RRA-EMIESS24E893DAV-04Av0

Certification Radio test report

According to the standard:

CFR 47 FCC PART 15

RSS GEN – Issue 5
RSS 247 – Issue 3

Equipment under test:

DAVEY TRONIC 5 BENCH MONITOR

FCC ID: *2AUQC-DT5GBMO*
IC NUMBER: *25586-DT5GBMO*

Company:

DAVEY BICKFORD

Distribution: Mrs STOJANOVIC (**Company:** DAVEY BICKFORD)

Number of pages: 58 with 2 appendixes

Ed.	Date	Modified Page(s)	Technical Verification and Quality Approval Name and Function	Visa
0	9-Dec-24	Creation	M. DUMESNIL, Radio Laboratory Manager	

Duplication of this document is only permitted for an integral photographic facsimile. It includes the number of pages referenced here above.
This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole manufactured products of the tested sample.
Information in italics are declared by the manufacturer/customer and are under his responsibility

S51 RTY 000 INT 00015 [04]

DESIGNATION OF PRODUCT:	***DAVEY TRONIC 5 BENCH MONITOR***
Serial number (S/N):	*0001*
Model:	*BMO*
Reference (P/N):	*62143 / BH024*
Firmware version:	*0x17 (LoRa Module)*
MANUFACTURER:	*DAVEY BICKFORD*

COMPANY SUBMITTING THE PRODUCT:

Company:	DAVEY BICKFORD
Address:	LE MOULIN GASPARD CHEMIN DE LA PYROTECHNIE 89550 HERY FRANCE
Responsible:	Mrs STOJANOVIC
DATES OF TEST:	17-Sep-24 to 26-Sep-24
TESTING LOCATION:	EMITECH ANGERS laboratory at JUIGNE SUR LOIRE (49) FRANCE FCC Accredited under US-EU MRA Designation Number: FR0009 Test Firm Registration Number: 873677 ISED Accredited under CANADA-EU MRA Designation Number: FR0001 Industry Canada Registration Number: 4452A
TESTED BY:	B. VOVARD **VISA:**
WRITTEN BY:	B. VOVARD

CONTENTS

REVISIONS HISTORY

Revision	Date	Modified pages	Modifications
0	**4-Oct-24**	/	Creation

1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment: ***DAVEY TRONIC 5 BENCH MONITOR***, in accordance with normative reference.

The equipment under test integrates:

- 2x LoRa 2.4 GHz transceiver radio module not already certified,
- WiFi 5 GHz transceiver radio module already certified (FCC ID: T7V-9026 / IC: 216Q-9026),
- 13.56MHz RFID Tag,
- GNSS module operational in the band 1559MHz – 1610MHz

This report concerns only LoRa 2.4 GHz Radio parts.

Measurements are done separately on two 2.4 GHz LoRa Module, named “LoRa 2A” and “LoRa 2B”.

The host device of certified module(s) shall be properly labeled to identify the module(s) within.

2. PRODUCT DESCRIPTION

Category of equipment (ISED):	I
Class:	A
Utilization:	Industrial
Antenna type and gain:	Integrated antenna Gain at 2414.8 MHz for LoRa 2A => +10.15 dBi Gain at 2436.4 MHz for LoRa 2A => +10.83 dBi Gain at 2473.2 MHz for LoRa 2A => +10.08 dBi Gain at 2414.8 MHz for LoRa 2B => +8.13 dBi Gain at 2436.4 MHz for LoRa 2B => +8.56 dBi Gain at 2473.2 MHz for LoRa 2B => +10.38 dBi
Operating frequency band:	From 2400 MHz to 2483.5 MHz
Operating frequency range:	From 2414.8 MHz to 2473.2 MHz
Number of channels:	17

Frequencies tested:	2414.8 MHz, 2436.4 MHz and 2473.2 MHz
Channel spacing:	0.8 to 8 MHz
Modulation:	LoRa
Power soft adjusted to	13 (LoRa 2A & LoRa 2B)
Power source:	Internal rechargeable Li-Ion battery 7.27 Vdc 7000mAh AC/DC Adapter (120Vac 60Hz / 12 Vdc)

The radio is not operational during charge mode. All measurements are realized on internal battery.

Power level, frequency range and channels characteristics are not user adjustable.
The details pictures of the product and the circuit boards are joined with this file.

3. NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below.
They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

CFR 47 FCC Part 15 (2024)	Radio Frequency Devices
ANSI C63.10	2013 Procedures for ComplianceTesting of Unlicensed Wireless Devices.
558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.
RSP-100	Issue 12, August 2019 Certification of Radio Apparatus and Broadcasting equipment
RSS-Gen	Issue 5, April 2018 General Requirements for Compliance of Radio Apparatus
RSS-247	Issue 3, August 2023 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

4. TEST METHODOLOGY

Radio performance tests procedures given in CFR 47 part 15:

Subpart C – Intentional Radiators

- Paragraph 203: Antenna requirement
- Paragraph 205: Restricted bands of operation
- Paragraph 209: Radiated emission limits; general requirements
- Paragraph 215: Additional provisions to the general radiated emission limitations
- Paragraph 247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

Radio performance tests procedures given in RSS-Gen:

- Paragraph 2 - General
- Paragraph 3 - Normative publications and related documents
- Paragraph 4 - Labelling requirements
- Paragraph 6 - General administrative and technical requirements
- Paragraph 8 - Licence-exempt Radio Apparatus

Radio performance tests procedures given in RSS-247:

- Paragraph 3 - Certification requirements
- Paragraph 4 - Measurement method
- Paragraph 5 - Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last calibration (DD/MM/YY)	Calibration interval (years) (DD/MM/YY)	Next calibration due (DD/MM/YY)
0	BAT-EMC V3.18.0.26	Software	/	/	/
1406	EMCO 6502	Loop antenna	04/04/2024	1	04/04/2025
4087	Filtek LP03/1000-7GH	Low Pass Filter	07/02/2023	3	06/02/2026
4088	R&S FSP40	Spectrum Analyzer	10/06/2024	2	10/06/2026
7124	A.H. Systems SAS-572	Antenna	23/05/2022	3	22/05/2025
7171	R&S HL223	Antenna	19/05/2022	3	18/05/2025
7190	R&S HL223	Antenna	17/03/2022	3	16/03/2025
7240	Emco 3110	Biconical antenna	17/03/2022	3	16/03/2025
7279	SUCOFLEX SF104 N 1.5m	Cable	31/05/2024	2	31/05/2026
7299	Microtronics BRM50702	Reject band filter	16/08/2022	3	15/08/2025
7566	Testo 608-H1	Meteo station	12/12/2022	2	11/12/2024
8528	Schwarzbeck VHA 9103	Biconical antenna	19/05/2022	3	18/05/2025
8548	Midwest Microwave 10dB	Attenuator	08/02/2023	3	07/02/2026
8732	Emitech	OATS	28/03/2022	3	27/03/2025
8785	N-1.5m Emitech	Cable	10/07/2024	2	10/07/2026
8813	Emitech	N Cable	04/06/2024	2	04/06/2026
8855	EMITECH	Turntable and mat controller	/	/	/
8864	Champ libre Juigné. V3.5	Software	/	/	/
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
8974	STORM MICROWAE k-20cm	cable	29/01/2024	2	28/01/2026
9399	N-1m	Cable	29/01/2024	2	28/01/2026
10759	COMTEST Cage 3	Anechoic chamber	/	/	/
10771	EMCO 3117	Antenna	30/11/2022	3	30/11/2025

Emitech Number	Model	Type	Last calibration (DD/MM/YY)	Calibration interval (years) (DD/MM/YY)	Next calibration due (DD/MM/YY)
10789	MATURO	Turntable and mat controller NCD	/	/	/
12590	LUCIX Corp S005180M3201	Low-noise amplifier	29/05/2024	1	29/05/2025
14303	SUCOFLEX N-2m	cable	01/12/2022	2	30/11/2024
14903	Fluke 177	Multimeter	22/12/2023	2	21/12/2025
15666	R&S FSV40	Spectrum Analyzer	27/09/2022	2	26/09/2024
16109	C&C HPF180400	High pass filter	11/08/2022	3	10/08/2025
17008	R&S ESW44	Test receiver	03/05/2024	1	03/05/2025
18418	MecHANC - Type K - 1m	Cable	02/09/2024	2	02/09/2026
19154	QOTANA DBLNA317202120S	Low-noise amplifier 18-26GHz	23/09/2024	1	23/09/2025
19246	HYTEM - N - 5m	Cable	22/01/2024	2	21/01/2026
19249	HYTEM - N - 2.5m	Cable	22/01/2024	2	21/01/2026
19266	Radiall R412706124	Attenuator 6dB	06/12/2023	3	06/12/2026
19267	Radiall R412706124	Attenuator 6dB	06/12/2023	3	06/12/2026
19274	ASC - ASC805C	Low-noise amplifier	12/01/2024	1	11/01/2025
//	RS Commander V2.4.2	Software	/	/	/

6. TESTS RESULTS SUMMARY

6.1 CFR 47 part 15requirements

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.203	ANTENNA REQUIREMENT	X				Note 1
FCC Part 15.205	RESTRICTED BANDS OF OPERATION	X				
FCC Part 15.207	CONDUCTED LIMITS			X		Note 2
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				Note 3
FCC part 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				Note 4
	(c) 20 dB bandwidth and band-edge compliance	X				
FCC Part 15.247	OPERATION WITHIN THE BANDS 902-928 MHZ, 2400-2483.5 MHz and 5725-5850 MHz					
	(a) (1) Hopping systems			X		
	(a) (2) Digital modulation techniques	X				Note 5
	(b) Maximum peak output power	X				
	(c) Operation with directional antenna gains > 6 dBi	X				
	(d) Intentional radiator	X				
	(e) Peak power spectral density	X				
	(f) Hybrid system			X		
	(g) Frequency hopping requirements			X		
	(h) Frequency hopping intelligence			X		
	(i) RF exposure compliance	X				

NAp: Not Applicable NAs: Not Asked

Note 1: Integral antenna with unknow gain.

Note 2: The radio is not operational during charge mode. All measurements are realized on internal battery.

Note 3: See FCC part 15.247 (d).

Note 4: See FCC part 15.209. Unwanted emissions levels are all below the fundamental emission field strength level.

Note 5: The minimum 6 dB bandwidth of the equipment is 546 kHz for LoRa Modulation.

6.2 RSS-Gen requirements

Test procedure	Description of test	Criteria respected ?				Comment
		Yes	No	NAp	NAs	
Paragraph 8	Licence-exempt radio apparatus					
§ 8.1	Measurement Bandwidths and Detector Functions	X				
§ 8.2	Pulsed operation	X				
§ 8.3	Prohibition of amplifiers	X				
§ 8.4	User manual notice	X				see certification documents
§ 8.5	Measurement of licence-exempt devices on-site (in-situ)			X		
§ 8.6	Operating frequency range of devices in master/slave networks	X				
§ 8.7	Radio frequency identification (RFID) devices			X		
§ 8.8	AC power line conducted emissions limits			X		Note 1
§ 8.9	Transmitter emission limits	X				
§ 8.10	Restricted frequency bands	X				
§ 8.11	Frequency stability			X		

NAp: Not Applicable NAs: Not Asked

Note 1: The radio is not operational during charge mode. All measurements are realized on internal battery.

6.3 RSS-247 requirements

Test Procedure RSS-247	Description of test	Criteria respected ?				Comment
		Yes	No	NAp	NAs	
Paragraph 5	Standard specifications for frequency hopping system and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz					
5.1	Frequency hopping systems (FHSS)			X		
5.2	Digital transmission systems	X				Note
5.3	Hybrid systems			X		
5.4	Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements	X				
5.5	Unwanted emissions	X				

NAp: Not Applicable NAs: Not Asked

Note : The minimum 6 dB bandwidth of the equipment is 546 kHz for LoRa Modulation.

7. MEASUREMENT UNCERTAINTY

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s)

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

Parameter	Emitech Uncertainty
RF power, conducted	± 0.8dB
Radiated emission valid to 26 GHz 9kHz – 30MHz 30MHz – 1GHz 1GHz – 18GHz 18GHz – 40GHz	 ± 4.3 dB ± 5.9 dB ± 4.8 dB ± 5.9 dB
AC Power Lines conducted emissions	± 3.7 dB
Temperature	± 0.95 °C
Humidity	± 4.6 %

8. OCCUPIED BANDWIDTH

Temperature (°C) : 23 **Humidity (%HR):** 58 to 57 **Date :** September 23, 2024 to September 24, 2024

Technician : B. VOVARD

Standard: FCC Part 15
RSS-247

Test procedure:
Method of paragraphs 11.8 of ANSI C63.10 (6dB Measurement)
Method of paragraphs 6.9.3 of ANSI C63.10 (99% Measurement)

Test set up:

Test realized in near field.

Setting:

Measure	**6dB**	**99%**
Center frequency	The centre frequency of the channel under test	
Detector	Peak	
Span	2 to 5 times the OBW	1.5 to 5 times the OBW
RBW	100kHz	1% to 5% of the OBW
VBW	300kHz	3 x RBW
Trace	Max hold	
Sweep	Auto	

Test operating condition of the equipment:

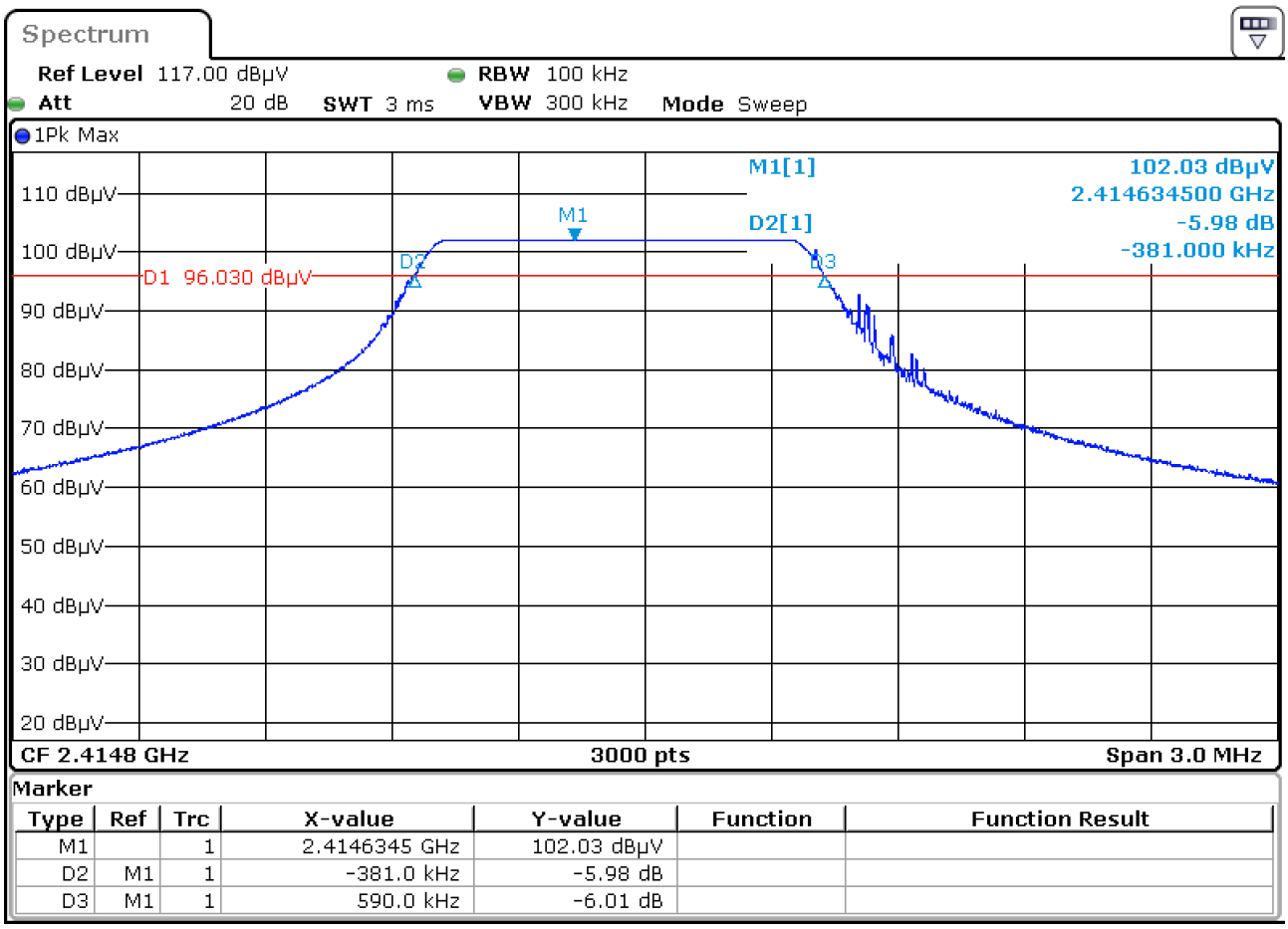
The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

