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Rapport d'essai / *Test report*

N° 201009-6521CR-R2-E **JDE :** 102205

DELIVRE A / *ISSUED TO* : **SOLEM**
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5 ure Georges BESSE
34830 CLAPIERS - FRANCE

Objet / *Subject* : Essais de compatibilité électromagnétique conformément aux normes **FCC CFR 47 Part 15, Subpart B et C.**
Electromagnetic compatibility tests according to the standards ***FCC CFR 47 Part 15, Subpart B and C***

Matériel testé / *Apparatus under test* :

- Produit / *Product* : **RF WATERING SYSTEM**
- Marque / *Trade mark* : **SOLEM**
- Constructeur / *Manufacturer* : **SOLEM**
- Type / *Model* : **TBOSII-FTUS + TBOSII-ADUS + TBOSII-CM-1**
- N° de série / *serial number* : **Proto1 / Proto1 / Proto1**
- FCC ID : **YWW-TBOSIIFTUS and YWW-TBOSIIADUS**

Date des essais / *Test date* : Du 15 au 21 Octobre 2010 / *From October 15th to 21st, 2010*

Lieu d'essai / *Test location* : **LCIE SUD-EST**
ZI Centr'Alp – 170 rue de Chatagnon
38430 MOIRANS - France

Test réalisé par / *Test performed by* : Anthony MERLIN

Ce document comporte /*Composition of document :* 42 pages.

MOIRANS, LE 16 JUIN 2011 / *JUNE 16TH, 2011*

Ecrit par / *Written by,*
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Approuvé par / *Approved by,*
Jacques LORQUIN

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1. TEST PROGRAM

Standard: **- FCC Part 15, Subpart C 15.247**
- ANSI C63.4 (2009)

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance at mains ports 150kHz-30MHz	**Frequency**	**Quasi-peak value (dBµV)**	**Average value (dBµV)**	**PASS**
	150-500kHz	66 to 56	56 to 46	
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 9kHz-30MHz	**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**
Radiated emissions 30MHz-25GHz*	**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**
Bandwidth 6dB 15.247 (a) (2)	**At least 500kHz**			**PASS**
Maximum Peak Output Power 15.247 (b)	**Limit: 30dBm** Conducted or Radiated measurement			**PASS**
Band Edge Measurement 15.247 (d)	**Limit: -20dBc or Radiated emissions limits in restricted bands**			**PASS**
Power spectral Density 15.247 (e)	**Limit: 8dBm/3kHz**			**PASS**

***§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

The system was configured for testing in a typical fashion (as a customer would normally use it).
The Field Transmitter sends and receives data information from Radio Adaptor for programming the Control Module TBOSII.

2.2. HARDWARE IDENTIFICATION

- **Equipment under test (EUT):**

TBOSII-FTUS + TBOSII-ADUS + TBOSII-CM-1
Sn: Proto1 / Proto1 / Proto1
FCC ID: **YWW-TBOSIIFTUS and YWW-TBOSIIADUS**
Internal max frequencies: 32MHz

- **Power supply:**

- 1 x Adaptor AC/DC TDC POWER, model DE-05-12D 41/9, 230-240VAC 50Hz, 12VDC. (For FT)
- Battery Ni-MH 2.7VDC (FT)
- Battery Alkaline 9VDC (Radio Adaptor)
- Battery Alkaline 9VDC (Control Module)

- **Input/output:**

- 1 x Power supply DC, jack. (FT)
- 1 x RJ11, IR internal, length: 2m. (FT)

- **Auxiliaries used for testing:**

- None

- **Equipment information: Field Transmitter**

- External antenna connector: NO
- Radiated fundamental frequency band: [902-928]MHz, 1 channel @ 915MHz
- Antenna type: Internal
- Stand By mode: Yes
- Modulation Type: FSK
- Modulation Technology: DSSS
- Maximum Antenna Gain: 0dBi

- **Equipment information: Radio Adaptor**

- External antenna connector: NO
- Radiated fundamental frequency band: [902-928]MHz, 1 channel @ 915MHz
- Antenna type: External
- Stand By mode: Yes
- Modulation Type: FSK
- Modulation Technology: DSSS
- Maximum Antenna Gain: 0dBi

2.3. EUT CONFIGURATION

The system was configured for testing in a typical fashion (as a customer would normally use it).
Inboard test firmware version: Field Transmitter (1.42) / Radio Adaptor (1.15)
Special configurations of the EUT permit:
- Permanent emission without modulation
- Permanent emission with modulation
- Permanent receiver mode
- Permanent standby mode

For the Field Transmitter, the Infra Red function is tested.

2.4. EQUIPMENT MODIFICATIONS

None

2.5. SPECIAL ACCESSORIES

None

3. CONDUCTED EMISSION DATA

3.1. CLIMATIC CONDITIONS

Date of test : October 26th, 2010
Test performed by : Bertrand DESBORDES
Atmospheric pressure : 985mB
Relative humidity : 39%
Ambient temperature : 21.5°C

3.2. SETUP FOR CONDUCTED EMISSIONS MEASUREMENT

The product has been tested according to ANSI C63.4-(2009) and FCC Part 15 subpart B and C.

The product has been tested with 120V/60Hz power line voltage and compared to the FCC Part 15 subpart B §15.107 and C §15.207 limits. Measurement bandwidth was 9kHz from 150 kHz to 30 MHz.

Measurement is made with a Rohde & Schwarz ESU8 receiver in peak mode. 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.

3.3. TEST SETUP

The EUT is placed on the ground reference plane, at 80cm from the LISN. The distance between the EUT and the vertical ground plane is 40cm.
Auxiliaries are powered by another LISN.
The cable has been shorted to 1meter length. The EUT is powered trough the LISN (measure).

Conducted emission test setup

3.4. TEST SEQUENCE AND RESULTS

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.

TBOSII-FTUS:
Mode RF

Measure on L1:	graph Emc#1	(see annex 1)
Measure on N:	graph Emc#3	(see annex 1)

Mode IR

Measure on L1:	graph Emc#2	(see annex 1)
Measure on N:	graph Emc#4	(see annex 1)

RESULT: PASS

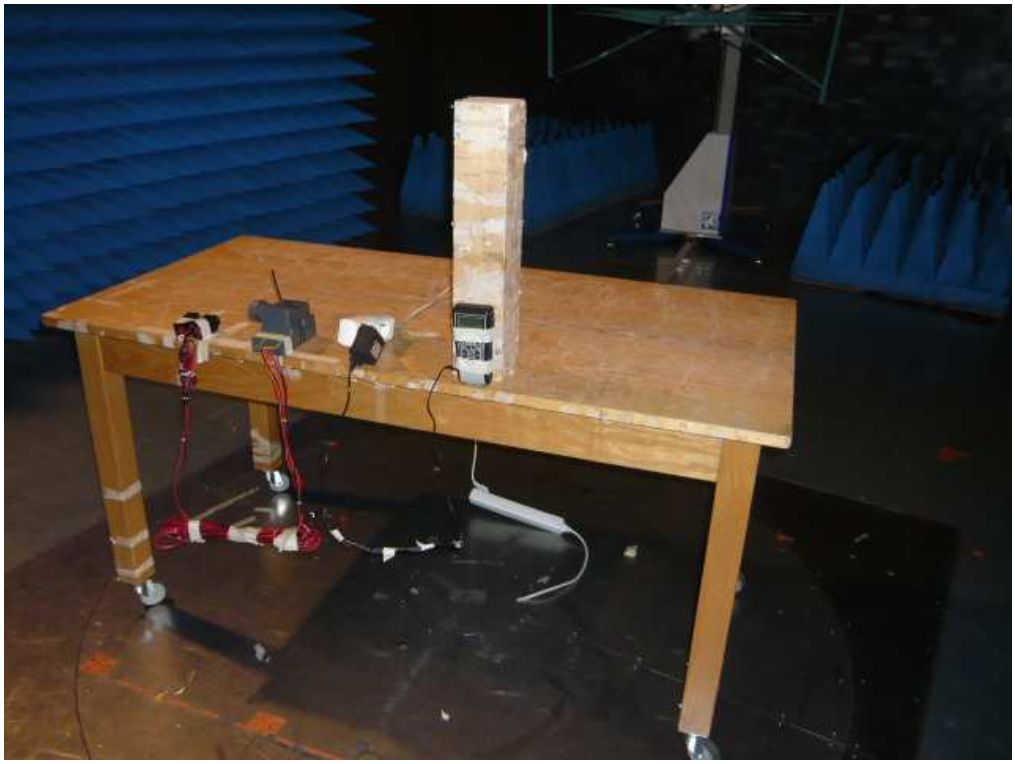
4. RADIATED EMISSION DATA

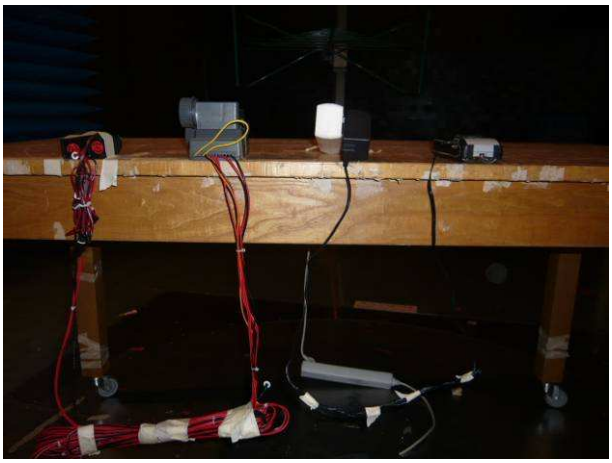
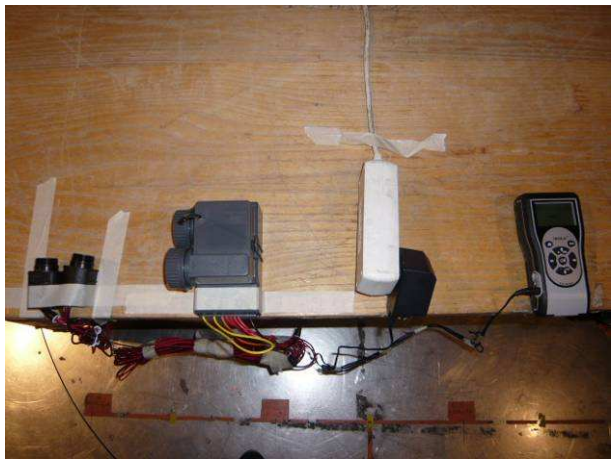
4.1. CLIMATIC CONDITIONS

Test performed by	: A.MERLIN		
Date of test	: October 18th, 2010	and	October 20th, 2010
Ambient temperature	: 22°C		21°C
Atmospheric pressure	: 980mb		983mb
Relative humidity	: 45%		48%

4.2. TEST SETUP

The installation of EUT is identical for pre-characterization measurement in a 3 meters semi anechoic chamber and for measures on a 10 meters Open site.



Radiated emission test setup

4.3. TEST SEQUENCE AND RESULTS

4.3.1. Pre-characterization at 3 meters [9kHz-30MHz]

A pre-scan of all the setup has been performed in a 3 meters semi anechoic chamber.
The distance between EUT and antenna is 3 meters. For Pre-characterization, the loop antenna was rotated during the test for maximized the emission measurement. Measurement performed on 3 axis of EUT.
Frequency band investigated is 9kHz to 30MHz.

The pre-characterization graphs are obtained in PEAK detection.

TBOSII-FTUS:
9kHz-30MHz band: **Emr#1** (See annex 1)

TBOSII-ADUS with TBOSII-CM-1:
9kHz-30MHz band: **Emr#2** (See annex 1)

4.3.2. Pre-characterization [30MHz-10GHz]

For frequency band 30MHz to 1GHz, a pre-scan of all the setup has been performed in a 3 meters semi anechoic chamber.
The distance between EUT and antenna is 3 meters. Test is performed in horizontal (H) and vertical (V) polarization with a log-periodic antenna. The EUT is being rotated on 360° and on 3 axis during the measurement. The pre-characterization graphs are obtained in PEAK detection.
For frequency band 1GHz to 10GHz, a search is performed in the semi-anechoic chamber in order to determine frequencies radiated by the EUT.

TBOSII – FT:

H polarization	**Emr#3**	*TX mode*	(See annex 1)
V polarization	**Emr#4**	*TX mode*	(See annex 1)

TBOSII – ADUS with TBOSII – CM-1:

H polarization	**Emr#5**	*TX mode*	(See annex 1)
V polarization	**Emr#6**	*TX mode*	(See annex 1)

4.3.3. Characterization on 10 meters open site below 30 MHz

The product has been tested according to ANSI C63.4 (2009), 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 §15.109 limits and C §15.209.
Antenna height was 1m for both horizontal and vertical polarization.
Antenna was rotated around its vertical axis.
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 in following tables.

Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	Qpeak (dBµV/m)	Qpeak-Limit (Margin dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
No Significant Frequency Observed						

*: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)

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

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart B §15.109 limits and C §15.209 limits. Measurement bandwidth was 120kHz from 30 MHz to 1GHz and 1MHz from 1GHz to 10GHz.
Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. 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 clause 3.2

Worst case final data result:

TBOSII-FTUS:

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
No significative frequency observed									

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

TBOSII-ADUS with TBOSII-CM-1:

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
No significative frequency observed									

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

Frequency band 1GHz to 10GHz
Measurements are performed using a PEAK and Average detection. (RBW = 1MHz)

TBOSII-FTUS:

No	Frequency (MHz)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	1830	54.0	45.4	**-8.6**	110	H	110	29.3	-
2	2745	54.0	34.7	**-19.3**	135	V	100	32.3	-
3	3660	54.0	38.3	**-15.7**	45	V	120	35.1	-
4	4575	54.0	38.8	**-15.2**	10	V	110	36.0	-
5	5490	54.0	40.9	**-13.1**	285	V	110	38.4	-
6	6405	54.0	48.6	**-5.4**	120	H	110	38.9	-

No	Frequency (MHz)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	1830	74.0	63.1	**-10.9**	110	H	110	29.3	-
2	2745	74.0	52.1	**-21.9**	135	V	100	32.3	-
3	3660	74.0	58.9	**-15.1**	45	V	120	35.1	-
4	4575	74.0	58.1	**-15.9**	10	V	110	36.0	-
5	5490	74.0	57.4	**-16.6**	285	V	110	38.4	-
6	6405	74.0	63.1	**-10.9**	120	H	110	38.9	-

Note: Measures have been done at 3m distance.

RESULTS: PASS

TBOSII-ADUS with TBOSII-CM-1:

No	Frequency (GHz)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	1830	54.0	56.1	**2.1**	75	H	110	29.3	**See Note2**
2	2745	54.0	44.6	**-9.4**	190	V	100	32.3	**-**
3	3660	54.0	49.5	**-4.5**	295	H	120	35.1	**-**
4	4575	54.0	46.3	**-7.7**	0	V	110	36.0	**-**
5	5490	54.0	46.4	**-7.6**	15	V	110	38.4	**-**
6	6405	54.0	59.0	**5.0**	65	H	110	38.9	**See Note2**

No	Frequency (GHz)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin (Mes-Lim) (Db)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	1830	74.0	69.3	**-4.7**	75	H	110	29.3	**-**
2	2745	74.0	61.1	**-12.9**	190	V	100	32.3	**-**
3	3660	74.0	65.2	**-8.8**	295	H	120	35.1	**-**
4	4575	74.0	64.2	**-9.8**	0	V	110	36.0	**-**
5	5490	74.0	63.3	**-10.7**	15	V	110	38.4	**-**
6	6405	74.0	69.9	**-4.1**	65	H	110	38.9	**-**

Note1: Measures have been done at 3m distance.
Note2: Not emitted in restricted band, margin with peak output power >20dB, comply with requirements.

RESULTS: PASS

4.4. 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.

5. BANDWIDTH (15.247)

5.1. TEST CONDITIONS

Test performed by : A.MERLIN
Date of test : October 18th, 20910
Ambient temperature : 22°C
Relative humidity : 45%
Atmospheric pressure : 980mb

5.2. LIMIT

The 6 dB bandwidth must be greater than 500 kHz.

5.3. SETUP

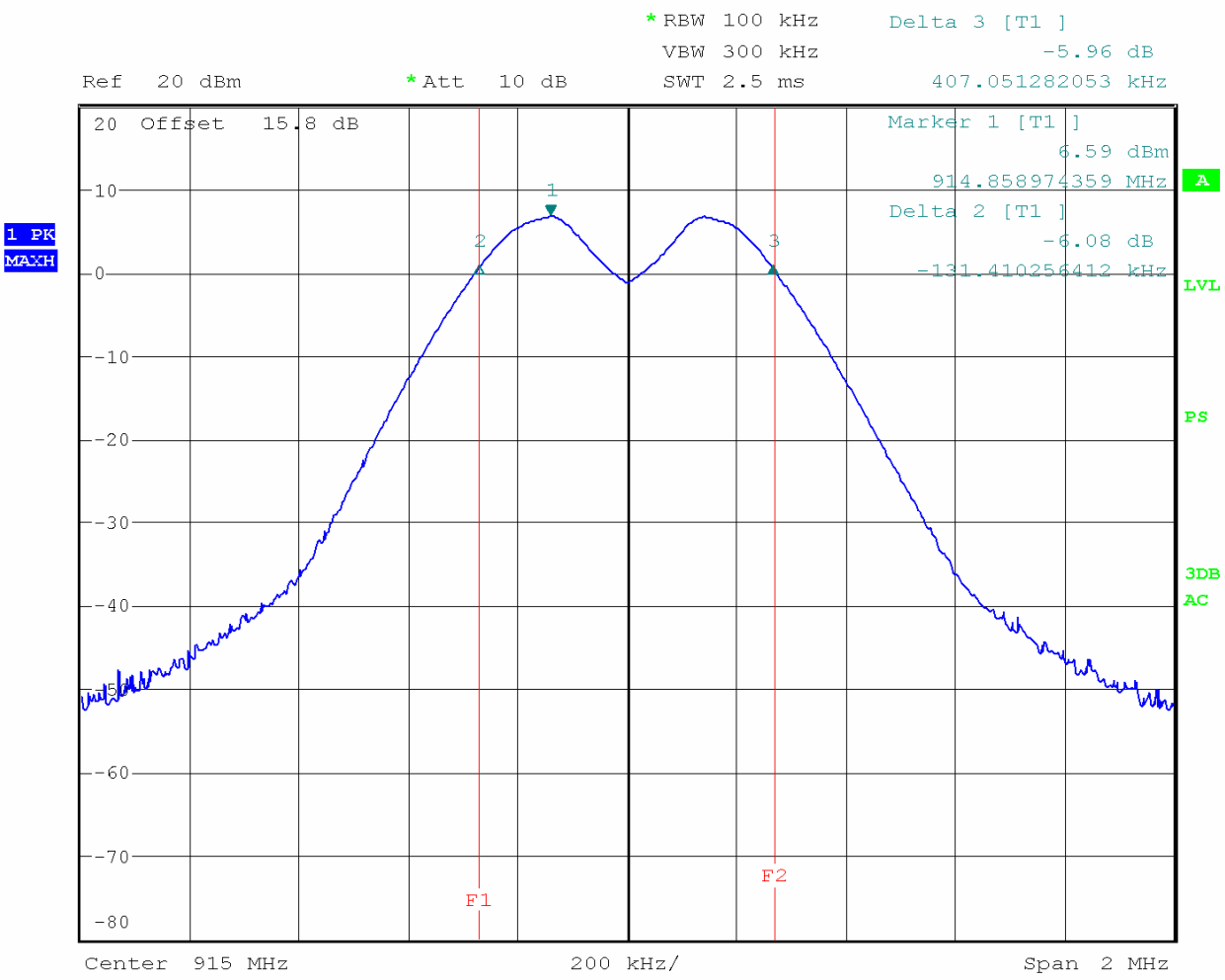
Conducted measurement:
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency and using 100kHz RBW and VBW>RBW, the span greater than RBW.
The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Radiated measurement:
The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency and using 100kHz RBW and VBW>RBW, the span greater than RBW.
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.

5.4. RESULTS

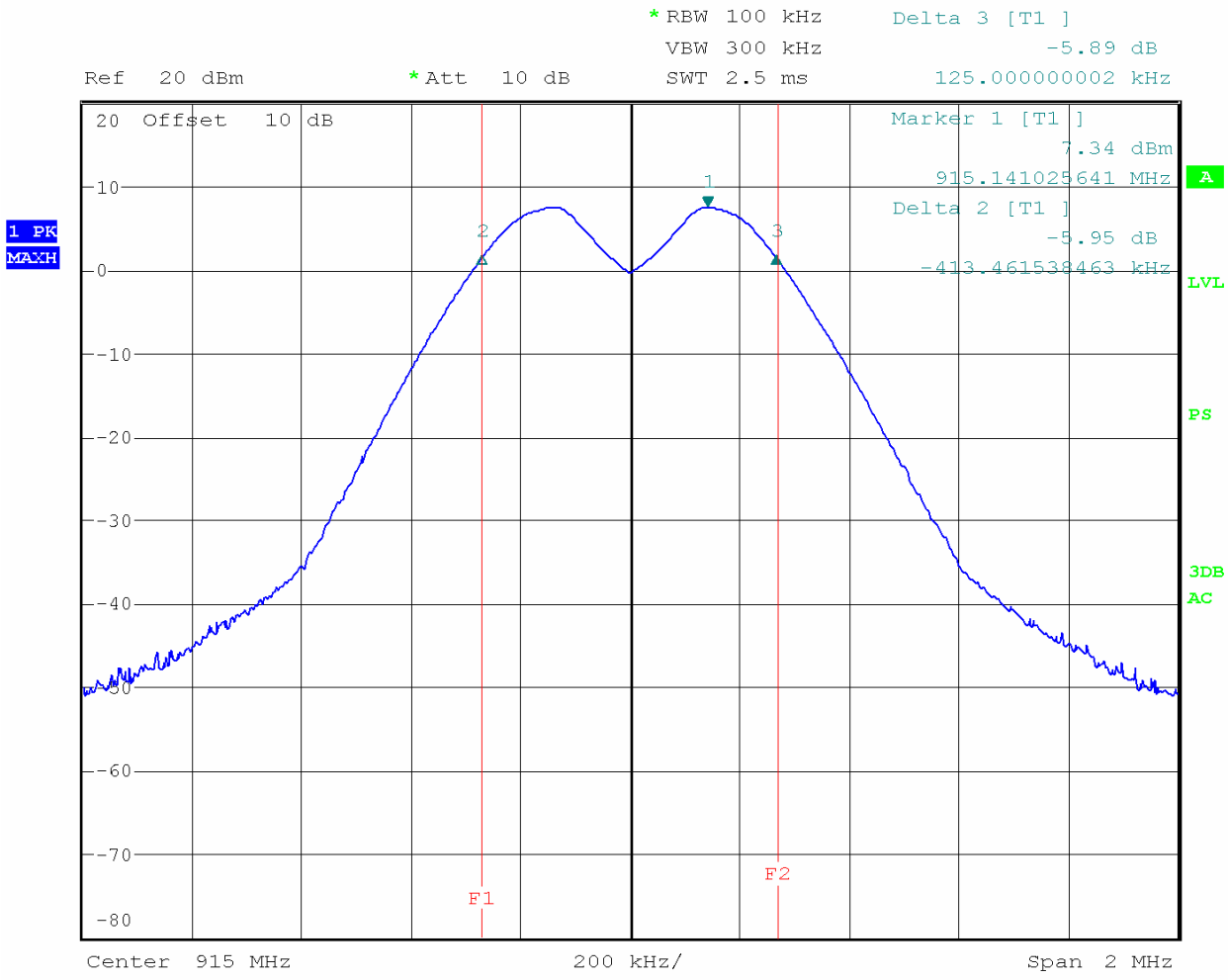
TBOSII-FT:

Channel Frequency (MHz)	6dB Bandwidth (kHz)	PASS / FAIL
915	538	PASS



TBOSII-Radio Adaptor:

Channel Frequency (MHz)	6dB Bandwidth (kHz)	PASS / FAIL
915	538	PASS



6. MAXIMUM PEAK OUTPUT POWER (15.247)

6.1. TEST CONDITIONS

Test performed by : A.MERLIN
Date of test : October 15th, 2010
Ambient temperature : 22°C
Relative humidity : 40%
Atmospheric pressure : 999mb

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 and using 1MHz RBW and 3MHz VBW (greater than 6dB bandwidth)
The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Radiated measurement:
The product has been tested at a distance of 3 meters from the antenna and using 3MHz RBW and 10MHz VBW.
Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. 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:

