

RRA-EMIESS23E444DAV-06Av0

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 REMOTE BLASTER

FCC ID: 2AUQC-DT5GRB
IC NUMBER: 25586-DT5GRB

Company:

DAVEY BICKFORD

Distribution: Mrs STOJANOVIC

(Company: DAVEY BICKFORD)

Number of pages: 42 with 2 annexes

Ed.	Date	Modified Page(s)	Technical Verification and Quality Approval	
			Name and Function	Visa
0	18-Apr-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

DESIGNATION OF PRODUCT: *DAVEY TRONIC 5 REMOTE BLASTER*

Serial number (S/N): 9203

Reference / model (P/N): *RB*

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: From 27-Sep-23 to 10-Oct-23

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

A handwritten signature in black ink, appearing to read "B. Vovard", with a long horizontal stroke extending to the right.

CONTENTS

TITLE	PAGE
1. INTRODUCTION	4
2. PRODUCT DESCRIPTION	4
3. NORMATIVE REFERENCE	5
4. TEST METHODOLOGY	6
5. TEST EQUIPMENT CALIBRATION DATES	7
6. TESTS RESULTS SUMMARY	9
7. MEASUREMENT UNCERTAINTY	11
8. AC CONDUCTED EMISSIONS.....	12
9. OCCUPIED BANDWIDTH	15
10. BAND EDGE	22
11. PEAK CONDUCTED OUTPUT POWER	25
12. RADIATED SPURIOUS EMISSIONS	27
13. PEAK CONDUCTED POWER SPECTRAL DENSITY	32
APPENDIX 1: TEST EQUIPMENT LIST	37
APPENDIX 2: RADIATED TEST SETUP	41

REVISIONS HISTORY

Revision	Date	Modified pages	Modifications
0	27-Oct-23	/	Creation

1. INTRODUCTION

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

The equipment under test integrates:

- LoRa 2.4 GHz transceiver radio module not already certified,
- RFID Reader not already certified,
- GNSS module operational in the band 1559MHz – 1610MHz

This report concerns only LoRa 2.4 GHz Radio part.

2. PRODUCT DESCRIPTION

Category of equipment (ISED):	I
Class:	A
Utilization:	Industrial
Antenna type and gain:	External antenna 2 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
Power source:	Rechargeable Internal battery 7.4Vdc 4200mAh AC/DC adapter (120Vac 60Hz / 19Vdc)

The radio is operational during charge mode.

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 (2023) Radio Frequency Devices

ANSI C63.10 2013
Procedures for Compliance Testing 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 207: Conducted limits
- 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	Calibration interval (years)	Next calibration due
0	BAT-EMC V3.18.0.26	Software	/	/	/
1406	EMCO 6502	Loop antenna	11/04/2023	1	10/04/2024
4087	Filtek LP03/1000-7GH	Low Pass Filter	07/02/2023	3	06/02/2026
4088	R&S FSP40	Spectrum Analyzer	13/05/2022	2	12/05/2024
4353	ATM WR28	Antenna	02/08/2022	3	01/08/2025
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	20/05/2022	2	19/05/2024
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
8508	California instruments 1251RP	Power source	(1)	(1)	(1)
8528	Schwarzbeck VHA 9103	Biconical antenna	19/05/2022	3	18/05/2025
8535	EMCO 3115	Antenna	13/04/2023	3	12/04/2026
8548	Midwest Microwave 10dB	Attenuator	08/02/2023	3	07/02/2026
8590	RG214 N-5m	Cable	23/02/2022	2	23/02/2024
8593	SIDT Cage 2	Anechoic chamber	31/03/2022	3	30/03/2025
8719	Thurbly Thandar Instruments 1600	LISN	24/02/2022	2	24/02/2024
8732	Emitech	OATS	28/03/2022	3	27/03/2025
8750	La Crosse Technology WS-9232	Meteo station	24/10/2022	1	24/10/2023
8855	EMITECH	Turntable and mat controller	/	/	/
8864	Champ libre Juigné. V3.5	Software	/	/	/

(1) The equipment is not verified; instead, the output voltage is checked before each measurement with the calibrated multimeter.

Emitech Number	Model	Type	Last calibration	Calibration interval (years)	Next calibration due
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
8974	STORM MICROWAE k-20cm	cable	09/12/2021	2	09/12/2023
9398	N-1.5m	cable	22/07/2022	2	21/07/2024
10523	EMITECH	Absorber sheath current	24/02/2022	2	24/02/2024
10730	Mini-circuit ZFL-1000LN	Low-noise amplifier	30/11/2022	1	30/11/2023
10759	COMTEST Cage 3	Anechoic chamber	/	/	/
10771	EMCO 3117	Antenna	30/11/2022	3	30/11/2025
10788	Emitech	Outside room Hors cage	/	/	/
10789	MATURO	Turntable and mat controller NCD	/	/	/
11535	R&S EZ-25	High pass filter	02/01/2023	3	01/01/2026
12590	LUCIX Corp S005180M3201	Low-noise amplifier	21/06/2023	1	20/06/2024
12911	Huber + Suhner N-2m	cable	20/05/2022	2	19/05/2024
14303	SUCOFLEX N-2m	cable	01/12/2022	2	30/11/2024
14475	Oregon Scientific BAR206	Meteo station	11/04/2023	1	10/04/2024
14736	MATURO	Turntable and mat controller MCU	/	/	/
14903	Fluke 177	Multimeter	01/02/2022	2	01/02/2024
15666	R&S FSV40	Spectrum Analyzer	27/09/2022	2	26/09/2024
15812	COMP-POWER PAM-118A	Low-noise amplifier 18GHz	21/06/2023	1	20/06/2024
15883	SUCOFLEX	cable N 5m	08/02/2023	2	07/02/2025
15913	SUCOFLEX SF104 N 2.5m	Cable	01/12/2022	2	30/11/2024
16109	C&C HPF180400	High pass filter	11/08/2022	3	10/08/2025
17008	R&S ESW44	Test receiver	08/02/2023	1	08/02/2024
18413	MechANC - N - 5m	Cable	15/02/2022	2	15/02/2024
18418	MechANC - Type K - 1m	Cable	02/03/2022	2	01/03/2024
19154	QOTANA DBLNA317202120S	Low-noise amplifier 18-26GHz	14/09/2023	1	13/09/2024
//	RS Commander V2.4.2	Software	/	/	/

6. TESTS RESULTS SUMMARY

6.1 CFR 47 part 15 requirements

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				
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				Note 2
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 3
	(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 4
	(b) Maximum peak output power	X				
	(c) Operation with directional antenna gains > 6 dBi			X		
	(d) Intentional radiator	X				Note 5
	(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: Professionally installed equipment.

Note 2: See FCC part 15.247 (d).

Note 3: See FCC part 15.209. Unwanted emissions levels are all below the fundamental emission field strength level.

Note 4: The minimum 6 dB bandwidth of the equipment is 943.12 kHz for LoRa Modulation.

Note 5: We used the radiated method in anechoic room.

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
§ 8.9	Transmitter emission limits	X				
§ 8.10	Restricted frequency bands	X				
§ 8.11	Frequency stability			X		

NAp: Not Applicable

NAs: Not Asked

Note : the conducted emissions shall be performed in the final product.