We used for power source the internal battery of the equipment and we noted:
Voltage at the beginning of test (Vdc): 7.27
Voltage at the end of test (Vdc): 7.25
Percentage of voltage drop during the test (%): 0.27

Results for LoRa 2A:

Sample N° 1

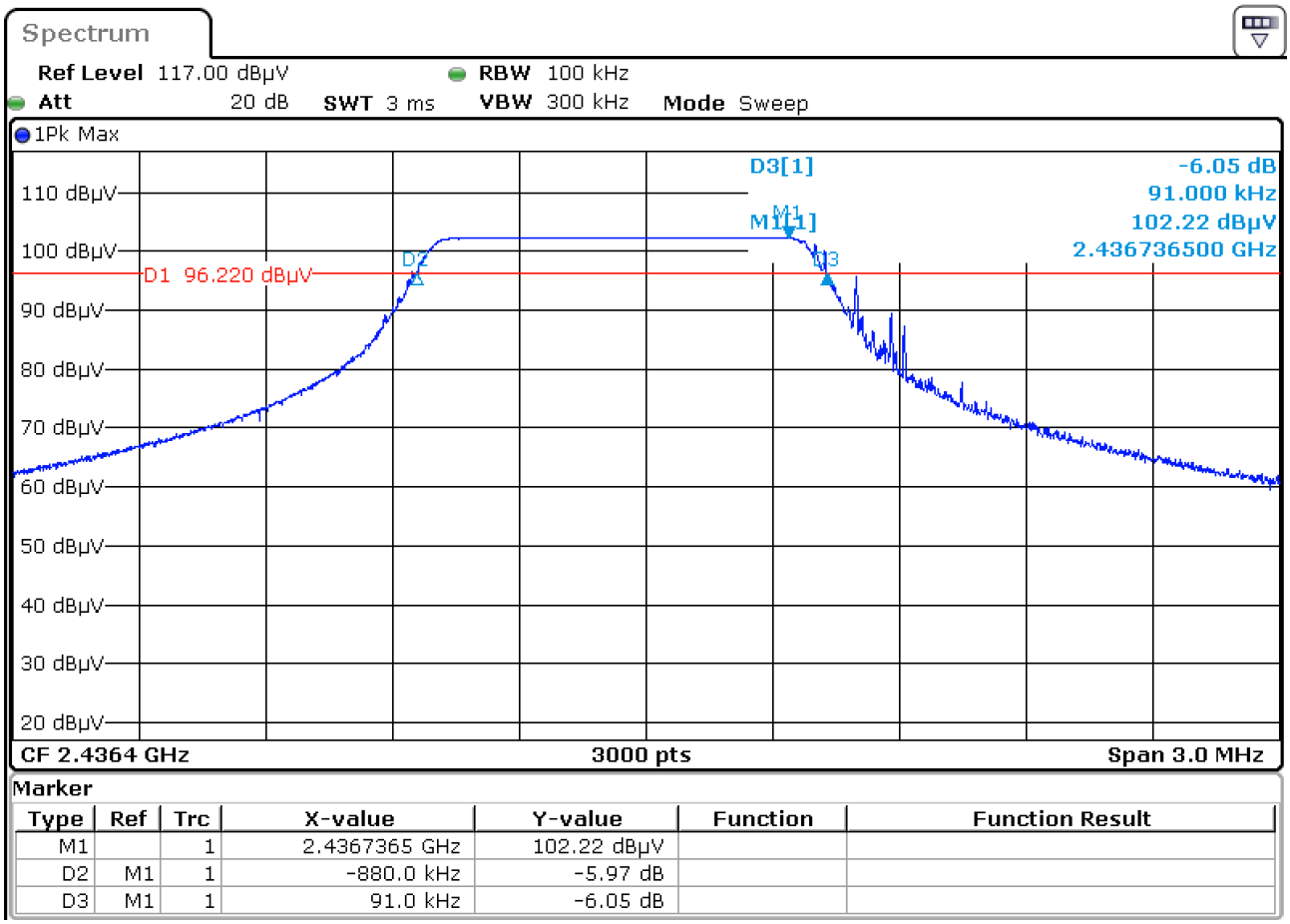
6dB bandwidth – Low Channel 2414.8 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4146345 GHz	102.03 dBµV		
D2	M1	1	-381.0 kHz	-5.98 dB		
D3	M1	1	590.0 kHz	-6.01 dB		

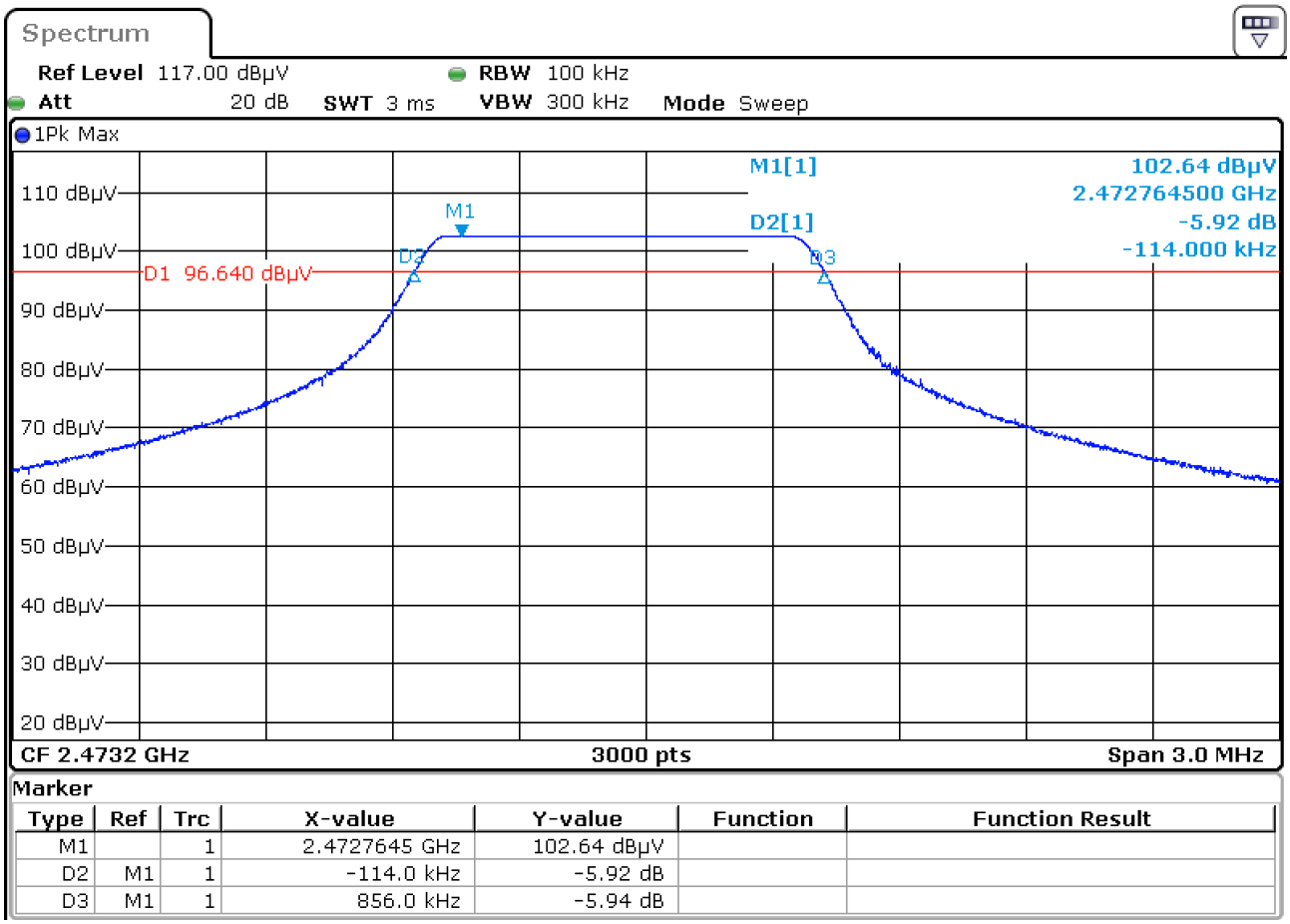
6dB bandwidth – Central Channel 2436.4 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4367365 GHz	102.22 dBµV		
D2	M1	1	-880.0 kHz	-5.97 dB		
D3	M1	1	91.0 kHz	-6.05 dB		

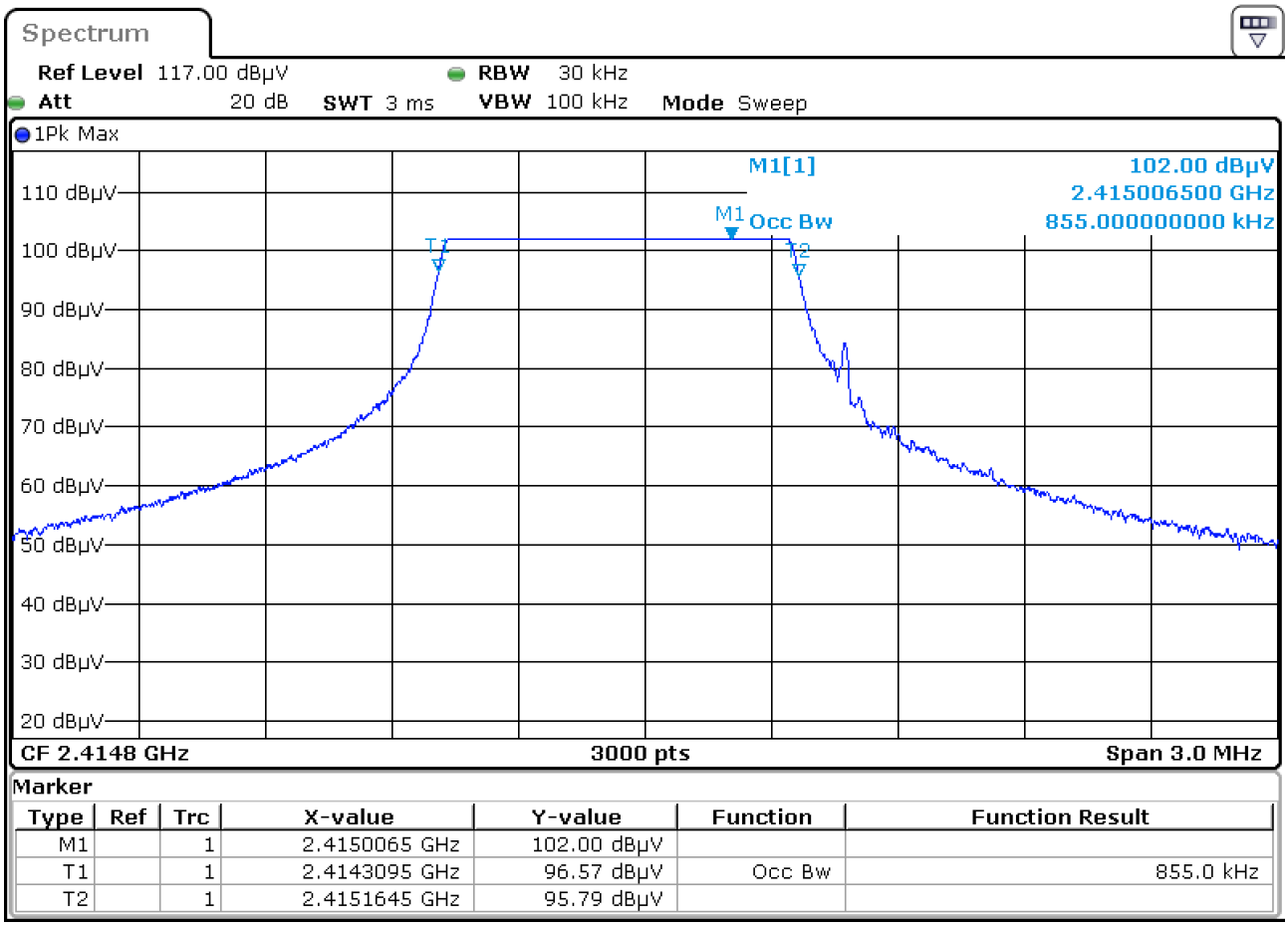
6dB bandwidth – High Channel 2473.2 MHz



Limit:

Shall be at least 500 kHz

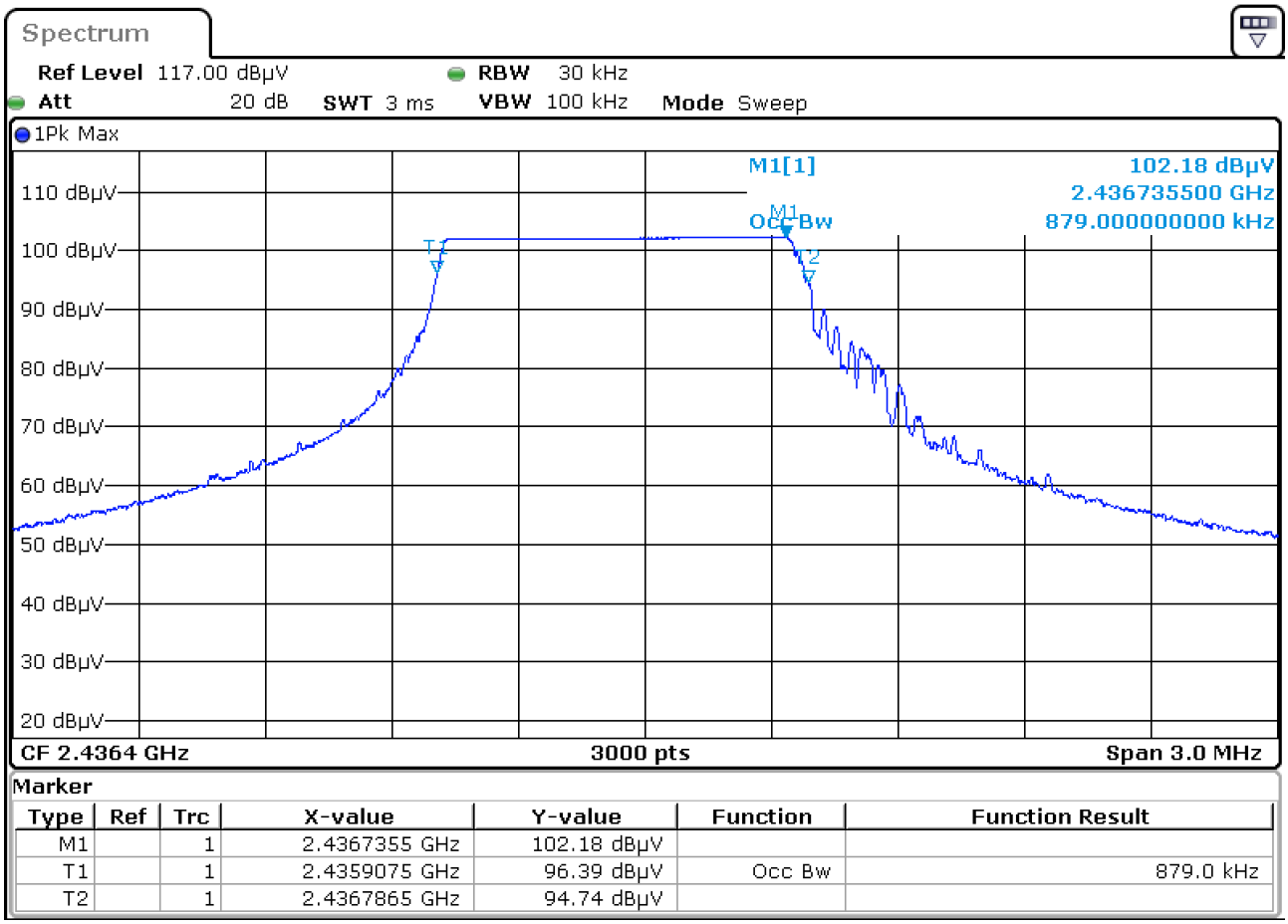
99% bandwidth – Low Channel 2414.8 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4150065 GHz	102.00 dBµV		
T1		1	2.4143095 GHz	96.57 dBµV	Occ Bw	855.0 kHz
T2		1	2.4151645 GHz	95.79 dBµV		

