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

Matériel testé : *Equipment under test*:	**ST / NUCLEO-WBA52CG (MB1863A-03)** *(Trademark / Marketing name or product reference)*

Demandeur de certification : **STMicroelectronics (Rousset) SAS**
Applicant for certification: 190 Avenue Celestin Coq, 13106 – ROUSSET – France

Client : **STMicroelectronics**
Customer: 12 Rue Jules Horowitz, 38000 – Grenoble – France

Numéro d'affaire : 14708
Work number :

Référence de la proposition : 082022-25582
Proposal number:

Date de l'essai : Du 10 au 28 Octobre 2022 / 22 novembre 2022
Date of test: *October 10th to 28th,2022 / November 22nd, 2022*

Objectif des essais : EMC qualification accordingly to following standards:
Test purpose: - 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 3
(Digital Transmission Systems Operating in the Bands 902–928 MHz)
Measurement standards:
ANSI C63.10 (2013)

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

Test réalisé par : Chemseddine KERMICHE
Test realized by:

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

Ed.	Date	Modifications / Pages	Written by: Visa	Approved by: Visa
1	January 8th, 2024	Initial Edition	Chemseddine KERMICHE *Test operator*	Laurent CHAPUS *Technical Manager*

COORDONNEES
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Contents

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 (October 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 (Issue 3/2023)	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

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**
Antenna requirement	FCC 15.203 RSS-GEN § 6.8		**PASS**

- **General conclusion:**

Measures and tests performed on the sample of the product *ST / NUCLEO-WBA52CG (MB1863A-03)*, 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*	**ST / NUCLEO-WBA52CG (MB1863A-03)** *(Trademark / Marketing name or product reference)*	Sn: D214700167

FCC ID:	YCP-MB1863000
IC:	8976A-MB1863000
Model / HVIN:	MB1863A-03
Product name / PMN:	NUCLEO-WBA52CG
FVIN:	V0.2.0
Alimentation / *Power supply*	5V DC from USB Port.
Auxiliaires / *Auxiliaries*	Laptop ASUS, model F200M for equipment programming only.

Entrées-Sorties / *Input / Output*

	Câbles pour essai / *Cables for test*	Blindé / *Shielded*	Prévu pour >3m / *Intended for >3m*
Micro-USB Cable	1.0m	Yes	No

Mode de fonctionnement / *Running mode*	The device (MB1801A+MB1863A) is powered by DC 5V, the device is connected to Samsung tablet for wireless communication (BLE), with the ST BLE Sensor application.
Programme de test / *Test program /*	ST BLE Sensor application V4.17.2 (122)
Fréquence max interne EST / *Max internal EUT frequency*	2.480GHz 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 7.5dBm - Duty cycle: 85% - Modulation: Bluetooth Low Energy (1Mbps, 2Mbps) - BLE version 5.3 - Antenna type: Printed PCB (Max antenna gain 1.95dBi) - Powered by 5V 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*	48mm x 43x 8 (PCB)

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

4. Test conditions

Power supply voltage:

Equipment under test:	5V DC
Auxiliaries AC mains:	120V/60Hz

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)

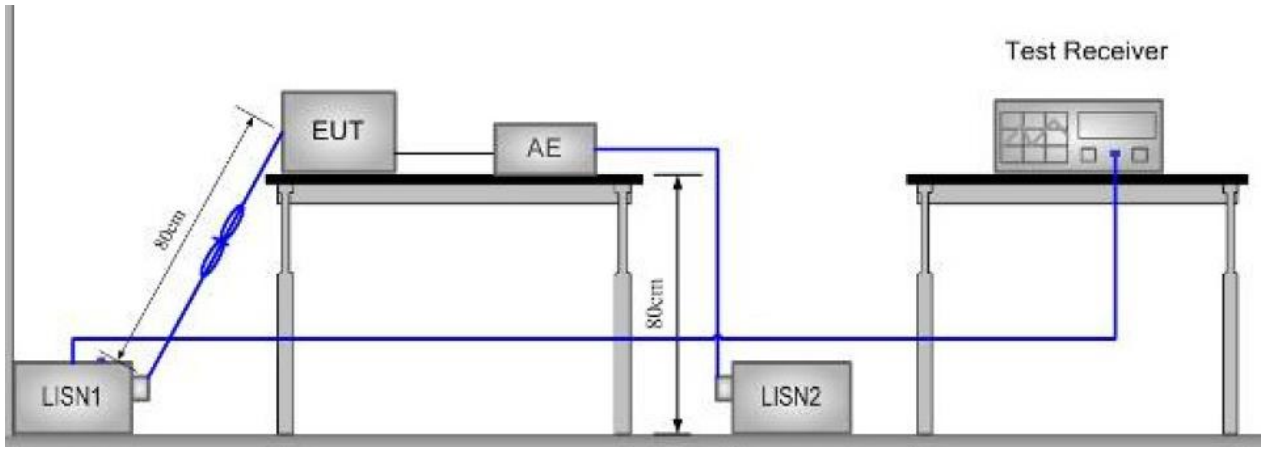
8. Field Strength Calculation

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

Example:
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)

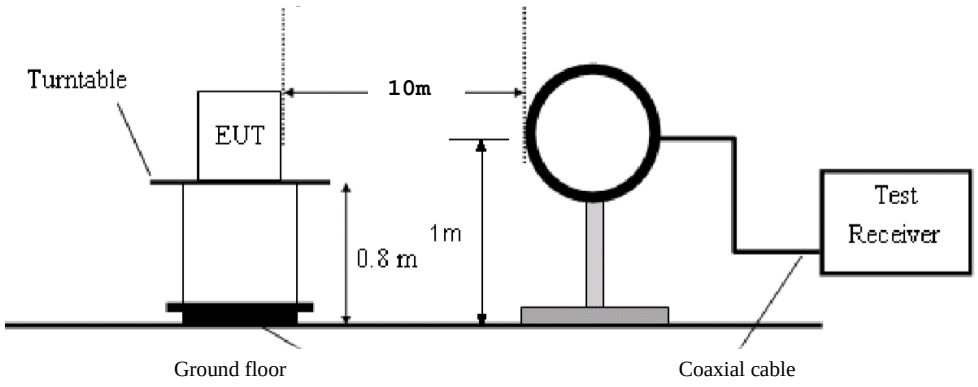
9. Test Setup Diagrams

Test Setup for conducted emission



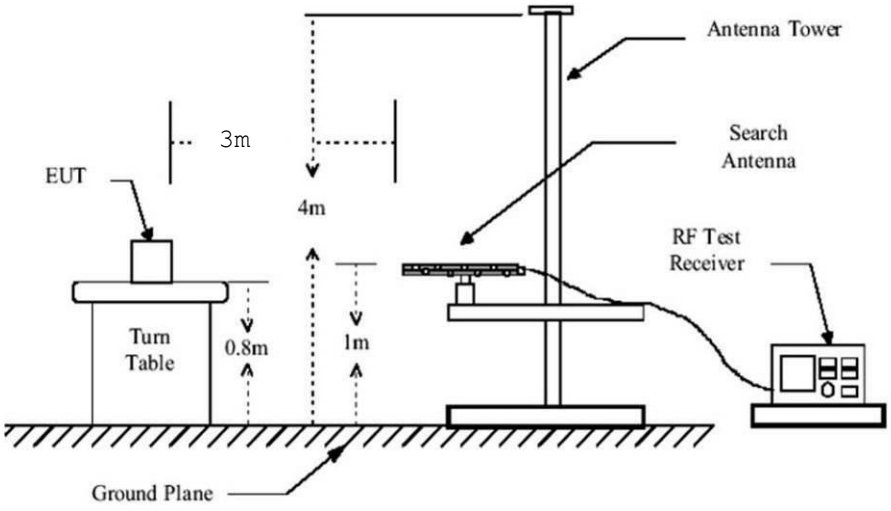
Ground reference plane

Test Setup for radiated emission

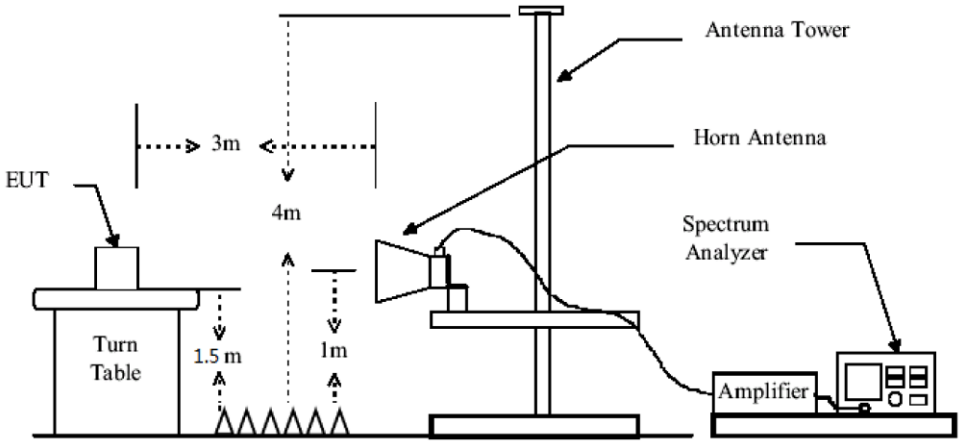


Test setup for 9k-30MHz (OATS)

Test Setup for radiated emission

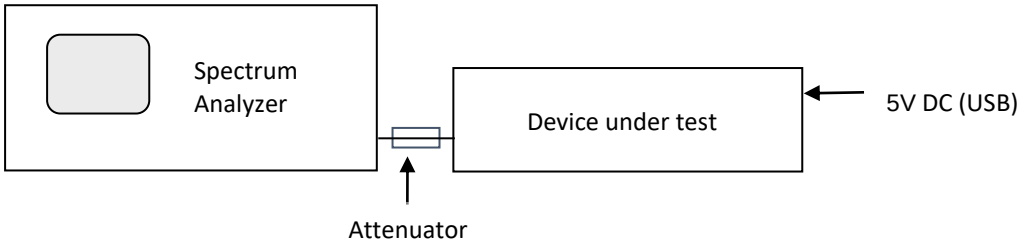


Test setup for 30-1000MHz (SAC 3m)



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

Test Setup for conducted antenna port measurement



10. Conducted Emission Measurement (150kHz-30MHz)

TEST: Limits for conducted disturbance 150kHz – 30MHz	**Verdict**
Method: The LISN is placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane. This distance was between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment were at least 0,8 m from the AMN. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on lines were made at the output of the LISN. The EUT is 80cm above the ground reference plane and 40cm from the vertical ground plane. The AC power cable is 1m length.	**Pass**

Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	20 to 30 °C	24°C ± 2
Relative Humidity	25 to 70 %	54% ± 5
Fully configured sample scanned over the following frequency range	Frequency range on each side of line	Measurement Point
	150kHz to 30MHz	AC input port (120V/60Hz)