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 943.12 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	$\pm 0.8\text{dB}$
Radiated emission valid to 26 GHz	
9kHz – 30MHz	$\pm 2.7. \text{ dB}$
30MHz – 1GHz	$\pm 5.0 \text{ dB}$
1GHz – 18GHz	$\pm 5.3 \text{ dB}$
18GHz – 40GHz	$\pm 6.1 \text{ dB}$
AC Power Lines conducted emissions	$\pm 3.4 \text{ dB}$
Temperature	$\pm 1 \text{ }^{\circ}\text{C}$
Humidity	$\pm 5 \%$

8. AC CONDUCTED EMISSIONS

Temperature (°C) : 25

Humidity (%HR): 50

Date : October 10, 2023

Technician : B. VOVARD

Standard: FCC Part 15
RSS-Gen

Test procedure:

For FCC Part 15: Paragraph 15.207

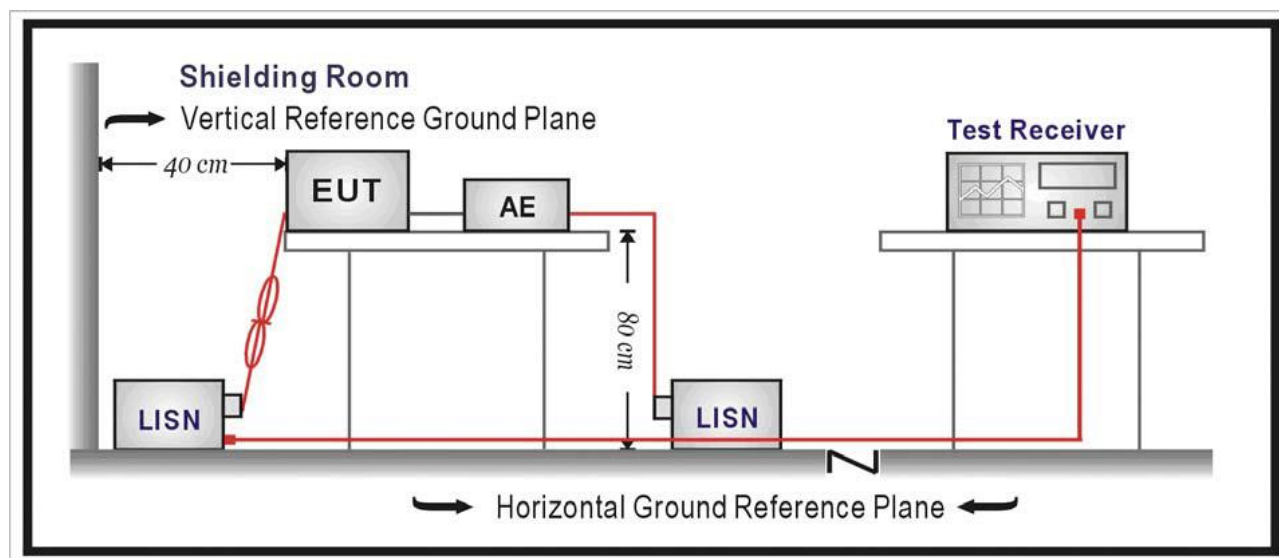
For RSS-Gen: Paragraph 8.8

Method of paragraph 6.2 of ANSI C63.10

Software used: BAT-EMC V3.18.0.26

Test set up:

The EUT is isolated and placed on a wooden table, 0.8 m over an horizontal reference plane and 0.4 m from a vertical reference plane. It is powered by an artificial main network placed on the ground reference plane. The equipment is powered with the AC power operating voltage of 120 V / 60 Hz.



Frequency range: 150 kHz - 30 MHz

Detection mode: Peak / Quasi-peak / Average

Bandwidth: 10 kHz / 9 kHz

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.

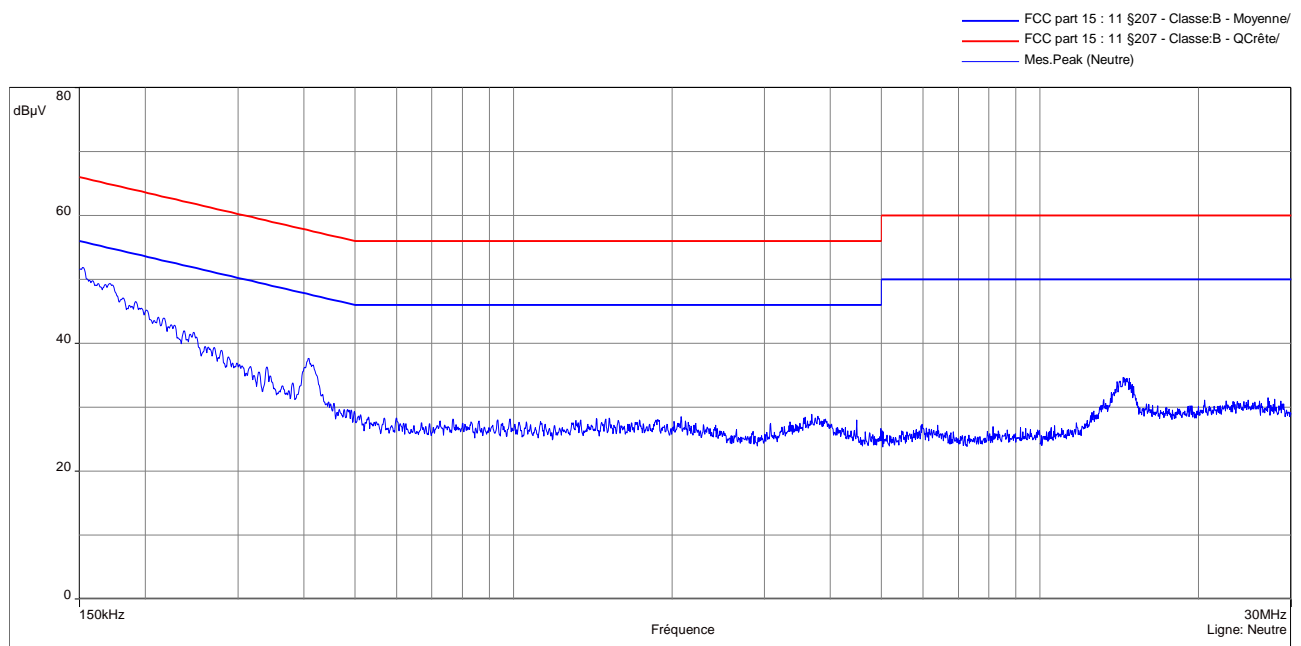
Results:

Sample N° 1:

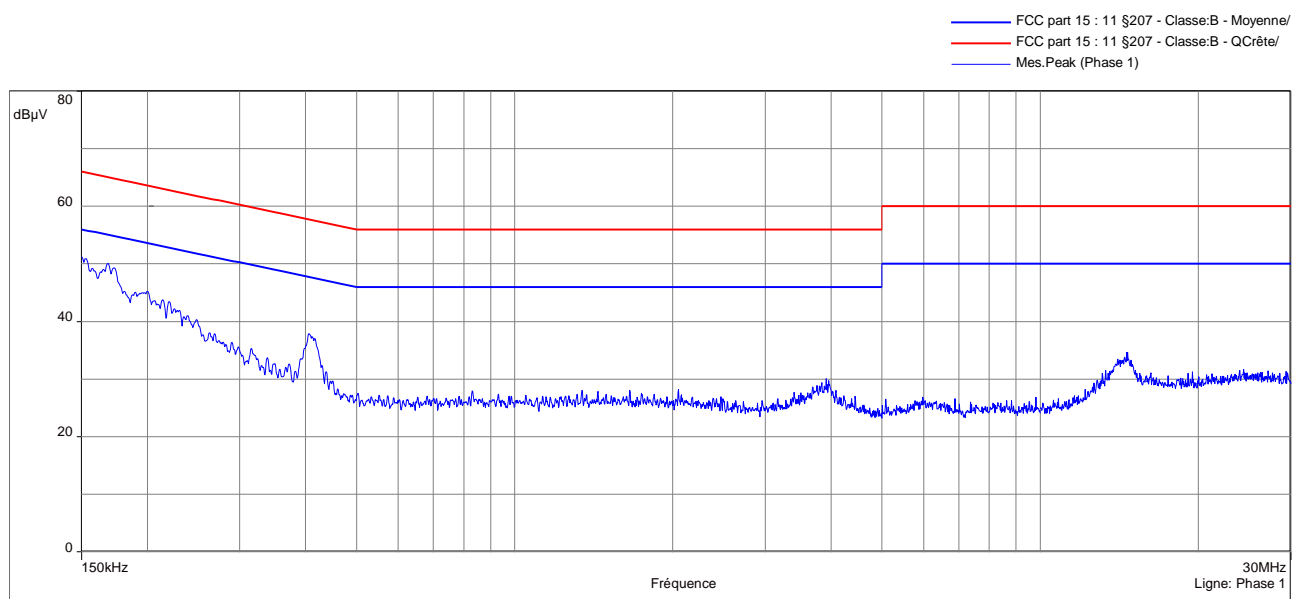
Measurement on the mains power supply:

The measurement is first realized with peak detector.