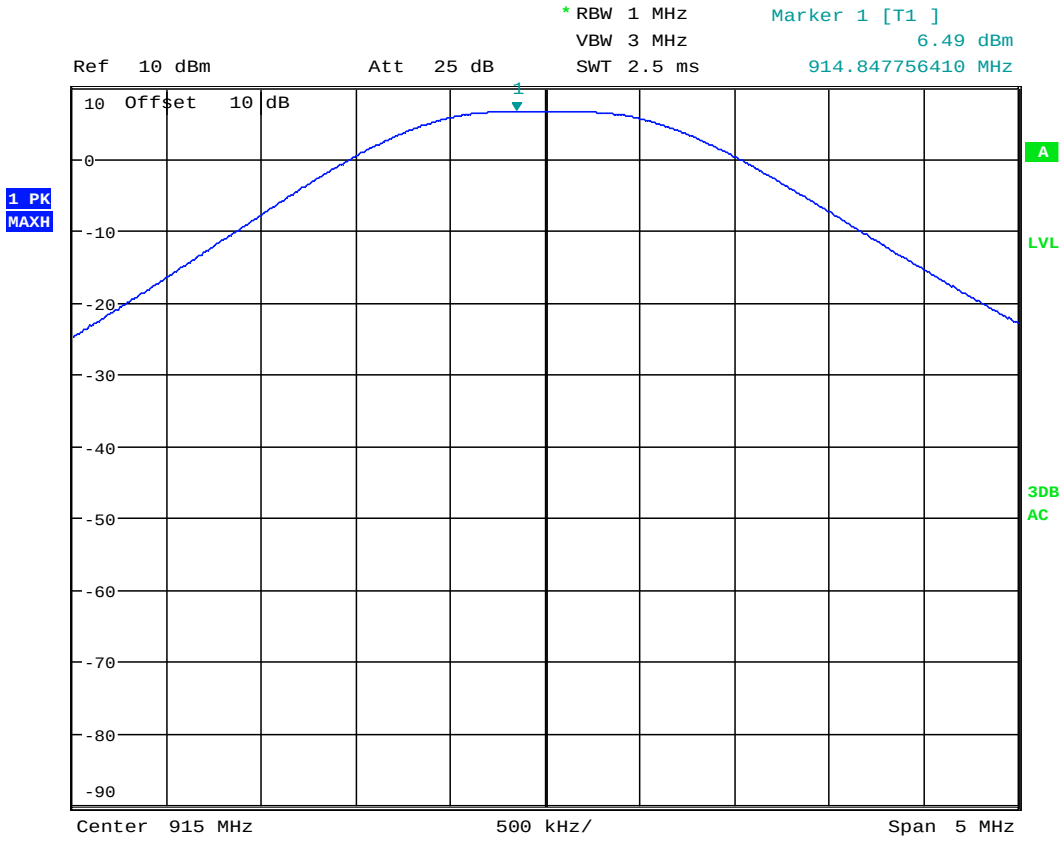
$$E = \frac{\sqrt{30PG}}{d}$$

Where:
- E is the measured maximum fundamental field strength in V/m, utilizing a RBW ≥ the 20 dB bandwidth of the emission, VBW > RBW, peak detector function. Follow the procedures in C63.4-1992 with respect to maximizing the emission.
- 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:

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

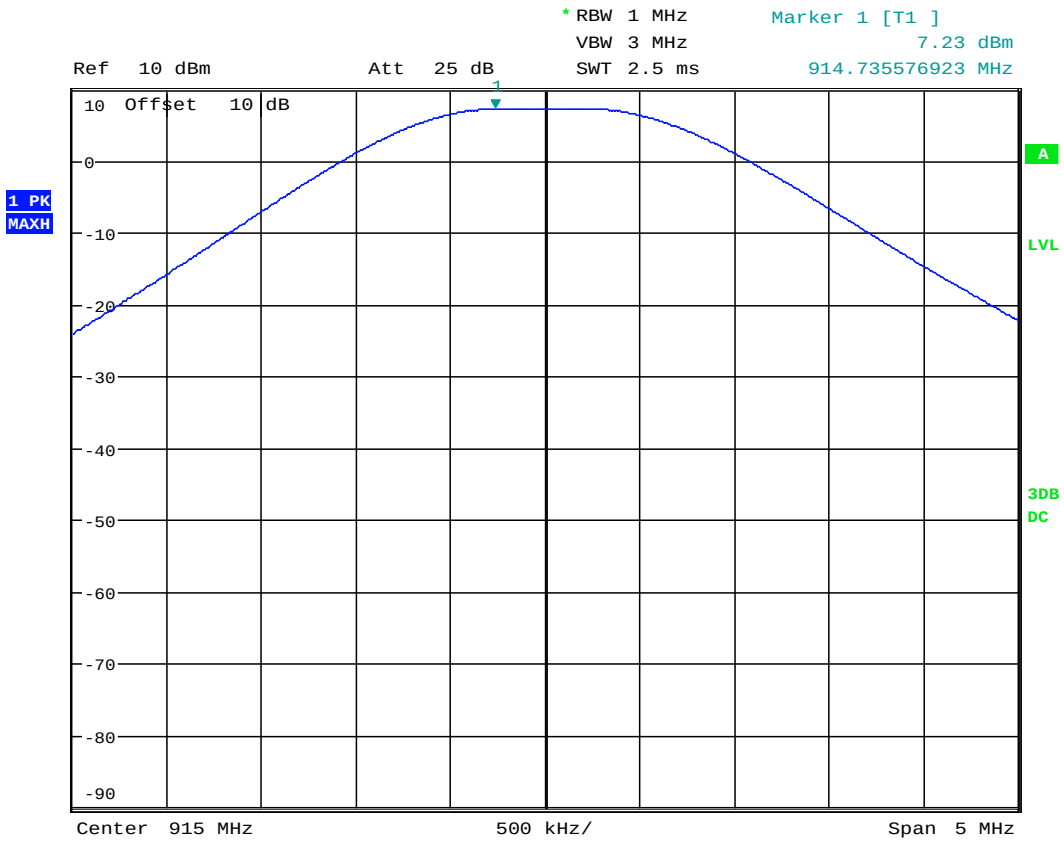
TBOSII-FT:

Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)	PASS / FAIL
915	6.5	30	PASS



TBOSII-Radio Adaptor:

Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)	PASS / FAIL
915	7.2	30	PASS



7. BAND EDGE MEASUREMENT (15.247)

7.1. TEST CONDITIONS

Test performed by : A.MERLIN
Date of test : October 18th, 20910
Ambient temperature : 22°C
Relative humidity : 45%
Atmospheric pressure : 980mb

7.2. LIMIT

RF antenna conducted test:
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.

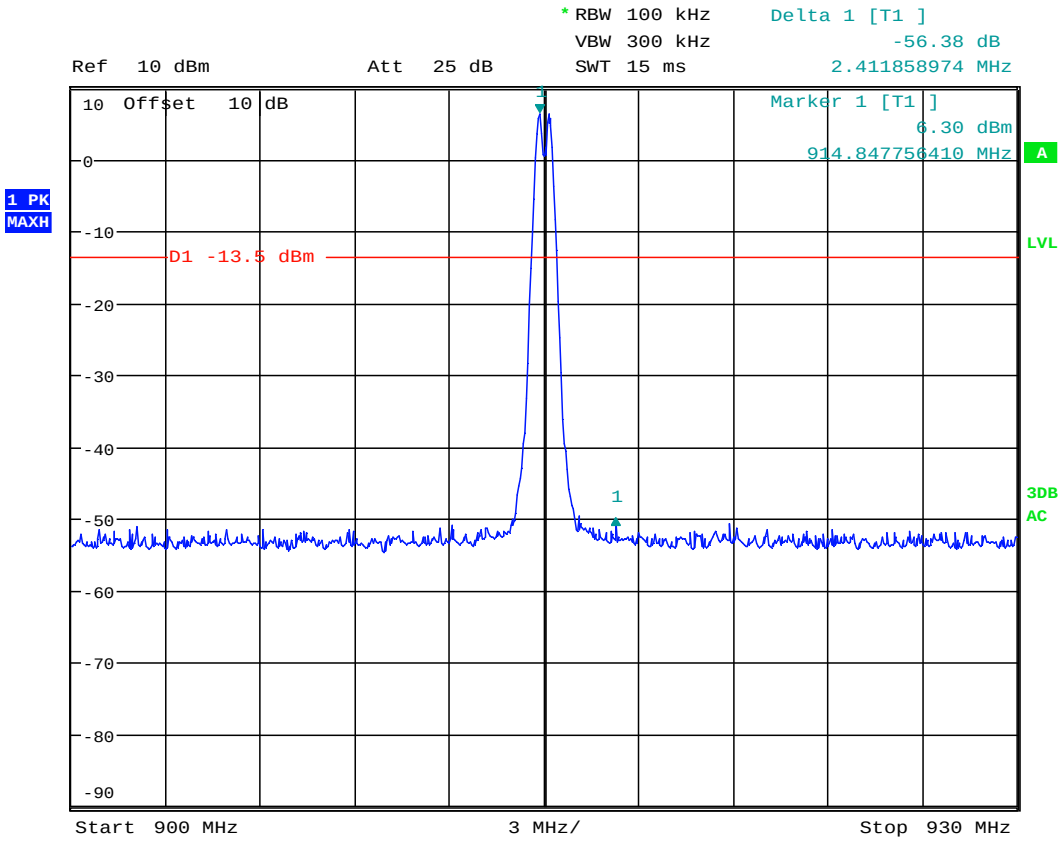
Radiated emission test:
Applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. For measurements above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for 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.

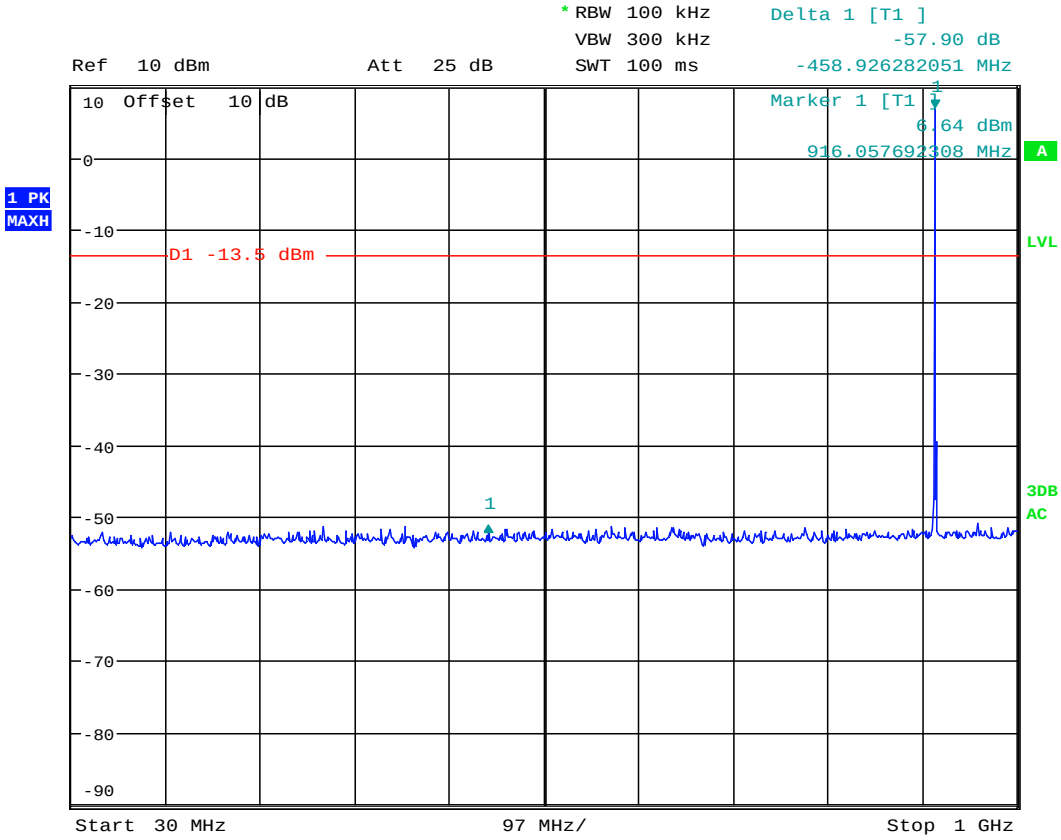
7.3. SETUP

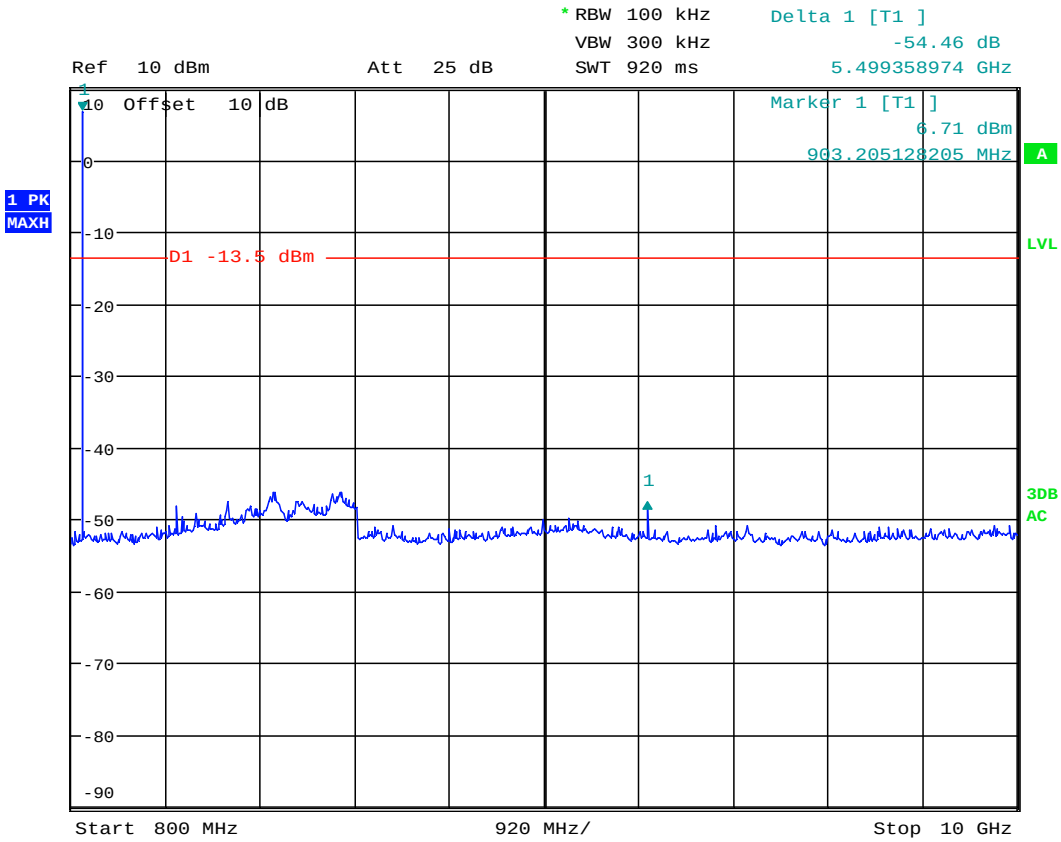
The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with Peak Output Power measurement. The EUT is turn ON; the graphs of the restrict frequency band are recorded with a display line indicating the highest level and other the 20dB offset below to show compliance with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

