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TEST REPORT

N°: 803117-R1-E **JDE : 135412**

Subject	**Electromagnetic compatibility and Radio spectrum Matters (ERM) tests according to standards: FCC CFR 47 Part 15, Subpart B et C RSS-247 Issue 1.0**
Issued to	**PETZL** Site de Crolles, Cedex 105A. 38920 CROLLES
Apparatus under test	
Product	**HEADLAMP**
Trade mark	**PETZL**
Manufacturer	**PETZL PRODUCTION**
Model under test	**REACTIK+**
Serial number	**E920445C01 GNDUFL & 150300242**
FCCID	**2AFG9-E95**
ICID	**20473-E95**
Test date	May 11th, 2015 to May 22th, 2015
Test location	Moirans
IC Test site	6500A-1 & 6500A-3
Test performed by	Gaëtan Deschamps
Composition of document	37 pages
Modification of the last version	None
Document issued on	July 10th, 2015

Written by :
Deschamps Gaetan
Tests operator

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SUMMARY

1. TEST PROGRAM

Standard:

- **FCC Part 15, Subpart C 15.247**
- **ANSI C63.10 (2013)**
- **RSS-247 Issue 1.0 – May 2015**
- **RSS-Gen Issue 4 – Nov 2014**
- **558074 D01 DTS Measurement Guidance v03r03**

EMISSION TEST	LIMITS			RESULTS
Limits for conducted disturbance at mains ports 150kHz-30MHz	**Frequency**	**Quasi-peak value (dBµV)**	**Average value (dBµV)**	☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
	150-500kHz	66 to 56	56 to 46	
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 9kHz-30MHz *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5*	**Measure at 300m** 9kHz-490kHz : 67.6dBµV/m /F(kHz) **Measure at 30m** 490kHz-1.705MHz : 87.6dBµV/m /F(kHz) 1.705MHz-30MHz : 29.5 dBµV/m			☐ **PASS** ☐ **FAIL** ☑ **NA** ☐ **NP**
Radiated emissions 30MHz-25GHz* *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5* ***Highest frequency :16MHz*** ***(Declaration of provider)***	**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** ☐ **FAIL** ☐ **NA** ☐ **NP**
Bandwidth 6dB *CFR 47 §*15.247 (a) (2) *RSS-210 §A8.2*	**At least 500kHz**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Maximum Peak Output Power *CFR 47 §*15.247 (b) *RSS-210 §A8.4 (4)*	**Limit: 30dBm** Conducted or Radiated measurement			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Band Edge Measurement *CFR 47 §15.209 (a)* *CFR 47 §15.247 (d)* *RSS-210 §A8.5*	**Limit: -20dBc or** **Radiated emissions limits in restricted bands**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Power spectral Density *CFR 47 §15.247 (e)* *RSS-210 §A8.2*	**Limit: 8dBm/3kHz**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Occupied bandwidth *RSS-Gen §4.6.1*	**No limit**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Receiver Spurious Emission** *RSS-Gen §4.10*	**See RSS-Gen §4.10**			☐ **PASS** ☐ **FAIL** ☑ **NA** ☐ **NP**

***§15.33:** The highest internal source of a testing device is defined like more the highest frequency generated or used in the testing device or on which the testing device works or agrees.

- If the highest frequency of the internal sources of the testing device is lower than 108 MHz, measurement must be only performed until 1GHz.
- If the highest frequency of the internal sources of the testing device ranges between 108 MHz and 500 MHz, measurement must be only performed until 2GHz.
- If the highest frequency of the internal sources of the testing device ranges between 500 MHz and 1 GHz, measurement must be only performed until 5GHz.

If the highest frequency of the internal sources of the testing device is above 1 GHz, measurement must be only performed until 5 times the highest frequency or 40 GHz, while taking smallest of both.

2. SYSTEM TEST CONFIGURATION

2.1. JUSTIFICATION:

REATICK+ have two reference following color: REACTIK+ and E95HNE. References have the same electronic and mechanical elements. All tests are performed on the product REACTIK+ whose colour is coral.

2.2. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):
REACTIK+ Serial Number: E920445C01 GNDUFL & 150300242

Equipment Under Test

Power supply:
During all the tests, EUT is supplied by V_{nom}: 3.7VDC
For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply1	☐ AC ☐ DC ☑ Battery	3.7VDC	E920975C01	-

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
Power supply	USB	0.2	☑	☑	☑	-

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Power supply DC	TDK	-	A7044059
USB adaptor	-	-	-

Equipment information:

Bluetooth LE Type:	☐ **v4.0**		☑ **v4.1**	
Frequency band:	[2400 – 2483.5] MHz			
Spectrum Modulation:	☑ DSSS (Tested like it)			
Number of Channel:	40			
Spacing channel:	2MHz			
Channel bandwidth:	1MHz			
Antenna Type:	☑ Integral	☐ External	☐ Dedicated	
Antenna connector:	☐ Yes	☑ No	☑ Temporary for test	
Transmit chains:	☑ 1			
	Single antenna			
	Gain: -4.5dBi			
Beam forming gain:	No			
Receiver chains	1			
Type of equipment:	☑ Stand-alone	☐ Plug-in	☐ Combined	
Duty cycle:	☑ Continuous duty	☐ Intermittent duty	☐ 100% duty	
Equipment type:	☐ Production model		☑ Pre-production model	
Operating temperature range:	Tmin:	☑ -20°C	☐ 0°C	☐ °C
	Tnom:	20°C		
	Tmax:	☐ 35°C	☐ 55°C	☑ 45°C
Type of power source:	☐ AC power supply	☑ DC power supply	☑ Battery (Lithium)	
Operating voltage range:	Vnom:	☐ 230V/50Hz	☑ 3.7Vdc	

CHANNEL PLAN			
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
Cmin: 0	2402	**Cmid: 20**	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	**Cmax: 39**	2480

DATA RATE		
Data Rate (Mbps)	**Modulation Type**	**Worst Case Modulation**
1	GFSK	☑

2.3. RUNNING MODE

The EUT is set in the following modes during tests with software (SDK 7.1 / DTM):
- Permanent emission with modulation on a fixed channel in the data rate that produced the highest power
- Permanent reception

All tests are performed at Cmin, Cmid and Cmax.

There 2 configurations tests:
- The EUT is powered by USB (called in report “DC mode”), the LED and Bluetooth function is off.
- The EUT is powered by battery (called in report “Battery mode), the LED and Bluetooth are on.

The EUT is set in the following modes during tests in Battery mode:
- Permanent emission/reception with iPhone by PETZL application Version CEM

The EUT sequences are:
- TX 2402: 0x80 0x28
- TX 2440: 0x93 0x28
- TX 2480: 0xA7 0x28
- RX 2402: 0x40 0x28
- RX 2440: 0x53 0x28
- RX 2480: 0x67 0x28

Firmware / Software Lamp version: V1.4

2.4. EQUIPMENT MODIFICATION

☑ None ☐ Modification:

2.5. FIELD STRENGTH CALCULATION

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

FS = RA + AF + CF – AG

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

Assume a receiver reading of 52.5dBµV is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dBµV/m.
FS = 52.5 + 7.4 + 1.1 – 29 = 32 dBµV/m
The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
Level in µV/m = Common Antilogarithm [(32dBµV/m)/20] = 39.8 µV/m.

2.6. CALIBRATION DATE

The calibration intervals are extended at 12+2 months. This extended interval is based on the fact that there is sufficient calibration data to statistically establish a trend or based on experience of use of the test equipment to assure good measurement results for a longer period

3. CONDUCTED EMISSION DATA

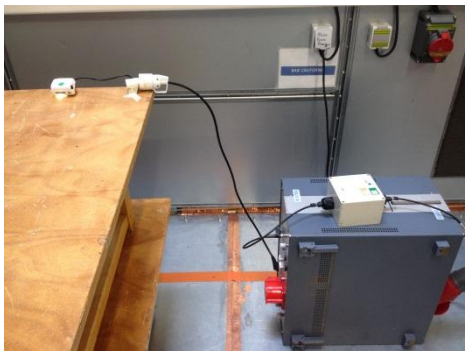
3.1. ENVIRONMENTAL CONDITIONS

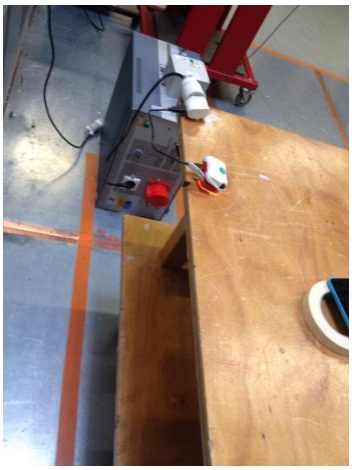
Date of test	: May 19th,2015
Test performed by	: N.Gagnaire
Atmospheric pressure (hPa)	: 990
Relative humidity (%)	: 40
Ambient temperature (°C)	: 21

3.2. TEST SETUP

Mains terminals
The EUT and auxiliaries are set:
☑ 80cm above the ground on the non-conducting table (Table-top equipment)
☐ 10cm above the ground on isolating support (Floor standing equipment)
The distance between the EUT and the LISN is 80cm. The EUT is 40cm away for the vertical ground plane.

The EUT is powered by V_{nom}.
The EUT is powered through a LISN (measure). Auxiliaries are powered by another LISN.





Test setup in DC mode

3.3. TEST METHOD

The product has been tested according to ANSI C63.10 and FCC Part 15 subpart C. The product has been tested with 120V/60Hz power line voltage and compared to the FCC Part 15 subpart C §15.207 limits. Measurement bandwidth was 9kHz from 150kHz to 30MHz. This was followed by a Quasi-Peak, i.e. CISPR measurement for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. The LISN (measure) is 50Ω / 50µH. The Peak data are shown on plots in annex 1. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured. Interconnecting cables and equipment's were moved to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on the following page.
Measurements are performed on the phase (L1) and neutral (N) of power line voltage. Graphs are obtained in PEAK detection. Measures are also performed in Quasi-Peak and Average for any strong signal.

