Accreditation
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Template : May 28th, 2024

TEST REPORT

N°: **24329407-806666-D(FILE# 9310523-SRA)** Version: **01**

Subject	**Radio spectrum tests according to the standards:** **FCC CFR 47 Part 15.247 & ANSI C63.10** **RSS-247 & RSS-Gen**
Issued to	**STMICROELECTRONICS (Rousset) SAS** 190 Avenue Celestin Coq 13106 - Rousset FRANCE
Apparatus under test	
Product	**Bluetooth® LE and IEEE 802.15.4 radio module**
Trade mark	**STMICROELECTRONICS**
Manufacturer	**STMICROELECTRONICS**
Model under test	**STM32WBA5MMG**
Serial number	**None**
FCCID	**YCP-32WBA5MMG01**
IC	**8976A-32WBA5MMG01**
Conclusion	See Test Program chapter
Test date	December 03, 2024 to December 04, 2024
Test location	LCIE Grenoble
FCC Test site	FR0008 - 918017 (MOI)
ISED Test site	6500A (MOI)
Sample receipt date	November 20, 2024
Composition of document	57 pages
Document issued on	March 20, 2025

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PUBLICATION HISTORY

Version	Date	Author	Modification
01	March 20, 2025	Akram HAKKARI	Creation of the document

Each new edition of this test report replaces and cancels the previous edition. The control of the old editions of report is under responsibility of client.

SUMMARY

1. TEST PROGRAM

References

- **47 CFR Part 15.247 (2023)**
- **RSS 247 Issue 3**
- **RSS Gen Issue 5**
- **KDB 558074 D01 DTS Meas Guidance v05r02**
- **KDB 662911 D01 Multiple Transmitter Output v02r01**
- **ANSI C63.10 (2013)**

Radio requirement:

Clause - Test Description		Test result - Comments
Occupied Bandwidth	***ISED***	**PASS**
6dB Bandwidth	***FCC & ISED***	**PASS**
Maximum Conducted Output Power	***FCC & ISED***	**PASS**
Power Spectral Density	***FCC & ISED***	**PASS**
Unwanted Emissions in Non-Restricted Frequency Bands	***FCC & ISED***	**PASS**
Unwanted Emissions in Restricted Frequency Bands	***FCC & ISED***	**PASS**
Receiver Radiated Emissions	***ISED***	**PASS(2)**
This table is a summary of test report, see conclusion of each clause of this test report for detail.		

(1) Limited program
(2) Testing covered the receive mode, and receiver spurious emissions are considered to be the same as transmitter.

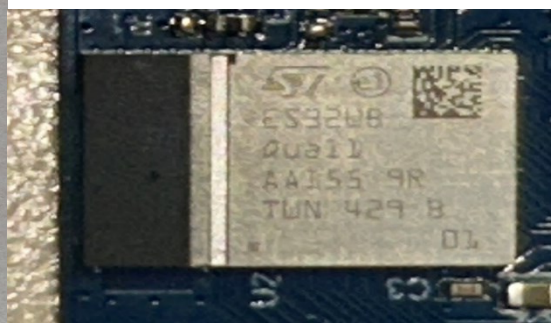
PASS: EUT complies with standard's requirement
FAIL: EUT does not comply with standard's requirement
NA: Not Applicable
NP: Test Not Performed

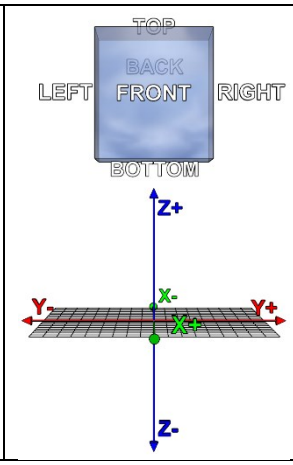
2. EQUIPMENT UNDER TEST: CONFIGURATION (DECLARED BY PROVIDER)

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):

Model under test:	**STM32WBA5MMG**
Serial Number:	**None**





Dimensions:	8mm x 12mm x 1.372mm (Length x Width x Height)
Type:	Table-Top

Power supply:

Name	Type	Rating	Reference / Sn	Comments
Supply1	DC	1.71 to 3.6 V	/	Module power supply
Supply2	DC	USB power supply (4 – 5.75V)	/	Switching AC/ Adapter

NC: Not communicated by provider

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Comments
Supply1	USB C	1.5	No	No	USB only on board and only for power
Supply2	USB C	1.5	No	No	100/240VAC – 5VDC
Access1	JTAG	0.1	No	No	Only for debug

NC: Not communicated by provider

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
LAPTOP	LENOVO	/	/
Daughter board	STLINK-V3MINE	/	/

NC: Not communicated by provider

Equipment information (declaration of provider):

Bluetooth Low Energy:	**V6.0**
Chipset / RF Module	**STM32WBA5MMG**
Frequency band:	[2400 – 2483.5] MHz
Spectrum Modulation:	DSSS (Tested like it – international agreements)
Number of Channel:	40
Spacing channel:	2MHz
Channel bandwidth:	2MHz
Antenna Type:	Internal
Antenna connector:	Permanent external
Antenna requirements §15.203	The transmitter uses an integral antenna and it permanently connected
Transmit chains:	1
Receiver chains	1

CHANNEL PLAN			
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
Cmin: 0	2402	**Cmid: 20**	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	**Cmax: 39**	2480

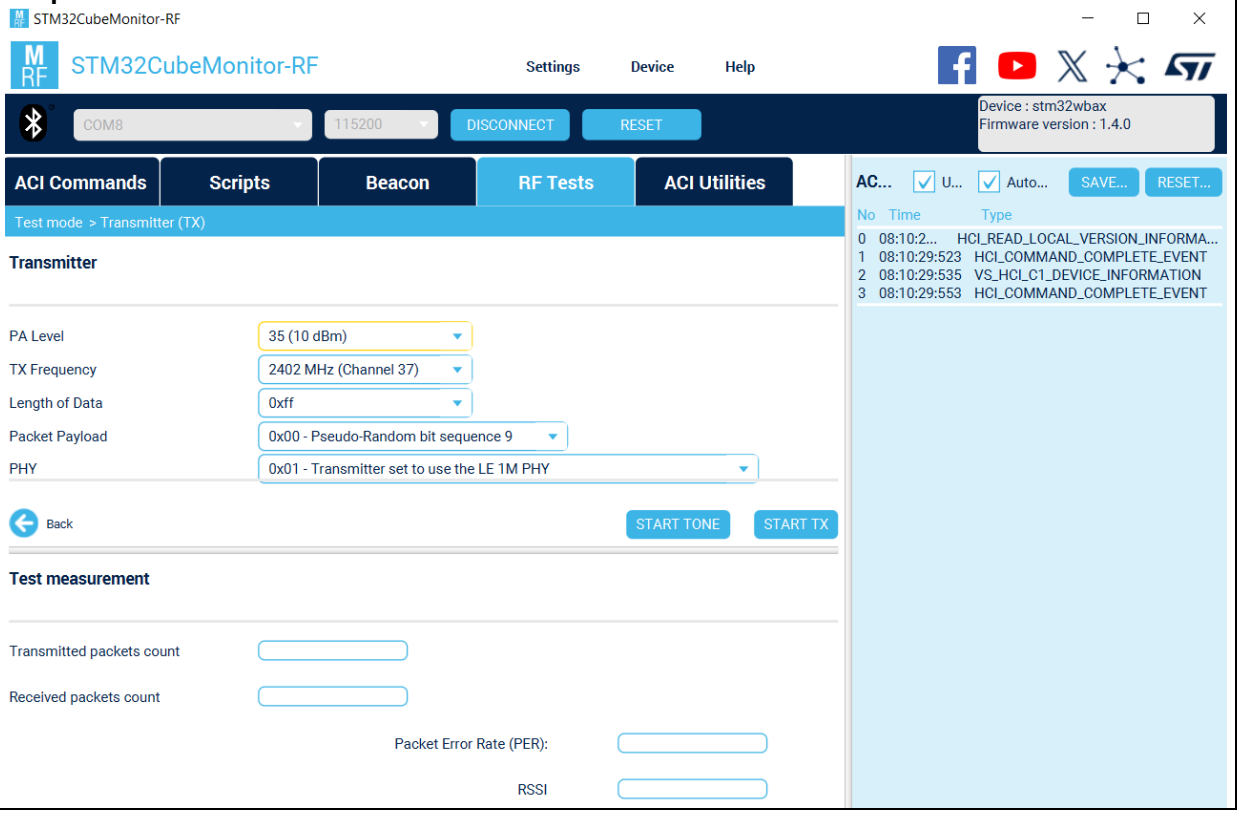
DATA RATE			
Available	**Data Rate (Mbps)**	**Modulation Type**	**Worst Case Modulation**
☐	0.25	GFSK (1MHz)	☐
☑	1	GFSK (1MHz)	☑
☑	2	GFSK (2MHz)	☐

Antenna Characteristic			
Antenna reference	Gain (dBi)	Frequency Band (MHz)	Impedance(Ω)
ethertronics, Part Number : 1001312	1.88	2400 to 2485 MHz	50

Hardware information				
Highest internal frequency (PLL, Quartz, Clock, Microprocessor…):		**$F_{Highest}$:**	**2500**	**MHz**
Firmware (if applicable):		**V:**	Device : stm32wbax Firmware version : 1.4.0	
Software (if applicable):		**V:**		
quipment intended:	Fixed			
Type of equipment:	Stand-alone			
Equipment sample:	Production model			
Duty cycle:	Continuous duty			
Operating temperature range:	T_{min}:	-40 °C		
	T_{nom}:	20°C		
	T_{max}:	85 °C		
Operating voltage:	V_{nom}:	1.71 to 3.6 VDC		

NC: Not communicated by provider

2.2. RUNNING MODE

Test mode	Description of test mode
Test mode 1	Permanent emission with modulation on a fixed channel in the data rate that produced the highest power. A daughter board with a JTAG connector is used to connect the module to the PC. The module is connected to a daughter board equipped with a JTAG connector. This daughter board is then connected to a PC via a USB-C port to configure the DUT (Device Under Test). The software used to configure the product is STM32CubeMonitor-RF, which allows configuring the module for BLE (Bluetooth Low Energy) and Zigbee. **The power used is +10 dBm** 

Test	Running mode
Occupied Bandwidth	Test mode 1
6dB Bandwidth	Test mode 1
Maximum Conducted Output Power	Test mode 1
Power Spectral Density	Test mode 1
Conducted Spurious Emission at the Band Edge	Test mode 1
Unwanted Emissions in Non-Restricted Frequency Bands	Test mode 1
AC Power Line Conducted Emission	Test mode 1
Unwanted Emissions in Restricted Frequency Bands	Test mode 1
Receiver Radiated Emissions	Test mode 2 (1)

(1) Testing covered the receive mode, and receiver spurious emissions are considered to be the same as transmitter.

2.3. EQUIPMENT LABELLING

Label
None

2.4. EQUIPMENT MODIFICATIONS DURING THE TESTS

None

2.5. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

$$FS = RA + AF + CF - AG$$

Where:
FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

Example:
Assume a receiver reading of 52.5dBµV is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dBµV/m.
FS = 52.5 + 7.4 + 1.1 – 29 = 32 dBµV/m
The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
Level in µV/m = Common Antilogarithm [(32dBµV/m)/20] = 39.8 µV/m.

2.6. TEST DISTANCE EXTRAPOLATION – FCC/ISED

The field strength is extrapolated to the new measurement distance using formula from FCC Part15.31 (f) and §6.5-6.6 RSS-GEN:

Below 30MHz,

$$FS_{\text{limit}} = FS_{\max} - 40\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right)$$

Above 30MHz,

$$FS_{\text{limit}} = FS_{\max} - 20\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right)$$

Where:
FS_{limit} is the calculation of field strength at the limit distance, expressed in dBµV/m
FS_{max} is the measured field strength, expressed in dBµV/m
$d_{measure}$ is the distance of the measurement point from the EUT
d_{limit} is the reference limit distance

2.7. CALIBRATION DATE

The calibration intervals are extended at Cal due +2 months. This extended interval is based on the fact that there is sufficient calibration data to statistically establish a trend or based on experience of use of the test equipment to assure good measurement results for a longer period. The symbol -/- replaces the date for equipment checking before test or that have none impact on the test or that have no calibration required by the standard.

2.8. METHOD TO DETERMINATE THE SPURIOUS RADIATED EMISSION

The Normalized Site Attenuation (NSA) is added to the maximum values observed during the azimuth search in order to obtain the spurious radiated emission. For spurious above -6dB from the limit found with the NSA, the Substitution Method is applied.
The substitution antenna replaces the equipment under test (EUT) for Effective Radiated Power (ERP) or Effective Isotropically Radiated Power (EIRP) measurement following the standard. Power is measured for a high level and calculated for the same level of radiated field strength obtained on the measuring antenna and EUT.

3. OCCUPIED BANDWIDTH

3.1. TEST CONDITIONS

Date of test	:	December 04, 2024
Test performed by	:	Akram HAKKARI
Relative humidity (%)	:	43
Ambient temperature (°C)	:	23

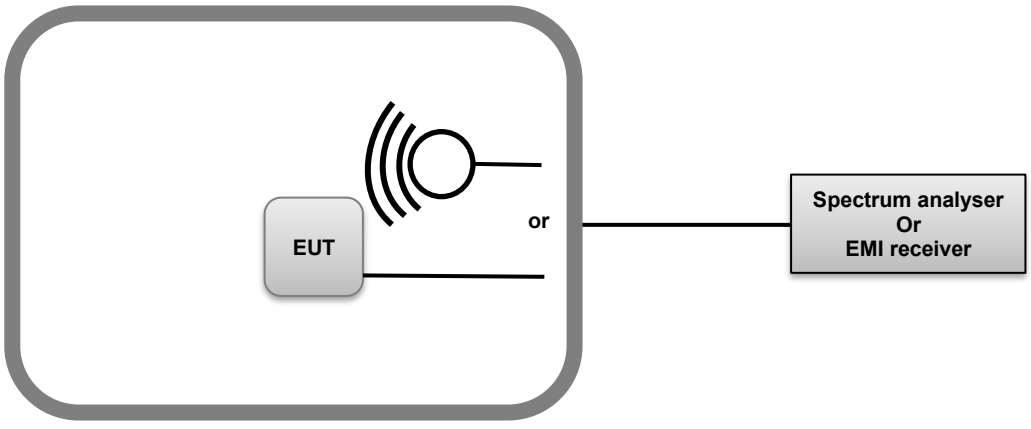
3.2. TEST SETUP

The Equipment Under Test is installed in an anechoic chamber.
Measurement is performed with a spectrum analyzer in conducted method.

