Rapport d'essais / *Test Report*

N° : **14768-FCC-ISED-2**

FCC Test Firm Designation Number: FR0014
ISED Wireless Device Testing Laboratory CAB Number: FR0004

Matériel testé : *Equipment under test*:	**ENGIE / PARHyS Sensor** *(Trademark / Marketing name or product reference)*

Demandeur de certification :
Applicant for certification:
ENGIE Lab CRIGEN
4, Rue Josephine Baker
93240 STAINS – FRANCE

Client :
Customer:
NEMEUS
36 rue des landelles
35510 – Cesson-Sevigne – France

Numéro d'affaire :
Work number :
092022-25649

Référence de la proposition :
Proposal number:
14768

Date de l'essai :
Date of test:
Du 7 au 24 Novembre 2022
November 7th to 24th,2022

Objectif des essais :
Test purpose:
EMC qualification accordingly to following standards:
- CFR 47, FCC Part 15, Subpart C
(Chapter 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz)
- Industry Canada RSS-247, Issue 2
(Digital Transmission Systems Operating in the Bands 902–928 MHz)
Measurement standards:
ANSI C63.10 (2013)

Lieu du test:
Test location:
SMEE, 385 Rue René Rambaud
38500 VOIRON - France

Test réalisé par :
Test realized by:
Chemseddine KERMICHE

Conclusion :
Conclusion:
L'équipement satisfait aux prescriptions et essais des normes citées en référence.
The appliance complies with requirements and tests of above mentioned standards.

Ed.	Date	Modifications / Pages	Written by: Visa	Approved by: Visa
1 2	January 9th, 2023 March 9th, 2023	Initial Edition Additional information	Chemseddine KERMICHE *Test operator*	Laurent CHAPUS *Technical Manager*

La copie de ce document n'est permise que sous sa forme intégrale. Ce document est le résultat d'essais effectués sur un échantillon. Il ne préjuge pas de la conformité de l'ensemble des produits fabriqués à l'objet essayé. Pour la déclaration de conformité de l'équipement, il n'est pas tenu compte de l'incertitude de mesure. Cette nouvelle édition de ce rapport annule et remplace l'édition précédente. Les modifications apportées à une nouvelle édition de ce rapport sont signalées par un trait vertical à gauche de la page.
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COORDONNEES
SMEE
385, Rue René Rambaud, ZA Le Parvis 2
38500 VOIRON - France
TEL : 04 76 65 76 50
FAX : 04 76 66 18 30

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1. Normatives References

FCC qualification according to:		
Standards	**Applied**	**Title**
ANSI C63.10 (2013)	X	American National Standard for Testing Unlicensed Wireless Devices
CFR47, Part 15 (November 2022)	X	Telecommunication – Federal Communication Commission – Radio frequency devices, Sections 15.207 / 15.209 / 15.247

ISED qualification according to:		
Standards	**Applied**	**Title**
RSS-Gen (Issue 5/2018, amendments 2019 and 2021)	X	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 (Issue2/2017)	X	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Note: Following guidance are used
- DTS Measurement Guidance 558074 D01 v05r02
- Determining ERP and EIRP Guidance 412172 D01 v01r01

Deviation from standard: None.

2. Test synthesis

Requirement for Systems using digital modulation techniques (DTS)

TEST	Paragraph number FCC Part 15 / ISED ICES & RSS	Spec. FCC Part 15 / ISED ICES & RSS	RESULTS (comments)
Conducted emissions test	15.207 (a) RSS-Gen § 8.8	Table 15.107 (a) / 15.207 (a) Table 4 / RSS-Gen	**PASS**
6dB Bandwidth	15.247 (a) (2) RSS-247 § 5.2 (a)	At least 500kHz	**PASS**
Maximum Peak Output Power	15.247 (b) (3) & (4) RSS-247 § 5.4 (d)	1W max / 30dBm (Conducted) 4W max / 36dBm (EIRP)	**PASS**
Maximum Power Spectral Density	15.247 (e) RSS-247 § 5.2 (b)	8dBm in a 3kHz band segment	**PASS**
Unwanted emissions into Non Restricted Frequency Bands	15.247 (d) / RSS-247 § 5.5	-20dBc in any 100kHz outside frequency band.	**PASS**
Unwanted emissions into Restricted Frequency Bands	15.209 (a) / 15.247 (d) / 15.205 (a) RSS-GEN §8.9, § 8.10 / RSS-247 § 5.5	Measure at 300m 9-490kHz: 2400µV/m/F(kHz) 6.370µA/m/F (kHz) Measure at 30m 0.490-1.705: 24000µV/m/F(kHz) 63.70µA/m/F (kHz) 1.705-30MHz: 30µV/m 0.08µA/m Measure at 3m 30MHz-88MHz : 40 dBµV/m 88MHz-216MHz : 43.5 dBµV/m 216MHz-960MHz : 46.0 dBµV/m Above 960MHz : 54.0 dBµV/m	**PASS**
Occupied Bandwidwth	RSS-GEN § 6.7	-20dB and BW at 99%	**PASS**

(1): Battery operated equipment

- **General conclusion:**

Measures and tests performed on the sample of the product *ENGIE / PARHyS Sensor*, in configuration and description presented in this test report, show compliance with standards FCC CFR 47, PART 15, Subpart C and ISED RSS-Gen & RSS-247.

3. Equipment Under Test (EUT)

Nom / *Identification*	**ENGIE / PARHyS Sensor** *(Trademark / Marketing name or product reference)* Sn: POC1.
FCC ID: **IC:** **Model / HVIN:**	2A9GC03664411000133 29772-03664411000 PARHYS SENSOR
Alimentation / *Power supply*	3.6V DC (2x SL-270 – 3.6V/19Ah internal batteries)
Auxiliaires / *Auxiliaries*	None.

Entrées-Sorties / *Input / Output*

	Câbles pour essai / *Cables for test*	Blindé / *Shielded*	Prévu pour >3m / *Intended for >3m*
No cable	-	-	-

Mode de fonctionnement / *Running mode*

The tested sample is able to:
- Transmit a carrier frequency on low, middle and high channels (Bluetooth Low Energy).

Programme de test / *Test program /*

None.

Fréquence max interne EST / *Max internal EUT frequency*

2.4GHz for RF data transmission.

Information sur l'équipement / Equipment information

Declaration of the applicant:
- Frequency band: 2400 to 2483.5 MHz (Tx & Rx, Wideband Data Transmission systems)
- BLE Power Setting: Power is set at 4dBm as declared by the manufacturer.
- Duty cycle: 85%
- Modulation: Bluetooth Low Energy (1Mbps)
- Antenna type: Chip SMD antenna
- Antenna Gain measured: -3.5dBi
- Powered by 3.6V DC from external power supply
- Equipment intended for use as a mobile device
- Equipment designed for continuous operation

Dimensions de l'EST / *Dimensions of EUT*

Height: 167mm
Diameter: 154mm

Note: The above information are declared by the manufacturer/customer and are under his responsibility.

4. Test conditions

Power supply voltage:

Equipment under test:	3.6V DC from internal batteries.
Auxiliaries:	None.

5. Modifications of the EUT

None.

6. Special accessory

None.

7. Measurement Uncertainty

Test Description	Expanded uncertainty
Conducted emissions test (150k-30MHz, AC mains)	± 3.5dB
Radiated emission test (9kHz-30MHz, electric field)	± 4.0dB
Radiated emission test (30-200MHz, SAC 3m)	± 5.6dB
Radiated emission test (200-1000MHz, SAC 3m)	± 5.3dB
Radiated emission test (1-18GHz, FAC 3m)	± 5.6dB
Radiated emission test (18-40GHz, FAC 3m)	± 5.6dB
Conducted RF output power at antenna port	± 1.6dB
Radiated RF output power (Peak, Power density)	± 5.6dB
DTS Bandwidth, 99% OBW	±4%
Temperature	± 1°C
Time and duty cycle calculation	±1%
AC and DC voltage	±1%

Note: Expended uncertainty at 95% confidence (k=2)

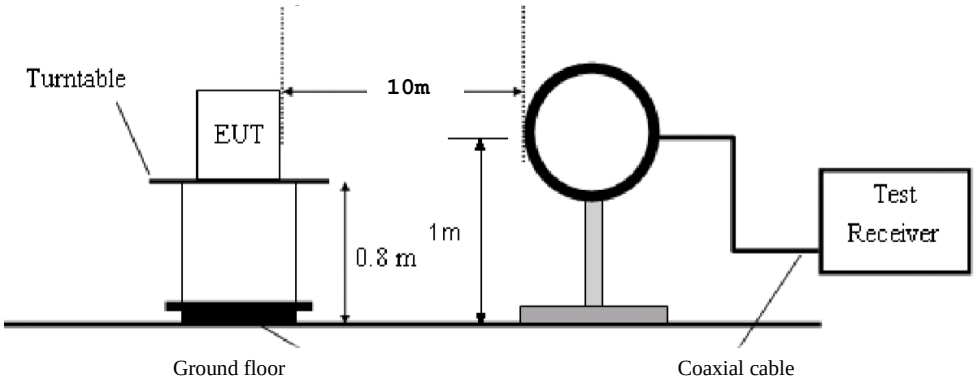
8. Field Strength Calculation

The field strength (level) is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follow:
FS = RA + AF + CF – AG
Where FS = Field Strength (Level)
RA = Receiver Amplitude (Meter Reading)
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain
Margin value = Emission level – Limit value