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3.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Cable + self	-	-	A5329578	05/14	05/15
Conducted emission comb generator	BARDET	-	A3169049	-	-
LISN tri-phase ESH2-Z5	RHODE & SCHWARZ	33852.19.53	C2320063	11/14	11/15
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	04/15	04/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15
Transient limiter	RHODE & SCHWARZ	ESH3-Z2	A7122204	11/14	11/15

3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

3.6. TEST RESULTS

Measurements are performed on the phase (L1) and neutral (N) of the power line.
Results in DC mode: (PEAK detection)

Measure on L1:	graph **Emc#1**	(see annex 1)
Measure on N:	graph **Emc#2**	(see annex 1)

3.7. CONCLUSION

Conducted emission data measurement performed on the sample of the product **REACTIK+**, SN: **150300242**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 Issue 1.0 limits.

4. RADIATED EMISSION DATA

4.1. ENVIRONMENTAL CONDITIONS

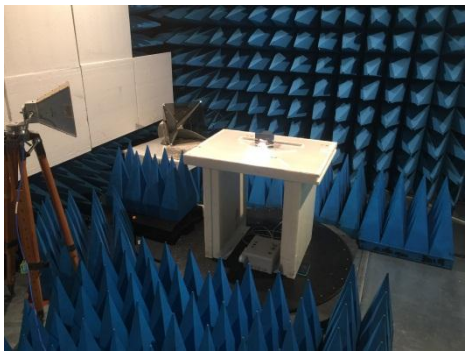
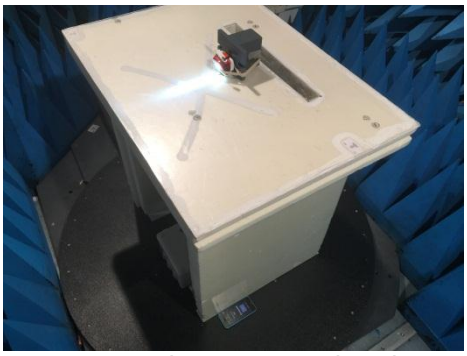
Date of test	: May 12th, 2015
Test performed by	: G.Deschamps
Atmospheric pressure (hPa)	: 1003
Relative humidity (%)	: 41
Ambient temperature (°C)	: 23

4.2. TEST SETUP

The installation of EUT is identical for pre-characterization measures in a 3 meters semi- anechoic chamber and for measures on the 10 meters Open site.
The EUT and auxiliaries are set:
☑ 80cm above the ground on the non-conducting table (Table-top equipment)
☑ 150cm above the ground on the non-conducting table (Table-top equipment) - Above 1GHz
☐ 10cm above the ground on isolating support (Floor standing equipment)
The EUT is powered by V_{nom}.

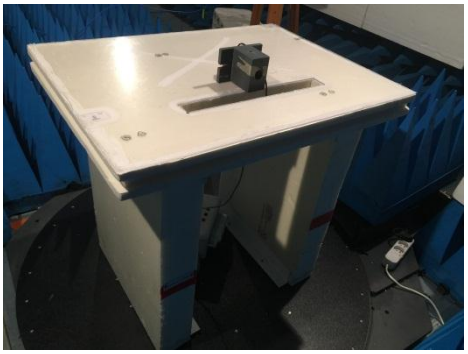


Test setup in Battery mode axis XY

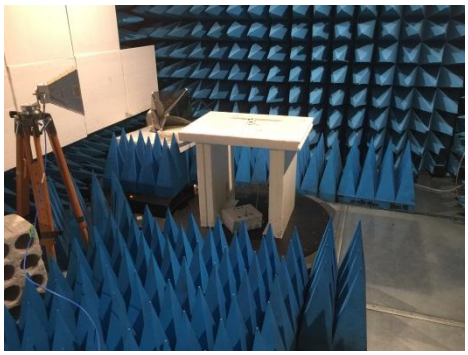
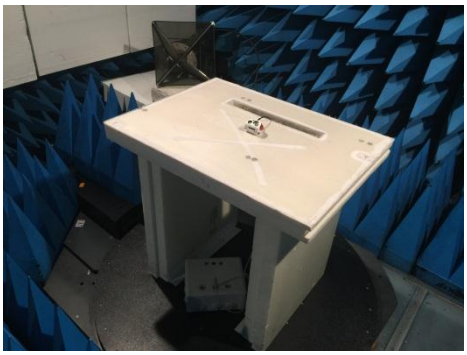




Test setup in Battery mode axis Z

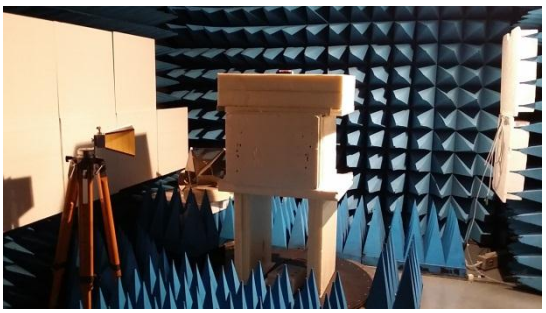




Test setup in DC mode axis Z(USB)


Test setup in DC mode axis XY(USB)



1.5m table above 1GHz

4.3. TEST METHOD

Pre-characterisation measurement: (30MHz – 1GHz)
A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber for frequency from 30MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test to maximize the emission measurement. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration.
The pre-characterization graphs are obtained in PEAK detection and PEAK/AVERAGE from 1GHz to 25GHz.

Characterization on 10 meters open site from 30MHz to 1GHz:
The product has been tested according to ANSI C63.10, FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC. The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C limits. Measurement bandwidth was 9kHz below 30MHz and 120kHz from 30 MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test to maximize the emission measurement. The height antenna is varied from 1m to 4m. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.
Frequency list has been created with anechoic chamber pre-scan results.

Characterization on 3 meters full anechoic chamber from 1GHz to 25GHz:
The product has been tested at a distance of **3 meters** from the antenna and compared to the FCC part 15 subpart C §15.209 limits. Measurement bandwidth was 1MHz from 1GHz to 25GHz.
Test is performed in horizontal (H) and vertical (V) polarization. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.The height antenna is
☐ On mast, varied from 1m to 4m
☑ Fixed and centered on the EUT (EUT smaller than the beamwidth of the measurement antenna, ANSI C63.10 §6.6.5)
Frequency list has been created with anechoic chamber pre-scan results.

4.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Amplifier 1-13GHz	LCIE SUD EST	-	A7102067	10/14	10/15
Antenna Bi-log	CHASE	CBL6111A	C2040172	04/13	04/15
Antenna horn	EMCO	3115	C2042029	09/14	09/15
High Pass (4.8-18GHz)	BL Microwave	SH4800-1800	A7484034	03/15	03/17
Cable Measure @3m	-	-	A5329038	08/14	08/15
Cable Measure @3m	-	-	A5329206	04/15	04/16
Cable Measure @1m	STORMFLEX	0	A5329680	10/14	10/15
Cable Measure @1m	STORMFLEX	0	A5329682	10/14	10/15
Semi-Anechoic chamber #3	SIEPEL	-	D3044017	-	-
Radiated emission comb generator	BARDET	-	A3169050	-	-
HF Radiated emission comb generator	LCIE SUD EST	-	A3169088	-	-
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

4.6. TEST RESULTS

4.6.1. Pre-characterization at 3 meters [30MHz-1GHz]

See graphs for 30MHz-1GHz:

Graph identifier		Polarization	Mode	EUT position	EUT configuration	Comments
Emr#	1	H/V	TX	Axis XY	Battery Mode	See annex 1
Emr#	2	H/V	TX	Axis XY	Battery Mode	See annex 1
Emr#	3	H/V	TX	Axis XY	DC Mode	See annex 1
Emr#	4	H/V	TX	Axis XY	DC Mode	See annex 1

4.6.2. Characterization on 10 meters open site from 30MHz to 1GHz

Worst case final data result:

Frequency list has been created with semi-anechoic chamber pre-scan results.
Measurements are performed using a QUASI-PEAK detection.

No	Frequency (MHz)	Limit Quasi-Peak (dBµV/m)	Measure Quasi-Peak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. Factor (dB)	Comments
No significant frequency observed.									

Note: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@3m = M@10m+10.5dB)

4.6.3. Characterization on 3meters anechoic chamber from 1GHz to 25GHz

Worst case final data result:

The frequency list is created from the results obtained during the pre-characterization in anechoic chamber.
Measurements are performed using a PEAK and AVERAGE detection.

No	Frequency (MHz)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin Peak (dB)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin Average (dB)	Angle Table (°)	Pol. Ant.	Ht. Ant. (cm)	FC (dB)	Remark
1	2363.100	74.0	39.1	**-34.9**	54.0	25.7	**-28.3**	0	H	100	-2.6	
2	2485.280	74.0	46.4	**-27.6**	54.0	28.7	**-25.3**	360	H	100	-2.3	
3	4804.000	74.0	54.5	**-19.5**	54.0	43.5	**-10.5**	360	H	100	3.6	
4	4884.000	74.0	55.7	**-18.3**	54.0	44.7	**-9.3**	5	H	100	3.8	
5	7326.000	74.0	51.8	**-22.2**	54.0	38.2	**-15.8**	5	H	100	7.5	
6	7440.000	74.0	47.9	**-26.1**	54.0	35.1	**-18.9**	5	H	100	7.7	
7	12010.000	74.0	54.1	**-19.9**	54.0	40.6	**-13.4**	0	H	100	11.5	
8	12210.000	74.0	55.0	**-19.0**	54.0	41.9	**-12.1**	5	H	100	11.7	
9	12400.000	74.0	52.3	**-21.7**	54.0	38.2	**-15.8**	5	H	100	11.8	

Note: Measures have been done at 3m distance.

4.7. CONCLUSION

Radiated emission data measurement performed on the sample of the product **REACTIK+**, SN: **150300242**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 Issue 1.0 limits.