Limits

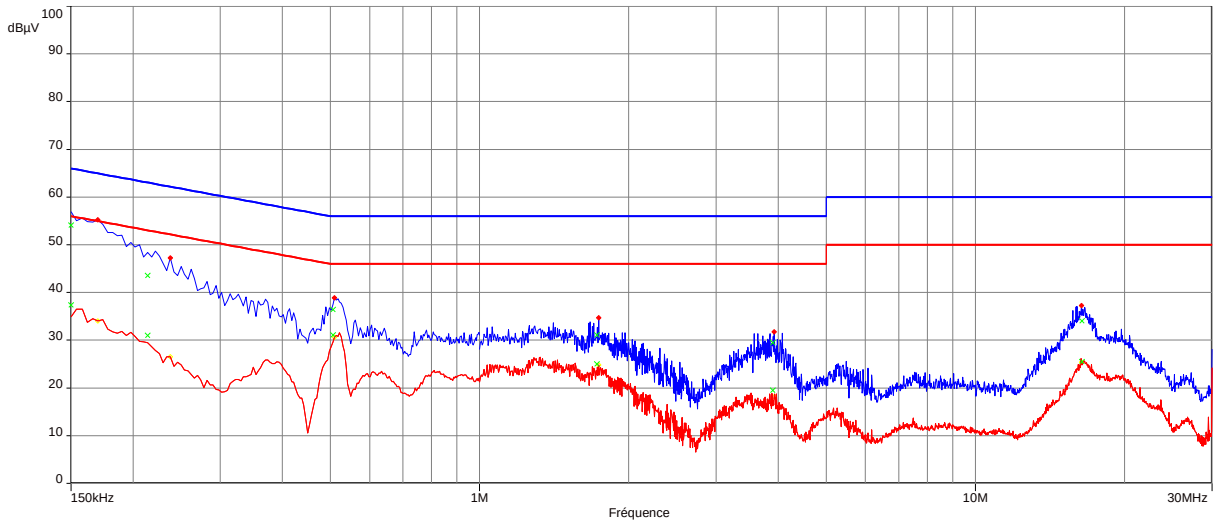
Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Result	Average	Result
0.15 – 0.50	66 \ 56	**PASS**	56 \ 46	**PASS**
0.50 - 5	56	**PASS**	46	**PASS**
5 – 30	60	**PASS**	50	**PASS**

Supplementary information:
Test location: SMEE
Test date: October 27th, 2022 by C KERMICHE.
Power supply voltage: 5V DC from USB-Port. (PC is powered by 120V/60Hz)

Tabulated Results for Mains Terminal Disturbance Voltage on AC port								
FREQ	**Meas. PK**	**Mes. QP**	**LIMIT QP**	**Margin QP**	**Mes. AV**	**LIMIT AV**	**Margin AV**	Line
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dBµV)	(dBµV)	(dB)	
0.150043	59.97	54.1	66	-11.9	37.36	56	-18.64	L1
0.215685	50.67	43.51	63.05	-19.54	31.04	53.05	-22.01	L1
0.506961	40.94	36.41	56	-19.59	31.06	46	-14.94	L1
1.725065	36.27	31.11	56	-24.89	24.98	46	-21.02	L1
3.904897	36.35	29.5	56	-26.5	19.53	46	-26.47	L1
16.393795	40.59	34.07	60	-25.93	25.45	50	-24.55	L1
0.153517	59.37	52.19	65.78	-13.59	34.17	55.78	-21.61	N
0.184043	55.79	47.94	64.21	-16.28	30.55	54.21	-23.67	N
0.519459	38.02	32.02	56.00	-23.98	26.97	46.00	-19.03	N
1.726622	35.10	30.01	56.00	-25.99	23.58	46.00	-22.42	N
4.085077	32.17	25.45	56.00	-30.55	15.63	46.00	-30.37	N
16.568179	41.11	35.07	60.00	-24.93	27.10	50.00	-22.90	N

RBW:	9kHz
Voltage:	120V/60Hz
Limit:	FCC Part 15.207 / RSS-Gen: Issue 5, §8.8 Table 4
Final measurement detector:	Quasi-Peak and CISPR Average (AV)
RESULT:	PASS
Measured value calculation:	The measured value (level) is calculated by adding the Cable Factor, the Transient suppressor attenuation and LISN attenuation from the receiver amplitude reading. The basic equation is as follow: Meas. = RA + CF + ATT_{TRAN} + ATT_{LISN} Where Meas. = Level (dBµV) RA = Receiver Amplitude CF = Cable Factor ATT_{TRAN} = Transient suppressor attenuation ATT_{LISN} = LISN attenuation Margin value = Emission level – Limit value (A negative margin shows compliance to limit)

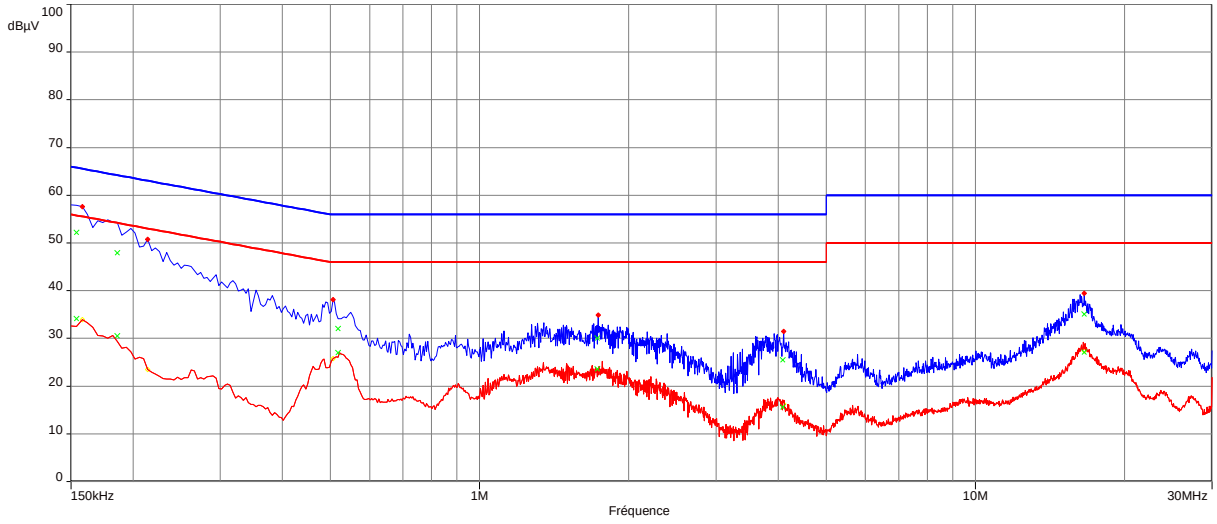
Graphical representation of Conducted Disturbance Measurement (Peak and Average detection)
AC port, Line L1



Note : Same result for all transmit modes on all channels.

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

Graphical representation of Conducted Disturbance Measurement (Peak and Average detection)
AC port, Line Neutral



Note : Same result for all transmit modes on all channels.

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

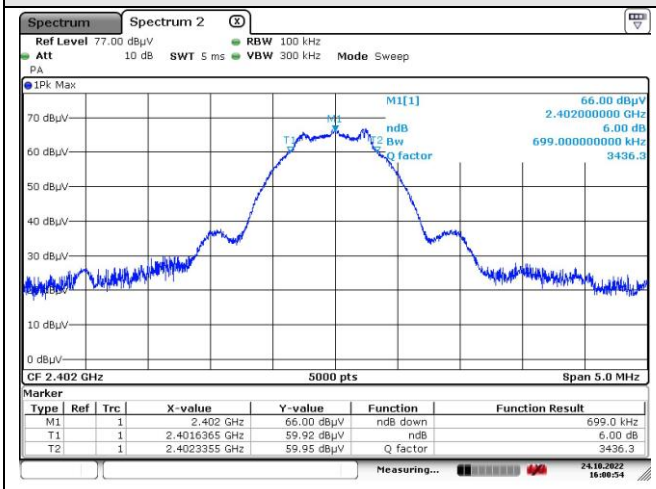
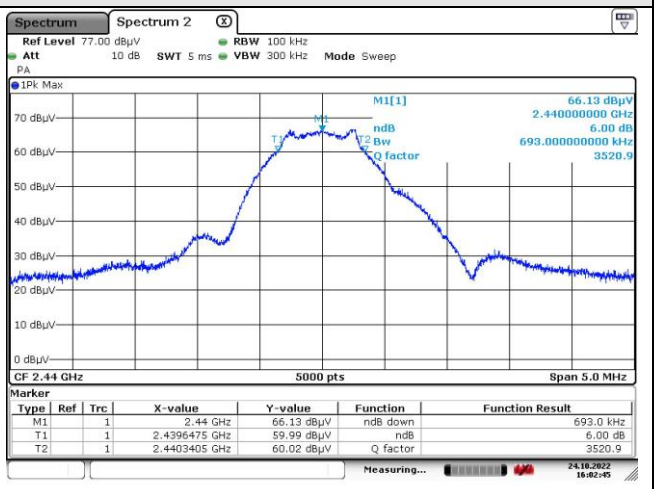
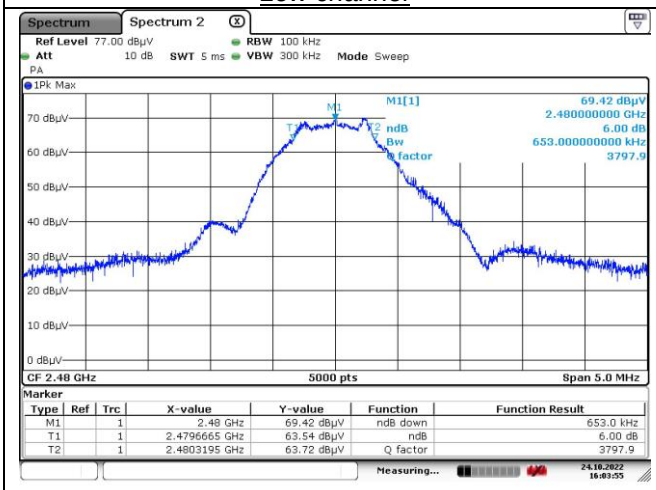
11. DTS Bandwidth

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	24°C ± 2
Relative Humidity	25 to 70 %	54% ± 5