7.4. RESULTS

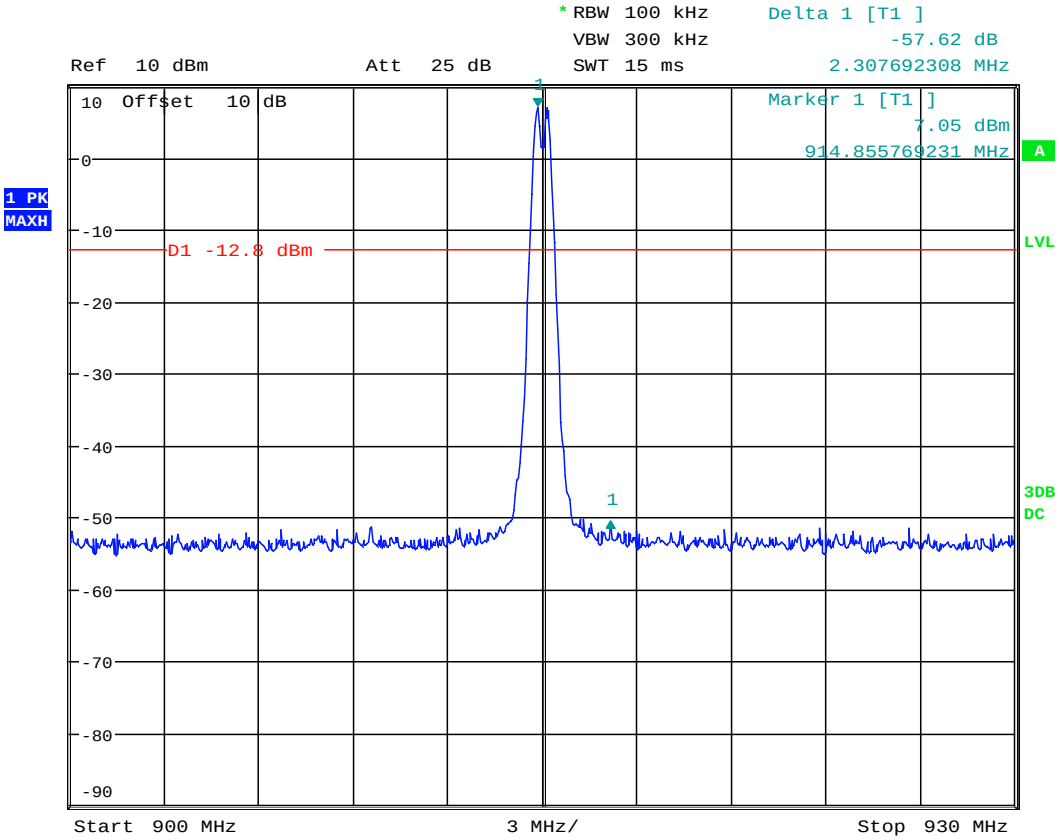
TBOSII-FT :

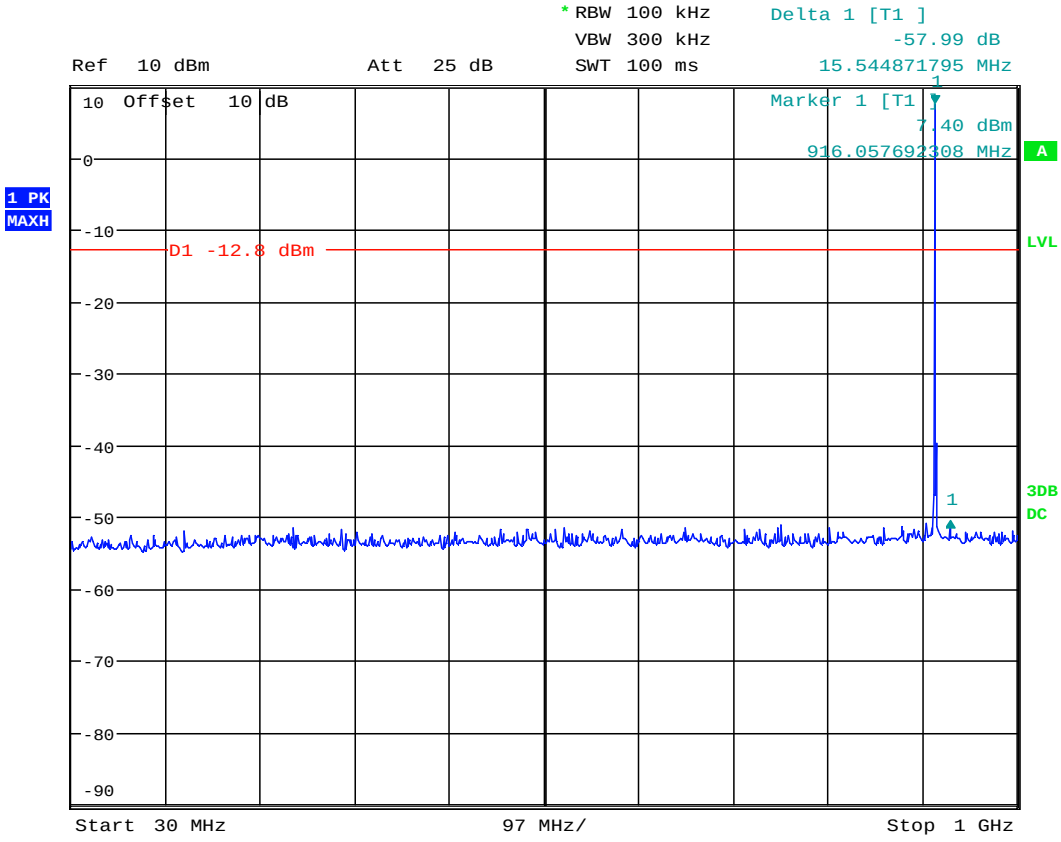


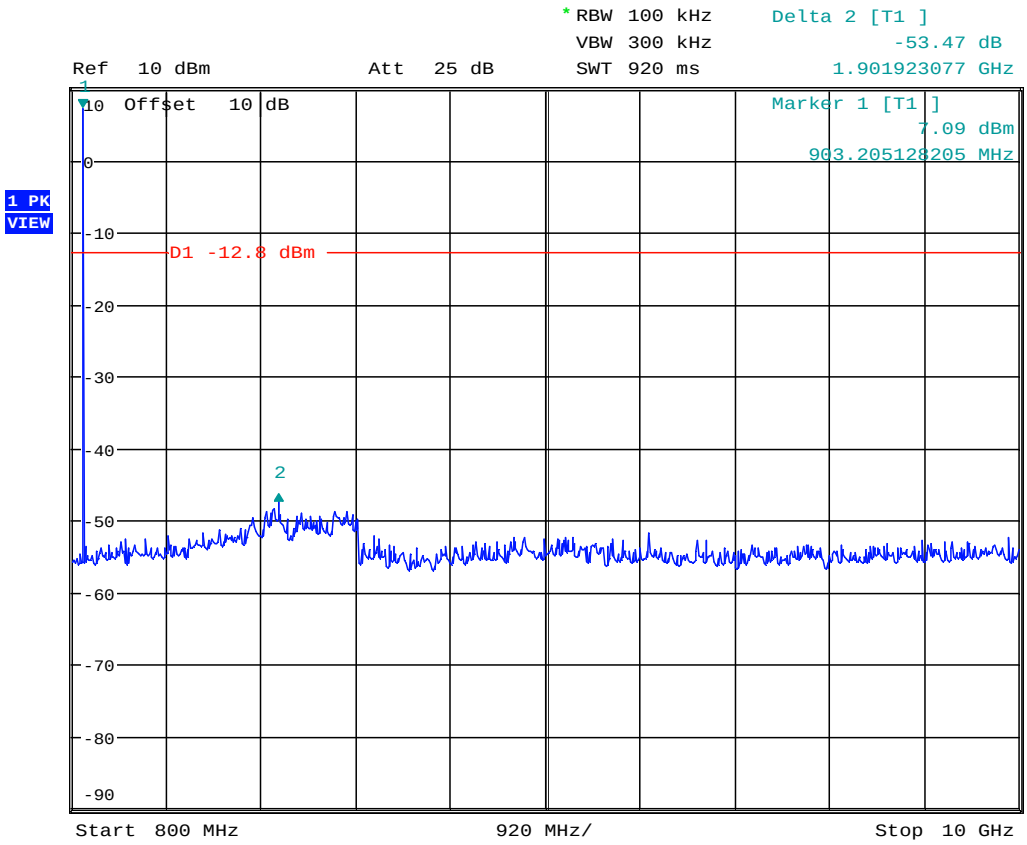

* RBW 100 kHz
VBW 300 kHz
SWT 100 ms
Delta 1 [T1]
-57.90 dB
-458.926282051 MHz
Ref 10 dBm
Att 25 dB
10 Offset 10 dB
Marker 1 [T1]
6.64 dBm
916.057692308 MHz
1 PK
MAXH
A
LVL
3DB
AC
D1 -13.5 dBm
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Start 30 MHz
97 MHz/
Stop 1 GHz


* RBW 100 kHz
VBW 300 kHz
SWT 920 ms
Delta 1 [T1]
-54.46 dB
5.499358974 GHz
Ref 10 dBm
Att 25 dB
10 Offset 10 dB
Marker 1 [T1]
6.71 dBm
903.205128205 MHz
1 PK
MAXH
A
LVL
3DB
AC
D1 -13.5 dBm
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Start 800 MHz
920 MHz/
Stop 10 GHz

TBOSII-Radio Adaptor :




* RBW 100 kHz
VBW 300 kHz
SWT 100 ms
Delta 1 [T1]
-57.99 dB
15.544871795 MHz
Ref 10 dBm
Att 25 dB
10 Offset 10 dB
Marker 1 [T1]
7.40 dBm
916.057692308 MHz
1 PK
MAXH
A
LVL
3DB
DC
D1 -12.8 dBm
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Start 30 MHz
97 MHz/
Stop 1 GHz


* RBW 100 kHz
VBW 300 kHz
SWT 920 ms
Delta 2 [T1]
-53.47 dB
1.901923077 GHz
Ref 10 dBm
Att 25 dB
10 Offset 10 dB
Marker 1 [T1]
7.09 dBm
903.205128205 MHz
1 PK
VIEW
D1 -12.8 dBm
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Start 800 MHz
920 MHz/
Stop 10 GHz

7.5. MEASUREMENT IN RESTRICTED BAND

Frequency band 1GHz to 10GHz
Radiated measurements are performed using a PEAK and Average detection (RBW = 1MHz) for frequency in the restricted band.

TBOSII-FT:

No	Frequency (GHz)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	2745.00	54.0	34.7	**-19.3**	**0**	**V**	**100**	-1.7	
2	3660.00	54.0	38.3	**-15.7**	**10**	**V**	**100**	1.1	
3	4575.00	54.0	38.8	**-15.2**	**0**	**V**	**100**	2.0	

No	Frequency (GHz)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	2745.00	74.0	46.8	**-27.2**	**0**	**V**	**100**	-1.7	
2	3660.00	74.0	50.3	**-23.7**	**10**	**V**	**100**	1.1	
3	4575.00	74.0	49.9	**-24.1**	**0**	**V**	**100**	2.0	

Note: Measures have been done at 3m distance.