The EUT is turned ON, the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Test Procedure:
ANSI C63.10 § 6.9.2 and RSS-Gen Issue 5 § 6.7

- RBW used in the range of 1% to 5% of the anticipated emission bandwidth
- Set the video bandwidth (VBW) ≥ 3 x RBW.
- Detector = Peak.
- Trace mode = Max Hold.
- Sweep = Auto couple.
- Allow the trace to stabilize.
- OBW 99% function of spectrum analyzer used



Test setup of Occupied Bandwidth

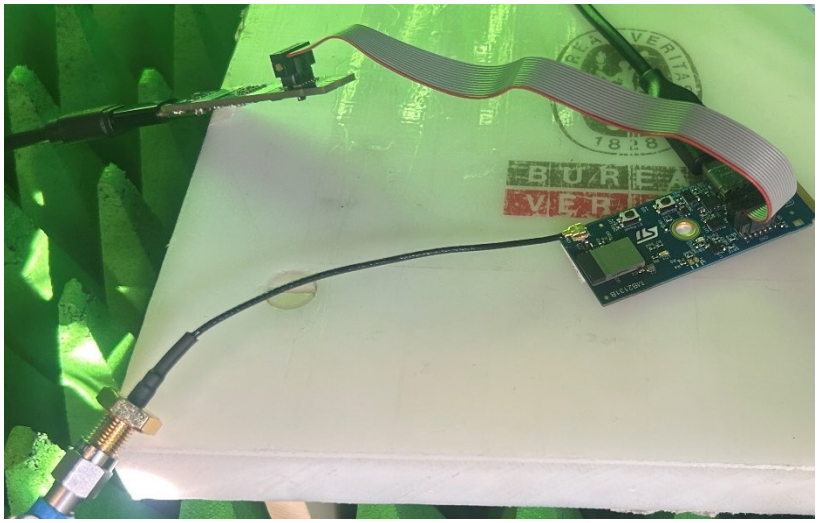


Photo of Occupied bandwidth

3.3. LIMIT

None

3.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Cable SMA UFL	_	_	A5329762	07/23	07/25
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
Full Anechoic Room	SIEPEL	_	D3044024	-/-	-/-
SMA 1.5m	SUCOFLEX	18GHz	A5329863	08/24	08/25
SMK 1.2m (Ampl <-> chamber)	HUBER-SUHNER	SUCOFLEX 102	A5330062	04/23	04/26
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	04/24	04/26
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25

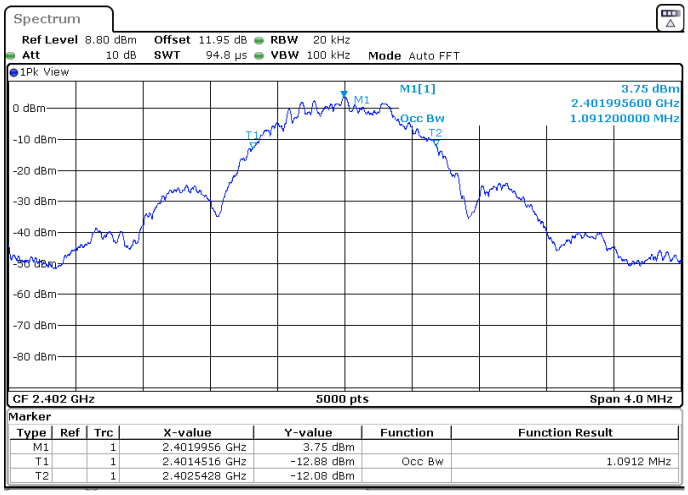
3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

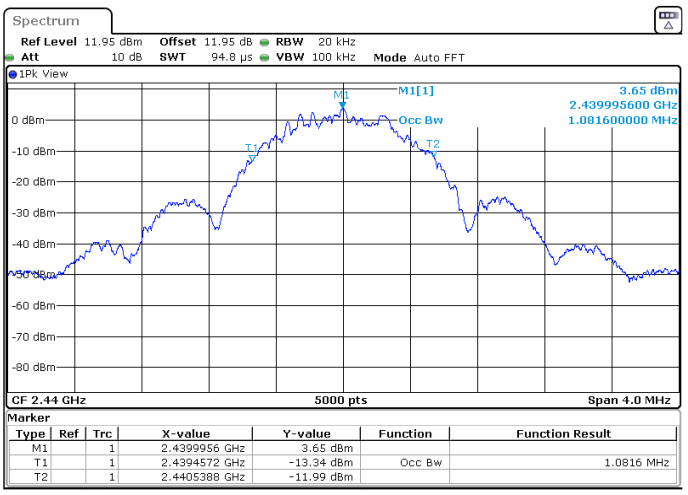
3.6. RESULTS

Occupied Bandwidth

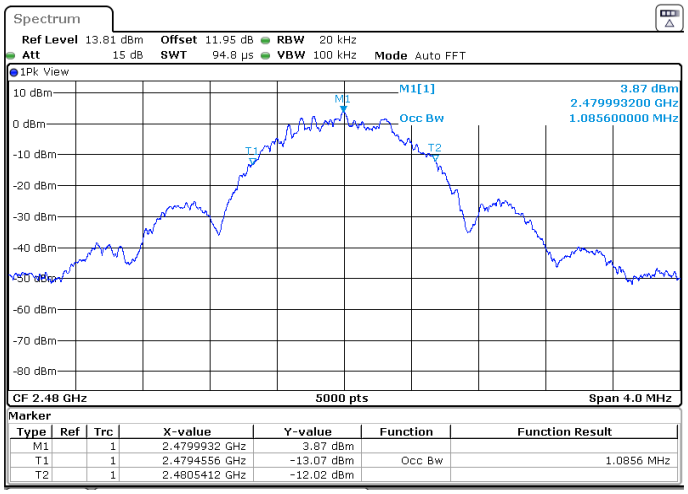
Cmin



Cmid

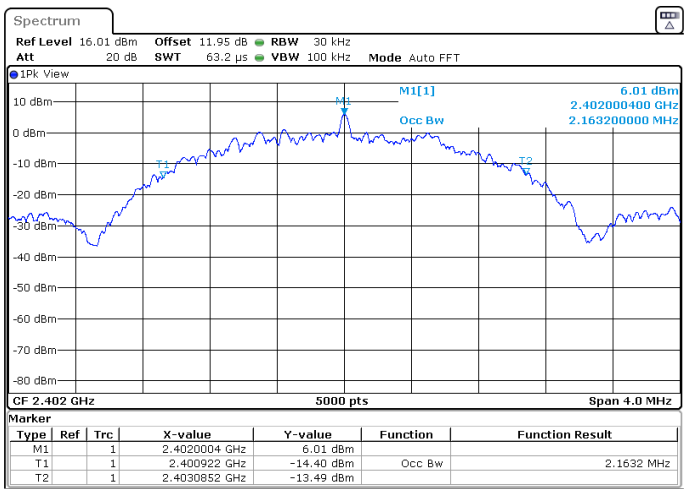
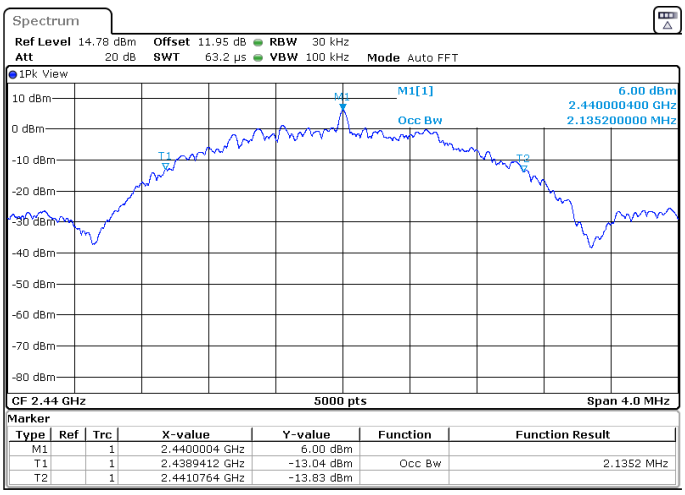
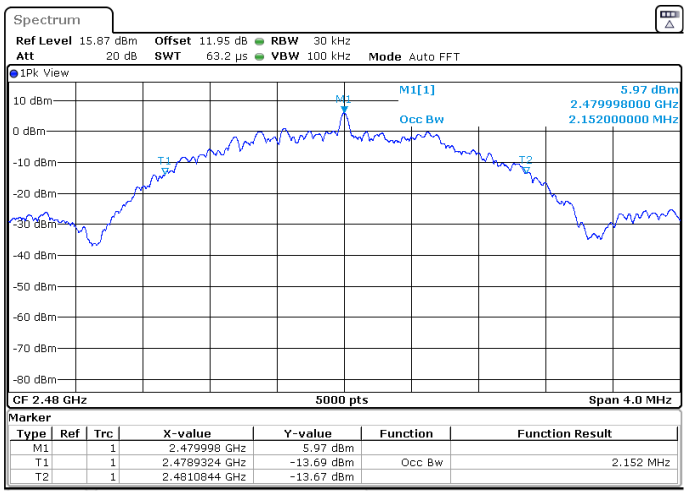


Cmax



Configuration: BLE - 1MBits/s

Channel	Occupied Bandwidth (MHz)
Cmin	1.091
Cmid	1.082
Cmax	1.086

Occupied Bandwidth	
Cmin	**Cmid**
	
Cmax	**Configuration: BLE - 2MBits/s**
	

Channel	Occupied Bandwidth (MHz)
Cmin	2.1632
Cmid	2.1352
Cmax	2.152

3.7. CONCLUSION

Occupied Channel Bandwidth measurement performed on the sample of the product **STM32WBA5MMG**, Sn: **None**, in configuration and description presented in this test report, show levels **compliant** to the **RSS-GEN** limits.

4. 6dB BANDWIDTH

4.1. TEST CONDITIONS

Date of test	:	December 04, 2024
Test performed by	:	Akram HAKKARI
Relative humidity (%)	:	43
Ambient temperature (°C)	:	23

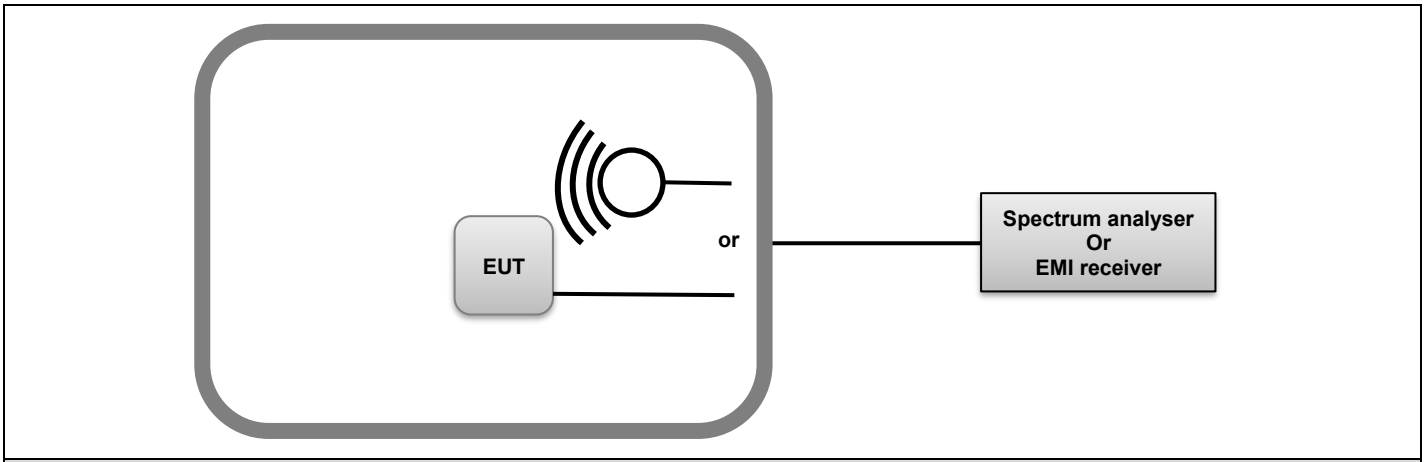
4.2. TEST SETUP

The Equipment Under Test is installed in an anechoic chamber.
Measurement is performed with a spectrum analyzer in conducted method.

The EUT is turned ON, the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Test Procedure:
KDB 558074 D01 DTS Meas Guidance v05r02 § 8.2

- Set resolution bandwidth (RBW) = 100kHz.
- Set the video bandwidth (VBW) ≥ 3 x RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer.



Test setup of 6dB Bandwidth

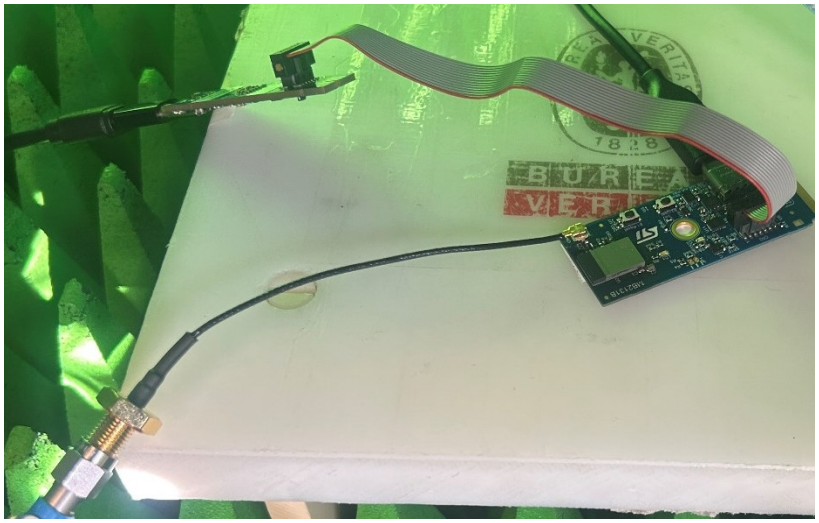


Photo of 6dB bandwidth

4.3. LIMIT

Frequency range	6dB bandwidth
902-928MHz 2400MHz to 2483.5MHz 5725-5850 MHz	≥500kHz

4.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Cable SMA UFL	_	_	A5329762	07/23	07/25
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
Full Anechoic Room	SIEPEL	_	D3044024	-/-	-/-
SMA 1.5m	SUCOFLEX	18GHz	A5329863	08/24	08/25
SMK 1.2m (Ampl <-> chamber)	HUBER-SUHNER	SUCOFLEX 102	A5330062	04/23	04/26
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	04/24	04/26
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25

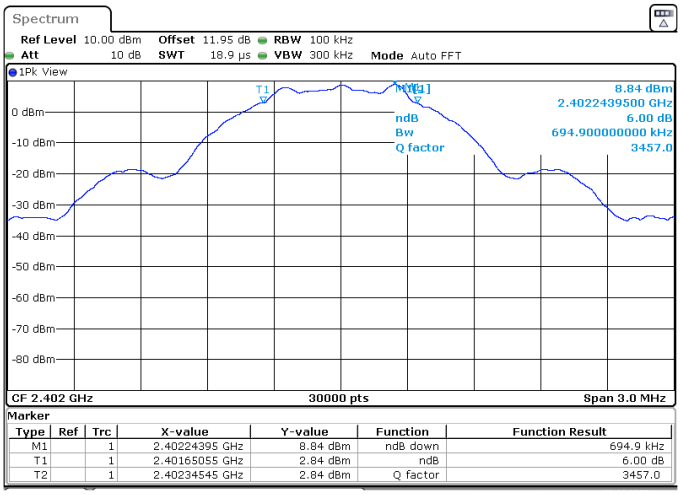
4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

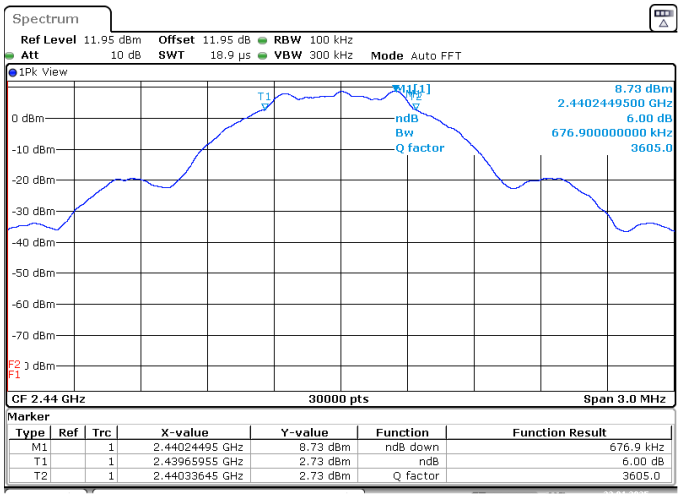
4.6. RESULTS

6dB Bandwidth

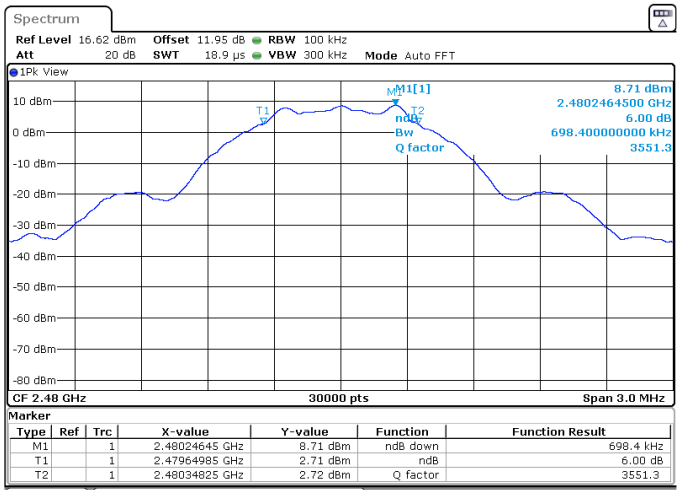
Cmin



Cmid

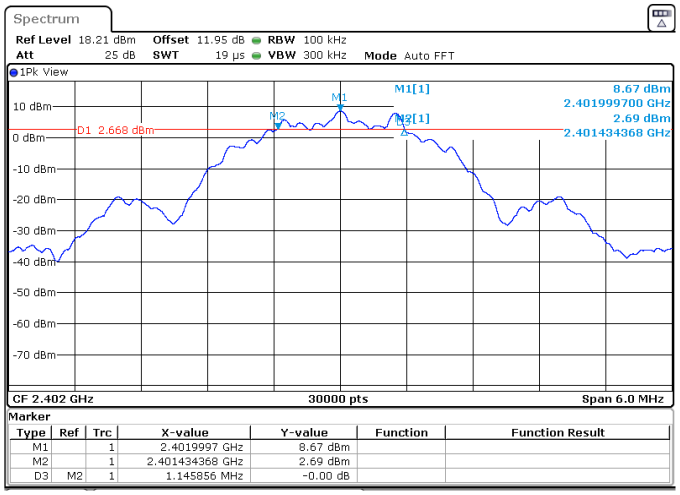
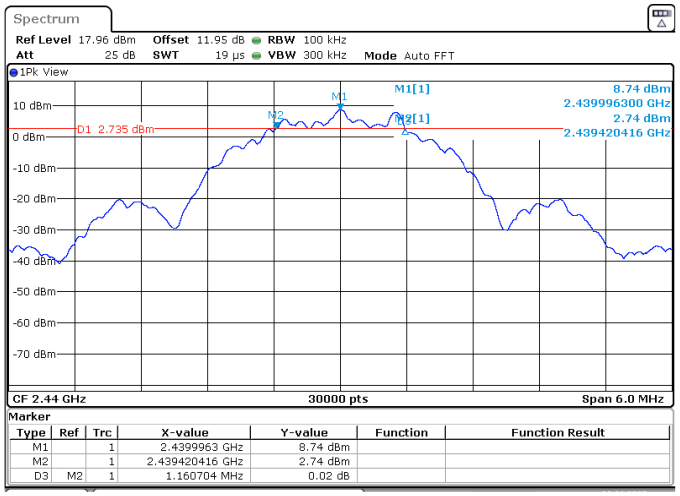
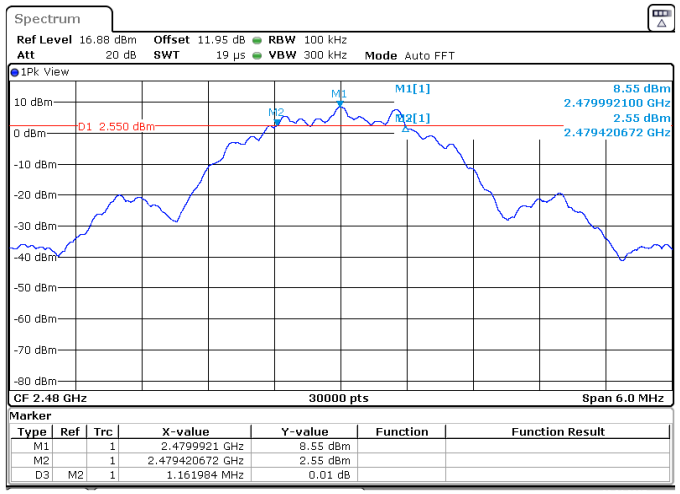