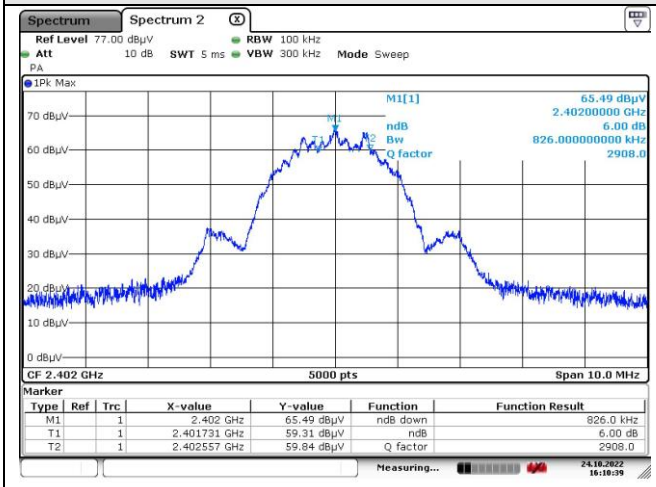
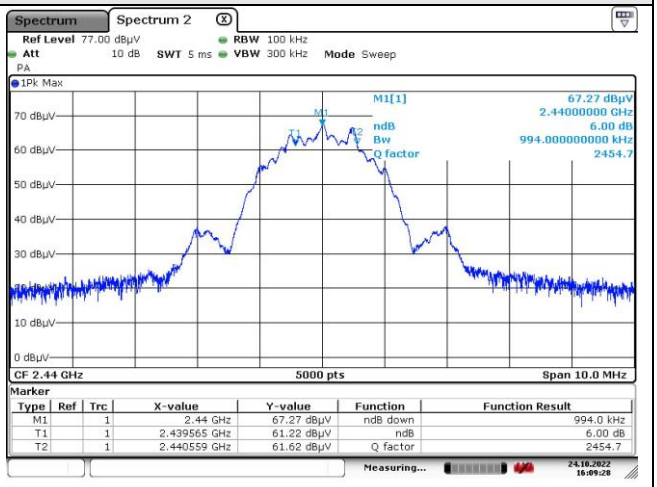
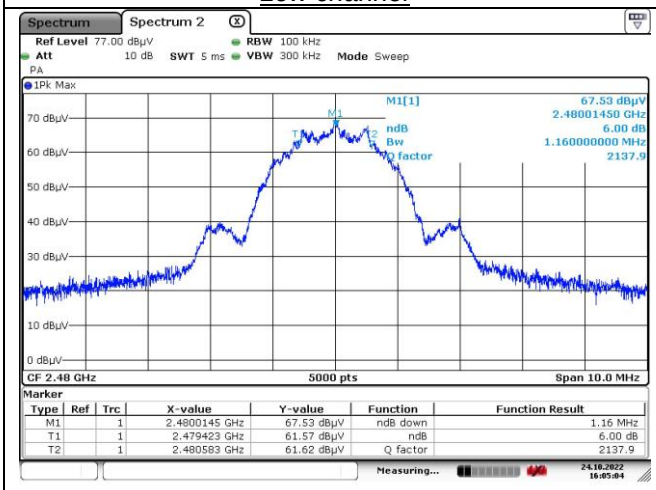
Limits – FCC Part 15.247 (a) / RSS-247 §5.2 (a)		
Frequency (MHz)	**Level for Bandwidth**	**Limit**
2402.0	6dB below the maximum output power	At least 500kHz
2440.0		
2480.0		

Supplementary information:
Test location: SMEE.
Test date: October 24th, 2022 by C KERMICHE.
Power supply voltage: 5V DC from USB-Port.

Tabulated Results for Occupied Bandwidth		
Frequency (MHz)	**6dB Bandwidth** (kHz)	**Result**
BLE: 1MBps		
2402.0	699.0	**Pass**
2440.0	693.0	**Pass**
2480.0	653.0	**Pass**
BLE: 2MBps		
2402.0	826.0	**Pass**
2440.0	994.0	**Pass**
2480.0	1160.0	**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

Graphical representation of 6dB Bandwidth / BLE: 2Mbps	
	
Low channel	*Mid channel*
	
High channel	

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

12. Maximum Peak Output power

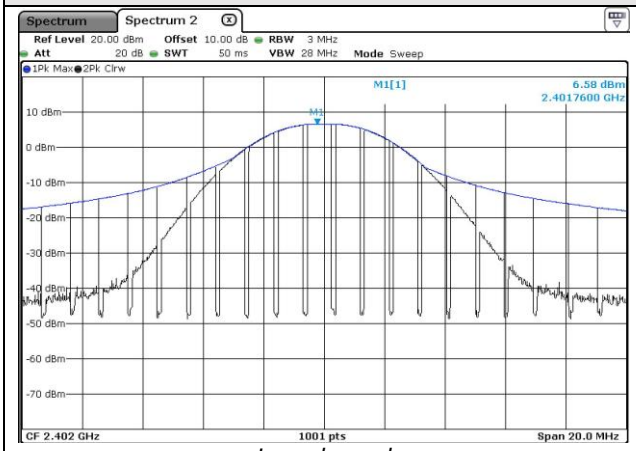
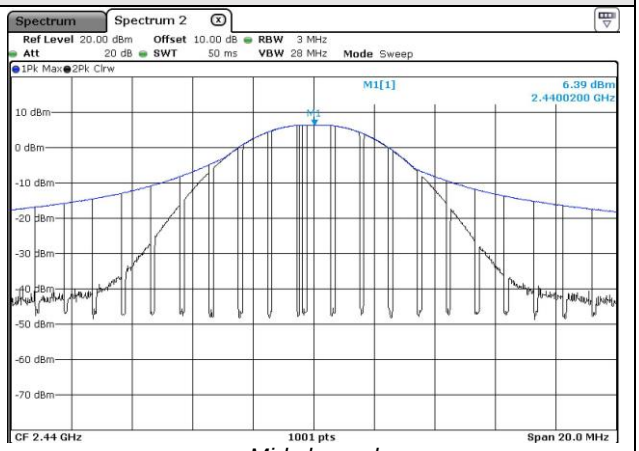
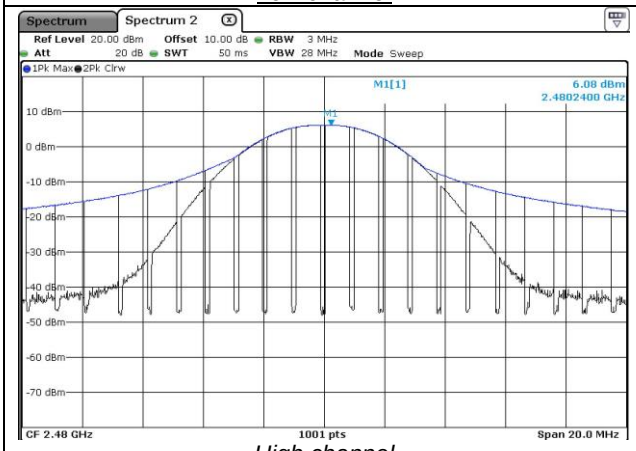
TEST: Maximum peak conducted output power		**Verdict**
Method: A conducted measurement is performed. The RBW is wide enough to capture the maximum amplitude level. The SPAN is wide enough to capture all products of the modulation process. A MaxHold Peak detector is used. The spectrum analyzer is connected to the antenna port of the device under test. (Connector replacing the antenna) The tested equipment is set to transmit operation with modulation on its nominal channels.		**Pass**
Laboratory Parameters:	Required prior to the test	During the test
Ambient Temperature	20 to 30 °C	25°C ± 2
Relative Humidity	25 to 70 %	54% ± 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**

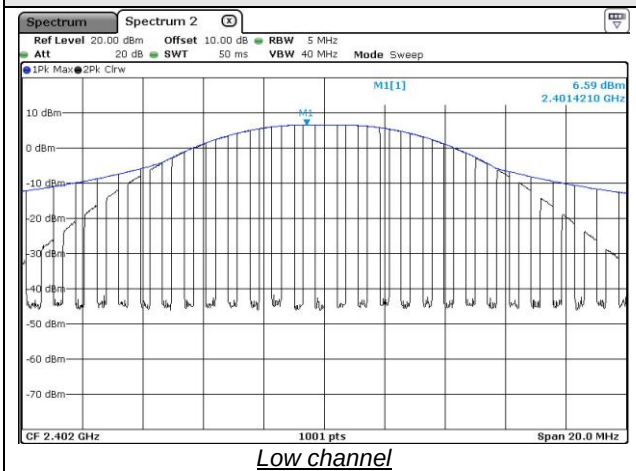
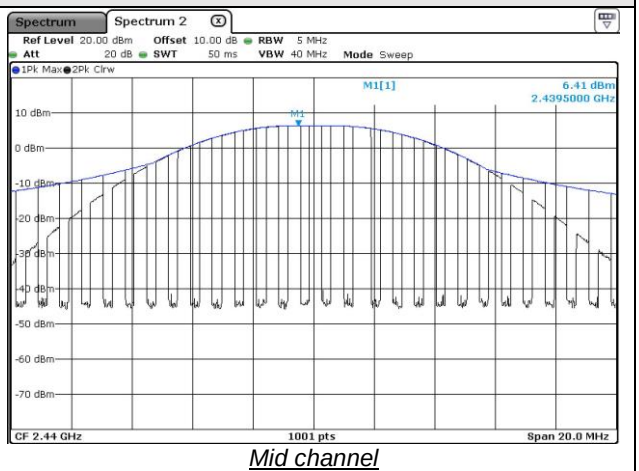
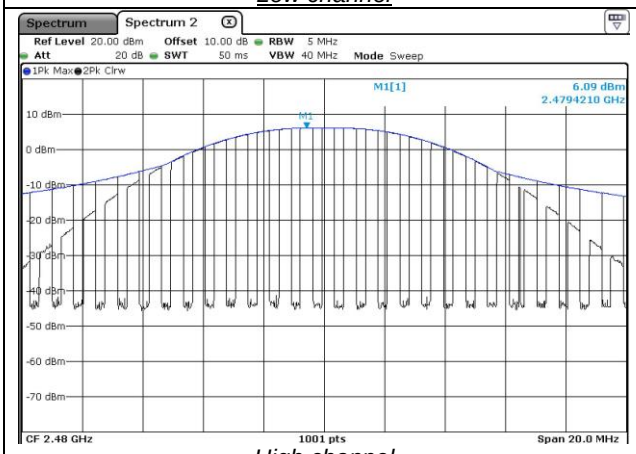
Supplementary information:
Test location: SMEE
Test date: October 10th, 2022 by C KERMICHE.
Power supply voltage: 5V DC from USB-Port.

Tabulated Results for Maximum peak output power (Conducted & Radiated measurement)						
FREQ	**Conducted power**	**Antenna Gain**	**Radiated power E.I.R.P**	**Conducted Limit**	**Radiated Limit**	**Result**
(MHz)	(dBm)	(dBi)	(dBm)	(dBm)	(dBm)	
1Mbps						
2402	6.6	1.95	8.6	30.0	36.0	**Pass**
2440	6.4	1.95	8.4	30.0	36.0	**Pass**
2480	6.1	1.95	8.1	30.0	36.0	**Pass**
2Mbps						
2402	6.6	1.95	8.6	30.0	36.0	**Pass**
2440	6.4	1.95	8.4	30.0	36.0	**Pass**
2480	6.1	1.95	8.1	30.0	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 = Conducted power (dBm) + Antenna Gain (dBi) Where Antenna gain = 1.95 dBi (declared by the manufacturer).