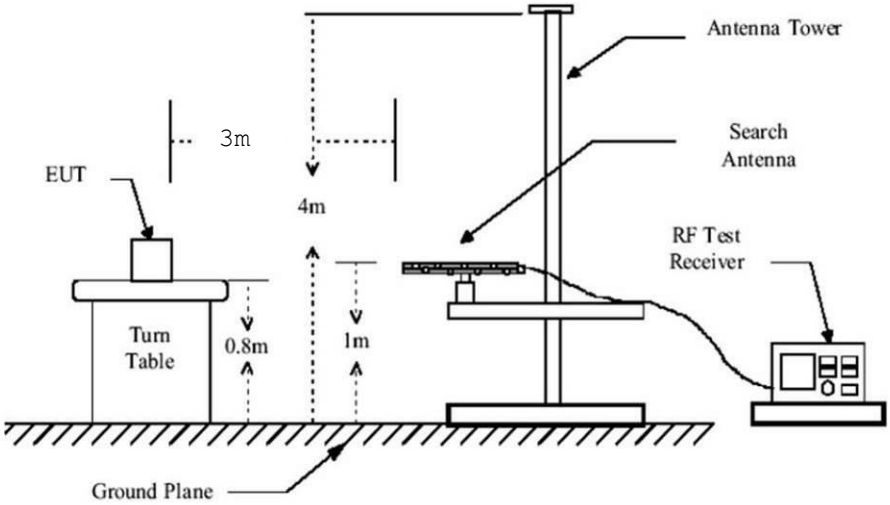
<u>Example</u>:
RA: 14.0dBµV / AF: 16.5 dBm^{-1} / CF: 3.5dB / AG: 15dB
→ Total factor: $5dBm^{-1}$
→ Field level: 19.0dBµV/m (-21.0dB for margin if limit is 40dBµV/m)

9. Test Setup Diagram

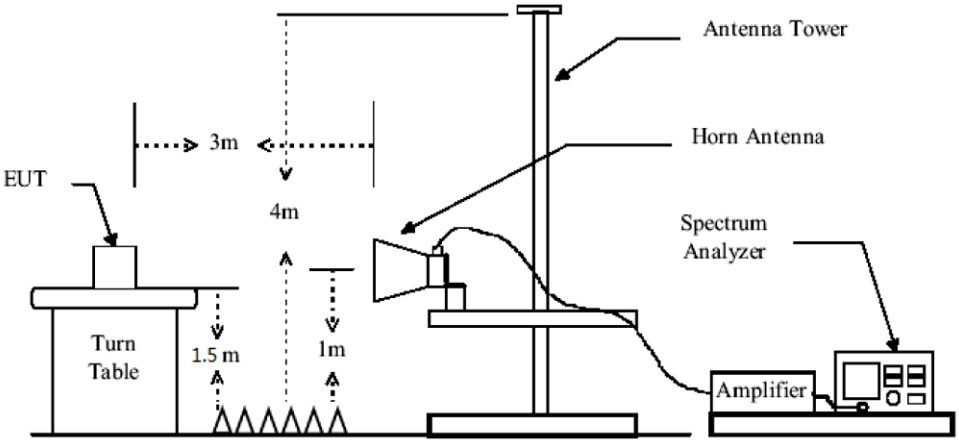
Test Setup for radiated emission



Test setup for 9k-30MHz (FS OATS)



Test setup for 30-1000MHz (SAC 3m)



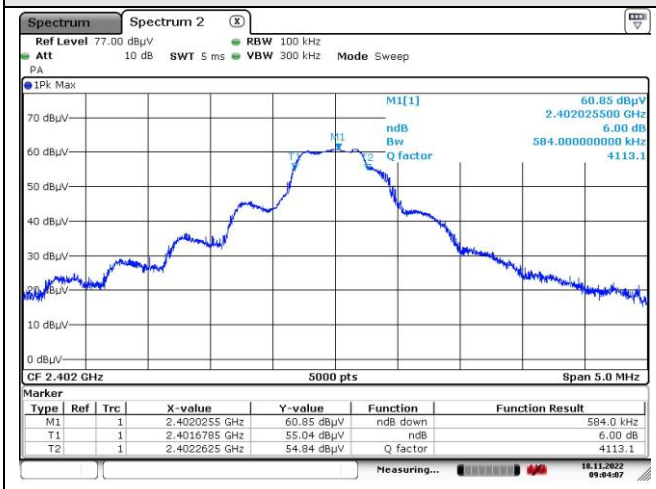
Test setup for 1-25GHz (SAC 3m, tilt antenna mast used)

10. DTS Bandwidth

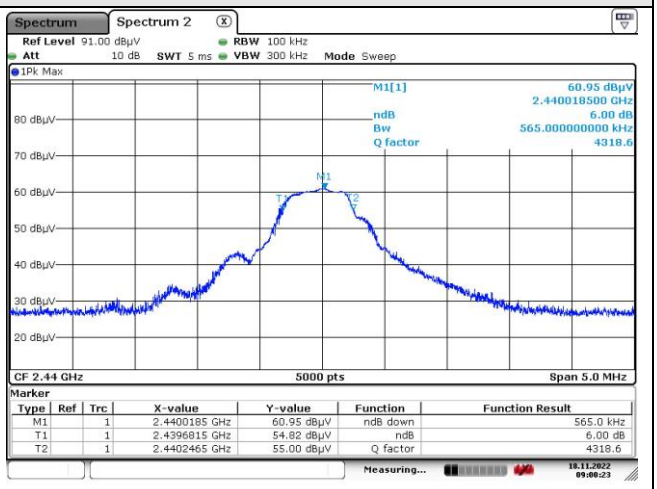
TEST: DTS Bandwidth		**Verdict**
Method: The setup is in an anechoic chamber. The spectrum analyzer is connected to the measuring antenna. A radiated measurement is performed. The RBW is 100kHz, with VBW ≥ 3 x RBW. The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. Automatic function of the spectrum analyser is used. The tested equipment is set to transmit operation with modulation on low, mid and high channels.		**Pass**
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	20 to 30 °C	22°C ± 2
Relative Humidity	25 to 70 %	49% ± 5
Limits – FCC Part 15.247 (a) / RSS-247 §5.2 (a)		
Frequency (MHz)	**Level for Bandwidth**	**Limit**
2402.0	6dB below the maximum output power	At least 500kHz
2440.0		
2480.0		
Supplementary information: Test location: SMEE. Test date: November 18th, 2022 by C KERMICHE. Power supply voltage: 3.6V DC from internal battery.		

Tabulated Results for Occupied Bandwidth		
Frequency (MHz)	**6dB Bandwidth** (kHz)	**Result**
2402.0	584.0	**Pass**
2440.0	565.0	**Pass**
2480.0	508.0	**Pass**

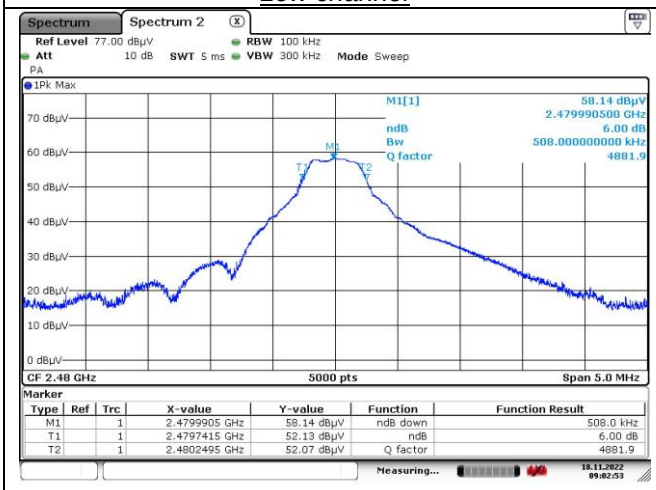
Graphical representation of 6dB Bandwidth / BLE: 1Mbps



Low channel



Mid channel



High channel

Frequency band investigated:	2400MHz to 2483.5MHz
RBW :	100kHz
Measurement detector :	Peak

11. Maximum Peak Output power

TEST: Maximum peak conducted output power		**Verdict**
Method: A radiated measurement is performed. The RBW is wide enough to capture the maximum amplitude level. The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. Radiated field strength of RF Output Power is measured at 3m in a Semi Anechoic Chamber (SAC) that complies with ANSI C63.10 / ANSI C63.4. Maximum field strength (Peak) is performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity The tested equipment is set to transmit operation with modulation on low, mid and high channels.		**Pass**
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	20 to 30 °C	22°C ± 2
Relative Humidity	25 to 70 %	49% ± 5

Limits – FCC Part 15.247 (b) / RSS-247 §5.4 (d)		
Frequency (MHz)	Limits (dBµV/m)	
	Level / Detector	Results
2400 to 2483.5	36 dBm / Pk / 3m (Radiated)	**Pass**
2400 to 2483.5	30 dBm / Pk (Conducted)	**Pass**

Supplementary information:
Test location: SMEE.
Test date: November 18th, 2022 by C KERMICHE.
Power supply voltage: 3.6V DC from internal battery.

Tabulated Results for Maximum peak output power (Radiated measurement)				
FREQ	**Field Strength 3m**	**Calculated EIRP**	**Limit**	**Result**
(MHz)	(dBµV/m)	(dBm)	(dBm)	
2402	95.7	0.5	36.0	**Pass**
2440	95.7	0.5	36.0	**Pass**
2480	95.3	0.1	36.0	**Pass**

RBW:	1MHz
Measurement distance:	3m
Limit:	FCC Part 15.247 / RSS-247
Final measurement detector:	Peak
RESULT:	PASS
Note:	EIRP is calculated using the following equation: EIRP = E + 20xlog (D) – 104.8 – GR Where EIRP = Equivalent Isotropic Radiated Power in dBm E = Electric field strength in dBµV/m D = Measuring distance in meter GR = Ground reflection in dB (0dB above 1GHz)

Tabulated Results for Maximum peak output power (Conducted)			
FREQ (MHz)	**Conducted power** (dBm)	**Limit** (dBm)	**Result**
2402	**4.0**	30.0	**Pass**
2440	**4.0**	30.0	**Pass**
2480	**3.6**	30.0	**Pass**

RBW:	1MHz
Limit:	FCC Part 15.247 / IC RSS-247
Final measurement detector:	Peak
RESULT:	PASS
Note:	(1): Maximum conducted Peak output power is calculated as follow: Pc = EIRP – G Where Pc = Conducted power dBm EIRP = Equivalent Isotropic Radiated Power in dBm G = Antenna gain in dBi (-3.5dBi, as measured from declared power by the manufactory and EIRP measurement in full anechoic chamber).