Cmax



Configuration: BLE - 1MBits/s

Channel	6dB Bandwidth (MHz)	Limit (MHz)
Cmin	0.695	**> 0.5**
Cmid	0.677	**> 0.5**
Cmax	0.698	**> 0.5**

6dB Bandwidth	
Cmin	**Cmid**
	
Cmax	**Configuration: BLE - 2MBits/s**
	**Channel** / **6dB Bandwidth (MHz)** / **Limit (MHz)** **Cmin** / 1.146 / **> 0.5** **Cmid** / 1.161 / **> 0.5** **Cmax** / 1.162 / **> 0.5**

4.7. CONCLUSION

6dB Bandwidth measurement performed on the sample of the product **STM32WBA5MMG**, Sn: **None**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247** limits.

5. MAXIMUM CONDUCTED OUTPUT POWER

5.1. TEST CONDITIONS

Date of test	:	December 04, 2024
Test performed by	:	Akram HAKKARI
Relative humidity (%)	:	43
Ambient temperature (°C)	:	23

5.2. TEST SETUP

The Equipment Under Test is installed in an anechoic chamber.
Measurement is performed with a spectrum analyzer in conducted method.

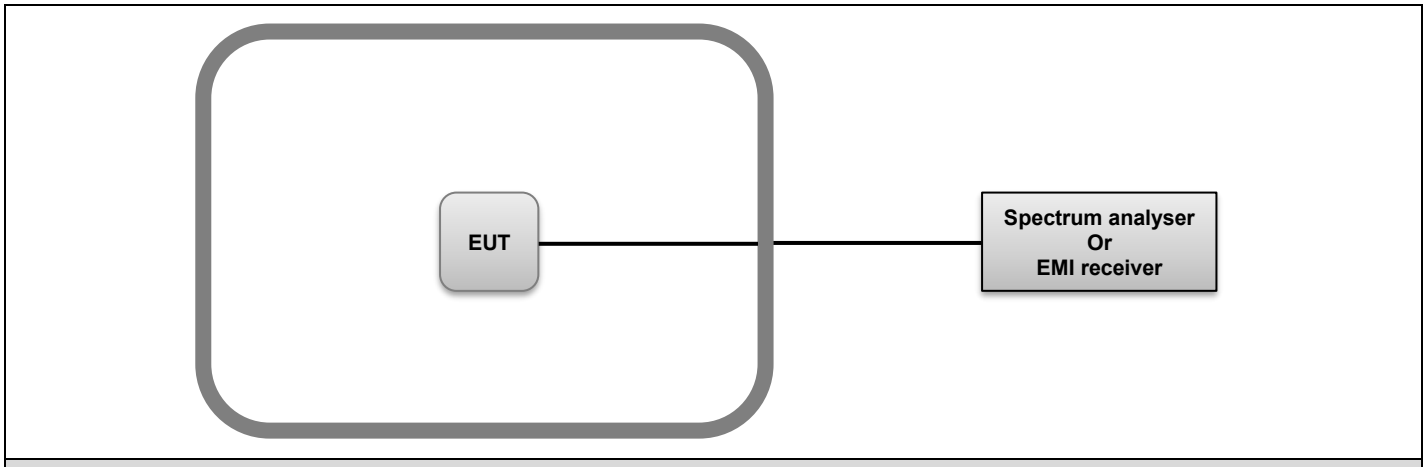
The EUT is turned ON, the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Test Procedure used: KDB 558074 D01 DTS Meas Guidance v05r02 § 8.3.1.1

KDB 558074 D01 DTS Meas Guidance v05r02 § 8.3.1.1

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- Set the RBW ≥ DTS bandwidth.
- Set VBW ≥ 3 x RBW.
- Set span ≥ 3 x RBW
- Sweep time = auto couple.
- Detector = peak.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use peak marker function to determine the peak amplitude level.



Test setup of Maximum Conducted Output Power

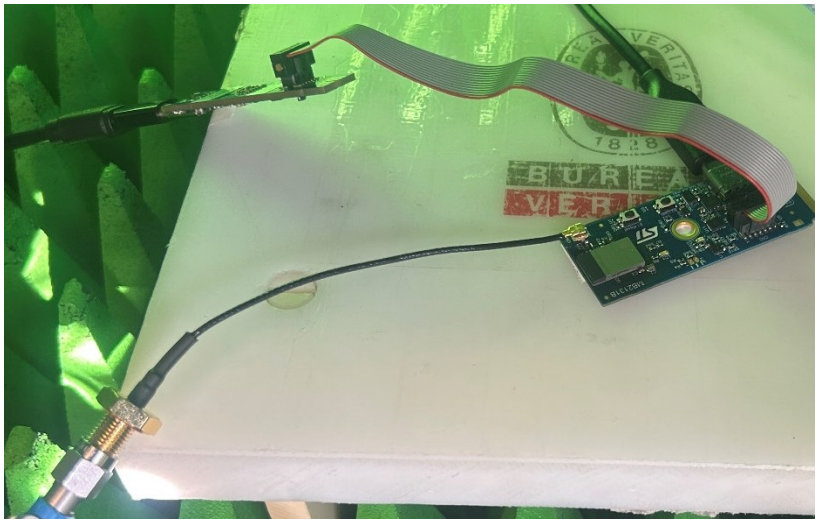


Photo of Maximum Conducted Output Power

5.3. LIMIT

Frequency range	Maximum Conducted Output Power
2400MHz to 2483.5MHz	≤30dBm*

*Remark: Limits are reduced by G-6dBi if Overall Antenna Gain above 6dBi

5.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Cable SMA UFL	_	_	A5329762	07/23	07/25
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
Full Anechoic Room	SIEPEL	_	D3044024	-/-	-/-
SMA 1.5m	SUCOFLEX	18GHz	A5329863	08/24	08/25
SMK 1.2m (Ampl <-> chamber)	HUBER-SUHNER	SUCOFLEX 102	A5330062	04/23	04/26
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	04/24	04/26
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25

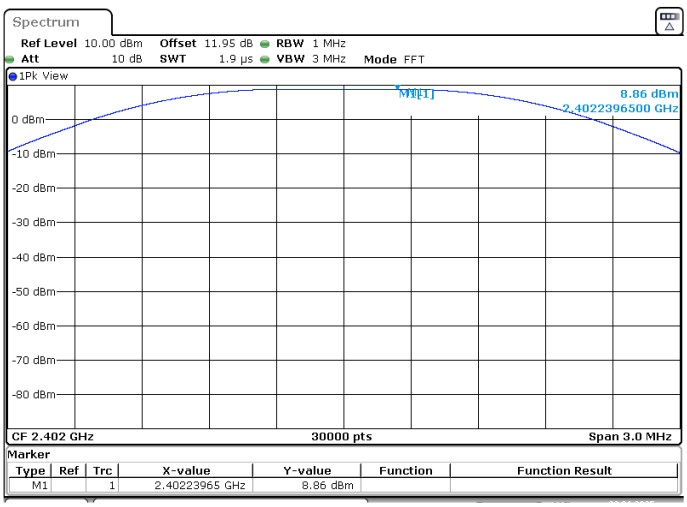
5.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

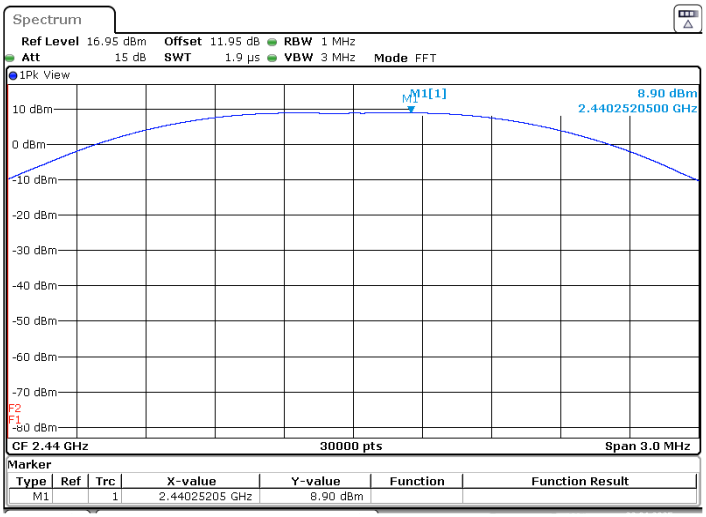
5.6. RESULTS

Maximum Conducted Output Power

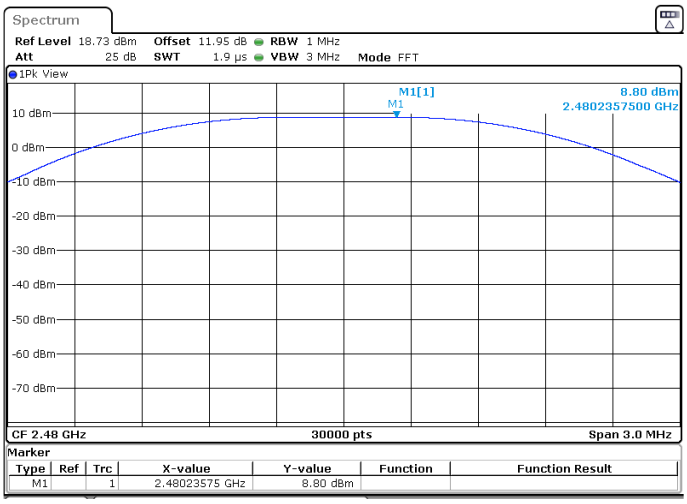
Cmin



Cmid

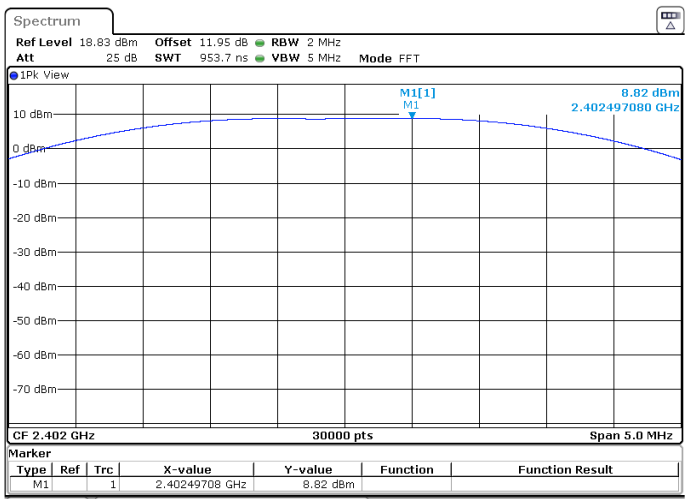
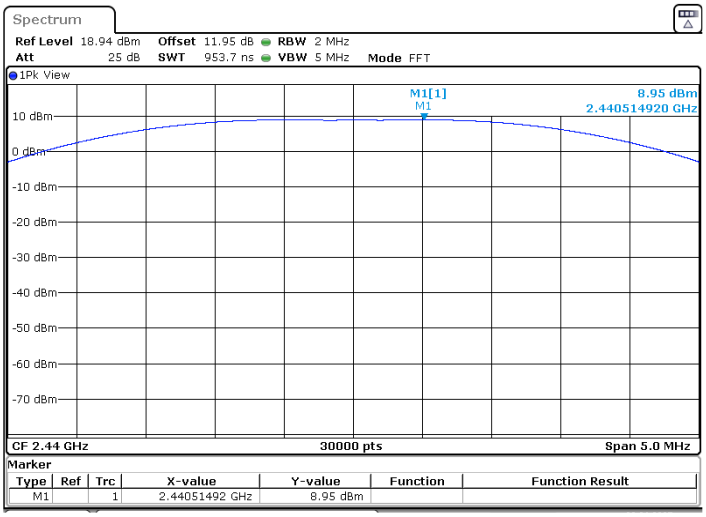
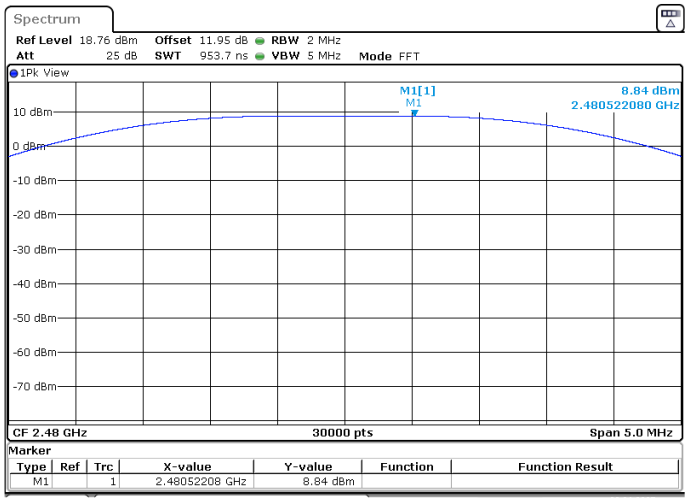


Cmax



Configuration: BLE - 1MBits/s

Channel	Offset Cable+Att (dB)	Antenna Gain (dBi)	Conducted Power (dBm)	Limit (dBm)
Cmin	11.95	1.88	8.86	**30**
Cmid	11.95	1.88	8.90	**30**
Cmax	11.95	1.88	8.80	**30**

Maximum Conducted Output Power	
Cmin	**Cmid**
	
Cmax	**Configuration: BLE - 2MBits/s**
	

Channel	Offset Cable+Att (dB)	Antenna Gain (dBi)	Conducted Power (dBm)	Limit (dBm)
Cmin	11.95	1.88	8.82	**30**
Cmid	11.95	1.88	8.95	**30**
Cmax	11.95	1.88	8.84	**30**

5.7. CONCLUSION

Maximum Output Conducted Power measurement performed on the sample of the product **STM32WBA5MMG**, Sn: **None**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247** limits.

6. POWER SPECTRAL DENSITY

6.1. TEST CONDITIONS

Date of test	:	December 04, 2024
Test performed by	:	Akram HAKKARI
Relative humidity (%)	:	43
Ambient temperature (°C)	:	23

6.2. TEST SETUP

The Equipment Under Test is installed in an anechoic chamber.
Measurement is performed with a spectrum analyzer in conducted method.