Graphical representation for Maximum Peak Output power (1Mbps)	
 *Low channel*	 *Mid channel*
 *High channel*	

Measurement:	Conducted measurement
Limit:	FCC Part 15.247 / RSS-247
RBW:	3MHz (RBW ≥ DTS bandwidth)
VBW:	28MHz (VBW ≥ [3 × RBW])
Span:	10MHz (Set span ≥ [3 × RBW])

Graphical representation for Maximum Peak Output power (2Mbps)	
 *Low channel*	 *Mid channel*
 *High channel*	

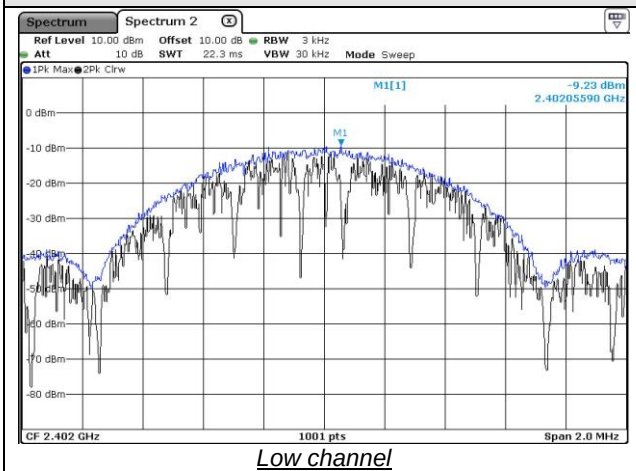
Measurement:	Conducted measurement
Limit:	FCC Part 15.247 / RSS-247
RBW:	5MHz (RBW ≥ DTS bandwidth)
VBW:	40MHz (VBW ≥ [3 × RBW])
Span:	20MHz (Set span ≥ [3 × RBW])

13. Maximum Power Spectral Density Level in the fundamental emission

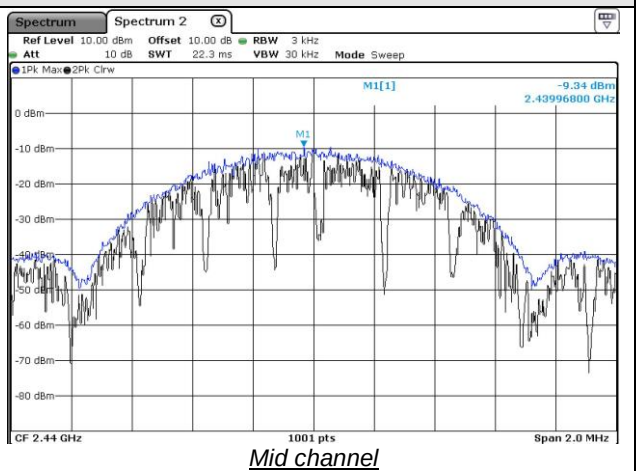
TEST: Maximum Peak Power Spectral Density		**Verdict**
Method: The setup is in an anechoic chamber. The spectrum analyzer is connected to the antenna port of the device under test. A conducted measurement is performed. The tested equipment is set to transmit operation with modulation on its nominal channel		**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 %	33% ± 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: October 24th, 2022 by C KERMICHE. Power supply voltage: 5V DC from USB-Port.		

Tabulated Results for Maximum Conducted Power Spectral Density			
Frequency (MHz)	**PSD (dBm/3kHz)**	**Limit**	**Result**
BLE: 1Mbps			
2402.0	-9.2	8dBm/3kHz	**Pass**
2441.0	-9.3	8dBm/3kHz	**Pass**
2480.0	-9.5	8dBm/3kHz	**Pass**
BLE: 2Mbps			
2402.0	-10.9	8dBm/3kHz	**Pass**
2441.0	-11.3	8dBm/3kHz	**Pass**
2480.0	-11.6	8dBm/3kHz	**Pass**
RBW:	3kHz		
Limit:	FCC Part 15.247 / RSS-247		
Final measurement detector:	Peak		
RESULT:	PASS		

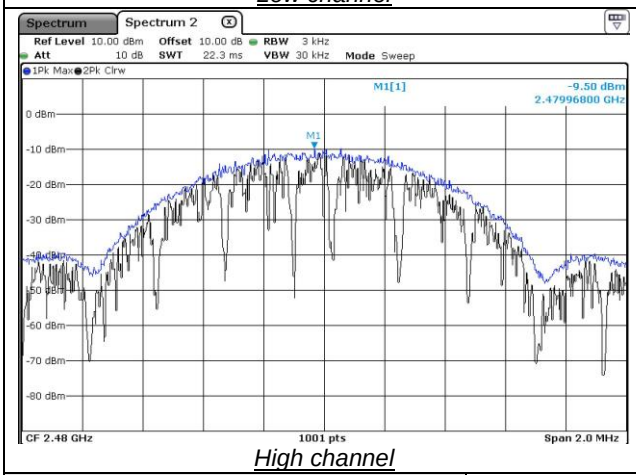
Graphical representation for Maximum Power Spectral Density / BLE: 1Mbps



Low channel



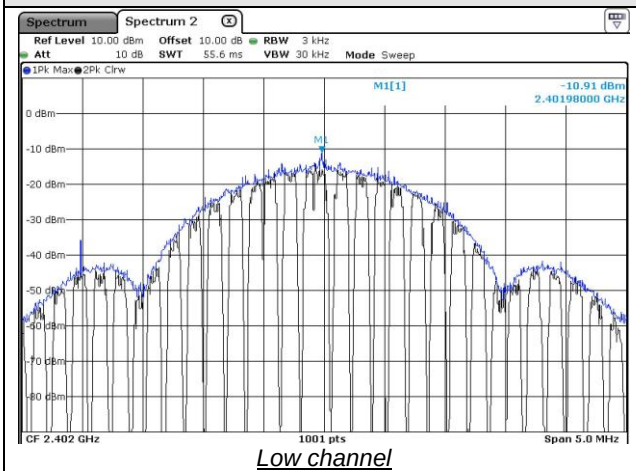
Mid channel



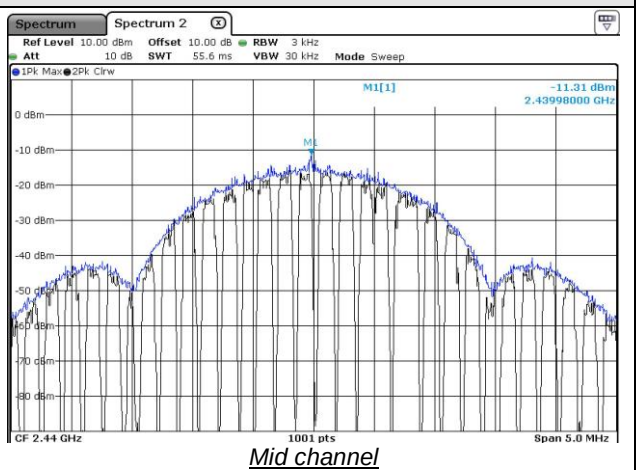
High channel

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

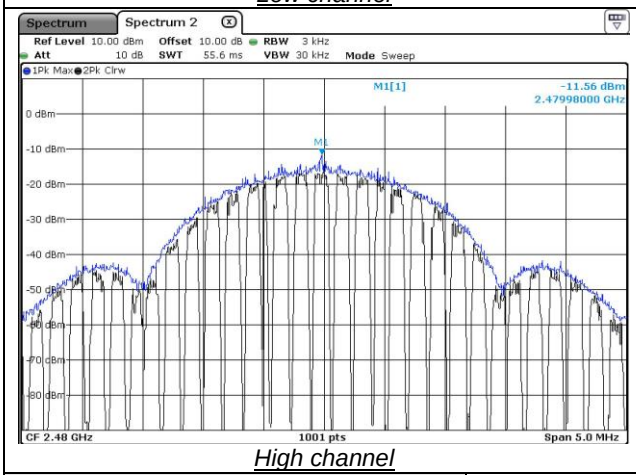
Graphical representation for Maximum Power Spectral Density / BLE: 2Mbps



Low channel



Mid channel



High channel

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

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

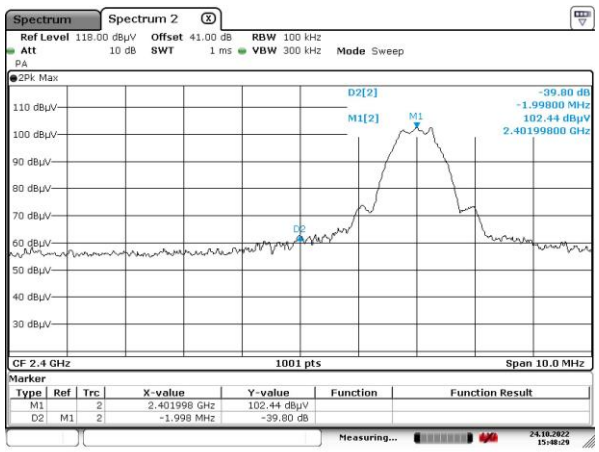
TEST: Unwanted emissions in Non-Restricted Frequency Bands			**Verdict**
Method: Measurements were made in a 3-meter Semi Anechoic Room (SAR) up to 1GHz and in a 3-meter Full Anechoic environment (SAR with floor absorbers) above 1GHz. The Semi Anechoic Room complies with CISPR16-1-4 / ANSI C63.4 requirements. 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 %		33% ± 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 / Analyser RBW	Limit	Results
30 to 25000	Pk / 100kHz	20dB below the maximum Peak level	**Pass**
Supplementary information: Test location: SMEE Test date: October 24th, 2022 by C KERMICHE. Power supply voltage: 5V DC from USB-Port.			

Tabulated Results for Peak Output Power Reference level	
FREQ	**Field Strength 3m**
(MHz)	(dBµV/m)
2402.0	100.5 (1)
2440.0	99.6 (1)
2480.0	99.1 (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 **79.1 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)
BLE: 1Mbps				
2400.00	62.6	79.1	**-16.5**	**Pass**
All others spurious are at least 10 dB below the -20dBc limit See pre-scan graphs in chapter 15.				
BLE: 2Mbps				
2400.00	70.5	79.1	**-8.6**	**Pass**
All others spurious are at least 10 dB below the -20dBc limit See pre-scan graphs in chapter 15.				