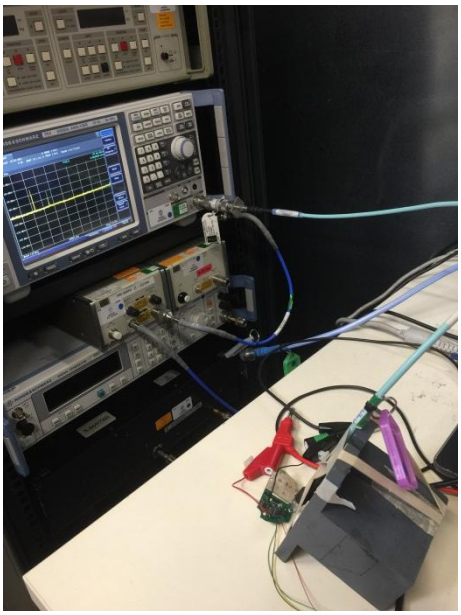
5. BANDWIDTH (15.247)

5.1. TEST CONDITIONS

Date of test : May 12th, 2015
Test performed by : G.Deschamps
Atmospheric pressure (hPa) : 1003
Relative humidity (%) : 41
Ambient temperature (°C) : 23

5.2. SETUP

☑ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.
Offset: Attenuator+cable 10.5dB



Test setup:

☐ ***Radiated measurement:***
The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete, a delta marker is used to measure the frequency difference as the emission bandwidth.

Measurement Procedure: §8.1 Option 1 (DTS Measurement Guidance)
1. Set resolution bandwidth (RBW) = 100kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer.

5.3. TEST EQUIPMENT LIST

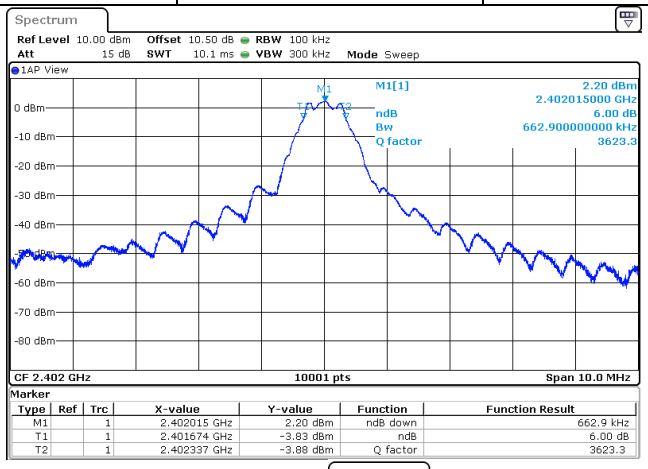
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Cable Measure	-	18G	A5329603	08/14	08/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

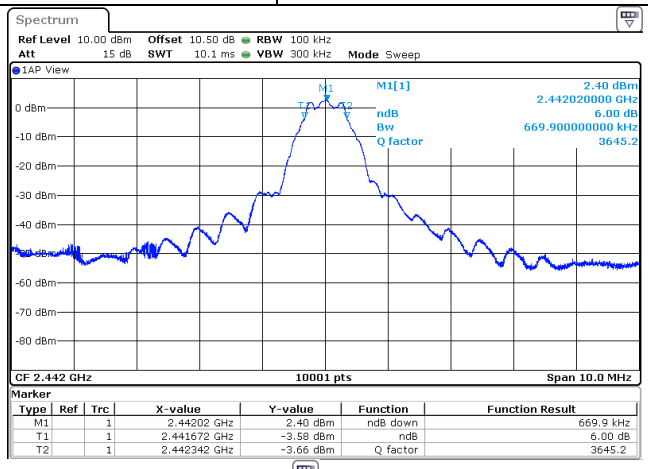
5.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

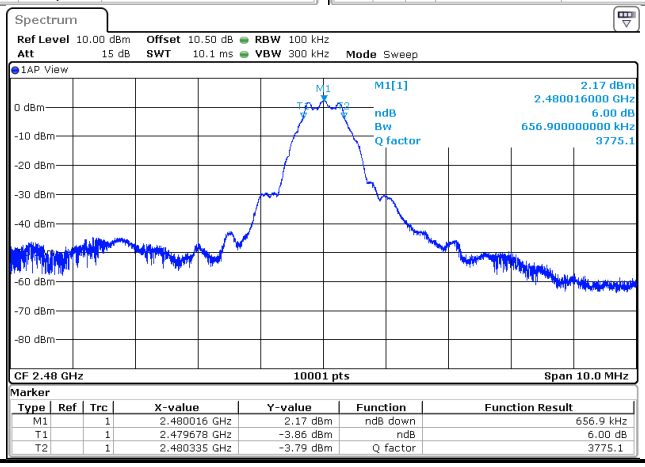
☑ None ☐ Divergence:

5.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Bandwidth Limit (kHz)
Cmin	2402	**662.9**	**>500**
Cmid	2442	**669.9**	**>500**
Cmax	2480	**656.9**	**>500**







5.6. CONCLUSION

Bandwidth measurement performed on the sample of the product **REACTIK+**, SN: **E920445C01 GNDUFL**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 Issue 1.0 limits.

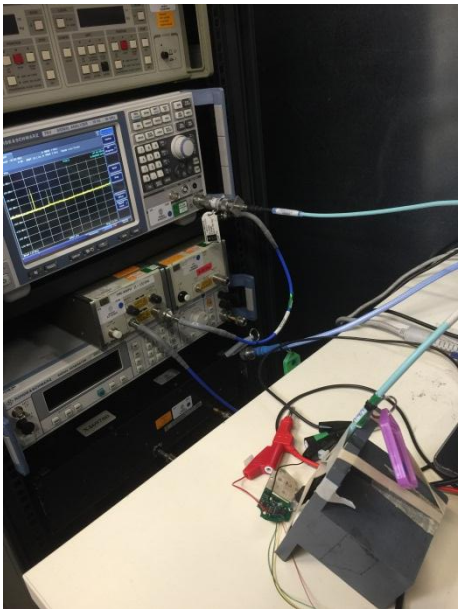
6. MAXIMUM PEAK OUTPUT POWER (15.247)

6.1. TEST CONDITIONS

Date of test : May 12th, 2015
Test performed by : G.Deschamps
Atmospheric pressure (hPa) : 1003
Relative humidity (%) : 41
Ambient temperature (°C) : 23

6.2. SETUP

☑ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency.
Offset: Attenuator+cable 10.5dB



Test setup:

☐ ***Radiated measurement:***
The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency.
The product has been tested at a distance of 3 meters from the antenna. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT. A summary of the worst case emissions found in all test configurations and modes is shown on following table. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.
To demonstrate compliance with peak output power requirement of section 15.247 (b), the transmitter's peak output power is calculated using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where:
- E is the measured maximum fundamental field strength in V/m.
- G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.
- d is the distance in meters from which the field strength was measured.
- P is the power in watts for which you are solving:

$$P = \frac{(Ed)^2}{30G}$$

Maximum peak conducted output power

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

- ☑ ***RBW ≥ DTS bandwidth §9.1.1 (DTS Measurement Guidance)***

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ 3 x RBW.
c) Set span ≥ 3 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

- ☐ ***Integrated band power method***

This procedure may be used when the maximum available RBW of the measurement instrument is less than the DTS bandwidth.

a) Set the RBW = 1 MHz.
b) Set the VBW ≥ 3 x RBW
c) Set the span ≥ 1.5 x DTS bandwidth.
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges

6.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Cable Measure	-	18G	A5329603	08/14	08/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

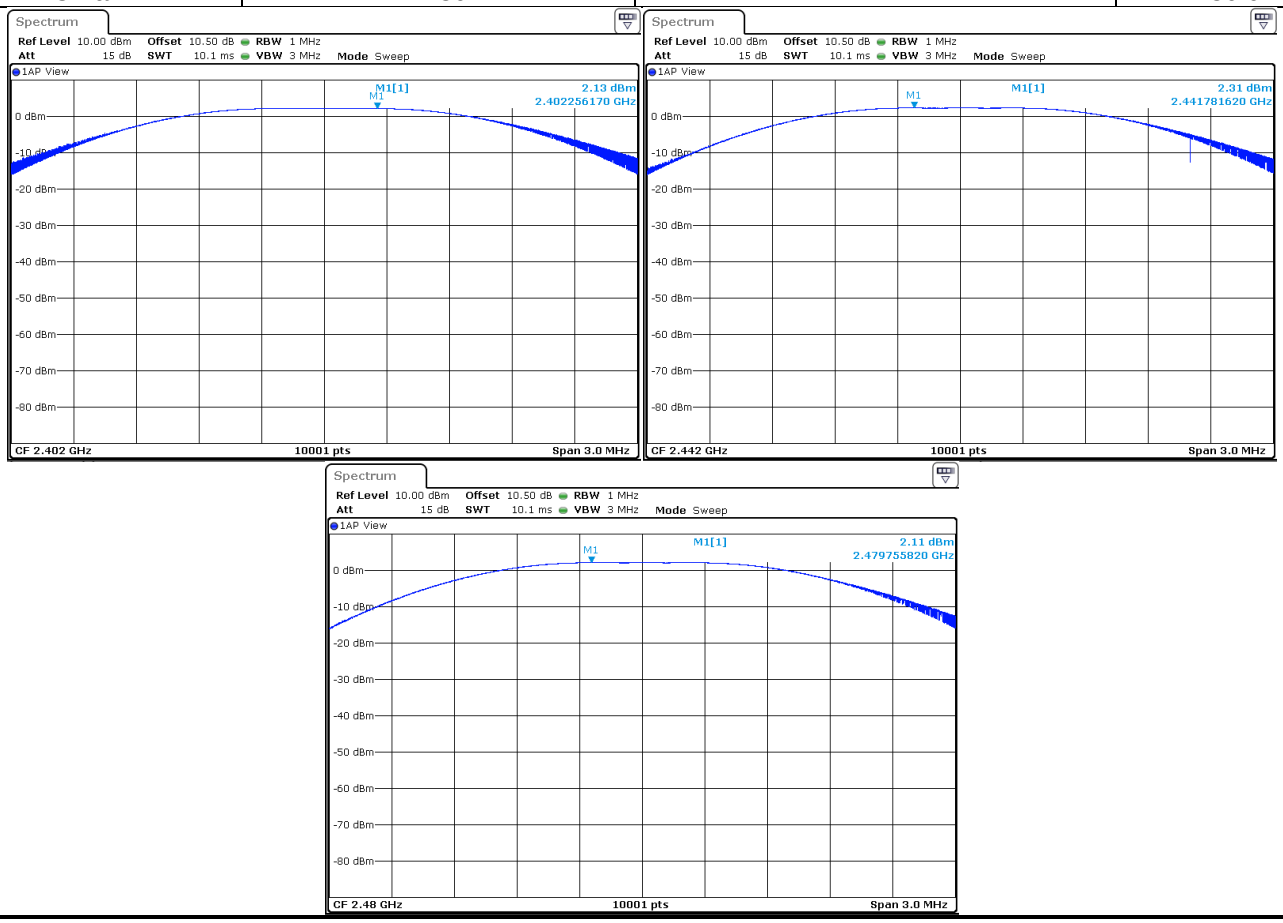
6.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

6.5. TEST SEQUENCE AND RESULTS

Modulation:

Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)
Cmin	2402	**2.13**	30.0
Cmid	2442	**2.31**	30.0
Cmax	2480	**2.11**	30.0



6.6. CONCLUSION

Maximum Peak Output Power measurement performed on the sample of the product **REACTIK+**, SN: **E920445C01 GNDUFL**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 Issue 1.0 limits.