12. Maximum Power Spectral Density Level in the fundamental emission

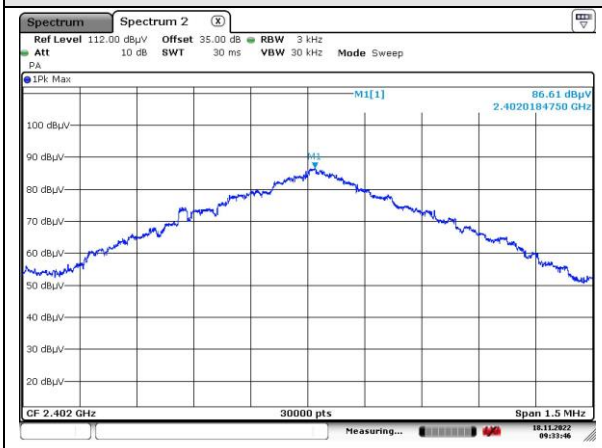
TEST: Maximum Peak Power Spectral Density		**Verdict**
Method: A radiated measurement is performed. The RBW is set at 3kHz. The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. Radiated field strength of RF Output Power is measured at 3m in a Semi Anechoic Chamber (SAC) that complies with ANSI C63.10 / ANSI C63.4. Maximum field strength (Peak) is performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity The tested equipment is set to transmit operation with modulation on low, mid and high channels.		**Pass**
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	20 to 30 °C	22°C ± 2
Relative Humidity	25 to 70 %	49% ± 5
Limits – FCC Part 15.247 (e) / RSS-247 §5.2 (b)		
Frequency (MHz)	**Level (Detector)**	**Limit**
2402 / 2440 / 2480	8 dBm/3kHz (Pk)	**Pass**
Supplementary information: Test location: SMEE. Test date: November 18th, 2022 by C KERMICHE. Power supply voltage: 3.6V DC from internal battery		

Tabulated Results for Maximum Spectral Density (Radiated measurement)				
FREQ	**Field Strength 3m**	**Calculated Radiated PSD (EIRP)**	**Limit**	**Result**
(MHz)	(dBµV/m)	(dBm)	(dBm)	
2402	86.6	-8.7	-	-
2440	85.8	-9.5	-	-
2480	84.4	-10.9	-	-
RBW:	3kHz			
Measurement distance:	3m			
Limit:	FCC Part 15.247 / RSS-247			
Final measurement detector:	Peak			
Note:	EIRP/PSD is calculated using the following equation: EIRP = E + 20xlog (D) – 104.8 – GR Where EIRP = Equivalent Isotropic Radiated Power in dBm E = Electric field strength in dBµV/m D = Measuring distance in meter GR = Ground reflection in dB (0dB above 1GHz)			

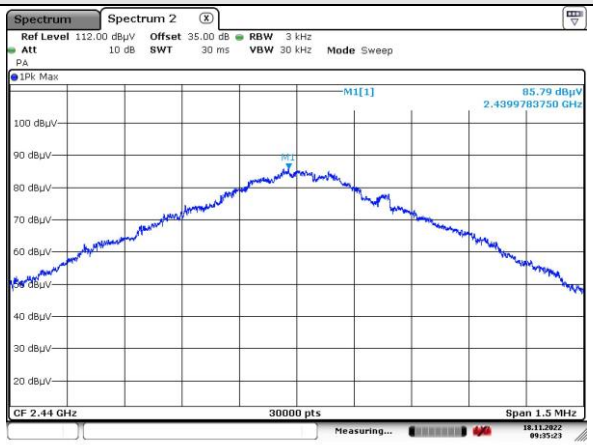
Tabulated Results for Maximum Conducted Power Spectral Density			
Frequency (MHz)	**PSD (dBm/3kHz)**	**Limit**	**Result**
2402.0	-5.2	8dBm/3kHz	**Pass**
2441.0	-6.0	8dBm/3kHz	**Pass**
2480.0	-7.4	8dBm/3kHz	**Pass**

RBW:	3kHz
Limit:	FCC Part 15.247 / RSS-247
Final measurement detector:	Peak
RESULT:	PASS
Note:	Maximum conducted power spectral density is calculated as follow: $P_{SD} = P_{SD\text{-}EIRP} - G$ Where P_{SD} = Conducted power spectral density $P_{SD\text{-}EIRP}$ = Equivalent Isotropic Radiated PSD in dBm G = Antenna gain in dBi (-3.5dBi, as measured from declared power by the manufactorer and EIRP measurement in full anechoic chamber).

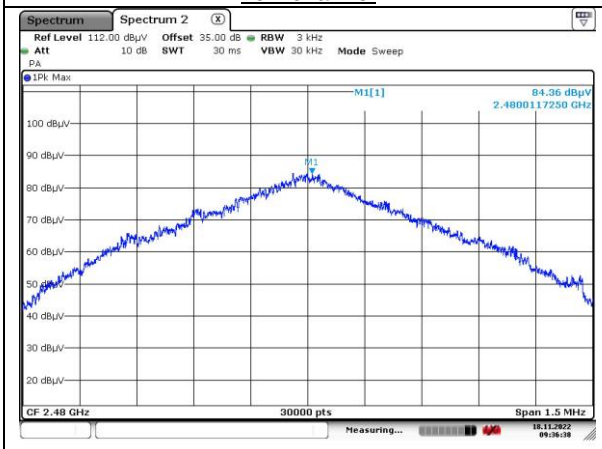
Graphical representation for Maximum Power Spectral Density / BLE: 1Mbps



Low channel



Mid channel



High channel

RBW:	3kHz
Limit:	FCC Part 15.247 / RSS-247
RESULT:	PASS

13. Unwanted emissions in Non-Restricted Frequency bands (Radiated emissions)

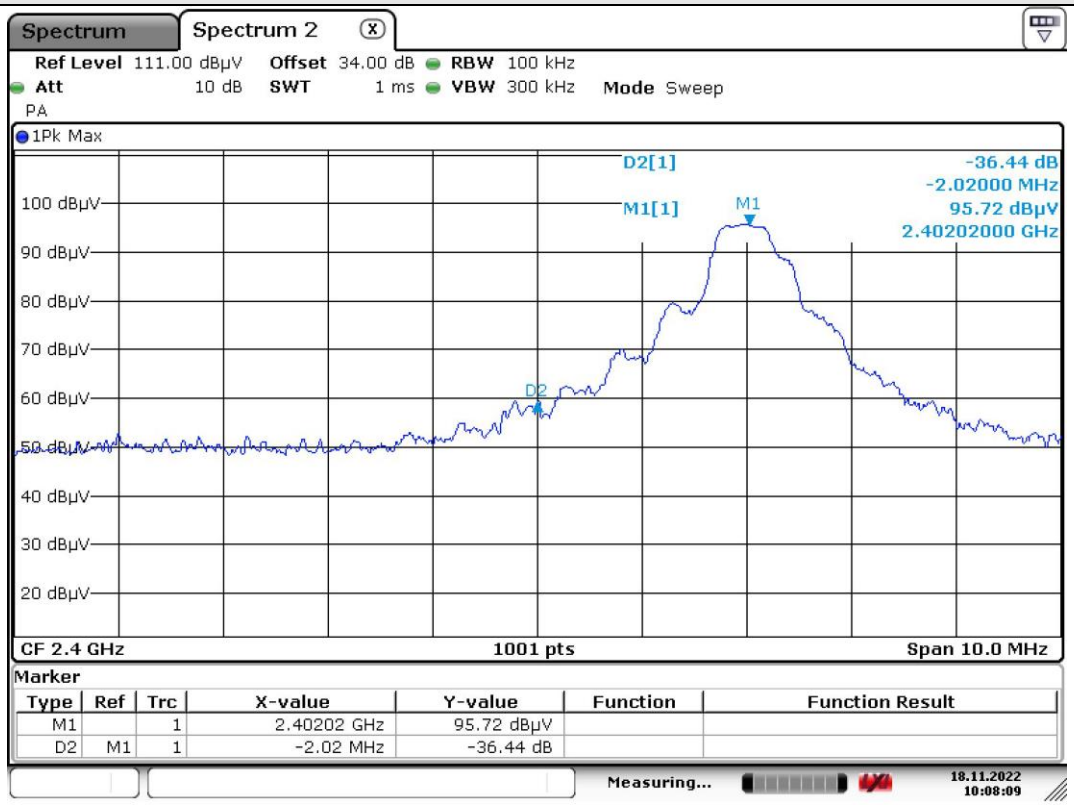
TEST: Unwanted emissions in Non-Restricted Frequency Bands			**Verdict**
Method: Measurements were made in a 3-meter Semi Anechoic Room (SAR) up to 1GHz and in a 3-meter Full Anechoic environment (SAR with floor absorbers) above 1GHz. The Semi Anechoic Room complies with CISPR16-1-4 / ANSI C63.4 requirements. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meters. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. The pre-characterization graphs are obtained in PEAK detection. Final measurements (Peak, Quasi-peak, Average) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.			**Pass**
Laboratory Parameters:	Required prior to the test		During the test
Ambient Temperature	20 to 30 °C		22°C ± 2
Relative Humidity	25 to 70 %		49% ± 5
Fully configured sample scanned over the following frequency range	Frequency range on each side of line		Measurement Point
	30MHz – 25GHz		3m measurement distance
Limits – FCC Part 15.247 (d) / RSS-247 § 5.5			
Frequency (MHz)	Limits (dBµV/m)		
	Detector / Analyzer RBW	Limit	Results
30 to 25000	Pk / 100kHz	20dB below the maximum Peak level	**Pass**
Supplementary information: Test location: SMEE. Test date: November 18th, 2022 by C KERMICHE. Power supply voltage: 3.6V DC from internal battery			

Tabulated Results for Peak Output Power Reference level	
FREQ	**Field Strength 3m**
(MHz)	(dBµV/m)
2402.0	95.7 (1)
2440.0	95.7 (1)
2480.0	95.3 (1)
RBW:	100kHz
Measurement distance:	3m
Limit:	Ref. level only – For 15.247 (d) / RSS-247 § 5.5
Final measurement detector:	Peak
Note:	(1): Only for identification of limit in non-restricted band Limit is **75.3 dBµV/m** Peak for out-of-band frequencies in Non-Restricted bands (with a 100kHz RBW on the spectrum analyser), and Power setting at 7.5dBm for Field Strength at 3m measurement.

