

RCE-100-18-100848-1-A

E.M.C Test Report

According to the standard:
FCC 47 CFR PART 15 : 2018 (§15.247)

Equipment under test:
LoRa SPY 915 T1
FCC ID : W4512267

Company:
JRI

FCC accredited: FR0004

DISTRIBUTION: Mr. PEYRICHOU

(Company: JRI)

Number of pages: 29 with 2 annexes

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			Name	Visa	Name	Visa
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production of the item tested.*



TEST CERTIFICATION FOR: FCC Certification

NAME OF THE EQUIPMENT UNDER TEST: LoRa SPY 915 T1

Serial number: PRE-SERIE

Reference / model (P/N): -

Software version: -

NAME OF THE MANUFACTURER: JRI

ADDRESS OF THE APPLICANT:

Company: JRI

Address: 16, Rue Louis Rameau
95870 BEZONS
FRANCE

Person in charge: Mr. VERMEESCH

Person present during the tests Mr. FENG

DATES OF TESTS: 16/01/2019 to 17/01/2019

TESTS LOCATION: EMITECH laboratory in Montigny Le Bretonneux (78)
FRANCE.

TESTS OPERATOR: F. LHEUREUX

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1. INTRODUCTION

This document presents the results of Electromagnetic Compatibility tests performed on the equipment «LoRa SPY 915 T1» according to reference documents listed below.

2. REFERENCE DOCUMENTS

FCC 47 CFR Part 15: 2018

Code of Federal Regulations. Title 47- Telecommunication

Chapter 1- Federal Communication Commission

Part 15- Radio frequency devices

ANSI C63.4: 2014

Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronics Equipment in the range of 9 kHz to 40 GHz.

KDB 558074 D01 DTS Meas Guidance V04

Guidance for performing compliance measurement on Digital Transmission Systems (DTS) operating under § 15.247.

ANSI C63.10 : 2013

American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

3. PRODUCT DESCRIPTION

Class:	B (residential environment)
Antenna type and gain:	Integral antenna: Not communicated
Operating frequency range:	from 903 MHz to 927 MHz
Number of channels:	Not communicated
Channel spacing:	500 kHz
Modulation:	LORA
Power source:	3.6 Vdc by battery
Software power setting:	-

Modification of the equipment during the tests: No.

For all tests performed in this report, the transmit power is set to +11 dBm.

4. TESTS AND CONCLUSION

The following table summarizes test results of the EUT.

Subpart B of the standard FCC part 15 – Unintentional radiators

Test procedure	Designation of test	Test results				Comments
		Pass	Fail	N.A.	N.P.	
15.107	Measurement of conducted emission on AC mains ports			X		
15.109	Radiated emission limits	X				

Subpart C of the standard FCC part 15 – Intentional radiators

Test procedure	Designation of test	Test results				Comments
		Pass	Fail	N.A.	N.P.	
15.205	Restricted bands of operation	X				
15.207	Measurement of conducted emission on AC mains ports			X		
15.209	Radiated emission limits; general requirements	X				
15.215	Additional provisions to the general radiated emission limitations					
	(a) Alternative to general radiated emission limits	X				
	(b) Unwanted emissions outside of § 15.247 frequency bands	X				
	(c) 20 dB bandwidth and band-edge compliance			X		
15.247	Intentional radiated emissions					
	a) frequency hopping and digitally modulated					
	a) (1) hopping mode			X		
	a) (1) (i) frequency hopping in the band 902-928 MHz			X		
	a) (1) (ii) frequency hopping in the band 5725–5850 MHz			X		
	a) (1) (iii) frequency hopping in the band 2400–2483.5 MHz			X		
	a) (2) systems using digital modulation in the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz (6 dB bandwidth)	X				
	b) maximum peak conducted					
	b) (1) frequency hopping in the bands 2400–2483.5 MHz or 5725–5850 MHz			X		
	b) (2) frequency hopping in the band 902-928 MHz			X		

Test procedure	Designation of test	Test results				Comments
		Pass	Fail	N.A.	N.P.	
	b) (3) systems using digital modulation in the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz	X				
	b) (4) maximum peak conducted > 6 dBi					
	b) (4) (i) frequency hopping in the band 2400–2483.5 MHz			X		
	b) (4) (ii) frequency hopping in the band 5725–5850 MHz			X		
	b) (4) (iii) fixed, point-to-point			X		
	c) directional antenna > 6 dBi					
	c) (1) fixed, point-to-point operation			X		
	c) (1) (i) in the band 2400–2483.5 MHz			X		
	c) (1) (ii) in the band 5725–5850 MHz			X		
	c) (1) (iii) fixed, point-to-point			X		
	c) (2) multiple directional beams in the band 2400–2483.5 MHz			X		
	c) (2) (i) information			X		
	c) (2) (ii) sum of the power supplied to all antennas			X		
	c) (2) (iii) one antenna for multiple directional beams			X		
	c) (2) (iv) single directional beam			X		
	d) intentional radiator	X				
	e) peak power spectral density	X				
	f) hybrid system			X		
	g) continuous data stream during the test			X		
	h) to avoid hopping on occupied channels			X		
	i) RF exposure compliance			X		P < 500 mW

N.A.: Not Applicable

N.P.: Not Performed

Conclusion:

The tested sample « **LoRa SPY 915 T1** » submitted to the tests complies with the requirements of the standard:

➤ FCC 47 CFR PART 15 : 2018

According to the limits specified in this report.

5. DIGITAL MODULATION SYSTEMS

Standard: FCC 47 CFR PART 15 : 2018

Section: §15.247 a) (2)

Test configuration:

The system is tested in normalized test site.

The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

The level was maximised in antenna height, azimuth and polarization. The maximum level measured on the spectrum analyser was recorded.

Distance of antenna: 3 meters

Instrumentation test list:

Order Nr	Category	Manufacturer	Type	Last validity date	Next validity date
14768	Receiver	Rohde & Schwarz	ESR7	11/01/2019	11/01/2020
11178	Cable	C&C	N-2m	04/05/2018	04/07/2020
11182	Cable	C&C	N-2m	18/04/2018	18/06/2020
11183	Cable	C&C	N-8m	18/04/2018	18/06/2020
03106	Antenna	Schwarzbeck	UHALP 9108	07/04/2017	07/06/2019
14803	Shielded enclosure	Comtest	SAC 3m	---	---

Equipment under test operating condition:

EUT is in continuous transmission mode.

Measure conditions:

Ambient temperature (°C): 22

Relative humidity (%): 50

Resolution bandwidth: 100 kHz

Results:

Power source: 3.6 Vdc

6 dB bandwidth

Frequency	Results	Comments
903.0 MHz	796.15 kHz	See annex n°1
914.9 MHz	810.40 kHz	See annex n°1
927.0 MHz	805.90 kHz	See annex n°1

Test conclusion: Complies with the requirements of the standard.

6. TRANSMITTER OUTPUT POWER

Standard: FCC 47 CFR PART 15 : 2018

Section: §15.247 b) (3)

Test configuration:

The system is tested in normalized test site.

The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

The level was maximised in antenna height, azimuth and polarization. The maximum level measured on the spectrum analyser was recorded.

Distance of antenna: 3 meters

Instrumentation test list:

Order Nr	Category	Manufacturer	Type	Last validity date	Next validity date
03106	Antenna	Schwarzbeck	UHALP 9108	07/04/2017	07/06/2019
11178	Cable	C&C	N-2m	04/05/2018	04/07/2020
11182	Cable	C&C	N-2m	18/04/2018	18/06/2020
11183	Cable	C&C	N-8m	18/04/2018	18/06/2020
14768	Receiver	Rohde & Schwarz	ESR7	11/01/2019	11/01/2020
14803	Shielded enclosure	Comtest	SAC 3m	---	---

Equipment under test operating condition:

EUT is in continuous transmission mode.