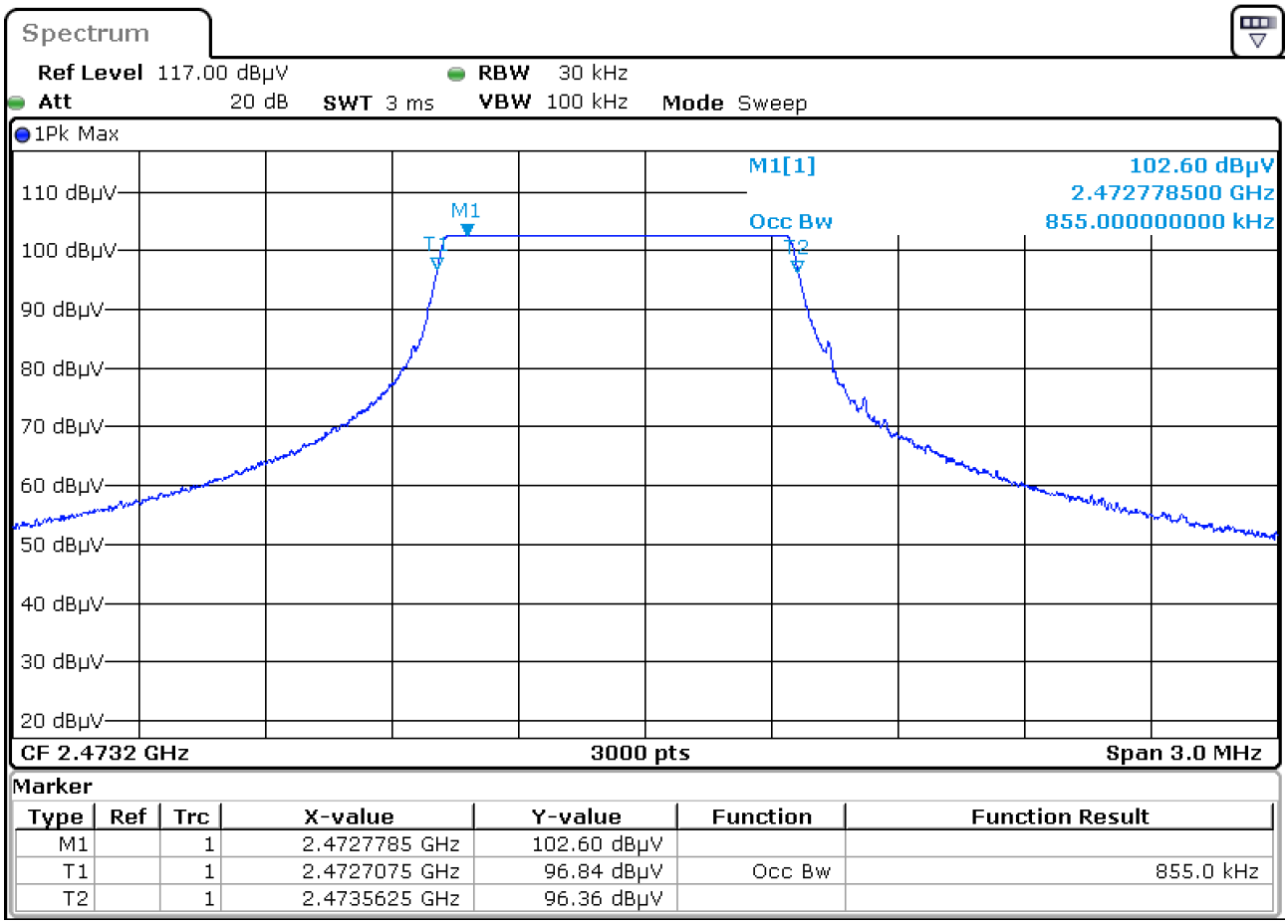
99% bandwidth – Central Channel 2436.4 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4367355 GHz	102.18 dBµV		
T1		1	2.4359075 GHz	96.39 dBµV	Occ Bw	879.0 kHz
T2		1	2.4367865 GHz	94.74 dBµV		

99% bandwidth – High Channel 2473.2 MHz

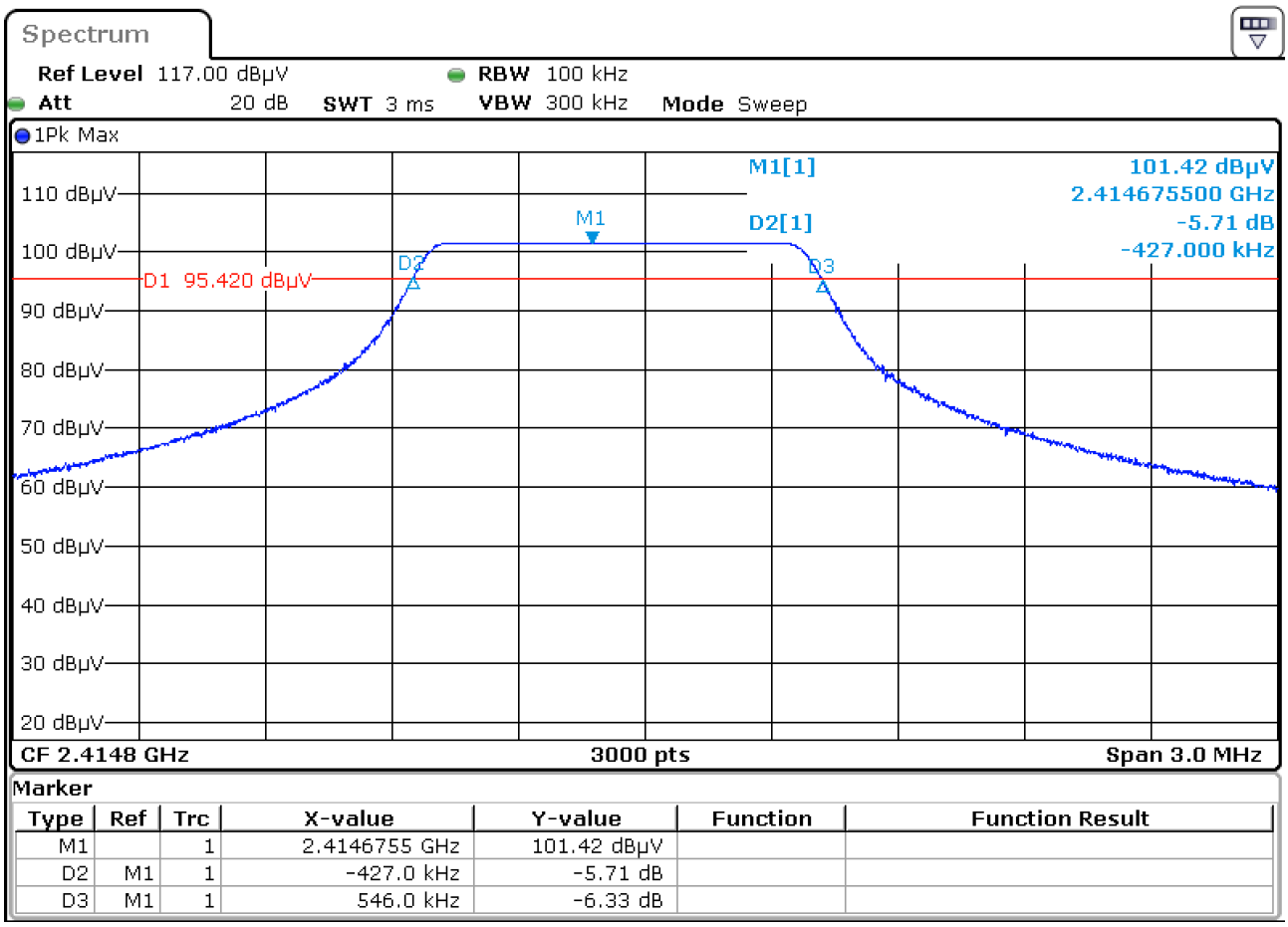


Measure realized for reporting only

Results for LoRa 2B:

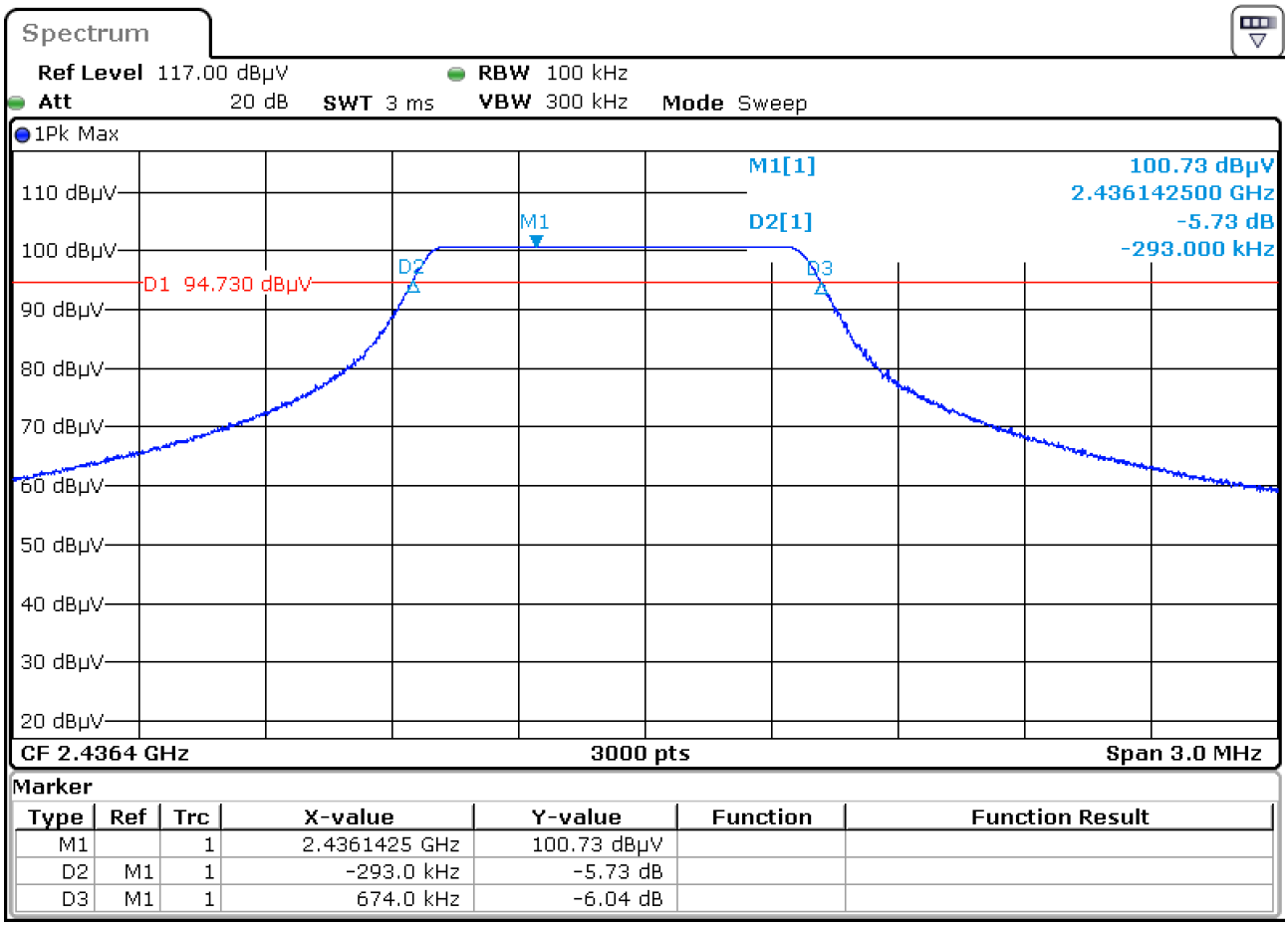
Sample N° 1

6dB bandwidth – Low Channel 2414.8 MHz



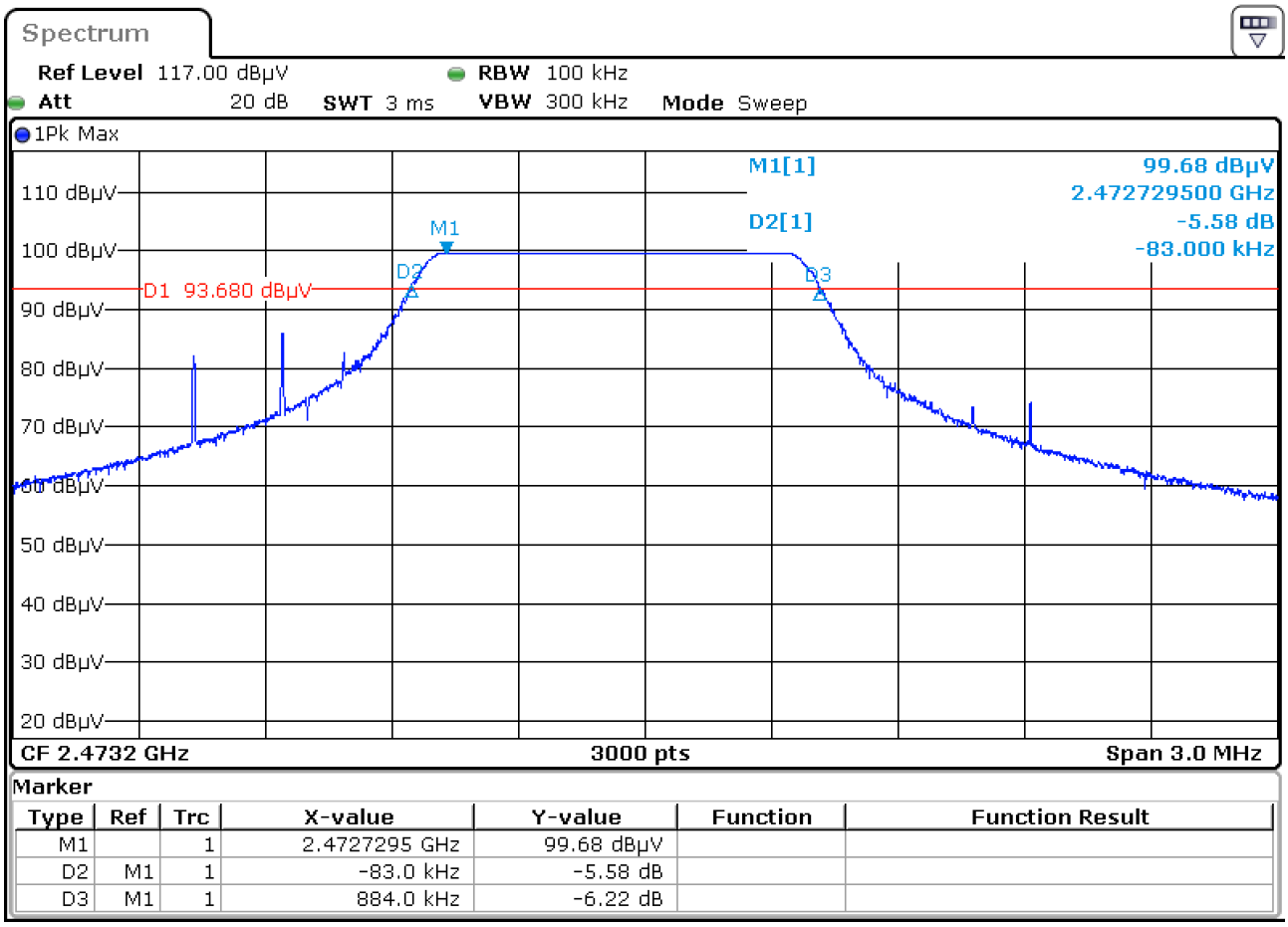
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4146755 GHz	101.42 dBµV		
D2	M1	1	-427.0 kHz	-5.71 dB		
D3	M1	1	546.0 kHz	-6.33 dB		

6dB bandwidth – Central Channel 2436.4 MHz



Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4361425 GHz	100.73 dBµV		
D2	M1	1	-293.0 kHz	-5.73 dB		
D3	M1	1	674.0 kHz	-6.04 dB		