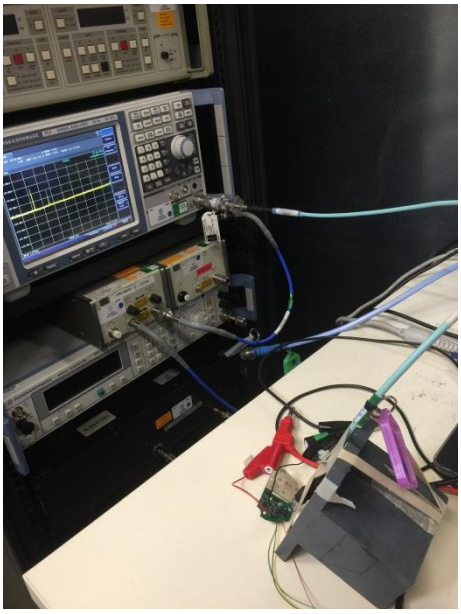
7. POWER SPECTRAL DENSITY (15.247)

7.1. TEST CONDITIONS

Date of test : May 12th, 2015
Test performed by : G.Deschamps
Atmospheric pressure (hPa) : 1003
Relative humidity (%) : 41
Ambient temperature (°C) : 23

7.2. SETUP

☑ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency.
Offset: Attenuator+cable 10.5dB



Test setup:

☐ ***Radiated measurement:***
The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency.
The product has been tested at a distance of 3 meters from the antenna. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT. A summary of the worst case emissions found in all test configurations and modes is shown on following table. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.
To demonstrate compliance with peak output power requirement of section 15.247 (b), the transmitter's peak output power is calculated using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where:
- E is the measured maximum fundamental field strength in V/m.
- G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.
- d is the distance in meters from which the field strength was measured.
- P is the power in watts for which you are solving:

$$P = \frac{(Ed)^2}{30G}$$

Measurement Procedure PKPSD: §10.2 (DTS Measurement Guidance)

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

7.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Cable Measure	-	18G	A5329603	08/14	08/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

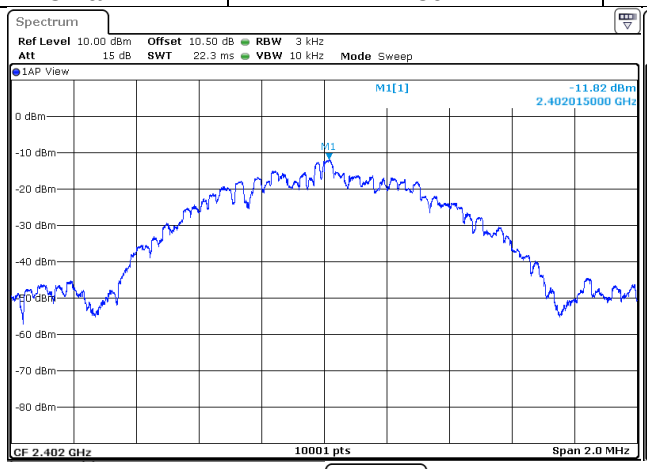
7.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

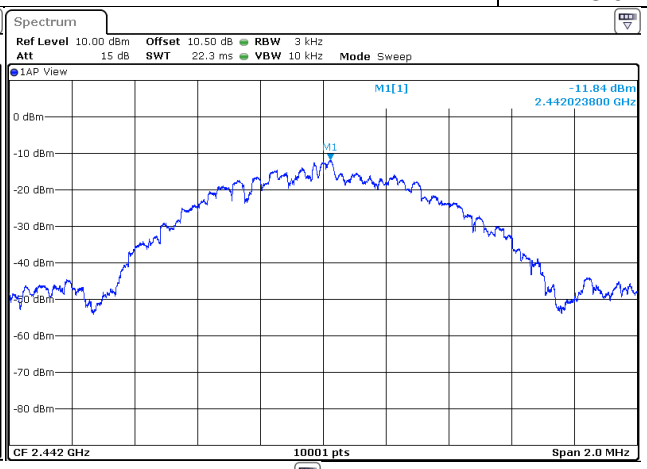
☑ None ☐ Divergence:

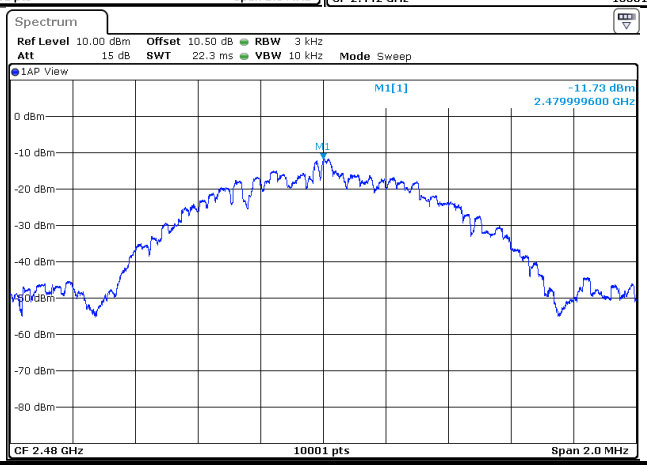
7.5. TEST SEQUENCE AND RESULTS

Modulation:

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
Cmin	2402	**-11.82**	8.0
Cmid	2442	**-11.84**	8.0
Cmax	2480	**-11.73**	8.0







7.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product **REACTIK+**, SN: **E920445C01 GNDUFL**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 Issue 1.0 limits.

8. BAND EDGE MEASUREMENT (15.247)

8.1. TEST CONDITIONS

Date of test	: May 12th, 2015
Test performed by	: G.Deschamps
Atmospheric pressure (hPa)	: 1003
Relative humidity (%)	: 41
Ambient temperature (°C)	: 23

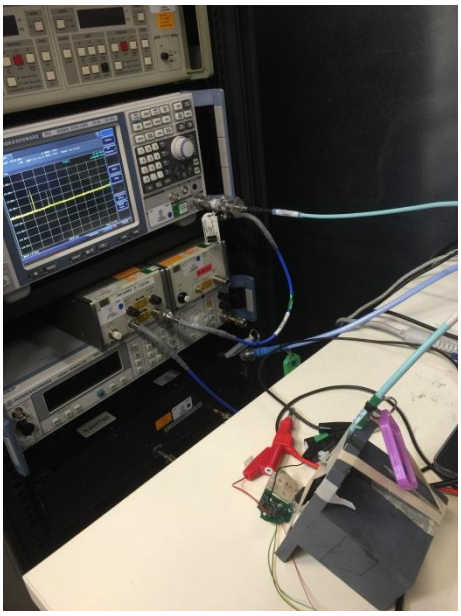
8.2. LIMIT

RF antenna conducted test: § 11 (DTS Measurement Guidance)
Set RBW = 100 kHz, Video bandwidth (VBW) > RBW, scan up through 10th harmonic. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. Note: If the device complies with the use of power option 2 the attenuation under this paragraph shall be 30 dB instead of 20 dB. *For -20dBc limit, lowest power output level is considered, worst case.*

Radiated emission test: § 12 (DTS Measurement Guidance)
Applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. For measurements above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation. See results in Radiated emissions section before.

8.3. SETUP

The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with Peak Output Power measurement. The EUT is turn ON; the graphs of the restrict frequency band are recorded with a display line indicating the highest level and other the 20dB offset below to show compliance with 15.247 (d) and 15.205. The emissions in restricted bands are compared to 15.209 limits.
RBW: 100kHz
VBW: 300kHz



Test setup:

8.4. TEST EQUIPMENT LIST

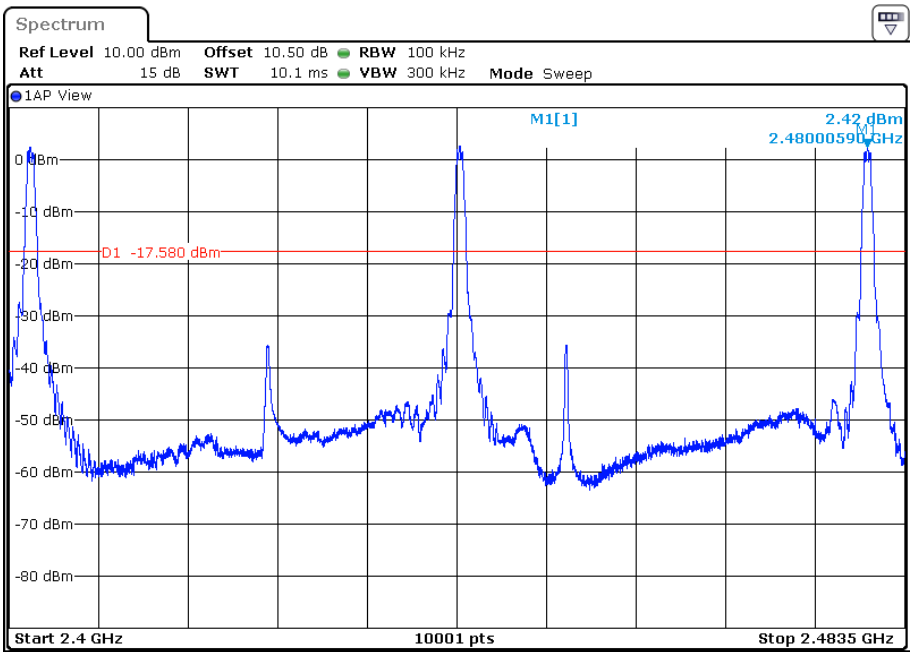
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Cable Measure	-	18G	A5329603	08/14	08/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