Measure conditions:

Ambient temperature (°C): 22

Relative humidity (%): 50

Resolution bandwidth: 1 MHz

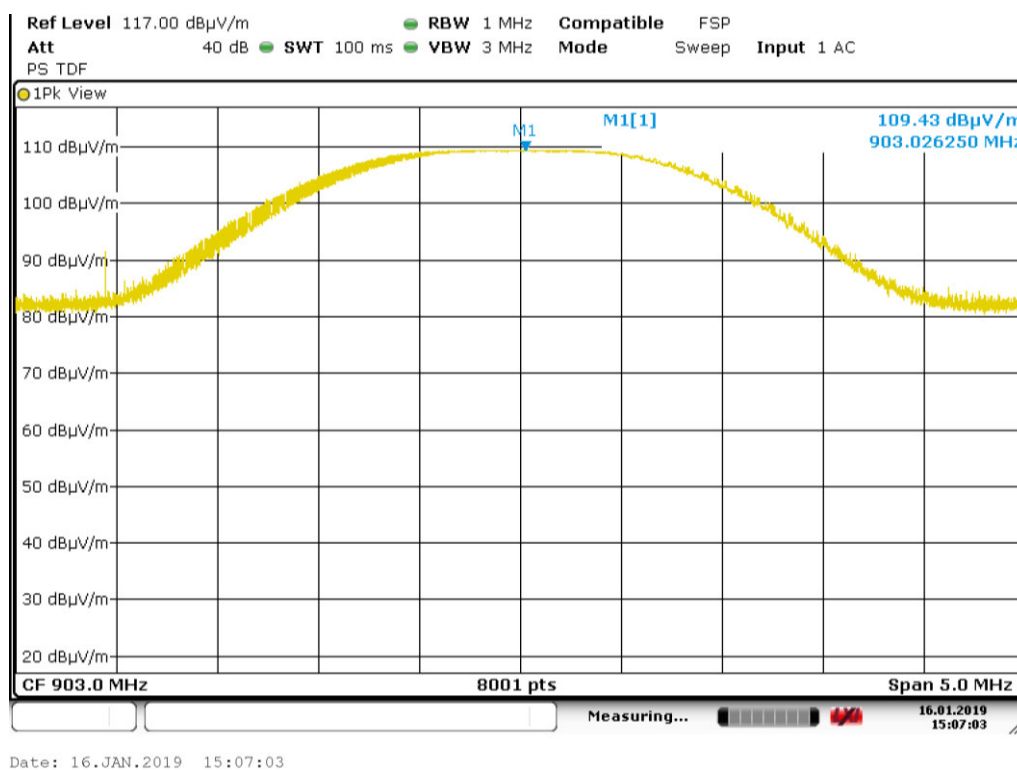
Results:

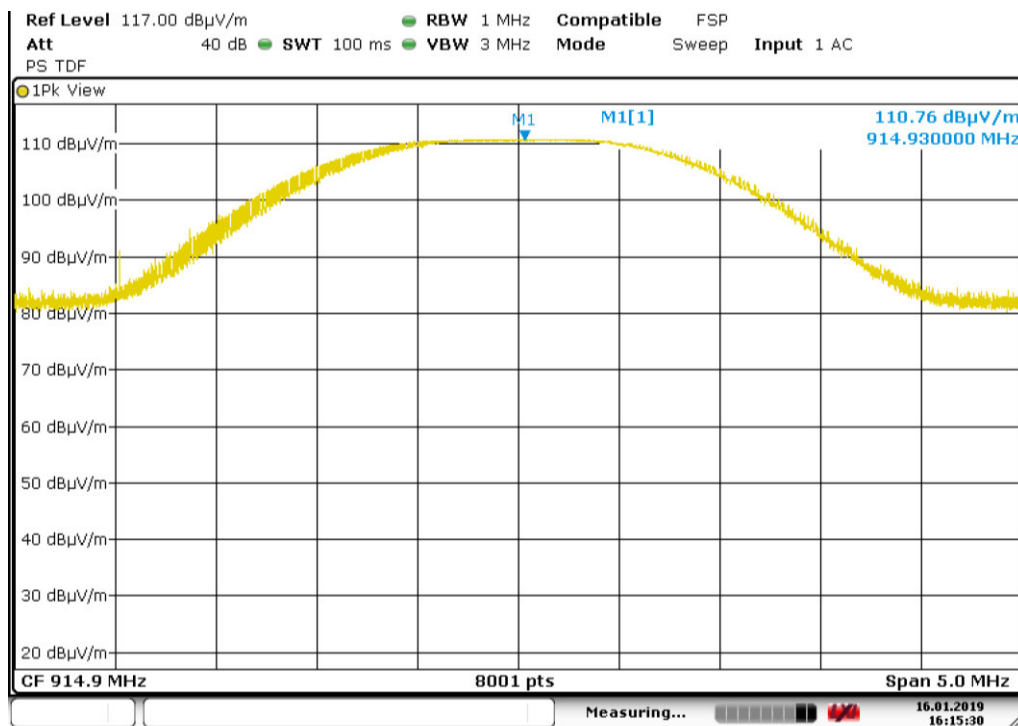
Power source: 3.6 Vdc

Frequency	Electro-magnetic field (dB μ V/m)	TP* (dBm)	Limit (dBm)
903.0 MHz	109.43	+12.05	+ 30
914.9 MHz	110.76	+13.38	+ 30
927.0 MHz	110.68	+13.30	+ 30

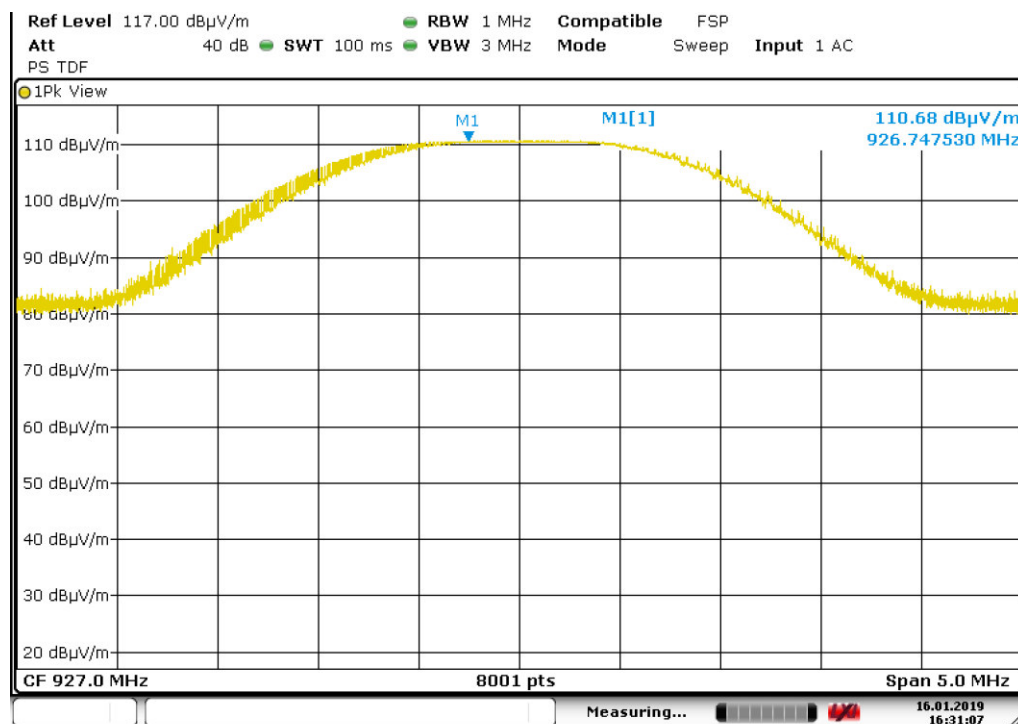
* TP = $(E \times d)^2 / (30 \times 1.64)$ for d = 3 m

Test conclusion: Complies with the requirements of the standard.





