RRA-EMIESS22Q160SKF-01Av1

This report cancels and replaces the test report N° **RRA-EMIESS22Q160SKF-01Av0**

Certification Radio test report

According to the standard:

CFR 47 FCC PART 15

RSS GEN – Issue 5
RSS 247 – Issue 3

Equipment under test:

CMWA 6100-EX

FCC ID: 2AJ99-CMWA-6100-EX
IC NUMBER: 26053-CMWA6100EX

Company:

SKF FRANCE

Distribution: Mr PINON **(Company:** SKF FRANCE**)**

Number of pages: 56 with 3 appendixes

Ed.	Date	Modified Page(s)	Technical Verification and Quality Approval Name and Function	Visa
1	18-Mar-25	See Vertical Lines	M. DUMESNIL, Radio Laboratory Manager	

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Information in italics are declared by the manufacturer/customer and are under his responsibility

S51 RTY 000 INT 00015 [03]

Product used for BLE tests: Sample 1

DESIGNATION OF PRODUCT:	***CMWA 6100-EB***
Serial number (S/N):	*0013*
Reference / model (P/N):	*CMWA 6100-EX*
Software/firmware version:	*V3.3*

Product used for MIRA tests: Sample 2

DESIGNATION OF PRODUCT:	***SK-2810***
Serial number (S/N):	*01*
Reference / model (P/N):	*CMWA 6100-EX*
Software/firmware version:	*Mira test FW: SVN rev: 3962*

MANUFACTURER: ***SKF FRANCE***

COMPANY SUBMITTING THE PRODUCT:

Company: SKF FRANCE

Address: 204, BOULEVARD CHARLES DE GAULLE
TSA 40208
37542 SAINT-CYR SUR LOIRE CEDEX
FRANCE

Responsible: Mr PINON

Person present during the tests: Mr PINON

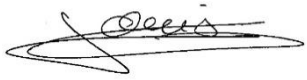
DATES OF TEST: From 6-Feb-23 to 7-Feb-23

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: S. LOUIS **VISA:**



WRITTEN BY: S. LOUIS

CONTENTS

REVISIONS HISTORY

Revision	Date	Modified pages	Modifications
0	**28-Feb-23**	/	Creation
1	**15-Oct-24**	1, 2, 5, 7, 27, 28, 37 to 42 and 46	Modification of standard version Modification of Model Modification of the BLE / MIRA antenna gain and result of computed conducted power / density Suppression of internal photo

1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment: ***CMWA 6100-EX***, in accordance with normative reference.

The equipment under test integrates:

- BLE transceiver radio part function declared already certified,
- MIRA transceiver radio part function declared already certified, (802.15.4)

These two functions used the same Radio part
This report concerns the two functions.

2. PRODUCT DESCRIPTION

Category of equipment (ISED):	I
Class:	B
Utilization:	Industrial
Antenna type and gain:	Integrated Antenna (Maximum gain: -1.95 dBi)
Operating frequency range:	From 2400 MHz to 2483.5 MHz

Sample 1: BLE

Number of channel which it can operate: 40
Channel separation: 2 MHz
Nominal Channel bandwidth: 2 MHz
Modulation: GFSK

Nominal Operating Frequencies:

Sample N°= 1 ⇨ 2402 MHz Full tests
Sample N°= 1 ⇨ 2426 MHz Full tests
Sample N°= 1 ⇨ 2480 MHz Full tests

Sample 2: MIRA

Number of channel which it can operate: 80
Channel separation: 1 MHz
Nominal Channel bandwidth: 1 MHz
Modulation: GFSK

Nominal Operating Frequencies:

Sample N°= 2 ⇨ 2401 MHz Full tests
Sample N°= 2 ⇨ 2440 MHz Full tests
Sample N°= 2 ⇨ 2480 MHz Full tests

Power source: 3.6Vdc by 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 (2022)	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 207: Conducted limits
- Paragraph 209: Radiated emission limits; general requirements
- Paragraph 212: Modular transmitter
- 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	08/04/2022	1	08/04/2023
4088	R&S FSP40	Spectrum Analyzer	14/05/2022	2	13/05/2024
4353	ATM WR28	Antenna	03/08/2022	3	02/08/2025
4354	ALC ALS2640-30-10	Low-noise amplifier	08/04/2022	1	08/04/2023
7124	A.H. Systems SAS-572	Antenna	24/05/2022	3	23/05/2025
7279	SUCOFLEX SF104 N 1.5m	Cable	21/05/2022	2	20/05/2024
7299	Microtronics BRM50702	Reject band filter	17/08/2022	3	16/08/2025
8511	HP 8447D	Low-noise amplifier	29/11/2022	1	29/11/2023
8526	Schwarzbeck VHBB 9124	Biconical antenna	22/08/2021	3	21/08/2024
8535	EMCO 3115	Antenna	28/04/2020	3	28/04/2023
8543	Schwarzbeck UHALP 9108A	Log periodic antenna	05/08/2021	3	04/08/2024
8593	SIDT Cage 2	Anechoic chamber	01/04/2022	3	31/03/2025
8704	LUCIX Corp S180265L3201 LNA	Low-noise amplifier	26/07/2022	1	26/07/2023
8750	La Crosse Technology WS-9232	Meteo station	25/10/2022	2	24/10/2024
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
8974	STORM MICROWAE k-20cm	cable	09/12/2021	2	09/12/2023
8975	STORM MICROWAE k-20cm	cable	09/12/2021	2	09/12/2023
10771	EMCO 3117	Antenna	30/11/2022	3	30/11/2025
10811	R&S EMC 32	Software	/	/	/
12911	Huber + Suhner N-2m	cable	21/05/2022	2	20/05/2024
14736	MATURO	Turntable and mat controller MCU	/	/	/
14831	Fluke 177	Multimeter	01/02/2022	2	01/02/2024
15666	R&S FSV40	Spectrum Analyzer	28/09/2022	2	27/09/2024
15812	COMP-POWER PAM-118A	Low-noise amplifier 18GHz	23/07/2022	1	23/07/2023
18413	MecHANC - N - 5m	Cable	15/02/2022	2	15/02/2024
/	Software	GPIB Shot V2.4	/	/	/

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		*Supplied by battery*
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				Note 2
FCC Part 15.212	MODULAR TRANSMITTERS			X		
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				
	(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 without standard connector.

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 672 kHz.

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		*Supplied by battery*
§ 8.9	Transmitter emission limits	X				
§ 8.10	Restricted frequency bands	X				
§ 8.11	Frequency stability			X		

NAp: Not Applicable NAs: Not Asked

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 1
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 672 kHz

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	 ± 2.7. dB ± 5.0 dB ± 5.3 dB ± 6.1 dB
AC Power Lines conducted emissions	± 3.4 dB
Temperature	± 1 °C
Humidity	± 5 %

8. OCCUPIED BANDWIDTH

Temperature (°C) : 20.1 **Humidity (%HR):** 35 **Date :** February 6, 2023
Technician : S. LOUIS

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:

Radiated test

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:

BLE: The equipment under test is blocked in discontinuous modulated transmission mode (advertising mode), at the highest output power level at which the transmitter is intended to operate.

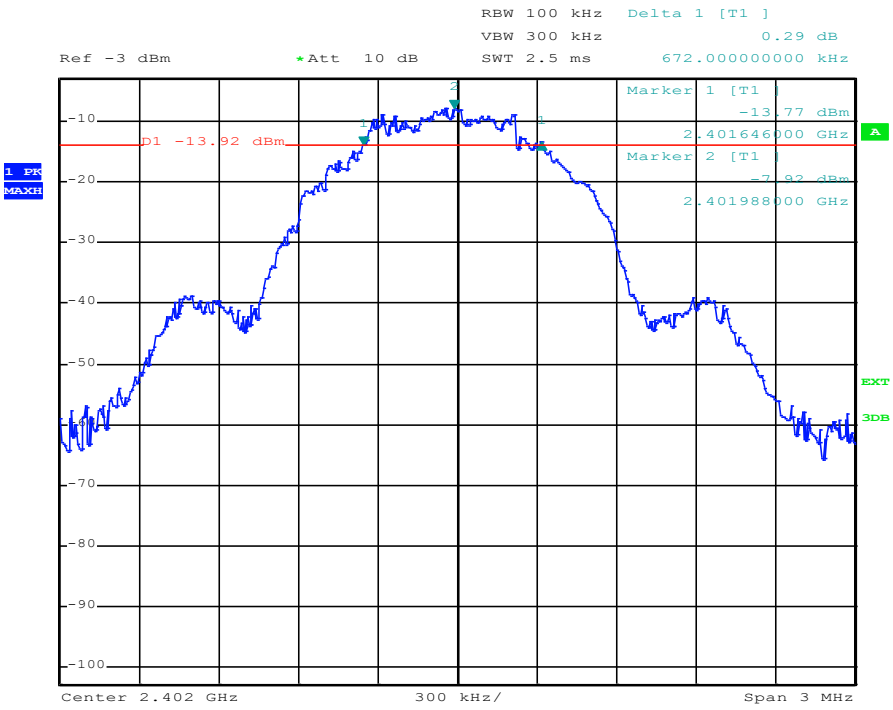
MIRA: The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

Power source: 3.6 Vdc by battery
Percentage of voltage variation during the test (%): ± 1

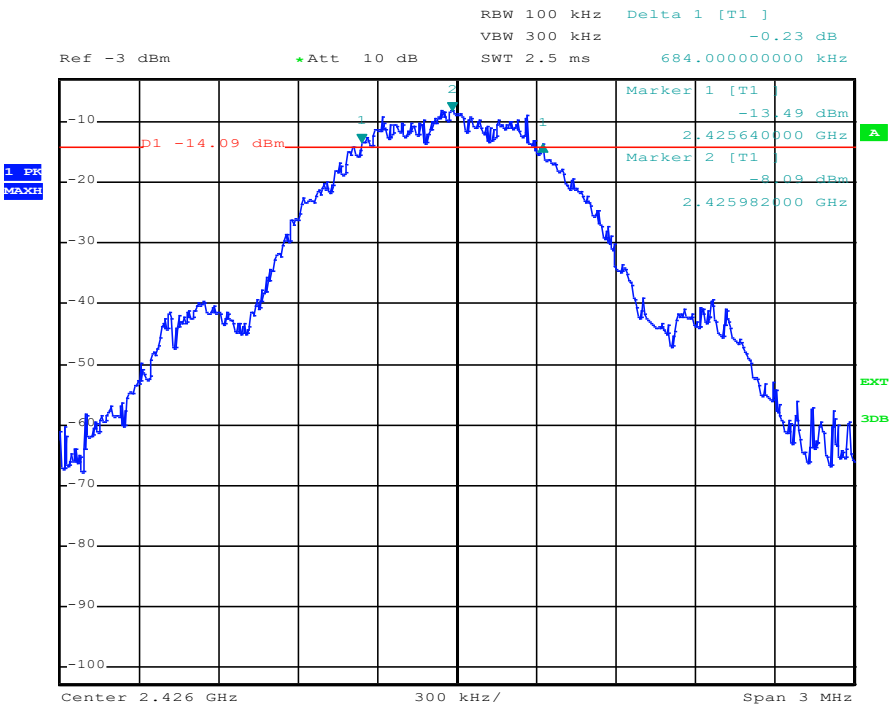
Results:

Sample N° 1

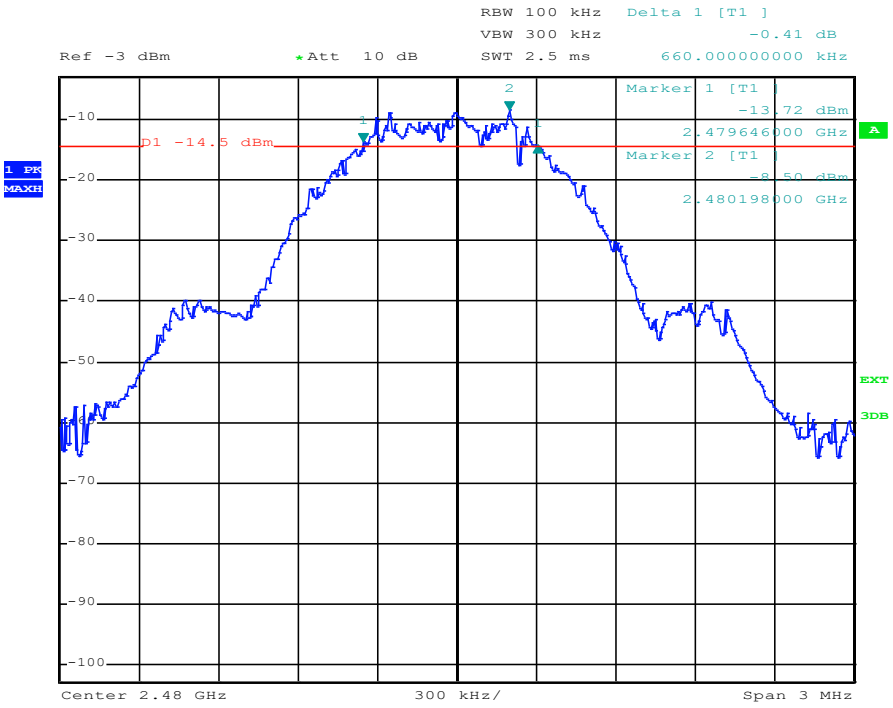
6dB bandwidth – Channel 2402MHz



6dB bandwidth – Channel 2426 MHz

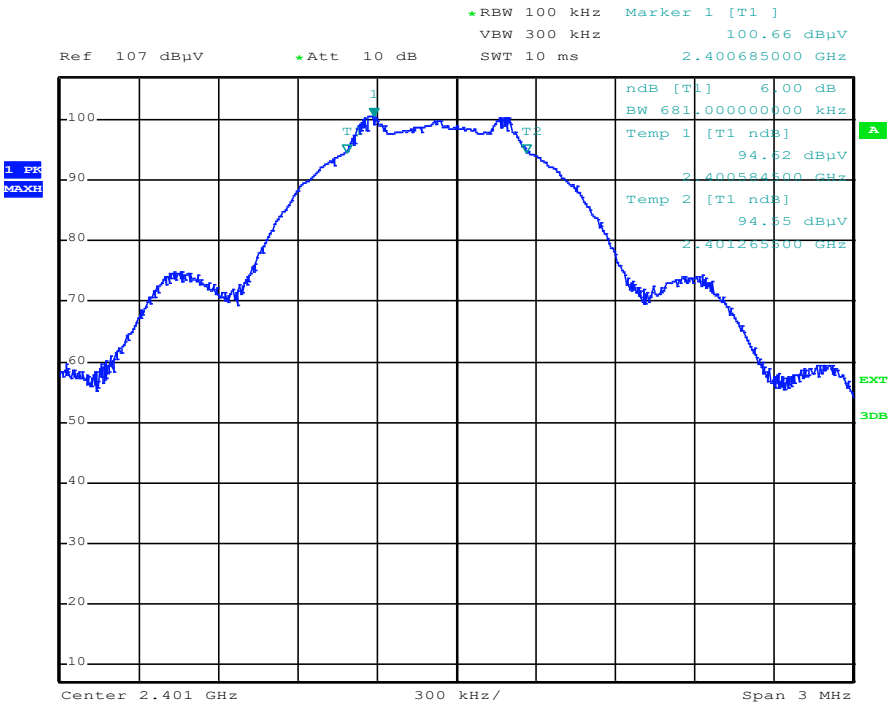


6dB bandwidth – Channel 2480 MHz

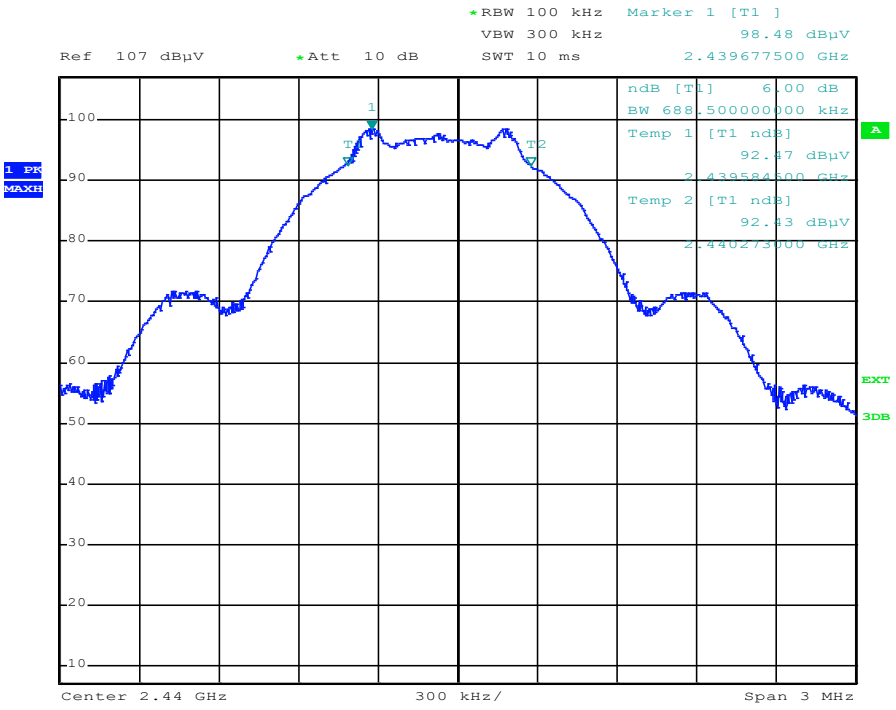


Sample N° 2

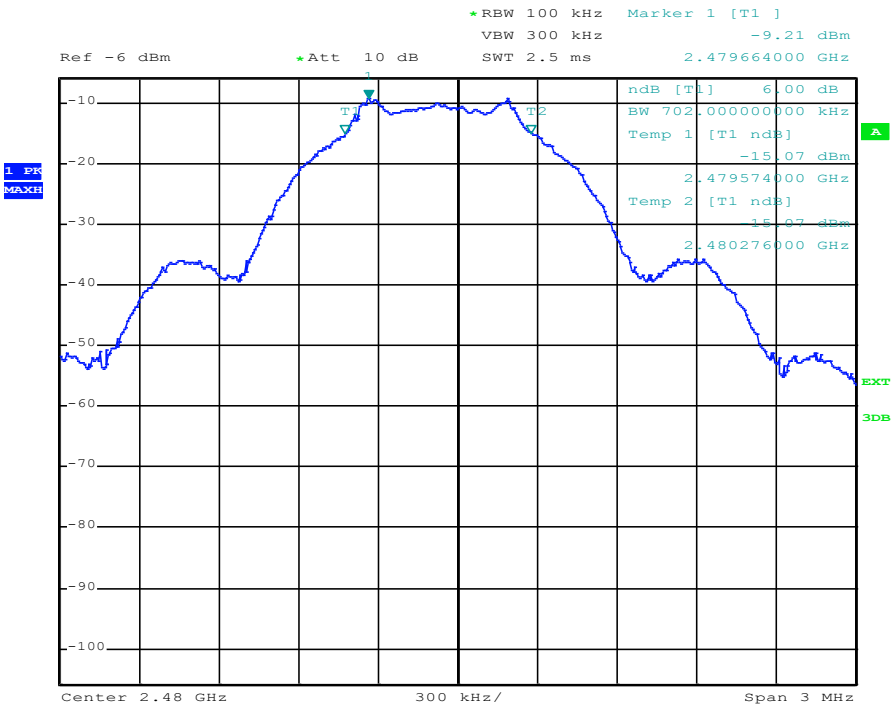
6dB bandwidth – Channel 2401MHz



6dB bandwidth – Channel 2440 MHz



6dB bandwidth – Channel 2480 MHz



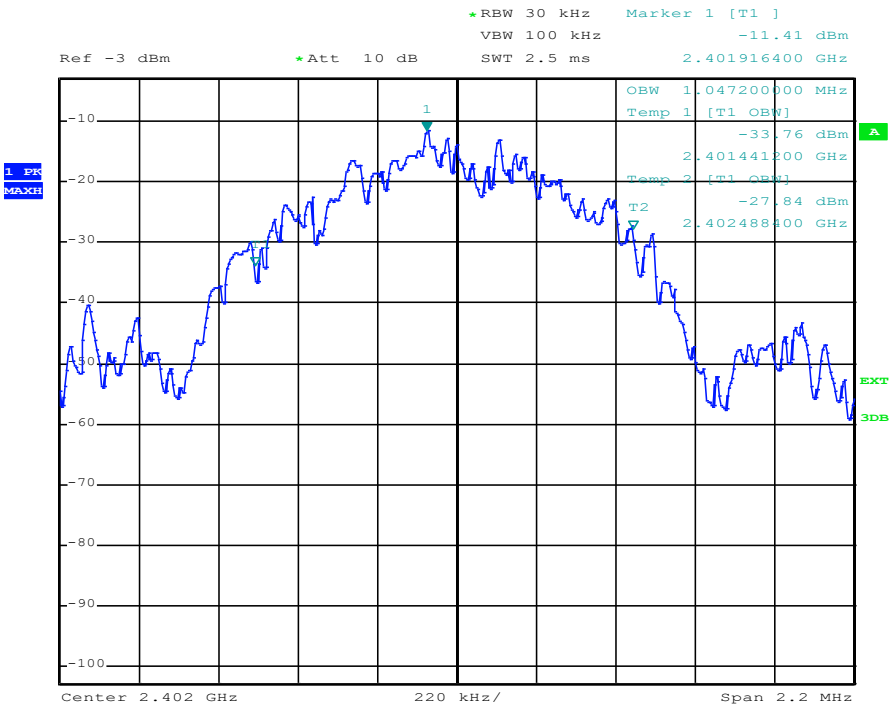
Limit:

Shall be at least 500 kHz

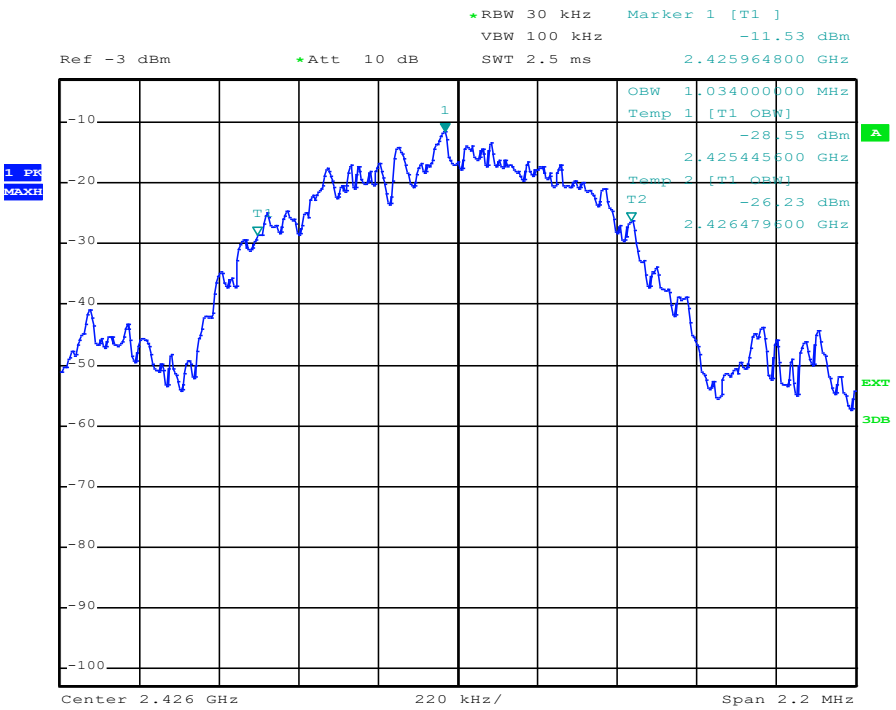
Results:

Sample N° 1

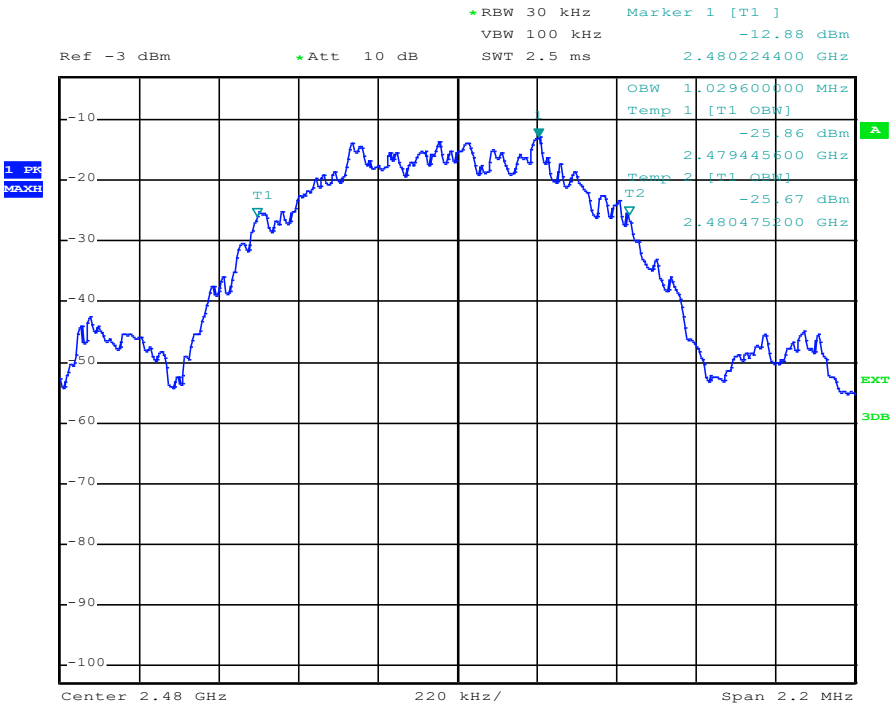
99% bandwidth – Channel 2402 MHz



99% bandwidth – Channel 2426 MHz

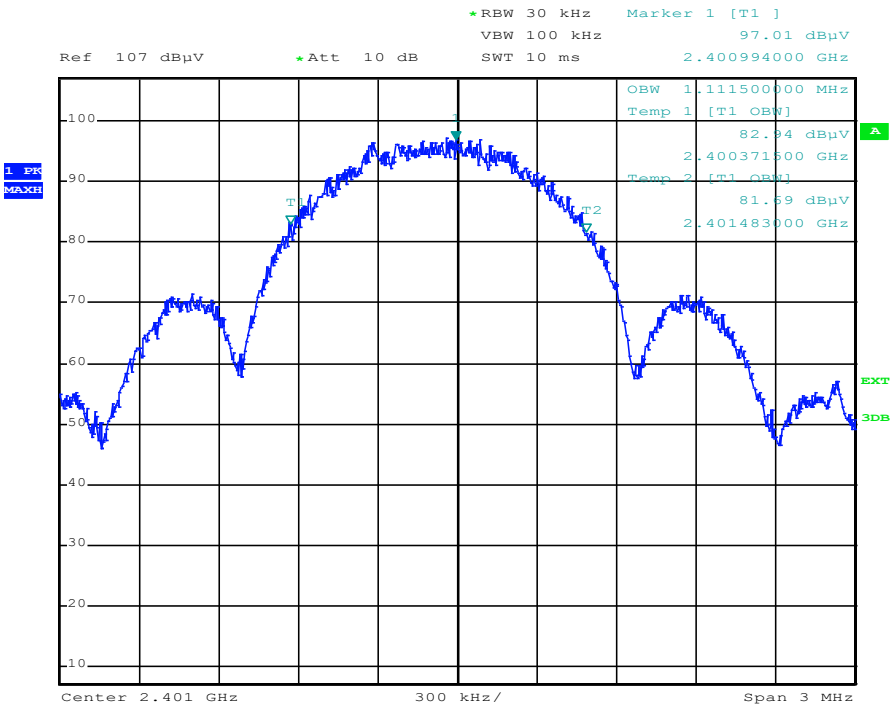


99% bandwidth – Channel 2480 MHz

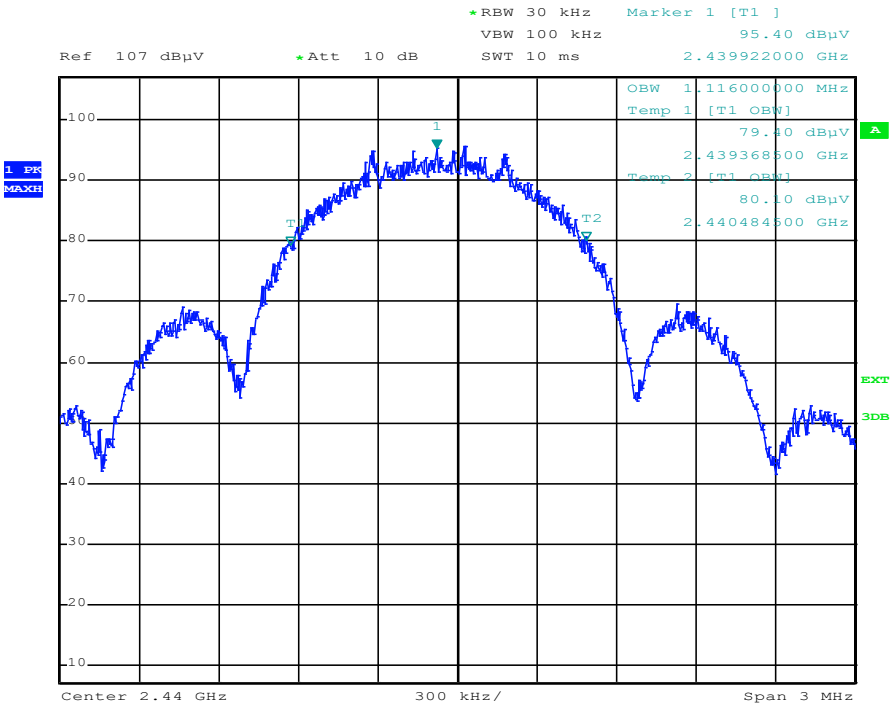


Sample N° 2

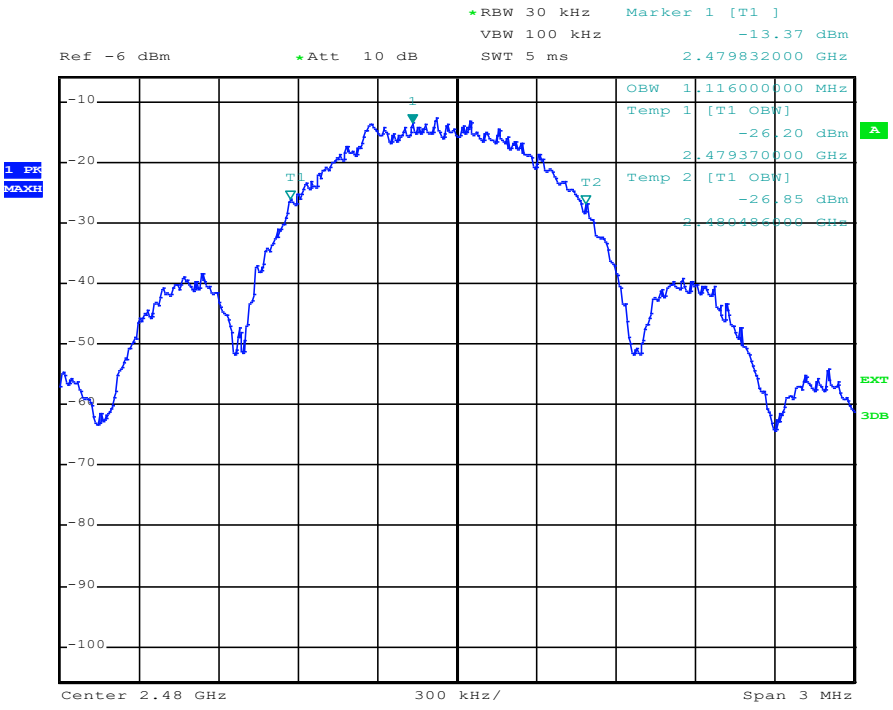
99% bandwidth – Channel 2401 MHz



99% bandwidth – Channel 2440 MHz



99% bandwidth – Channel 2480 MHz



Measure realized for reporting only

9. BAND EDGE

Temperature (°C) : 20.1 **Humidity (%HR):** 35 **Date :** February 6, 2023
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

Test procedure:

DTS:
Method of paragraph 11.13.2 of ANSI C63.10
Method of paragraph 11.13.3 of ANSI C63.10 or method of paragraph 11.13.4 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:

BLE: The equipment under test is blocked in discontinuous modulated transmission mode (advertising mode), at the highest output power level at which the transmitter is intended to operate.

MIRA: 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: 3.6 Vdc by battery
Percentage of voltage variation during the test (%): ± 1

Results:

Lower Band Edge: From 2400 MHz to 2402 MHz
Upper Band Edge: From 2483.5 MHz to 2485.5 MHz

Sample N° 1: BLE

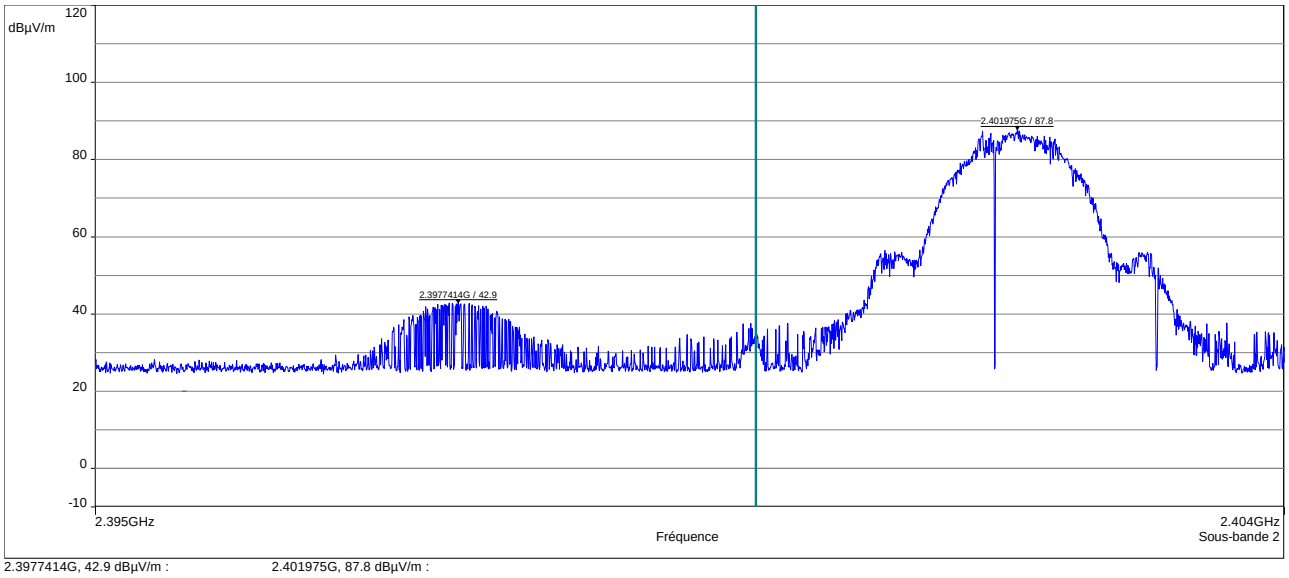
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	RBW (kHz)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) (1)	Calculated Max Out-of-Band Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2402	87.80	100	Peak	2397.741	-44.9	42.9	67.8	24.9
2480	87.70	1000	Peak	2483.748	-30.1	57.6	74	16.4
2480	87.70	1000	Average	2483.748	-37.1	50.6	54	3.4

(1) Marker-Delta method

Low channel at 2402MHz

LEGEND:

- Results obtained with 100 kHz RBW
- Blue curve represent measure with a peak detector
- Green curve are the limit of the band. (2400 MHz)

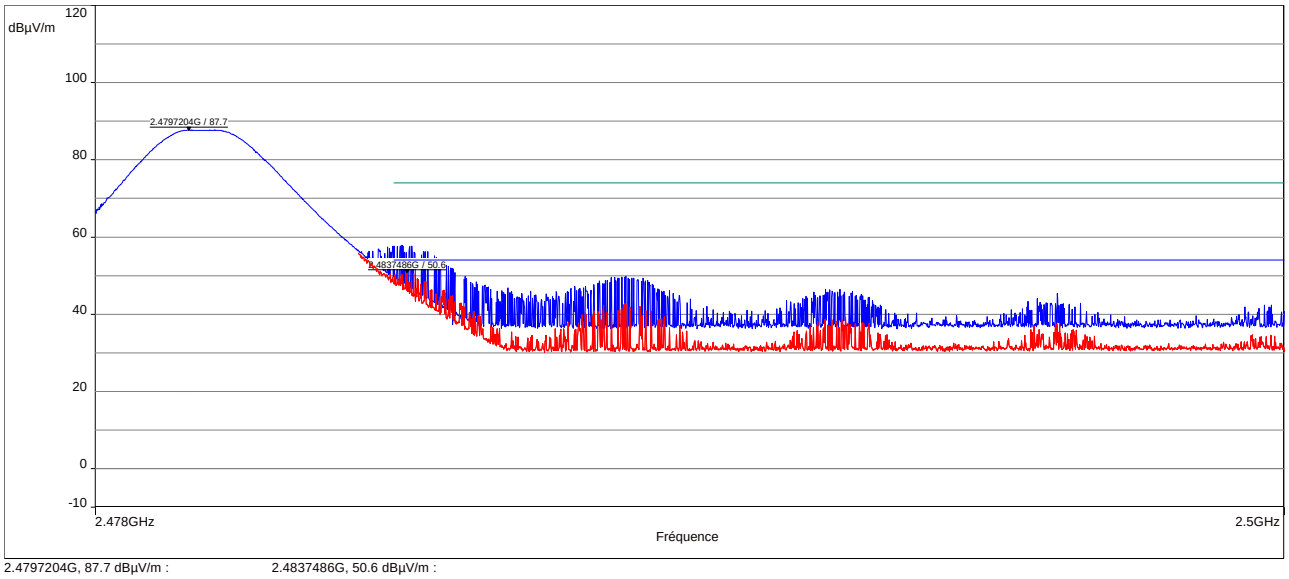


2.3977414G, 42.9 dBµV/m : 2.401975G, 87.8 dBµV/m :

High channel at 2480MHz

LEGEND:

- Results obtained with 1 MHz RBW
- Blue curve represent measure with a peak detector
- Green line : limit with a peak detector
- Red curve is the measure with average detector
- Blue line: limit with average detector.



2.4797204G, 87.7 dBµV/m : 2.4837486G, 50.6 dBµV/m :

Sample N° 2: MIRA

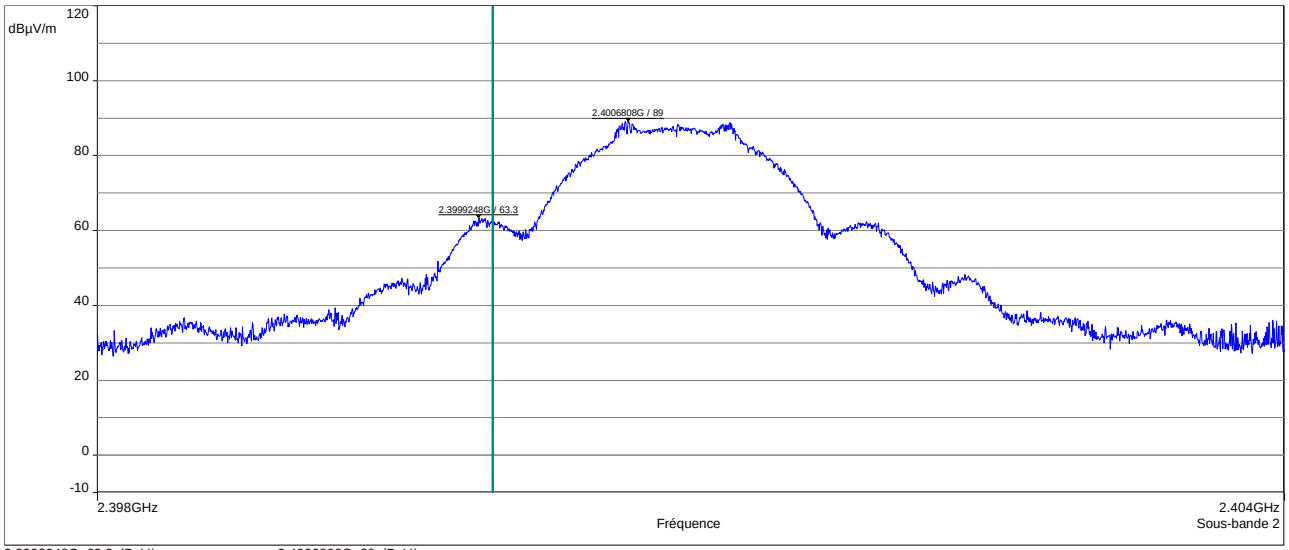
Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	RBW (kHz)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) (1)	Calculated Max Out-of-Band Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2401	89.0	100	Peak	2399.924	-25.7	63.3	69	5.7
2480	86.2	1000	Peak	2483.535	-29.0	57.2	74	16.8
2480	86.2	1000	Average	2483.535	-36.6	49.6	54	4.4

(1) Marker-Delta method

Low channel at 2401MHz

LEGEND:

- Results obtained with 100 kHz RBW
- Blue curve represent measure with a peak detector
- Green curve are the limit of the band. (2400 MHz)

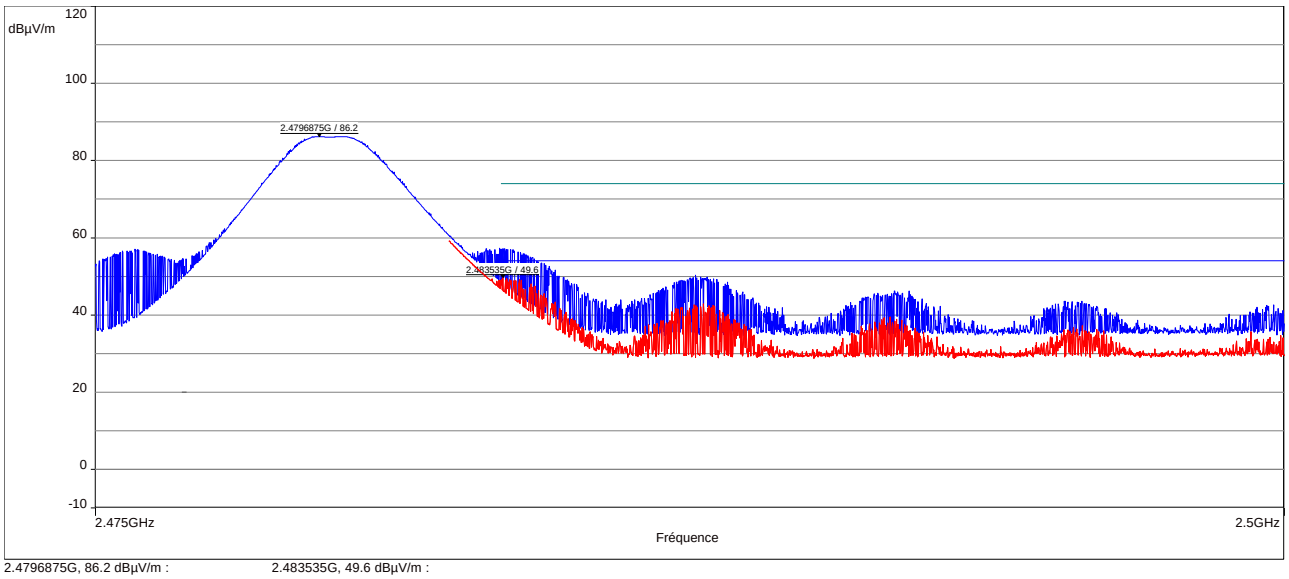


2.3999248G, 63.3 dBµV/m : 2.4006808G, 89 dBµV/m :

High channel at 2480MHz

LEGEND:

- Results obtained with 1 MHz RBW
- Blue curve represent measure with a peak detector
- Green line: limit with a peak detector
- Red curve is the measure with average detector
- Blue line: limit with average detector.