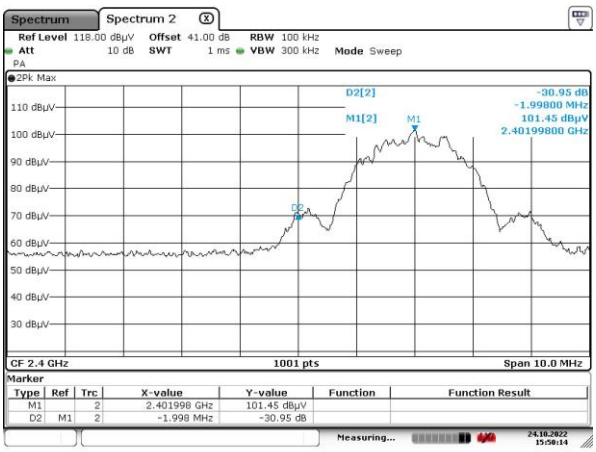
RBW:	100kHz
Measurement distance:	3m
Limit:	FCC 15.247 / RSS-247
Final measurement detector:	Peak
RESULT:	PASS
Note:	See band-edge measurement

Graphical representation of Band-edge compliance (LOW)



Low band edge compliance: BLE/1Mbps

Radiated Peak level is 62.6dBµV/m (limit 79.1dBµV/m)
D2 = 2400MHz.



Low band edge compliance: BLE/2Mbps

Radiated Peak level is 70.5dBµV/m (limit 79.1dBµV/m)
D2 = 2400MHz.

RESULT: PASS.
Note: Radiated measurement.

15. 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 %	33% ± 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**

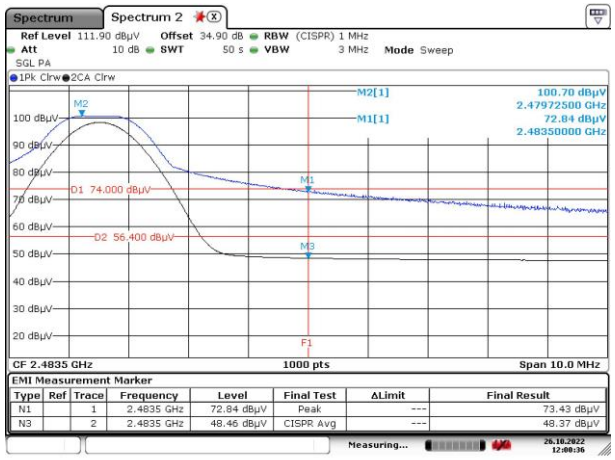
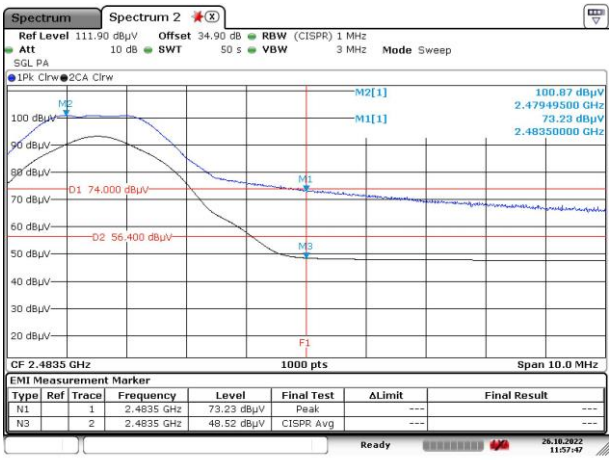
Supplementary information:
Test location: SMEE
Test date: October 11th, 2022 by C KERMICHE.
Power supply voltage: 5V DC from USB-Port.

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.						

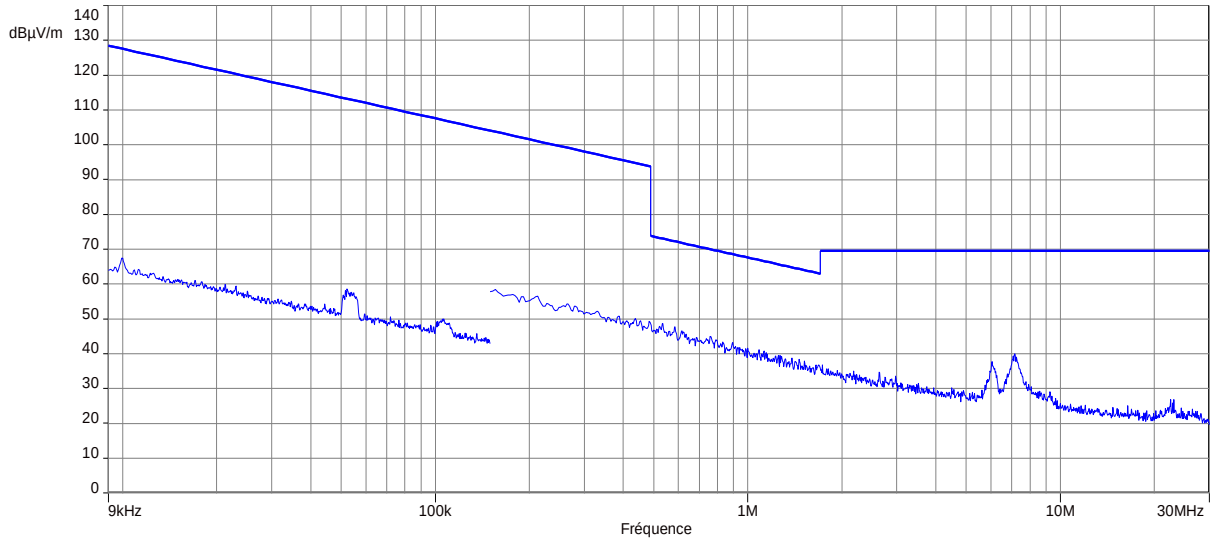
Tabulated Results for Unwanted emissions (490kHz-30MHz)							
FREQ	**RF field @ 30m**	**Limit @ 30m**	**Detector**	**Margin**	**Ant. angle**	**Table angle**	**Correc. Fact. (CF)**
MHz	dBµV/m	dBµV/m	Pk / QP	dB	Degree	Degree	dB
All levels are at least 20dB below applicable limits							
Supplementary 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
299.993927	43.91	42.63	46.0	-3.37	195.9	1.07	16.02	H
499.98907	41.93	40.61	46.0	-5.39	0	1	19.47	H
699.993393	34.46	31.92	46.0	-14.08	182.2	1	23.22	H
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										
All levels are at least 10dB below applicable limits										
Middle channel										
All levels are at least 10dB below applicable limits										
High channel										
All levels are at least 10dB below applicable limits										
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	High band edge compliance: BLE/2Mbps
Radiated Peak level is 72.8dBµV/m at 2483.5MHz (limit 74dBµV/m). Max radiated Average level is 48.5dBµV/m (limit 54dBµV/m, CISPR Average detector measurement).	Radiated Peak level is 73.2dBµV/m at 2483.5MHz (limit 74dBµV/m). Max radiated Average level is 48.5dBµV/m (limit 54dBµV/m, CISPR Average detector measurement).
RESULT: PASS Note: Radiated measurement. Power setting at 7.5dBm.	

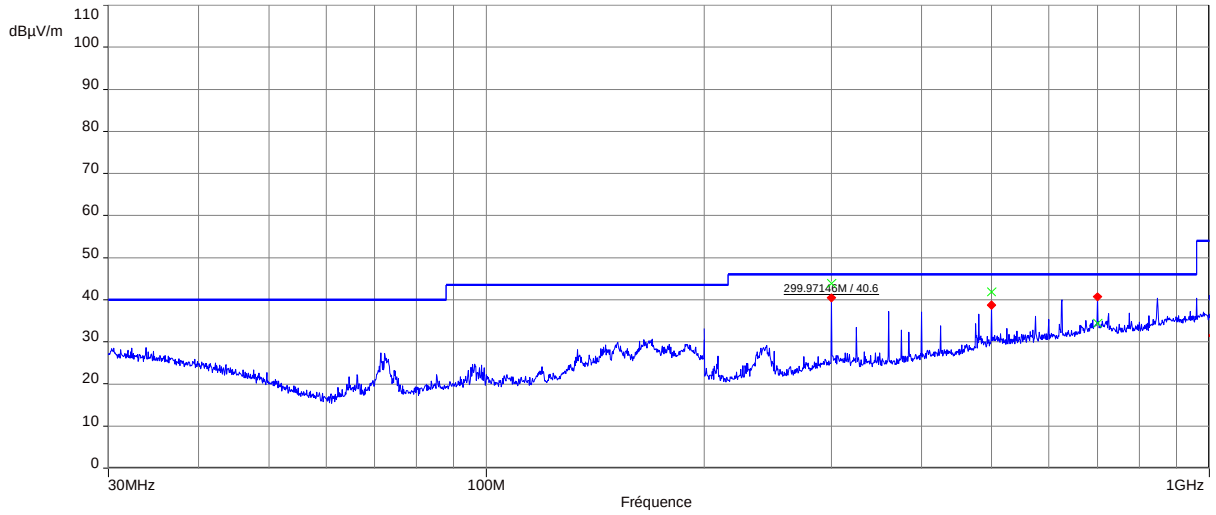
Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 9kHz-30MHz / 3m / Parallel & Perpendicular antenna position / Transmit mode)

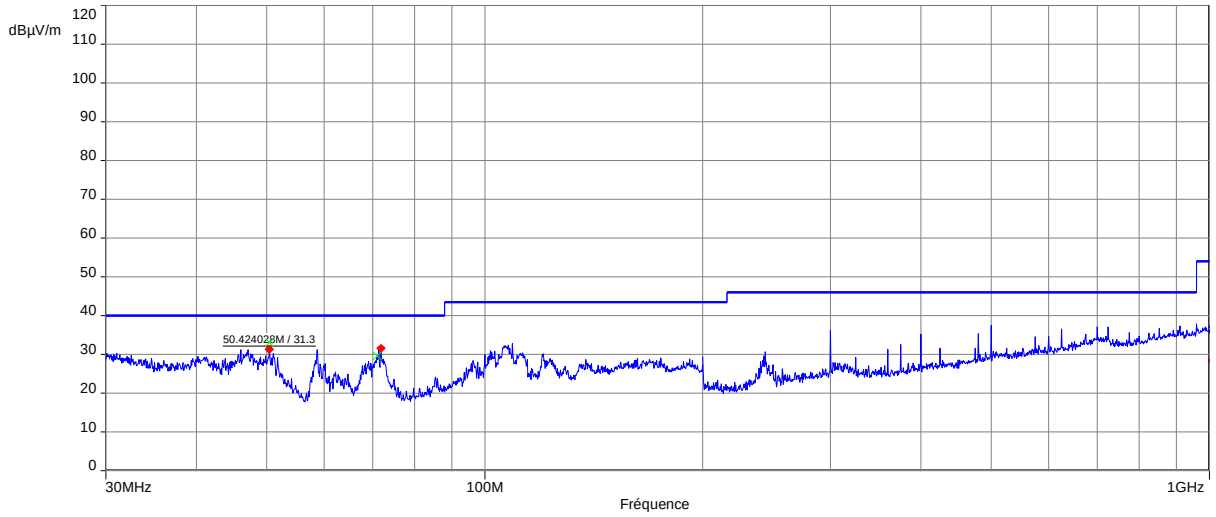


Notes: Pre-scan graph only for identification purpose.
Same result for transmit mode on all channels.