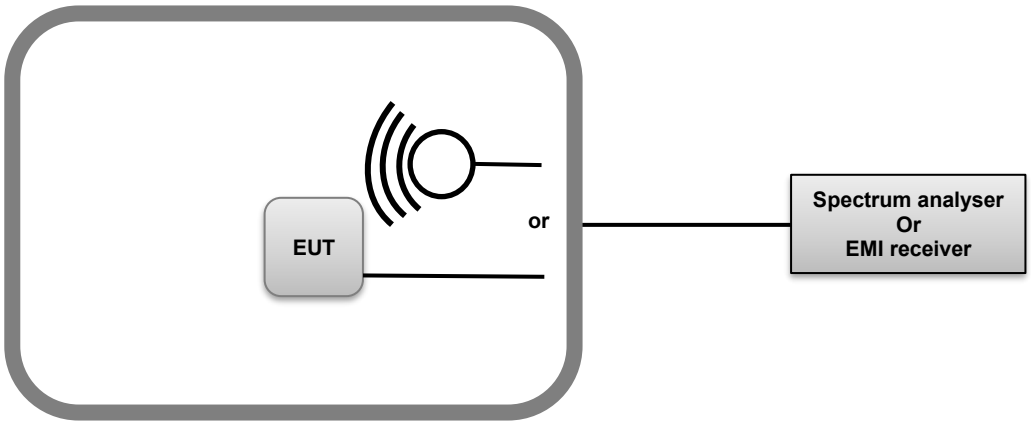
The EUT is turned ON, the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Test Procedure used: KDB 558074 D01 DTS Meas Guidance v05r02 § 8.4 (Method PKPSD)

KDB 558074 D01 DTS Meas Guidance v05r02 § 8.4 (Method PKPSD)

Subclause 11.10 of ANSI C63.10 is applicable

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: 3 kHz.
- Set the VBW ≥ 3 x RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test setup of Power Spectral Density

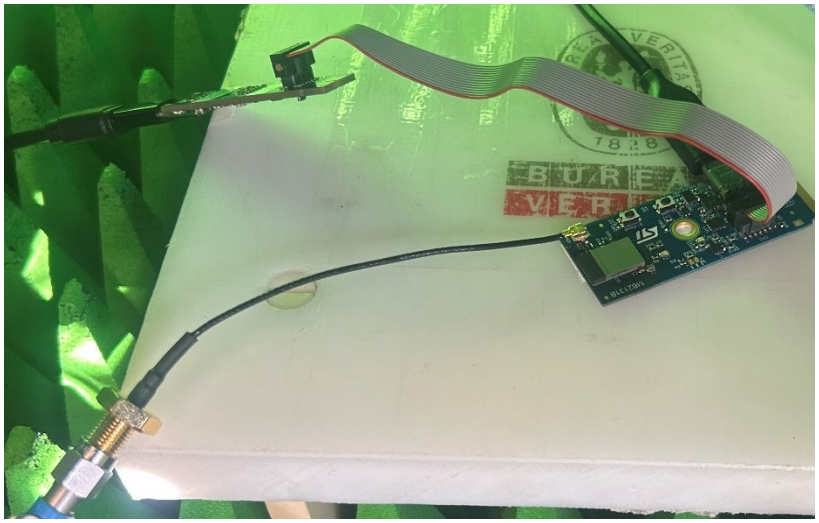


Photo of Power Spectral Density

6.3. LIMIT

Frequency range	Power Spectral Density
2400MHz to 2483.5MHz	≤8dBm / 3kHz *

*Remark: Limits are reduced by G-6dBi if Overall Antenna Gain above 6dBi

6.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Cable SMA UFL	_	_	A5329762	07/23	07/25
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
Full Anechoic Room	SIEPEL	_	D3044024	-/-	-/-
SMA 1.5m	SUCOFLEX	18GHz	A5329863	08/24	08/25
SMK 1.2m (Ampl <-> chamber)	HUBER-SUHNER	SUCOFLEX 102	A5330062	04/23	04/26
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	04/24	04/26
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25

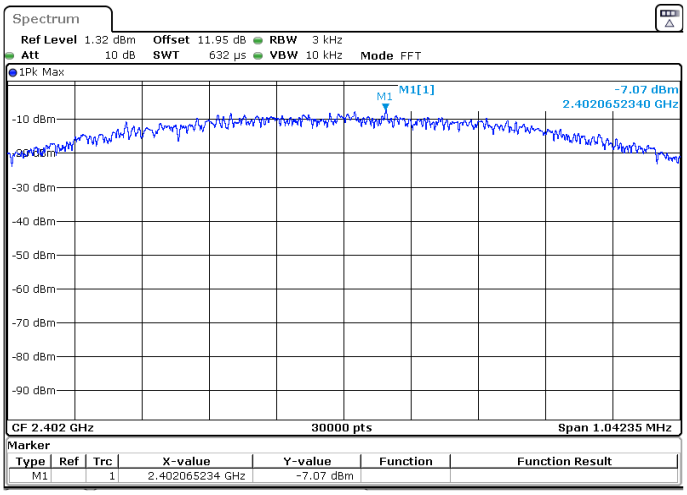
6.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

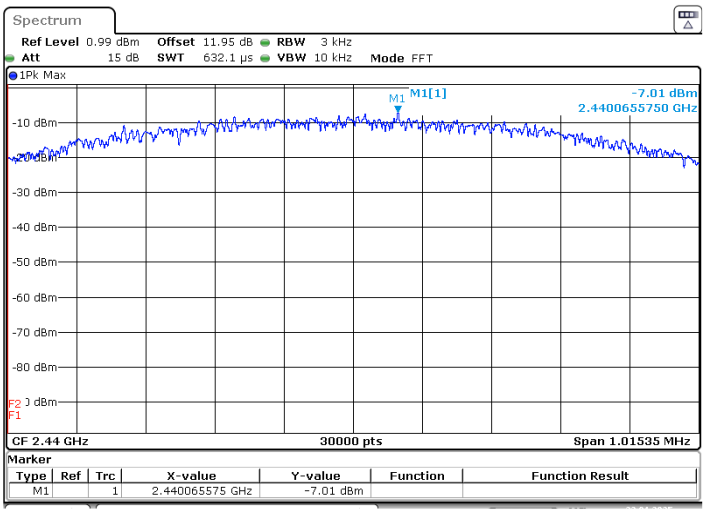
6.6. RESULTS

Power Spectral Density

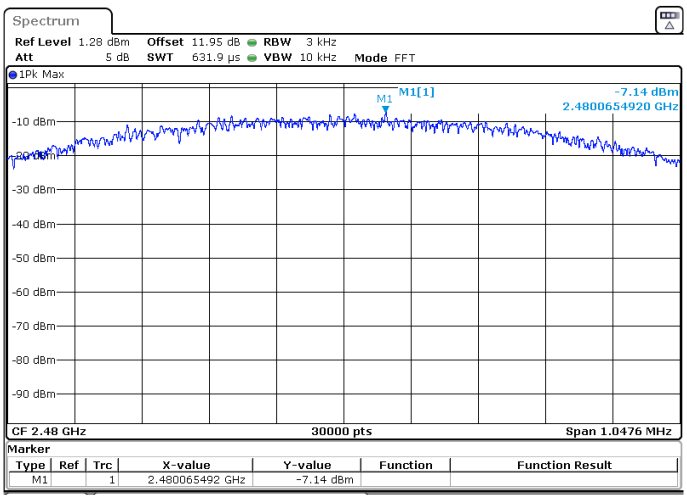
Cmin



Cmid

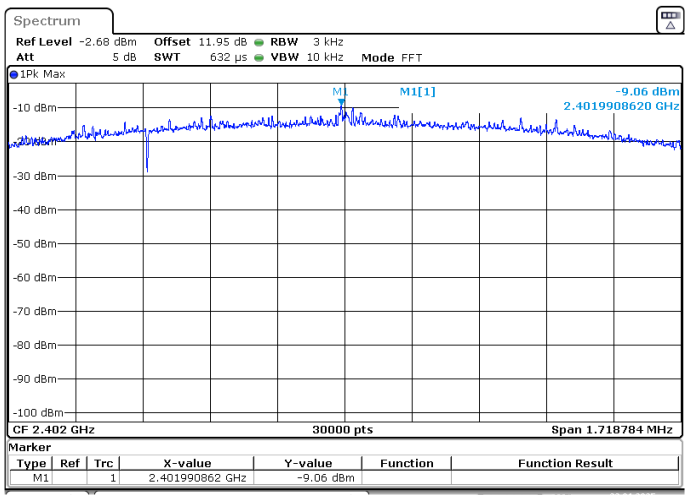
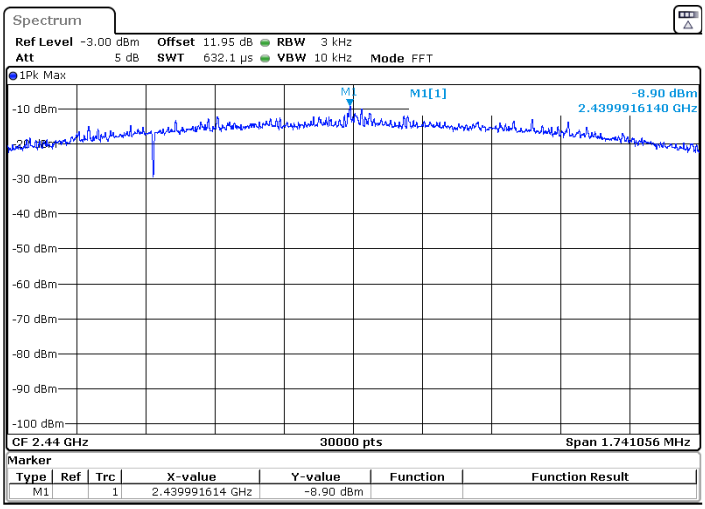
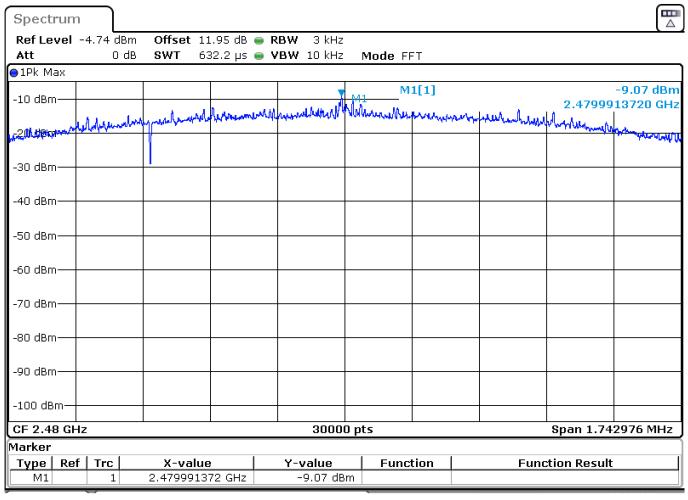


Cmax



Configuration: BLE - 1MBits/s

Channel	Offset Cable+Att (dB)	Antenna Gain (dBi)	Power Spectral Density (dBm)	Limit (dBm)
Cmin	11.95	1.88	-7.07	**≤ 8**
Cmid	11.95	1.88	-7.01	**≤ 8**
Cmax	11.95	1.88	-7.14	**≤ 8**

Power Spectral Density	
Cmin	**Cmid**
	
Cmax	**Configuration: BLE - 2MBits/s**
	

Channel	Offset Cable+Att (dB)	Antenna Gain (dBi)	Power Spectral Density (dBm)	Limit (dBm)
Cmin	11.95	1.88	-9.06	**≤ 8**
Cmid	11.95	1.88	-8.90	**≤ 8**
Cmax	11.95	1.88	-9.07	**≤ 8**

6.7. CONCLUSION

Power Spectral Density measurement performed on the sample of the product **STM32WBA5MMG**, Sn: **None**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247** limits.

7. UNWANTED EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS

7.1. TEST CONDITIONS

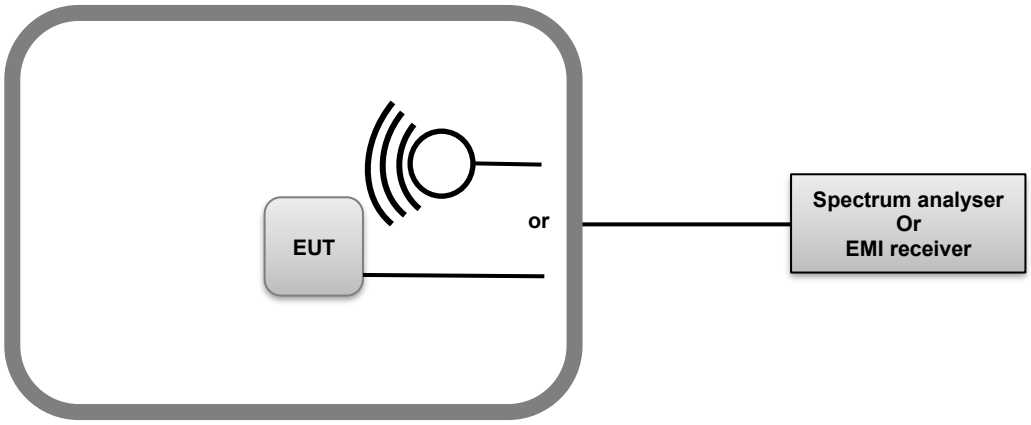
Date of test	:	December 04, 2024
Test performed by	:	Akram HAKKARI
Relative humidity (%)	:	43
Ambient temperature (°C)	:	23

7.2. TEST SETUP

The Equipment Under Test is installed in an anechoic chamber.
Measurement is performed with a spectrum analyzer in conducted method.

The EUT is turned ON, the captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Test Procedure:
KDB 558074 D01 DTS Meas Guidance v05r02 § 8.5



Test setup of Unwanted emissions in non-restricted frequency bands

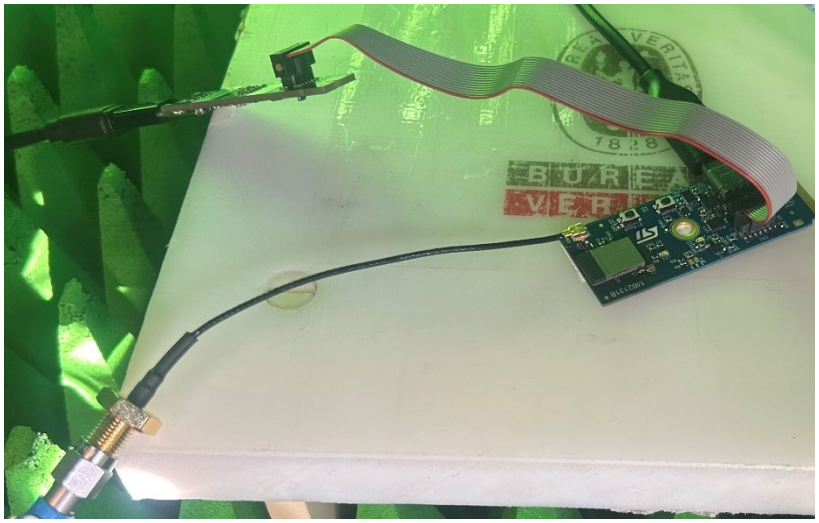


Photo of Unwanted emissions in non-restricted frequency bands

7.3. LIMIT

All Spurious Emissions must be at least 20dB below the Fundamental Radiator Level at the Band Edge of operating frequency band and in non-restricted bands.