8.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

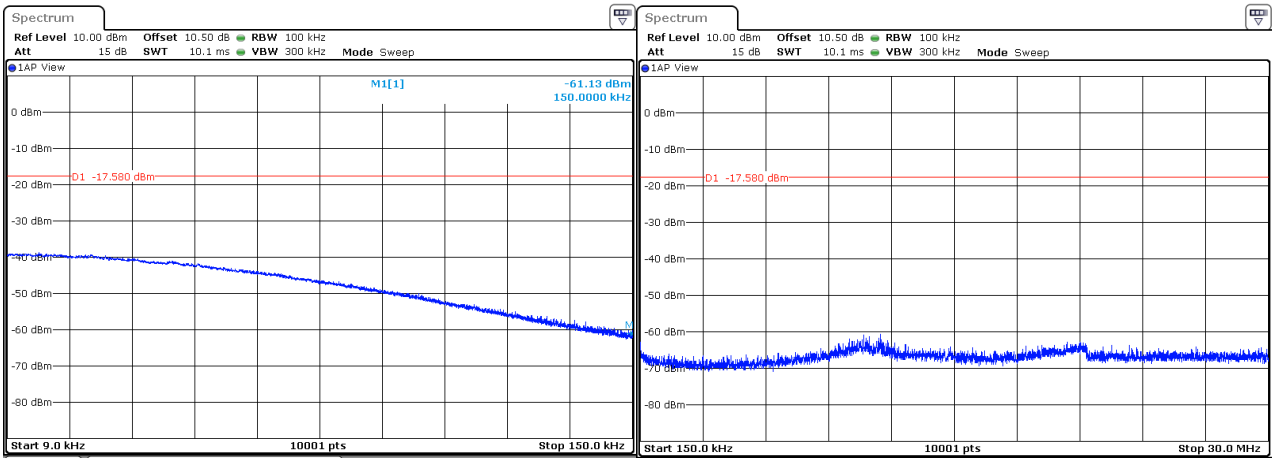
☑ None ☐ Divergence:

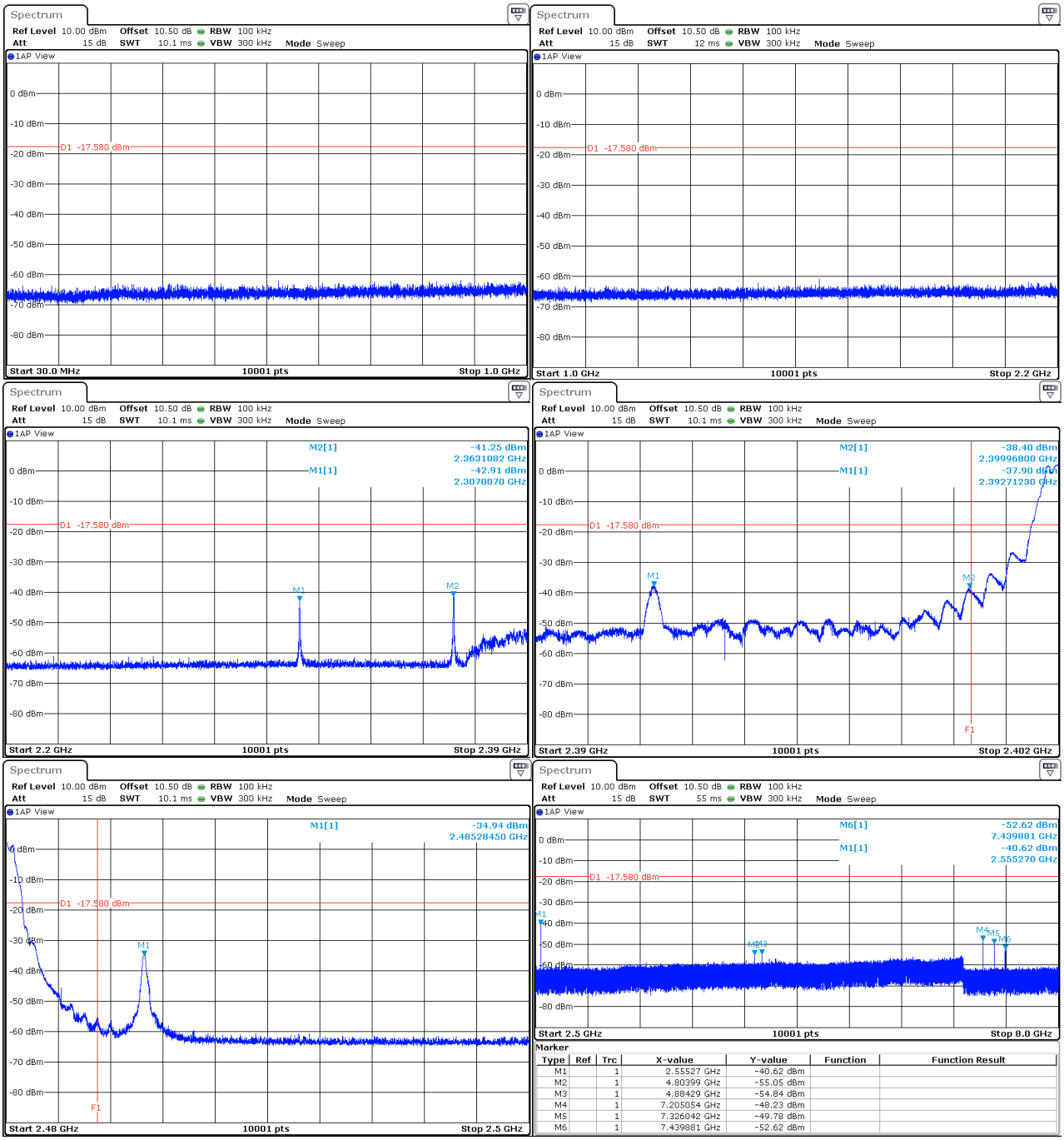
8.6. TEST SEQUENCE AND RESULTS

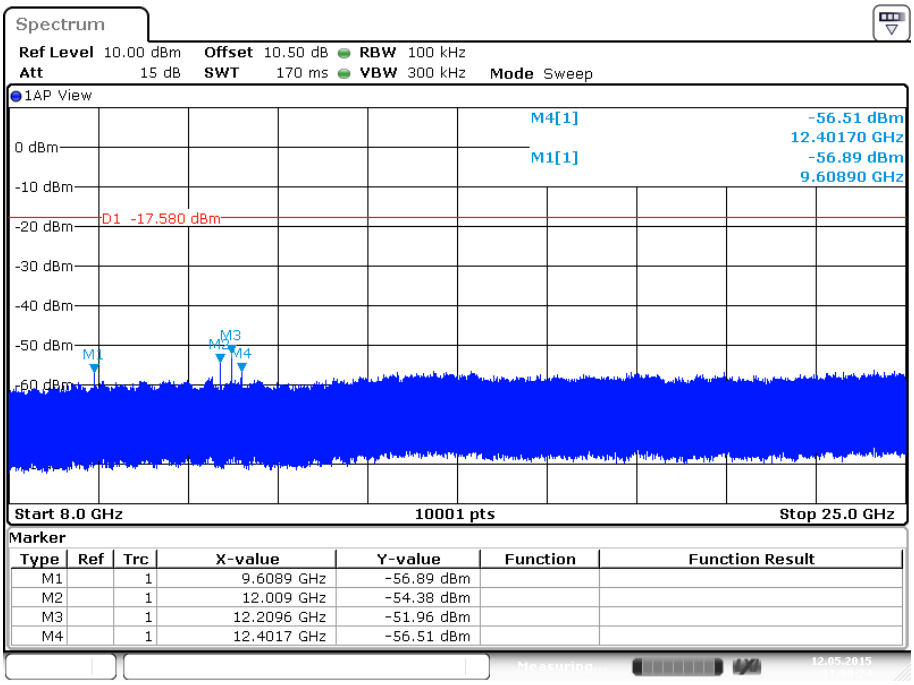
Offset: Attenuator+cable 10.5dB
GRAPH / MODULATION.



Worst case in Cmax and display line at -17.58dBm




Spectrum
Ref Level 10.00 dBm Offset 10.50 dB RBW 100 kHz
Att 15 dB SWT 10.1 ms VBW 300 kHz Mode Sweep
1AP View
D1 -17.580 dBm
Start 30.0 MHz 10001 pts Stop 1.0 GHz
Spectrum
Ref Level 10.00 dBm Offset 10.50 dB RBW 100 kHz
Att 15 dB SWT 12 ms VBW 300 kHz Mode Sweep
1AP View
D1 -17.580 dBm
Start 1.0 GHz 10001 pts Stop 2.2 GHz
Spectrum
Ref Level 10.00 dBm Offset 10.50 dB RBW 100 kHz
Att 15 dB SWT 10.1 ms VBW 300 kHz Mode Sweep
1AP View
M2[1] -41.25 dBm 2.3631082 GHz
M1[1] -42.91 dBm 2.3070070 GHz
D1 -17.580 dBm
Start 2.2 GHz 10001 pts Stop 2.39 GHz
Spectrum
Ref Level 10.00 dBm Offset 10.50 dB RBW 100 kHz
Att 15 dB SWT 10.1 ms VBW 300 kHz Mode Sweep
1AP View
M2[1] -38.40 dBm 2.39996800 GHz
M1[1] -37.90 dBm 2.39271230 GHz
D1 -17.580 dBm
Start 2.39 GHz 10001 pts Stop 2.402 GHz
Spectrum
Ref Level 10.00 dBm Offset 10.50 dB RBW 100 kHz
Att 15 dB SWT 10.1 ms VBW 300 kHz Mode Sweep
1AP View
M1[1] -34.94 dBm 2.48528450 GHz
D1 -17.580 dBm
Start 2.48 GHz 10001 pts Stop 2.5 GHz
Spectrum
Ref Level 10.00 dBm Offset 10.50 dB RBW 100 kHz
Att 15 dB SWT 55 ms VBW 300 kHz Mode Sweep
1AP View
M6[1] -52.62 dBm 7.439881 GHz
M1[1] -40.62 dBm 2.555270 GHz
D1 -17.580 dBm
Start 2.5 GHz 10001 pts Stop 8.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.55527 GHz -40.62 dBm
M2 1 4.80399 GHz -55.05 dBm
M3 1 4.88429 GHz -54.84 dBm
M4 1 7.205054 GHz -48.23 dBm
M5 1 7.326042 GHz -49.78 dBm
M6 1 7.439881 GHz -52.62 dBm



8.7. CONCLUSION

Band Edge Measurement performed on the sample of the product **REACTIK+**, SN: **E920445C01 GNDUFL**, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 Issue 1.0 limits.