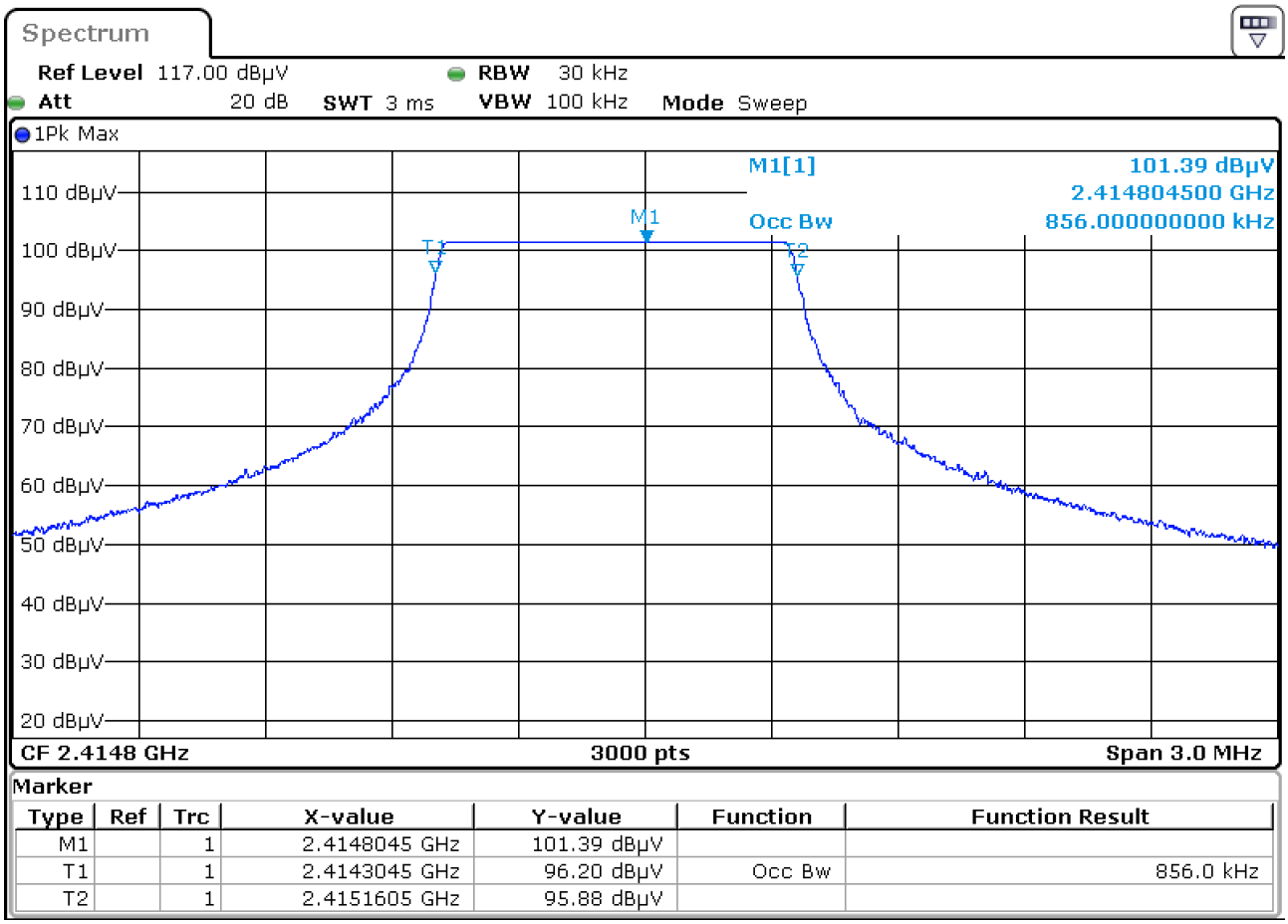
6dB bandwidth – High Channel 2473.2 MHz



Limit:

Shall be at least 500 kHz

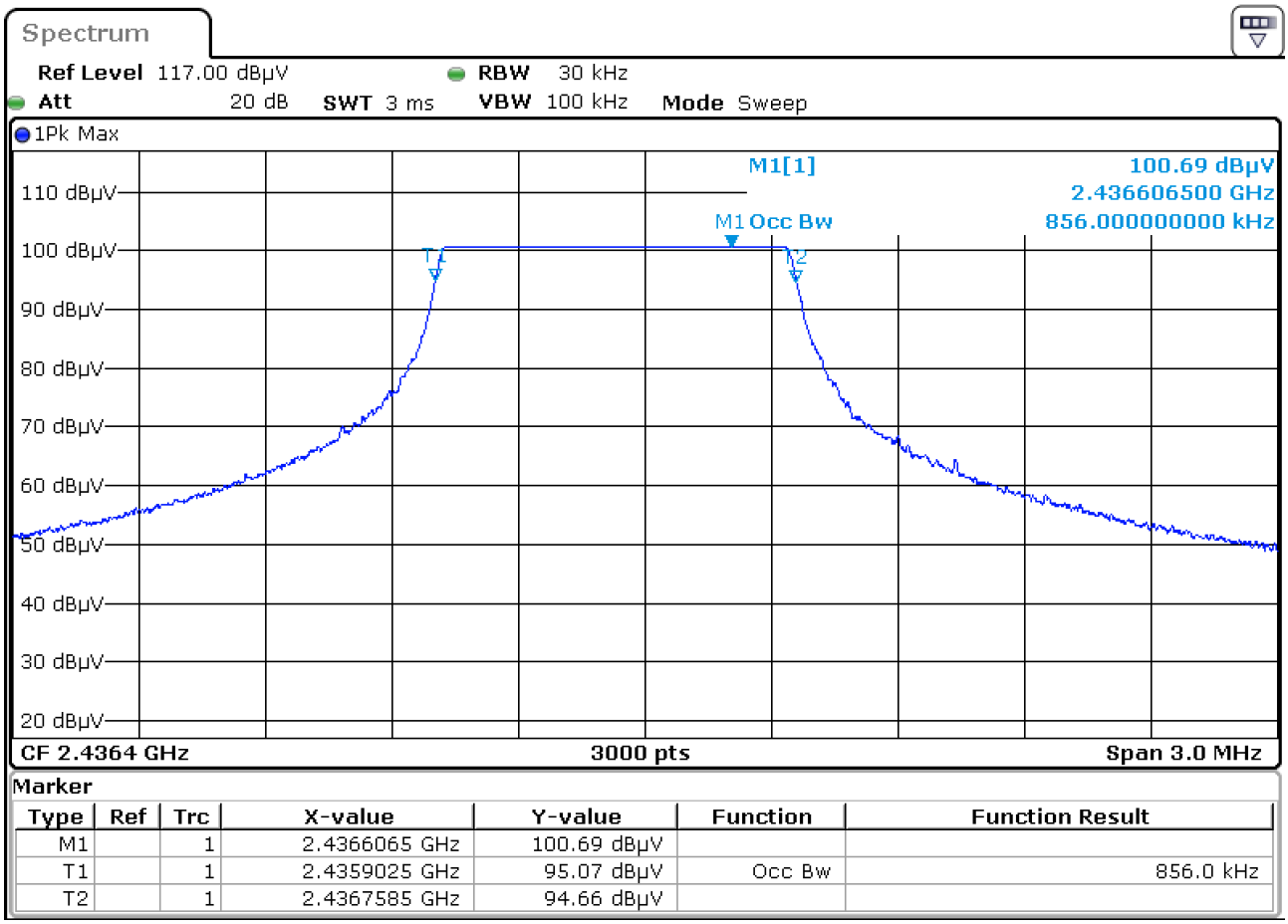
99% bandwidth – Low Channel 2414.8 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4148045 GHz	101.39 dBµV		
T1		1	2.4143045 GHz	96.20 dBµV	Occ Bw	856.0 kHz
T2		1	2.4151605 GHz	95.88 dBµV		

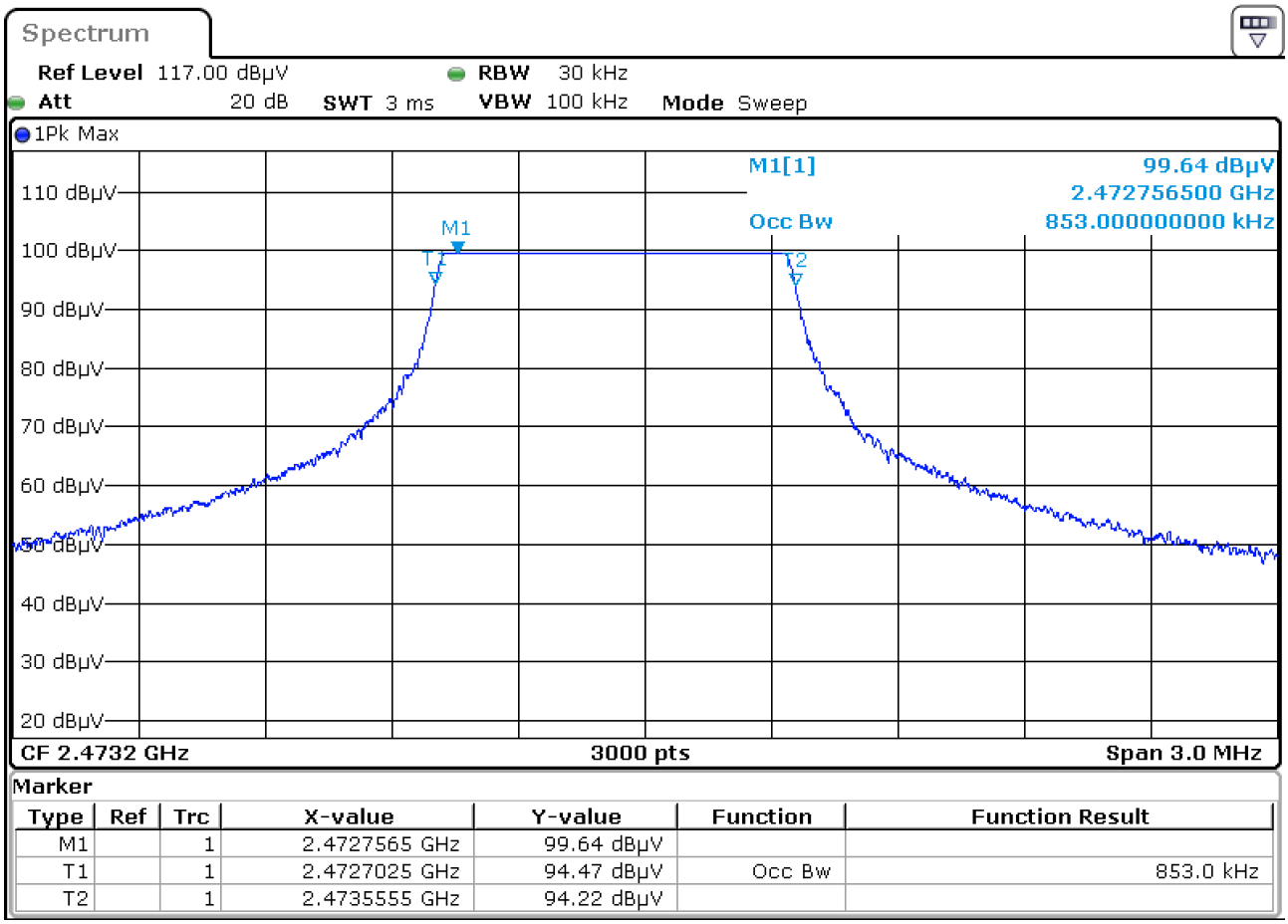
99% bandwidth – Central Channel 2436.4 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4366065 GHz	100.69 dBµV		
T1		1	2.4359025 GHz	95.07 dBµV	Occ Bw	856.0 kHz
T2		1	2.4367585 GHz	94.66 dBµV		

99% bandwidth – High Channel 2473.2 MHz



Measure realized for reporting only

9. BAND EDGE

Temperature (°C) : 23 **Humidity (%HR):** 58 to 57 **Date :** September 23, 2024 to September 24, 2024

Technician : B. VOVARD

Standard: FCC Part 15
RSS-247

Test procedure:

Method of paragraph 11.13.3 of ANSI C63.10

Test set up:

Test realized in near field. All field strength measurements are correlated with the radiated maximum peak output power.

Test operating condition of the equipment:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

We used for power source the internal battery of the equipment and we noted:
Voltage at the beginning of test (Vdc): 7.27
Voltage at the end of test (Vdc): 7.25
Percentage of voltage drop during the test (%): 0.27

Results:

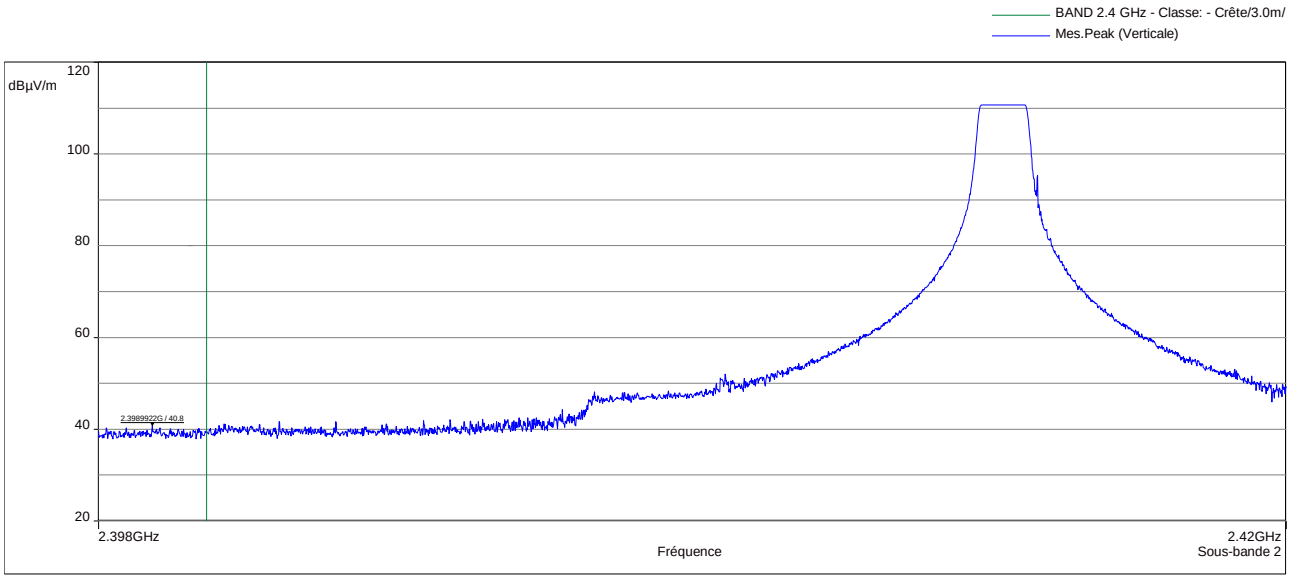
Lower Band Edge: From 2398 MHz to 2400 MHz
Upper Band Edge: From 2483.5 MHz to 2485.5 MHz

Results for LoRa 2A:

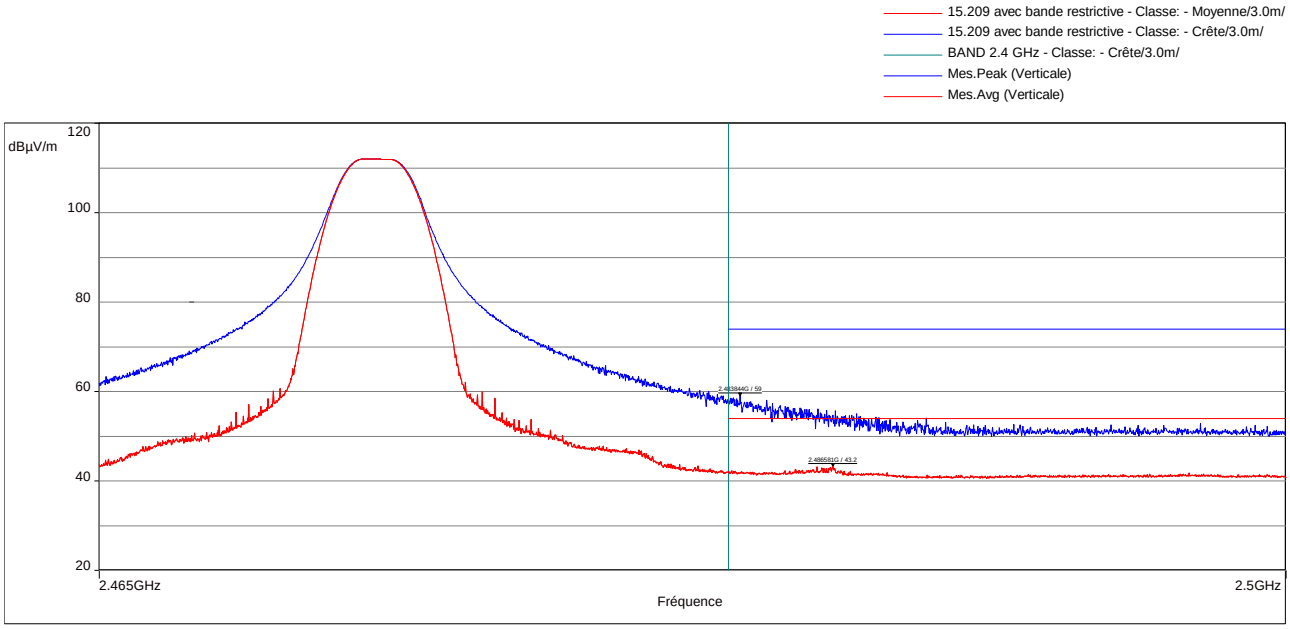
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	Detector (Peak or Average)	RBW (kHz)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) (1)	Calculated Max Out-of-Band Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2414.8	111	Peak	100	2398.99	70.2	40.8	91	50.2
2473.2	112	Peak	1000	2483.84	53	59	74	15
2473.2	112	Average	1000	2486.58	68.8	43.2	54	10.8