Curve N° 1: measurement on the Neutral with peak detector



Curve N° 2: measurement on the Line with peak detector



The highest frequencies are then analyzed with Quasi-peak detector and Average detector

Table N° 1: measurement on the Neutral, for the frequency range:

Frequency (MHz)	Quasi-peak (dBμV)	QP Limit (dBμV)	QP margin (dB)
0.152	42.66	65.87	23.21
0.171	42.5	64.90	22.40
0.192	39.86	63.95	24.09
0.217	36.36	62.94	26.58
0.397	28.1	57.92	29.82
0.409	33.6	57.68	24.08
14.016	25.82	60	34.18
14.39	26.53	60	33.47

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average margin (dB)
0.152	24.97	55.87	30.90
0.171	29.37	54.90	25.53
0.192	22.33	53.95	31.62
0.217	20.36	52.94	32.58
0.397	20.29	47.92	27.63
0.409	27.45	47.68	20.23
14.016	18.63	50	31.37
14.39	18.73	50	31.27

Table N° 2: measurement on the Line, for the frequency range:

Frequency (MHz)	Quasi-peak (dBμV)	QP Limit (dBμV)	QP margin (dB)
0.153	42.55	65.84	23.29
0.168	43.57	65.04	21.47
0.2	36.57	63.60	27.03
0.249	30.34	61.78	31.44
0.397	28.61	57.92	29.31
0.406	33.78	57.73	23.95
0.424	28.30	57.38	29.08
14.614	25.70	60	34.30

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average margin (dB)
0.153	23.92	55.84	31.92
0.168	27.23	55.04	27.81
0.2	19.67	53.60	33.93
0.249	15.59	51.78	36.19
0.397	20.79	47.92	27.13
0.406	27.19	47.73	20.54
0.424	20.48	47.38	26.9
14.614	18.04	50	31.96

Test conclusion:

RESPECTED STANDARD

9. OCCUPIED BANDWIDTH**Temperature (°C) :** 22**Humidity (%HR):** 42**Date :** October 5, 2023**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.

Power source: 120 Vac 60 Hz by an external power supply

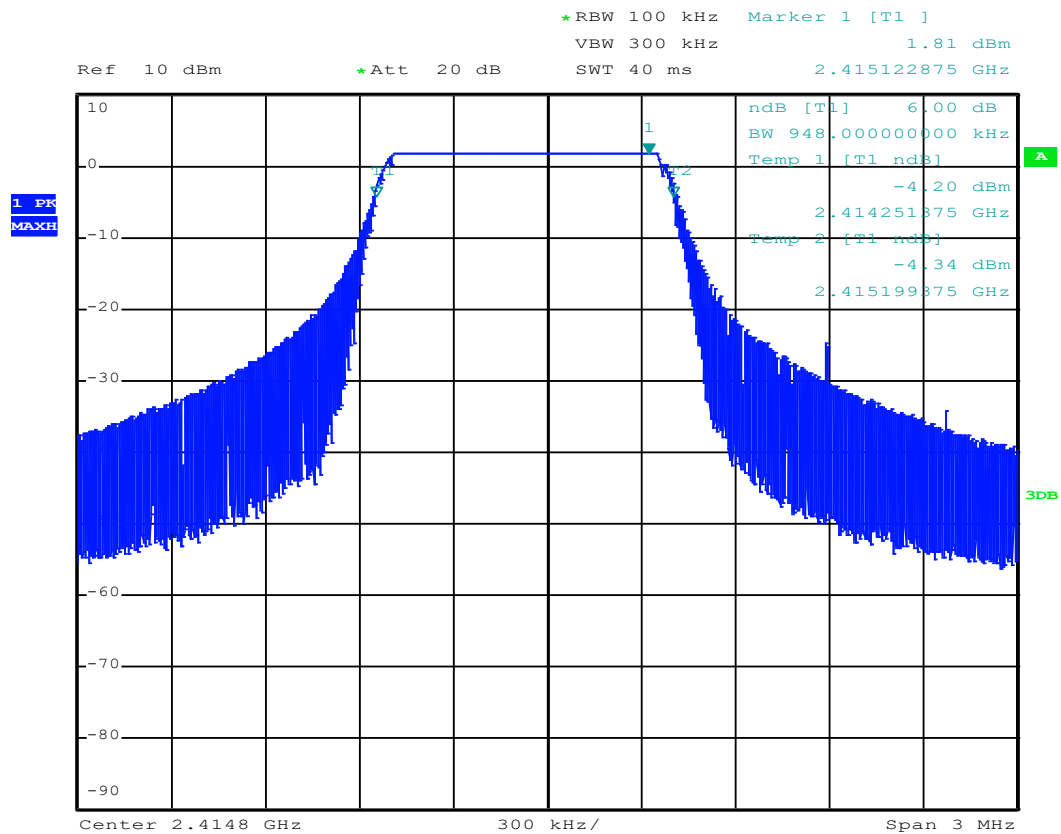
Percentage of voltage variation during the test (%):

 ± 1

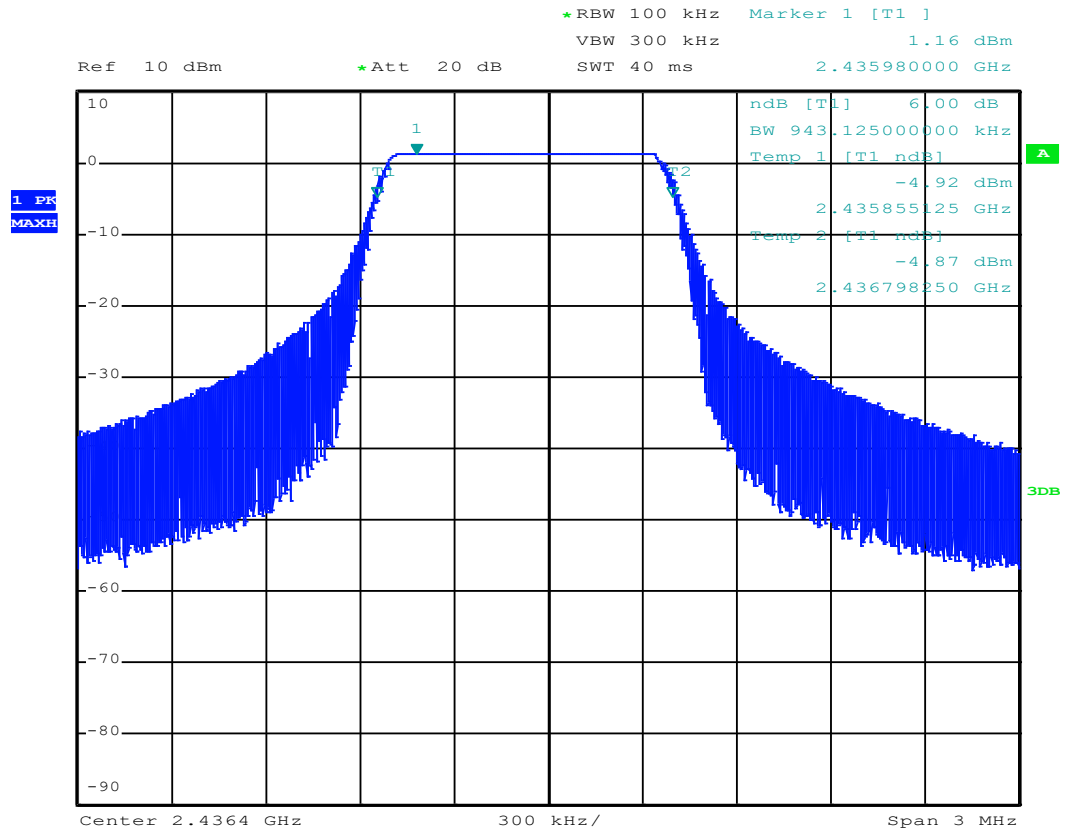
Results:

Sample N° 1

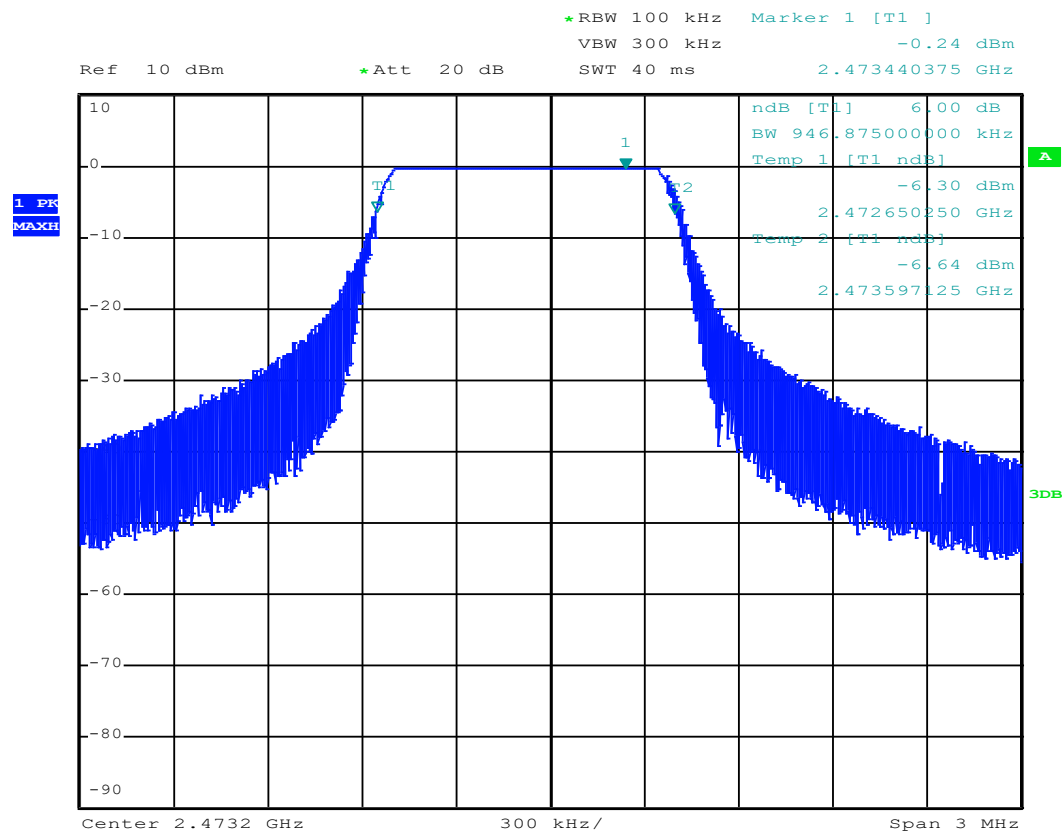
6dB bandwidth – Low Channel 2414.8 MHz



6dB bandwidth – Central Channel 2436.4 MHz



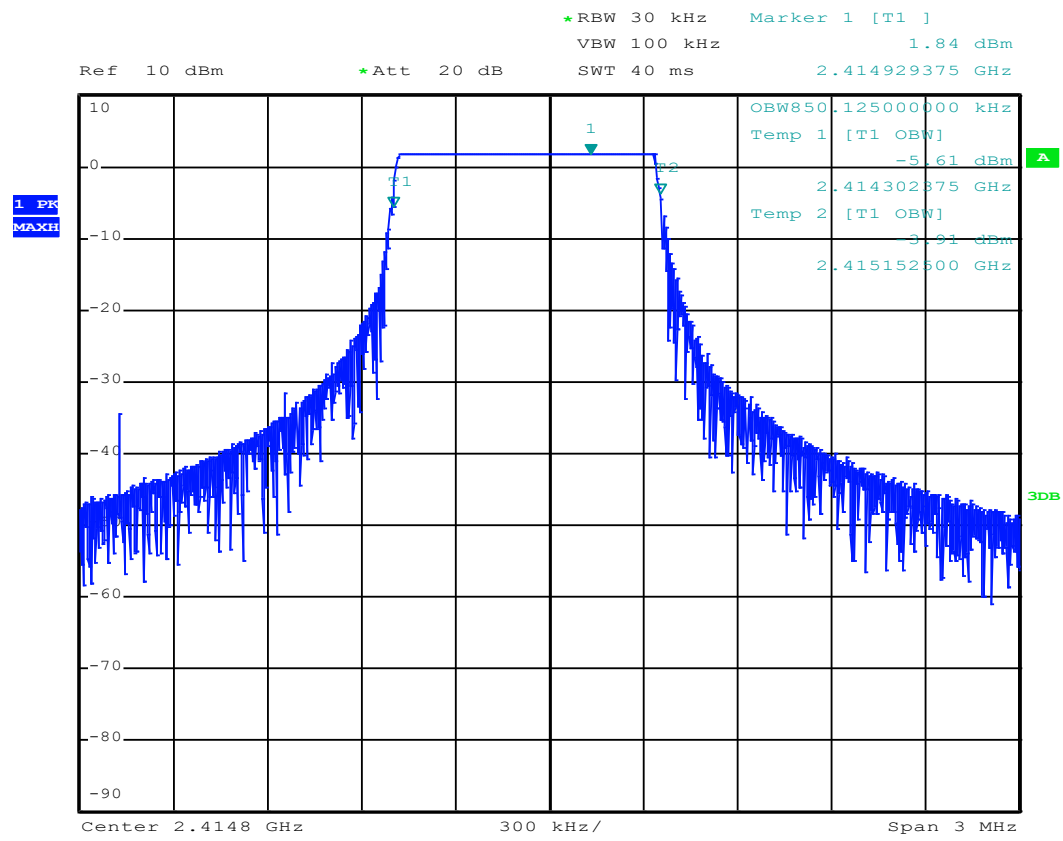
6dB bandwidth – High Channel 2473.2 MHz



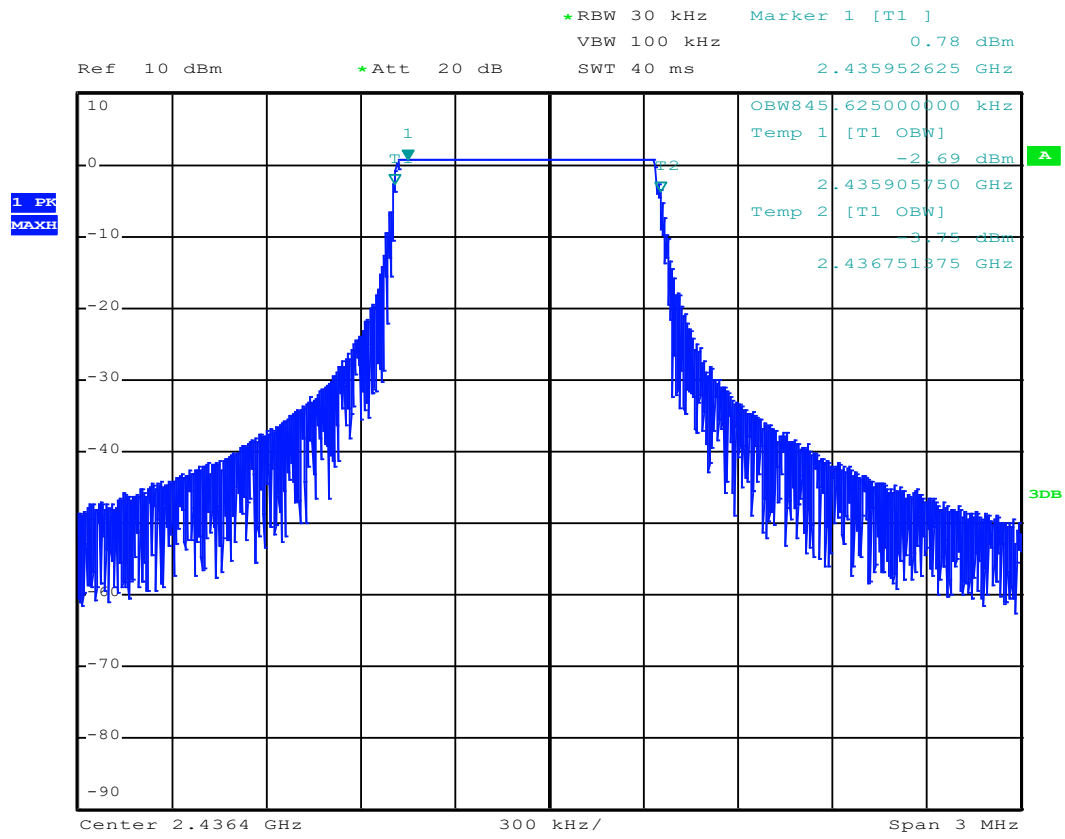
Limit:

Shall be at least 500 kHz

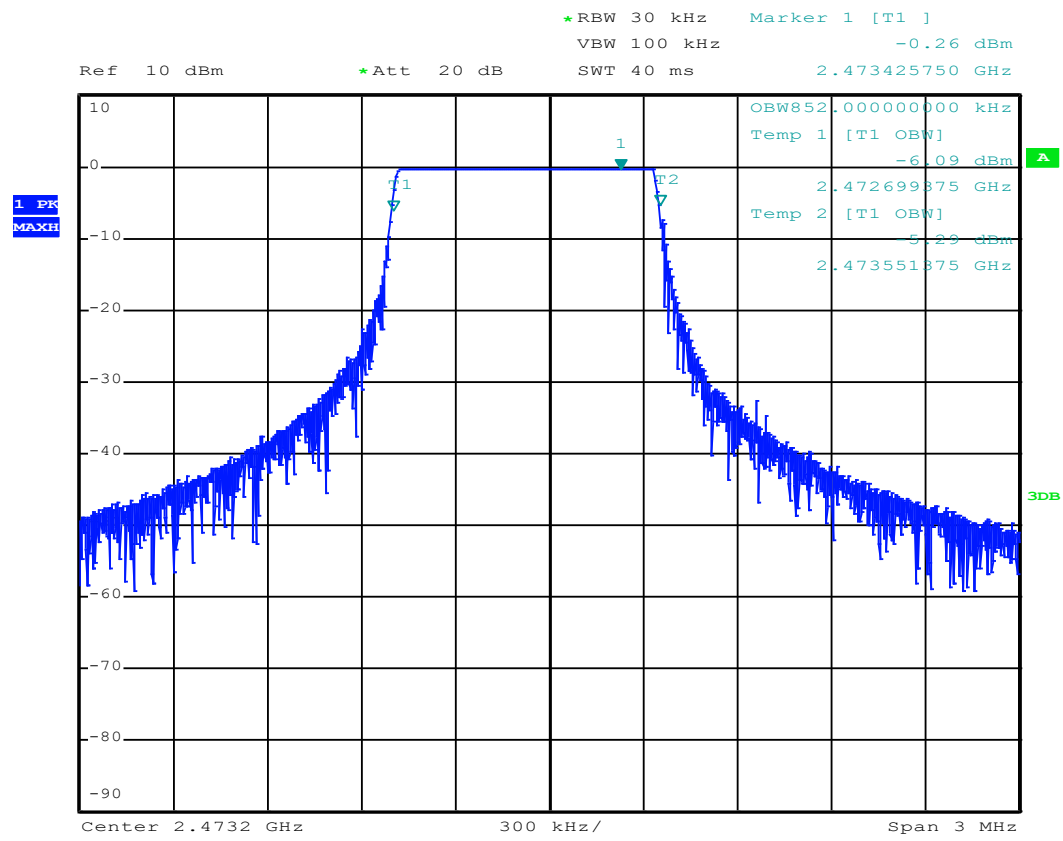
99% bandwidth – Low Channel 2414.8 MHz



99% bandwidth – Central Channel 2436.4 MHz



99% bandwidth – High Channel 2473.2 MHz



Measure realized for reporting only

10. BAND EDGE**Temperature (°C) :** 22**Humidity (%HR):** 42**Date :** October 5, 2023**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.

Power source: 120 Vac 60 Hz by an external power supply

Percentage of voltage variation during the test (%): ± 1

Results:

Lower Band Edge: From 2398 MHz to 2400 MHz

Upper Band Edge: From 2483.5 MHz to 2485.5 MHz

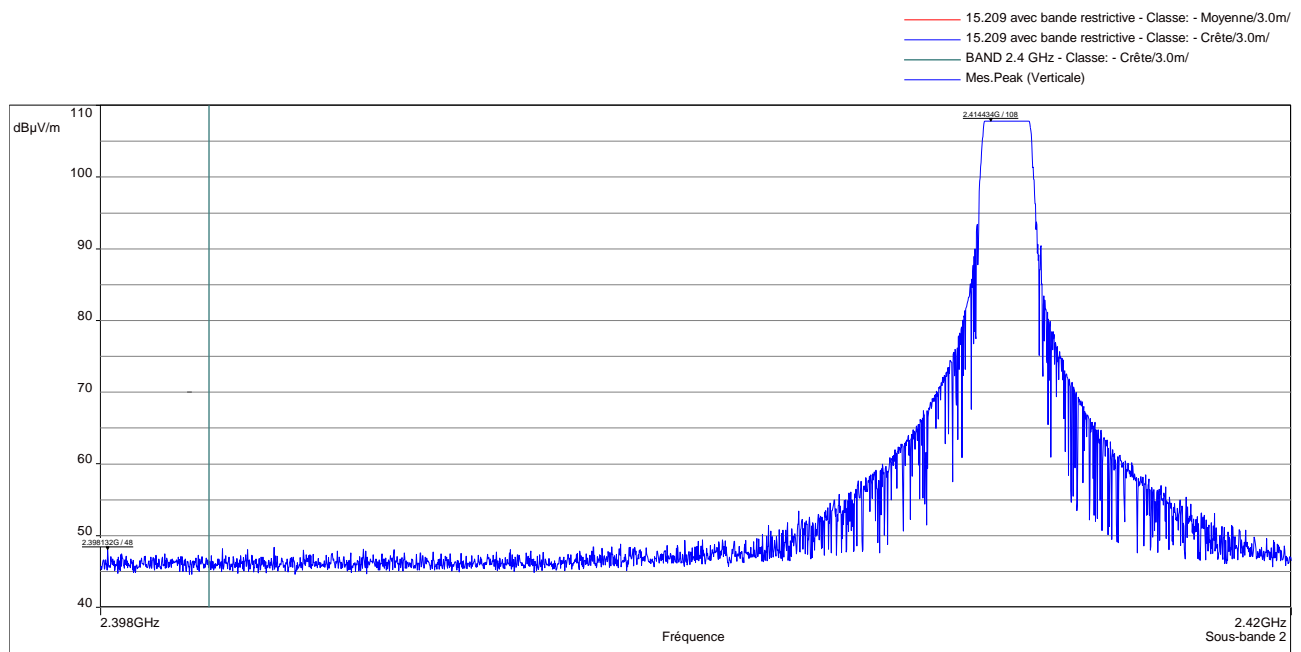
Sample N° 1 : LoRa Modulation

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	107.88	Peak	100	2398.13	59.88	48.0	88	40.0
2473.2	105.49	Peak	1000	2483.71	44.1	53.4 (2)	74	20.6

(1) Marker-Delta method

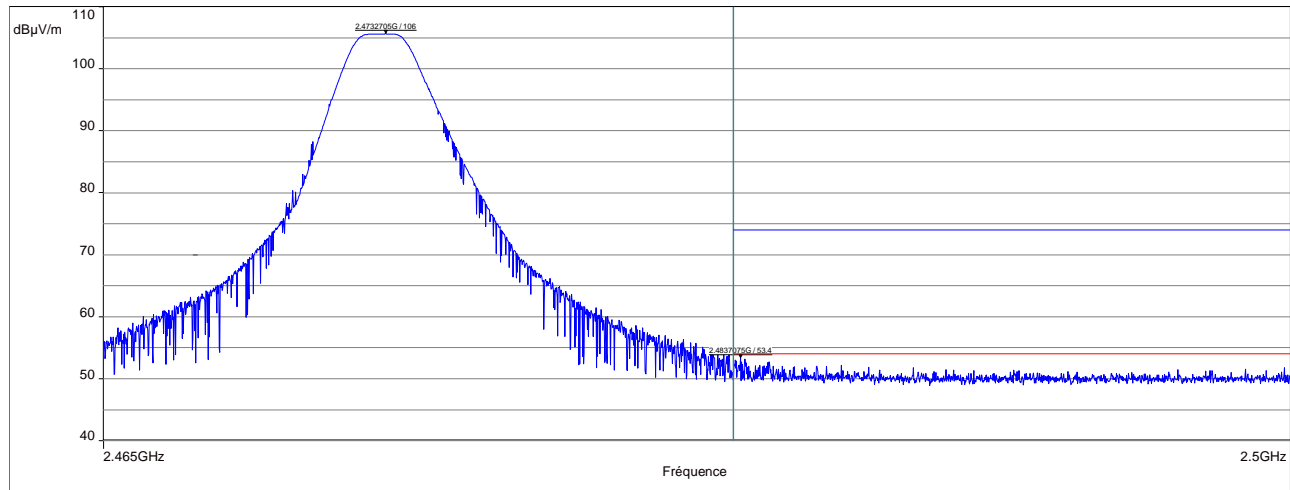
(2) The peak level is lower than the average limit (54 dBμV/m)

Low Channel – LoRa Modulation: Band edge worst case measurement



High Channel – LoRa Modulation: Band edge worst case measurement

— 15.209 avec bande restrictive - Classe: - Moyenne/3.0m/
 — 15.209 avec bande restrictive - Classe: - Crête/3.0m/
 — BAND 2.4 GHz - Classe: - Crête/3.0m/
 — Mes.Peak (Verticale)



Test conclusion:

RESPECTED STANDARD

11. PEAK CONDUCTED OUTPUT POWER**Temperature (°C) :** 22**Humidity (%HR):** 42**Date :** October 5, 2023**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 \geq 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 three orthogonal planes.