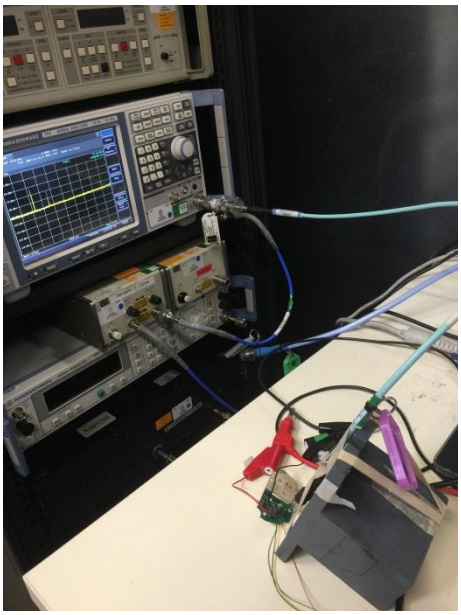
9. OCCUPIED BANDWIDTH

9.1. TEST CONDITIONS

Date of test : May 12th, 2015
Test performed by : G.Deschamps
Atmospheric pressure (hPa) : 1003
Relative humidity (%) : 41
Ambient temperature (°C) : 23

9.2. SETUP

☑ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.
Offset: Attenuator+cable 10.5dB



Test setup:

☐ ***Radiated measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Measurement Procedure:

a) RBW shall be in the range of 1% to 5% of the anticipated occupied bandwidth
b) Set the video bandwidth (VBW) ≥ 3 x RBW
c) SPAN = Capture all products of the modulation process
d) Detector = Peak.
e) Trace mode = max hold.
f) Sweep = auto couple.
g) Allow the trace to stabilize.
h) OBW 99% function of spectrum analyzer used

9.3. TEST EQUIPMENT LIST

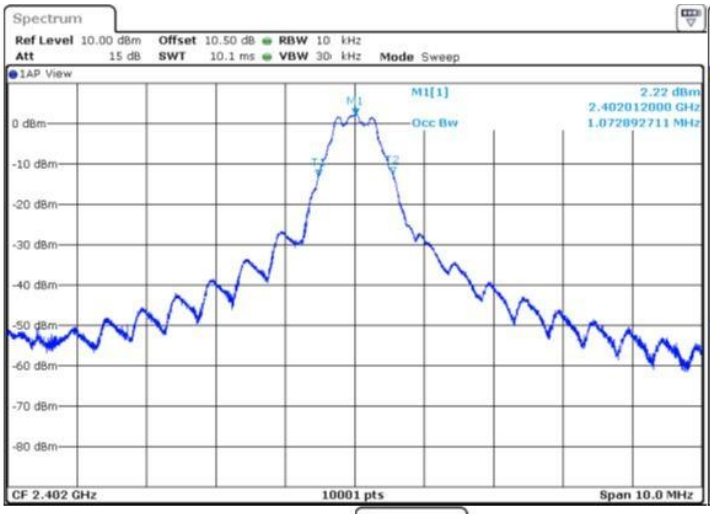
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Cable Measure	-	18G	A5329603	08/14	08/15
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	01/15	01/16
Thermo-hygrometer (PM2)	OREGON	BAR916HG-G	B4206011	04/14	04/15

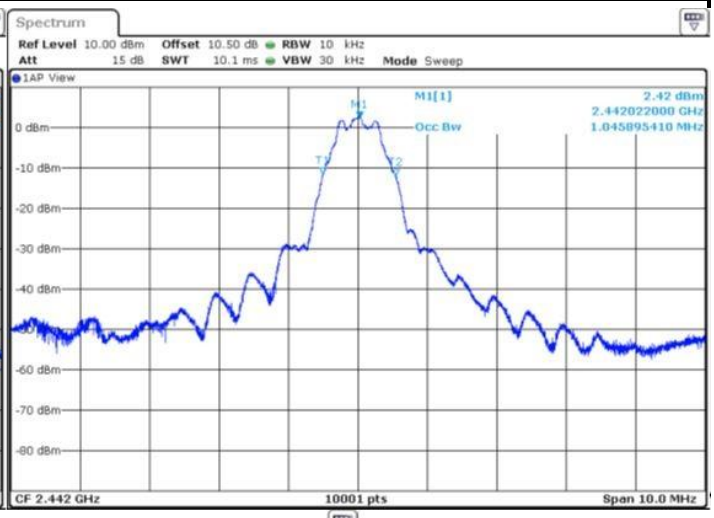
9.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

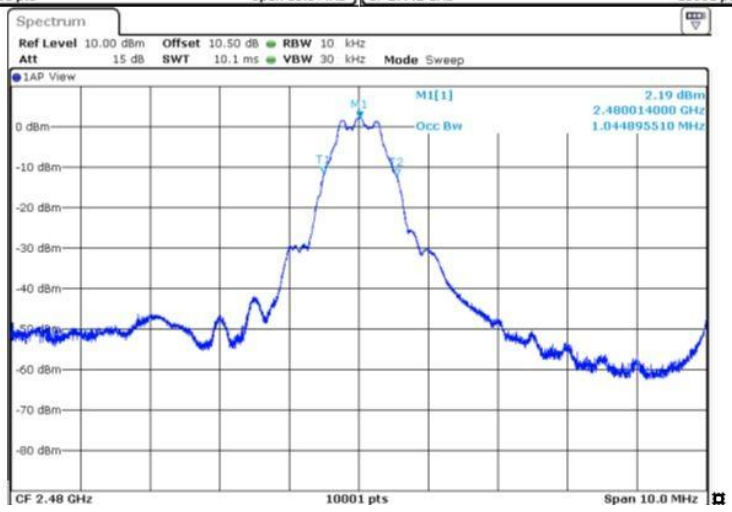
☑ None ☐ Divergence:

9.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
Cmin	2402	**1.072**
Cmid	2442	**1.045**
Cmax	2480	**1.044**