(1) Marker-Delta method
(2) The peak level is lower than the average limit (54 dBµV/m)

Low Channel – LoRa Modulation: Band edge worst case measurement



High Channel – LoRa Modulation: Band edge worst case measurement

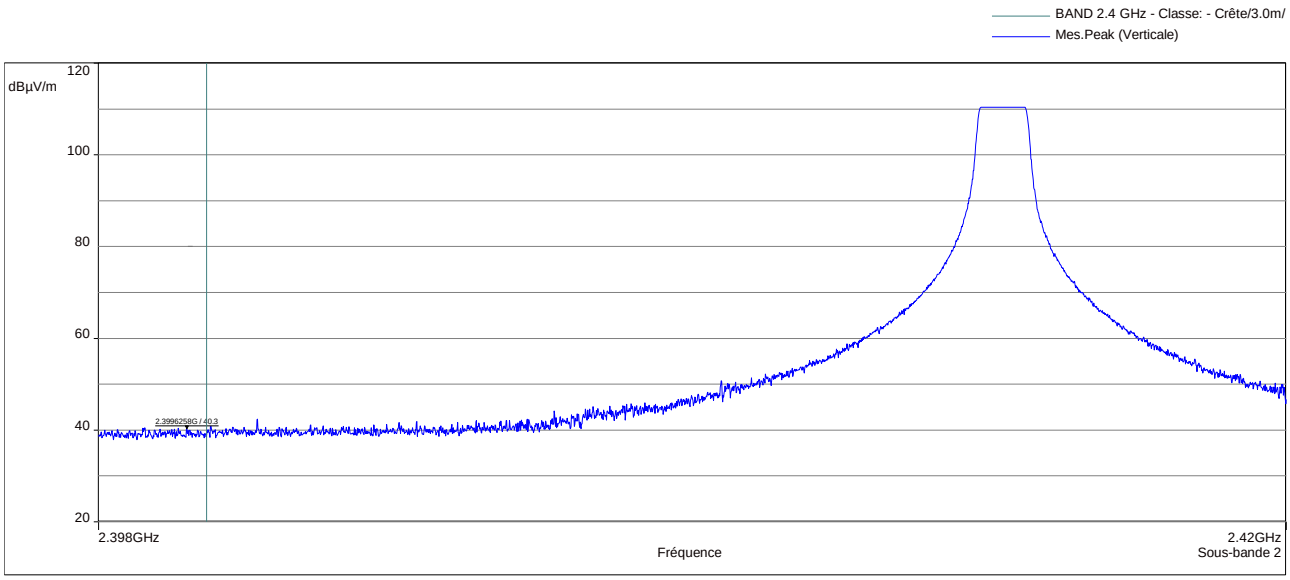


Results for LoRa 2B:

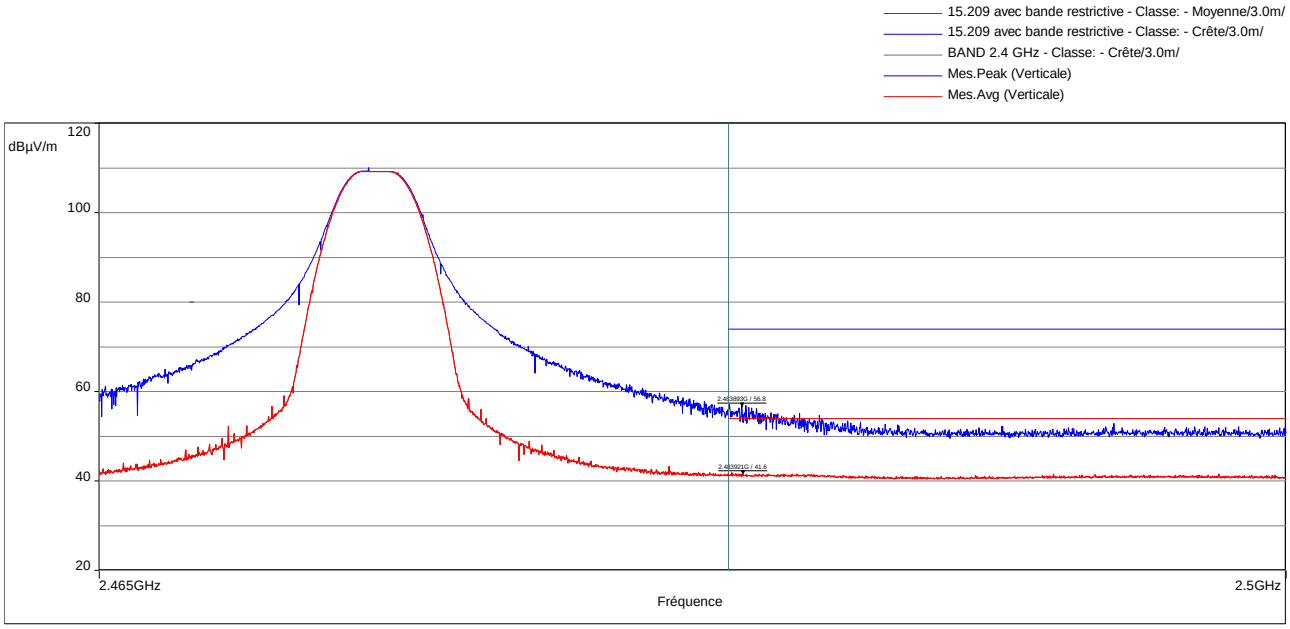
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	Detector (Peak or Average)	RBW (kHz)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) (1)	Calculated Max Out-of-Band Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2414.8	110	Peak	100	2399.62	69.7	40.3	90	49.7
2473.2	110	Peak	1000	2483.89	53.2	56.8	74	17.2
2473.2	110	Average	1000	2483.92	68.4	41.6	54	12.4

(1) Marker-Delta method

Low Channel – LoRa Modulation: Band edge worst case measurement



High Channel – LoRa Modulation: Band edge worst case measurement



Test conclusion:

RESPECTED STANDARD

10. PEAK CONDUCTED OUTPUT POWER

Temperature (°C) : 23 **Humidity (%HR):** 58 to 57 **Date :** September 23, 2024 and September 24, 2024

Technician : B. VOVARD

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.247 (b)
For RSS-247: paragraph 5.4

RBW≥DTS bandwidth method of paragraph 11.9.1.1 of ANSI C63.10

Test set up: (Refer Appendix 2)

First an exploratory radiated measurement was performed. During this phase the product is oriented in this normal position.

Then the final measurement is realized with the product on the most critical orientation.

The system is tested in anechoic chamber, the EUT is placed on a rotating table, 1.5 m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

See test setup in appendix 2

Distance of antenna: 3 meters (in anechoic room)

Antenna height: 1.5 meter (in anechoic room)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

The measurement of the radiated electro-magnetic field is realized with an analyser and peak detector. The resolution bandwidth is adjusted at 10 MHz and video bandwidth at 10 MHz. (11.9.1.1 of ANSI C63.10)

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning of test (Vdc):	7.25
Voltage at the end of test (Vdc):	7.22
Percentage of voltage drop during the test (%):	0.41

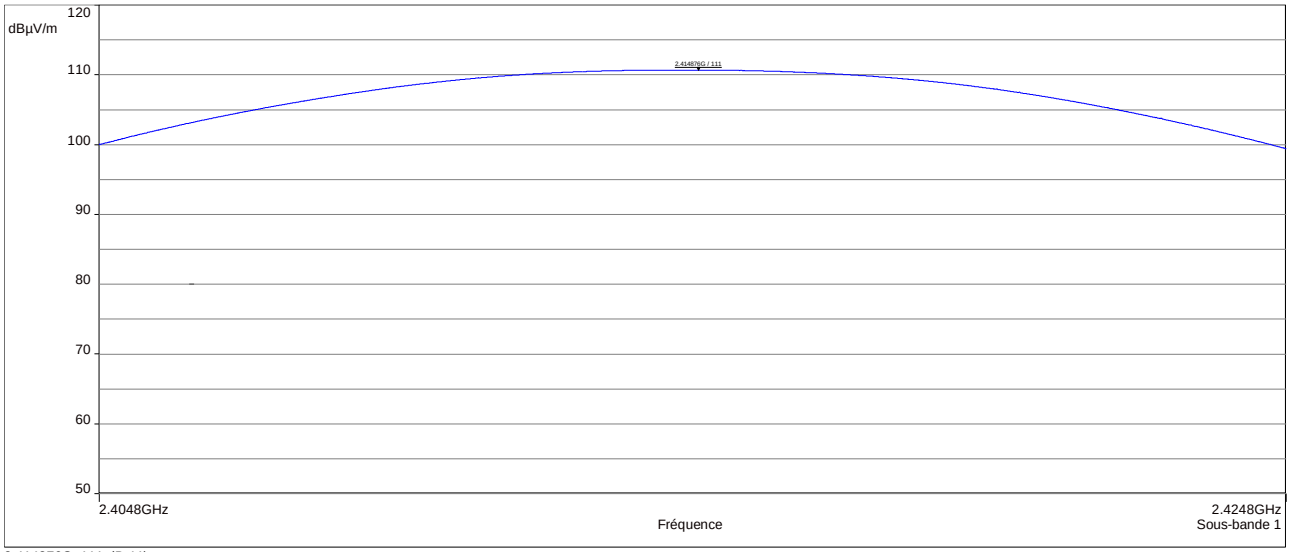
Results for LoRa 2A:

Sample N° 1 Low Channel (F = 2414.8MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted output power		Limit
		(dBm)	(W)	(W)
Nominal supply voltage: 7.27 Vdc	111	5.59	0.003624	0.631

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 99 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 10.15 dBi.



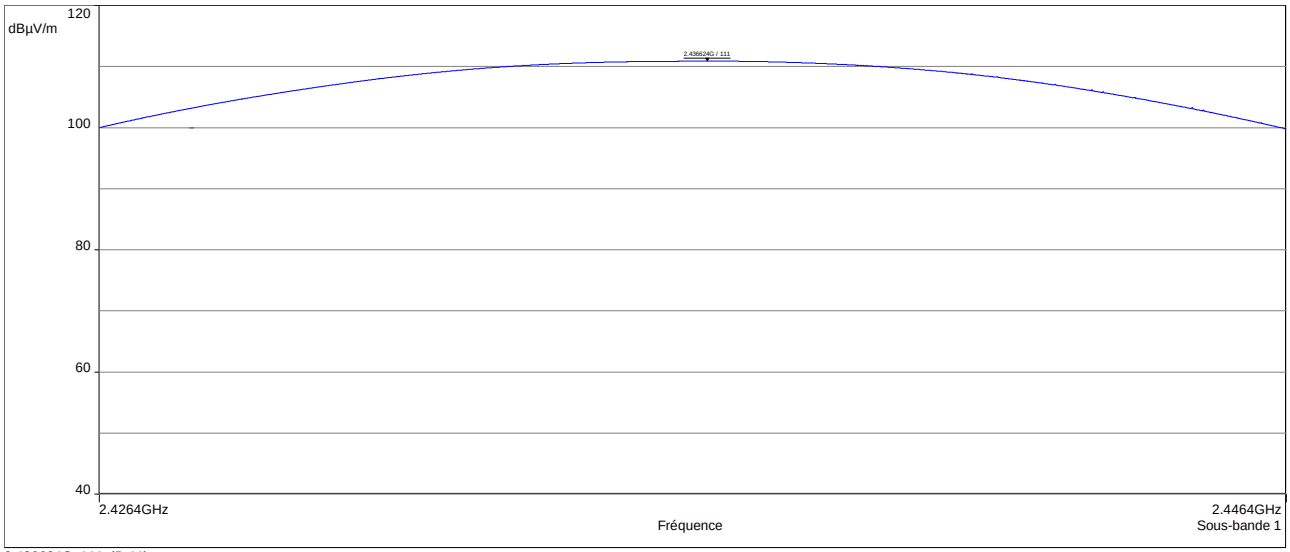
2.414876G, 111 dBµV/m :

Sample N° 1 Central Channel (F = 2436.4 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted output power		Limit
		(dBm)	(W)	(W)
Nominal supply voltage: 7.27 Vdc	111	4.91	0.003097	0.631

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 95 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 10.83 dBi.



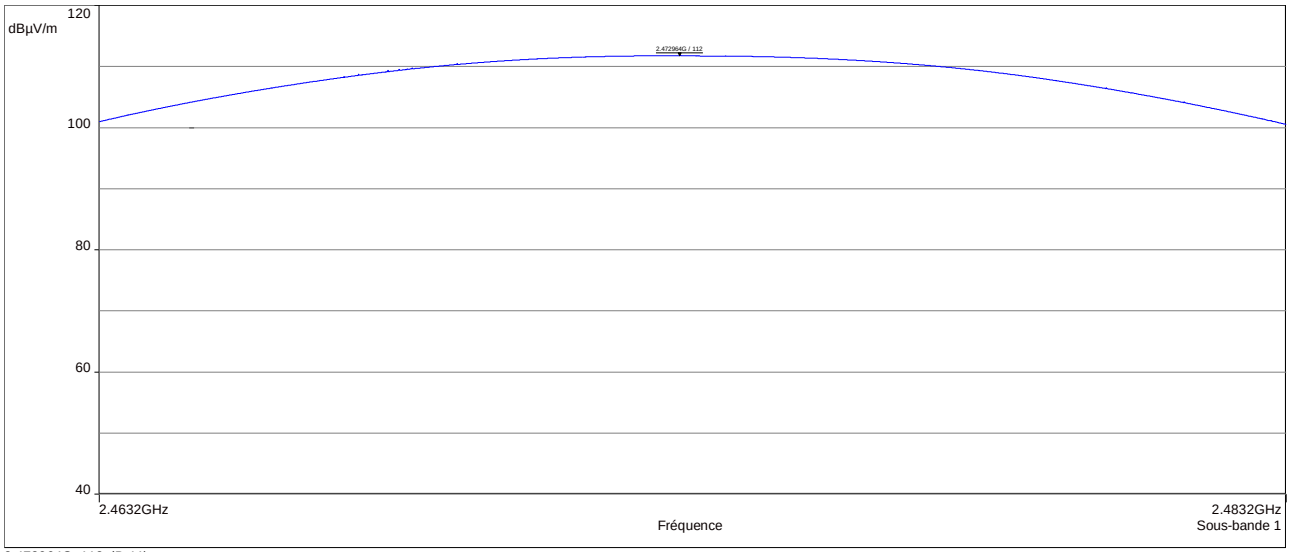
2.436624G, 111 dBµV/m :

Sample N° 1 High Channel (F = 2473.2 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted output power		Limit
		(dBm)	(W)	(W)
Nominal supply voltage: 7.27 Vdc	112	6.66	0.004634	0.631

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 97 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 10.08 dBi.