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7. PEAK POWER SPECTRAL DENSITY

Standard: FCC 47 CFR PART 15 : 2018

Section: §15.247 e)

Test configuration:

The system is tested in normalized test site.

The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

The level was maximised in antenna height, azimuth and polarization. The maximum level measured on the spectrum analyser was recorded.

Distance of antenna: 3 meters

Instrumentation test list:

Order Nr	Category	Manufacturer	Type	Last validity date	Next validity date
03106	Antenna	Schwarzbeck	UHALP 9108	07/04/2017	07/06/2019
11178	Cable	C&C	N-2m	04/05/2018	04/07/2020
11182	Cable	C&C	N-2m	18/04/2018	18/06/2020
11183	Cable	C&C	N-8m	18/04/2018	18/06/2020
14768	Receiver	Rohde & Schwarz	ESR7	11/01/2019	11/01/2020
14803	Shielded enclosure	Comtest	SAC 3m	---	---

Equipment under test operating condition:

EUT is in continuous transmission mode.

Measure conditions:

Ambient temperature (°C): 22

Relative humidity (%): 50

Resolution bandwidth: 3 kHz

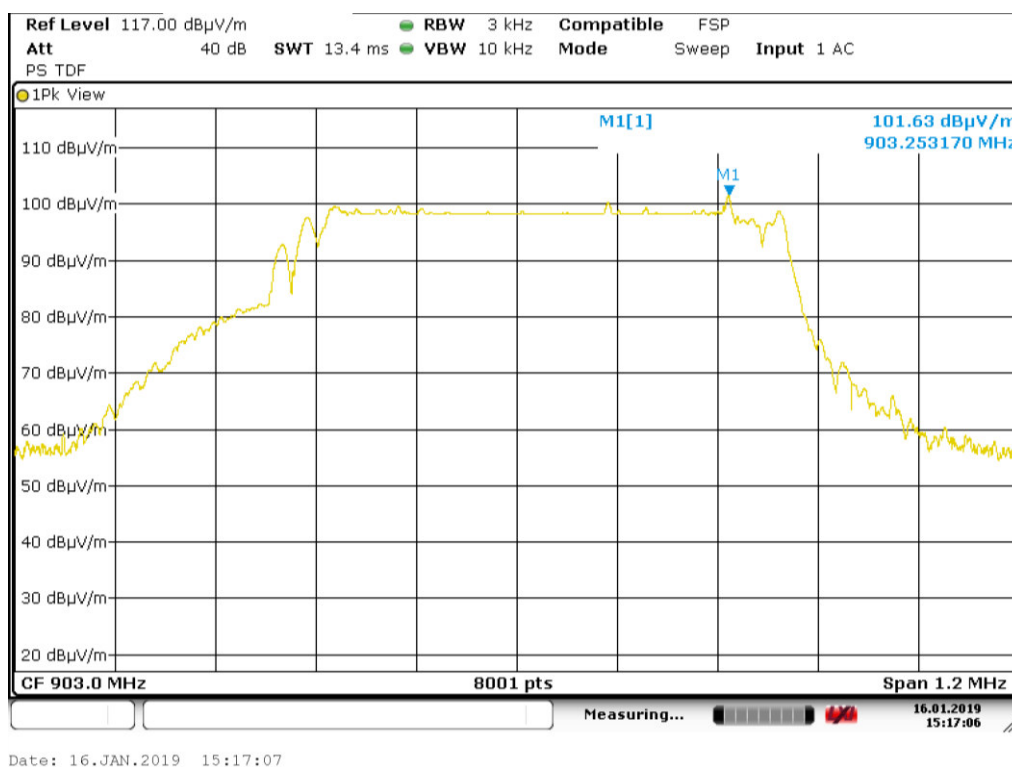
Video bandwidth: 10 kHz

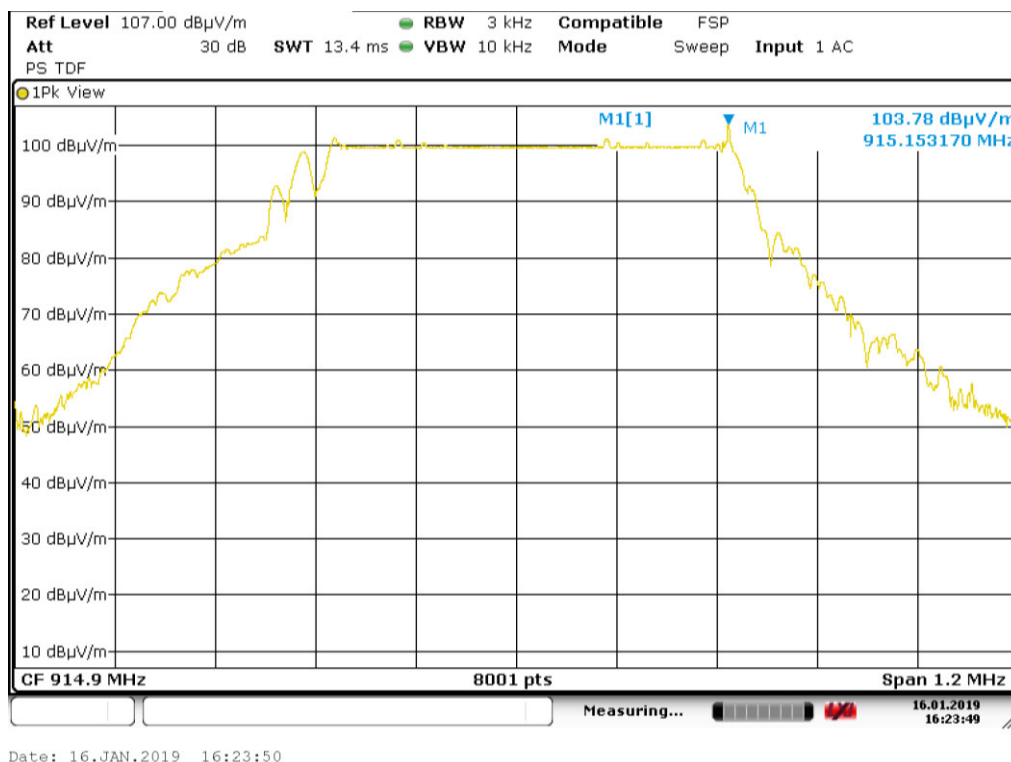
Results:

Power source: 3.6 Vdc

Frequency	Electro-magnetic field (dB μ V/m)	PPSD* (dBm)	Limit (dBm)
903.0 MHz	101.63	+ 4.25	+ 8.0
914.9 MHz	103.78	+ 6.40	
927.0 MHz	103.52	+ 6.14	

* PPST = $(E \times d)^2 / (30 \times 1.64)$ for $d = 3$ m





Test conclusion: Complies with the requirements of the standard.