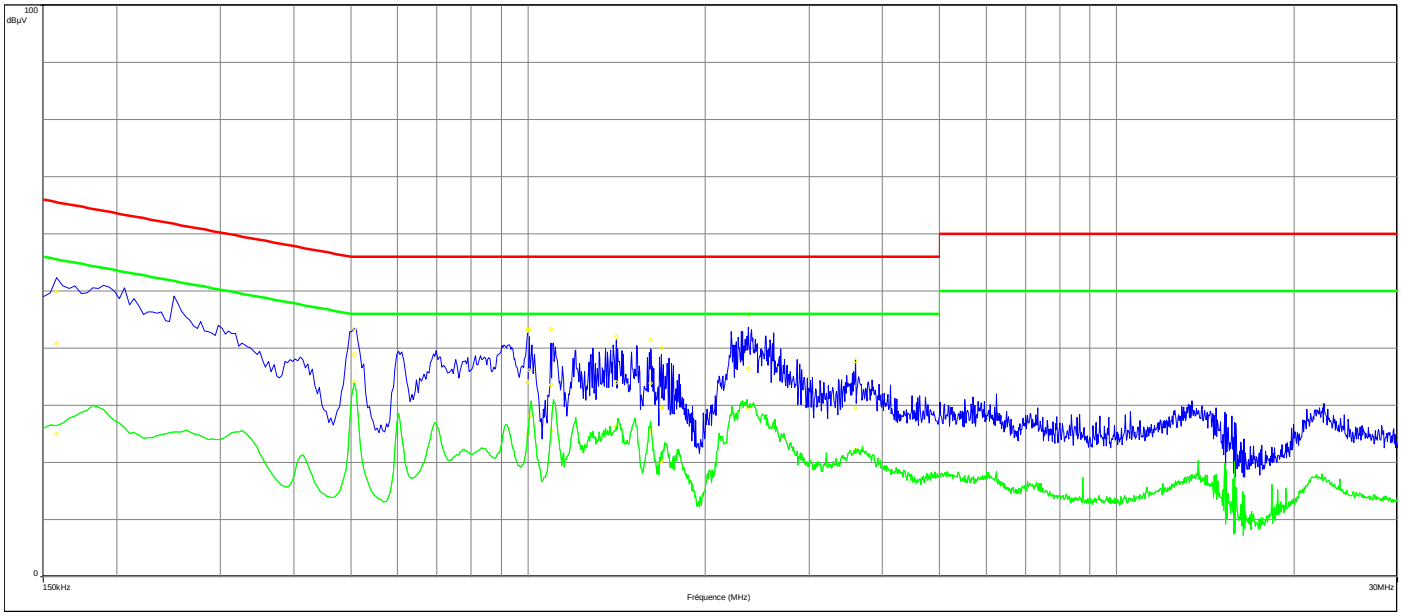






10. ANNEX 1 (GRAPHS)

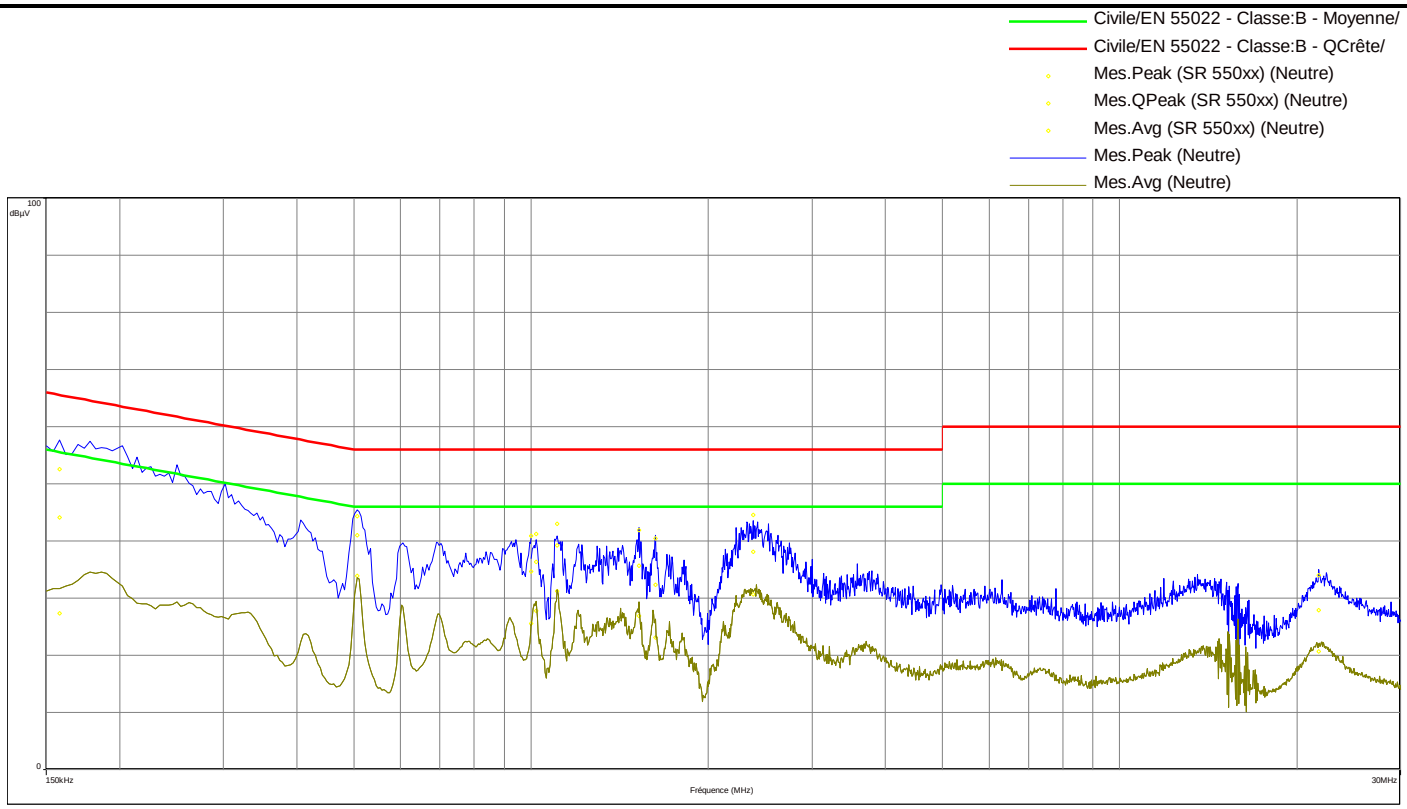
CONDUCTED EMISSIONS			
Graph name:	Emc#1	**Test configuration:**	
Limit:	EN 55022	L (RSIL) ESU8	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	230VAC / 50Hz	**RBW :**	10kHz
Line:	Neutral	**VBW :**	30kHz



Spurious emissions

Frequency (MHz)	Mes.Peak (dBµV)	Mes.QPeak (dBµV)	LimQP (dBµV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBµV)	LimAvg (dBµV)	Mes.Avg-LimAvg (dB)
0.158	49.9	40.8	65.57	-24.77	25.02	55.57	-30.55
0.506	43.36	38.92	56	-17.08	34.02	46	-11.98
0.998	43.25	34.05	56	-21.95	24.93	46	-21.07
1.004	43.37	36.09	56	-19.91	28.14	46	-17.86
1.092	43.36	33.53	56	-22.47	25.51	46	-20.49
1.412	41.97	33.95	56	-22.05	26.36	46	-19.64
1.616	41.43	33.93	56	-22.07	25.54	46	-20.46
1.684	39.97	29.54	56	-26.46	20.21	46	-25.79
2.368	45.89	36.41	56	-19.59	29.46	46	-16.54
3.604	37.77	29.46	56	-26.54	22.21	46	-23.79

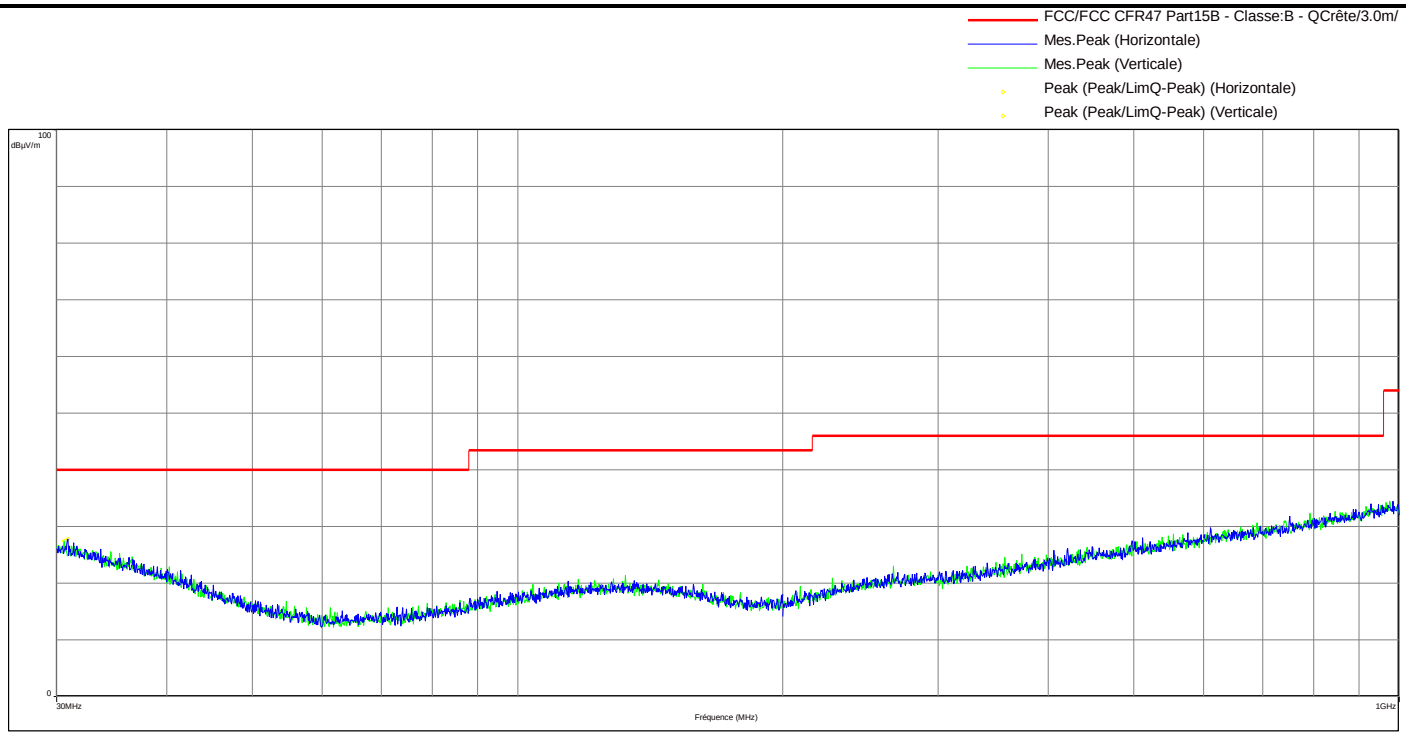
CONDUCTED EMISSIONS			
Graph name:	Emc#2	**Test configuration:**	
Limit:	EN 55022	N (RSIL) ESU8	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	230VAC / 50Hz	**RBW :**	10kHz
Line:	Neutral	**VBW :**	30kHz



Spurious emissions

Frequency (MHz)	Mes.Peak (dBµV)	Mes.QPeak (dBµV)	LimQP (dBµV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBµV)	LimAvg (dBµV)	Mes.Avg-LimAvg (dB)
0.158	52.61	44.13	65.57	-21.44	27.39	55.57	-28.18
0.506	44.33	41.04	56	-14.96	33.88	46	-12.12
1	40.85	34.7	56	-21.3	25.6	46	-20.4
1.02	41.26	36.36	56	-19.64	27.81	46	-18.19
1.108	42.98	39.21	56	-16.79	31.26	46	-14.74
1.524	41.85	35.68	56	-20.32	26.94	46	-19.06
1.628	40.43	32.37	56	-23.63	23.16	46	-22.84
2.384	44.53	38.11	56	-17.89	30.65	46	-15.35
21.792	34.01	27.91	60	-32.09	20.72	50	-29.28

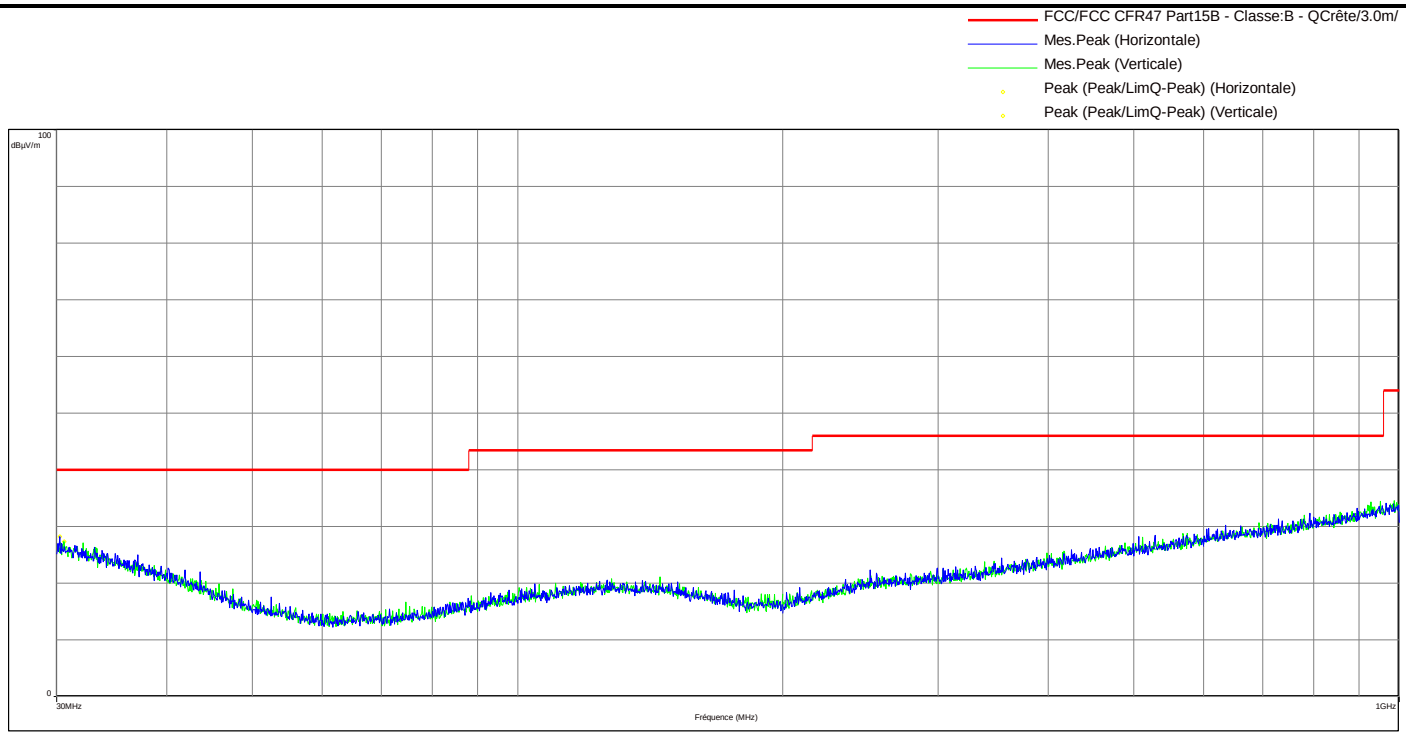
RADIATED EMISSIONS			
Graph name:	Emr#1	**Test configuration:**	
Limit:	FCC CFR47 Part15B	(H+V) - Battery mode - Axis XY	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	Polarization
30.918	27.8	Horizontal
30.595	27.47	Vertical