2.4796875G, 86.2 dBµV/m : 2.483535G, 49.6 dBµV/m :

Test conclusion:

RESPECTED STANDARD

10. PEAK CONDUCTED OUTPUT POWER

Temperature (°C) : 20.1 **Humidity (%HR):** 35 **Date :** February 6, 2023
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

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

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

Test set up:

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

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 photos in appendix 2.

Distance of antenna: 3 meters

Antenna height: 1.5 meter

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 1 MHz and video bandwidth at 3 MHz. (11.9.1.1 of ANSI C63.10)

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 with a Gain (unit in dBi) different following the frequencies used.

Equipment under test operating condition:

BLE: The equipment under test is blocked in discontinuous modulated transmission mode (advertising mode), at the highest output power level at which the transmitter is intended to operate.

MIRA: 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: 3.6 Vdc by battery
Percentage of voltage variation during the test (%): ± 1

Results:

Sample N° 1 Low Channel (F = 2402 MHz)

	Electro-magnetic field at 3m (dBµV/m):	Maximum Peak conducted output power (1)		Limit
		(dBm)	(W)	(W)
Nominal supply voltage:	88.7	-4.60	0.000347	1

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat Position - (azimuth: 240 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 = -1.95 dBi.

Sample N° 1 Central Channel (F = 2426 MHz)

	Electro-magnetic field at 3m (dBµV/m):	Maximum Peak conducted output power (1)		Limit
		(dBm)	(W)	(W)
Nominal supply voltage:	88.2	-4.65	0.000343	1

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat Position - (azimuth: 240 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 = -2.40 dBi.

Sample N° 1 High Channel (F = 2480 MHz)

	Electro-magnetic field at 3m (dBµV/m):	Maximum Peak conducted output power (1)		Limit
		(dBm)	(W)	(W)
Nominal supply voltage:	87.8	-3.99	0.000399	1

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat Position - (azimuth: 240 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 = -3.46 dBi.

Results:

Sample N° 2 Low Channel (F = 2401 MHz)

	Electro-magnetic field at 3m (dBµV/m):	Maximum Peak conducted output power (1)		Limit
		(dBm)	(W)	(W)
Nominal supply voltage:	89.4	-3.90	0.000407	1

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat Position - (azimuth: 276 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 = -1.95 dBi.

Sample N° 2 Central Channel (F = 2440 MHz)

	Electro-magnetic field at 3m (dBµV/m):	Maximum Peak conducted output power (1)		Limit
		(dBm)	(W)	(W)
Nominal supply voltage:	87.7	-5.40	0.000288	1

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat Position - (azimuth: 286 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 = -2.15 dBi.

Sample N° 2 High Channel (F = 2480 MHz)

	Electro-magnetic field at 3m (dBµV/m):	Maximum Peak conducted output power (1)		Limit
		(dBm)	(W)	(W)
Nominal supply voltage:	86.7	-5.09	0.000310	1

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat Position - (azimuth: 307 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 = -3.46 dBi.

Test conclusion:

RESPECTED STANDARD

11. RADIATED SPURIOUS EMISSIONS

Temperature (°C) : 19.4 / 20.1 **Humidity (%HR):** 32 /35 **Date :** February 6, 2023 and February 7, 2023

Technician : S. LOUIS

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

DTS:
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:

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

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 photos in appendix 2.

Frequency range: From 9 kHz to 26GHz - 10th harmonic of the highest fundamental frequency (2480MHz)

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:

BLE: The equipment under test is blocked in discontinuous modulated transmission mode (advertising mode), at the highest output power level at which the transmitter is intended to operate.

MIRA: 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: 3.6 Vdc by battery
Percentage of voltage variation during the test (%): ± 1

Results:

Sample N° 1 Low Channel (F = 2402 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
4804 (1)	P	150	1000	1	H	52.6 (2)	74	21.4
7206	P	150	100	1	H	55.4	68.7	13.3
9608	P	150	100	1	H	53.0	68.7	15.7

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

Sample N° 1 Central Channel (F = 2426 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
4852 (1)	P	150	1000	1	H	52.4 (2)	74	21.6
7278 (1)	P	150	1000	1	H	55.0	74	19.0
7278 (1)	Av	150	1000	1	H	48.6	54	5.4
9704	P	150	100	2	V	55.2	68.7	13.5

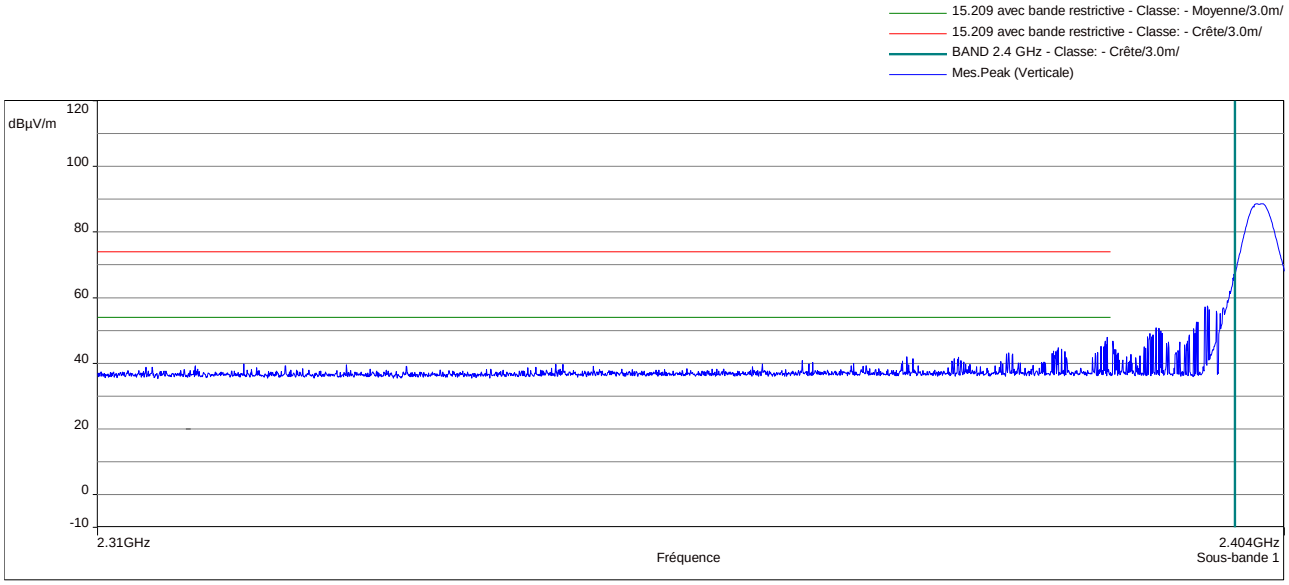
P= Peak, QP=Quasi-peak, Av=Average.
(1) Restricted bands of operation in 15.205
(1) Restricted bands of operation as defined in Table 6 of RSS-Gen
(2) The peak level is lower than the average limit (54 dBµV/m)

Sample N° 1 High Channel (F = 2480 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
4960 (1)	P	150	1000	1	H	53.9 (2)	74	20.1
7440 (1)	P	150	1000	1	H	53.6 (2)	74	20.4
9720	P	150	100	2	V	55.3	68.7	13.4

P= Peak, QP=Quasi-peak, Av=Average.
(1) Restricted bands of operation in 15.205
(1) Restricted bands of operation as defined in Table 6 of RSS-Gen
(2) 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 88.7 dBµV/m on low channel.
So the applicable limit is 68.7 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:

Sample N° 2 Low Channel (F = 2401 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
4802 (1)	P	150	1000	1	H	57.1	74	16.9
4802 (1)	Av	150	1000	1	H	50.7	54	3.3

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

Sample N° 2 Central Channel (F = 2440 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
4880 (1)	P	150	1000	1	H	56.9	74	17.1
4880 (1)	Av	150	1000	1	H	50.5	54	3.5

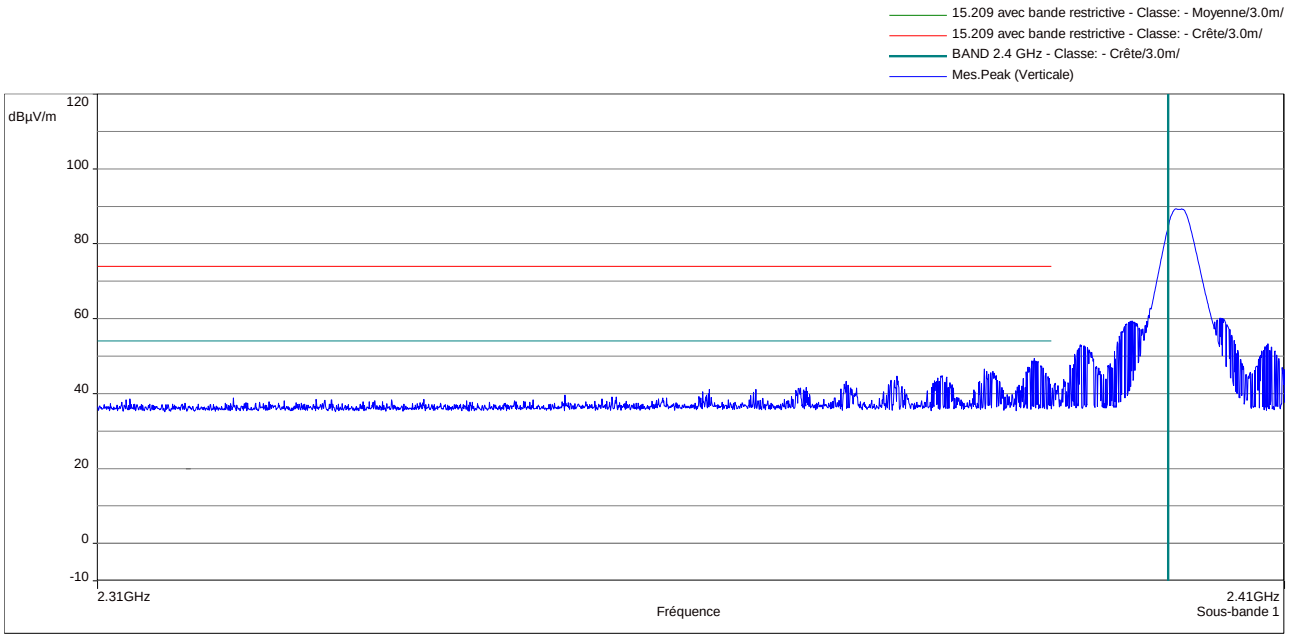
P= Peak, QP=Quasi-peak, Av=Average.
(1) Restricted bands of operation in 15.205
(1) Restricted bands of operation as defined in Table 6 of RSS-Gen
(2) The peak level is lower than the average limit (54 dBµV/m)

Sample N° 2 High Channel (F = 2480 MHz)

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength Measured at 3m (dBµV/m)	Limits at 3 m (dBµV/m)	Margin (dB)
4960 (1)	P	150	1000	1	H	58.0	74	16.0
4960 (1)	Av	150	1000	1	H	51.6	54	2.4

P= Peak, QP=Quasi-peak, Av=Average.
(1) Restricted bands of operation in 15.205
(1) Restricted bands of operation as defined in Table 6 of RSS-Gen
(2) 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 89.4 dBµV/m on low channel.
So the applicable limit is 69.4 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) : 20.1 **Humidity (%HR):** 35 **Date :** February 6, 2023
Technician : S. LOUIS

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:

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

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 photos in appendix 2.

Distance of antenna: 3 meters

Antenna height: 1.5 meter

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:	4MHz
Resolution bandwidth:	3kHz
Video bandwidth:	10kHz
Detector:	Peak
Number of points:	8001
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 with a Gain (unit in dBi) different following the frequencies used.

Equipment under test operating condition:

BLE: The equipment under test is blocked in discontinuous modulated transmission mode (advertising mode), at the highest output power level at which the transmitter is intended to operate.

MIRA: 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: 3.6 Vdc by battery
Percentage of voltage variation during the test (%): ± 1

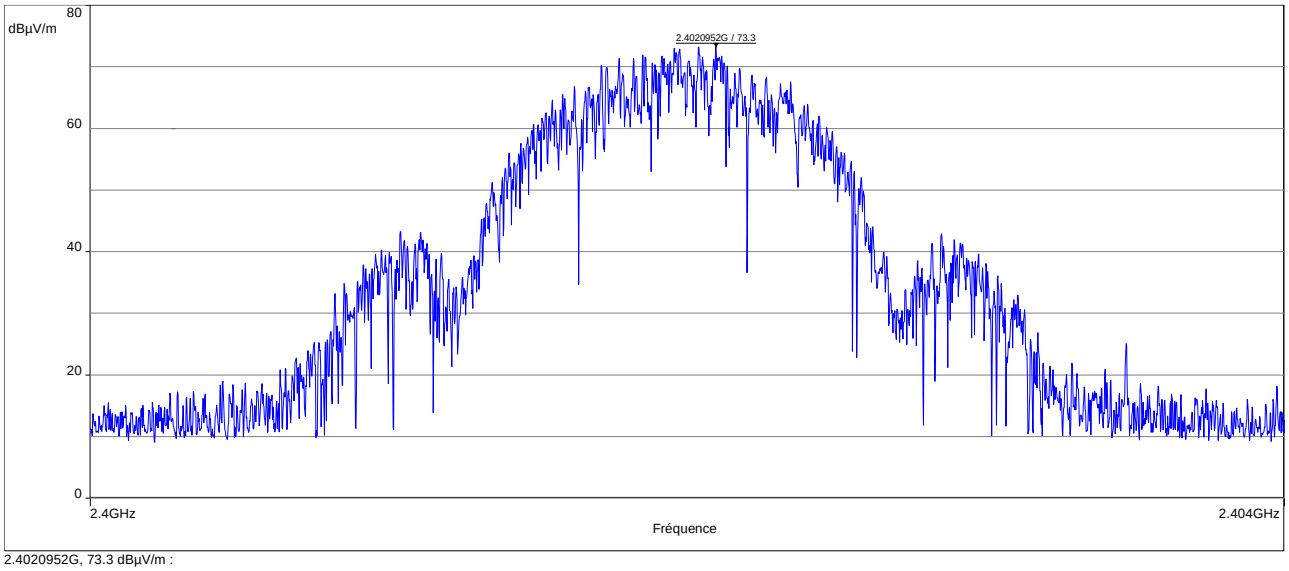
Results:

Sample N° 1 Low Channel (F = 2402 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	73.3	-20.00	8

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat (azimuth: 240 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 = -1.95 dBi.