8. ADDITIONAL PROVISIONS TO THE GENERAL RADIATED EMISSIONS LIMITATION

Standard: FCC 47 CFR PART 15 : 2018

Sections: §15.215 (b) and §15.247 (d)

Instrumentation test list:

Order Nr	Category	Manufacturer	Type	Last validity date	Next validity date
03106	Antenna	Schwarzbeck	UHALP 9108	07/04/2017	07/06/2019
11178	Cable	C&C	N-2m	04/05/2018	04/07/2020
11182	Cable	C&C	N-2m	18/04/2018	18/06/2020
11183	Cable	C&C	N-8m	18/04/2018	18/06/2020
14768	Receiver	Rohde & Schwarz	ESR7	11/01/2019	11/01/2020
14803	Shielded enclosure	Comtest	SAC 3m	---	---

Equipment under test arrangement:

The system is tested in normalized test site.

The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

The level was maximised in antenna height, azimuth and polarization. The maximum level measured on the spectrum analyser was recorded.

Results:

Ambient temperature (°C): 22

Relative humidity (%): 50

Polarization of test antenna: Vertical (height = 140 cm)
Position of equipment: azimuth = 300°

} For 903.0 MHz

Polarization of test antenna: Vertical (height = 130 cm)
Position of equipment: azimuth = 150°

} For 927 MHz

Fundamental frequency (MHz)	Field Strength Level of fundamental (dB μ V/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) *	Calculated Max Out of Band Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
903.0	109.11	Peak	902.72	31.51	77.6	89.1	11.5
927.0	110.34	Peak	927.01	45.97	64.4	90.3	25.9

The band edge readings were performed with a peak detector and with the E.U.T. set in a constant 100 % transmit state.

* According to step 2 of Marker-Delta Method DA 00-705.

Band-edge curves are given in annex 2.

9. UNINTENTIONAL RADIATED EMISSIONS AND TRANSMITTER UNWANTED EMISSION IN THE BAND 9 KHz – 10 GHz

Standard: FCC 47 CFR PART 15 : 2018

Section: §15.205; 15.209 and §5.247

Equipment under test arrangement:

The equipment under test (EUT) is placed on a non-conductive test table at 0.8 m above the horizontal metal ground plane.

For maximum meter reading at each frequency, the antenna height is adjusted between 1 m and 4 m above the ground plane. A 360 degrees rotation of the EUT is performed in vertical and horizontal polarization. The frequency azimuth and antenna height are presented in the table on the next pages.

The E.U.T. is blocked in continuous transmission.

Frequencies range: 9 kHz – 30 MHz
30 MHz - 1 GHz
1 GHz – 10 GHz

Detection mode: Quasi-peak for 9 kHz – 30 MHz
Quasi-peak for 30 MHz - 1 GHz
Average for 1 GHz – 10 GHz

Resolution bandwidth: 200 Hz for 9 kHz – 150 kHz
9 kHz for 150 kHz – 30 MHz
120 kHz for 30 MHz - 1 GHz
1 MHz for 1 GHz – 10 GHz

Measurement distance: 3 meters from 9 kHz to 30 MHz
3 meters from 30 MHz to 10 GHz

- Limit for emission radiated outside the frequency band, except the harmonics, shall be attenuated by at least 20 dB below the level of fundamental or the general radiated emission limits.

From 9 kHz to 30 MHz

Frequencies range	Limit ($\mu\text{V/m}$)
9 – 490 kHz	2400/F (F in kHz) *
490 – 1705 kHz	24000/F (F in kHz) **
1.705 – 30 MHz	30 **

* Limits in $\mu\text{V/m}$ can be extrapolated to 3 m using 40 dB / decade.

** Limits in $\mu\text{V/m}$ can be extrapolated to 3 m using 20 dB / decade.

From 30 MHz to 10 GHz

Frequencies range (MHz)	Limit	
	(dB $\mu\text{V/m}$)	($\mu\text{V/m}$)
30 to 88	40.0	100
88 to 216	43.5	150
216 to 960	46.0	200
Above 960	54.0	500

Instrumentation test list:

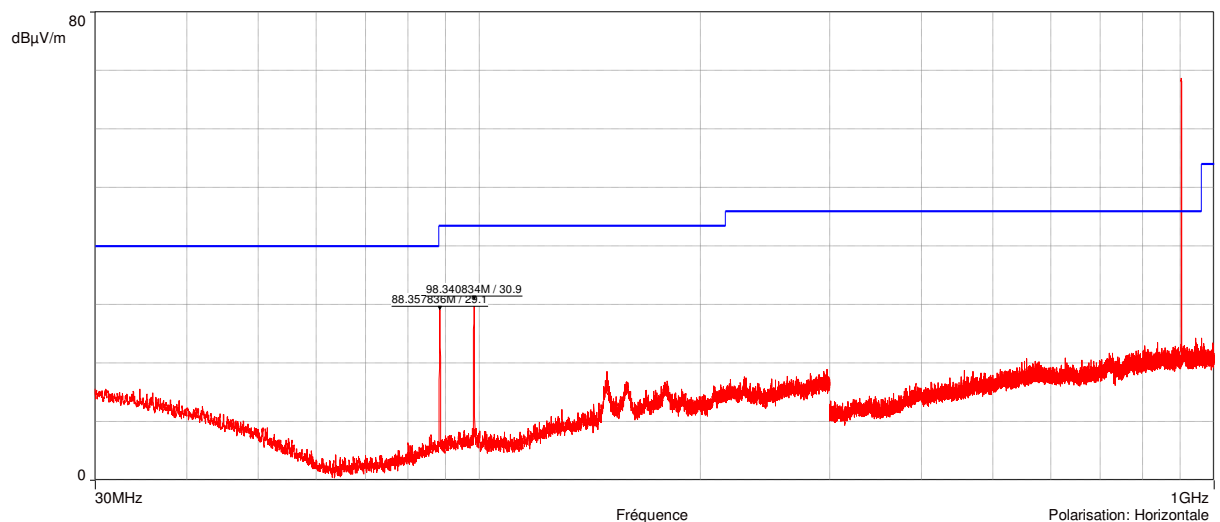
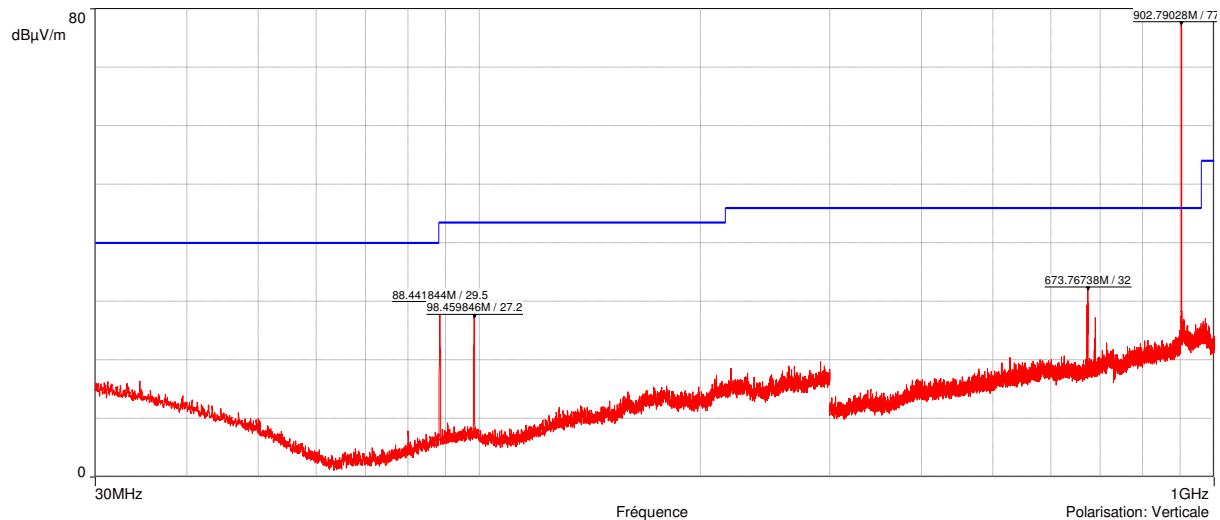
Order Nr	Category	Manufacturer	Type	Last validity date	Next validity date
5437	Amplifier	Mini-circuit	ZFL-1000N	22/10/2018	22/12/2019
14524	Amplifier	HP	8449B	20/04/2018	20/06/2019
0941	Antenna	Emco	3115	28/10/2015	28/12/2018*
3106	Antenna	Schwarzbeck	UHALP 9108	07/04/2017	07/06/2019
3426	Antenna	Schwarzbeck	VHA 9103	05/07/2017	05/09/2020
9579	Antenna	Emco	6502	10/04/2017	10/06/2019
11178	Cable	C&C	N-2m	04/05/2018	04/07/2020
11182	Cable	C&C	N-2m	18/04/2018	18/06/2020
11183	Cable	C&C	N-8m	18/04/2018	18/06/2020
0803	Filter	Trilithic	3VNF500/1000	20/11/2018	20/01/2021
1097	Filter	Trilithic	6HC1300-2.5-KK	10/05/2017	10/07/2019
14768	Receiver	Rohde & Schwarz	ESR7	11/01/2019	11/01/2020
14803	Shielded enclosure	Comtest	SAC 3m	---	---
5175	Spectrum analyzer	Rohde & Schwarz	FSP40 (V 4.00SP1-V3.0-10-2)	20/09/2018	20/11/2020