Tabulated Results for Unwanted emissions in Non-Restricted bands				
FREQ (MHz)	**Field Strength 3m** (dBµV/m)	**Limit** (dBµV/m)	**Margin** (dBµV/m)	**Result** (dBµV/m)
2400.00 (1)	60.0	75.3	**-15.3**	**Pass**
Levels are at least 10 dB below the -20dBc limit (75.3dBµV/m) See pre-scan graphs in chapter 14.				

RBW:	100kHz
Measurement distance:	3m
Limit:	FCC 15.247 / RSS-247
Final measurement detector:	Peak
RESULT:	PASS
Note:	(1): Band-edge measurement. See graph below.

Graphical representation of Band-edge compliance (LOW)



Low band edge compliance: BLE/1Mbps

Radiated Peak level is 60.0dBµV/m (limit 75.3dBµV/m)
D2 = 2400MHz.
Note: Radiated measurement.

14. Unwanted emissions in Restricted Frequency bands

TEST: Unwanted emissions into Restricted Frequency Bands		**Verdict**
Method: Measurements were made in a 3-meter Semi Anechoic Room (SAR) for frequency 30MHz to 1GHz and in a 3-meter Full Anechoic environment (SAR with floor absorbers) above 1GHz. The Semi Anechoic Room complies with CISPR16-1-4 / ANSI C63.4 requirements. For frequency 9kHz to 30MHz, measurements are performed on a free-space open area test site at 10m distance. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meter. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (Peak, Quasi-peak, Average) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.		**Pass**
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	20 to 30 °C	22°C ± 2
Relative Humidity	25 to 70 %	49% ± 5
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point
	9kHz – 30MHz	10 m measurement distance
	30MHz – 25GHz	3 m measurement distance

Limits – FCC Part 15.205, 15.209 (a), 15.247 (d) / RSS-GEN §8.9, §8.10, RSS-247 §5.5

Frequency (MHz)	Limits (dBµV/m)	
	Level / Detector / Distance	Results
0.009 to 0.090	107.6 – 87.6 / AV / 10m 127.6 – 107.6 / PK / 10m	**Pass**
0.090 to 0.110	87.6 – 85.9 / QP / 10m	**Pass**
0.110 to 0.490	85.7 – 72.9 / AV / 10m 105.7 – 92.9 / PK / 10m	**Pass**
0.490 to 1.705	52.9 – 42.1 / QP / 10m	**Pass**
1.705 to 30	48.6 / QP / 10m	**Pass**
30 to 88	40.0 / QP / 3m	**Pass**
88 to 216	43.5 / QP / 3m	**Pass**
216 to 960	46.0 / QP / 3m	**Pass**
960-1000	54.0 / QP / 3m	**Pass**
Above 1GHz	54.0 / AV / 3m 74.0 / PK / 3m	**Pass**

Supplementary information:
Test location: SMEE.
Test date: November 18th, 2022 by C KERMICHE.
Power supply voltage: 3.6V DC from internal battery

Tabulated Results for Unwanted emissions (9kHz-490kHz)							
FREQ	**RF field @ 300m**	**Limit @ 300m**	**Detector**	**Margin**	**Ant. angle**	**Table angle**	**Correc. Fact. (CF)**
MHz	dBµV/m	dBµV/m	Pk / QP / AV	dB	Degree	Degree	dB
All levels are at least 20dB below applicable limits							
Supplementary information: Frequency list measured has been created with pre-scan results.							
Frequency band investigated:	9kHz-490kHz						
RBW:	200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)						
Measurement distance:	10m						
Final measurement detector:	Peak / Quasi-Peak / Average						
Limit:	FCC Part 15.209 / RSS-Gen						
Note:	CF: Correction factor = Antenna factor + Cable loss *1: Measure have been done at 10m distance and corrected according to requirements of 15.209.e / RSS-Gen clause 6.5) (M@300m = M@10m-59.1dB) Loop antenna used and rotated about its axis to maximize any emission.						

Tabulated Results for Unwanted emissions (490kHz-30MHz)							
FREQ	**RF field @ 30m**	**Limit @ 30m**	**Detector**	**Margin**	**Ant. angle**	**Table angle**	**Correc. Fact. (CF)**
MHz	dBµV/m	dBµV/m	Pk / QP	dB	Degree	Degree	dB
All levels are at least 20dB below applicable limits							
Supplementary information: Frequency list measured has been created with pre-scan results.							
Frequency band investigated:	490kHz-30MHz						
RBW:	9kHz (150kHz-30MHz)						
Measurement distance:	10m						
Final measurement detector:	Quasi-Peak						
Limit:	FCC Part 15.209 / RSS-Gen						
Note:	CF: Correction factor = Antenna factor + Cable loss *1: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB) Loop antenna used and rotated about its axis to maximize any emission.						

Tabulated Results for Radiated Disturbance (3m measurement in semi anechoic room, 30MHz-1GHz)								
FREQ MHz	**Field level** (Pk) dBµV/m	**Field level** (QP) dBµV/m	**Limit** (QP) dBµV/m	**Margin** dB	**Table angle** Degree	**Antenna height** m	**Total factor** dB	**Pol** H/V
All levels are at least 10dB below applicable limits								

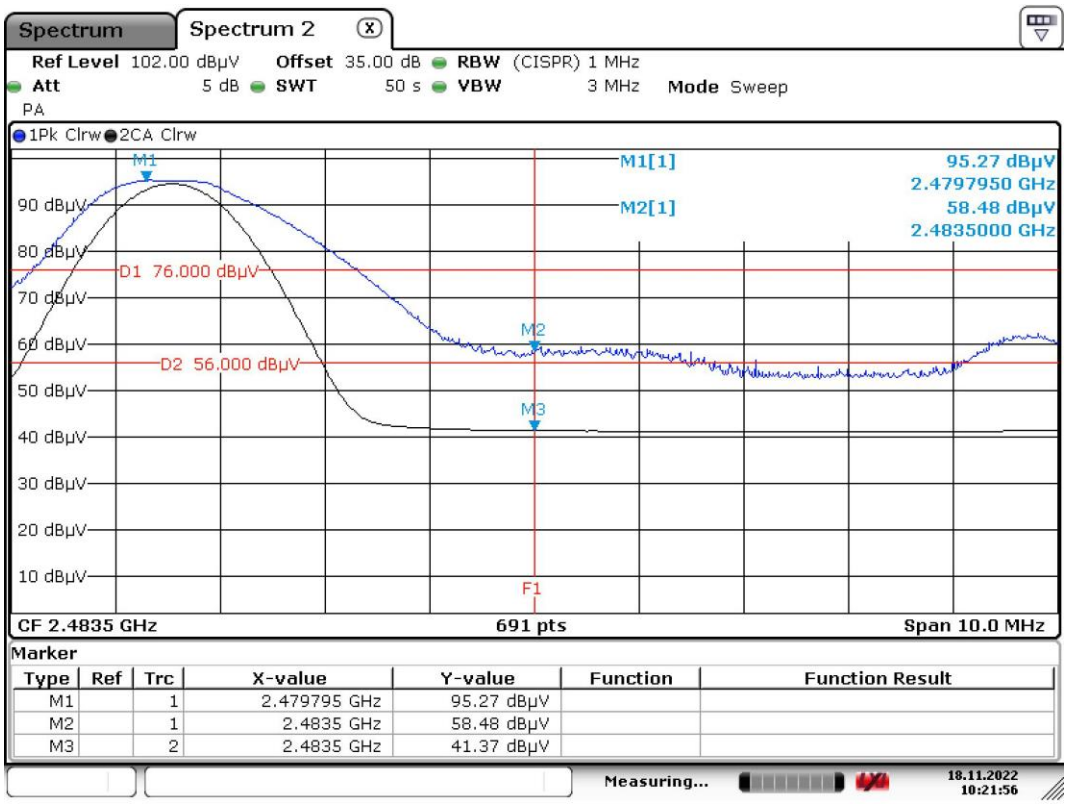
Frequency band investigated:	30MHz-1GHz
RBW:	120kHz
Measurement distance:	3m
Limit:	FCC Part 15.205 - 15.209 / RSS-GEN
Final measurement detector:	Quasi-Peak
Wide Measurement Uncertainty:	PASS
RESULT:	30MHz-1GHz