7.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Cable SMA UFL	_	_	A5329762	07/23	07/25
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
Full Anechoic Room	SIEPEL	_	D3044024	-/-	-/-
SMA 1.5m	SUCOFLEX	18GHz	A5329863	08/24	08/25
SMK 1.2m (Ampl <-> chamber)	HUBER-SUHNER	SUCOFLEX 102	A5330062	04/23	04/26
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	04/24	04/26
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25

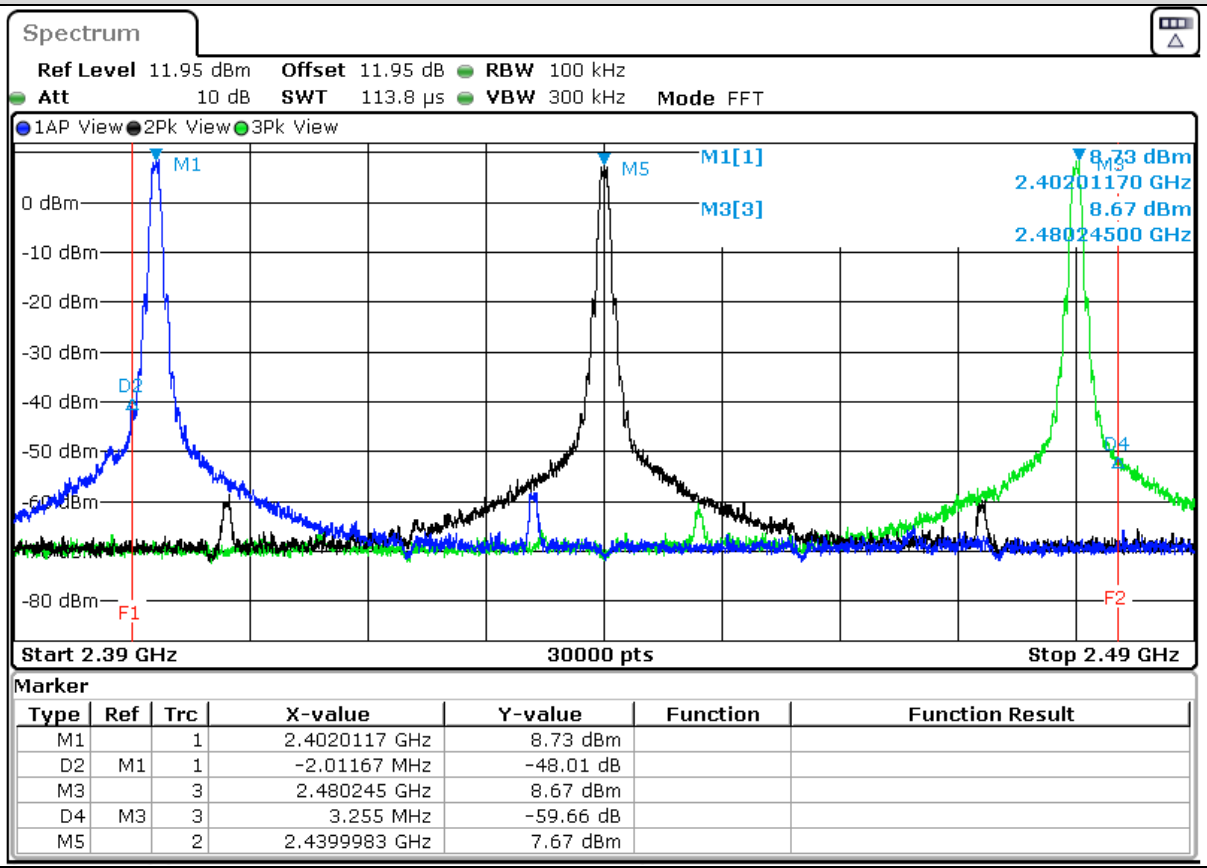
7.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

7.6. RESULTS

7.6.1. Operational frequency band

Unwanted emissions in non-restricted bands at the band edge
Configuration: BLE - 1MBits/s
Cmin / Cmid / Cmax
Delta limit (dBc) determination
Tx1

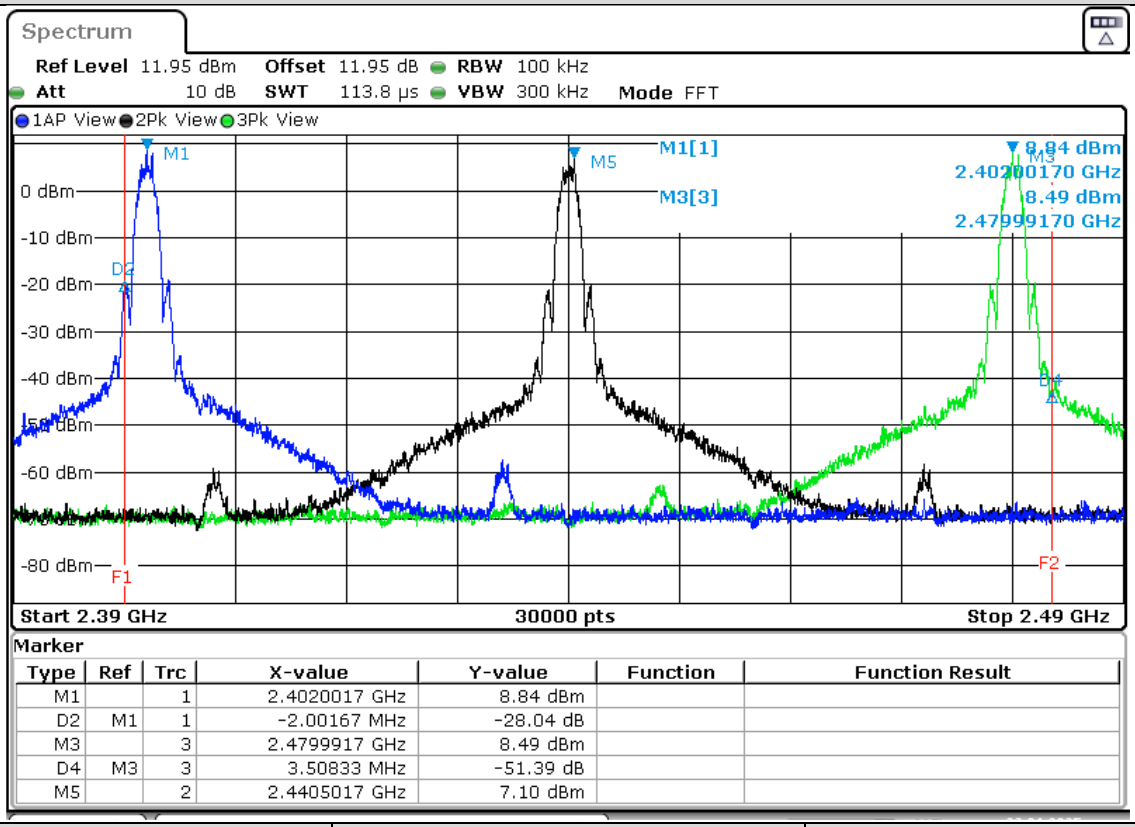


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4020117 GHz	8.73 dBm		
D2	M1	1	-2.01167 MHz	-48.01 dB		
M3		3	2.480245 GHz	8.67 dBm		
D4	M3	3	3.255 MHz	-59.66 dB		
M5		2	2.4399983 GHz	7.67 dBm		

Frequency (MHz)	Level (dBc)	Limit (dBc)
C_{min}	-48.01	-20
C_{max}	-59.66	-20

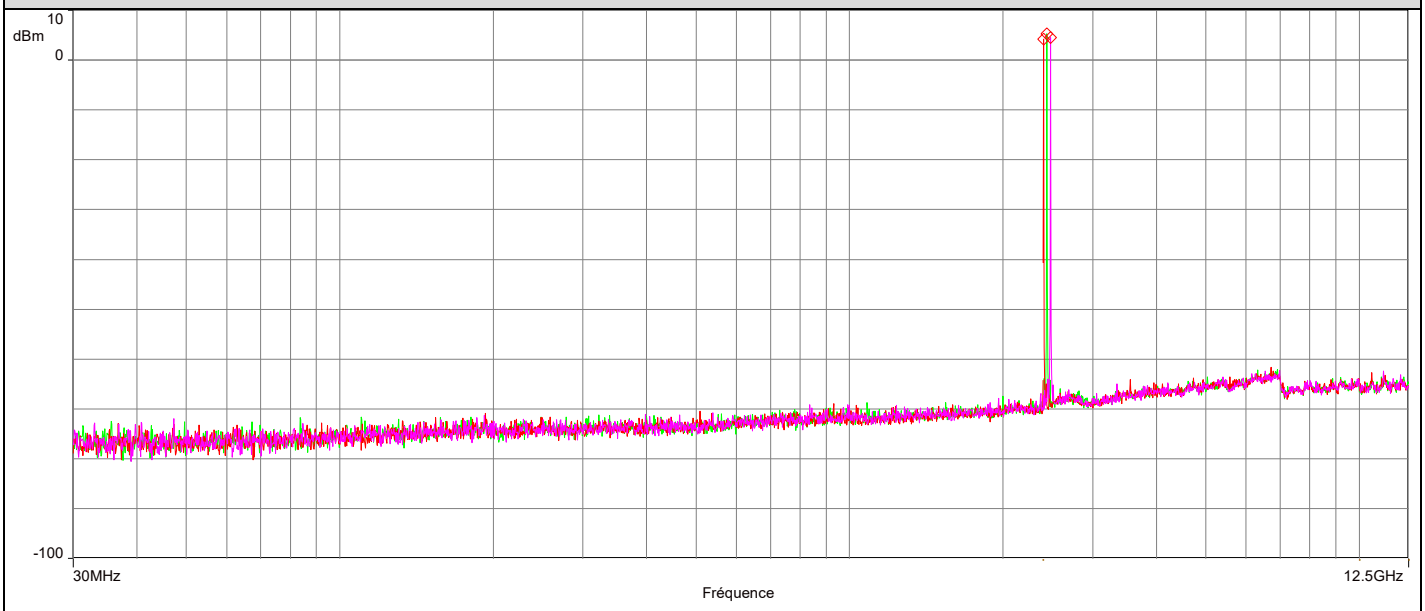
Unwanted emissions in non-restricted bands at the band edge
Configuration: BLE - 2MBits/s
Cmin / Cmid / Cmax
Delta limit (dBc) determination
Tx1



Frequency (MHz)	Level (dBc)	Limit (dBc)
C_{min}	-28.04	-20
C_{max}	-51.39	-20

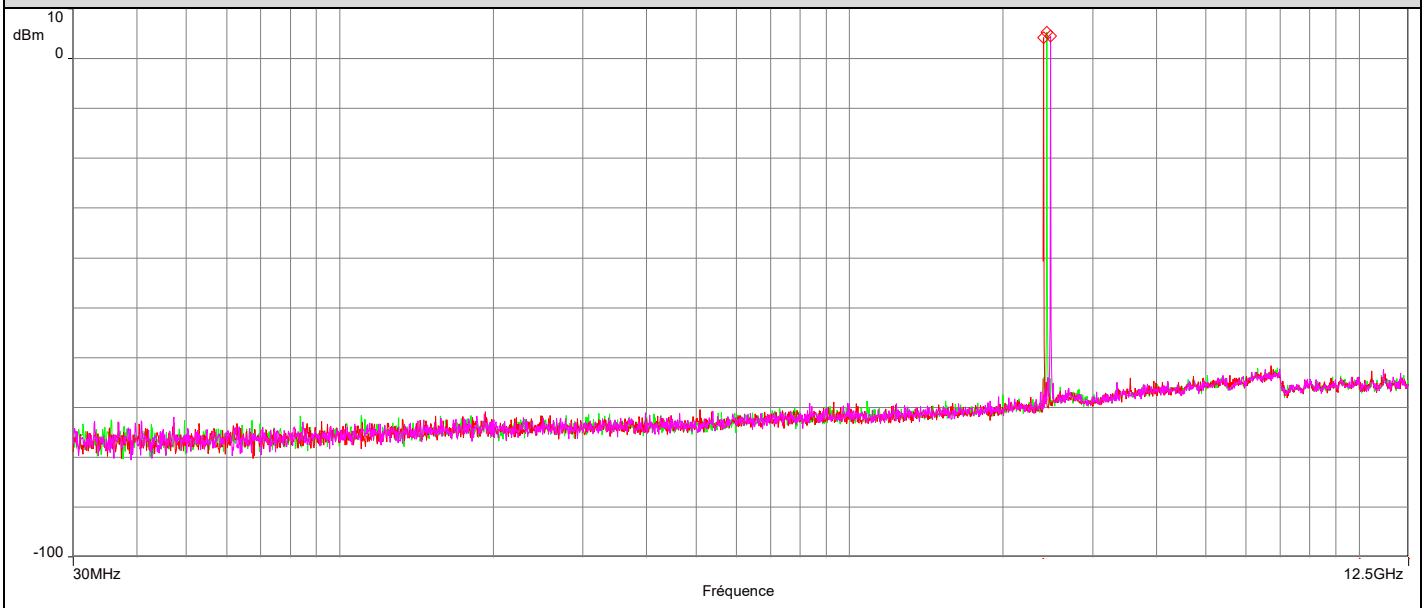
7.6.2. Non restricted frequency bands

Unwanted emissions in non-restricted bands		
Configuration: BLE - 1MBits/s		
Cmin / Cmid / Cmax		
Tx1		



Frequency (MHz)	Level (dBc)	Limit (dBc)
2401.52	5.23	
2439.773	5.93	
2479.8	5.21	

Unwanted emissions in non-restricted bands
Configuration: BLE - 2MBits/s
Cmin / Cmid / Cmax
Tx1



Frequency (MHz)	Level (dBc)	Limit (dBc)
2401.773	5.11	
2440.026	5.98	
2479.8	5.23	

7.7. CONCLUSION

Unwanted emissions in non-restricted bands and at the band edge measurement performed on the sample of the product **STM32WBA5MMG**, Sn: **None**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247** limits.

8. UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS

8.1. TEST CONDITIONS

Date of test : December 03, 2024
Test performed by : Akram HAKKARI
Relative humidity (%) : 34
Ambient temperature (°C) : 22

8.2. TEST SETUP

Test procedure:
ANSI C63.10 & FCC Part 15 subpart C

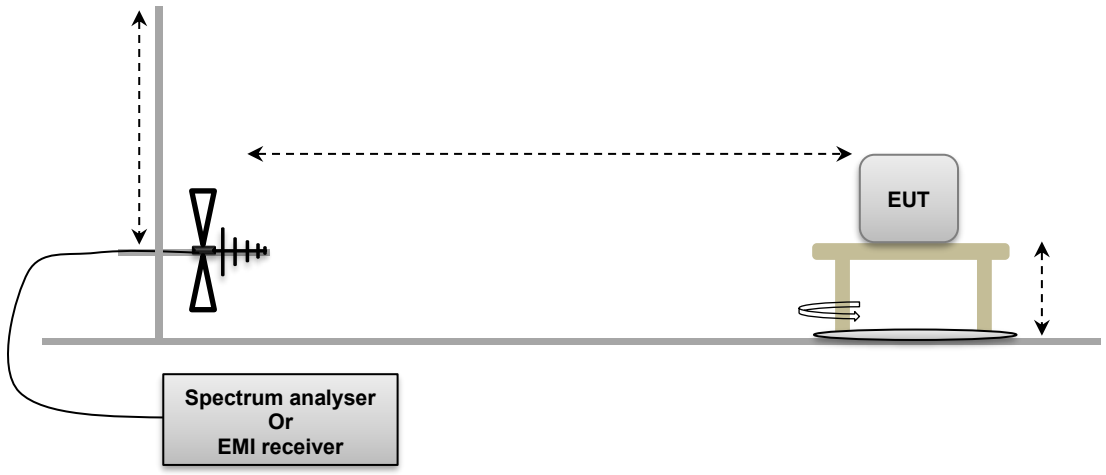
Following frequency ranges, test setup parameters are different and specified in this table:

Frequency range:	**9kHz to 30MHz**	
Test:	**Pre-Characterization**	**Qualification**
Antenna Polarization:	Parallel, Perpendicular and Ground parallel	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	1m
Antenna Type:	Loop	
RBW Filter:	200Hz below 150kHz / 9kHz above 150kHz	
Maximization:	Turntable rotation of 360 degrees range and all axis of EUT used in normal configuration	
EUT height:	1.5m	0.8m
Test site:	Full Anechoic Chamber	Open Aera Test Site
Distance EUT - Antenna:	3m	10m
Detector:	Peak	QPeak

Frequency range:	**30MHz to 1GHz**	
Test:	**Pre-Characterization**	**Qualification**
Antenna Polarization:	Horizontal and Vertical	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	Varied from 1m to 4m
Antenna Type:	Bi-Log	
RBW Filter:	120kHz	
Maximization:	Turntable rotation of 360 degrees range and all axis of EUT used in normal configuration	
EUT height:	1.5m	0.8m
Test site:	Full Anechoic Chamber	Open Aera Test Site
Distance EUT - Antenna:	3m	10m
Detector:	Peak	QPeak

Frequency range:	1GHz to 14GHz	
Test:	**Pre-Characterization**	**Qualification**
Antenna Polarization:	Horizontal and Vertical	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	Centered on EUT (§6.6.5 ANSI C63-10)
Antenna Type:	Horn	
RBW Filter:	1MHz	
Maximization:	Turntable rotation of 360 degrees range and all axis of EUT used in normal configuration	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Full Anechoic Chamber
Distance EUT - Antenna:	3m	3m
Detector:	Peak & Average	Peak & Average

Frequency range:	14GHz to 25GHz	
Test:	**Pre-Characterization**	**Qualification**
Antenna Polarization:	Horizontal and Vertical	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	Centered on EUT (§6.6.5 ANSI C63-10)
Antenna Type:	Horn	
RBW Filter:	1MHz	
Maximization:	Turntable rotation of 360 degrees range and all axis of EUT used in normal configuration	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Full Anechoic Chamber
Distance EUT - Antenna:	1m	1m
Detector:	Peak & Average	Peak & Average



Test setup of Unwanted Emissions in Restricted Frequency Bands

Photo of Unwanted Emissions in Restricted Frequency Bands

8.3. LIMIT

Measure at 300m		
Frequency range	**Level**	**Detector**
9kHz-490kHz	67.6dBµV/m /F(kHz)	QPeak
Measure at 30m		
Frequency range	**Level**	**Detector**
490kHz-1.705MHz	87.6dBµV/m /F(kHz)	QPeak
1.705MHz-30MHz	29.5dBµV/m	QPeak
Measure at 10m		
Frequency range	**Level**	**Detector**
30MHz to 88MHz	29.5dBµV/m	QPeak
88MHz to 216MHz	33dBµV/m	QPeak
216MHz to 960MHz	35.5BµV/m	QPeak
960MHz to 1000MHz	43.5dBµV/m	QPeak
Above 1000MHz	63.5dBµV/m	Peak
	43.5dBµV/m	Average
Measure at 3m		
Frequency range	**Level**	**Detector**
30MHz to 88MHz	40dBµV/m	QPeak
88MHz to 216MHz	43.5dBµV/m	QPeak
216MHz to 960MHz	46BµV/m	QPeak
960MHz to 1000MHz	54dBµV/m	QPeak
Above 1000MHz	74dBµV/m	Peak
	54dBµV/m	Average