2.472964G, 112 dBµV/m :

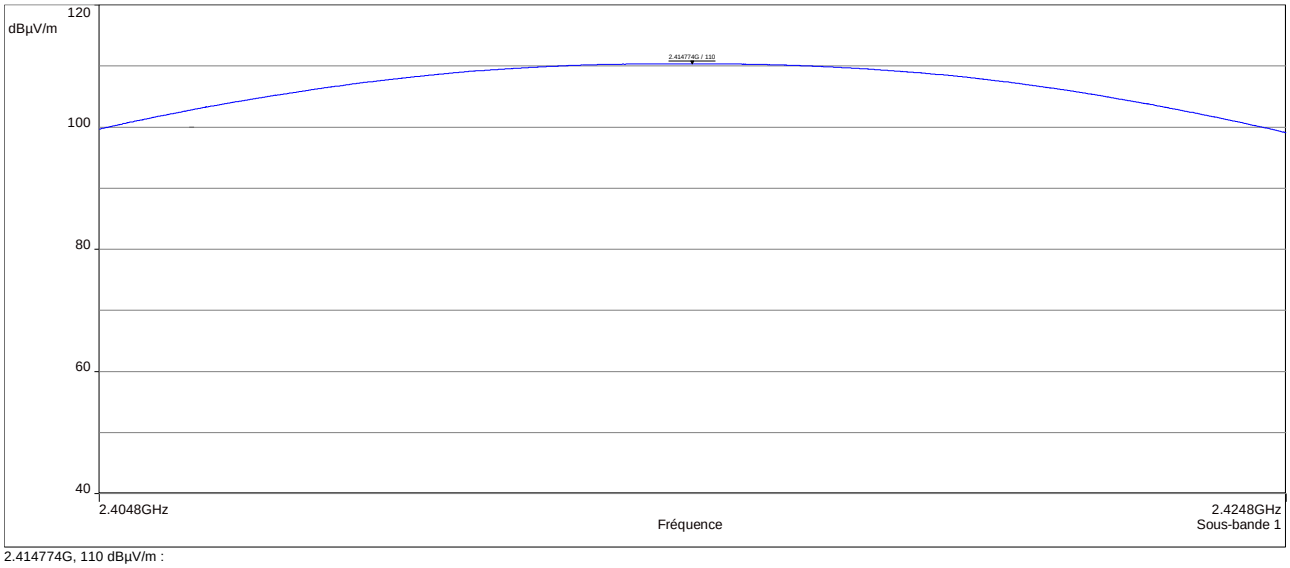
Results for LoRa 2B:

Sample N° 1 Low Channel (F = 2414.8MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted output power		Limit
		(dBm)	(W)	(W)
Nominal supply voltage: 7.27 Vdc	110	6.61	0.004581	0.631

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 234 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 8.13 dBi.



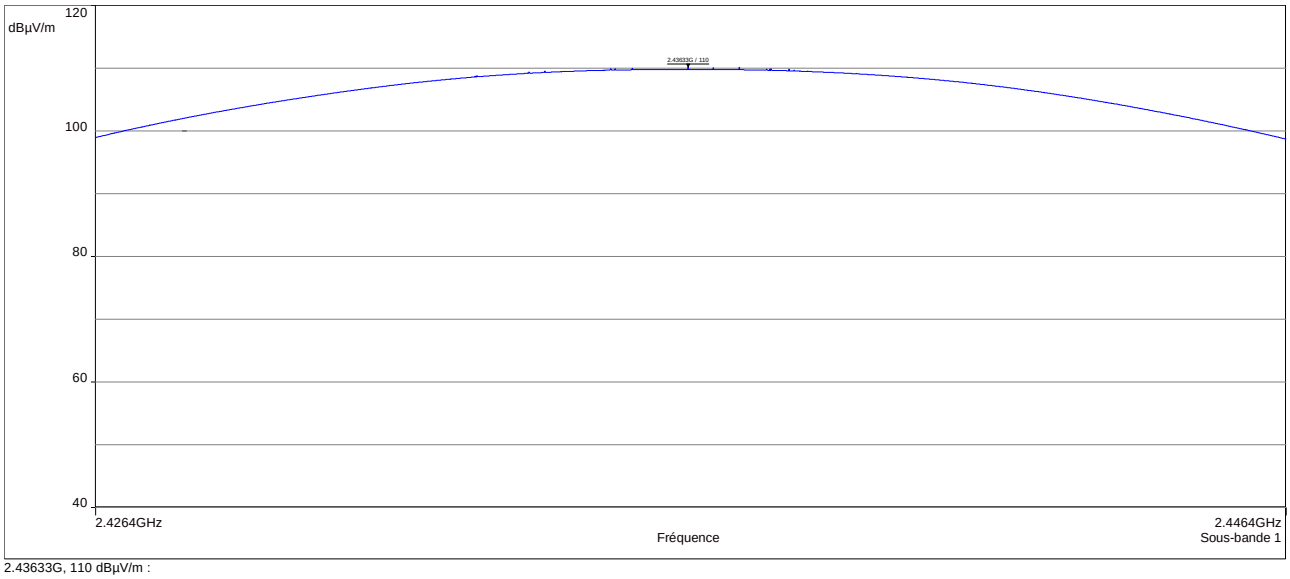
2.414774G, 110 dBµV/m :

Sample N° 1 Central Channel (F = 2436.4 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted output power		Limit
		(dBm)	(W)	(W)
Nominal supply voltage: 7.27 Vdc	110	6.18	0.004150	0.631

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 248 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 8.56 dBi.



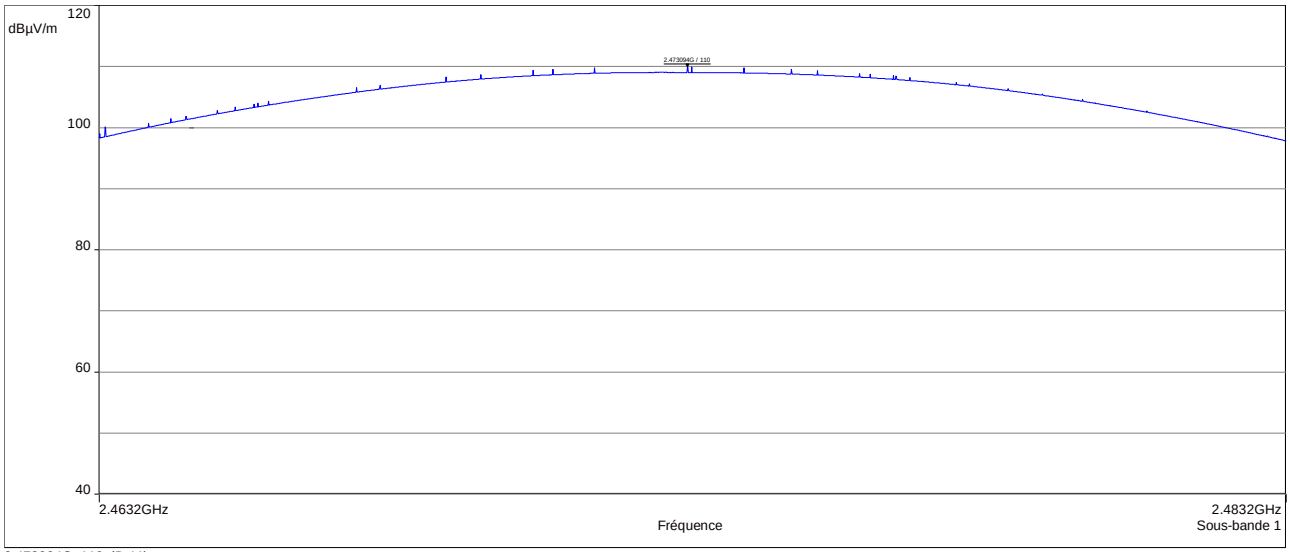
2.43633G, 110 dBµV/m :

Sample N° 1 High Channel (F = 2473.2 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted output power		Limit
		(dBm)	(W)	(W)
Nominal supply voltage: 7.27 Vdc	110	4.36	0.002729	0.631

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 258 degrees)

Maximum Peak conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 10.38 dBi.



2.473094G, 110 dBµV/m :

Test conclusion:

RESPECTED STANDARD

11. RADIATED SPURIOUS EMISSIONS

Temperature (°C) : 23 **Humidity (%HR):** 58 to 57 **Date :** September 23, 2024 and September 24, 2024

Technician : B. VOVARD

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.205, paragraph 15.209, paragraph 15.247 (d)
For RSS-247: paragraph 5.5

Emissions in non-restricted frequency bands method of paragraph 11.11 of ANSI C63.10
Emissions in restricted frequency bands method of paragraph 11.12 of ANSI C63.10

Test set up: (Refer Appendix 2)

First an exploratory radiated measurement was performed. During this phase the product is oriented in this normal position.

Then the final measurement is realized with the product on the most critical orientation.

The measure is realized on open area test site under 1 GHz and in anechoic chamber above 1 GHz.

When the system is tested in an open area test site (OATS), the EUT is placed on a rotating table, 0.8m from a ground plane.
When the system is tested in anechoic chamber, the EUT is placed on a rotating table, 1.5 m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

See test setup in appendix 2

Frequency range: From 9 kHz to 10th harmonic of the highest fundamental frequency (2473.2 MHz)

Detection mode: Quasi-peak (F < 1 GHz) Peak / Average (F > 1 GHz)

Bandwidth: 200Hz (9 kHz < F < 150kHz)
9 kHz (150 kHz < F < 30MHz)
120 kHz (30 MHz < F < 1 GHz)
100 kHz / 1 MHz (F > 1 GHz)

Distance of antenna: 10 meters (in open area test site) / 3 meters (in anechoic room)

Antenna height: 1 to 4 meters (in open area test site) / 1.5 meter (in anechoic room)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning of test (Vdc):	7.25
Voltage at the end of test (Vdc):	7.22
Percentage of voltage drop during the test (%):	0.41

Results for LoRa 2A:

Sample N° 1 Low Channel (F = 2414.8 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits (dBµV/m)	Margin (dB)
4829.6 (2)	P	250	1000	1	H	46.4 (3)	74	27.6
7244.4	P	126	100	1	V	39 (1)	92	53
9659.2	P	247	100	1	V	38.1 (1)	92	53.9
12074 (2)	P	150	1000	1	V	52.5 (3)	74	21.5
14488.8 (2)	P	150	1000	1	V	53.7 (3)	74	20.3
16903.6	P	150	100	1	H	47.6	92	44.4

P= Peak, QP=Quasi-peak, Av=Average
(1) Noise Floor
(2) Restricted bands of operation in 15.205
(2) Restricted bands of operation as defined in Table 6 of RSS-Gen
(3) The peak level is lower than the average limit (54 dBµV/m)

Sample N° 1 Central Channel (F = 2436.4 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits (dBµV/m) or (dBm)	Margin (dB)
4872.8 (2)	P	150	1000	1	V	46.7 (3)	74	27.3
7309.2 (2)	P	165	1000	1	V	48.4 (3)	74	25.6
9745.6	P	150	100	1	V	37.7 (1)	92	54.3
12182 (2)	P	150	1000	1	V	52.4 (3)	74	21.6
14618.4	P	150	100	1	V	46 (1)	92	46
17054.8	P	150	100	1	H	46 (1)	92	46

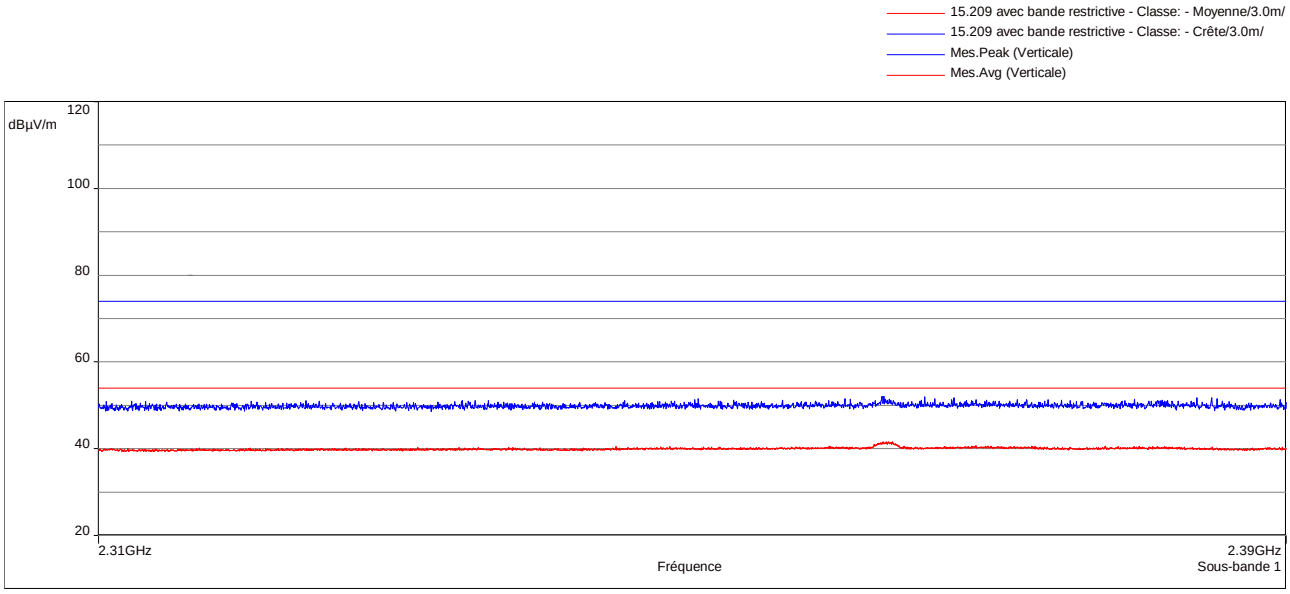
P= Peak, QP=Quasi-peak, Av=Average
(1) Noise Floor
(2) Restricted bands of operation in 15.205
(2) Restricted bands of operation as defined in Table 6 of RSS-Gen
(3) The peak level is lower than the average limit (54 dBµV/m)

Sample N° 1 High Channel (F = 2473.2 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits (dBµV/m)	Margin (dB)
4946.3 (2)	P	250	1000	1	H	46.7 (3)	74	27.3
7419.6 (2)	P	150	1000	1	V	47.9 (3)	74	26.1
9892.8	P	150	100	1	H	39.2 (1)	92	52.8
12366 (2)	P	150	1000	1	V	53.4 (3)	74	20.6
14839.2	P	150	100	1	V	49.2	92	42.8
17312.4	P	250	100	1	H	46.5	92	45.5

P= Peak, QP=Quasi-peak, Av=Average
(1) Noise Floor
(2) Restricted bands of operation in 15.205
(2) Restricted bands of operation as defined in Table 6 of RSS-Gen
(3) The peak level is lower than the average limit (54 dBµV/m)

Band edge worst case measurement (band 2.31GHz to 2.39GHz)



Applicable limits: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The highest level recorded in a 100 kHz bandwidth is 112 dBµV/m on the lowest channel.

So the applicable limit is 92 dBµV/m.

In addition, radiated emissions which fall in the restricted band, as defined in section 15.205 (a), must also comply with the radiated emission limits specified in section 15.209 (a) (see section 15.205 (c)).

In addition, radiated emissions which fall in the restricted band, as defined in Table 6 of RSS-Gen, must also comply with the radiated emission limits specified in Table 4 and Table 5 of RSS-Gen.