Tabulated Results for Unwanted emissions (1GHz-25GHz)										
FREQ	**Field level**	**Field level**	**Limit**	**Margin**	**Limit**	**Margin**	**Table angle**	**Ant height**	**Total factor**	**Pol**
MHz	(PK) dBµV/m	(AV) dBµV/m	(PK) dBµV/m	(PK) dB	(AV) dBµV/m	(AV) dB	Degree	m	dB	
Low channel										
9297.951	56.38	43.4	74	-17.62	54	-10.6	178.9	2.64	11.18	H
9300.686	55.72	43.33	74	-18.28	54	-10.67	60.7	1.11	11.2	H
9325.053	57.19	43.81	74	-16.81	54	-10.19	313.4	2.74	11.05	H
17501.12	59.42	46.42	74	-14.58	54	-7.58	332.7	2.82	18.59	H
17671.07	59.37	46.46	74	-14.63	54	-7.54	167.1	2.83	17.7	H
17688.66	59.56	46.97	74	-14.44	54	-7.03	309.4	2.92	17.85	H
9297.46	56.27	43.29	74	-17.73	54	-10.71	359.8	2.59	11.17	V
9301.73	56.41	43.28	74	-17.59	54	-10.72	38	1	11.19	V
9304.63	56.13	43.23	74	-17.87	54	-10.77	82.2	2.01	11.17	V
17703.43	60.33	47.06	74	-13.67	54	-6.94	66.7	2.4	17.9	V
17717.9	58.85	46.16	74	-15.15	54	-7.84	245	1.12	17.69	V
17893.47	59.22	46.07	74	-14.78	54	-7.93	323.7	2.61	18.19	V
Middle channel										
9298.74	56.9	43.43	74	-17.1	54	-10.57	194.1	2.64	11.19	H
9299.61	56.02	43.37	74	-17.98	54	-10.63	324.6	1.11	11.2	H
9306.41	56.01	43.18	74	-17.99	54	-10.82	69.2	1.5	11.16	H
17697.09	60.49	47.23	74	-13.51	54	-6.77	314.3	2.64	17.92	H
17700.48	60.15	47.19	74	-13.85	54	-6.81	179.7	1.11	17.94	H
17705.27	59.68	46.99	74	-14.32	54	-7.01	2.5	2.74	17.87	H
9297.89	56.52	43.48	74	-17.48	54	-10.52	238.4	2.64	11.18	V
9300.62	55.98	43.29	74	-18.02	54	-10.71	14.6	1.11	11.2	V
9302.05	56.5	43.29	74	-17.5	54	-10.71	199.1	2.83	11.19	V
17663.25	59.16	46.4	74	-14.84	54	-7.6	198.1	2.92	17.63	V
17896.63	59.8	46.15	74	-14.2	54	-7.85	350.1	2.59	18.25	V
17901.85	58.62	46.12	74	-15.38	54	-7.88	97.3	1	18.3	V
High channel										
9302.82	56.13	43.39	74	-17.87	54	-10.61	18.1	1.23	9302.82	H
9320.59	56.61	43.44	74	-17.39	54	-10.56	9.3	1.8	9320.59	H
9321.07	56.63	43.45	74	-17.37	54	-10.55	40.4	2.4	9321.07	H
17694.74	60.04	46.57	74	-13.96	54	-7.43	145.6	1.11	17694.74	H
17699.95	60.29	46.81	74	-13.71	54	-7.19	176.8	1.5	17699.95	H
17704.71	60.53	46.84	74	-13.47	54	-7.16	111.4	2.64	17704.71	H
9319.36	56.5	43.45	74	-17.5	54	-10.55	181.6	1.5	9319.36	V
9322.6	56.68	43.34	74	-17.32	54	-10.66	20.4	1.5	9322.6	V
9333.1	54.95	42.36	74	-19.05	54	-11.64	197.6	1.4	9333.1	V
17698.93	59.74	46.77	74	-14.26	54	-7.23	4.5	2.01	17698.93	V
17887.95	59.89	47	74	-14.11	54	-7	6.4	1.5	17887.95	V
17899.02	60.17	47.36	74	-13.83	54	-6.64	108.8	1.3	17899.02	V

Supplementary information:
Frequency list has been created with pre-scan results.

RBW	1MHz
Measurement distance:	3m
Limit:	FCC Part 15.205, 15.209, 15.247 / RSS-Gen, RSS-247
Final measurement detector:	Peak / CISPR Average
RESULT:	PASS

Graphical representation of Band-edge compliance (HIGH)

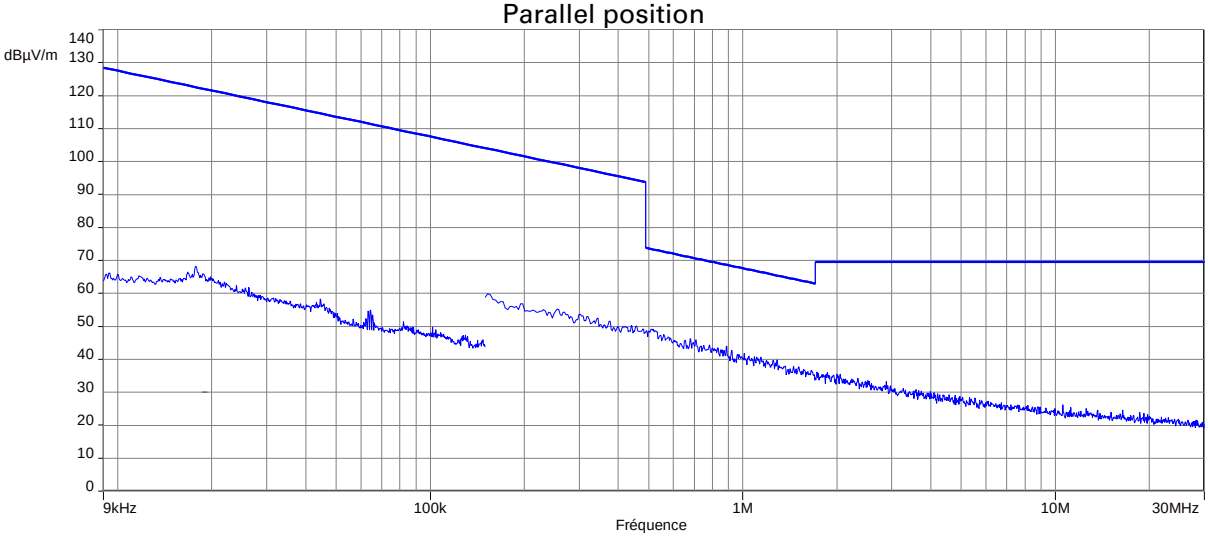


High band edge compliance: BLE/1Mbps

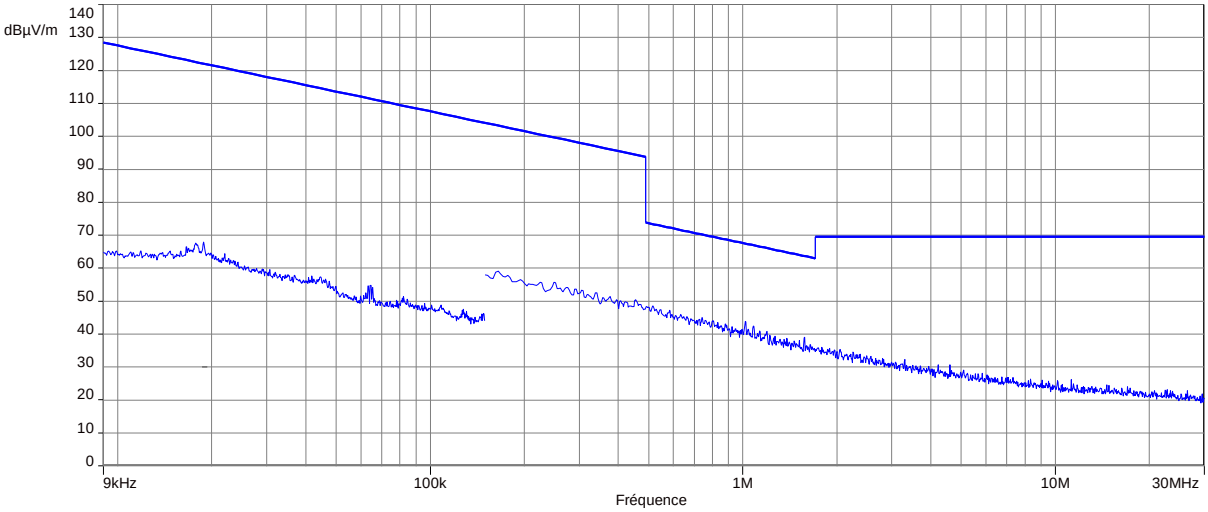
Radiated Peak level is 58.5dBµV/m at 2483.5MHz (limit 74dBµV/m).
Max radiated Average level is 41.4dBµV/m (limit 54dBµV/m, CISPR Average detector measurement).