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
Note:	

Graphical representation of Radiated Disturbance Measurement (Peak detection, Semi Anechoic Chamber pre-scan, 30MHz-1GHz / 3m / Horizontal & Vertical/ Transmit mode)



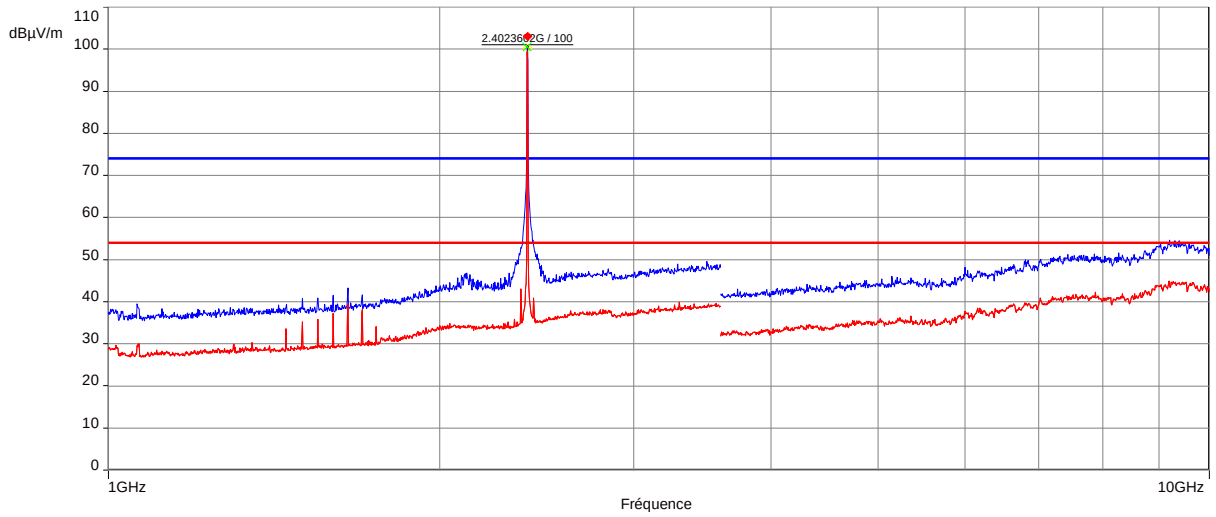


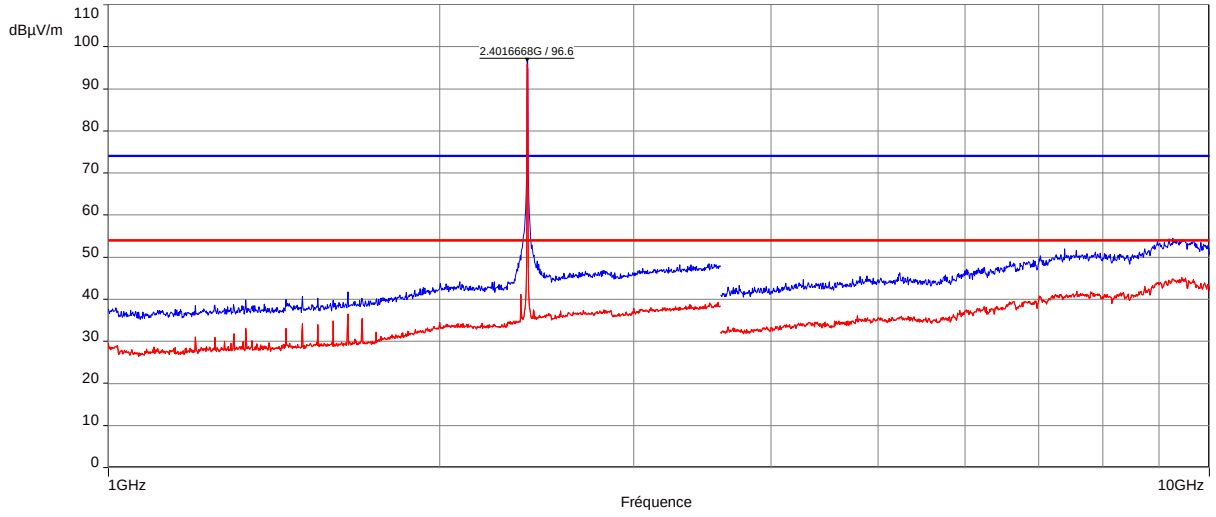
Note: Pre-scan graph only for identification purpose.
Same result for transmit mode on all channels.

------ : Peak trace	
Frequency band investigated:	30MHz-1GHz
Unit :	dBµV/m
RBW :	100kHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.209 / RSS-GEN
Measurement detector:	Peak
Note:	

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-10GHz / 3m / Horizontal & Vertical/ Transmit mode)

Low channel



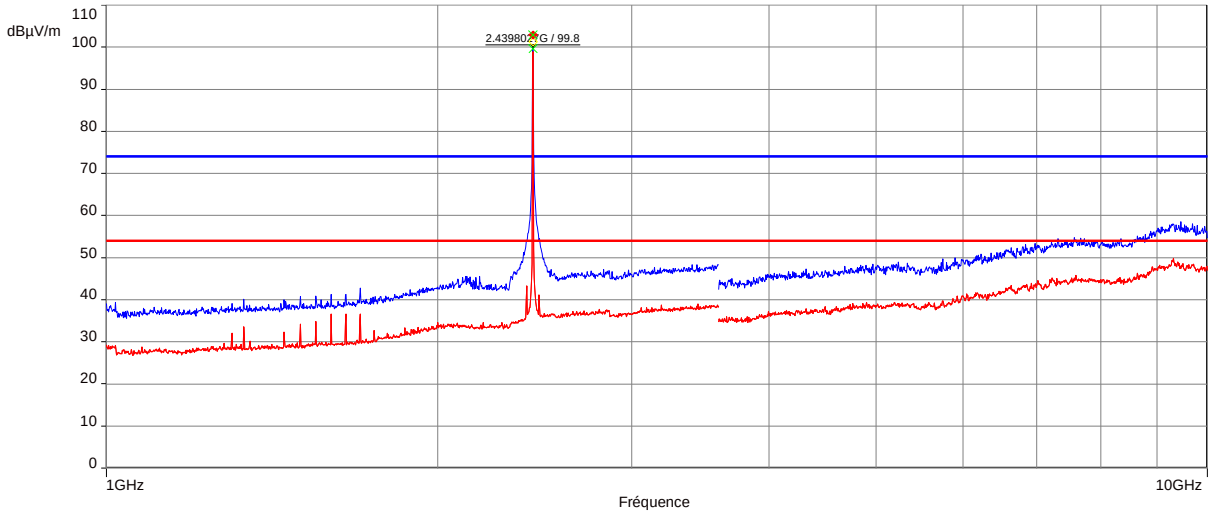


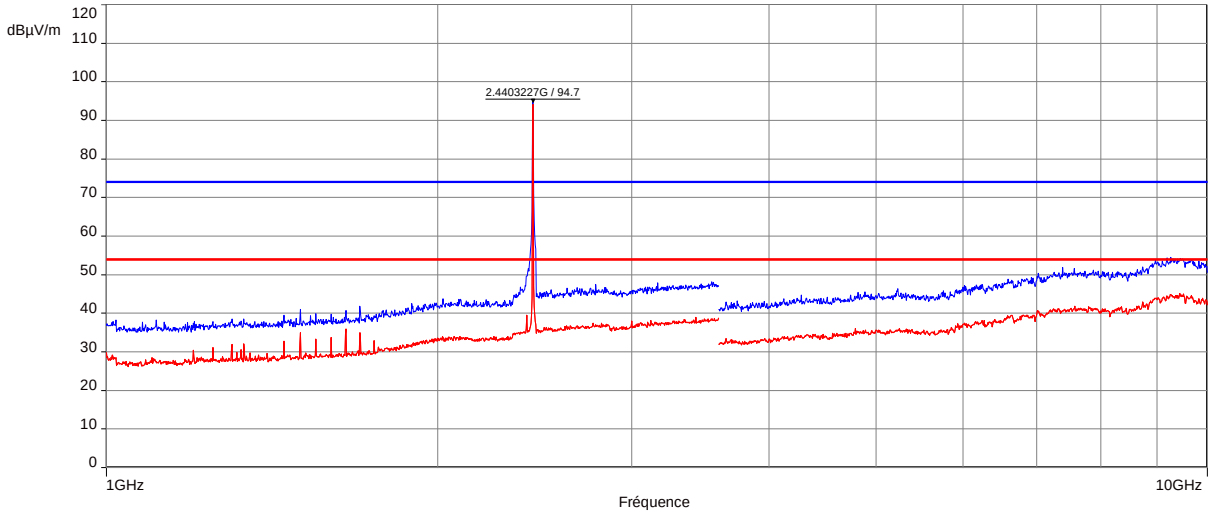
------ : Peak trace	------ : Average trace

Frequency band investigated:	1GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average
Note:	

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-10GHz / 3m / Horizontal & Vertical/ Transmit mode)