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.

Power source: 120 Vac 60 Hz by an external power supply

Percentage of voltage variation during the test (%):

 ± 1

Results: LoRa Modulation

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

	Electro-magnetic field (dBμV/m):	Maximum Peak conducted output power		Limit (W)
		(dBm)	(W)	
Nominal supply voltage: 120 Vac	107.88	10.65	0.0116	1

Polarization of test antenna: vertical (height: 150 cm)

Position of equipment: Position 1 - (azimuth: 0 degrees)

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

	Electro-magnetic field (dBμV/m):	Maximum Peak conducted output power		Limit (W)
		(dBm)	(W)	
Nominal supply voltage: 120 Vac	106.97	9.74	0.0094	1

Polarization of test antenna: vertical (height: 150 cm)

Position of equipment: Position 1 - (azimuth: 359 degrees)

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

	Electro-magnetic field (dBμV/m):	Maximum Peak conducted output power		Limit (W)
		(dBm)	(W)	
Nominal supply voltage: 120 Vac	105.49	8.26	0.0066	1

Polarization of test antenna: vertical (height: 150 cm)

Position of equipment: Position 1 - (azimuth: 16 degrees)

Maximum Peak conducted output power:

$EIRP(dBm) = E (dB\mu V/m) + 20\log(D) - 104.8$; where D is the measurement distance in meters and antenna Gain = 2 dBi.

Test conclusion:

RESPECTED STANDARD

12. RADIATED SPURIOUS EMISSIONS**Temperature (°C) :** 22**Humidity (%HR):** 41 to 43**Date :** October 5, 2023 and
October 6, 2023**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 three orthogonal planes.

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 ($9 \text{ kHz} < F < 150\text{kHz}$)
9 kHz ($150 \text{ kHz} < F < 30\text{MHz}$)
120 kHz ($30 \text{ MHz} < F < 1 \text{ GHz}$)
100 kHz / 1 MHz ($F > 1 \text{ GHz}$)**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.

Power source: 120 Vac 60 Hz by an external power supply

Percentage of voltage variation during the test (%): ± 1

Results:

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 (dB μ V/m)	Limits (dB μ V/m) or (dBm)	Margin (dB)
4829.6 (2)	P	150	1000	3	H	47 (3)	74	27
7244.4	P	150	100	1	H	46.4 (1)	88	41.6
9659.2	P	150	100	1	V	46.3 (1)	88	41.7
12074 (2)	P	150	1000	1	H	49.5 (1&3)	74	24.5
14488.8 (2)	P	150	1000	1	H	50.8 (1&3)	74	23.2
16903.6	P	150	100	3	H	54 (1)	88	34

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 dB μ V/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 (dB μ V/m)	Limits (dB μ V/m) or (dBm)	Margin (dB)
4872.8 (2)	P	150	1000	3	H	46.3 (3)	74	27.7
7309.2 (2)	P	150	1000	1	V	45.9 (1&3)	74	28.1
9745.6	P	150	100	3	H	45.1 (1)	87	41.9
12182 (2)	P	150	1000	1	V	49.8 (1&3)	74	24.2
14618.4	P	150	100	2	V	53.7 (1)	87	33.3
17054.8	P	150	100	1	V	54 (1)	87	33

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 dB μ V/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 (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
4946.3 (2)	P	150	1000	3	H	46 (3)	74	28
7419.6 (2)	P	150	1000	1	H	44.5 (1&3)	74	29.5
9892.8	P	150	100	3	H	46.6 (1)	86	39.4
12366 (2)	P	150	1000	1	V	50.1 (1&3)	74	23.9
14839.2	P	150	100	2	H	52.1 (1)	86	33.9
17312.4	P	150	100	3	V	54 (1)	86	32

P= Peak, QP=Quasi-peak, Av=Average

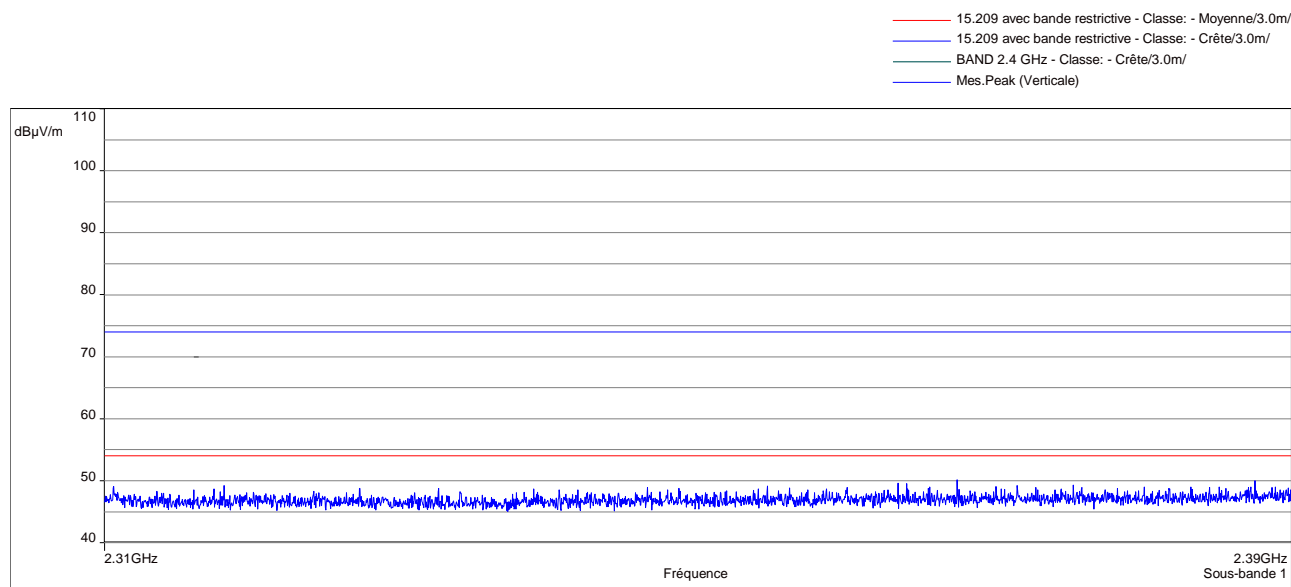
(1) Noise Floor

(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 dB μ V/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 108 dBμV/m on the lowest channel.

So the applicable limit is 88 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

13. PEAK CONDUCTED POWER SPECTRAL DENSITY**Temperature (°C) :** 22**Humidity (%HR):** 42**Date :** October 5, 2023**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 three orthogonal planes.

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:

$EIRP(dBm) = E (dB\mu V/m) + 20\log(D) - 104.8$; 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.

Power source: 120 Vac 60 Hz by an external power supply

Percentage of voltage variation during the test (%): ± 1

Results:

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

	Electro-magnetic field (dBμV/m):	Maximum Peak conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 120 Vac	99.3	2.07	8

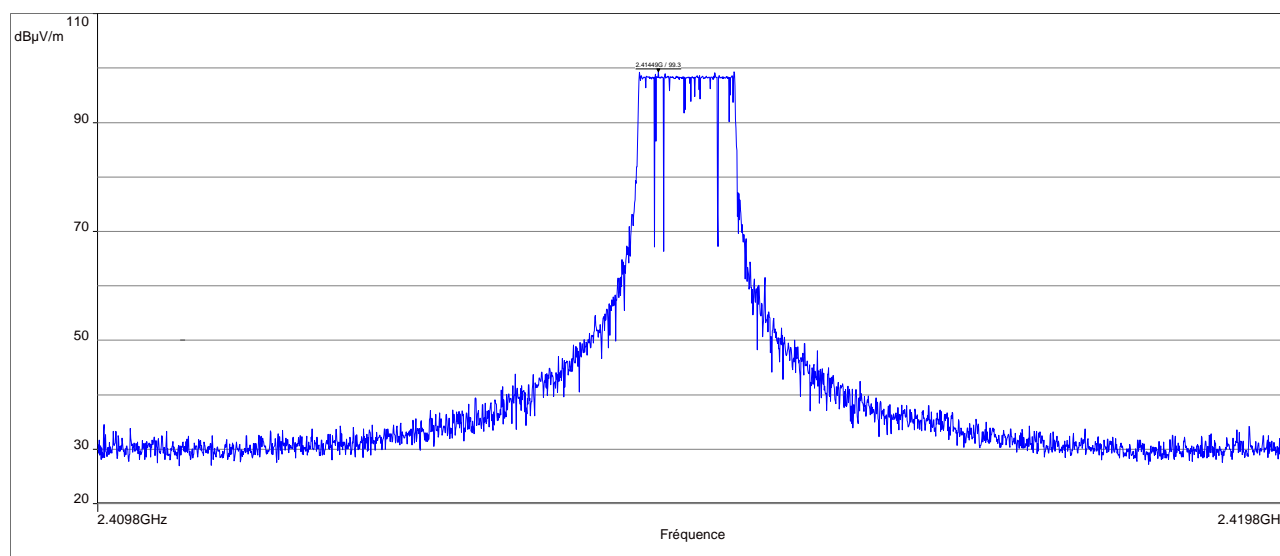
Polarization of test antenna: vertical (height: 150 cm)