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 9kHz-30MHz / 3m / Parallel & Perpendicular antenna position / Transmit mode)

Parallel position



Perpendicular position



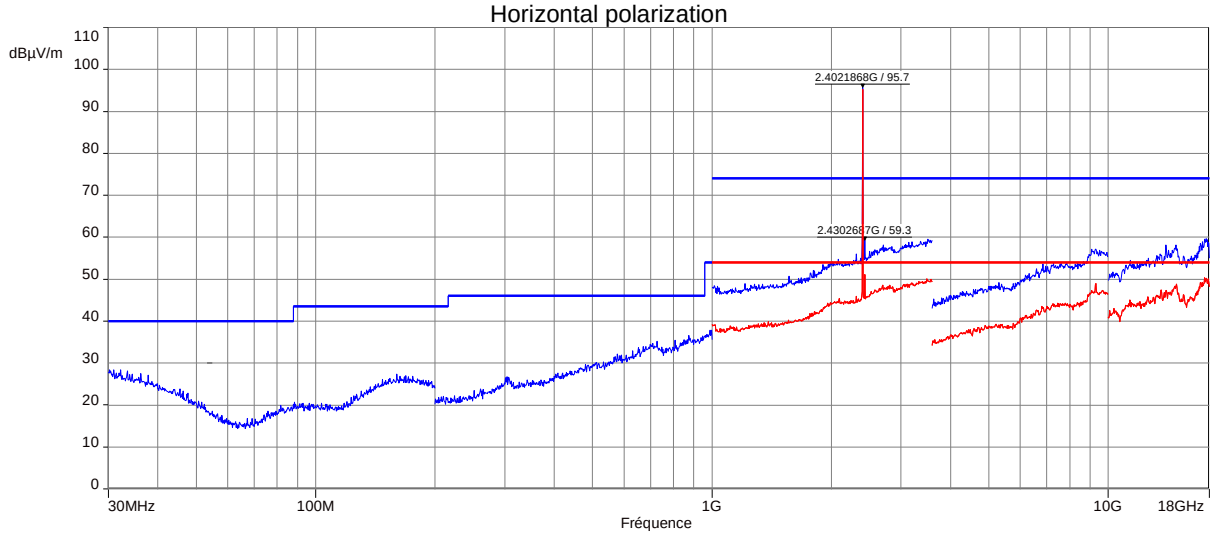
Notes: Pre-scan graph only for identification purpose.
Same result for transmit mode on all channels.

Frequency band investigated:	9kHz-30MHz
Unit:	dBµV/m
RBW:	200Hz (9kHz-150kHz) 9kHz (150kHz-30MHz)
Antenna polarization:	Parallel & Perpendicular to measurement axis
Measurement detector:	Peak

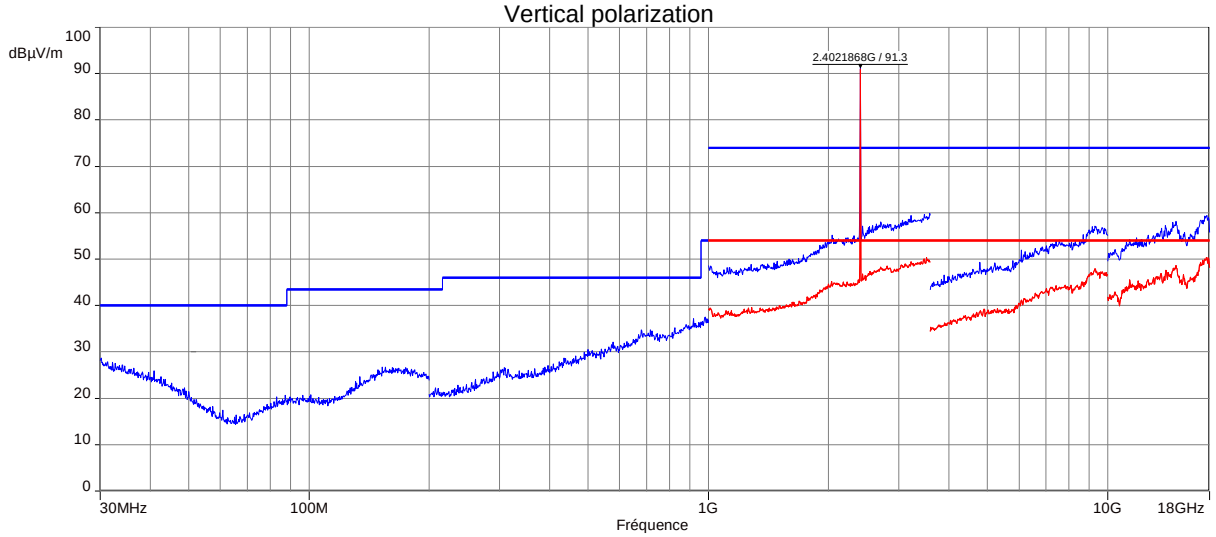
Graphical representation of Radiated Disturbance Measurement (Peak detection, Semi & Anechoic chamber pre-scan, 30MHz-18GHz / 3m / Horizontal & Vertical / Transmit mode)

Low channel

Horizontal polarization



Vertical polarization



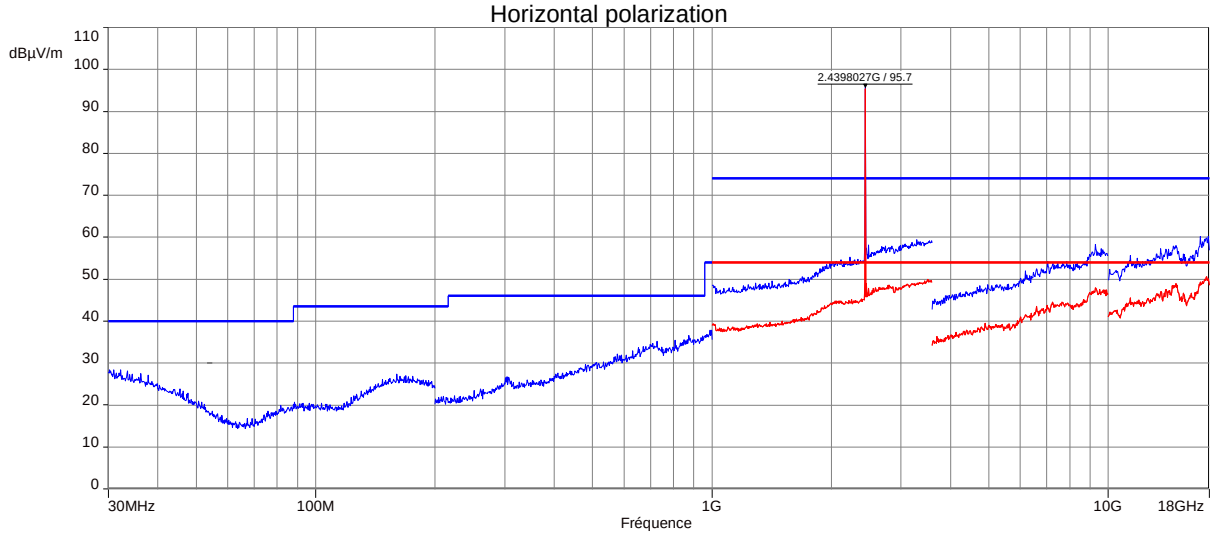
------ : Peak trace	------ : Average trace

Frequency band investigated:	30MHz-18GHz
Unit :	dBµV/m
RBW :	100kHz Freq < 1GHz, 1MHz Freq > 1GHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.6V DC from internal battery
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average

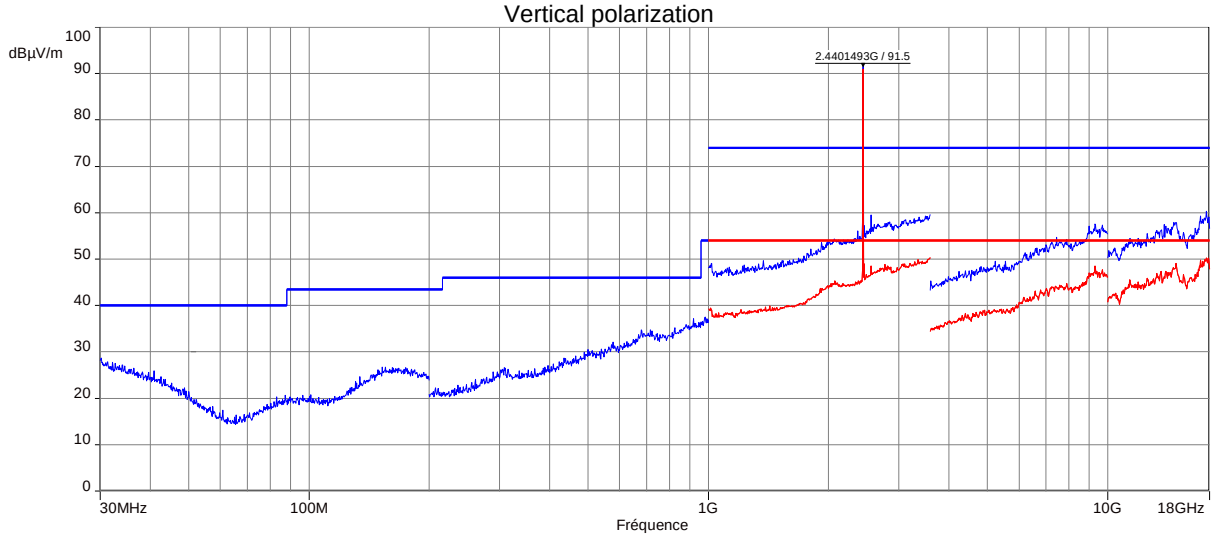
Graphical representation of Radiated Disturbance Measurement (Peak detection, Semi & Anechoic chamber pre-scan, 30MHz-18GHz / 3m / Horizontal & Vertical/ Transmit mode)