TBOSII-ADAPT:

No	Frequency (GHz)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	2745.00	54.0	44.6	**-9.4**	**10**	**V**	**100**	-1.7	
2	3660.00	54.0	49.5	**-4.5**	**15**	**H**	**100**	1.1	
3	4575.00	54.0	46.3	**-7.7**	**0**	**V**	**100**	2.0	

No	Frequency (GHz)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
1	2745.00	74.0	55.9	**-18.1**	**0**	**V**	**100**	-1.7	
2	3660.00	74.0	60.5	**-13.5**	**10**	**V**	**100**	1.1	
3	4575.00	74.0	57.9	**-16.1**	**0**	**V**	**100**	2.0	

Note: Measures have been done at 3m distance.

8. POWER SPECTRAL DENSITY (15.247)

8.1. TEST CONDITIONS

Test performed by : A.MERLIN
Date of test : October 18th, 20910
Ambient temperature : 22°C
Relative humidity : 45%
Atmospheric pressure : 980mb

8.2. 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 and using 3kHz RBW and VBW>RBW.
The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Radiated measurement:
The product has been tested at a distance of 3 meters from the antenna and using 3kHz RBW and VBW>RBW.
Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. 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 power spectral density requirement of section 15.247, the PSD is calculated using the following equation:

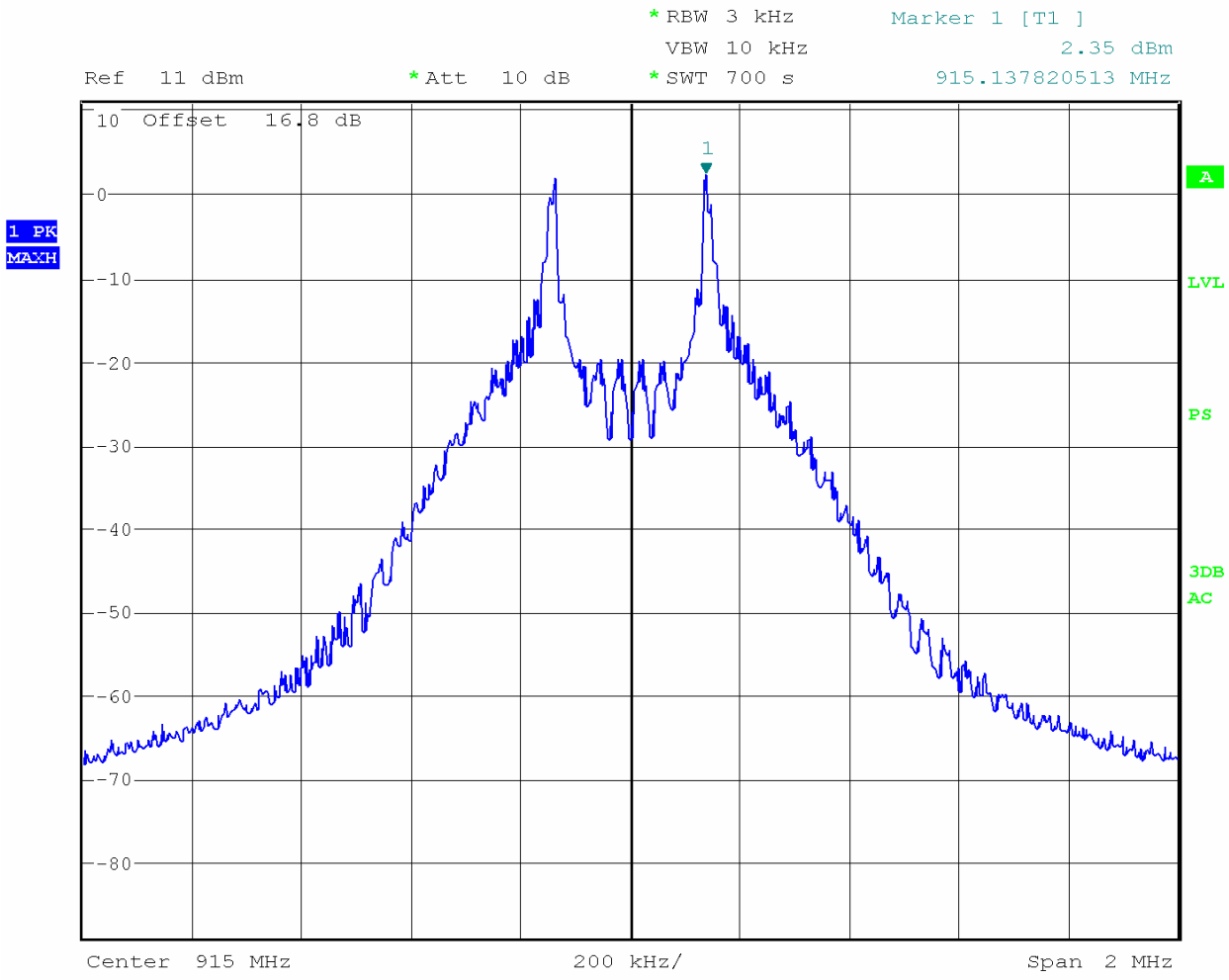
$$E = \frac{\sqrt{30PG}}{d}$$

Where:
- E is the measured maximum fundamental field strength in V/m, utilizing a RBW ≥ the 6dB bandwidth of the emission, VBW > RBW, peak detector function. Follow the procedures in C63.4-1992 with respect to maximizing the emission.
- 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:

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

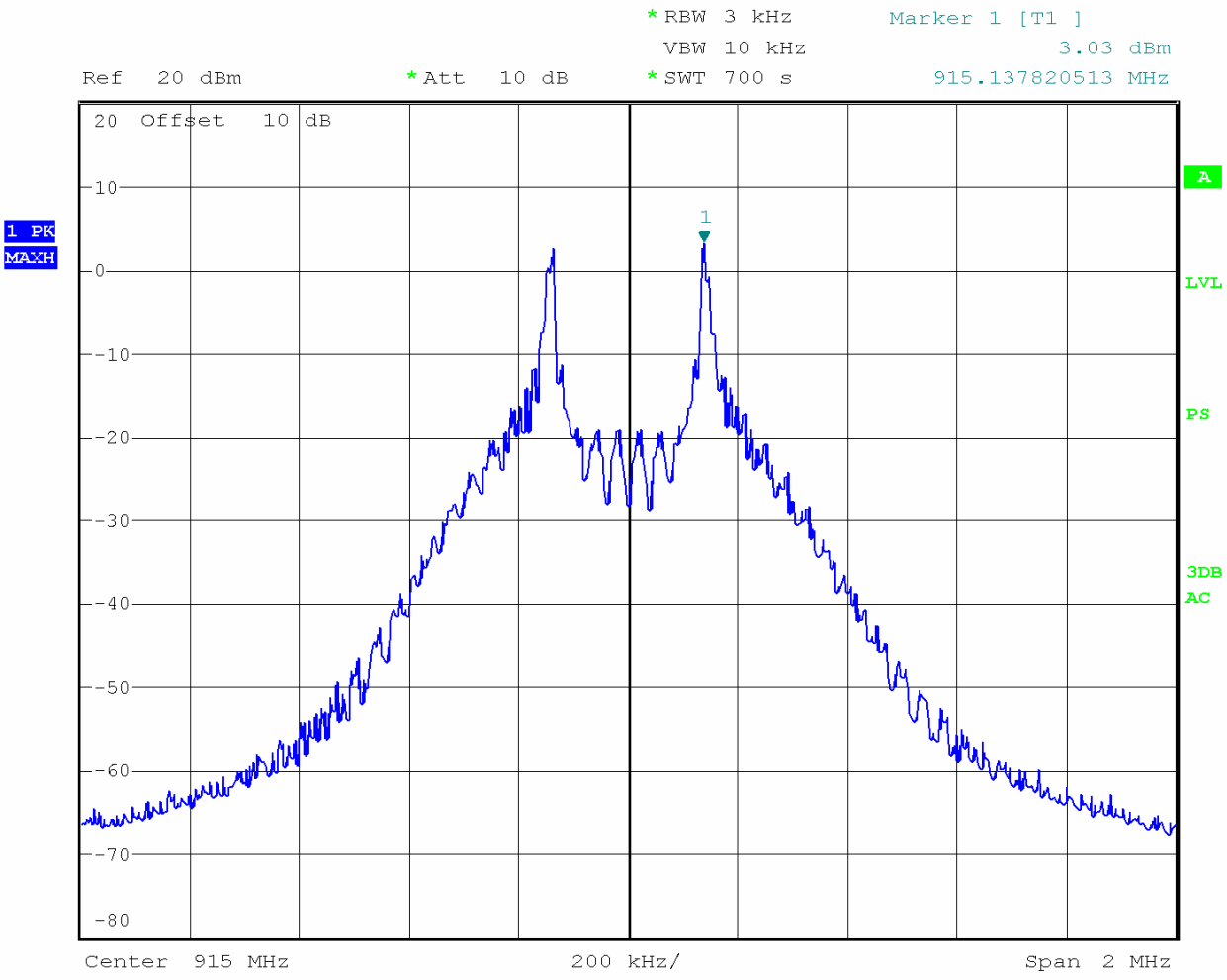
TBOSII-FT:

Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)	PASS / FAIL
915	2.4	8	PASS



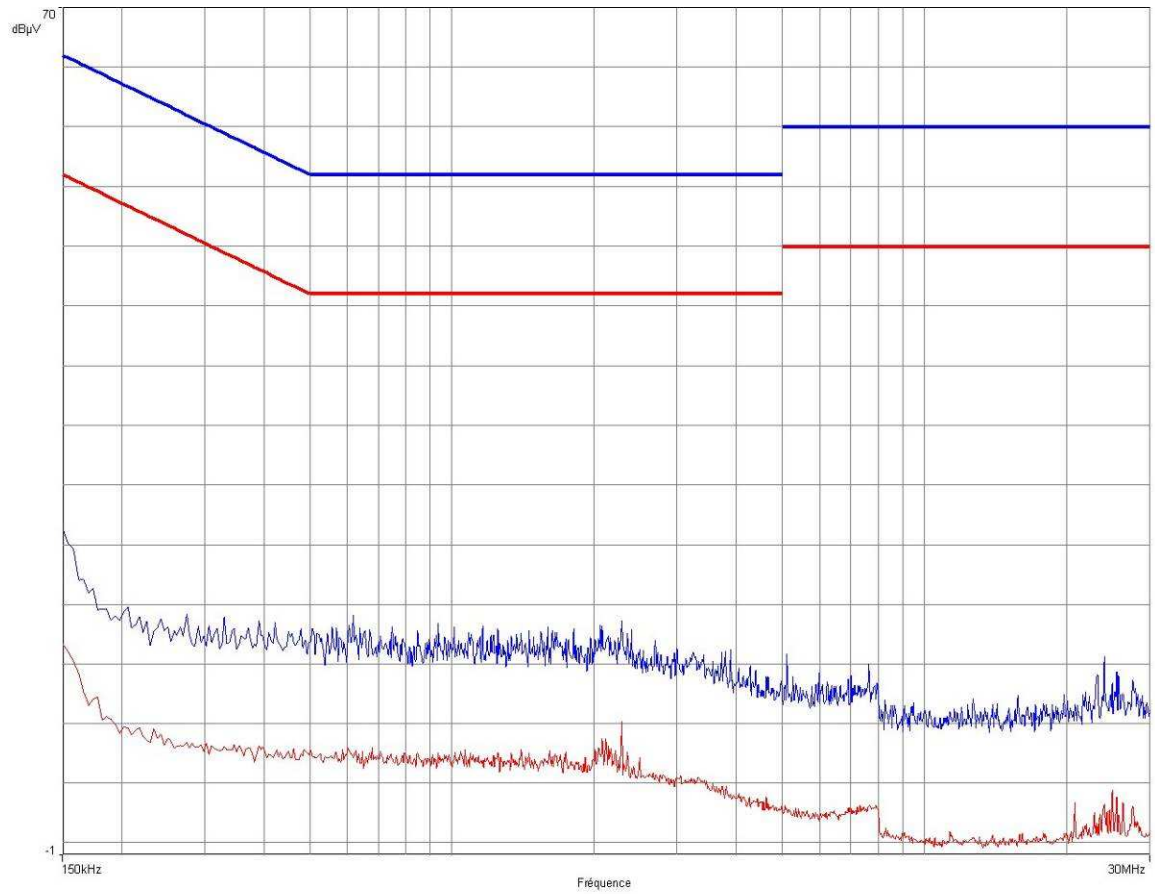
TBOSII-Radio Adaptor:

Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)	PASS / FAIL
915	3.1	8	PASS