Middle channel



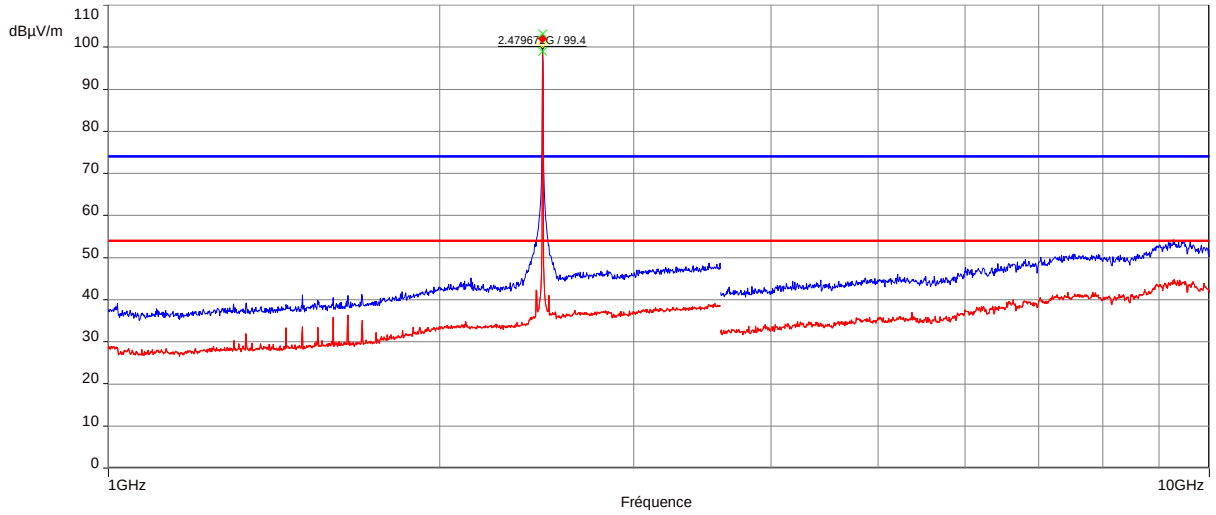


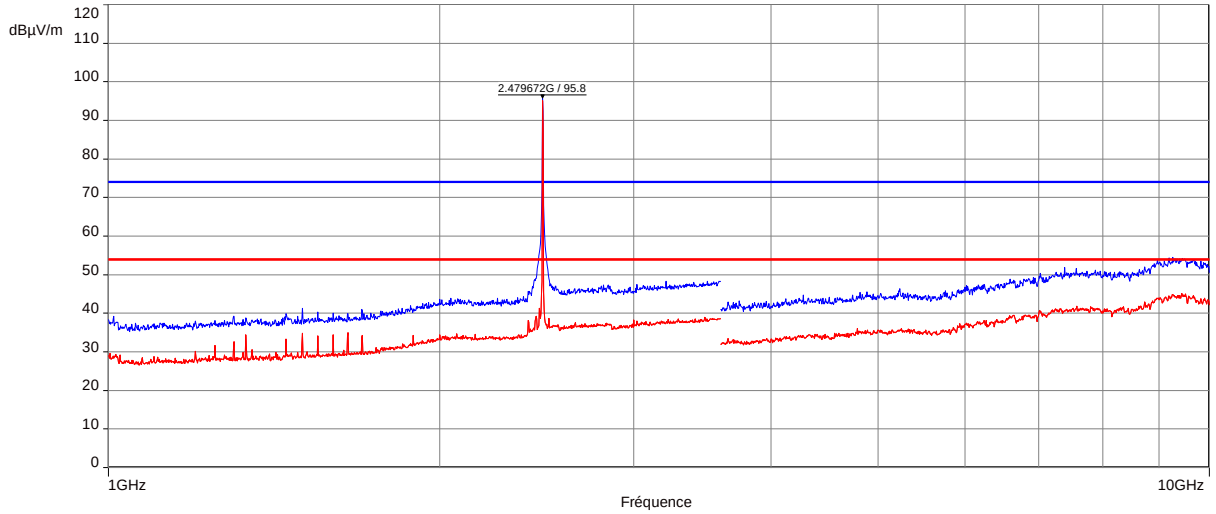
------ : Peak trace	------ : Average trace

Frequency band investigated:	1GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average
Note:	

Graphical representation of Radiated Disturbance Measurement (Peak detection, Anechoic chamber pre-scan, 1GHz-10GHz / 3m / Horizontal & Vertical/ Transmit mode)

High channel



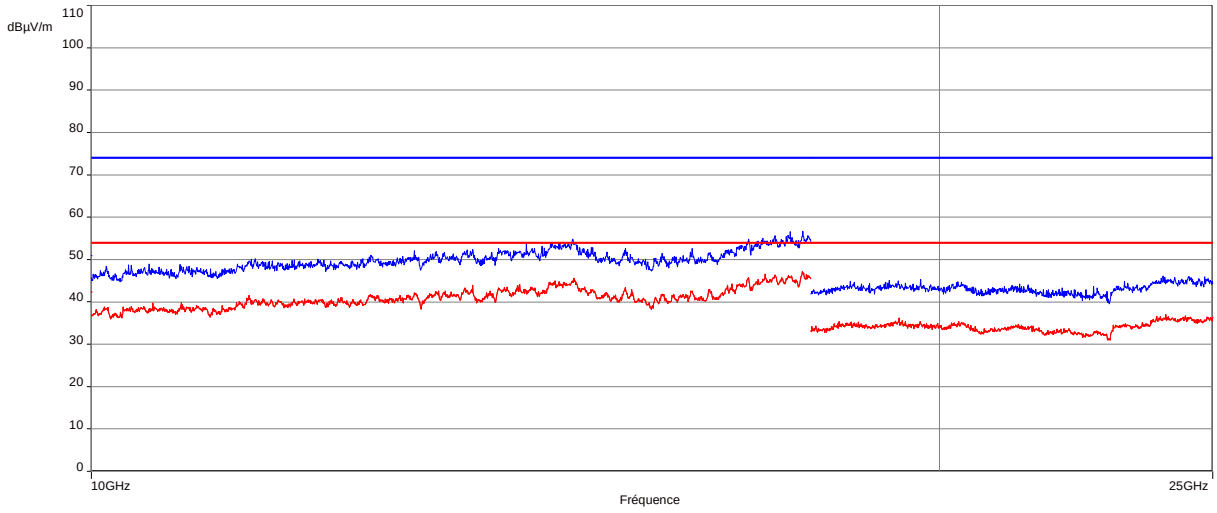


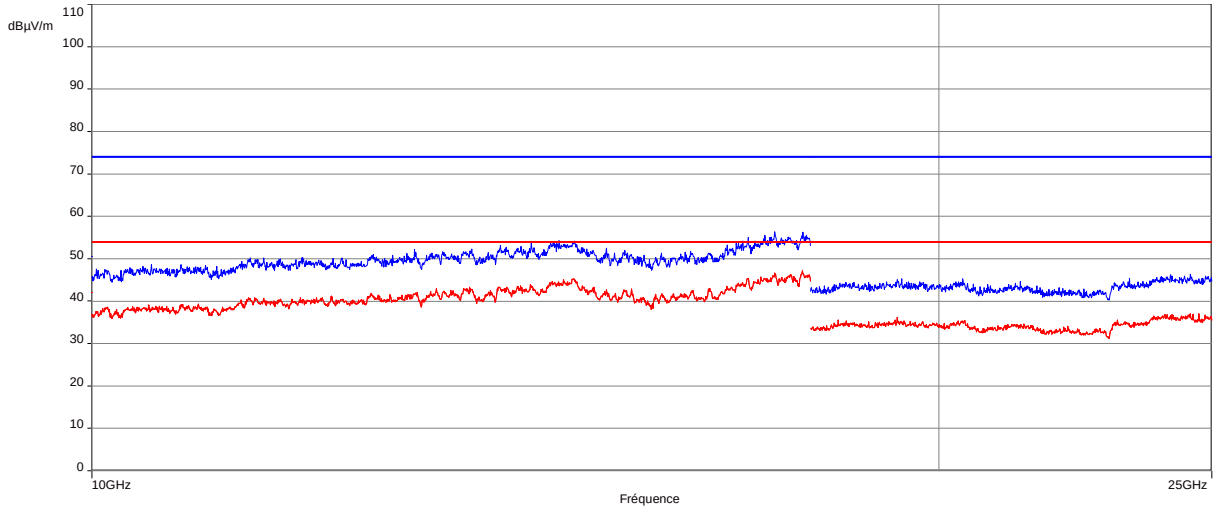
------: Peak trace	------: Average trace

Frequency band investigated:	1GHz-10GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average
Note:	Power setting at 7.5dBm.

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

Low / Middle / High channel





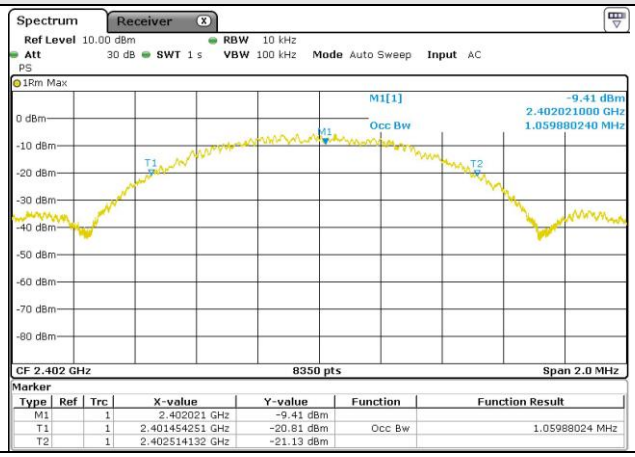
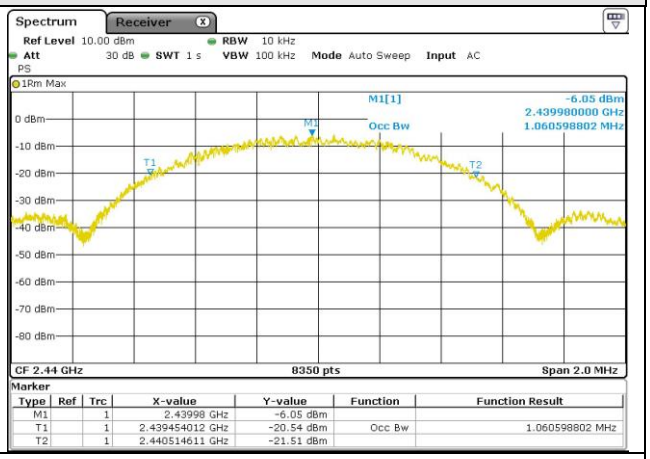
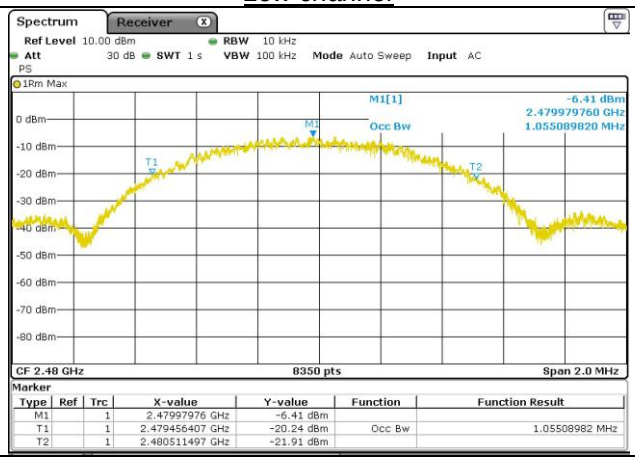
------ : Peak trace	------ : Average trace
Frequency band investigated:	10GHz-25GHz
Unit :	dBµV/m
RBW :	1MHz
Antenna polarization :	Horizontal & Vertical
Voltage:	5V DC
Limit:	FCC 15.247 / RSS-247
Measurement detector:	Peak / Average
Note:	