8.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

8.5. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Amplifier 10MHz - 18GHz	LCIE SUD EST	_	A7102082	11/22	03/25
Antenna Bi-log	AH System	SAS-521-7	C2040180	05/23	05/25
Antenna horn 18GHz	EMCO	3115	C2042027	04/22	04/25
BAT EMC	NEXIO	v3.21.0.32	L1000115	-/-	-/-
CABLE	TELEDYNE	R82-0404-0.5M	A5330010	03/22	03/25
Cable 0.75m	-	18GHz	A5329900	08/24	08/26
Cable SMA 40cm	WITHWAVE	W101-SM1-0.4M	A5329979	10/23	10/26
CONTROLLER	INNCO	CO3000	D3044034	-/-	-/-
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Emission Cable (SMA 3.3m)	TELEDYNE	26GHz	A5329875	08/22	08/25
Filter Matrice	LCIE SUD EST	Combined filters	A7484078	03/23	03/25
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
Rehausse Table C3	LCIE	_	F2000511	-/-	-/-
Rehausse Table C3	LCIE	_	F2000507	-/-	-/-
Semi-Anechoic chamber #3 (BF)	SIEPEL	_	D3044017_BF	04/22	04/25
Semi-Anechoic chamber #3 (VSWR)	SIEPEL	_	D3044017_VSWR	04/22	04/25
SMA Cable 18GHz 0.5m	TELEDYNE	18GHz	A5330060	05/24	05/25
SMA Cable 18GHz 0.5m	TELEDYNE	18GHz	A5330059	05/24	05/25
SMA Cable 18GHz 0.6m	TELEDYNE	18GHz	A5330055	05/24	05/25
SMA Cable 18GHz 3.5m	TELEDYNE	18GHz	A5330058	05/24	05/25
SMA Cable 18GHz 6m	TELEDYNE	18GHz	A5330057	05/24	05/25
Spectrum analyzer	ROHDE & SCHWARZ	FSU 26	A4060058	09/23	09/25
Table C3	LCIE	_	F2000461	-/-	-/-
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	05/23	05/25
TILT	INNCO	TILT	D3044033	-/-	-/-
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-/-	-/-
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444	-/-	-/-
Antenna horn 40GHz	SCHWARZBECK	BBHA 9170	C2042028	06/22	06/25
Emission Cable 0.5m (Ampl <-> receptor)	INTELLICONNECT	C-KPKP-1503-500MM	A5329988	04/23	04/26
PRE-AMPLIFIER	LCIE SUD EST	PRE-AMPLIFIER (40GHz)	A7080078	09/22	01/25
SMK 1.2m Emission Cable 0.5m (Ampl <->Chamber)	HUBER-SUHNER	SUCOFLEX 102	A5330063	08/24	08/25
Antenna loop	ELECTRO-METRICS	EM-6879	C2040294	08/22	12/24

8.6. RESULTS

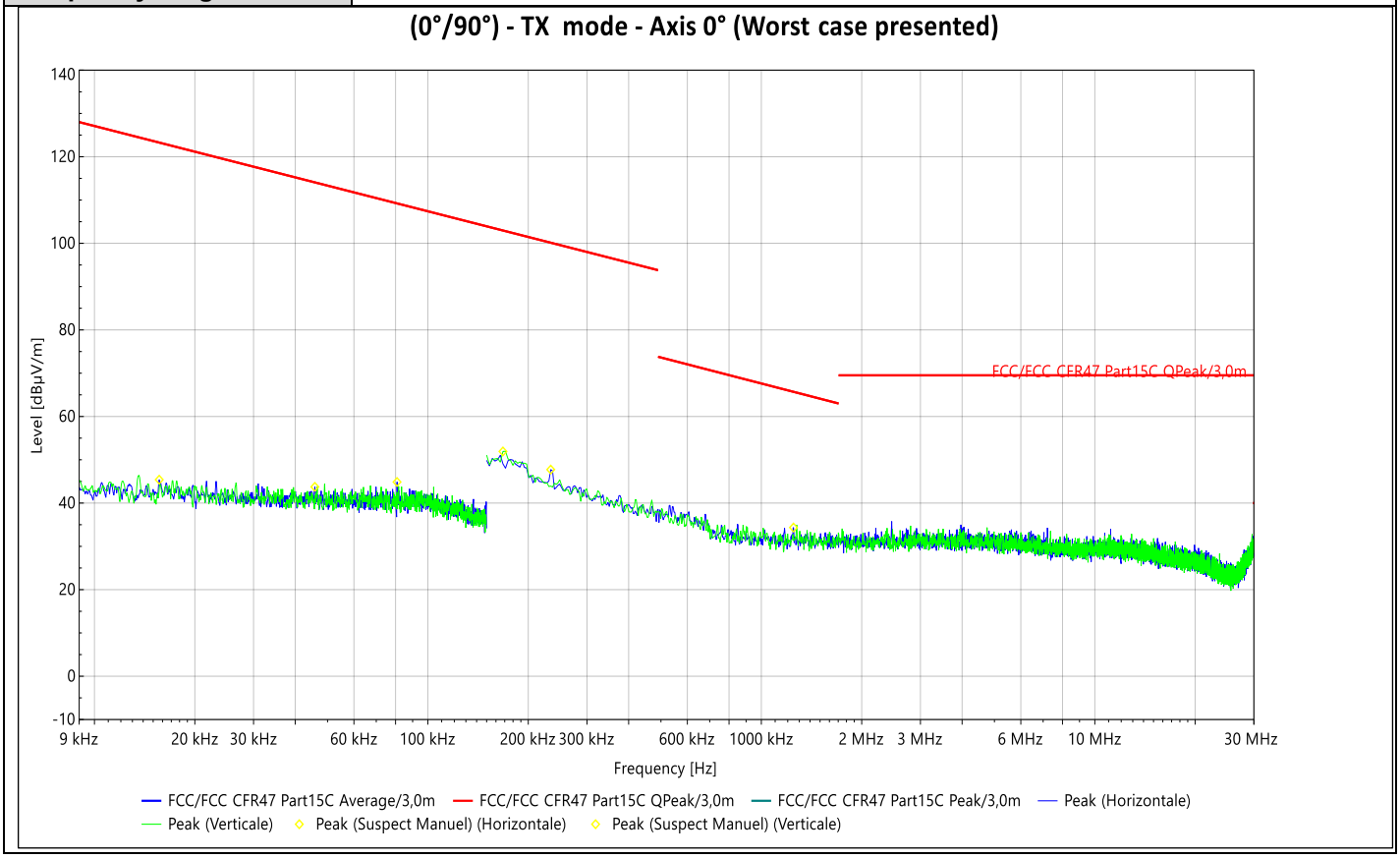
For all following measurements, worst case is presented with different configurations and modulations of EUT.

8.6.1. 9kHz to 30MHz

Graphs – Pre characterization:

Graph identifier	Polarization	Mode	Channel	EUT position	Comments
Emr# 1	0°/90°	TX	Cmid	Axis XY/Z	See the following results
Emr# 2	180°	TX	Cmid	Axis XY/Z	See the following results

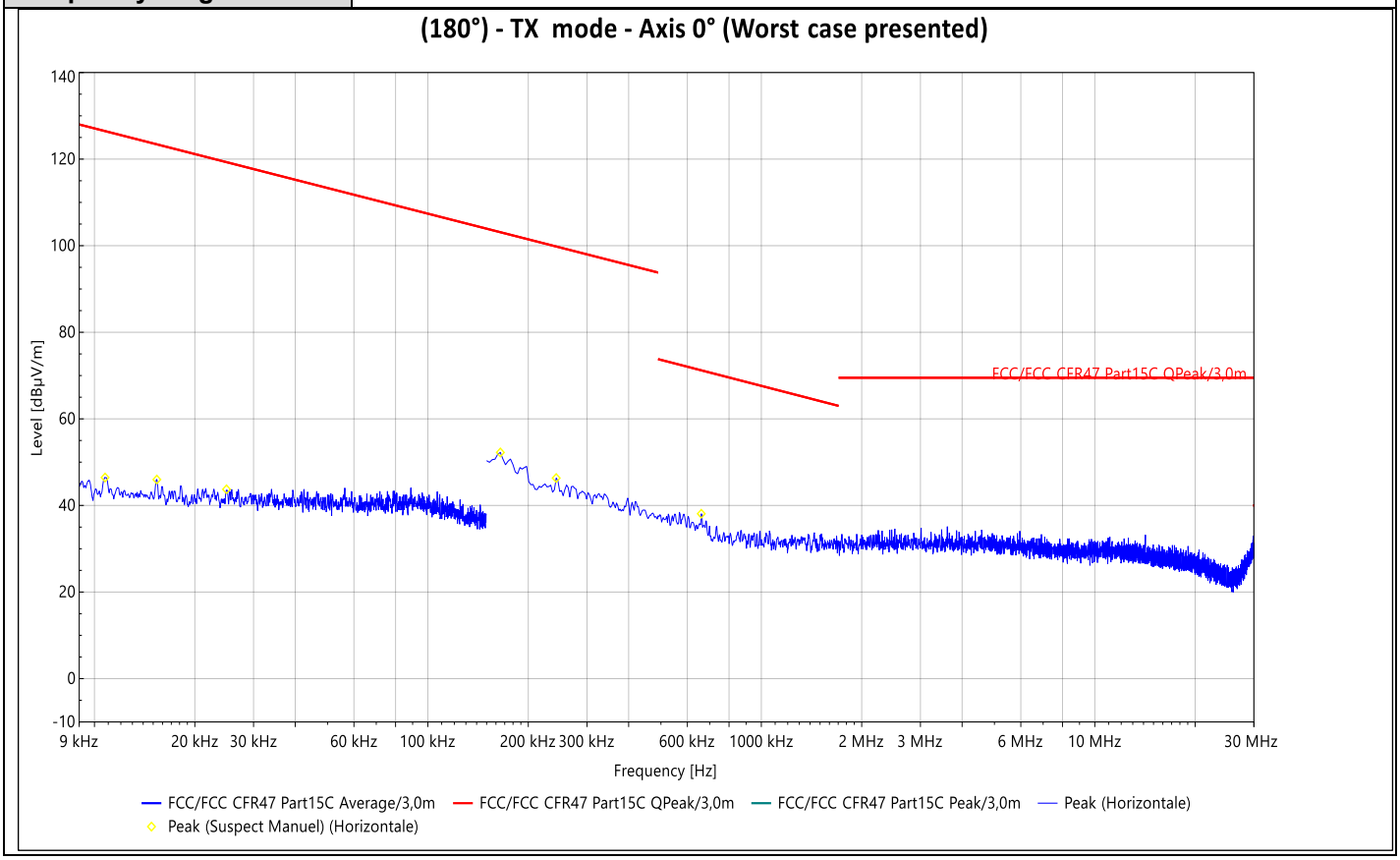
Radiated Emissions	
Graph name:	Emr#1
Frequency range:	9 kHz to 30 MHz



Frequency	PK Level (dBµV/m)	Lim.QP (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
15.641 kHz	45.40	123.27	164	H	59.98
45.815 kHz	43.74	114.08	287	H	60.11
80.797 kHz	44.87	109.22	41	H	60.23
233.58 kHz	47.73	100.14	0	H	53.24
1.24848 MHz	34.35	65.70	0	H	42.43
167.91 kHz	51.92	102.96	309	V	55.87

No significant frequency observed

Radiated Emissions	
Graph name:	Emr#2
Frequency range:	9 kHz to 30 MHz



Pre-Characterization:

Frequency	PK Level (dBµV/m)	Lim.QP (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
10.762 kHz	46.45	126.47	221	H	60.43
15.387 kHz	45.98	123.41	324	H	59.97
24.89 kHz	43.73	119.30	145	H	59.88
164.925 kHz	52.24	103.12	242	H	56.02
242.535 kHz	46.33	99.82	3	H	53.09
660.435 kHz	38.08	71.22	76	H	45.16

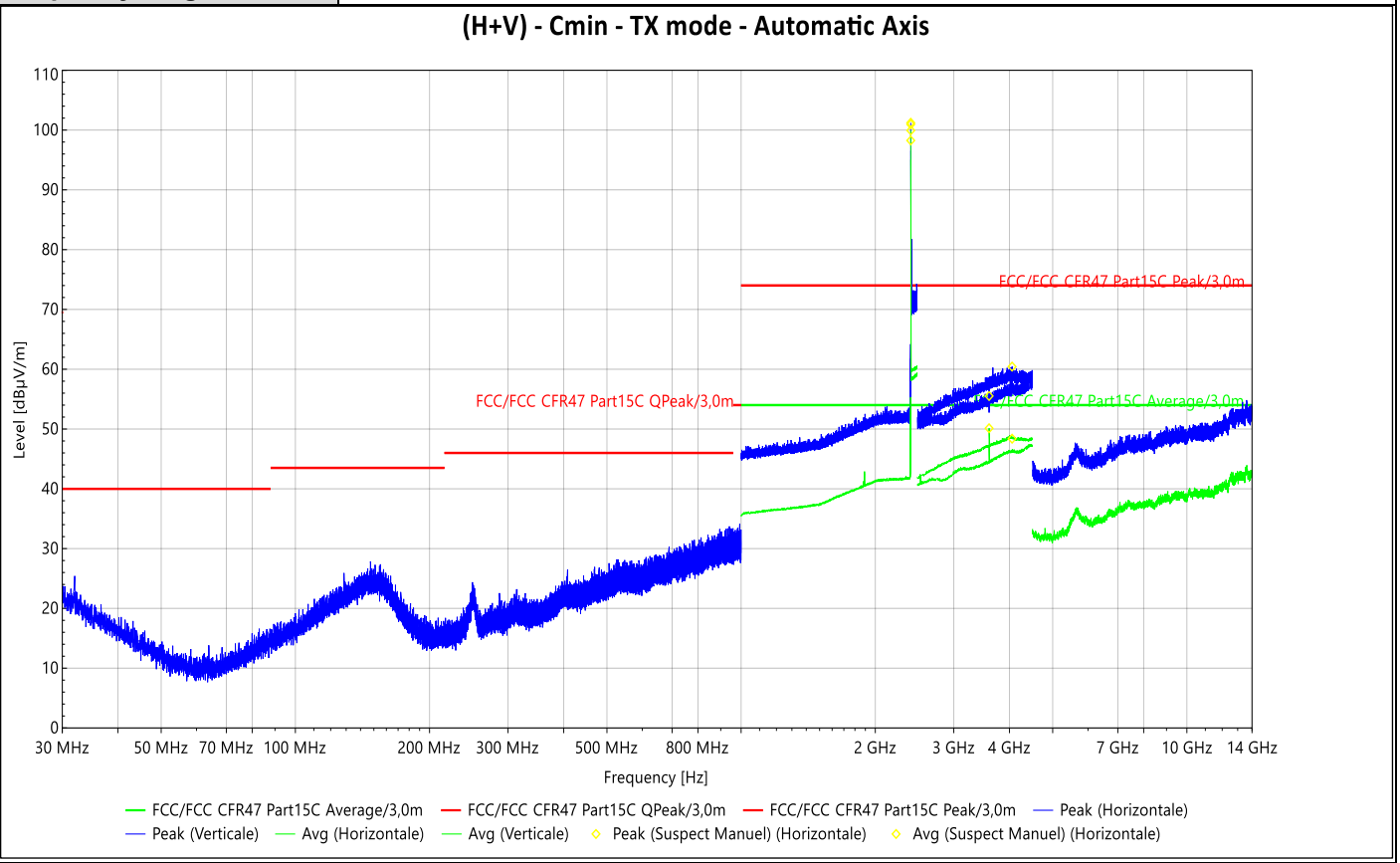
No significant frequency observed

8.6.2. 30MHz to 14GHz

Graphs – Pre characterization:

Graph identifier	Polarization	Mode	Channel	EUT position	Comments
Emr# 3	H/V	TX	Cmin	Axis XY/Z	See the following results
Emr# 4	H/V	TX	Cmid	Axis XY/Z	See the following results
Emr# 5	H/V	TX	Cmax	Axis XY/Z	See the following results