Middle channel

Horizontal polarization



Vertical polarization



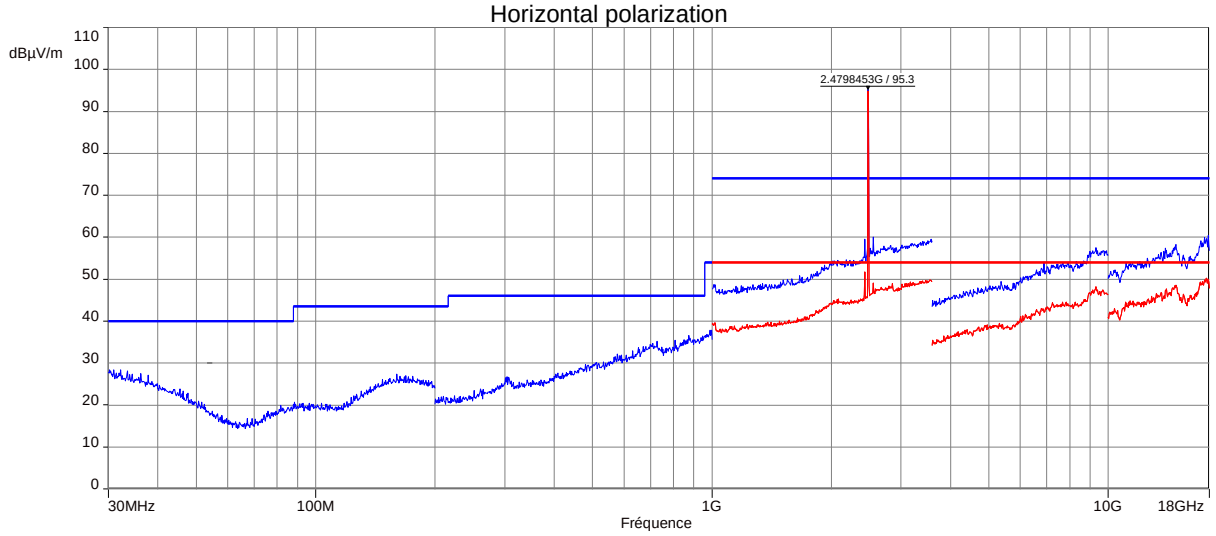
------ : Peak trace	------ : Average trace

Frequency band investigated:	30MHz-18GHz
Unit :	dBµV/m
RBW :	100kHz Freq < 1GHz, 1MHz Freq > 1GHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.6V DC from internal battery
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average

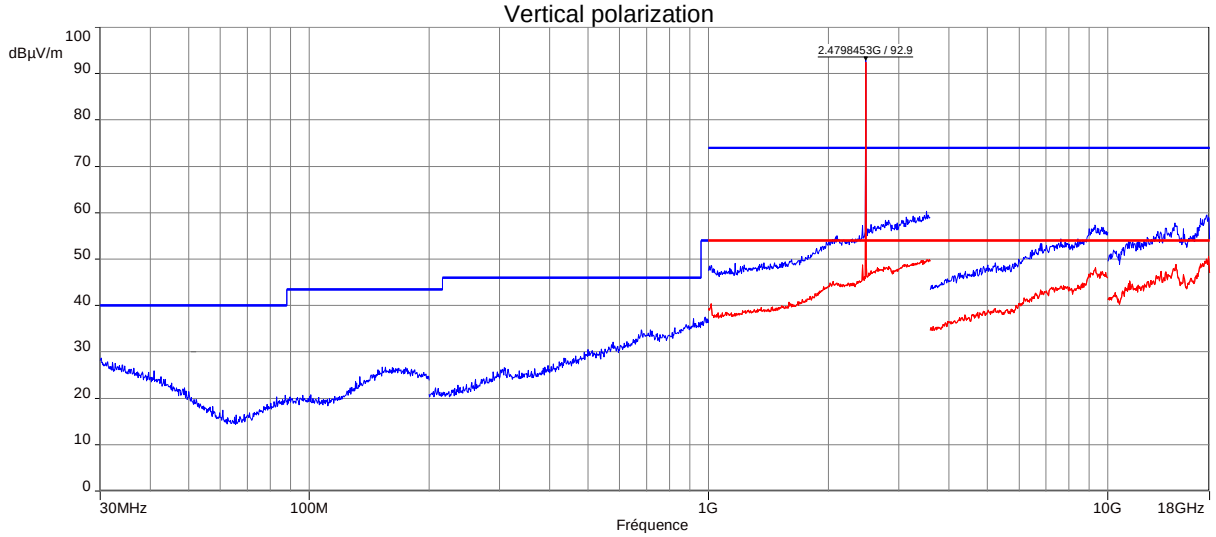
Graphical representation of Radiated Disturbance Measurement (Peak detection, Semi & Anechoic chamber pre-scan, 30MHz-18GHz / 3m / Horizontal & Vertical/ Transmit mode)

High channel

Horizontal polarization



Vertical polarization



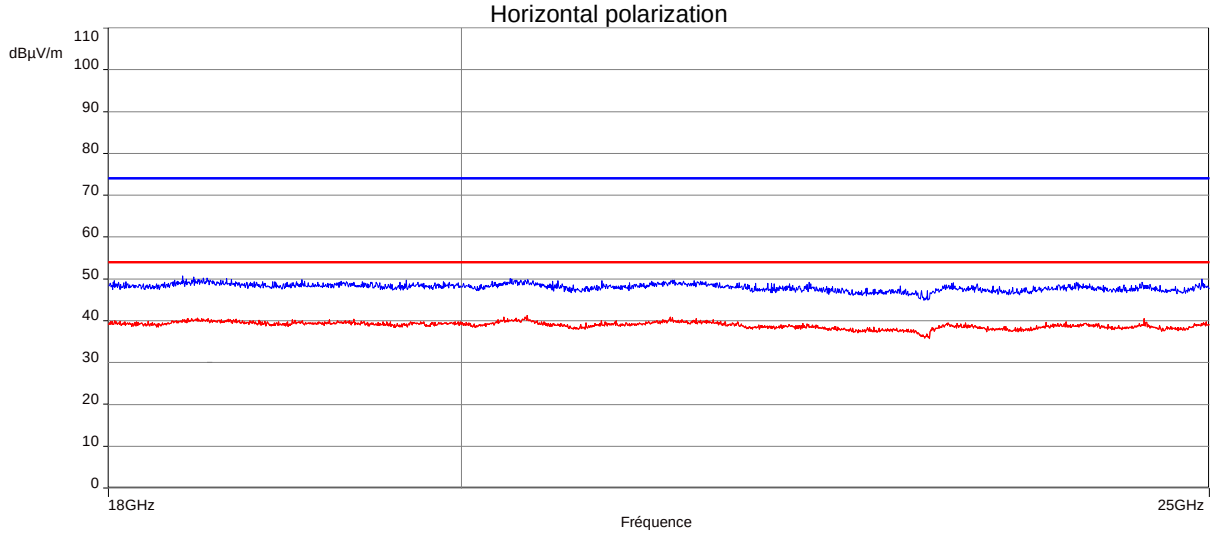
------ : Peak trace	------ : Average trace

Frequency band investigated:	30MHz-18GHz
Unit :	dBµV/m
RBW :	100kHz Freq < 1GHz, 1MHz Freq > 1GHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.6V DC from internal battery
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average

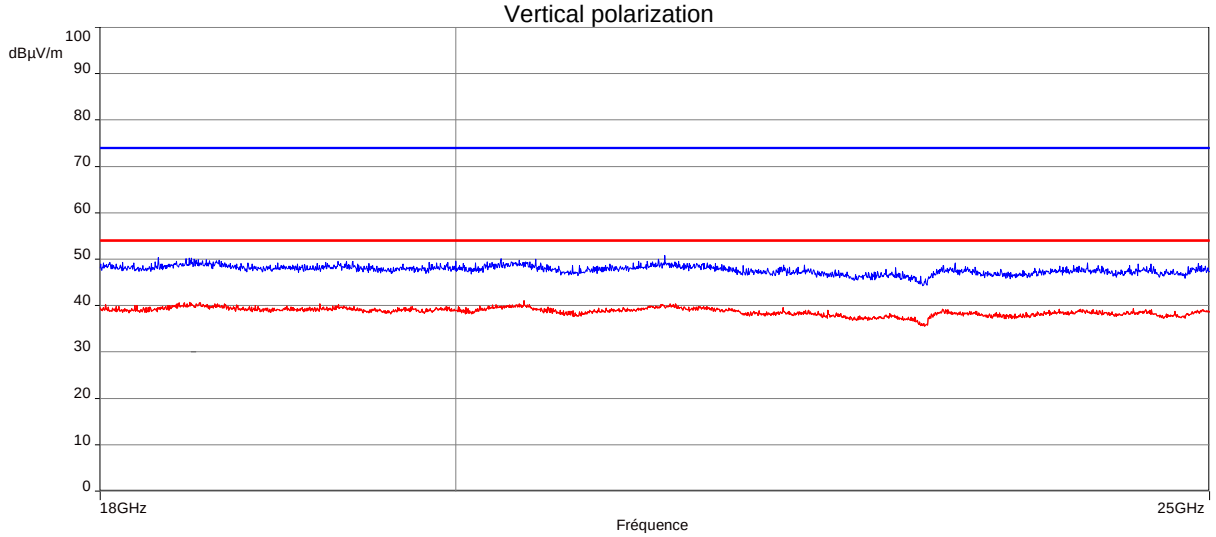
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 10GHz-25GHz / 3m / Horizontal & Vertical/ Transmit mode)

