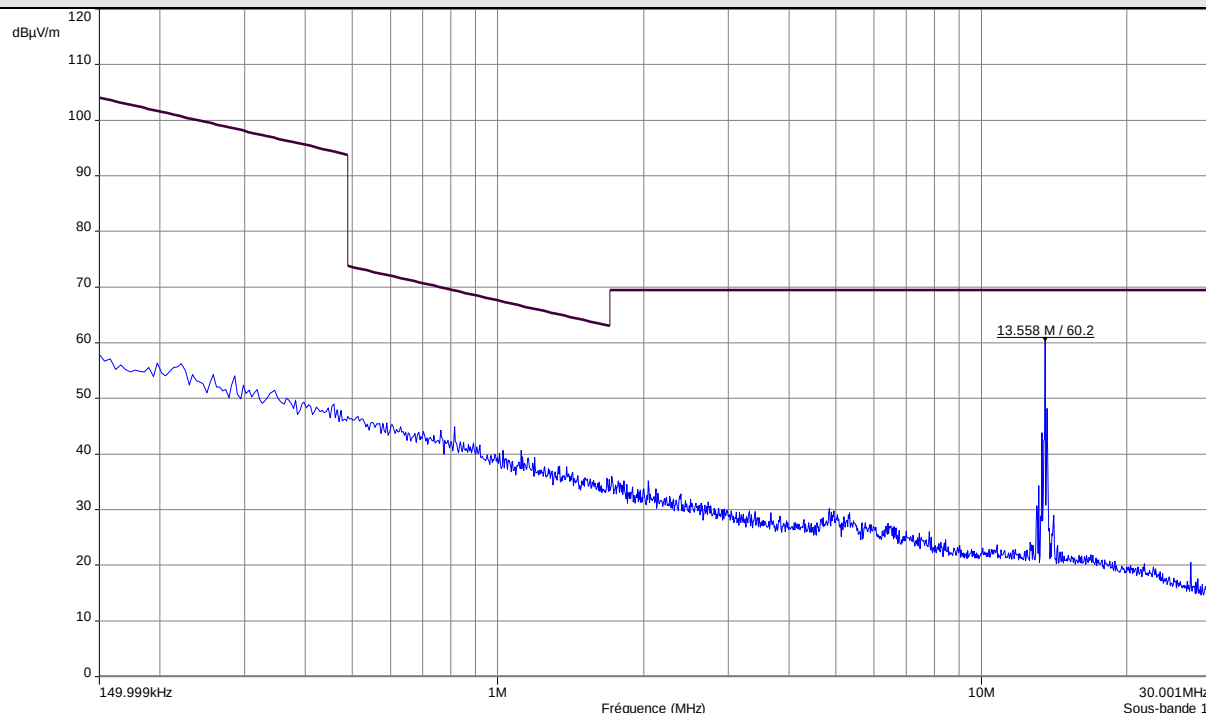
Frequency band investigated:	30MHz-1GHz
Unit :	dBμV/m
RBW :	100kHz
Antenna polarization :	Vertical
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 9kHz-150kHz / 3m / Polarization 1 & 2 / With EDP8 X005 TAG)