16. Occupied bandwidth

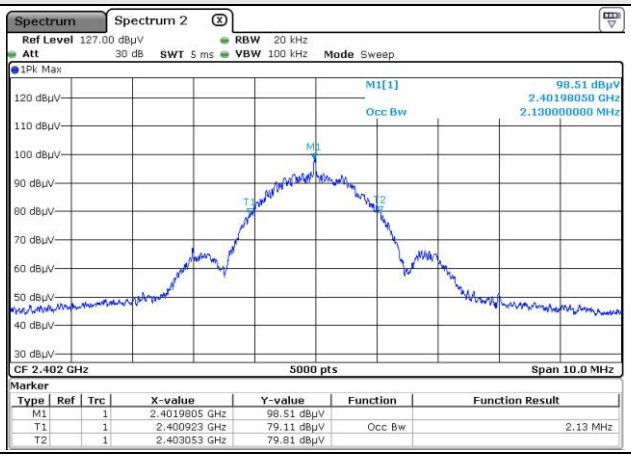
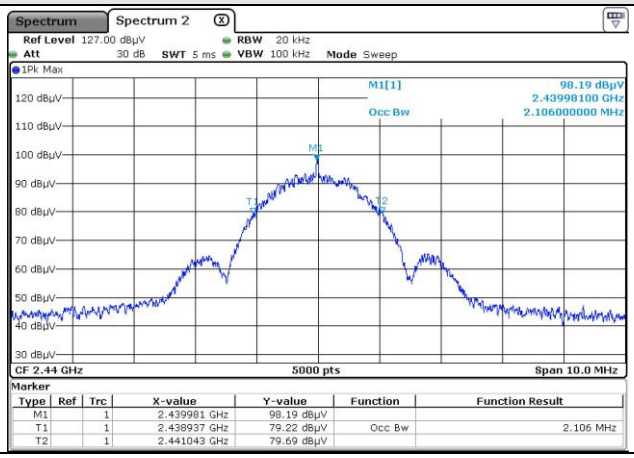
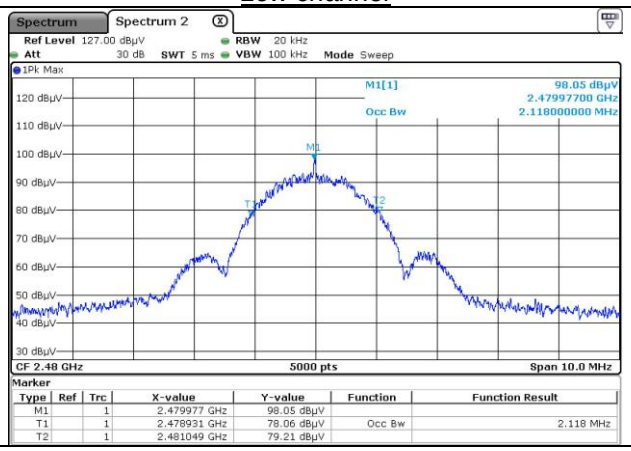
TEST: Occupied bandwidth (99%) / RSS-GEN		**Verdict**
Method: The setup is in an anechoic chamber. The spectrum analyzer is connected to the measuring antenna. A radiated measurement is performed. The RBW is set in the range of 1% to 5% of the OBW, with VBW ≥ 3 x RBW. The SPAN is wide enough to capture 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 %	33% ± 5

Supplementary information:
Test location: SMEE
Test date: October 24th, 2022 by C KERMICHE.
Power supply voltage: 5V DC from USB-Port.

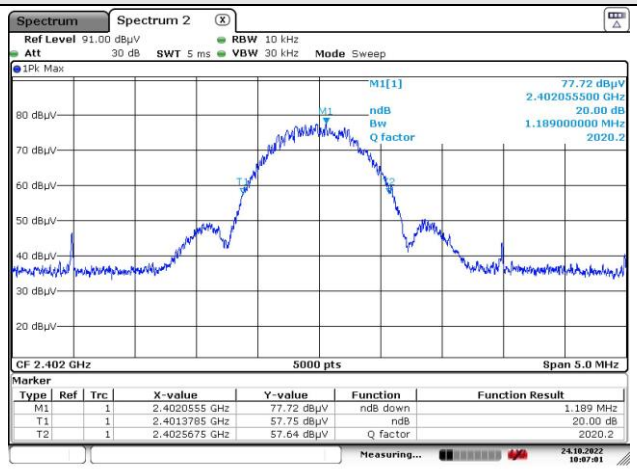
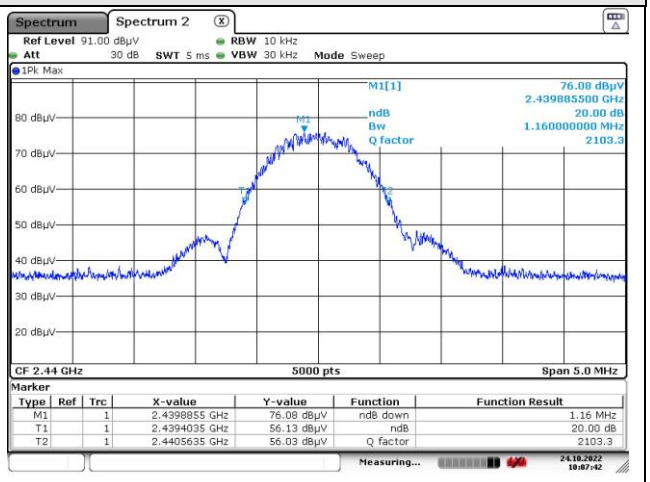
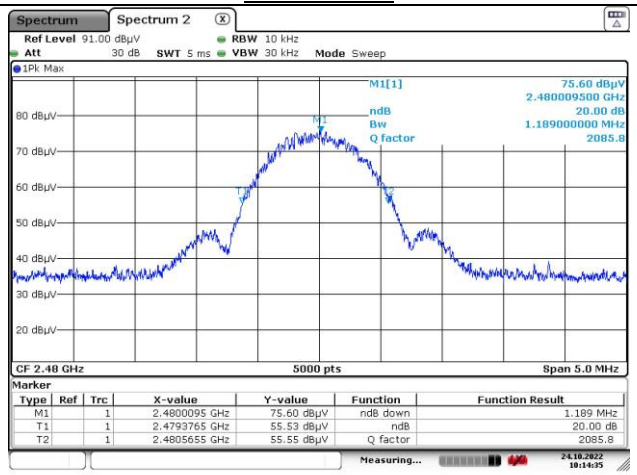
Tabulated Results for 99% Occupied Bandwidth	
Frequency (MHz)	**99% Occupied Bandwidth** (MHz)
BLE: 1Mbps	
2402.0	1.059
2440.0	1.060
2480.0	1.055
BLE: 2Mbps	
2402.0	2.130
2440.0	2.106
2480.0	2.118

Graphical representation of 99% Occupied Bandwidth / BLE: 1Mbps	
	
Low channel	*Mid channel*
	
High channel	

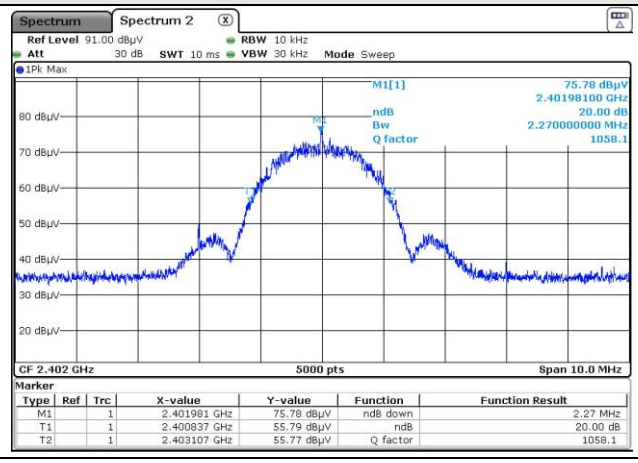
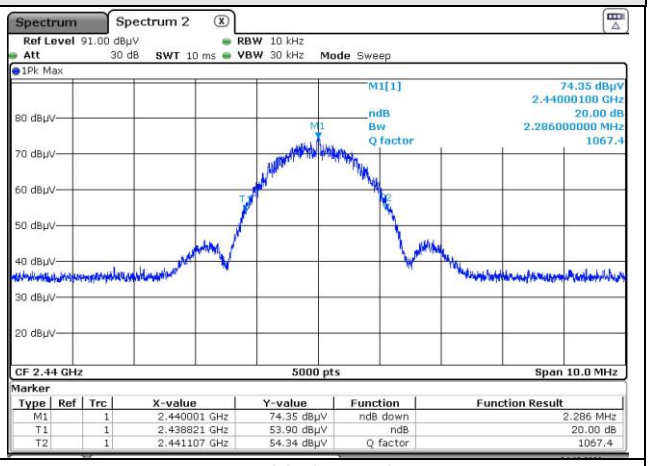
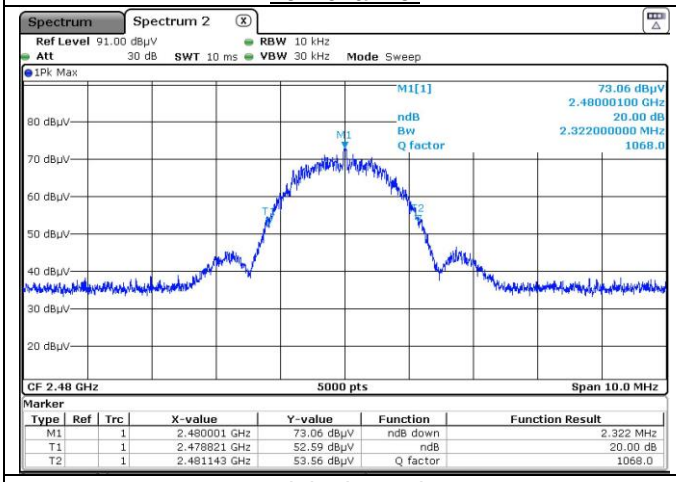
Frequency band investigated:	2402MHz to 2480MHz
RBW :	10kHz
Measurement detector:	Peak

Graphical representation of 99% Occupied Bandwidth / BLE: 2Mbps	
	
Low channel	*Mid channel*
	
High channel	

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

Graphical representation of Occupied 20dB Bandwidth / BLE: 1Mbps	
	
Low channel	*Mid channel*
	
High channel	

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

Graphical representation of Occupied 20dB Bandwidth / BLE: 2Mbps	
	
Low channel	*Mid channel*
	
High channel	

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

17. 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 conducted antenna port measurement					
Description	**Manufacturer**	**Model**	**ID**	**Date Cal.**	**Nxt. Cal.**
Measuring receiver	Rohde&Schwarz	ESRP	REC-151-002	2021/9	2023/11
Spectrum analyzer	Rohde&Schwarz	FSV40	ASP-171-004	2021/10	2023/10
RF Attenuator	Mini-Circuit	BW-N10W5+	ATT-171-008	2023/4	2024/4
EMC Software	NEXIO	BAT EMC	SOF-101-001	-	-

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
Loop antenna	EMCO	6502	ANT-101-009	2021/8	2023/8
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

Test Equipment Used for radiated emission					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Pre-amplifier	SMEE	18-40GHz	PRE-171-004	2022/4	2023/3
EMC Software	NEXIO	BAT EMC	SOF-101-001	-	-
Ref. Comb generator	SMEE	EMR-10M	REF-111-002	-	-
Ref. Comb generator	SMEE	EMR 1-6GHz	REF-141-003	-	-

END OF REPORT