* Current derogation

Results:

Ambient temperature (°C): 22
Relative humidity (%): 50
Power source: 3.6 Vdc

Frequency 903 MHz

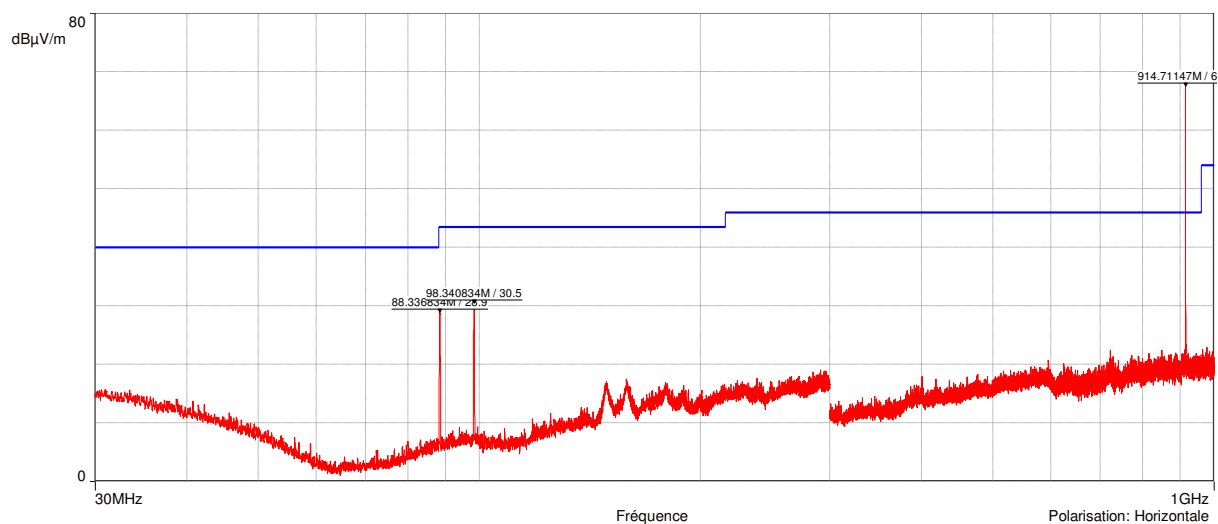
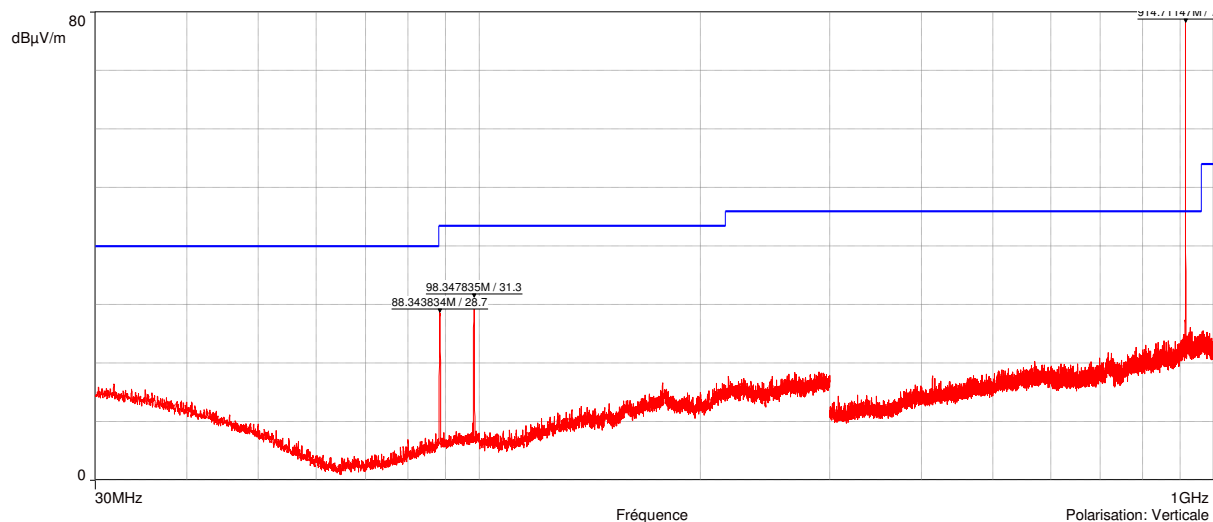


Frequencies between 1 GHz to 10 GHz.

Frequency (MHz)	Polarization	Electro-magnetic field (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2709.76	Vertical	51.2	54.0	2.8
3612.15	Vertical	53.4	54.0	0.6
4515.39	Vertical	43.1	54.0	10.9
5418.44	Vertical	40.7	54.0	13.3
8127.38	Vertical	47.1	54.0	6.9
2709.91	Horizontal	52.2	54.0	1.8
3612.21	Horizontal	50.4	54.0	3.6
4515.57	Horizontal	43.3	54.0	10.7
5418.44	Horizontal	41.8	54.0	12.2
8127.78	Horizontal	51.3	54.0	2.7

No significant frequency has been found other than those given above between 9 kHz to 30 MHz.
The peak frequencies at 88.4 MHz and 98.4 MHz are FM transmitter outside to measurement.
The peak frequency at 903.0 MHz corresponds to the carrier frequency.