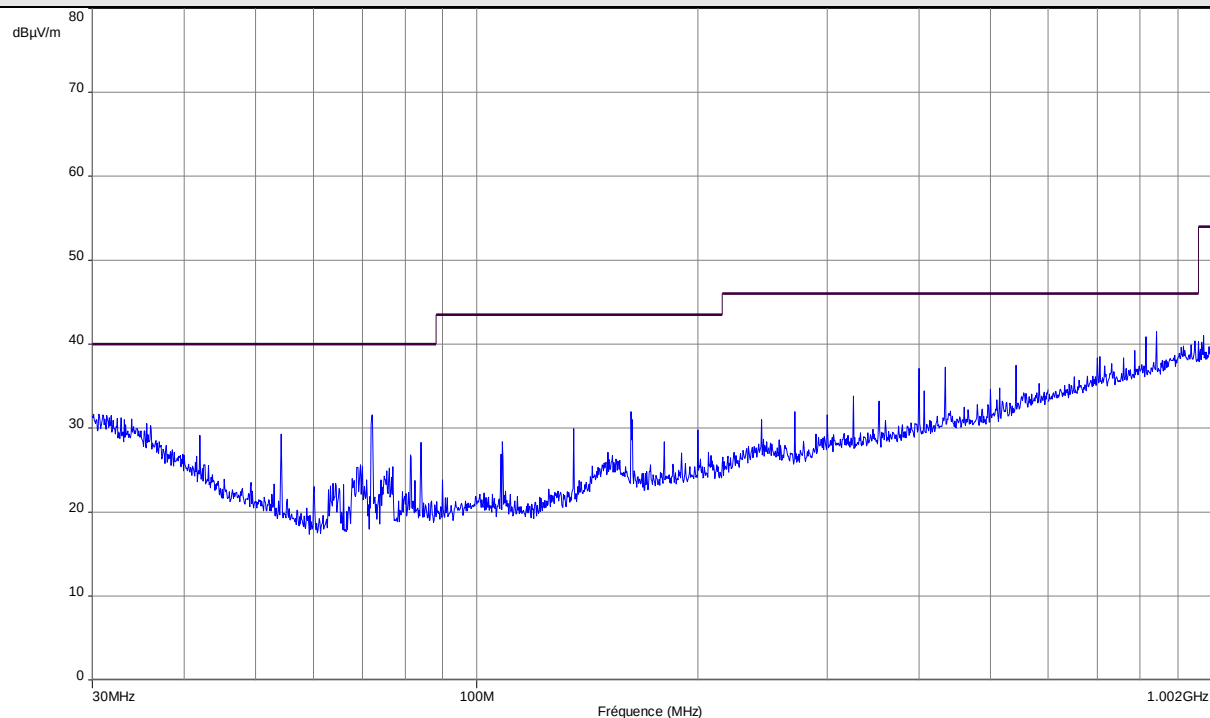
Frequency band investigated:	9kHz-150kHz
Unit :	dBμV/m
RBW :	200Hz
Antenna polarization :	Polarization 1 & 2
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 150kHz-30MHz / 3m / Polarization 1 & 2 / With EDP8 X005 TAG)



Frequency band investigated:	150kHz-30MHz
Unit :	dBμV/m
RBW :	9kHz
Antenna polarization :	Polarization 1 & 2
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Horizontal / With EDP8 X005 TAG)

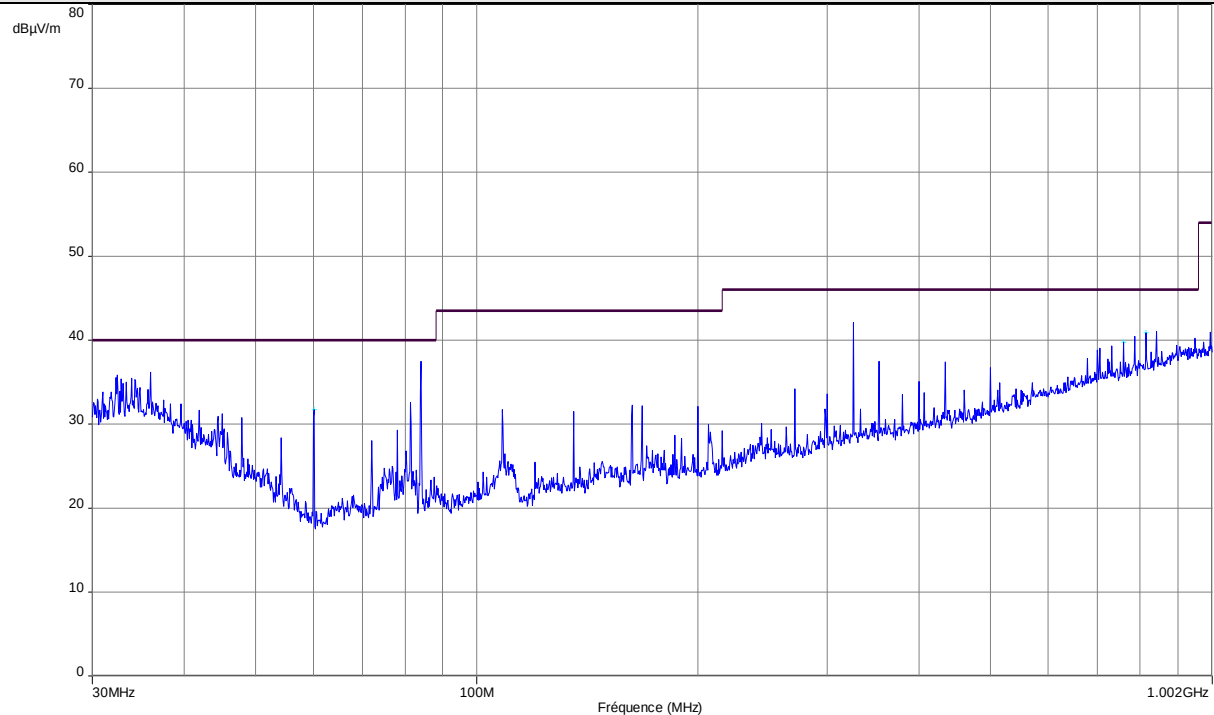


Frequency (MHz)	Peak Level (dBμV/m)
72.091	31.6
813.580	40.8
840.682	41.5

Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	30MHz-1GHz
Unit :	dBμV/m
RBW :	100kHz
Antenna polarization :	Horizontal
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 30MHz-1GHz / 3m / Vertical / With EDP8 X005 TAG)



Frequency (MHz)	Peak Level (dBμV/m)
36.001	36.2
60.036	31.7
81.352	32.6
83.963	37.5
325.432	42.1
759.355	39.8
786.423	40.5
813.580	40.9
840.725	41.0

Note: Pre-scan graph only for identification purpose.