Results for LoRa 2B:

Sample N° 1 Low Channel (F = 2414.8 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits (dBµV/m)	Margin (dB)
4829.6 (2)	P	150	1000	1	V	46.9 (3)	74	27.1
7244.4	P	150	100	1	H	37.2 (1)	90	52.8
9659.2	P	150	100	1	V	38.6	90	51.4
12074 (2)	P	187	1000	1	H	53 (3)	74	21
14488.8 (2)	P	150	1000	1	H	53.9 (3)	74	20.1
16903.6	P	150	100	1	V	47.1 (1)	90	42.9

P= Peak, QP=Quasi-peak, Av=Average
(1) Noise Floor
(2) Restricted bands of operation in 15.205
(2) Restricted bands of operation as defined in Table 6 of RSS-Gen
(3) The peak level is lower than the average limit (54 dBµV/m)

Sample N° 1 Central Channel (F = 2436.4 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits (dBµV/m) or (dBm)	Margin (dB)
4872.8 (2)	P	171	1000	1	V	47.5 (3)	74	26.5
7309.2 (2)	P	150	1000	1	H	47.9 (3)	74	26.1
9745.6	P	100	100	1	V	37.5	90	52.5
12182 (2)	P	100	1000	1	V	52.9 (3)	74	21.1
14618.4	P	150	100	1	V	44.6 (1)	90	45.4
17054.8	P	195	100	1	V	46.6	90	43.4

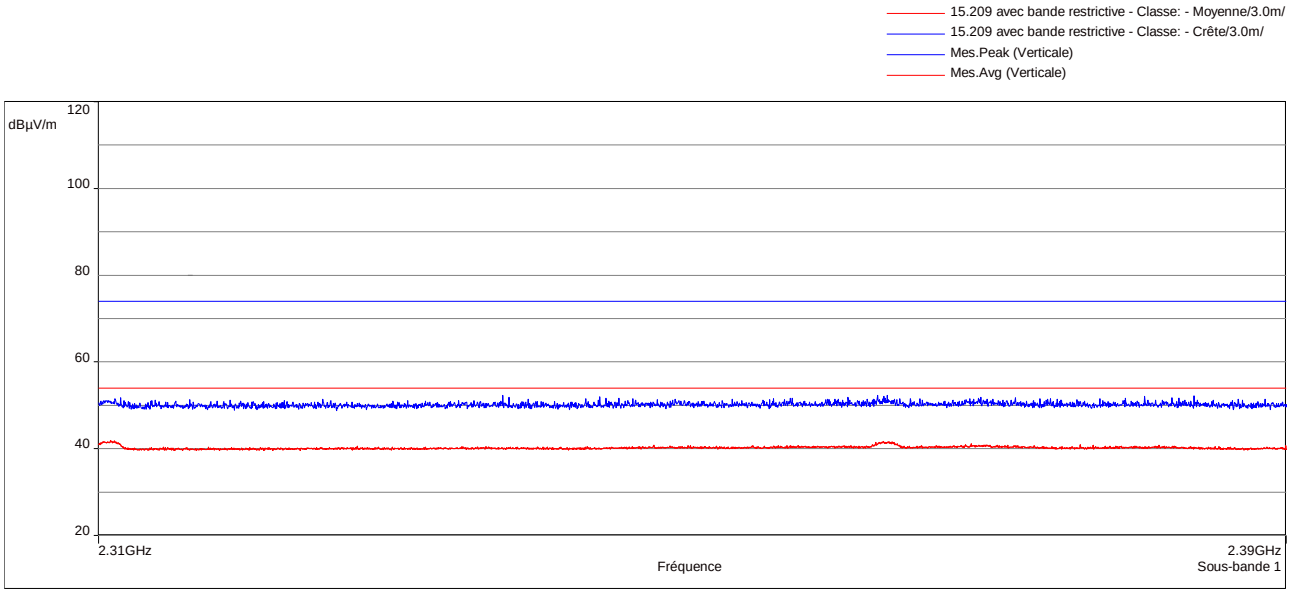
P= Peak, QP=Quasi-peak, Av=Average
(1) Noise Floor
(2) Restricted bands of operation in 15.205
(2) Restricted bands of operation as defined in Table 6 of RSS-Gen
(3) The peak level is lower than the average limit (54 dBµV/m)

Sample N° 1 High Channel (F = 2473.2 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3 m (dBµV/m)	Limits (dBµV/m)	Margin (dB)
4946.3 (2)	P	150	1000	1	H	46.2 (3)	74	27.8
7419.6 (2)	P	150	1000	1	H	47.6 (3)	74	26.4
9892.8	P	150	100	1	H	39.8	90	50.2
12366 (2)	P	150	1000	1	V	53.6 (3)	74	20.4
14839.2	P	150	100	1	H	43.9 (1)	90	46.1
17312.4	P	150	100	1	H	47.9	90	42.1

P= Peak, QP=Quasi-peak, Av=Average
(1) Noise Floor
(2) Restricted bands of operation in 15.205
(2) Restricted bands of operation as defined in Table 6 of RSS-Gen
(3) The peak level is lower than the average limit (54 dBµV/m)

Band edge worst case measurement (band 2.31GHz to 2.39GHz)



Applicable limits: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The highest level recorded in a 100 kHz bandwidth is 110 dBµV/m on the lowest channel.

So the applicable limit is 90 dBµV/m.

In addition, radiated emissions which fall in the restricted band, as defined in section 15.205 (a), must also comply with the radiated emission limits specified in section 15.209 (a) (see section 15.205 (c)).

In addition, radiated emissions which fall in the restricted band, as defined in Table 6 of RSS-Gen, must also comply with the radiated emission limits specified in Table 4 and Table 5 of RSS-Gen.

Test conclusion:

RESPECTED STANDARD

12. PEAK CONDUCTED POWER SPECTRAL DENSITY

Temperature (°C) : 23 **Humidity (%HR):** 58 to 57 **Date :** September 23, 2024 and September 24, 2024

Technician : B. VOVARD

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.247 (e), paragraph 15.247 (f)
For RSS-247: paragraph 5.2
PKPSD (Peak PSD) method of paragraph 11.10.2 of ANSI C63.10

Test set up: (Refer Appendix 2)

First an exploratory radiated measurement was performed. During this phase the product is oriented in this normal position.

Then the final measurement is realized with the product on the most critical orientation.

The system is tested in anechoic chamber, the EUT is placed on a rotating table, 1.5 m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

See test setup in appendix 2

Distance of antenna: 3 meters (in anechoic room)

Antenna height: 1.5 meter (in anechoic room)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

The measurement of the radiated electro-magnetic field is realized with an analyser.

Span:	10MHz
Resolution bandwidth:	3kHz
Video bandwidth:	10kHz
Detector:	Peak
Number of points:	Auto
Sweep time:	Auto
Trace mode:	MaxHold

Then the peak marker function is used.

Finally the radiated electro-magnetic field is converted in dBm with the following formula:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 2 dBi.

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning of test (Vdc):	7.25
Voltage at the end of test (Vdc):	7.22
Percentage of voltage drop during the test (%):	0.41

Results for LoRa 2A:

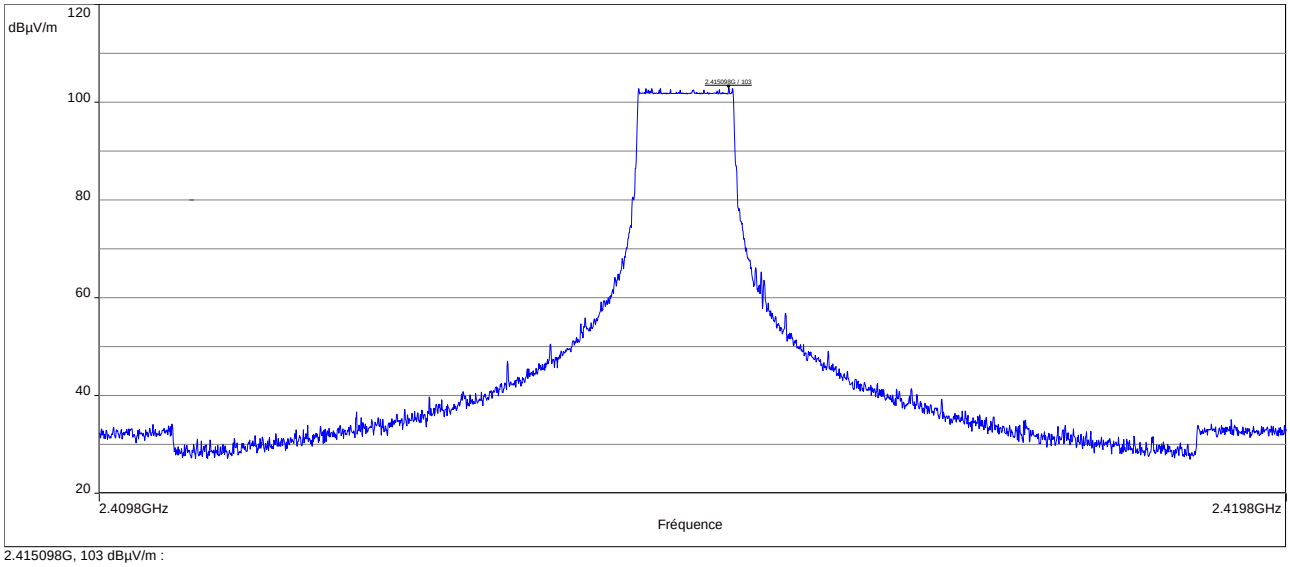
Sample N° 1 Low Channel (F = 2414.8MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 7.27 Vdc	103	-2.41	8

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 99 degrees)

Maximum Peak conducted power density:
EIRP(dBm / 3 kHz) = E (dBµV/m / 3 kHz) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 11.15 dBi.

Declared maximum antenna gain: 10.15 dBi



2.415098G, 103 dBµV/m :

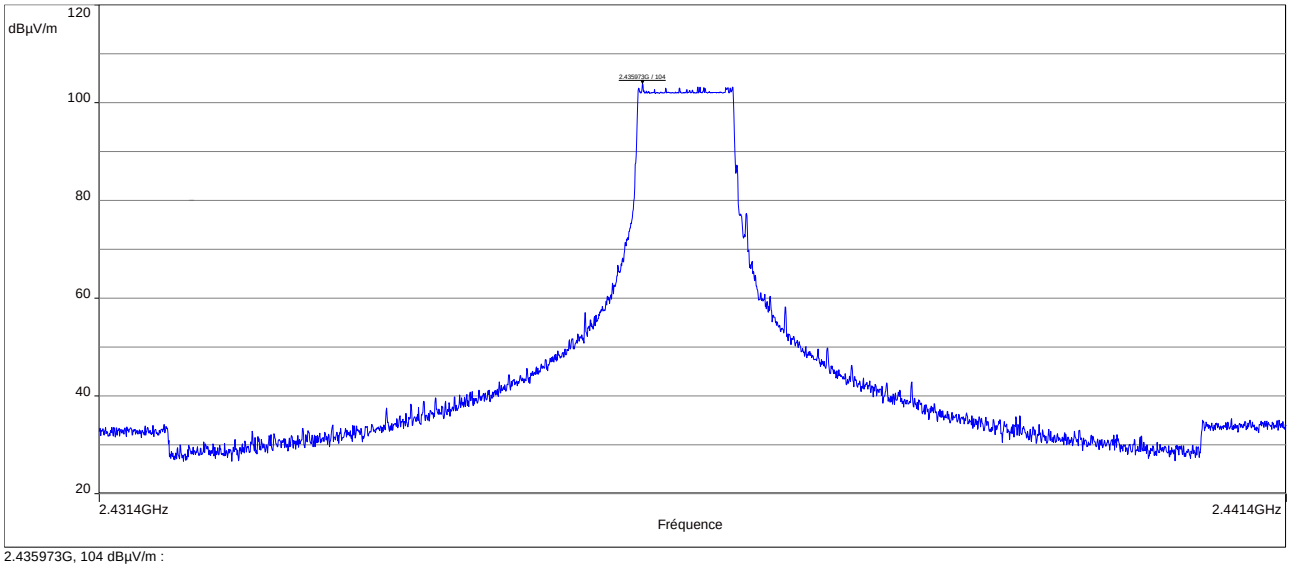
Sample N° 1 Central Channel (F = 2436.4 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 7.27 Vdc	104	-2.09	8

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 95 degrees)

Maximum Peak conducted power density:
EIRP(dBm / 3 kHz) = E (dBµV/m / 3 kHz) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 10.83 dBi.

Declared maximum antenna gain: 10.83 dBi



2.435973G, 104 dBµV/m :

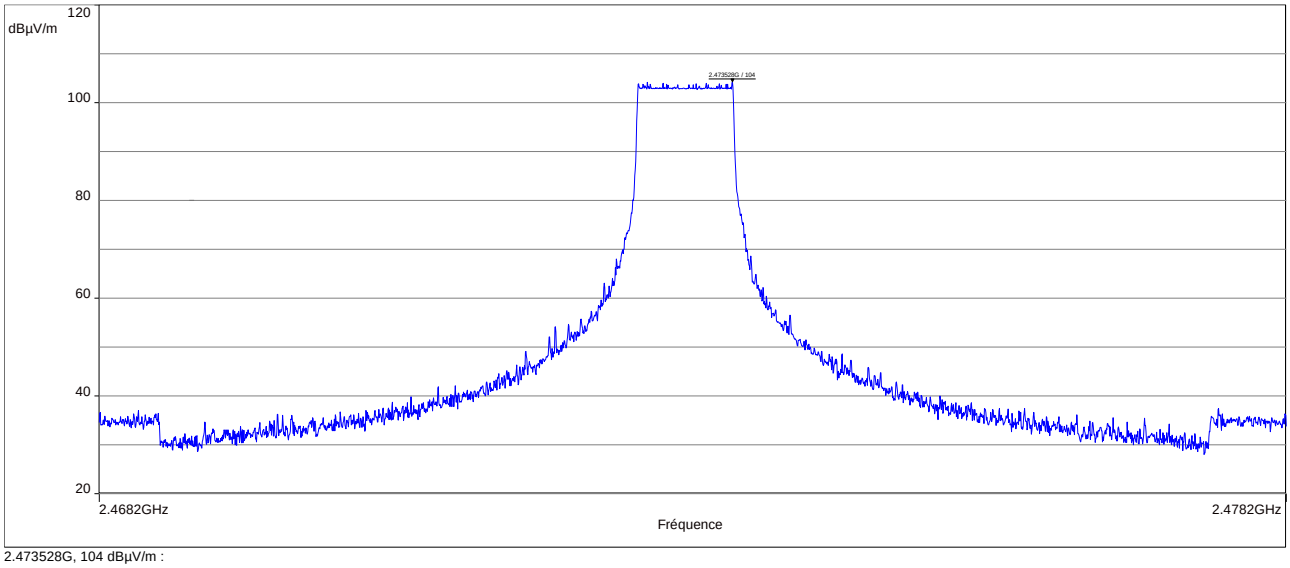
Sample N° 1 High Channel (F = 2473.2 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 7.27 Vdc	104	-1.34	8

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 97 degrees)

Maximum Peak conducted power density:
EIRP(dBm / 3 kHz) = E (dBµV/m / 3 kHz) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 10.08 dBi.

Declared maximum antenna gain: 10.08 dBi



2.473528G, 104 dBµV/m :

Results for LoRa 2B:

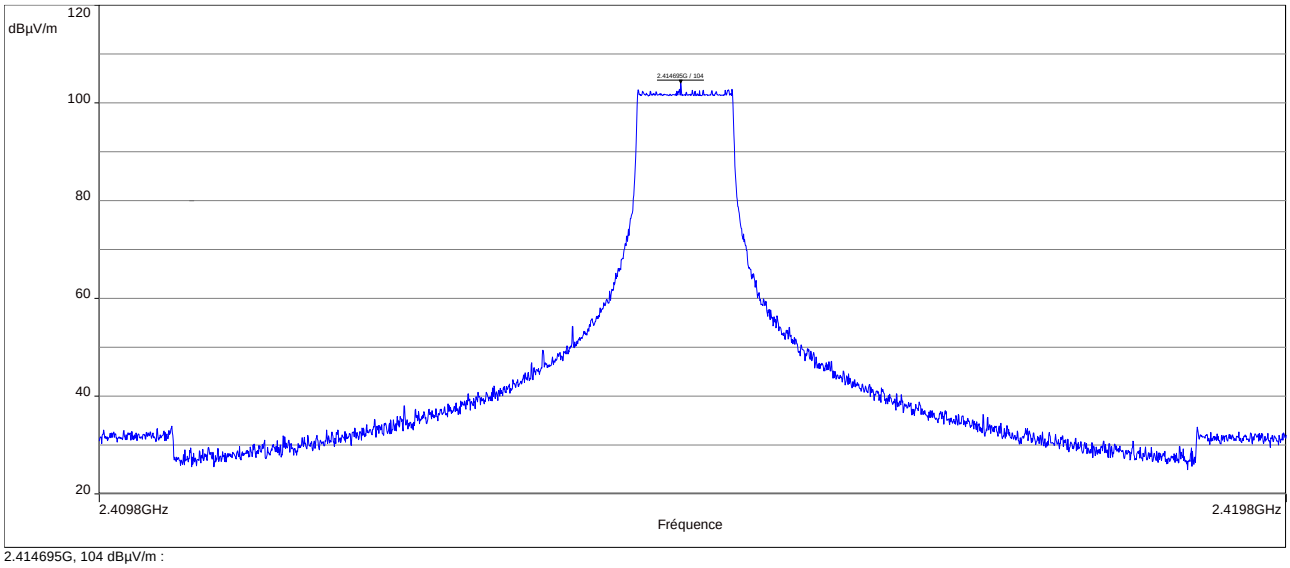
Sample N° 1 Low Channel (F = 2414.8MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 7.27 Vdc	104	0.61	8

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 234 degrees)

Maximum Peak conducted power density:
EIRP(dBm / 3 kHz) = E (dBµV/m / 3 kHz) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 8.13 dBi.