Frequency 914.9 MHz

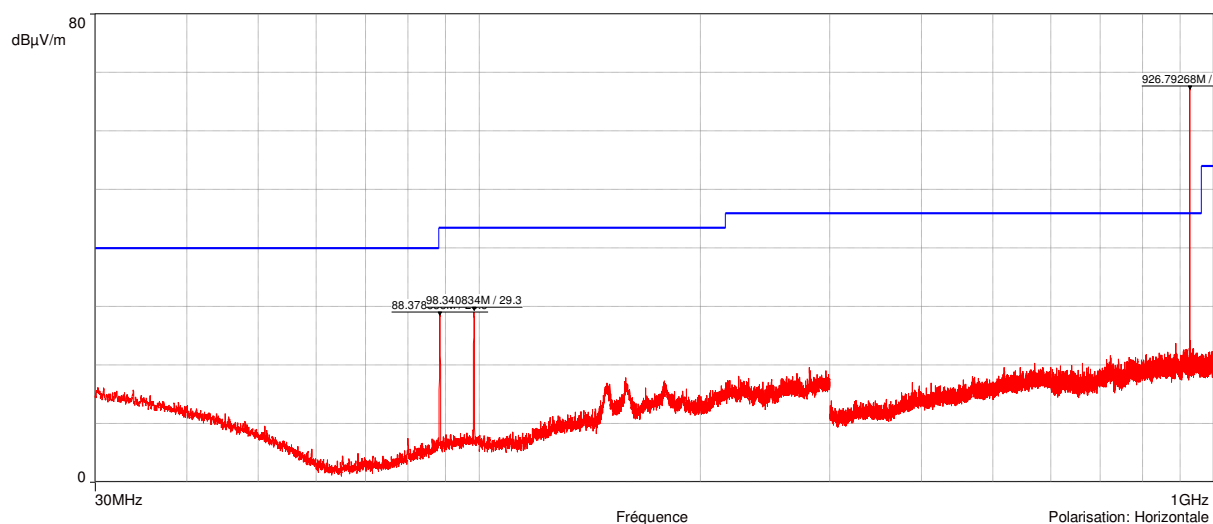
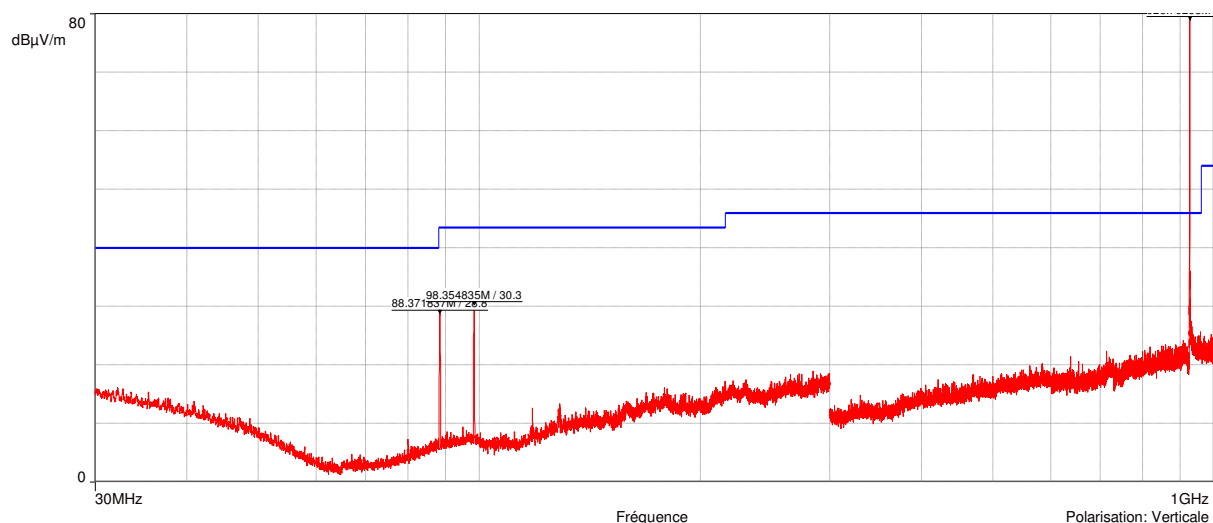


Frequencies between 1 GHz to 10 GHz.

Frequency (MHz)	Polarization	Electro-magnetic field (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2744.69	Vertical	52.8	54.0	1.2
3659.66	Vertical	53.3	54.0	0.7
4574.62	Vertical	44.9	54.0	9.1
5489.58	Vertical	40.7	54.0	13.3
2744.74	Horizontal	52.1	54.0	1.9
3659.66	Horizontal	50.7	54.0	3.3
4574.62	Horizontal	46.1	54.0	7.9
5489.57	Horizontal	42.4	54.0	11.6
7318.63	Horizontal	45.3	54.0	8.7

No significant frequency has been found other than those given above between 9 kHz to 30 MHz.
The peak frequencies at 88.4 MHz and 98.4 MHz are FM transmitter outside to measurement.
The frequency at 914.9 MHz corresponds to the carrier frequency.

Frequency 927 MHz



Frequencies between 1 GHz to 10 GHz.

Frequency (MHz)	Polarization	Electro-magnetic field (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2780.97	Vertical	49.7	54.0	4.3
3708.00	Vertical	51.5	54.0	2.5
4635.10	Vertical	44.5	54.0	9.5
7414.88	Vertical	45.0	54.0	9.0
8344.78	Vertical	49.9	54.0	4.1
2780.97	Horizontal	52.7	54.0	1.3
3708.00	Horizontal	51.0	54.0	3.0
4635.10	Horizontal	45.3	54.0	8.7
7415.22	Horizontal	48.3	54.0	5.7
8344.17	Horizontal	52.3	54.0	1.7

No significant frequency has been found other than those given above between 9 kHz to 30 MHz.
The peak frequencies at 88.4 MHz and 98.4 MHz are FM transmitter outside to measurement.
The frequency at 927 MHz corresponds to the carrier frequency.

Test conclusion:

The equipment complies with the requirements of the standard.

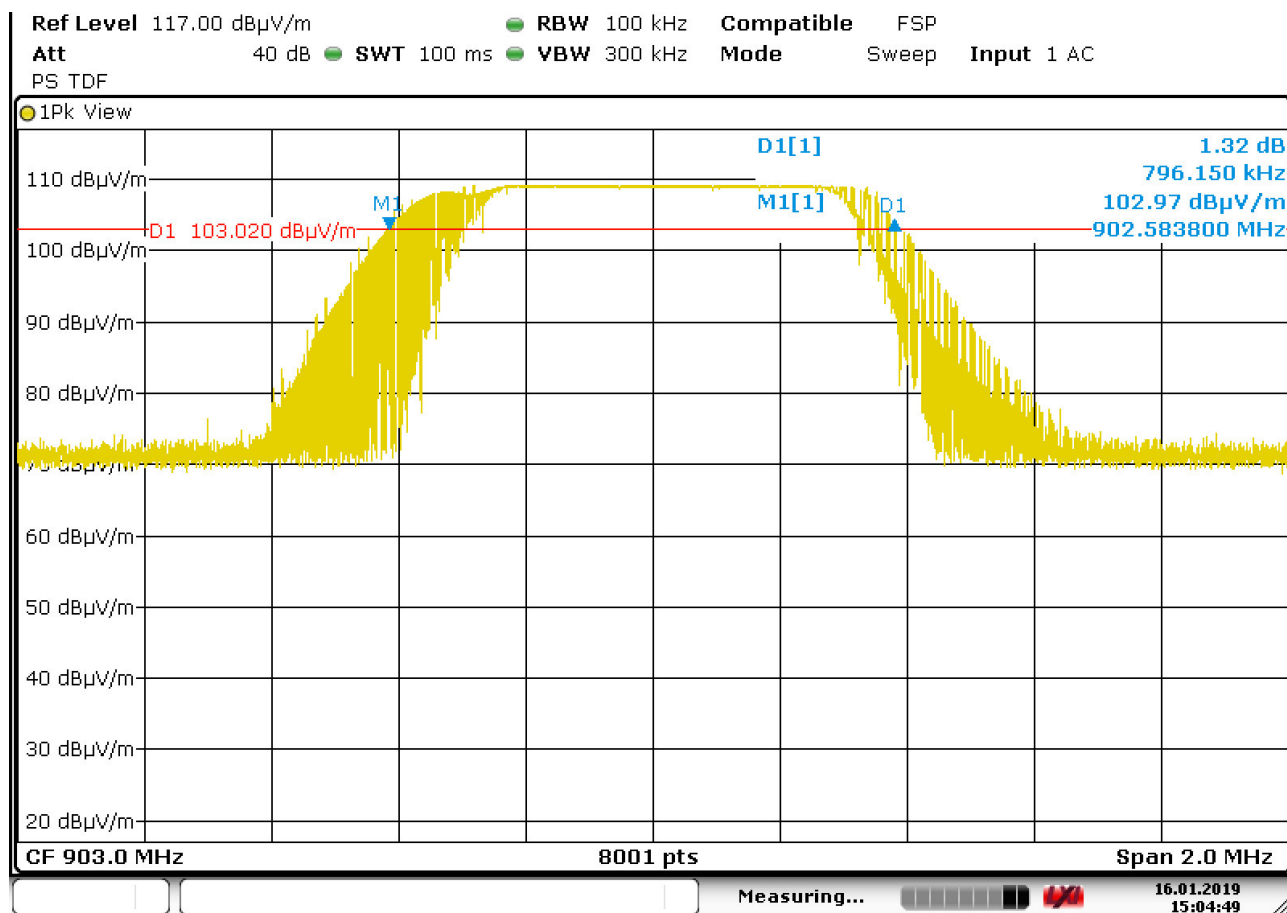
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ANNEX 1:

6 dB BANDWIDTH

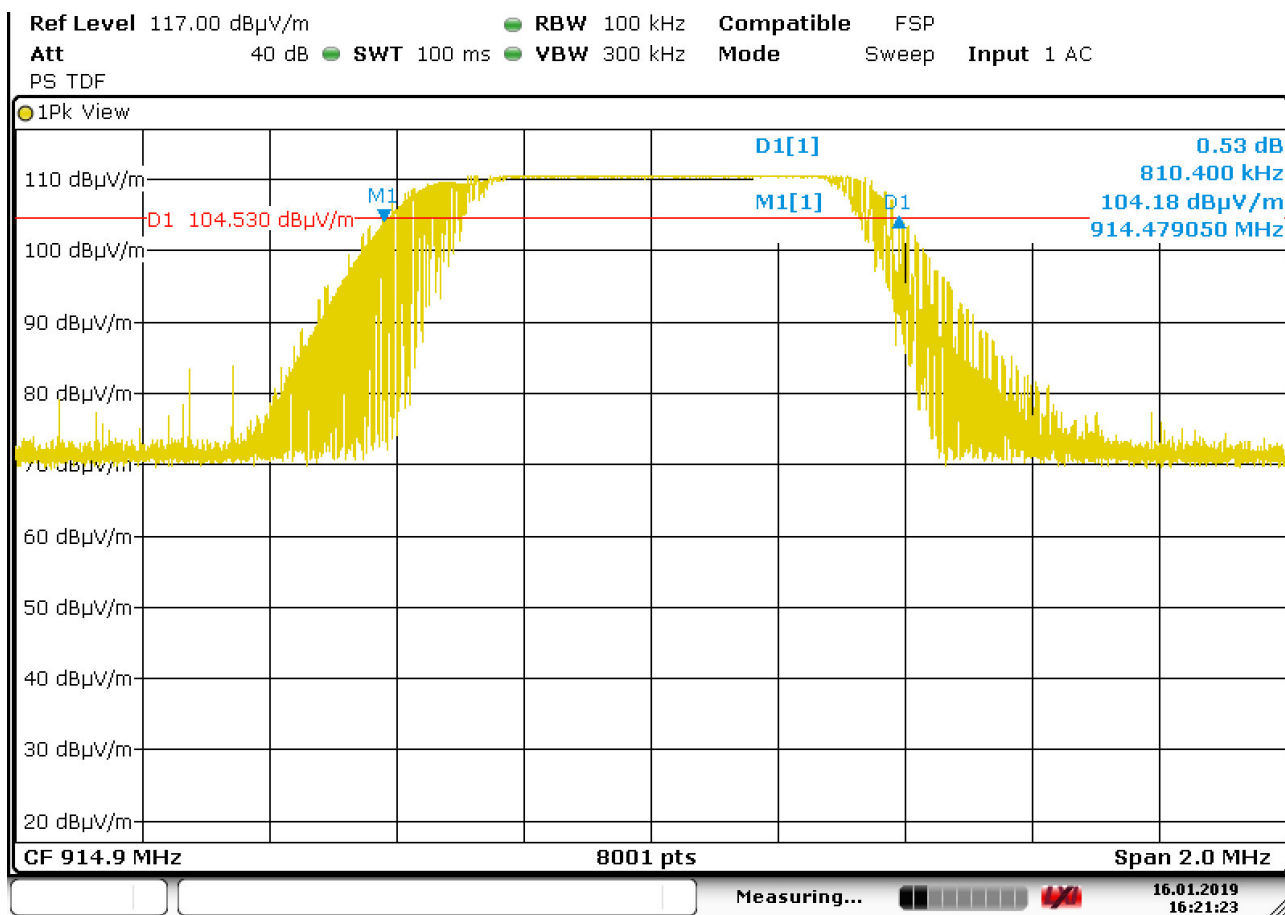
6 dB BANDWIDTH

Frequency 903.0 MHz



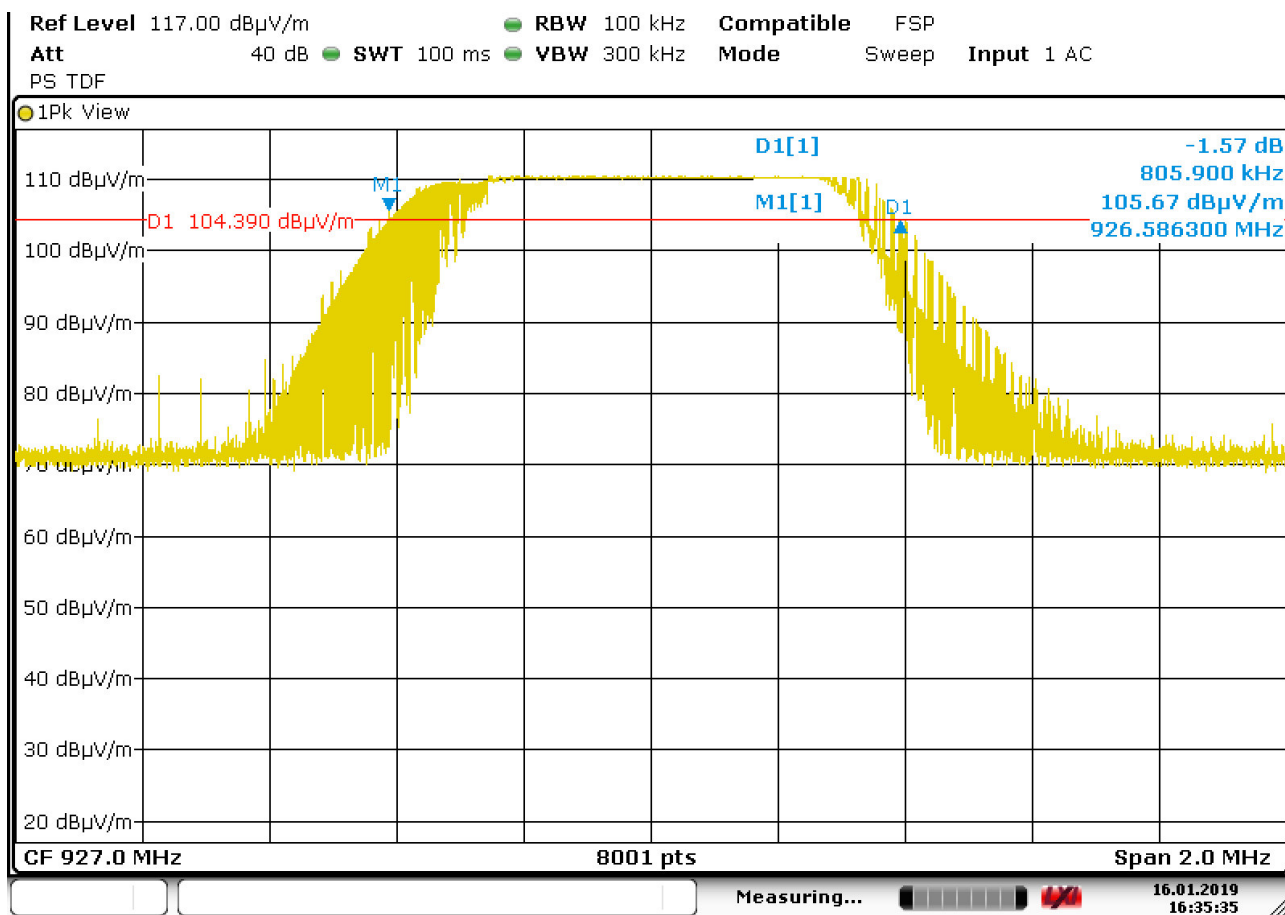
Date: 16.JAN.2019 15:04:50

Frequency 914.9 MHz



Date: 16.JAN.2019 16:21:24