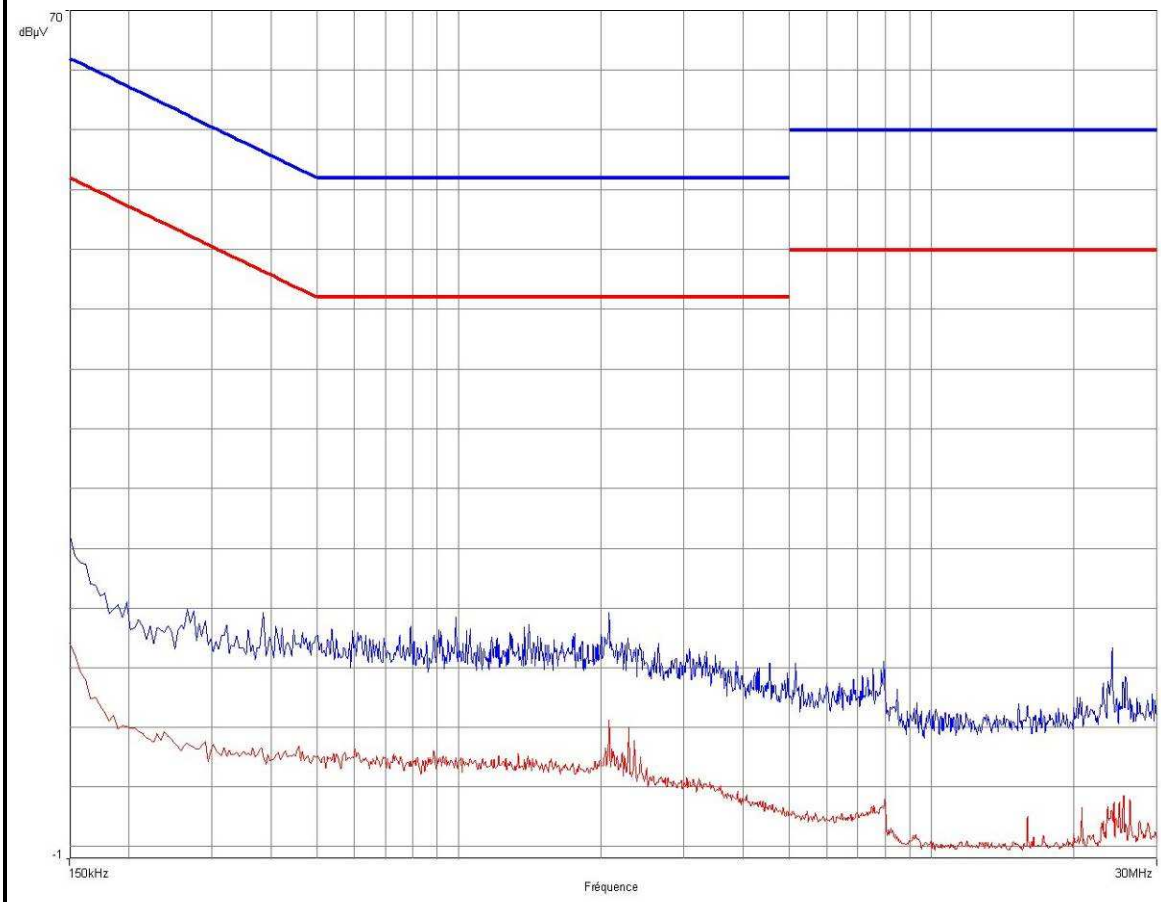


9. ANNEX 1 (GRAPHS)

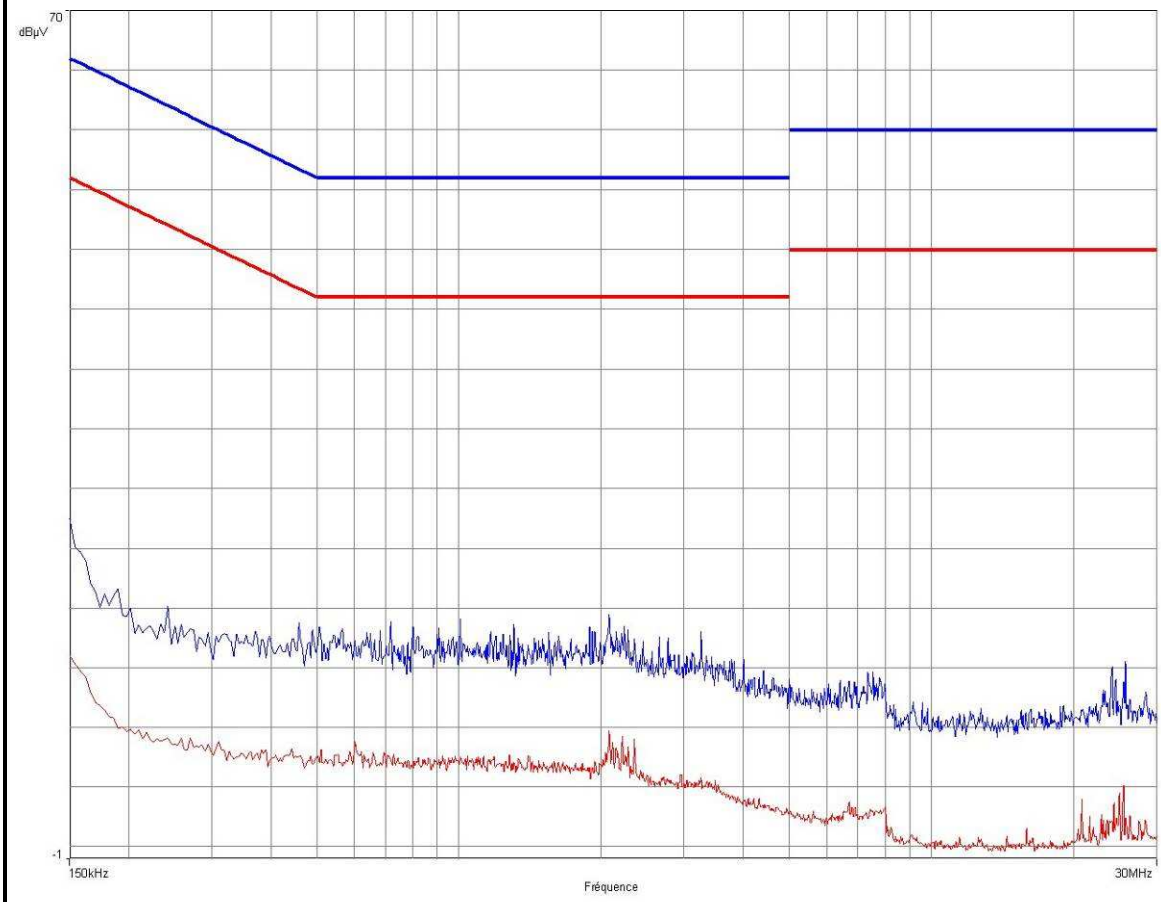
N°d'offre/Nom de projet :	201009-6521CR (SOLEM)		
CONDUCTED EMISSIONS		**Test configuration:**	
Graph name :	**Emc#1**		
Voltage / Frequency :	**120Vac/60Hz**	**Mode RF**	
Limite / Classe :	**EN 55022**		
Line/Port :	**Phase**	**Peak Measure**	**QPeak Limit**
RBW / VBW :	**9kHz/Auto**	**Average Measure**	**Average Limit**



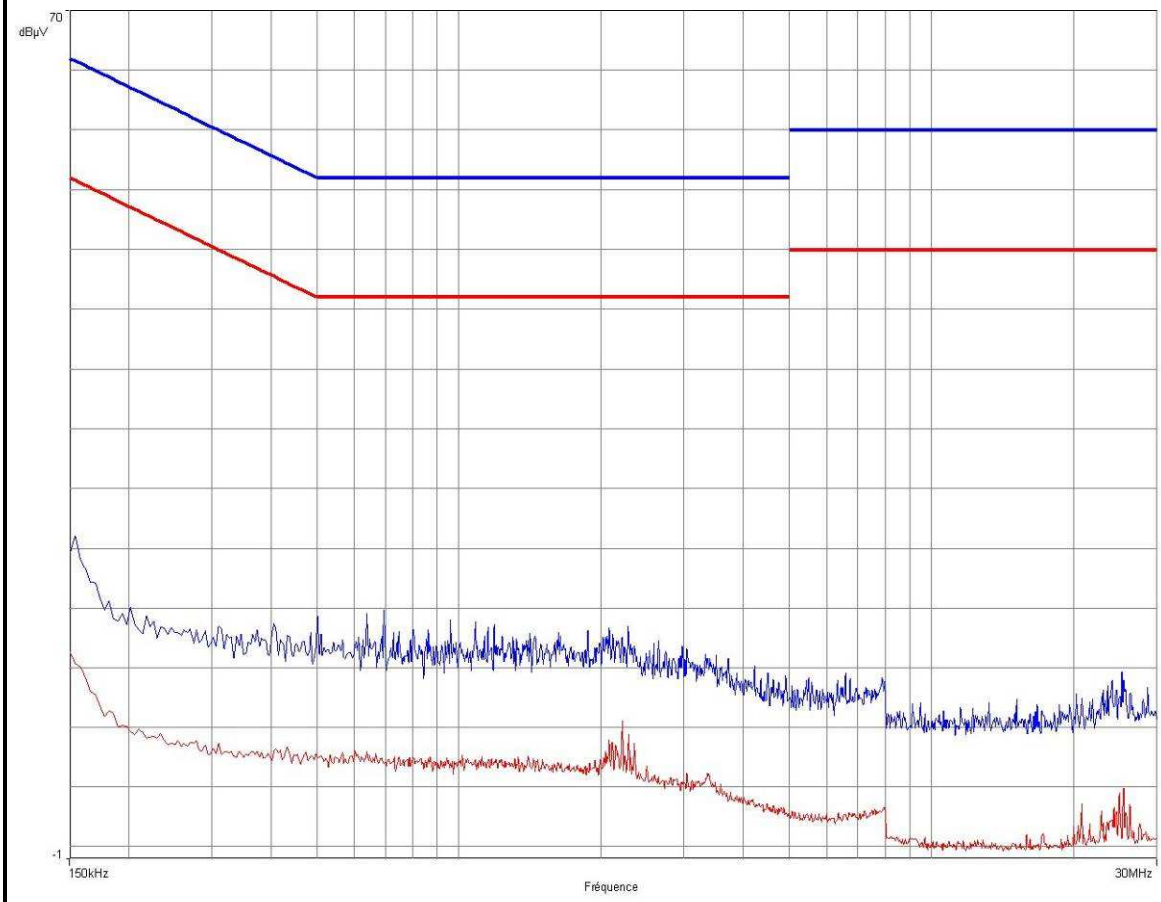
N°d'offre/Nom de projet :	**201009-6521CR (SOLEM)**				
CONDUCTED EMISSIONS		**Test configuration:**			
Graph name :	**Emc#2**				
Voltage / Frequency :	**110Vac/60Hz**	**Mode IR**			
Limite / Classe :	**EN 55022**				
Line/Port :	**Phase**		**Peak Measure**		**QPeak Limit**
RBW / VBW :	**9kHz/Auto**		**Average Measure**		**Average Limit**



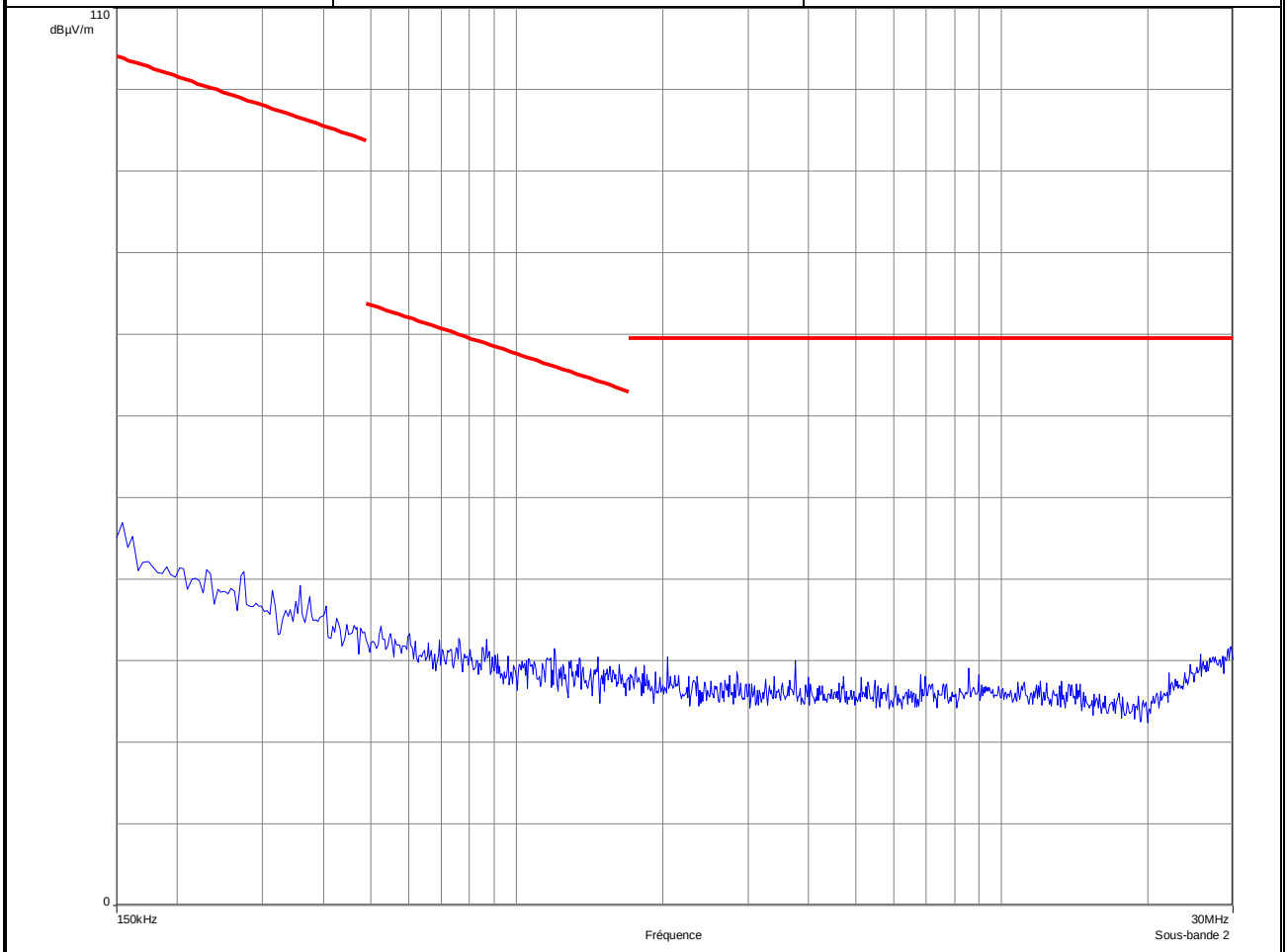
N°d'offre/Nom de projet :	**201009-6521CR (SOLEM)**				
CONDUCTED EMISSIONS		**Test configuration:**			
Graph name :	**Emc#3**				
Voltage / Frequency :	**110Vac/60Hz**	**Mode RF**			
Limite / Classe :	**EN 55022**				
Line/Port :	**Neutre**		**Peak Measure**		**QPeak Limit**
RBW / VBW :	**9kHz/Auto**		**Average Measure**		**Average Limit**