Declared maximum antenna gain: 8.13 dBi



2.414695G, 104 dBµV/m :

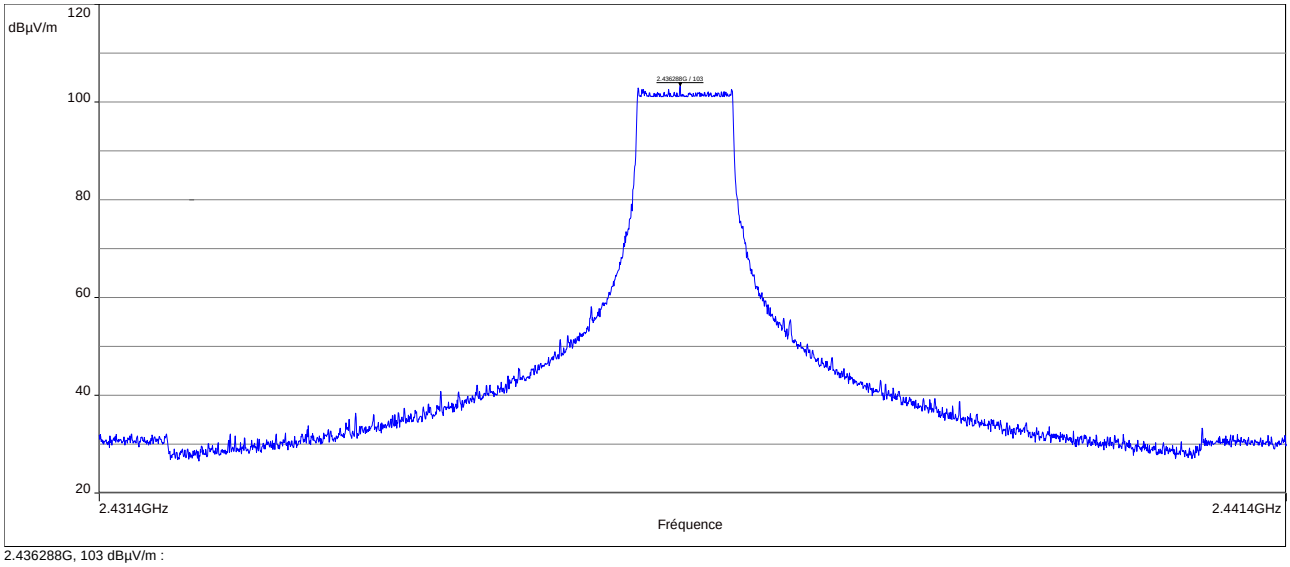
Sample N° 1 Central Channel (F = 2436.4 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 7.27 Vdc	103	-0.82	8

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 248 degrees)

Maximum Peak conducted power density:
EIRP(dBm / 3 kHz) = E (dBµV/m / 3 kHz) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 8.56 dBi.

Declared maximum antenna gain: 8.56 dBi



2.436288G, 103 dBµV/m :

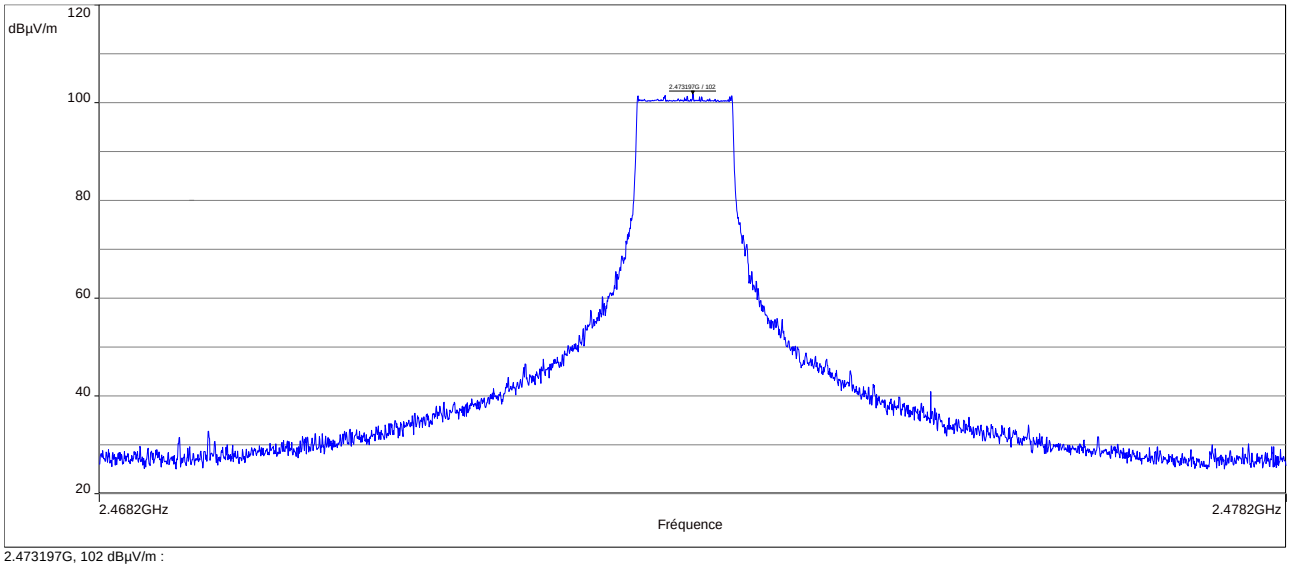
Sample N° 1 High Channel (F = 2473.2 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 7.27 Vdc	102	-3.64	8

Polarization of test antenna: vertical (height: 150 cm)
Position of equipment: Position 1 - (azimuth: 258 degrees)

Maximum Peak conducted power density:
EIRP(dBm / 3 kHz) = E (dBµV/m / 3 kHz) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 10.38 dBi.

Declared maximum antenna gain: 10.38 dBi



2.473197G, 102 dBµV/m :

Test conclusion:

RESPECTED STANDARD

□□□ End of report, 2 appendixes to be forwarded □□□

APPENDIX 1: Test equipment list

Occupied bandwidth

TYPE	MANUFACTURER	EMITECH NUMBER
Full anechoic chamber	EMITECH	10759
Turntable and mat controller NCD	MATURO	10789
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Antenna 3117	ETS-Lindgren	10771
Attenuator 10dB	Midwest Microwave	8548
N-1M Cable	SUCOFLEX	9399
N-2M Cable	SUCOFLEX	14303
N-5M Cable	HYTEM	19246
N-2.5M Cable	HYTEM	19249
Multimeter 177	Fluke	14903
Meteo station 608-H1	Testo	7566
Software	RS Commander V2.4.2	//

Band edge

TYPE	MANUFACTURER	EMITECH NUMBER
Full anechoic chamber	EMITECH	10759
Turntable and mat controller NCD	MATURO	10789
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Antenna 3117	ETS-Lindgren	10771
Attenuator 10dB	Midwest Microwave	8548
N-1M Cable	SUCOFLEX	9399
N-2M Cable	SUCOFLEX	14303
N-5M Cable	HYTEM	19246
N-2.5M Cable	HYTEM	19249
Multimeter 177	Fluke	14903
Meteo station 608-H1	Testo	7566
Software	BAT-EMC V3.18.0.26	0000

Peak conducted output power

TYPE	MANUFACTURER	EMITECH NUMBER
Full anechoic chamber	EMITECH	10759
Turntable and mat controller NCD	MATURO	10789
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Antenna 3117	ETS-Lindgren	10771
Low-noise amplifier S005180M3201	LUCIX Corp.	12590
Attenuator 10dB	Midwest Microwave	8548
N-1M Cable	SUCOFLEX	9399
N-2M Cable	SUCOFLEX	14303
N-5M Cable	HYTEM	19246
N-2.5M Cable	HYTEM	19249
Multimeter 177	Fluke	14903
Meteo station 608-H1	Testo	7566
Software	BAT-EMC V3.18.0.26	0000

Radiated spurious emissions

TYPE	MANUFACTURER	EMITECH NUMBER
Open test site	EMITECH	8732
Turntable and mat controller	EMITECH	8855
Full anechoic chamber	EMITECH	10759
Turntable and mat controller NCD	MATURO	10789
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Test receiver ESW44	Rohde & Schwarz	17008
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Loop antenna 6502	EMCO	1406
Biconical antenna VHA 9103	Schwarzbeck	8528
Biconical antenna 3110	Emco	7240
Log periodic antenna HL223	Rohde & Schwarz	7171
Log periodic antenna HL223	Rohde & Schwarz	7190
Antenna 3117	ETS-Lindgren	10771
Antenna SAS-572	A.H Systems	7124
Low-noise amplifier ASC805C	ASC	19274
Low-noise amplifier S005180M3201	LUCIX Corp.	12590
Low-noise amplifier BLNA317202120S	QOTANA	19154
Attenuator 6dB	Radiall	19266
Attenuator 6dB	Radiall	19267
N-1.5M Cable	SUCOFLEX	7279
N-1.5M Cable	EMITECH	8813
N-1.5M Cable	GYL	8785
N-1M Cable	SUCOFLEX	9399
N-2M Cable	SUCOFLEX	14303
N-5M Cable	HYTEM	19246
N-2.5M Cable	HYTEM	19249
Cable k-20cm	STORM MICROWAE	8974
Cable k-100cm	MecHANC	18418
Low pass filter LP03/1000-7GH	Filtek	4087
Reject band filter BRM50702	Microtronics	7299
High pass filter HPF180400	C&C	16109
Meteo station 608-H1	Testo	7566
Multimeter 177	Fluke	14903
Software	BAT-EMC V3.18.0.26	0000
Software	Champ libre Juigné. V3.5	8864

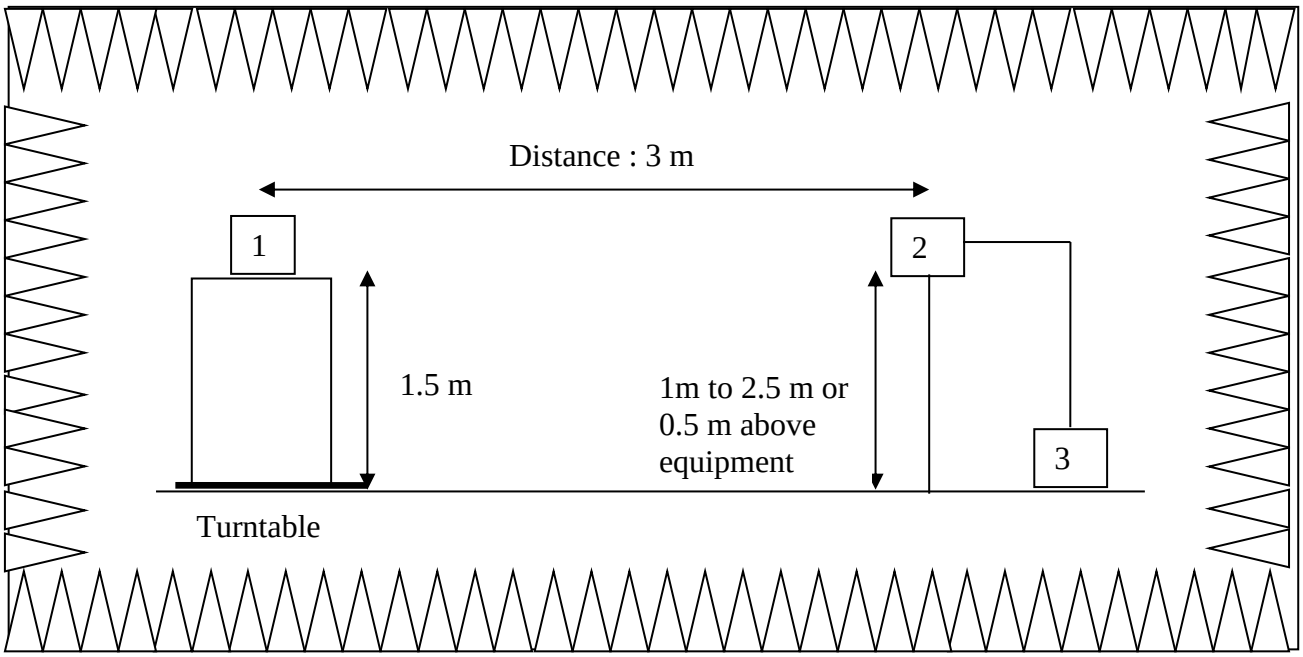
Peak conducted power spectral density

TYPE	MANUFACTURER	EMITECH NUMBER
Full anechoic chamber	EMITECH	10759
Turntable and mat controller NCD	MATURO	10789
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Antenna 3117	ETS-Lindgren	10771
Attenuator 10dB	Midwest Microwave	8548
N-1M Cable	SUCOFLEX	9399
N-2M Cable	SUCOFLEX	14303
N-5M Cable	HYTEM	19246
N-2.5M Cable	HYTEM	19249
Multimeter 177	Fluke	14903
Meteo station 608-H1	Testo	7566
Software	BAT-EMC V3.18.0.26	0000

APPENDIX 2: Radiated Test Setup

Anechoic chamber setup

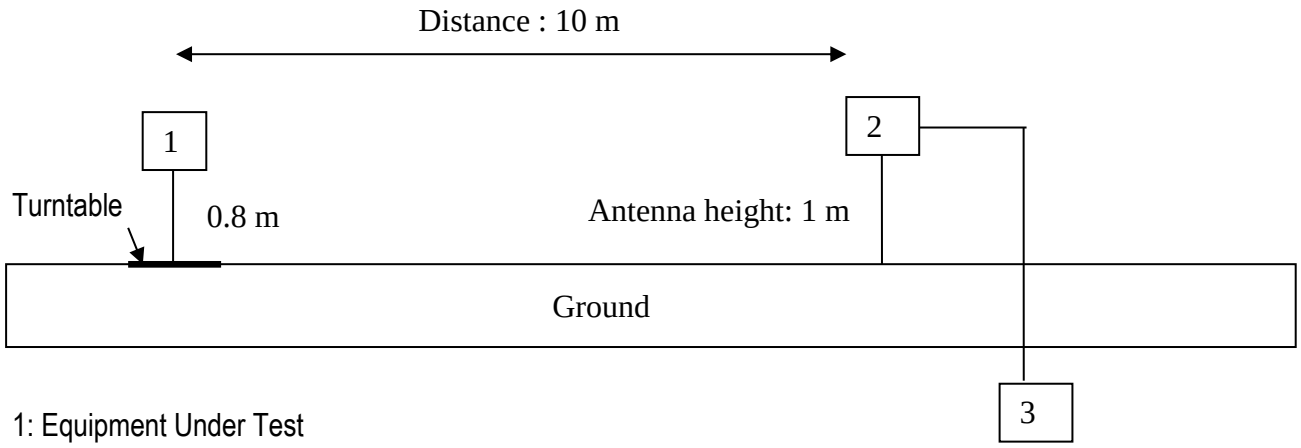
Above 1 GHz



1: Equipment Under Test
2: Measurement antenna
3: Measurement equipment

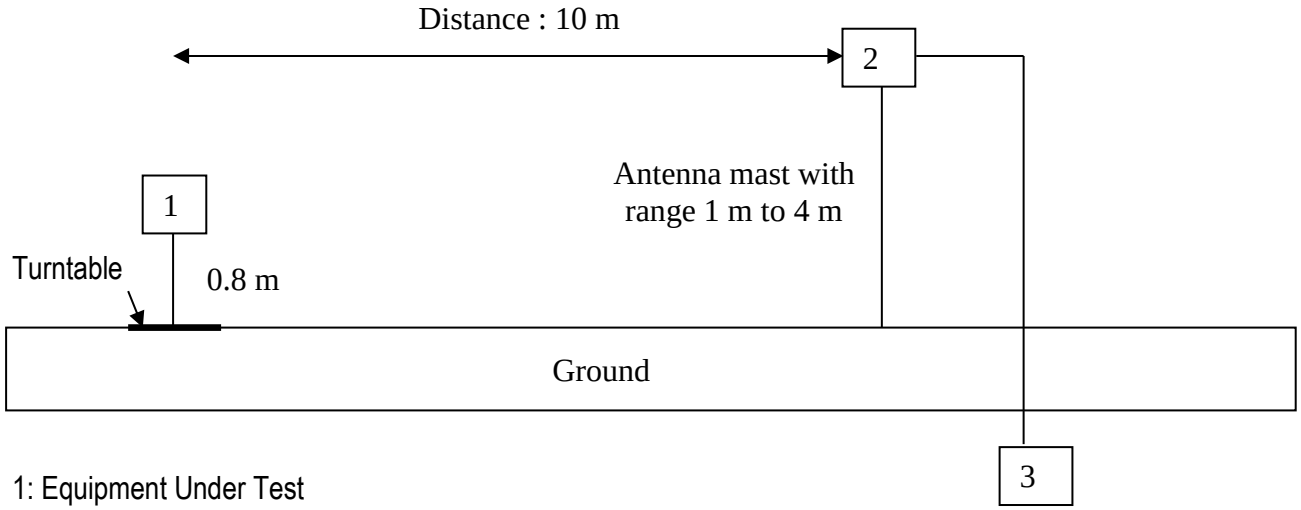
Open area setup

Below 30 MHz



1: Equipment Under Test
2: Measurement antenna
3: Measurement equipment

Between 30 MHz and 1 GHz



1: Equipment Under Test
2: Measurement antenna
3: Measurement equipment