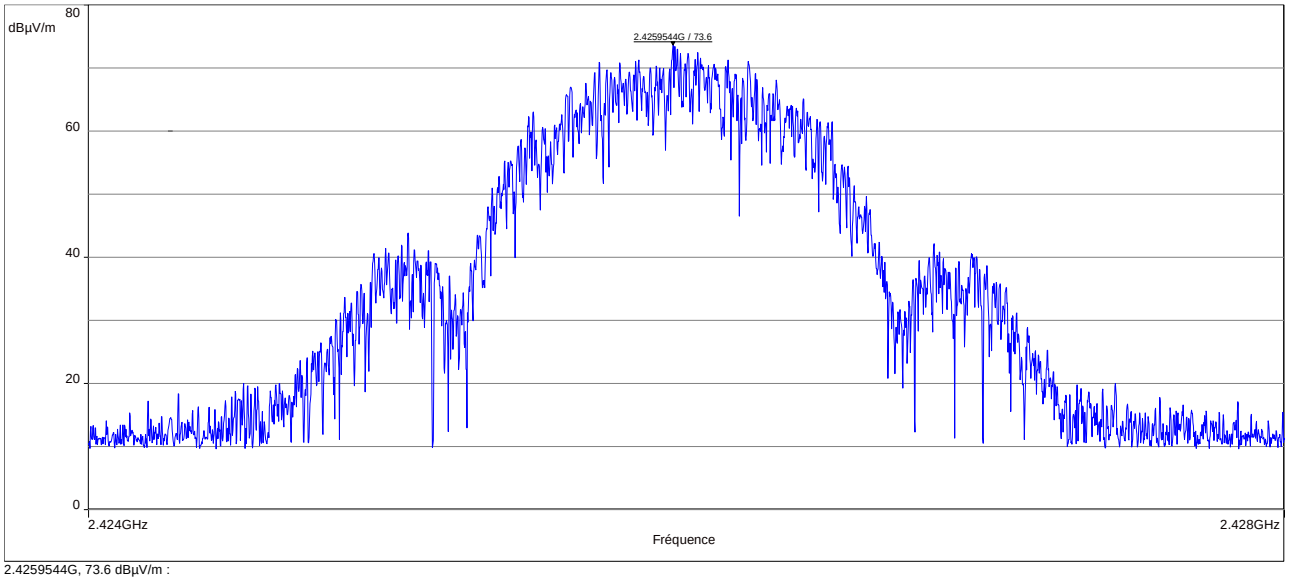
2.4020952G, 73.3 dBµV/m :

Sample N° 1 Central Channel (F = 2426 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	73.6	-19.25	8

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat (azimuth: 240 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 = -2.40 dBi.



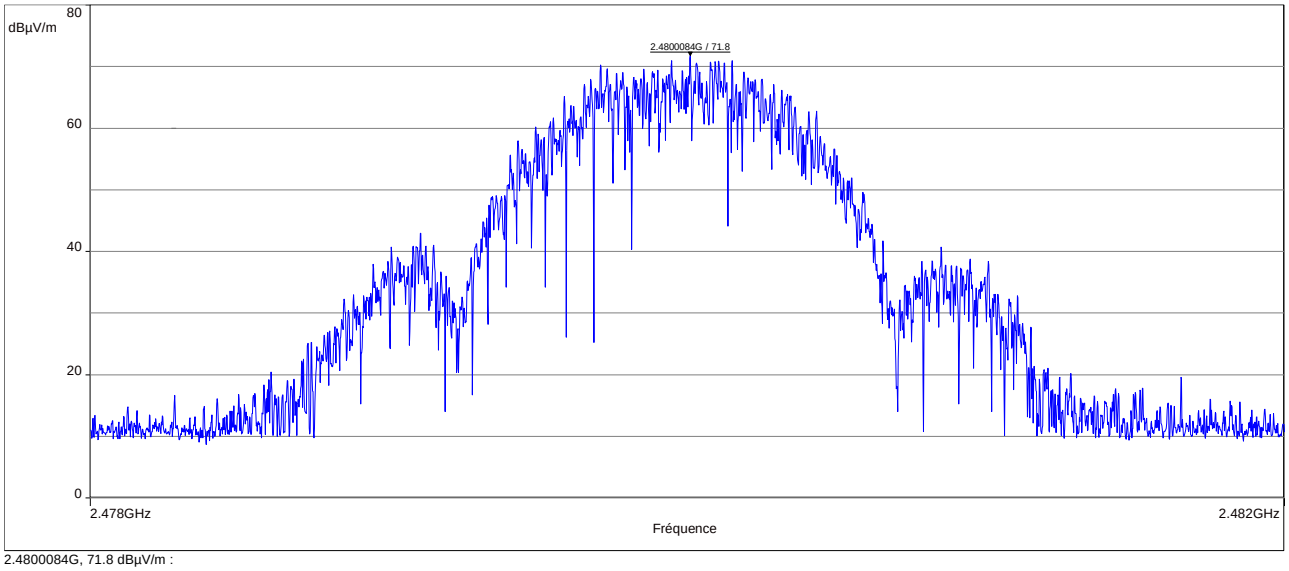
2.4259544G, 73.6 dBµV/m :

Sample N° 1 High Channel (F = 2480 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	71.8	-19.99	8

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat (azimuth: 240 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 = -3.46 dBi.



2.4800084G, 71.8 dBµV/m :

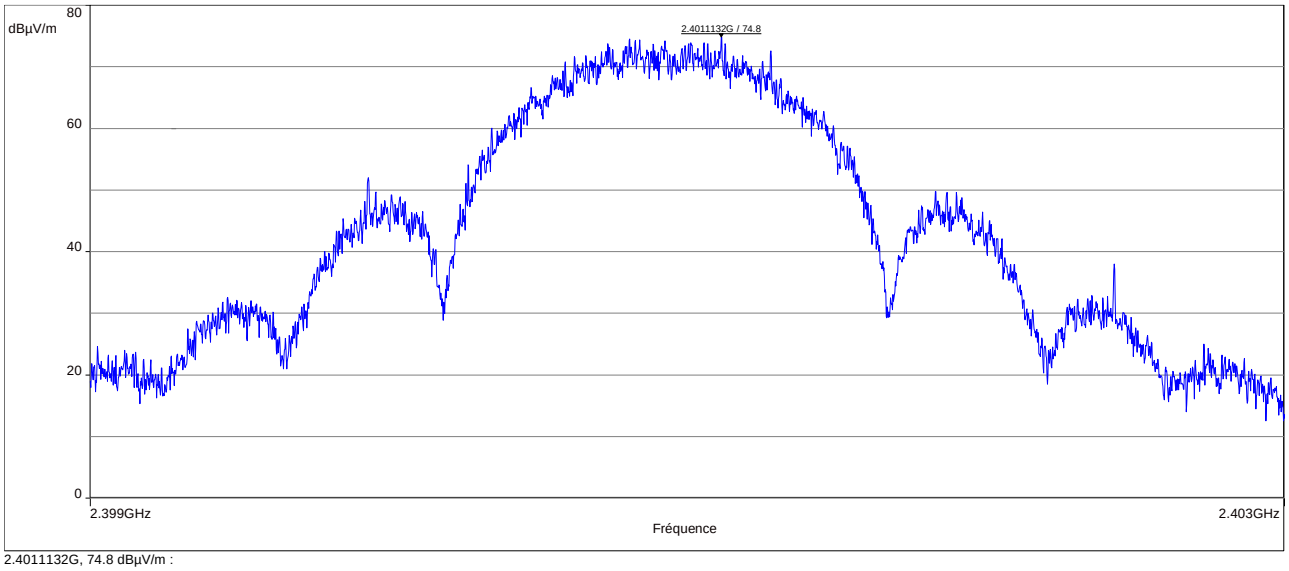
Results:

Sample N° 2 Low Channel (F = 2401 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	74.8	-18.50	8

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat (azimuth: 276 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 = -1.95 dBi.



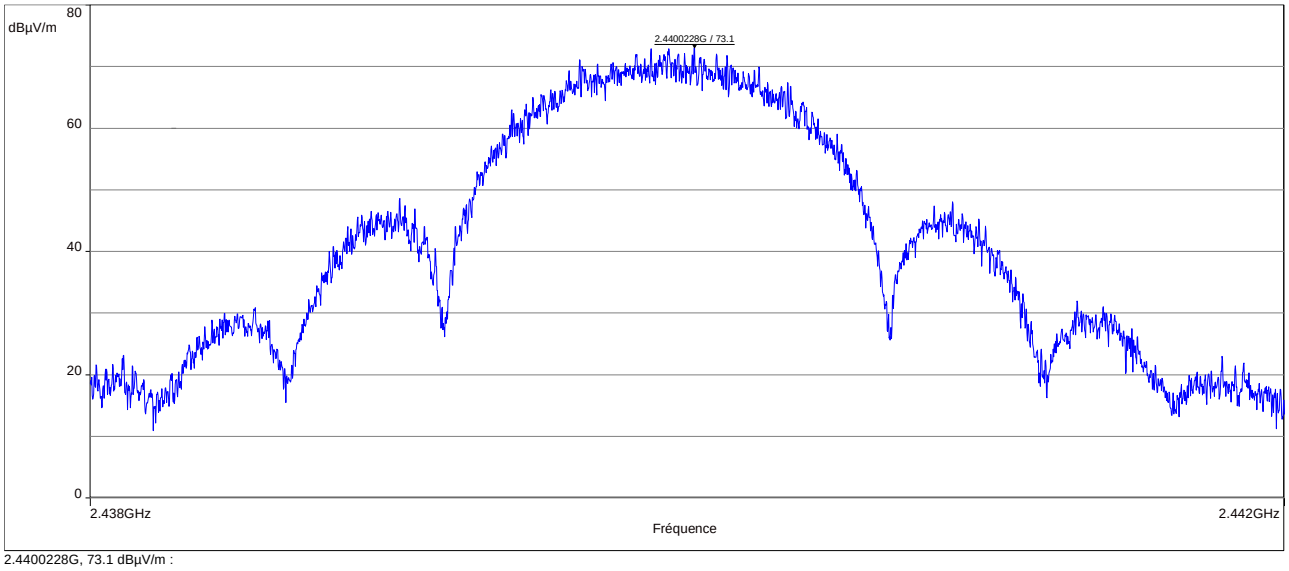
2.4011132G, 74.8 dBµV/m :

Sample N° 2 Central Channel (F = 2440 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	73.1	-20.00	8

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat (azimuth: 286 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 = -2.15 dBi.



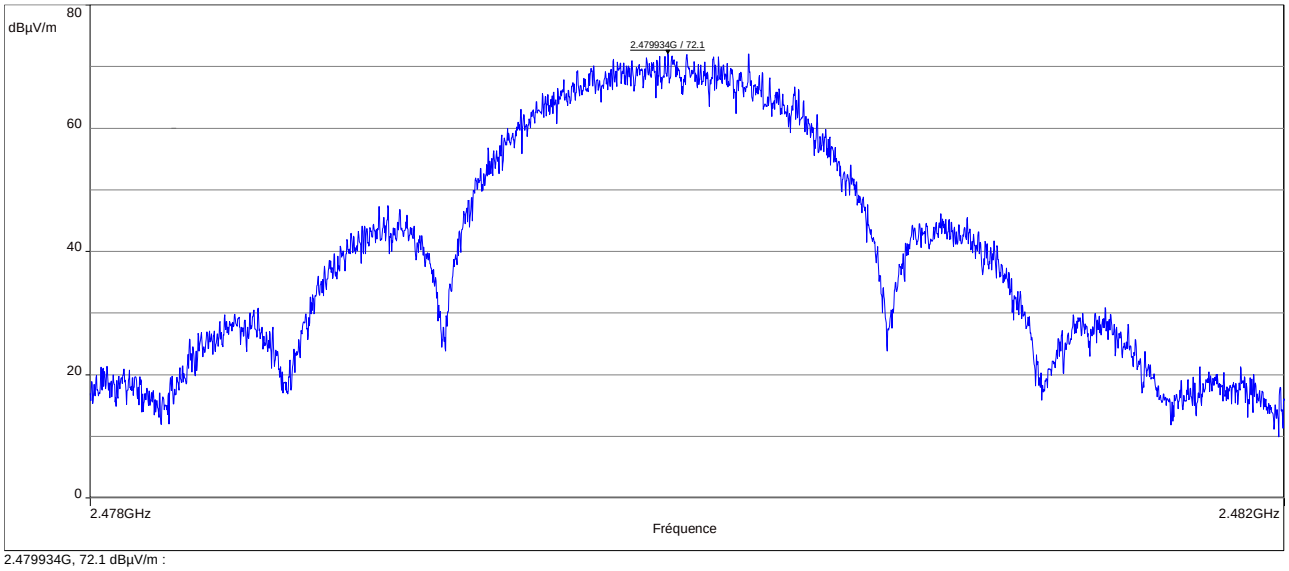
2.4400228G, 73.1 dBµV/m :

Sample N° 2 High Channel (F = 2480 MHz)

	Electro-magnetic field (dBµV/m):	Maximum Peak conducted power density(1) (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage:	72.1	-19.69	8

Polarization of test antenna: horizontal (height: 150 cm)
Position of equipment: Flat (azimuth: 307 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 = -3.46 dBi.