N°d'offre/Nom de projet :	**201009-6521CR (SOLEM)**				
CONDUCTED EMISSIONS		**Test configuration:**			
Graph name :	**Emc#4**				
Voltage / Frequency :	**110Vac/60Hz**	**Mode IR**			
Limite / Classe :	**EN 55022**				
Line/Port :	**Neutre**		**Peak Measure**		**QPeak Limit**
RBW / VBW :	**9kHz/Auto**		**Average Measure**		**Average Limit**

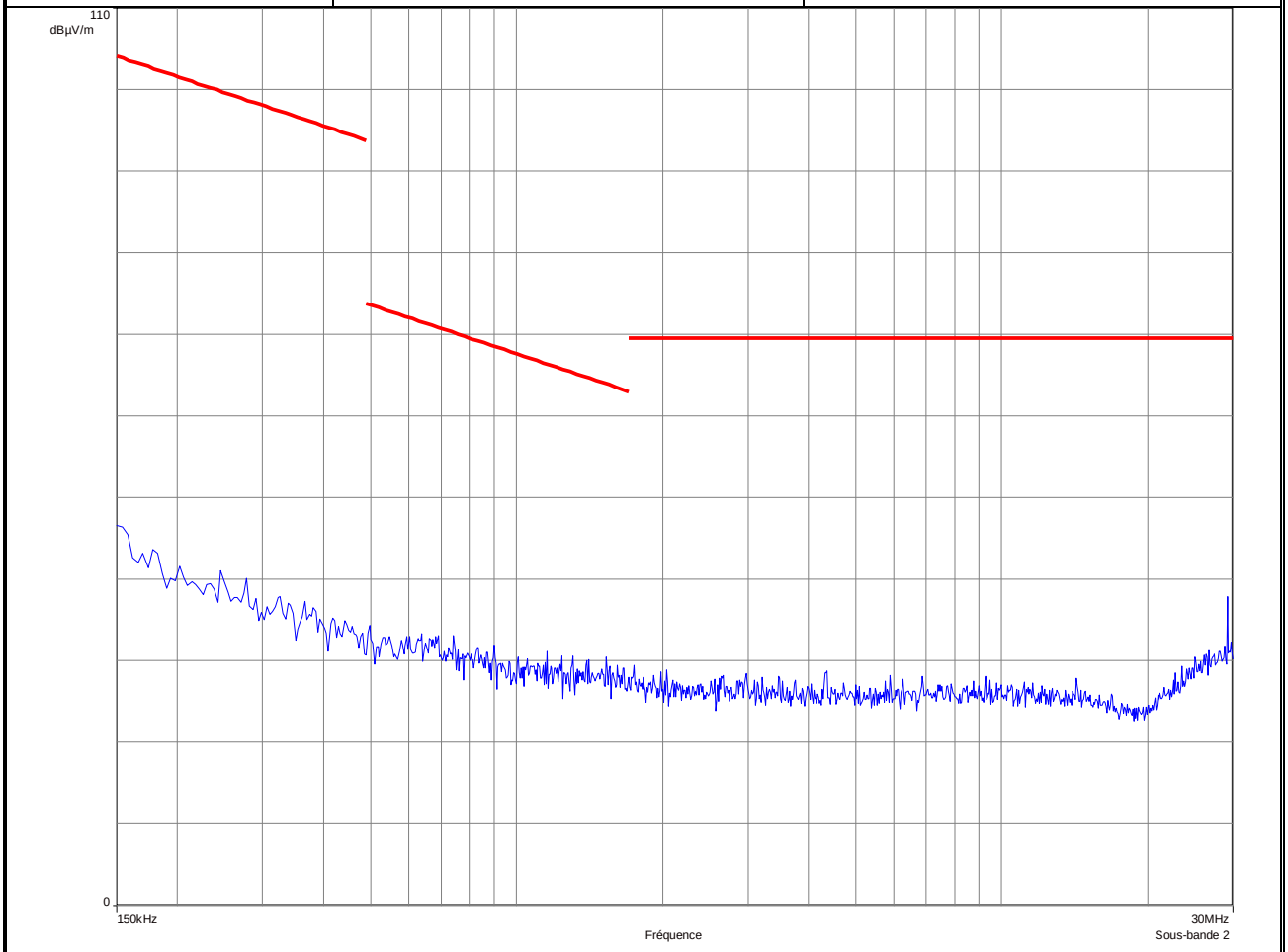


RADIATED EMISSIONS		**Test configuration:**
Graph name:	**Emr#1**	**TBOSII-FTUS**
Antenna polarization	**Worst case**	**TX**
Frequency band	**9kHz-30MHz**	**Worst Case**
Azimuth:	**0-359°**	



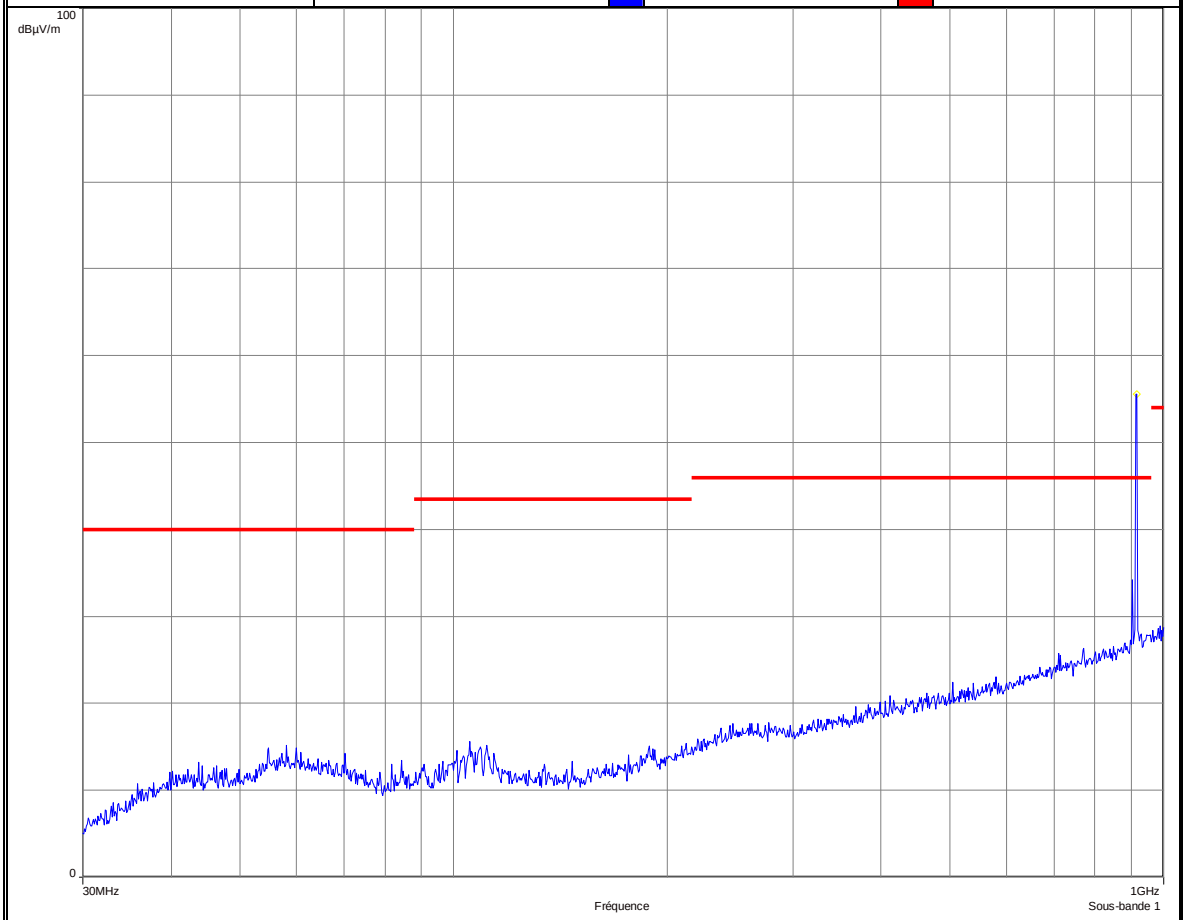
Frequency (MHz)	Peak (dBµV/m)
No Frequency Observed	

RADIATED EMISSIONS		**Test configuration:**
Graph name:	**Emr#2**	**TBOSII-ADUS**
Antenna polarization	**Worst case**	**TX**
Frequency band	**9kHz-30MHz**	**Worst Case**
Azimuth:	**0-359°**	



Frequency (MHz)	Peak (dBµV/m)
No Frequency Observed	

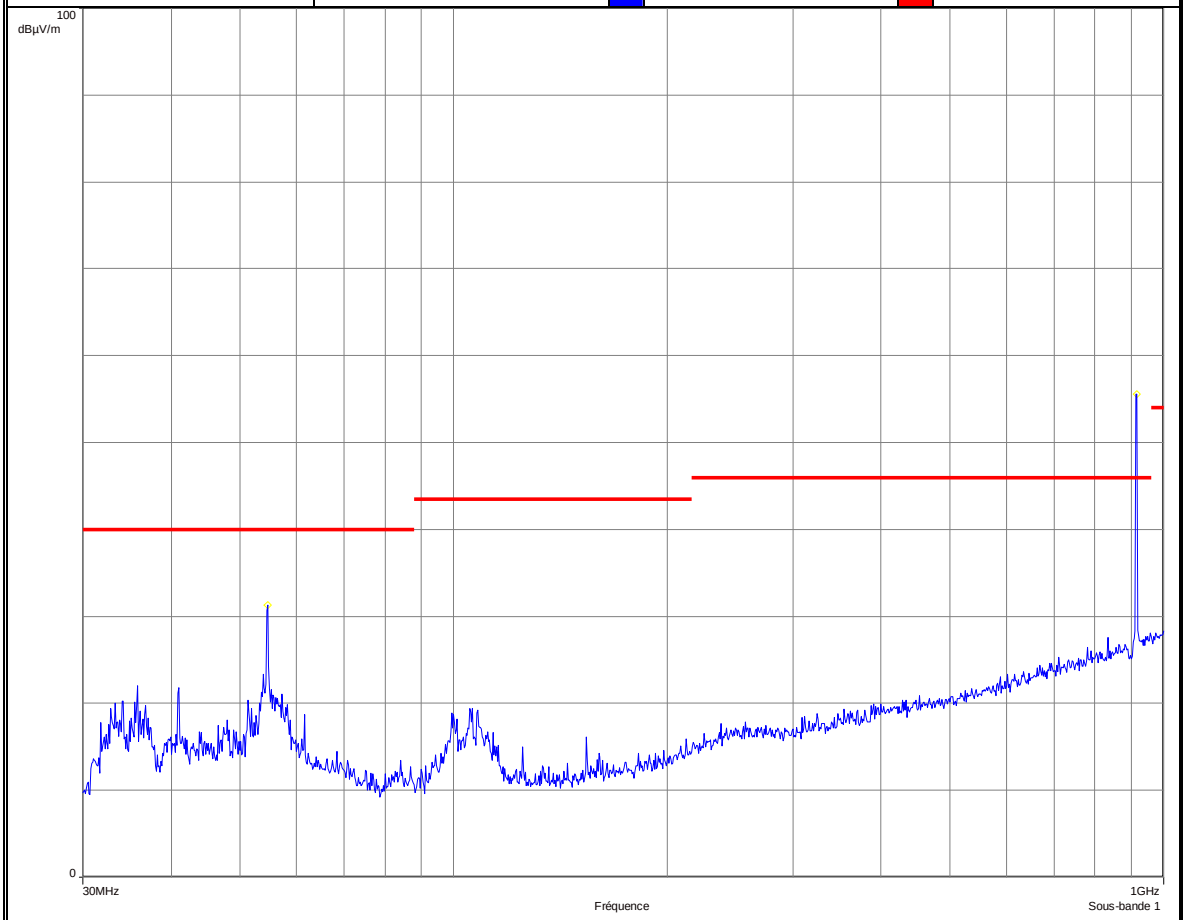
RADIATED EMISSION		Test configuration:
Graph name:	**Emr#3**	**TBOSII-FTUS**
Antenna position:	**Horizontal**	**TX**
Azimuth:	**0° - 360°**	**Worst Case**
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