Frequency band investigated:	30MHz-1GHz
Unit :	dBμV/m
RBW :	100kHz
Antenna polarization :	Vertical
Voltage:	5V DC from USB
Limit:	FCC Part 15.209 / RSS-Gen §8.9
Measurement detector:	Peak
Wide Measurement Uncertainty:	± 5dB (k=2)

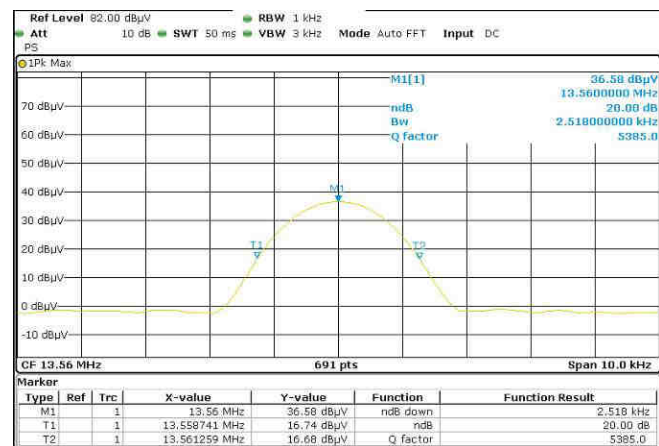
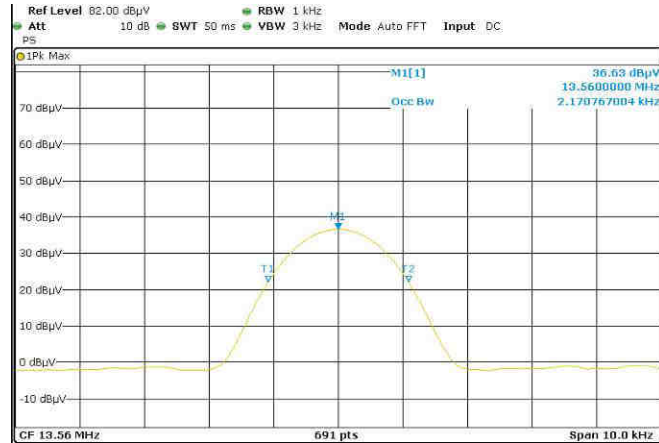
10. 99% Occupied Bandwidth

TEST: Occupied Bandwidth / 15.215 – RSS-Gen			Verdict
<u>Method:</u> The setup is in an anechoic chamber. The spectrum analyzer is connected to the measuring antenna. The RBW is set at 1kHz, with VBW ≥ 3 x RBW. The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. Measures are performed with OBW 99% and OBW 20dB down functions of the spectrum analyser.			Pass
Laboratory Parameters:	Required prior to the test	During the test	
Ambient Temperature	10 to 40 °C	20°C	
Relative Humidity	10 to 90 %	55%	
15.215 – RSS-Gen Issue 4 (§6.6)			
Frequency (MHz)	Level for Bandwidth	Limit	
13.56	99% occupied bandwidth	Inside permitted frequency band	
	20dB Bandwidth		
Supplementary information: Test location: SMEE – CE Mesures / Test date: October 18 th , 2016 Power supply voltage: 5V DC via USB port			

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Measuring Rec.	Rohde&Schwarz	ESRP	REC-151-002	2015/7	2018/7
Loop antenna	EMCO	6502	ANT-101-009	2015/3	2017/3
RF cable	HUBER+SUHNER	SF104	CAB-141-030	2016/3	2017/3
RF cable	Pasternack	PE302-120	CAB-131-024	2016/3	2017/3
Anechoic chamber	COMTEST	214263	CAG-141-001	-	-
Turntable	Innco- Systems	CT0800	PLA-141-001	-	-

Tabulated Results for Occupied Bandwidth		
Frequency (MHz)	99% Bandwidth (kHz)	20dB Bandwidth (kHz)
13.56MHz	2.1708	2.5180

Graphical representation of Occupied Bandwidth



Frequency: 13.56MHz

RBW : 1kHz

Measurement detector: Peak