2.479934G, 72.1 dBµV/m :

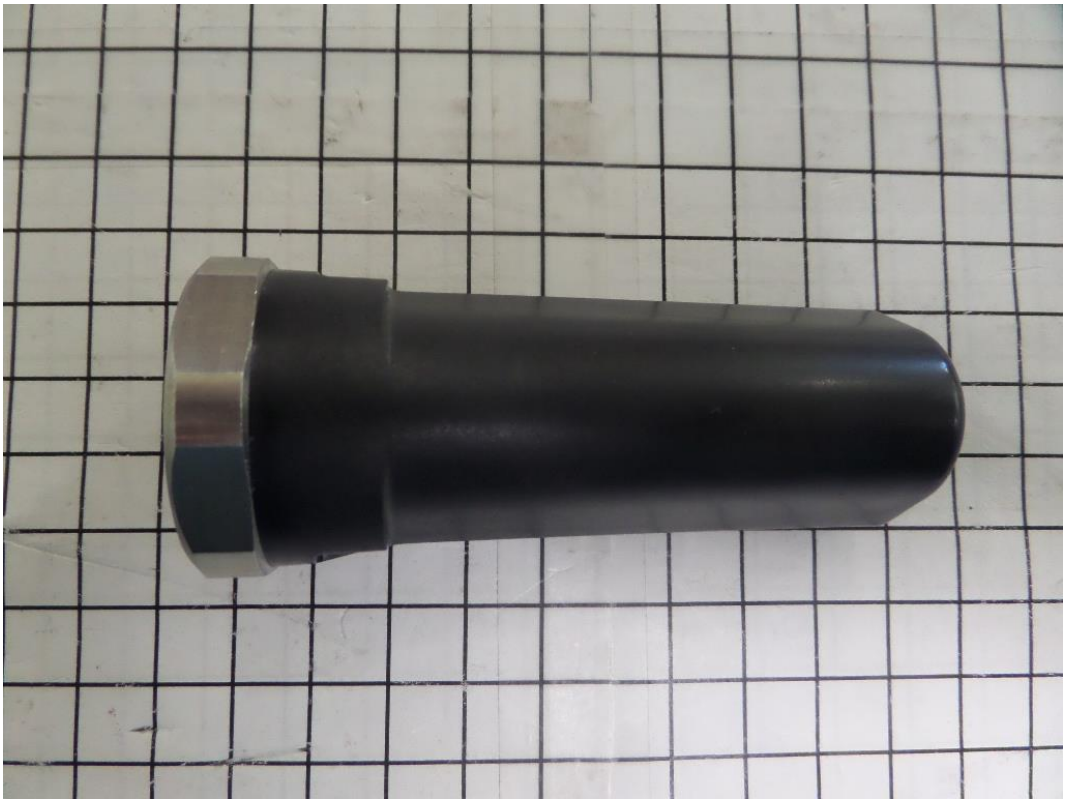
Test conclusion:

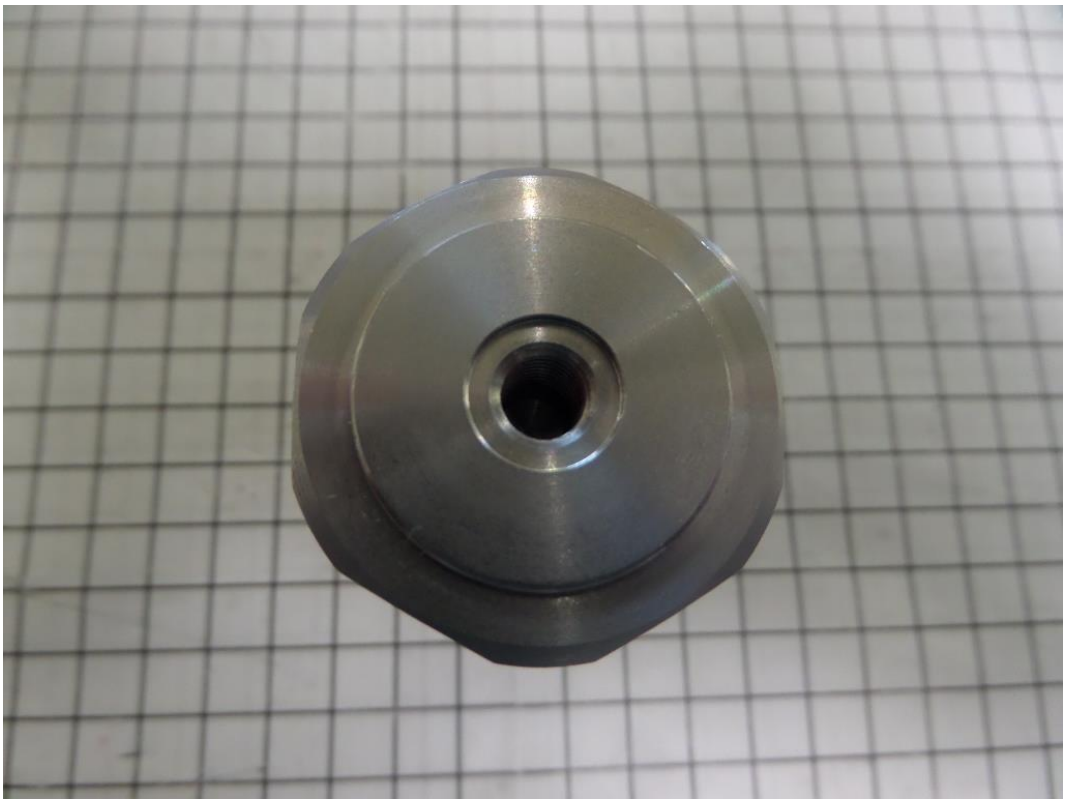
RESPECTED STANDARD

□□□ End of report, 3 appendixes to be forwarded □□□

APPENDIX 1: Photographies of the equipment under test

Sample 1



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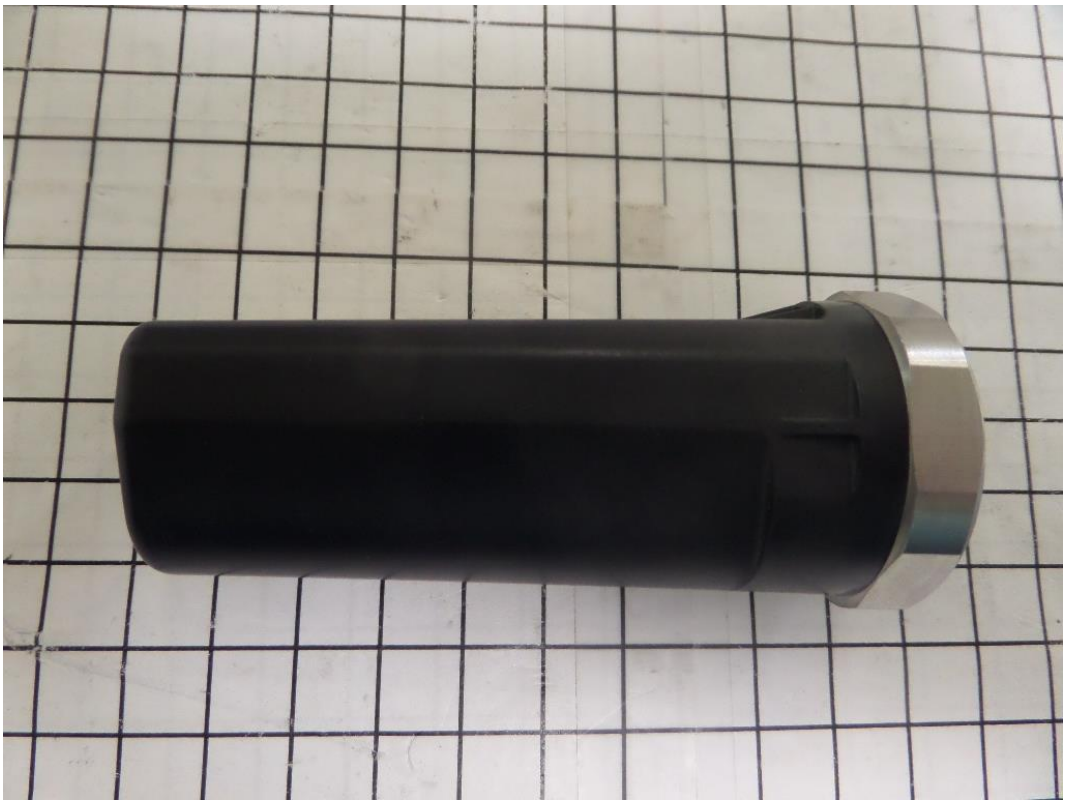
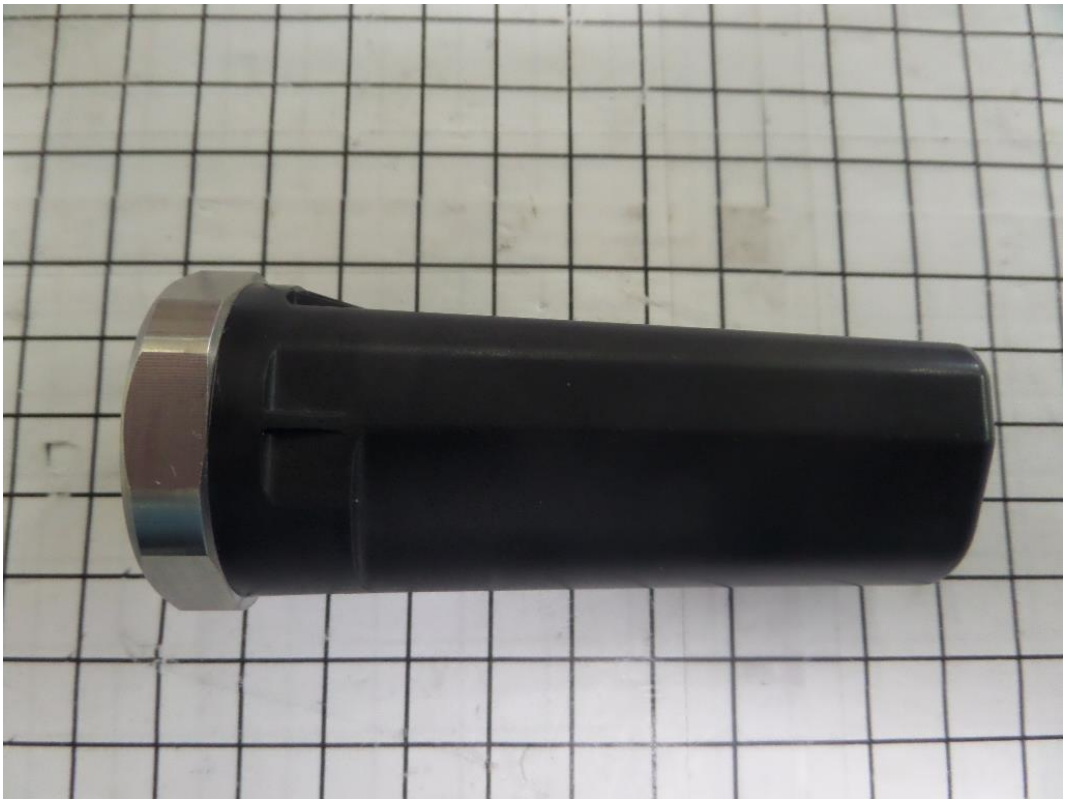
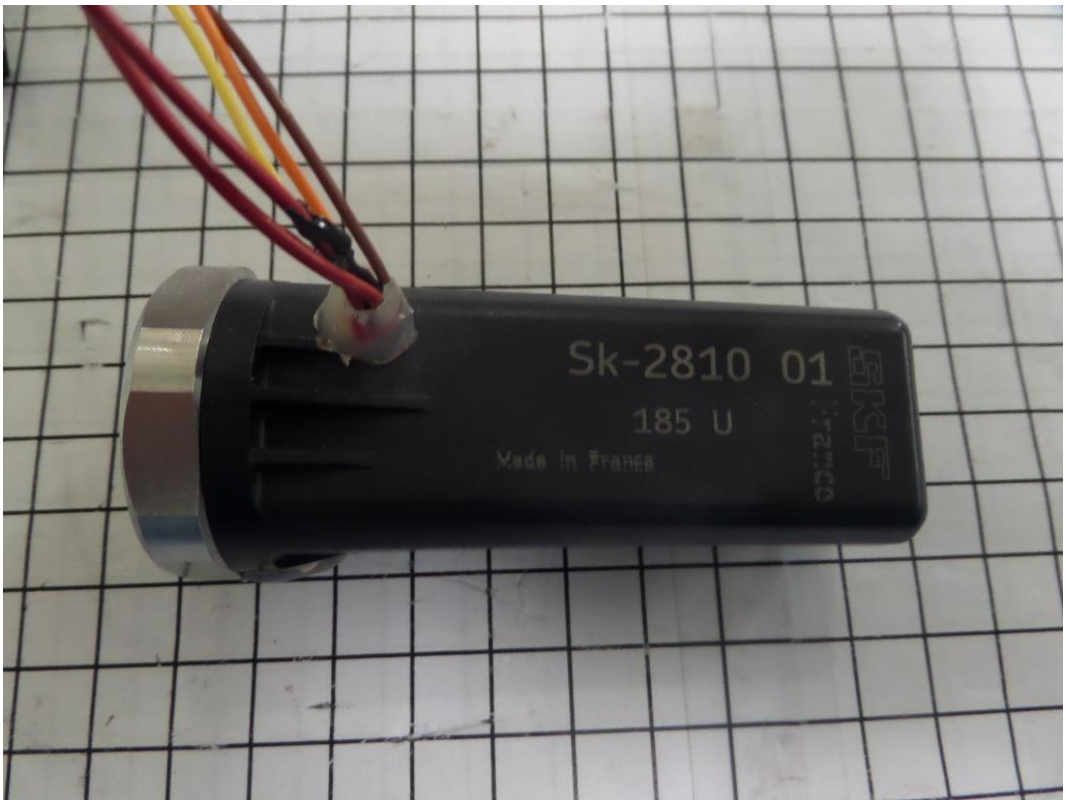