Position of equipment: Position 1 - (azimuth: 0 degrees)

Maximum Peak conducted power density:

$EIRP(dBm / 3 kHz) = E (dBμV/m / 3 kHz) + 20\log(D) - 104.8$; where D is the measurement distance in meters and antenna Gain = 2 dBi.

Declared maximum antenna gain: 2 dBi



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: 120 Vac	98.5	1.27	8

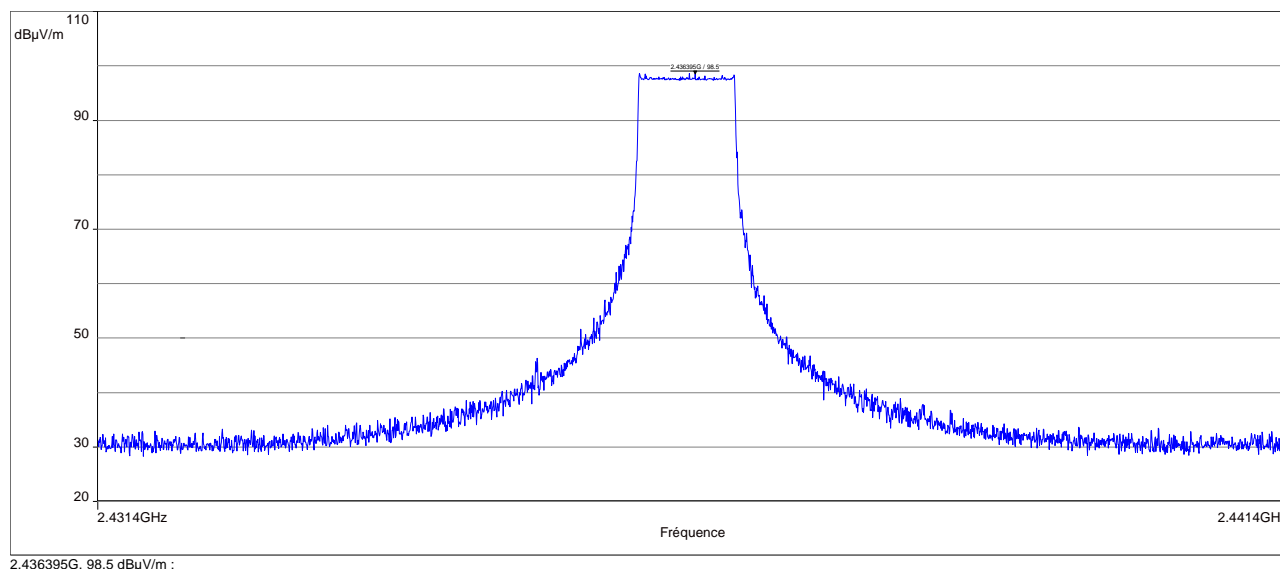
Polarization of test antenna: vertical (height: 150 cm)

Position of equipment: Position 1 - (azimuth: 359 degrees)

Maximum Peak conducted power density:

$EIRP(dBm / 3 \text{ kHz}) = E \text{ (dB}\mu\text{V/m} / 3 \text{ kHz}) + 20\log(D) - 104.8$; where D is the measurement distance in meters and antenna Gain = 2 dBi.

Declared maximum antenna gain: 2 dBi



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: 120 Vac	97.2	-0.03	8

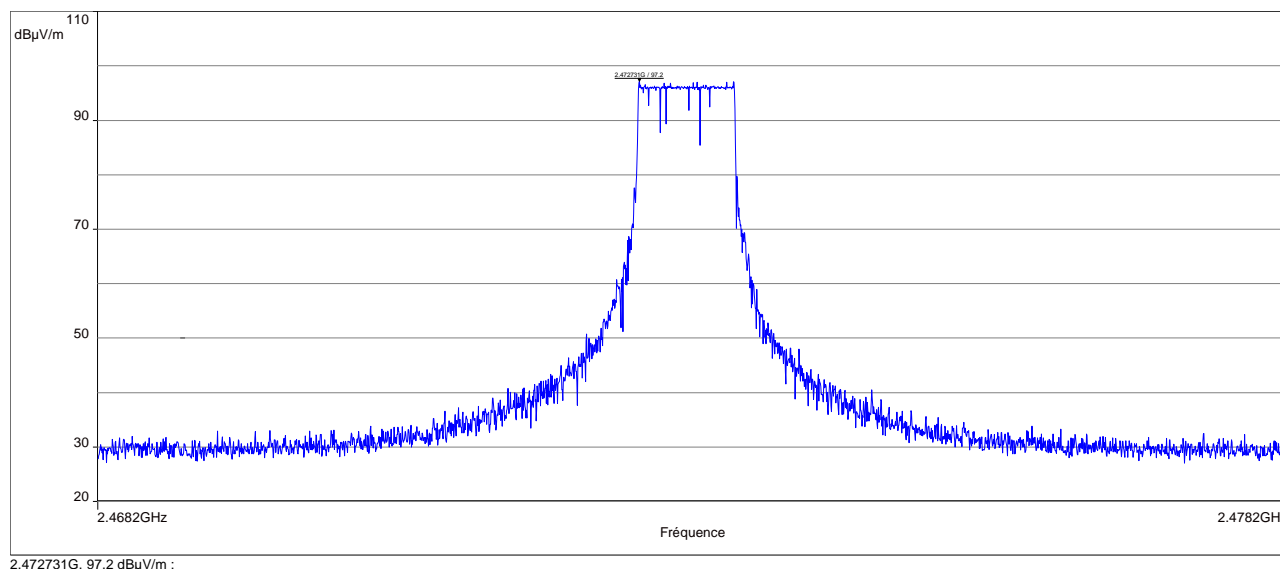
Polarization of test antenna: vertical (height: 150 cm)

Position of equipment: Position 1 - (azimuth: 359 degrees)

Maximum Peak conducted power density:

$EIRP(dBm / 3 \text{ kHz}) = E \text{ (dB}\mu\text{V/m / 3 kHz)} + 20\log(D) - 104.8$; where D is the measurement distance in meters and antenna Gain = 2 dBi.

Declared maximum antenna gain: 2 dBi



Test conclusion:

RESPECTED STANDARD

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

APPENDIX 1: Test equipment list

AC Conducted emission

TYPE	MANUFACTURER	EMITECH NUMBER
Outside room Hors cage	Emitech	10788
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Test receiver ESW44	Rohde & Schwarz	17008
LISN 1600	Thurbly Thandar Instruments	8719
High-pass filter EZ-25	Rohde & Schwarz	11535
Absorber sheath current	Emitech	10523
Cable N-5m RG214	Gyl Technologies	8590
Power source 1251RP	California instruments	8508
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000

Occupied bandwidth

TYPE	MANUFACTURER	EMITECH NUMBER
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Antenna 3115	EMCO	8535
N-1.5M Cable	SUCOFLEX	7279
N-2M Cable	Huber + Suhner	12911
N-5M Cable	MechANC	18413
Power source 1251RP	California instruments	8508
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750
Software	RS Commander V2.4.2	//

Band edge

TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Antenna 3115	EMCO	8535
Low-noise amplifier PAM-118A	COM-POWER	15812
N-1.5M Cable	SUCOFLEX	7279
N-2M Cable	Huber + Suhner	12911
N-5M Cable	MecHANC	18413
Attenuator 10dB	Midwest Microwave	8548
Power source 1251RP	California instruments	8508
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750