Same results for Low / Middle / High channel

Horizontal polarization



Vertical polarization



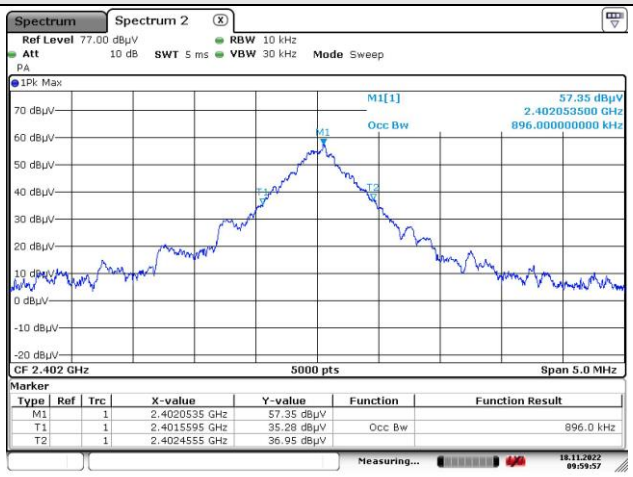
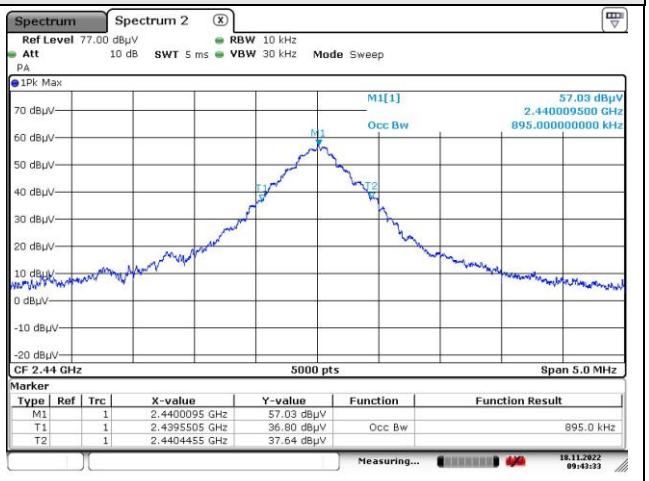
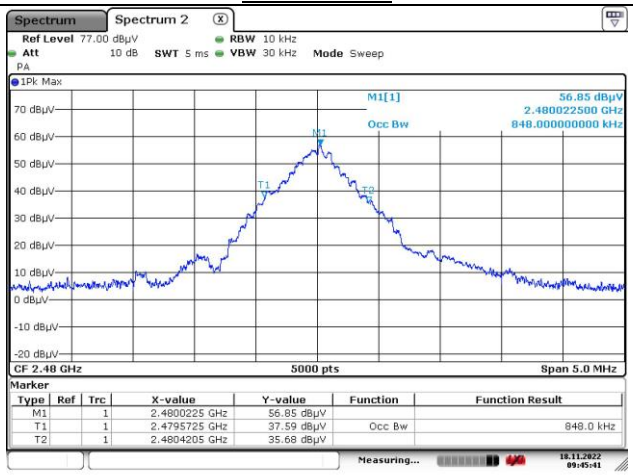
------ : Peak trace	------ : Average trace
Frequency band investigated:	18GHz-25GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	3.6V DC from internal battery
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average

15. Occupied bandwidth (99%)

TEST: Occupied bandwidth (99%) / RSS-GEN		Verdict
Method: The setup is in an anechoic chamber. The spectrum analyzer is connected to the measuring antenna. A radiated measurement is performed. The RBW is set in the range of 1% to 5% of the OBW, with VBW ≥ 3 x RBW. The SPAN is wide enough to capture all products of the modulation process. (Between 1.5 to 5 times the OBW). A MaxHold Peak detector is used. Automatic function of the spectrum analyser is used. The tested equipment is set to transmit operation with modulation on low, mid and high channels.		**Pass**
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	20 to 30 °C	22°C ± 2
Relative Humidity	25 to 70 %	49% ± 5
Supplementary information: Test location: SMEE. Test date: November 18th, 2022 by C KERMICHE. Power supply voltage: 3.6V DC from internal battery		

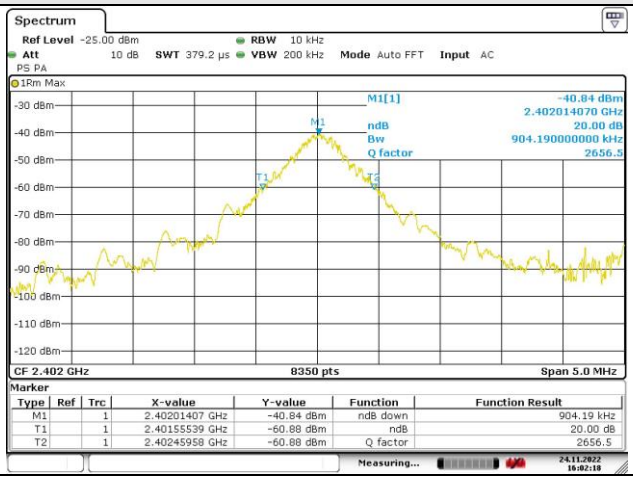
Tabulated Results for 99% Occupied Bandwidth	
Frequency (MHz)	**99% Occupied Bandwidth** (MHz)
2402.0	0.896
2440.0	0.895
2480.0	0.848

Tabulated Results for 20dB Bandwidth	
Frequency (MHz)	**20dB Bandwidth** (MHz)
2402.0	0.904
2440.0	0.803
2480.0	0.890

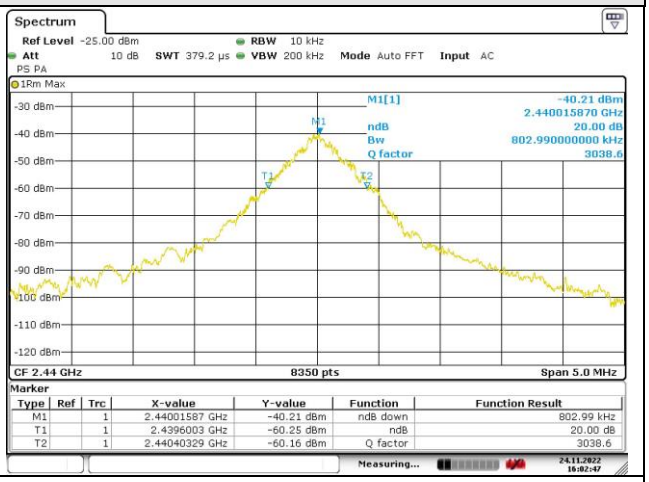
Graphical representation of 99% Occupied Bandwidth	
	
Low channel	*Mid channel*
	
High channel	

Frequency band investigated:	2402MHz to 2480MHz
RBW :	10kHz
Measurement detector:	Peak

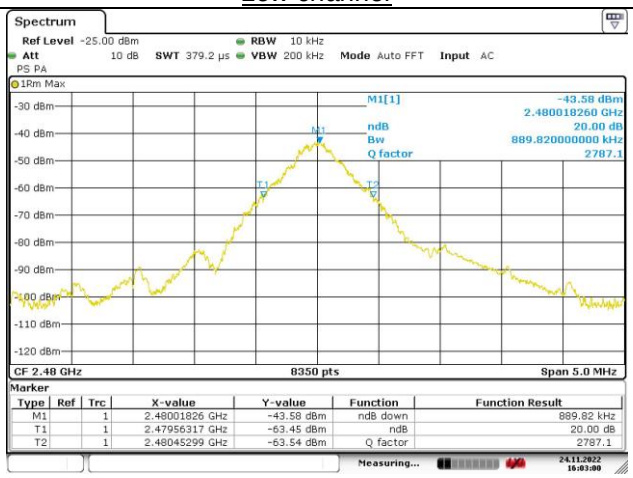
Graphical representation of Occupied 20dB Bandwidth



Low channel



Mid channel



High channel

Frequency band investigated:	2402MHz to 2480MHz
RBW :	10kHz
Measurement detector:	Peak

16. Test Equipment List

Test Equipment Used for conducted emission					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
AC power supply	PACIFIC POWER	AMX-125	ALI-101-002	-	-
Attenuator / limiter	SMEE	ATT#2	ATT-171-010	2022/4	2023/3
RF cable	RADIALL	RG58 / BNC / 5m	CAB-211-042	2022/4	2023/3
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2021/12	2023/12
LISN (50Ω / 50µH)	AFJ	LS16C	RSI-101-001	2021/7	2023/7
EMC Software	NEXIO	BAT EMC V3.21	SOF-101-002	-	-

Test Equipment Used for radiated emission					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Biconnic antenna	COM-POWER	AB- 900A	ANT-201-021	2020/12	2022/12
Log-periodic antenna	EMCO	3146	ANT-191-019	2021/7	2023/7
Horn antenna	COM-POWER	AH-118	ANT-101-004	2021/7	2024/7
Horn antenna	ETS-LINDGREN	3116	ANT-161-014	2021/7	2024/7
RF cable	HUBER+SUHNER	SF104/3m	CAB-141-030	2022/3	2023/3
RF cable	HUBER+SUHNER	SF102 (KN6m)	CAB-171-033	2022/4	2023/3
RF cable	TMS	LMR-400 / 9m	CAB-201-039	2022/3	2023/3
RF cable	HUBER+SUHNER	SF102 (K/2m)	CAB-171-034	2022/4	2023/3
RF cable	HUBER+SUHNER	SF102 (K/3m)	CAB-171-035	2022/4	2023/3
Semi anechoic room	COMTEST	218292	CAG-201-002	2022/3	2023/3
Antenna mast	Innco- Systems	MA4640-XP-ET	MAT-201-002	-	-
Turntable	Innco- Systems	DS1500-S-1t	PLA-201-003	-	-
Measuring Rec	Rohde&Schwarz	ESRP	REC-151-002	2021/12	2023/12
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2021/10	2023/10
Pre-amplifier	COM-POWER	1-18GHz	PRE-221-005	2022/4	2023/3
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2022/4	2023/3
High-Pass filter	Mini-circuit	VHF-3100+	FIL-151-006	2022/4	2023/3
High-Pass filter	Mini-circuit	ZHSS-8G-S+	FIL-191-010	2022/4	2023/3
EMC Software	NEXIO	BAT EMC V3.21	SOF-101-001	-	-
Ref. Comb generator	SMEE	EMR-10M	REF-111-002	-	-
Ref. Comb generatr	SMEE	EMR 1-6GHz	REF-141-003	-	-