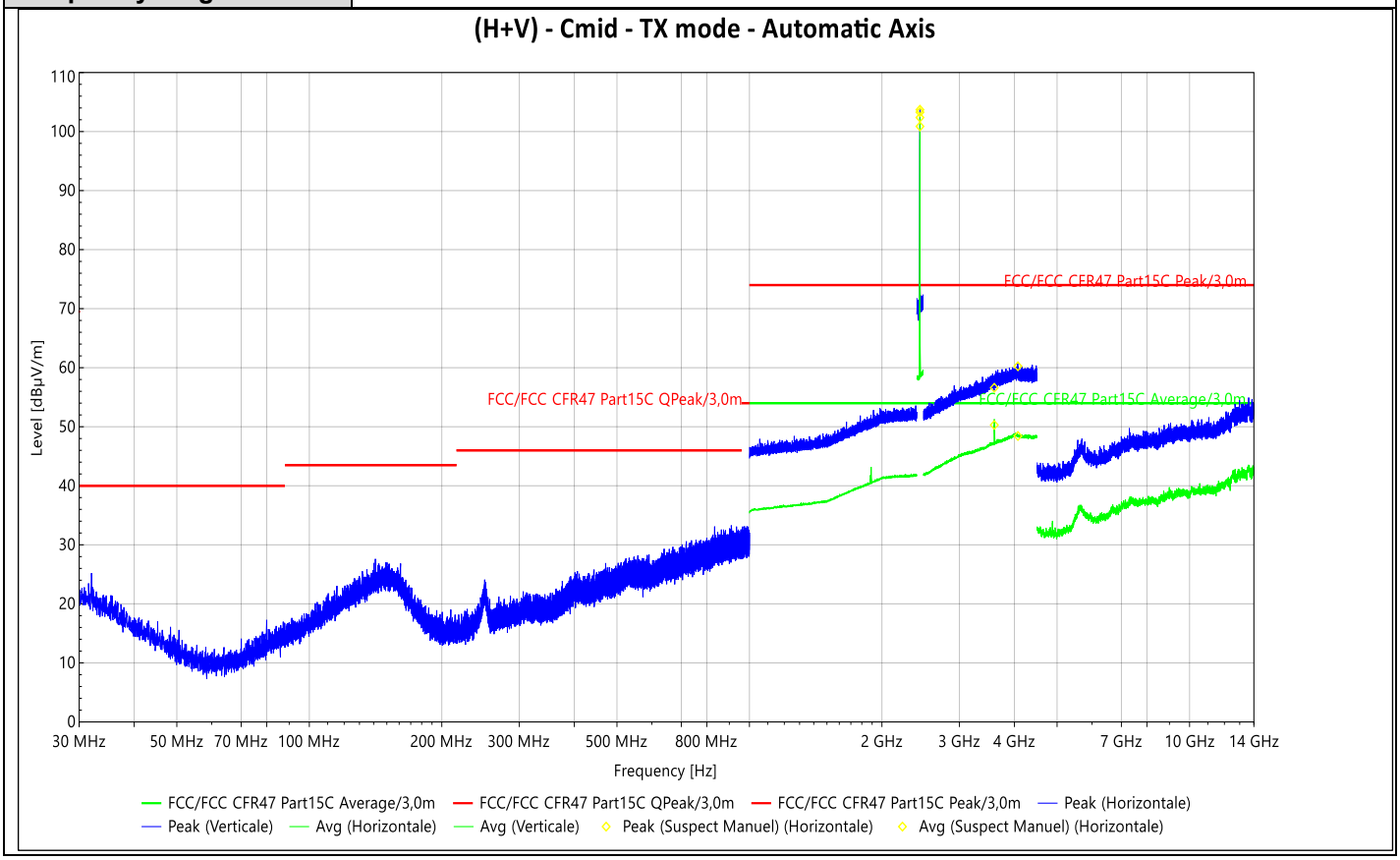
Radiated Emissions	
Graph name:	Emr#3
Frequency range:	30 MHz to 14 GHz



Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
2.40171175 GHz*	101.22	/	98.26	/	164	H	34.19
2.402004 GHz*	100.95	/	99.94	/	164	H	34.19
3.599834399 GHz	55.52	74.00	50.13	54.00	81	H	40.39
4.0535469 GHz	60.44	74.00	48.38	54.00	22	H	41.69

*Carrier frequency
No significant frequency observed

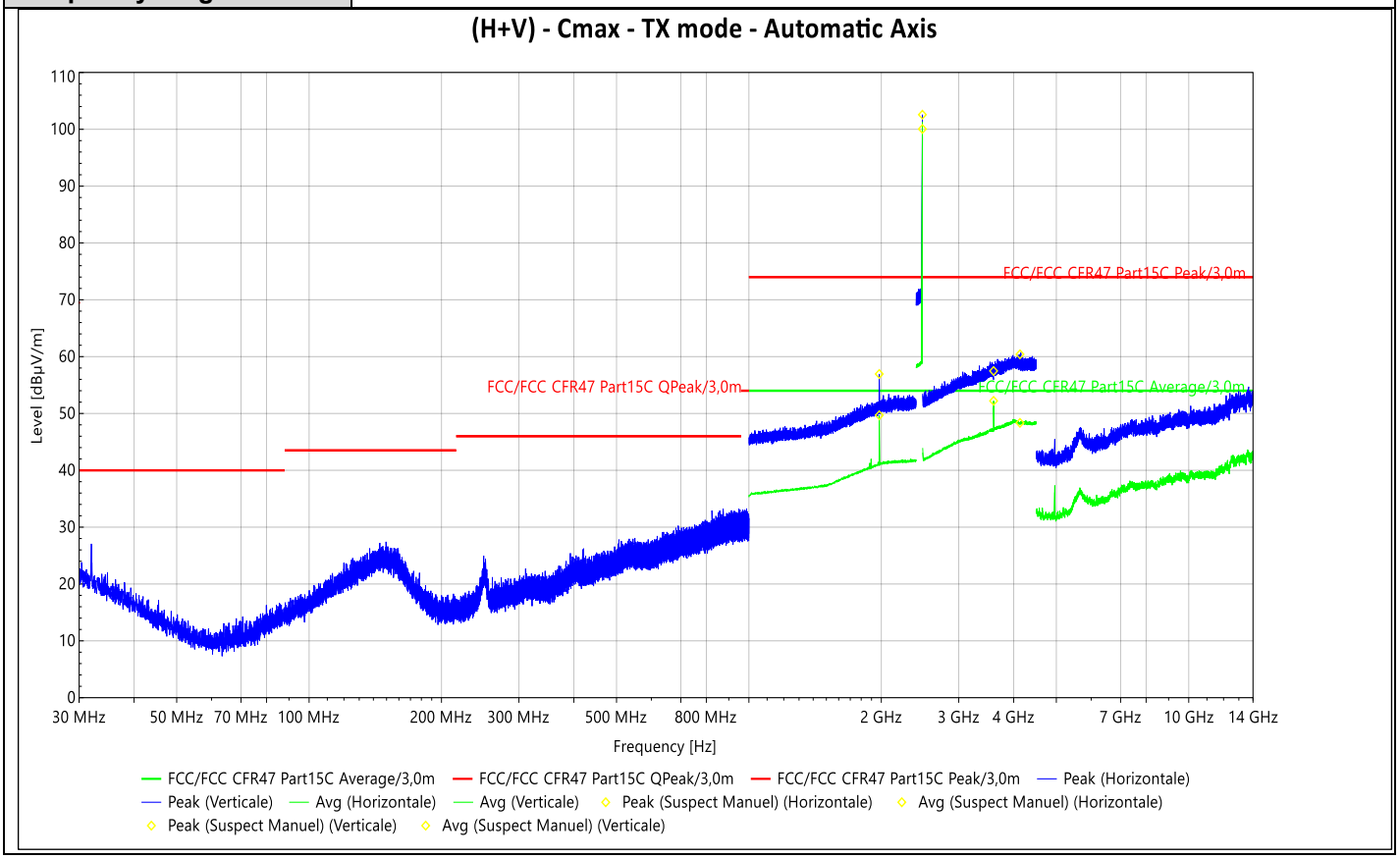
Radiated Emissions	
Graph name:	Emr#4
Frequency range:	30 MHz to 14 GHz



Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Lim.QP (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
2.43995475 GHz*	103.28	/	102.38	/	/	157	H	34.36
2.440247 GHz*	103.70	/	100.87	/	/	103	V	34.36
3.599834399 GHz	56.60	74.00	50.30	54.00	/	197	H	40.39
4.0737119 GHz	60.24	74.00	48.43	54.00	/	0	H	41.64

*Carrier frequency
No significant frequency observed

Radiated Emissions	
Graph name:	Emr#5
Frequency range:	30 MHz to 14 GHz



Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
2.47978425 GHz*	102.57	/	100.05	/	196	H	34.56
3.599834399 GHz	57.48	74.00	52.22	54.00	350	H	40.39
4.1334003 GHz	60.41	74.00	48.35	54.00	166	H	41.55
1.9786 GHz	56.95	74.00	49.69	54.00	325	V	35.32

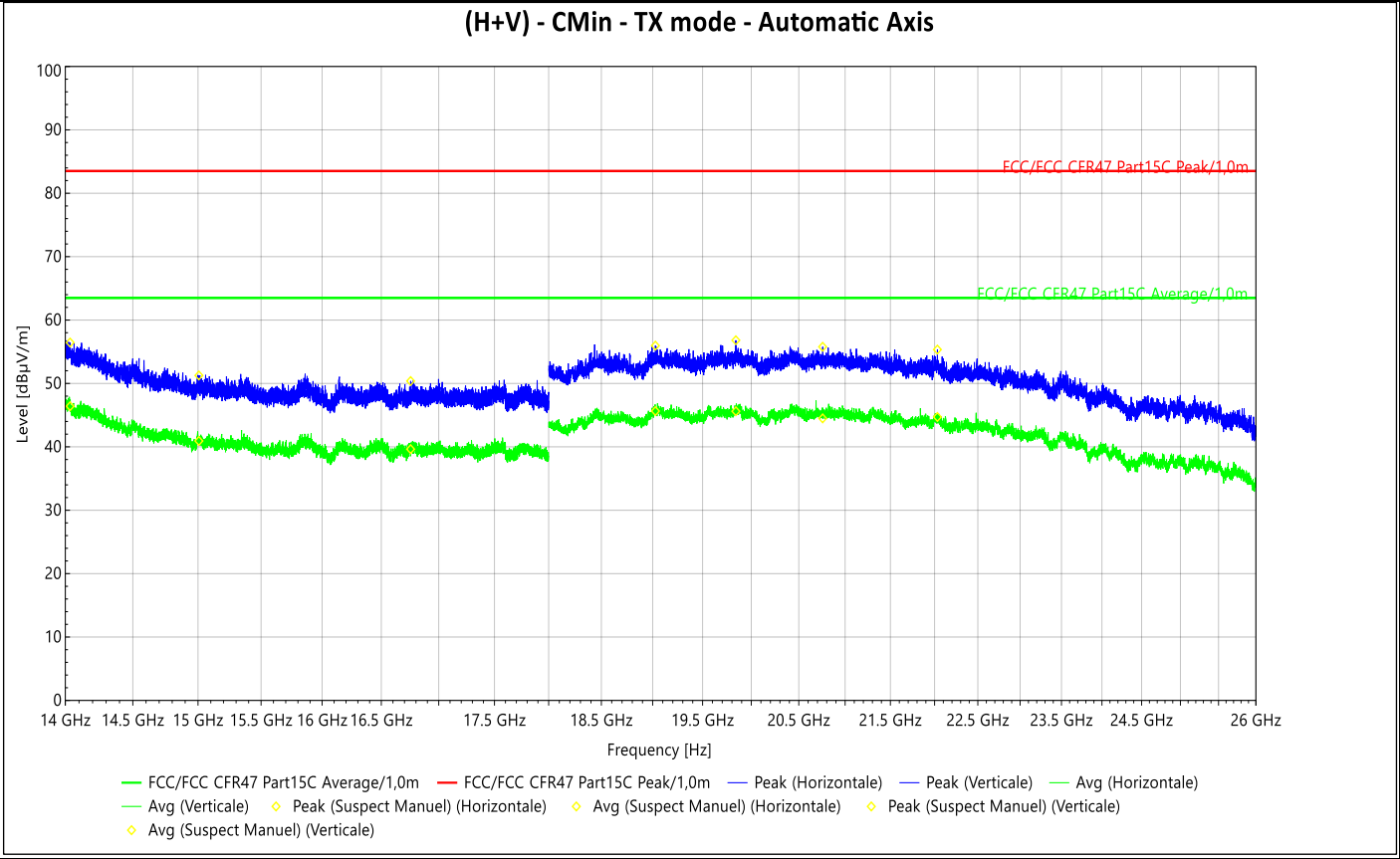
*Carrier frequency
No significant frequency observed (30 MHz to1GHz)

8.6.3. 14GHz to 25GHz

Graphs – Pre characterization:

Graph identifier	Polarization	Mode	Channel	EUT position	Comments
Emr# 6	H/V	TX	Cmin	Axis XY/Z	See the following results
Emr# 7	H/V	TX	Cmid	Axis XY/Z	See the following results
Emr# 8	H/V	TX	Cmax	Axis XY/Z	See the following results

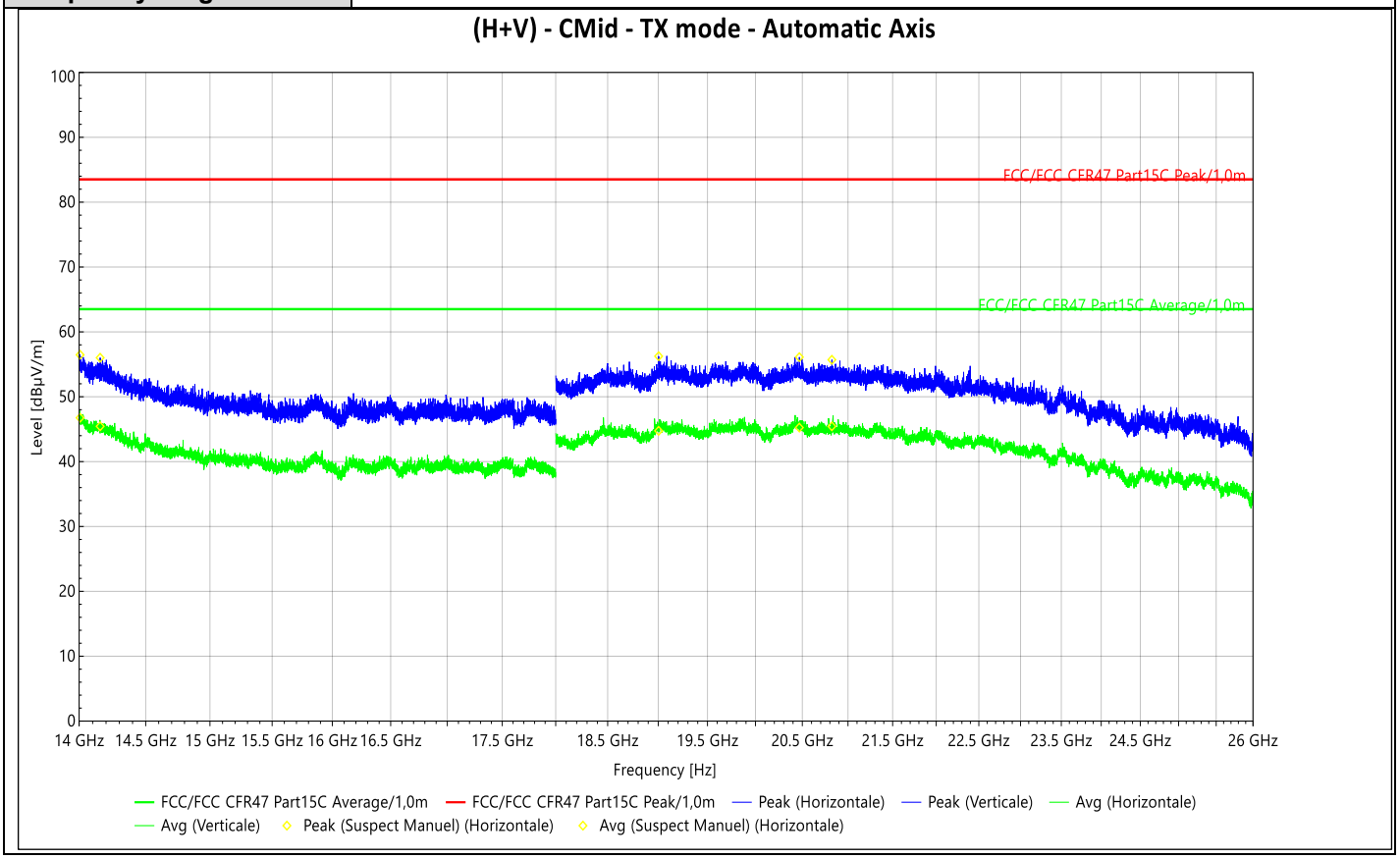
Radiated Emissions	
Graph name:	Emr#6
Frequency range:	14 GHz to 26 GHz



Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
22.032 GHz	55.34	83.50	44.70	63.50	205	H	-0.15
14.0345 GHz	56.45	83.50	46.40	63.50	303	V	3.42
15.007 GHz	51.26	83.50	40.93	63.50	55	V	-2.52
16.7535 GHz	50.38	83.50	39.63	63.50	133	V	-4.34
19.027 GHz	55.96	83.50	45.64	63.50	20	V	1.81
19.84 GHz	56.80	83.50	45.61	63.50	122	V	1.52
20.756 GHz	55.78	83.50	44.48	63.50	122	V	0.23