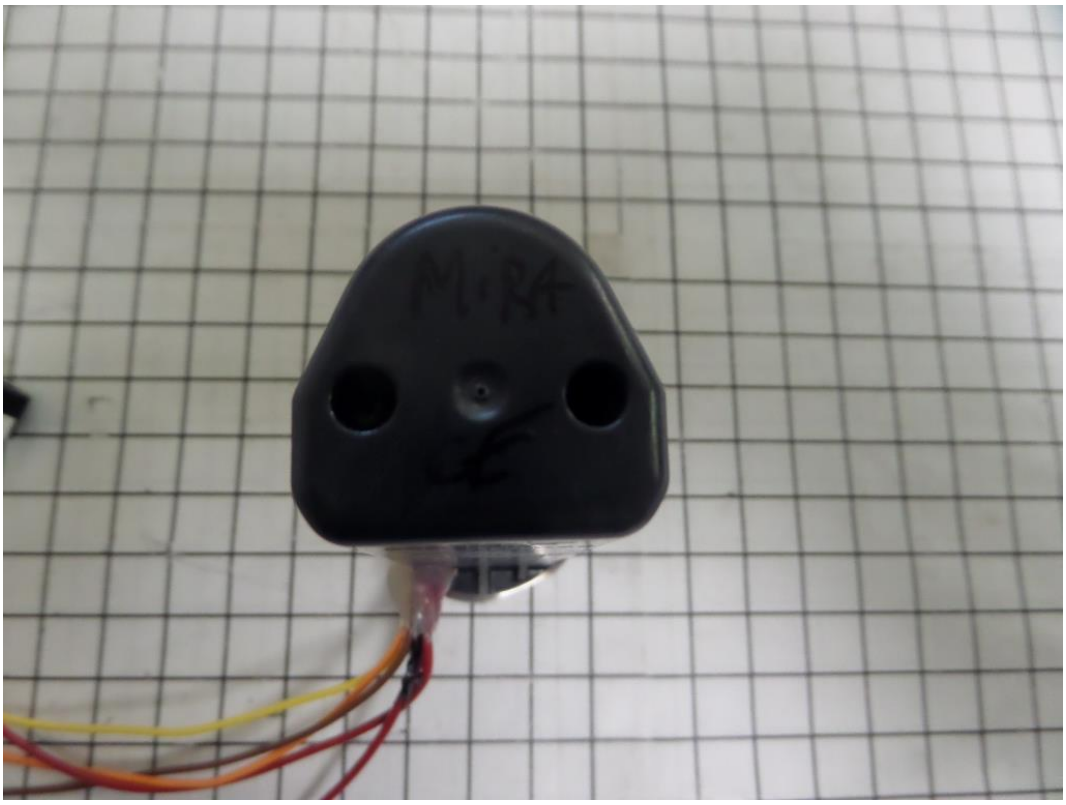


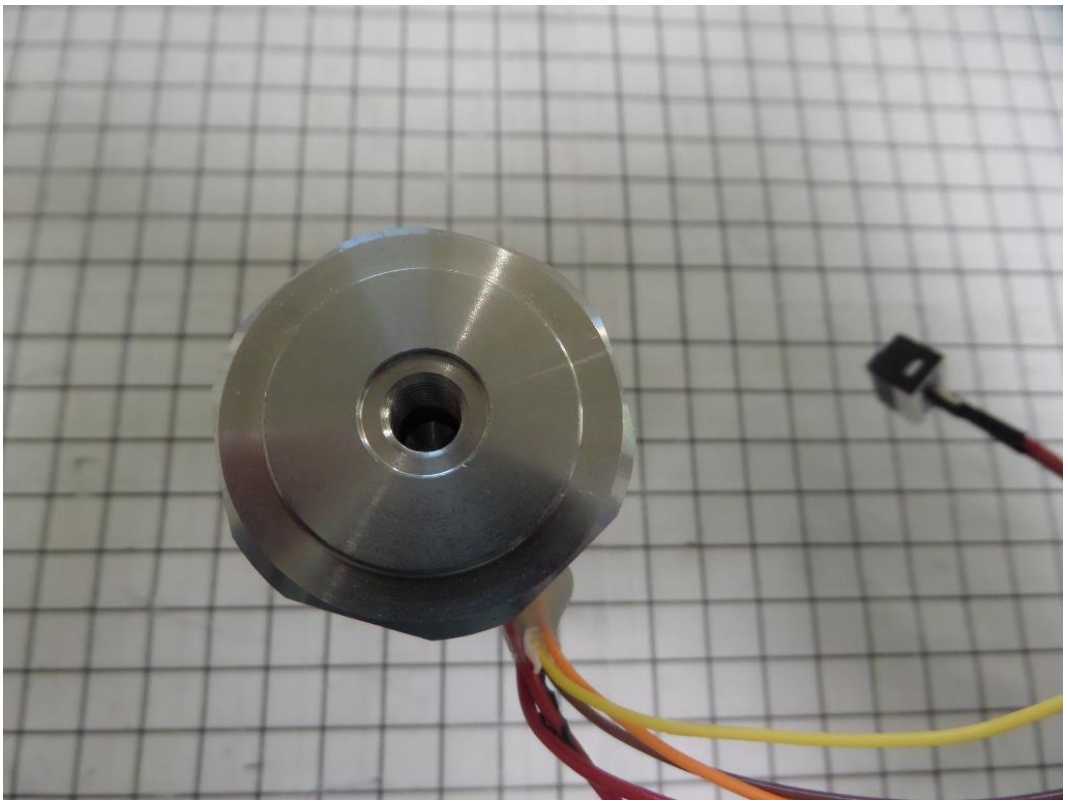
Internal view

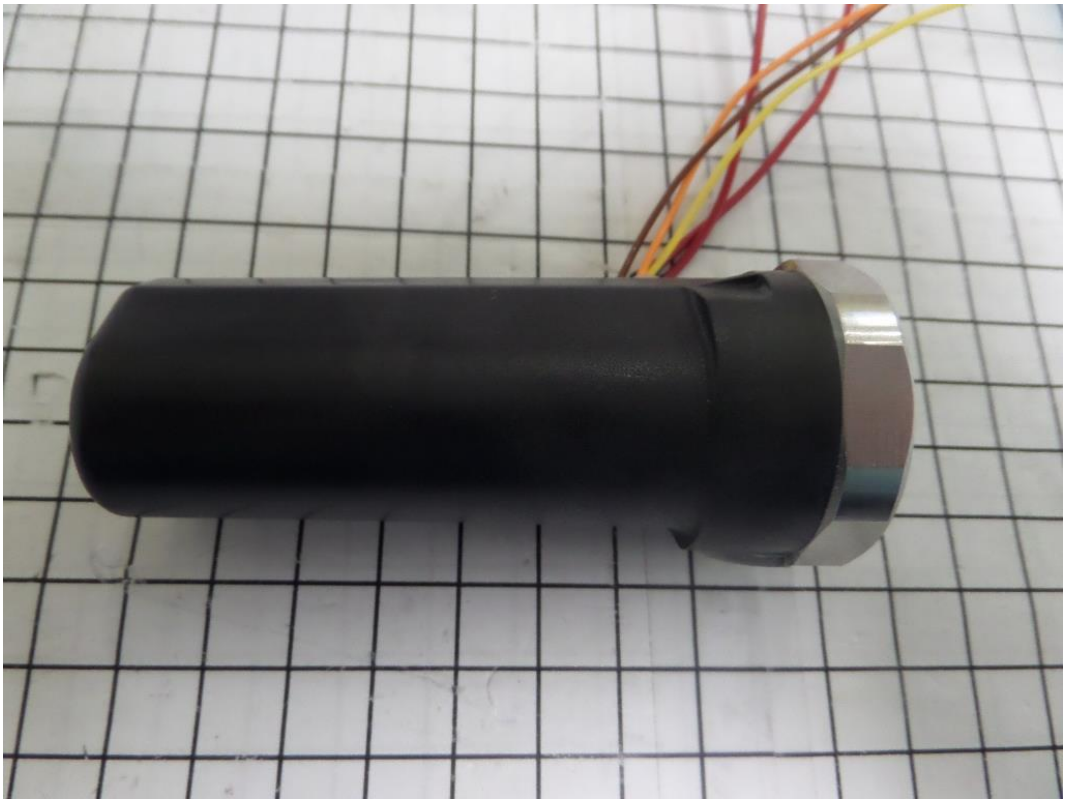
Confidential

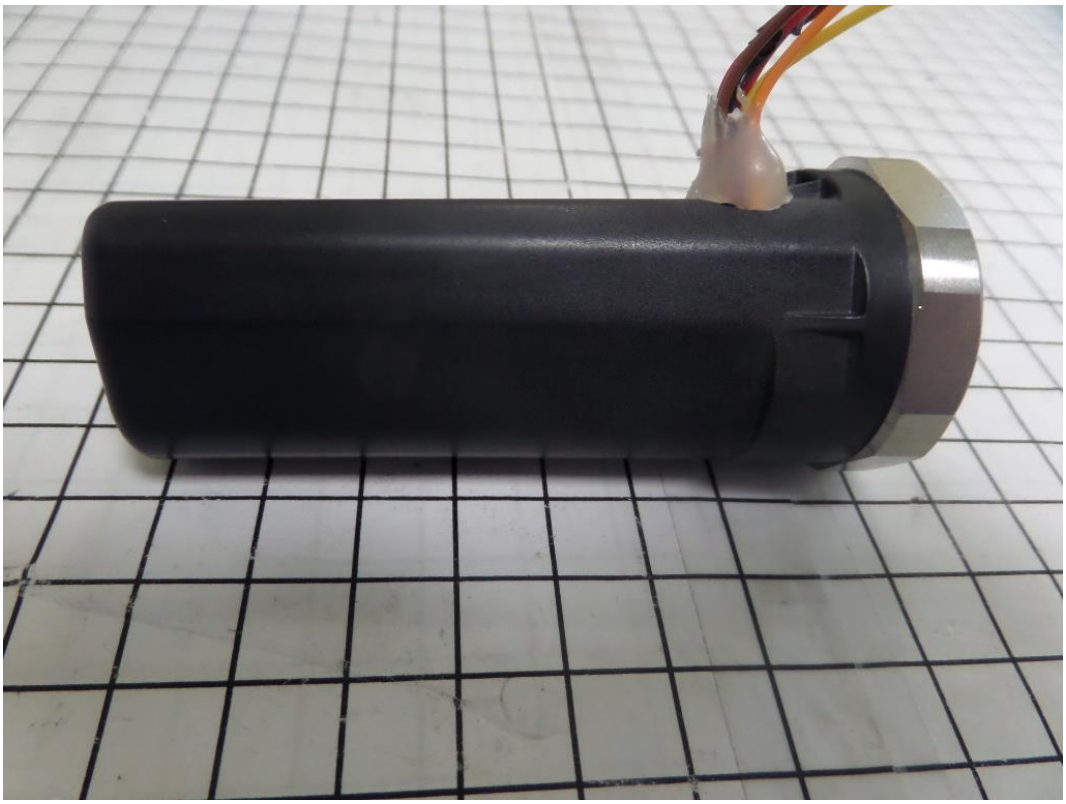
Sample 2

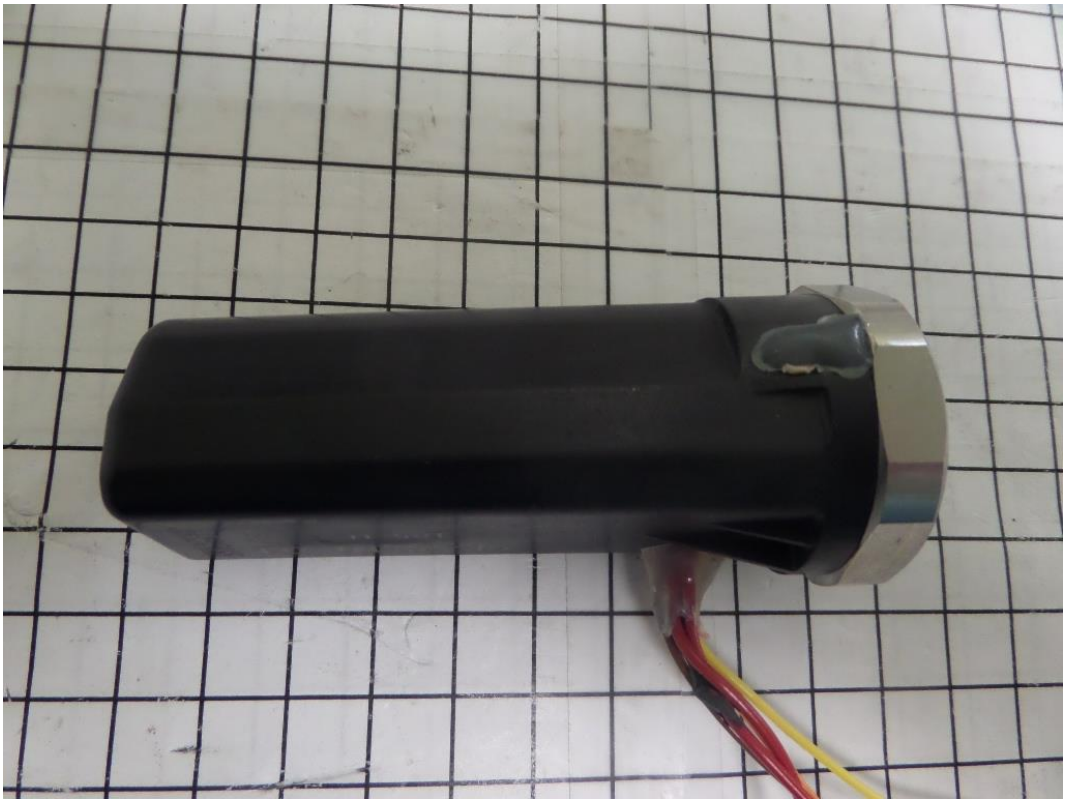






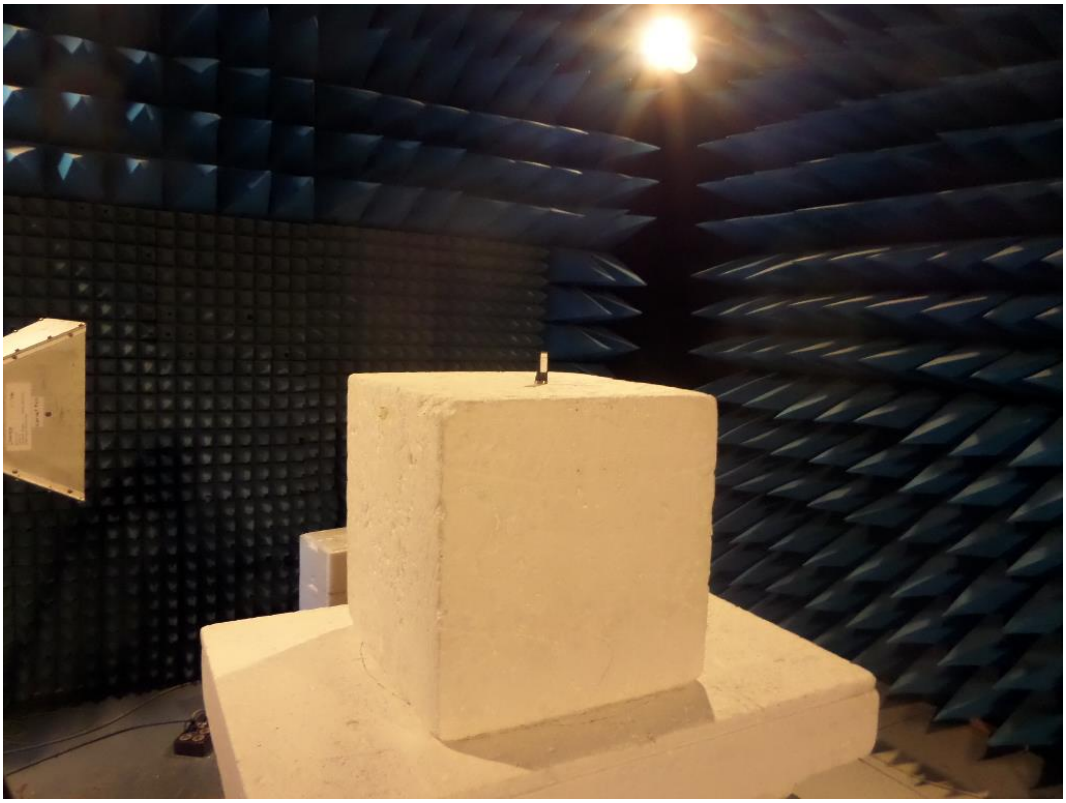


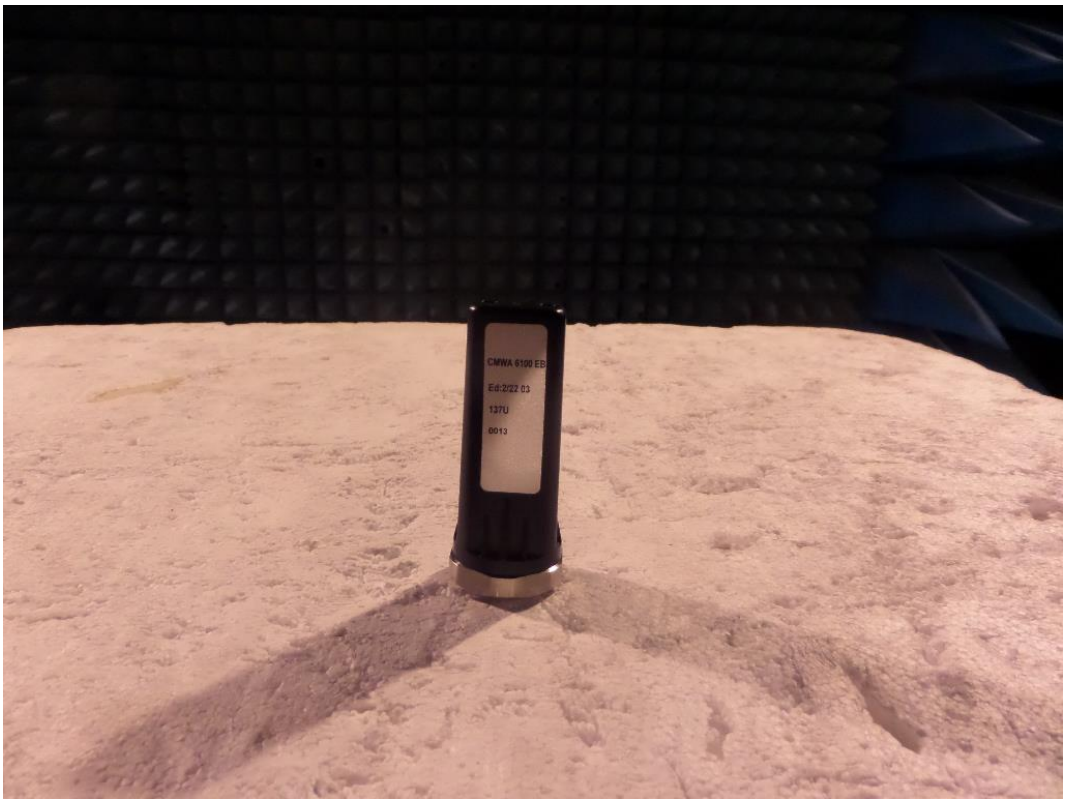




APPENDIX 2: Test set up

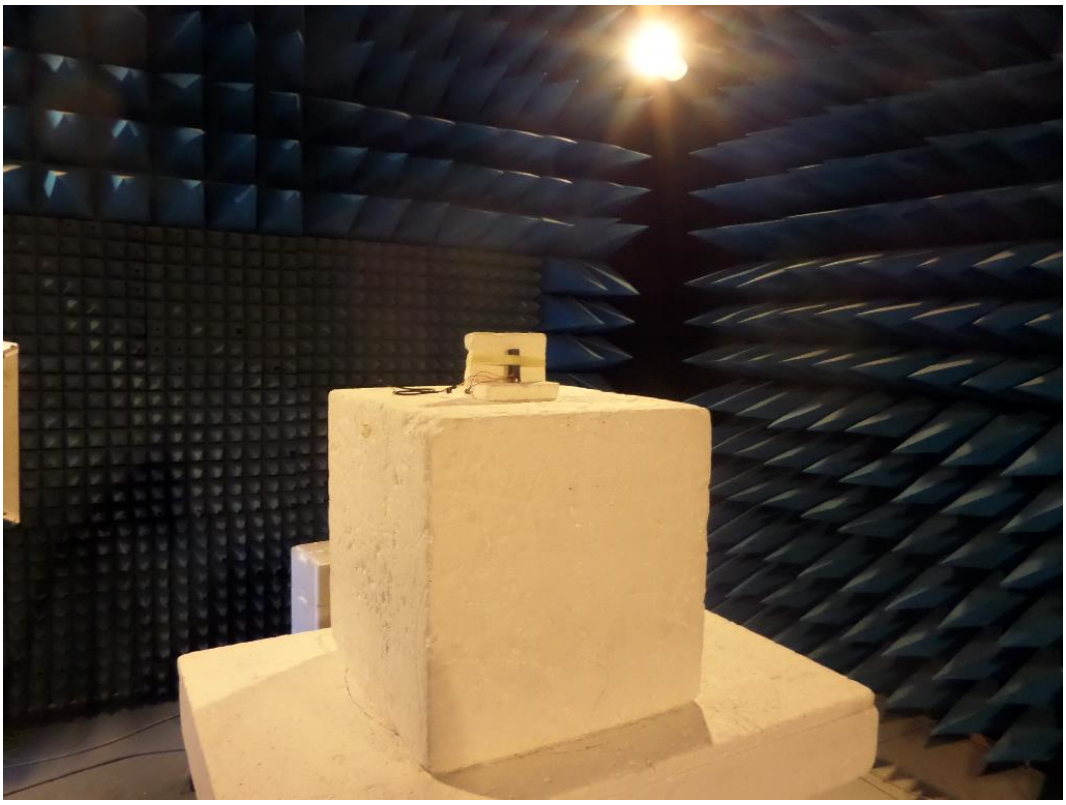
Sample 1 - Position 1

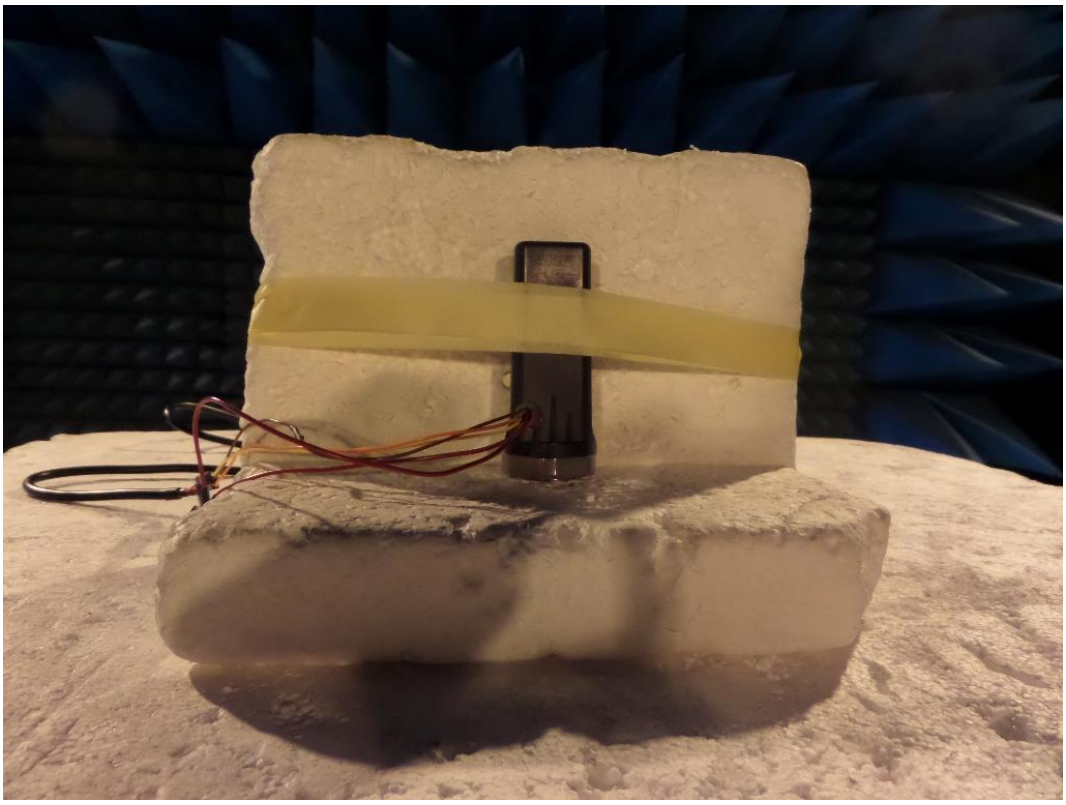




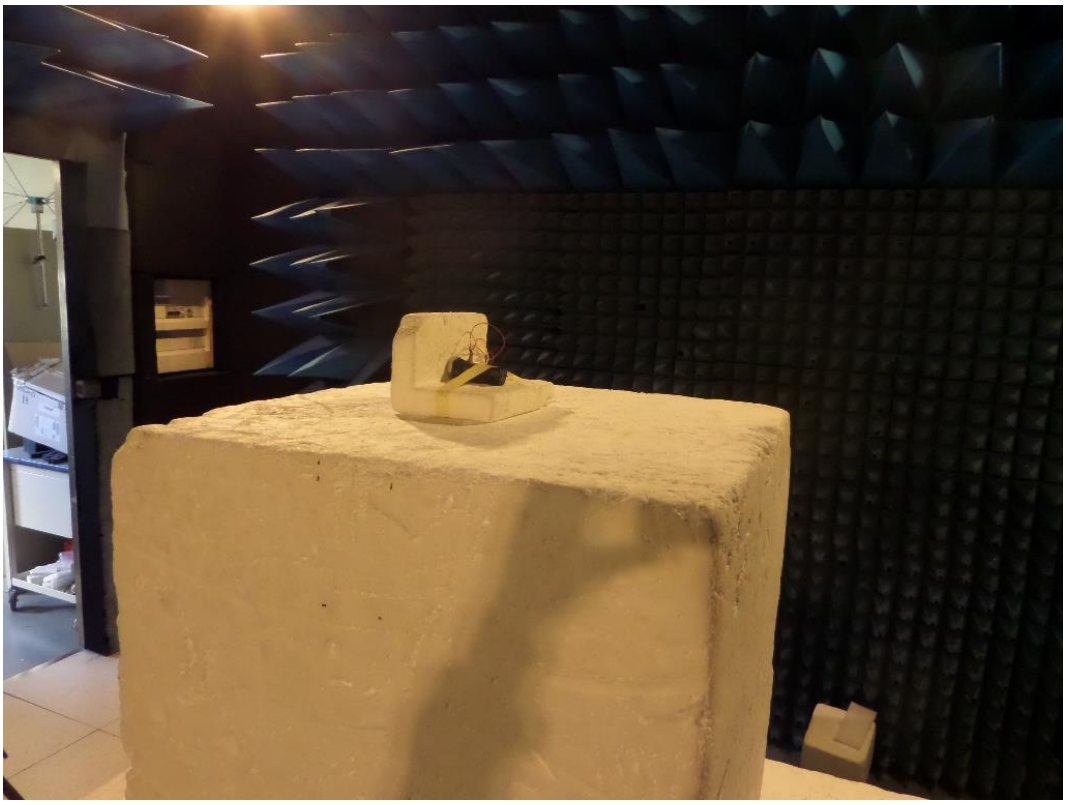
Sample 1 - Position 2

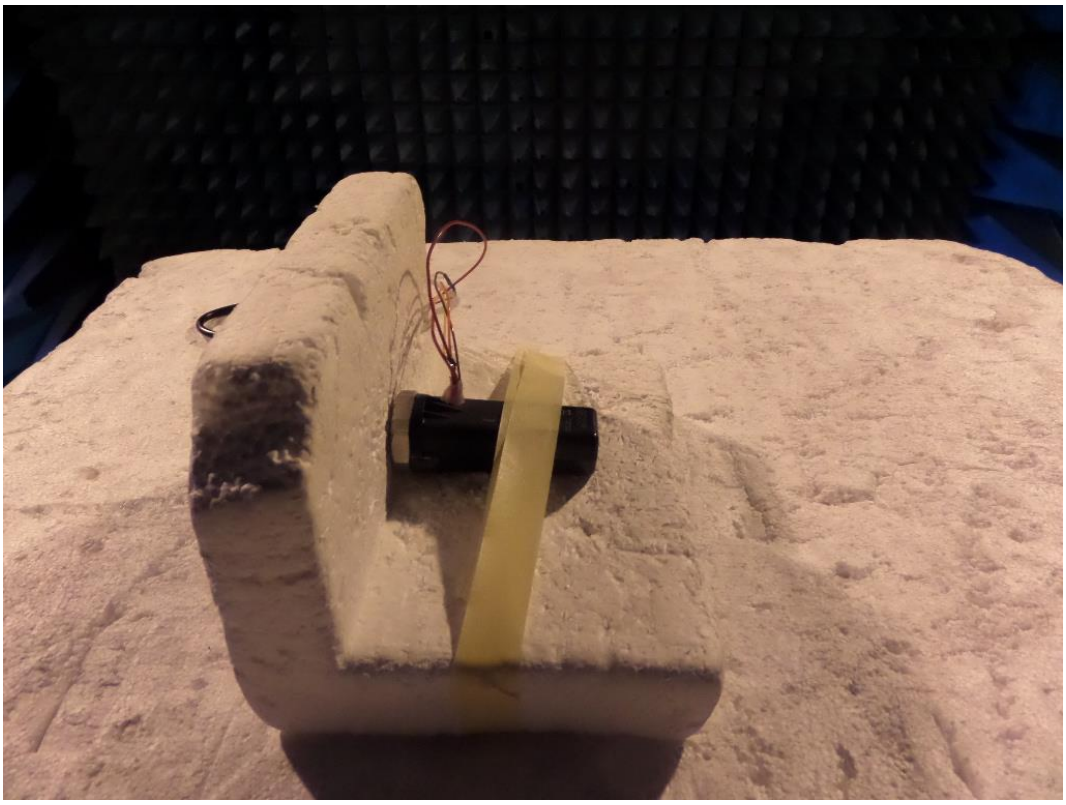
Sample 2 - Position 1





Sample 2 - Position 2





APPENDIX 3: Test equipment list

Occupied bandwidth

TYPE	MANUFACTURER	EMITECH NUMBER
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Antenna 3115	EMCO	8535
Antenna 3117	ETS-Lindgren	10771
N-1.5M Cable	SUCOFLEX	7279
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	GPIBShot V2.4	-

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
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
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
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	GPIBShot V2.4	-

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
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000

Radiated spurious emissions

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
Loop antenna 6502	EMCO	1406
Biconical antenna VHBB 9124	Schwarzbeck	8526
Log periodic antenna UHALP 9108A	Schwarzbeck	8543
Antenna 3115	EMCO	8535
Antenna SAS-572	A.H Systems	7124
Antenna WR28	ATM	4353
Low-noise amplifier 8447D	Hewlett Packard	8511
Low-noise amplifier PAM-118A	COM-POWER	15812
Low-noise amplifier S180265L3201	LUCIX Corp.	8704
Low-noise amplifier ALS2640-30-10	ALC	4354
N-1.5M Cable	SUCOFLEX	7279
N-2M Cable	Huber + Suhner	12911
N-5M Cable	MecHanc	18413
Cable k-20cm	STORM MICROWAE	8974
Cable k-20cm	STORM MICROWAE	8975
Reject band filter BRM50702	Microtronics	7299
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000

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
Software EMC 32	Rohde et Schwarz	10811
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000