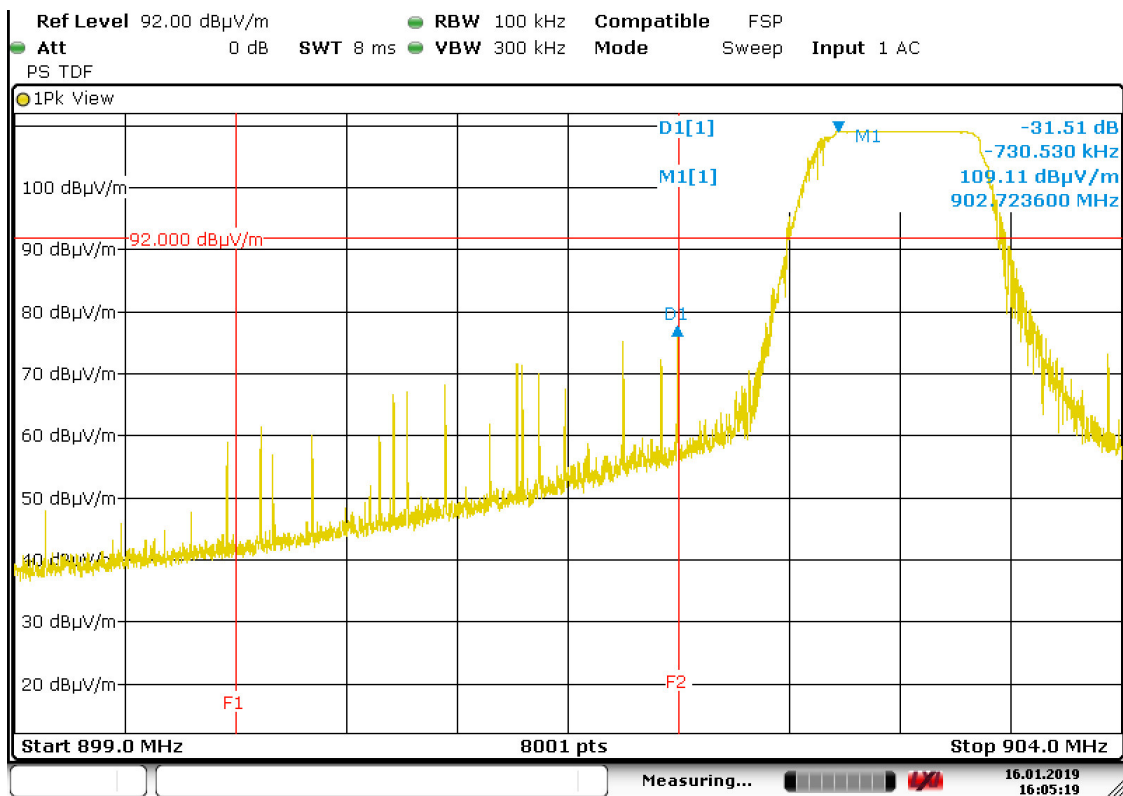
Frequency 927.0 MHz



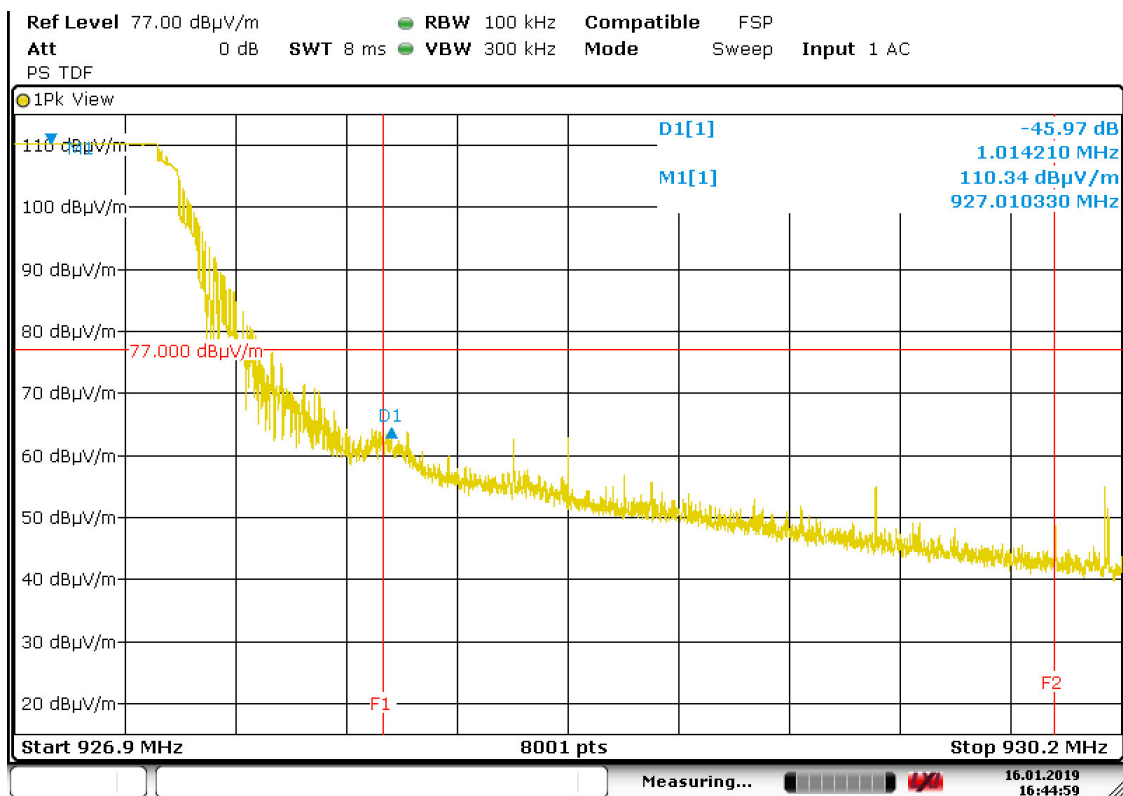
Date: 16.JAN.2019 16:35:35

ANNEX 2:

BAND EDGE



Date: 16.JAN.2019 16:05:20



Date: 16.JAN.2019 16:45:00