No significant frequency observed

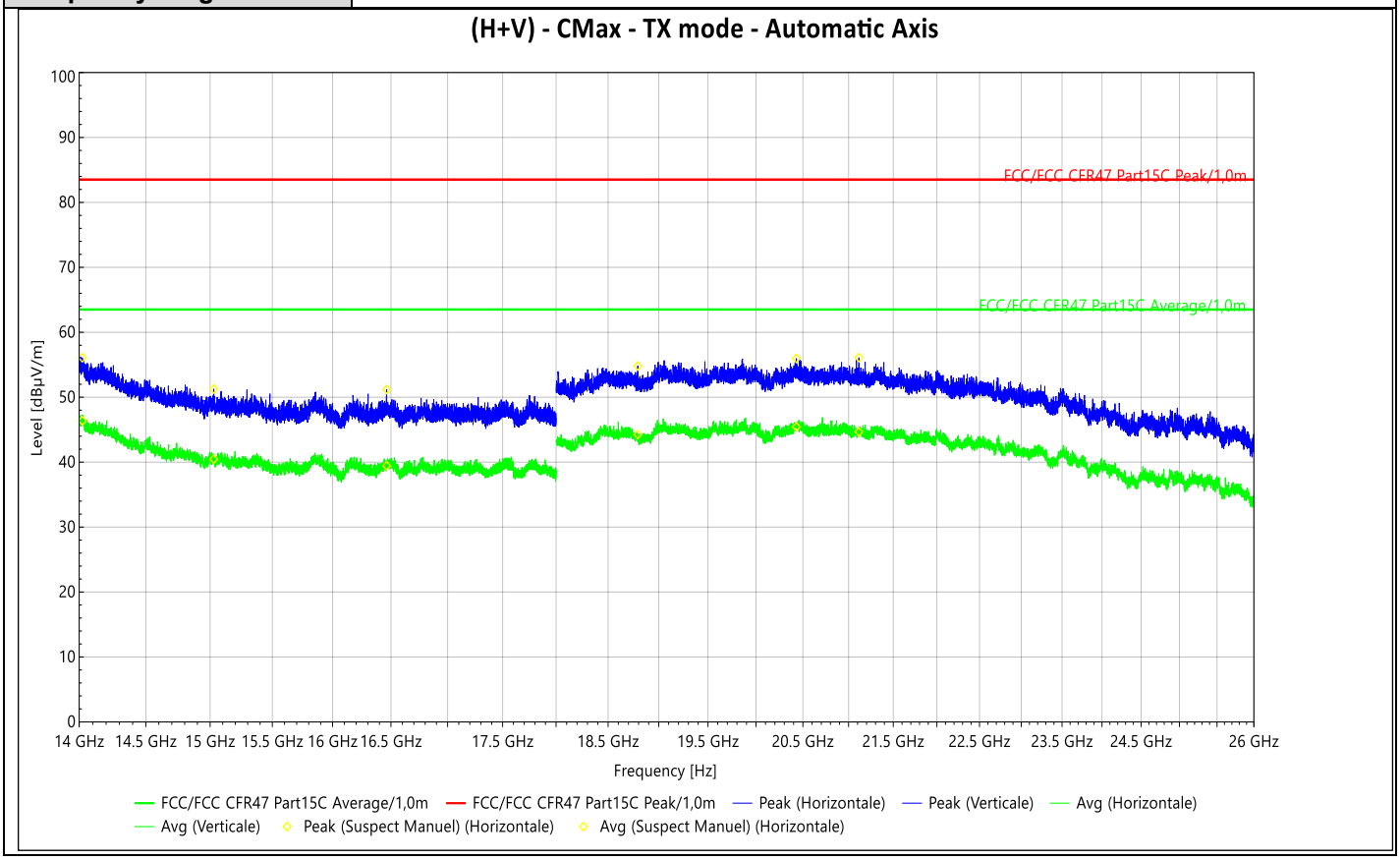
Radiated Emissions	
Graph name:	Emr#7
Frequency range:	14 GHz to 26 GHz



Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
14.007 GHz	56.47	83.50	46.76	63.50	181	H	3.58
14.156 GHz	56.02	83.50	45.44	63.50	205	H	2.34
19.004 GHz	56.25	83.50	44.75	63.50	310	H	1.69
20.468 GHz	56.11	83.50	45.25	63.50	52	H	1.19
20.822 GHz	55.70	83.50	45.44	63.50	73	H	0.32

No significant frequency observed

Radiated Emissions	
Graph name:	Emr#8
Frequency range:	14 GHz to 26 GHz



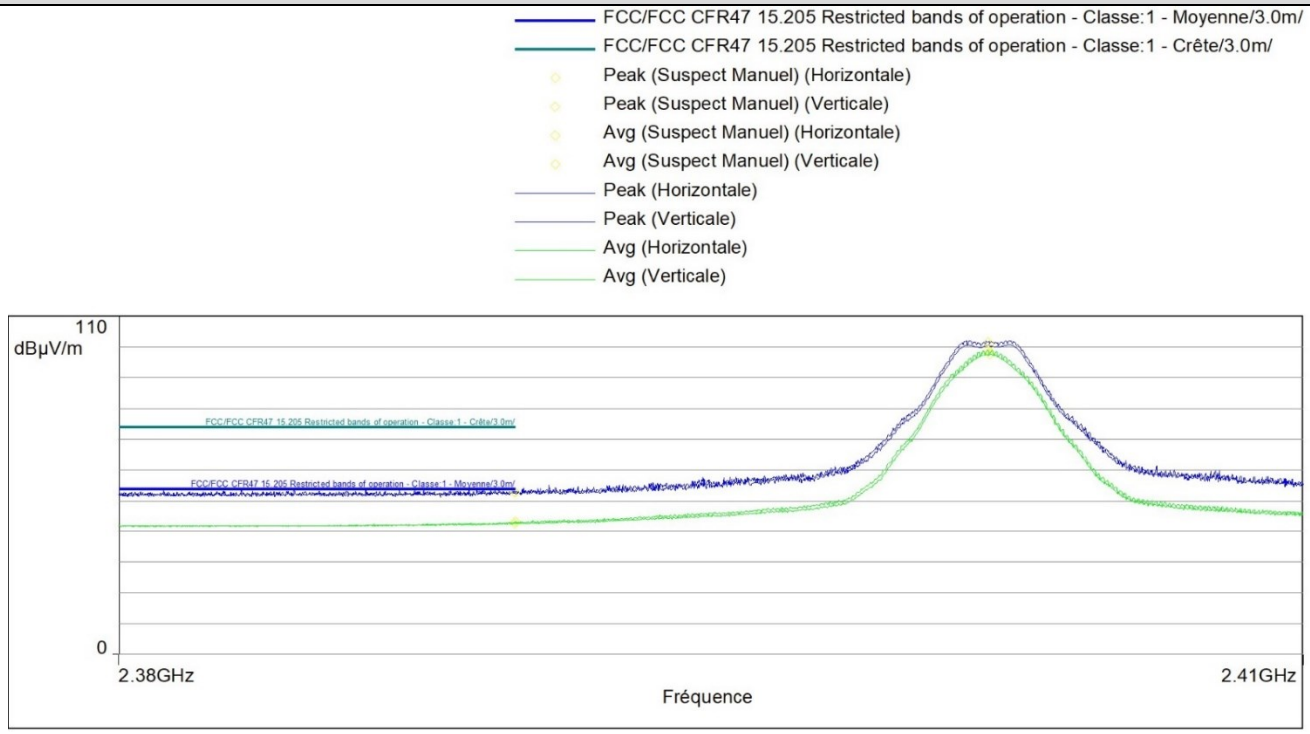
Pre-Characterization:

Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
14.023 GHz	56.09	83.50	46.38	63.50	204	H	3.49
15.029 GHz	51.28	83.50	40.46	63.50	283	H	-2.38
16.463 GHz	51.18	83.50	39.44	63.50	126	H	-4.82
18.792 GHz	54.82	83.50	44.25	63.50	237	H	-0.15
20.43 GHz	55.98	83.50	45.43	63.50	29	H	1.29
21.114 GHz	56.10	83.50	44.66	63.50	52	H	0.38

No significant frequency observed

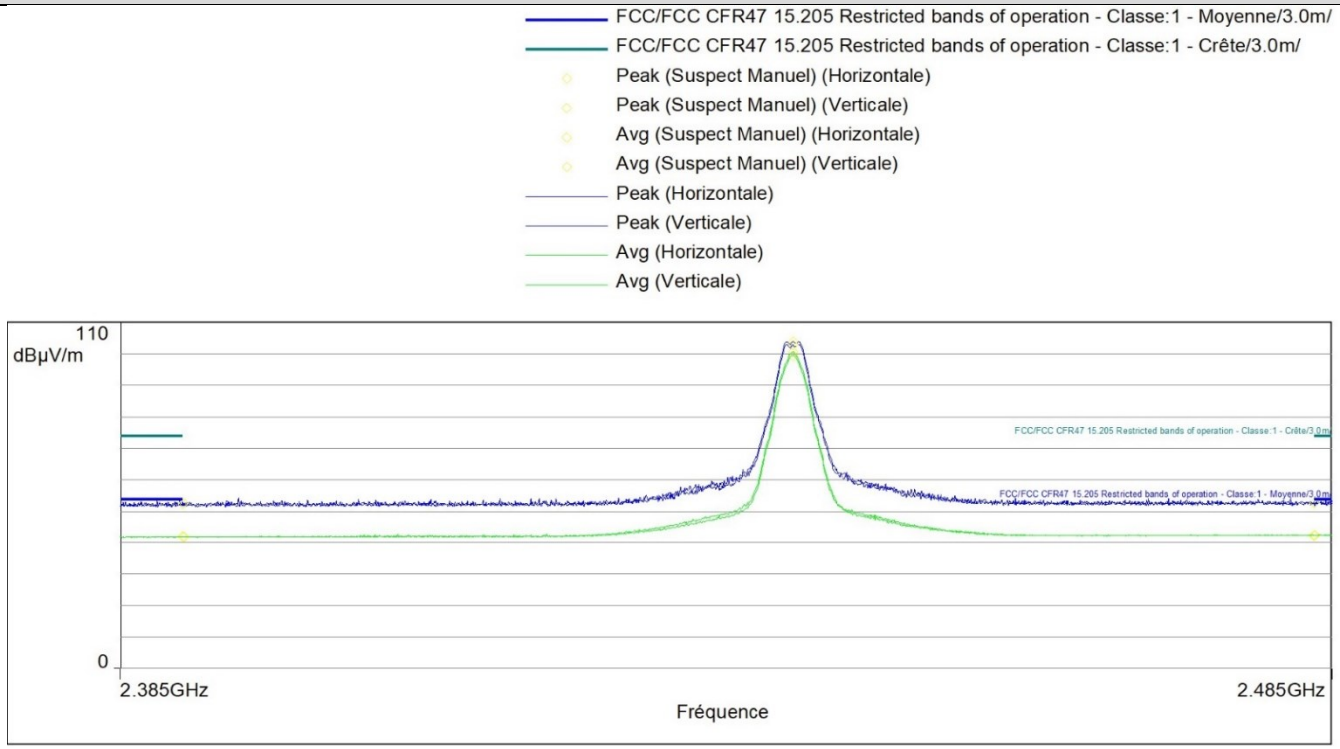
8.6.4. Restricted bands of operation

Unwanted emissions in restricted bands
Configuration: BLE - 2MBits/s (Worst case presented)
Cmin
Tx1



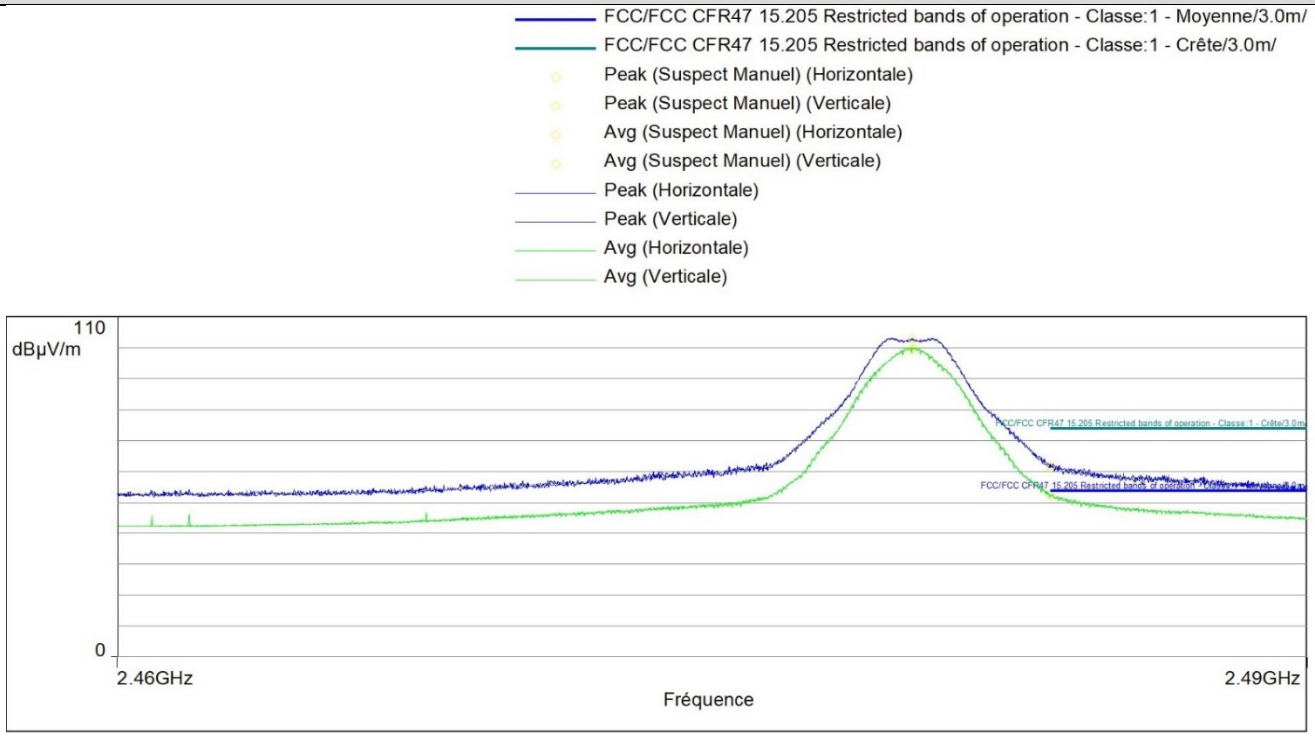
Frequency (MHz)	Peak (dBµV/m)	Lim.Peak (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Polarization	Correction (dB)
2390.005	52.78	74.00	43.11	54.00	Horizontal	34.48
2401.990	101.48	/	98.96	/	Horizontal	34.57
2389.990	52.74	74.00	42.50	54.00	Vertical	34.48
2402.020	100.63	/	97.65	/	Vertical	34.57

Unwanted emissions in restricted bands
Configuration: BLE - 2MBits/s (Worst case presented)
Cmid
Tx1



Frequency (MHz)	Peak (dBµV/m)	Lim.Peak (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Polarization	Correction (dB)
2390.000	52.29	74.00	41.77	54.00	Horizontal	34.48
2440.000	103.86	/	100.70	/	Horizontal	34.74
2483.500	52.44	74.00	42.24	54.00	Horizontal	34.97
2390.150	52.60	74.00	41.84	54.00	Vertical	34.48
2440.000	102.89	/	99.25	/	Vertical	34.74
2483.550	52.65	74.00	42.31	54.00	Vertical	34.97

Unwanted emissions in restricted bands
Configuration: BLE - 2MBits/s (Worst case presented)
Cmax
Tx1



Frequency (MHz)	Peak (dBµV/m)	Lim.Peak (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Polarization	Correction (dB)
2479.980	103.00	/	99.62	/	Horizontal	34.95
2483.505	61.97	74.00	52.29	54.00	Horizontal	34.97
2480.040	102.38	/	/	54.00	Vertical	34.95
2483.490	61.23	74.00	52.18	54.00	Vertical	34.97

8.7. CONCLUSION

Unwanted emissions in non-restricted bands measurement performed on the sample of the product **STM32WBA5MMG**, Sn: **None**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247** limits.

9. UNCERTAINTIES CHART

Kind of measurement	*Wide uncertainty laboratory*
Occupied Channel Bandwidth	±2.8 %
Humidity	±3.2 %
Power Spectral Density, Conducted	±1.7 dB
Radio frequency	±0.3 ppm
RF power, conducted	±1.2 dB
RF power, radiated (Full anechoic chamber above 1GHz)	±3.7 dB
RF power, radiated (Semi anechoic chamber & open test site)	±5.6 dB
Spurious emission, conducted	±2.3 dB
Spurious emission, radiated (Full anechoic chamber above 1GHz)	±3.8 dB
Spurious emission, radiated (Semi anechoic chamber & open test site)	±5.7 dB
Temperature	±0.75 °C
Time	±2.3 %
Voltage	±1.7 %

The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the standard. The conformity of the sample is directly established by the applicable limit values. This table includes all uncertainties maximum feasible for testing in the laboratory, whether or not made in this report.