Frequency (MHz)	Peak (dBµV/m)
915.36*	55.59

*** Carrier frequency**

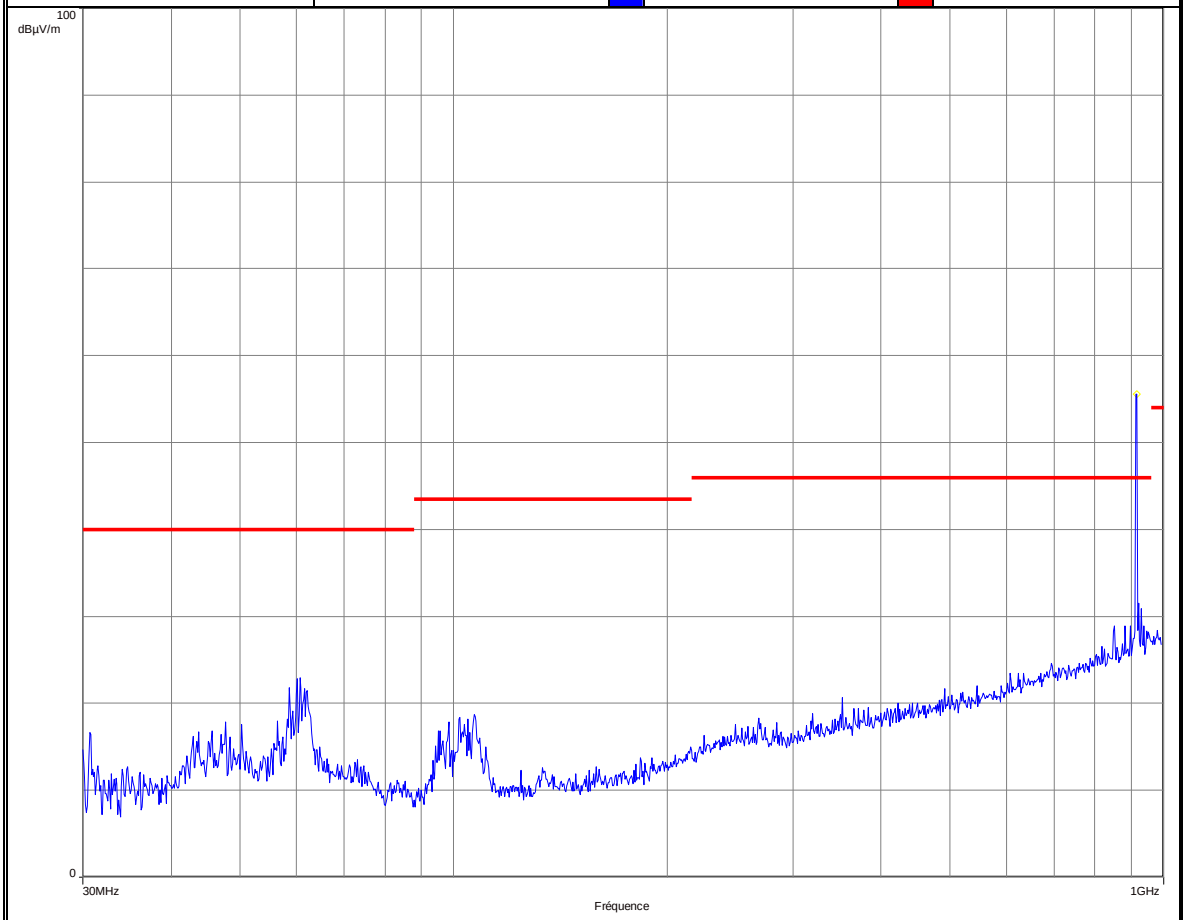
RADIATED EMISSION		Test configuration:
Graph name:	**Emr#4**	**TBOSII-FTUS**
Antenna position:	**Vertical**	**TX**
Azimuth:	**0° - 360°**	**Worst Case**
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



Frequency (MHz)	Peak (dBµV/m)
54.60	31.26
915.36*	55.56

*** Carrier frequency**

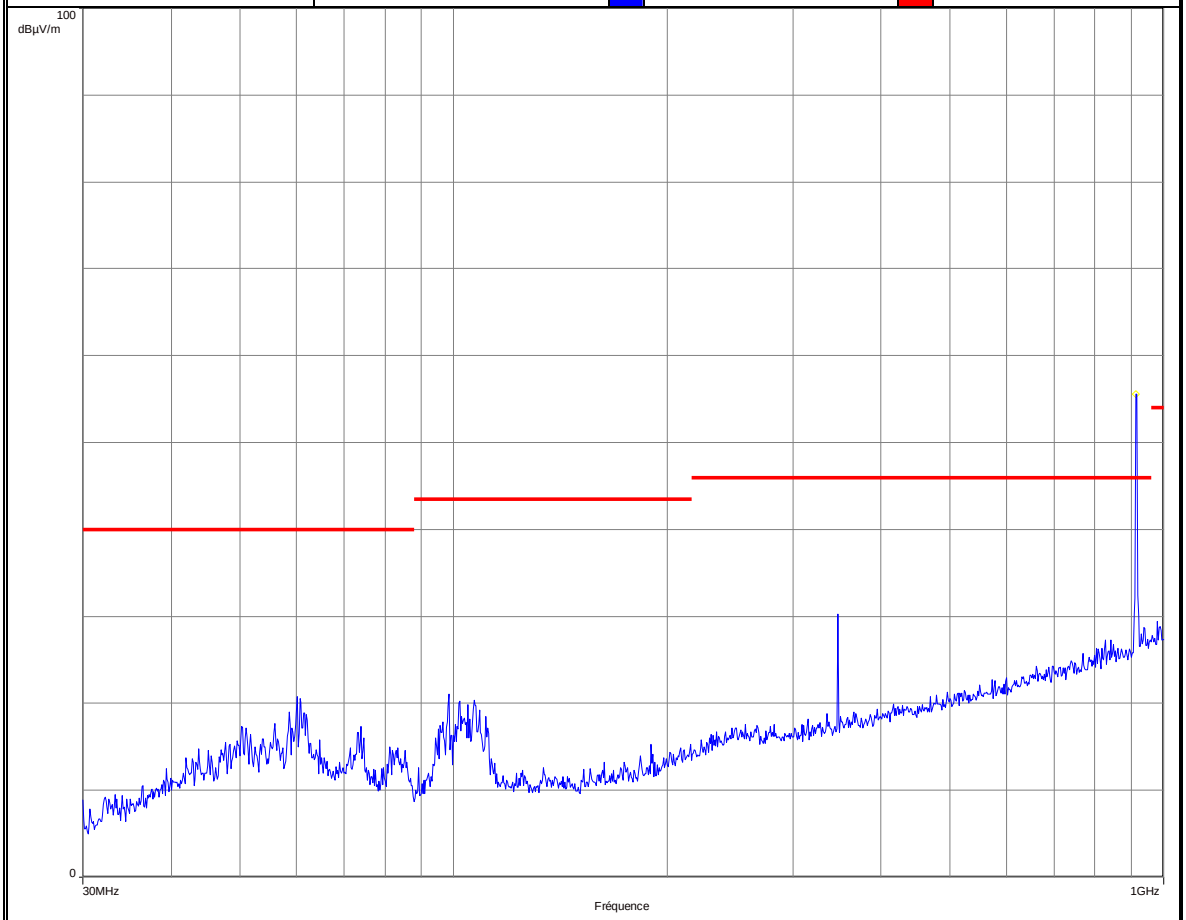
RADIATED EMISSION		Test configuration:
Graph name:	**Emr#5**	**TBOSII-ADUS**
Antenna position:	**Horizontal**	**TX**
Azimuth:	**0° - 360°**	**Worst Case**
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



Frequency (MHz)	Peak (dBµV/m)
915.36*	55.58

*** Carrier frequency**

RADIATED EMISSION		Test configuration:
Graph name:	**Emr#6**	**TBOSII-ADUS**
Antenna position:	**Vertical**	**TX**
Azimuth:	**0° - 360°**	**Worst Case**
RBW/VBW:	**120kHz / 300kHz**	**Peak Measure** / **QPeak Limit@3m**



Frequency (MHz)	Peak (dBµV/m)
915.36*	55.62

*** Carrier frequency**

10. TEST EQUIPMENT LIST

USED	N°LCIE	TYPE	COMPANY	REF	CAL DATE	CAL DUE
CONDUCTED EMISSION DATA						
x	A5329061	Cable	SUCOFLEX	106G	01/11	01/12
x	D3044010	Faraday Cage	RAY PROOF	-	01/11	01/12
x	C2320123	LISN	RHODE & SCHWARZ	ENV216	05/10	05/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
x	A4049061	Transient limiter	HEWLETT PACKARD	11947A	01/11	01/12
RADIATED EMISSION DATA						
x	A7102024	Amplifier 8 GHz	HEROTEK	A1080304A	01/11	01/12
x	A7102026	Amplifier 8-26GHz	ALDETEC	ALS01452	12/10	12/11
x	A7486006	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447F	04/10	04/11
x	C2040050	Antenna biconic	EMCO	3104C	01/10	01/11
x	C2040051	Antenna Bi-log	CHASE	CBL6111A	08/10	08/12
x	C2040056	Antenna log-periodic	EMCO	3146	01/10	01/11
x	C2040146	Antenna Bi-Log XWing	TESEQ	CBL6144	03/10	03/12
x	C2042027	Antenna horn	EMCO	3115	10/10	10/11
x	A5329038	Cable N/N	-	-	02/10	02/11
x	A5329045	Cable	-	-	03/11	03/12
x	A5329056	Cable	-	-	02/11	02/12
x	A5329057	Cable	-	-	02/11	02/12
x	A5329061	Cable	SUCOFLEX	106G	01/11	01/12
x	A5329188	Cable OATS (Mast at 10m)	UTIFLEX	-	05/10	05/11
x	A5329199	Cable OATS (Mast at 10m)	UTIFLEX	-	05/10	05/11
x	A5329206	Cable N/N	-	-	02/10	02/11
x	D3044015	Semi-Anechoic chamber #2	SIEPEL	-	01/11	01/12
x	D3044017	Semi-Anechoic chamber #3	SIEPEL	-	-	-
x	A3169050	Radiated emission comb generator	BARDET	-	-	-
x	A7484035	High Pass (1-15GHz)	WAINRIGHT	WHKX 1.03/15G-10SS	01/11	01/13
x	F2000409	OATS	-	-	08/10	08/11
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	10/10	10/11
x	A4060018	Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	02/10	02/11
x	B4204052	Thermo-hygrometer	HUGER	-	04/10	04/12
x	F2000371	Turntable chamber (Cage#3)	ETS Lingren	Model 2165	-	-
x	F2000372	Turntable / Mast controller (OATS)	ETS Lindgren	Model 2066	-	-
x	F2000392	Antenna mast (OATS)	ETS Lindgren	2071-2	-	-
BANDWIDTH						
x	A7122008	Attenuator 6dB 100W	BIRD	8343-060	01/10	01/11
x	A5329041	Cable SMA/SMA	-	-	-	-
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	07/09	07/10
MAXIMUM PEAK OUTPUT POWER						
x	A7122008	Attenuator 6dB 100W	BIRD	8343-060	01/10	01/11
x	A5329041	Cable SMA/SMA	-	-	-	-
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	07/09	07/10
BANDEDGE MEASUREMENT						
x	A7122008	Attenuator 6dB 100W	BIRD	8343-060	01/10	01/11
x	A5329041	Cable SMA/SMA	-	-	-	-
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	07/09	07/10
POWER SPECTRAL DENSITY						
x	A7122008	Attenuator 6dB 100W	BIRD	8343-060	01/10	01/11
x	A5329041	Cable SMA/SMA	-	-	-	-
x	A2642019	Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	07/09	07/10

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