Peak conducted output power

TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Antenna 3115	EMCO	8535
Low-noise amplifier PAM-118A	COM-POWER	15812
N-1.5M Cable	SUCOFLEX	7279
N-2M Cable	Huber + Suhner	12911
N-5M Cable	MecHANC	18413
Attenuator 10dB	Midwest Microwave	8548
Power source 1251RP	California instruments	8508
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750
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
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
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 ZFL-1000LN	Mini-circuit	10730
Low-noise amplifier S005180M3201	LUCIX Corp.	12590
Low-noise amplifier DBLNA317202120S	QOTANA	19154
N-5M Cable	MechANC	18413
N-1.5M Cable	SUCOFLEX	9398
N-2M Cable	SUCOFLEX	14303
N-5M Cable	SUCOFLEX	15883
N-2.5M Cable	H & S	15913
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 F190270-001	HPF180400	16109
Multimeter 177	Fluke	14903
Power source 1251RP	California instruments	8508
Meteo station BAR 206	Oregon Scientific	14475
Meteo station 608-H1	Testo	7566
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000
Software	Champ libre Juigné. V3.5	8864

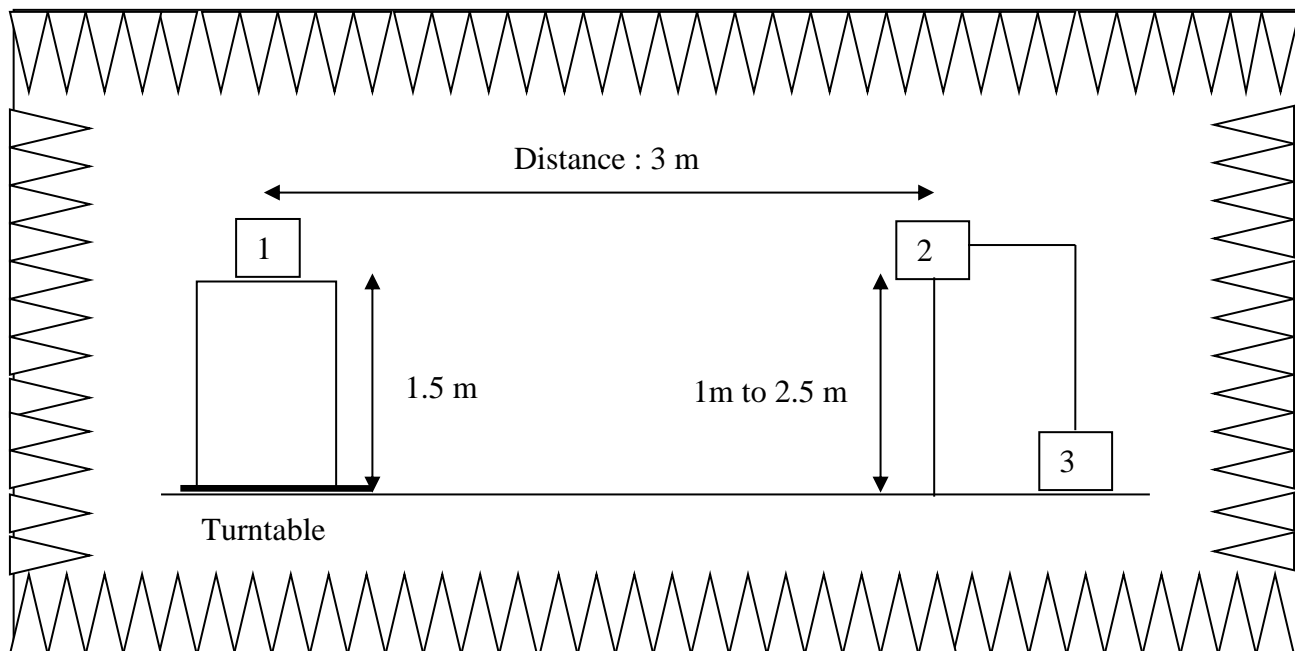
Peak conducted power spectral density

TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Antenna 3115	EMCO	8535
Low-noise amplifier PAM-118A	COM-POWER	15812
N-1.5M Cable	SUCOFLEX	7279
N-2M Cable	Huber + Suhner	12911
N-5M Cable	MecHANC	18413
Attenuator 10dB	Midwest Microwave	8548
Power source 1251RP	California instruments	8508
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000

APPENDIX 2: Radiated Test Setup

Anechoic chamber setup

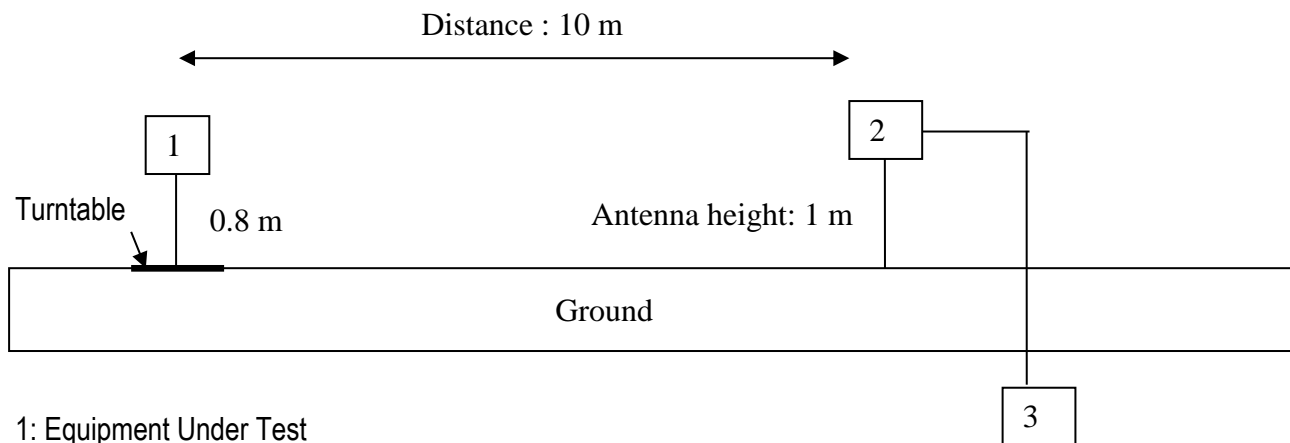
Above 1 GHz



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

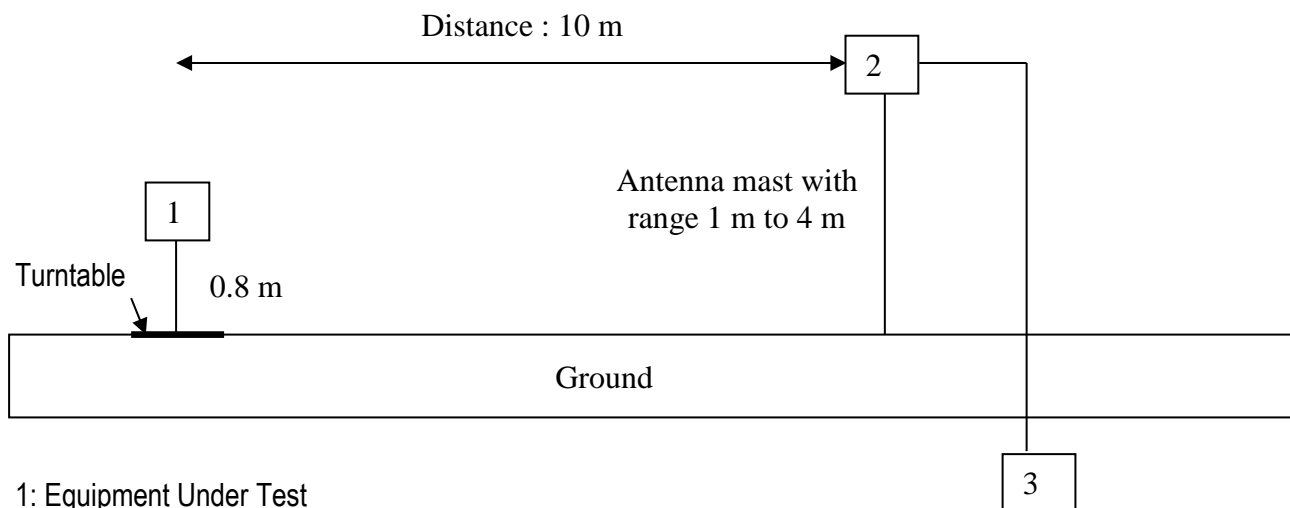
Open area setup

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