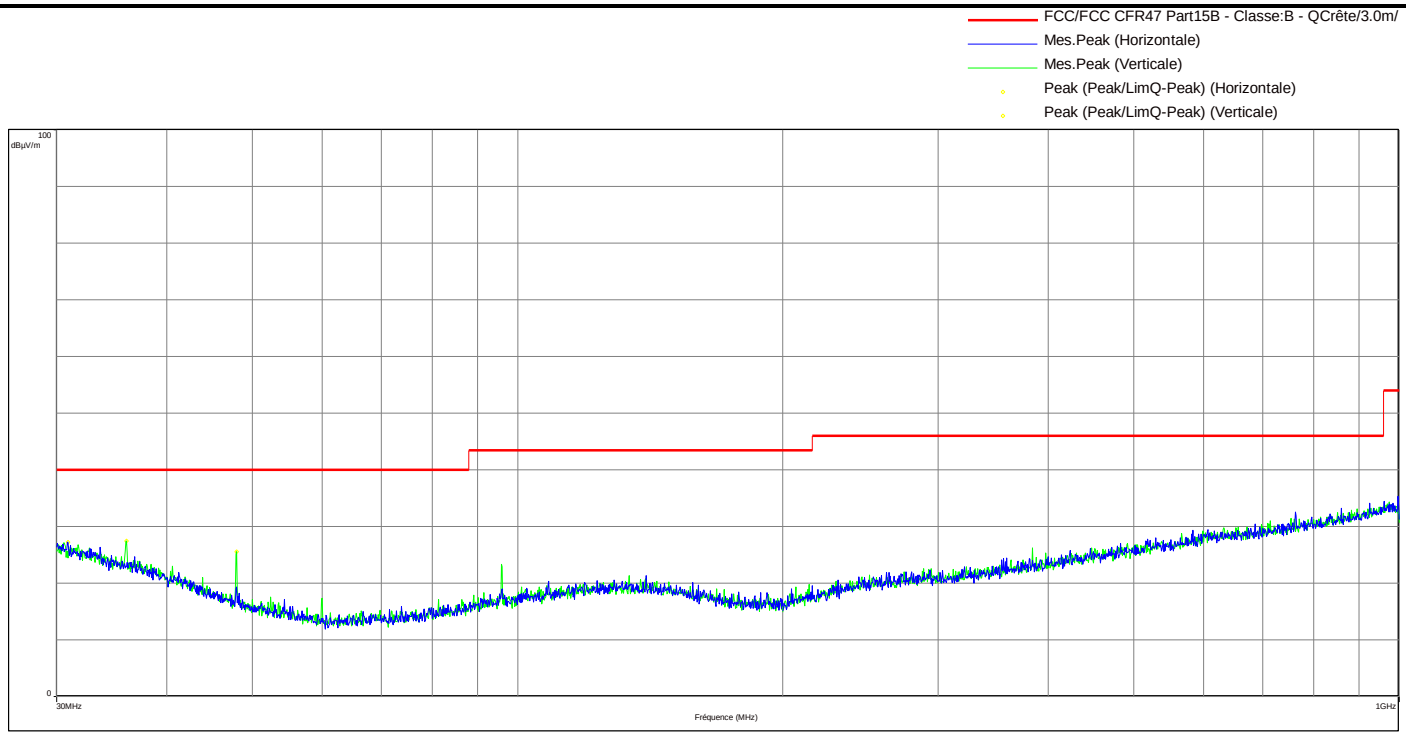
RADIATED EMISSIONS			
Graph name:	Emr#2	**Test configuration:**	
Limit:	FCC CFR47 Part15B	(H+V) - Battery mode - Axis Z	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	Polarization
30.238	28.2	Horizontal
30.578	27.34	Vertical

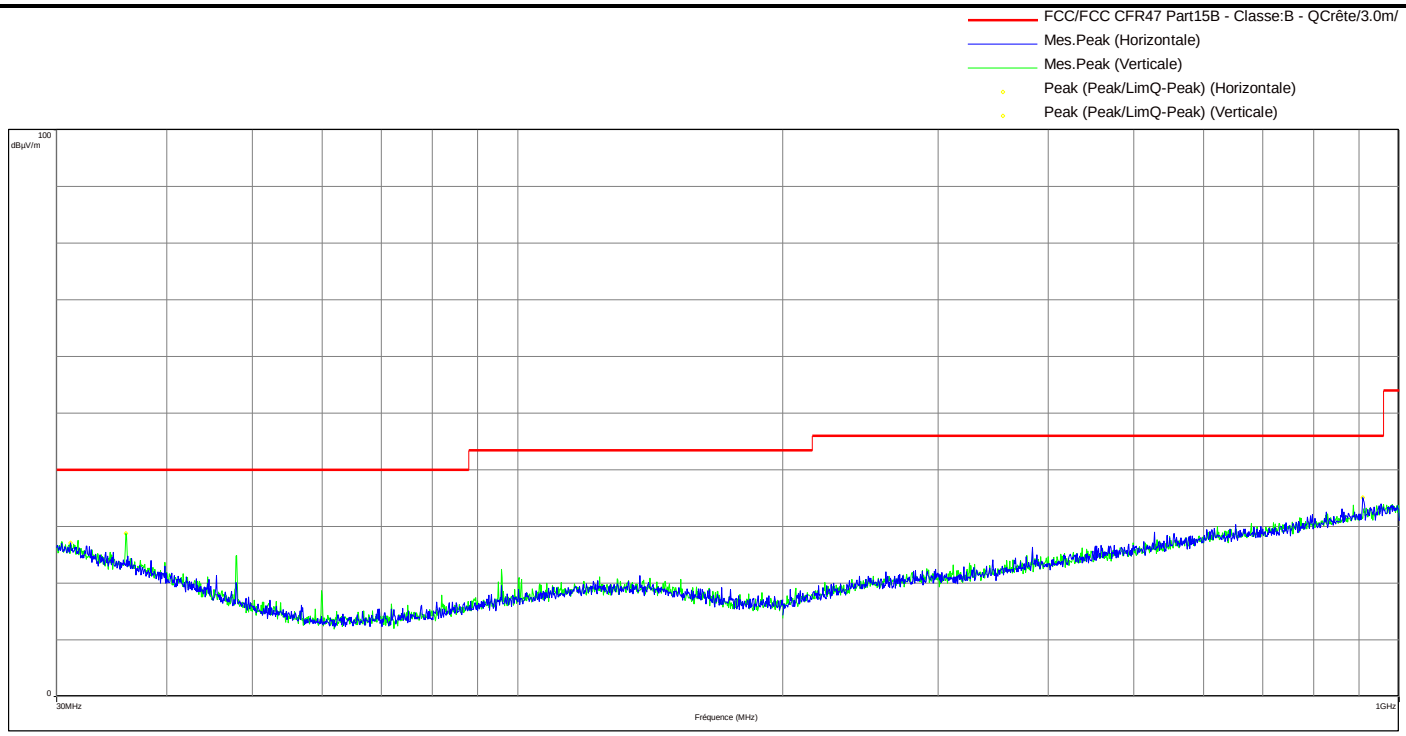
RADIATED EMISSIONS			
Graph name:	Emr#3	**Test configuration:**	
Limit:	FCC CFR47 Part15B	(H+V) - DC mode - Axis XY	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	Polarization
30.901	27.23	Horizontal
35.984	27.45	Vertical
47.969	25.57	Vertical

RADIATED EMISSIONS			
Graph name:	Emr#4	**Test configuration:**	
Limit:	FCC CFR47 Part15B	(H+V) - DC mode - Axis Z	
Class:	B		
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	Polarization
31.105	27.08	Horizontal
909.64	35.13	Horizontal
35.967	28.82	Vertical

11. UNCERTAINTIES CHART

Type de mesure / *Kind of measurement*	**Incertitude élargie laboratoire / *Wide uncertainty laboratory* (k=2) ± x**	**Incertitude limite du CISPR / *CISPR uncertainty limit* ± y**
Mesure des perturbations conduites en tension sur le réseau d'énergie *Measurement of conducted disturbances in voltage on the power port*	3.57 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication *Measurement of conducted disturbances in voltage on the telecommunication port.*	3.28 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension *Measurement of discontinuous conducted disturbances in voltage*	3.47 dB	3.6 dB
Mesure des perturbations conduites en courant *Measurement of conducted disturbances in current*	2.90 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans *Measurement of radiated electric field on the Moirans open area test site*	5.07 dB	5.2 dB

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par la norme, la conformité de l'échantillon est établie directement par les niveaux limites applicables. / *The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the standard. The conformity of the sample is directly established by the applicable limits values.*