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TEST REPORT

N°: 24329407-806666-F(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
- Trade mark
- Manufacturer
- Model under test
- Serial number
- FCCID
- IC

Bluetooth® LE and IEEE 802.15.4 radio module
STMICROELECTRONICS
STMICROELECTRONICS
STM32WBA5MMG
None
YCP-32WBA5MMG01
8976A-32WBA5MMG01

Conclusion

See Test Program chapter

Test date
Test location
FCC Test site
ISED Test site
Sample receipt date
Composition of document
Document issued on

December 03, 2024 to December 04, 2024
LCIE Grenoble
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November 20, 2024
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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

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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 [Pb](#)
- KDB 662911 D01 Multiple Transmitter Output v02r01 [Pb](#)
- ANSI C63.10 (2013)

Radio requirement:

Clause - Test Description		Test result - Comments
Occupied Bandwidth	<i>ISED</i>	PASS
6dB Bandwidth	<i>FCC & ISED</i>	PASS
Maximum Conducted Output Power	<i>FCC & ISED</i>	PASS
Power Spectral Density	<i>FCC & ISED</i>	PASS
Unwanted Emissions in Non-Restricted Frequency Bands	<i>FCC & ISED</i>	PASS
Unwanted Emissions in Restricted Frequency Bands	<i>FCC & ISED</i>	PASS
Receiver Radiated Emissions	<i>ISED</i>	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

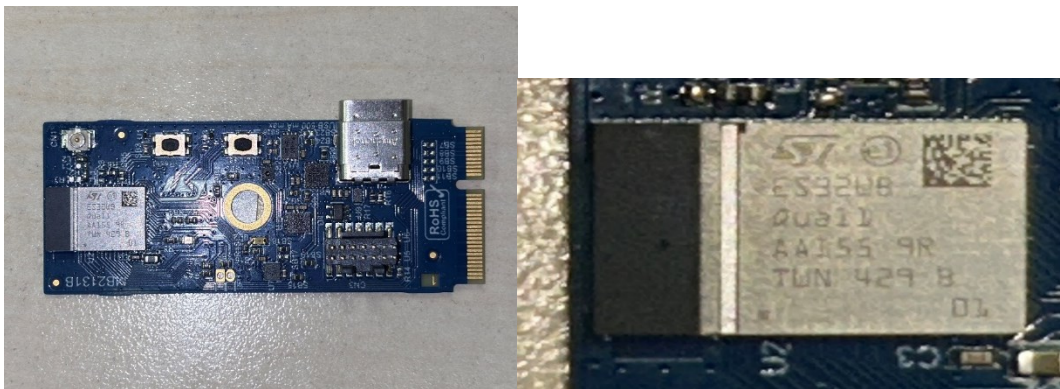
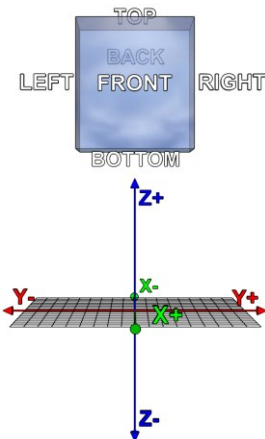
NA: Not Applicable

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):

802.15.4:	ZigBee
Chipset / RF Module	STM32WBA5MMG
Frequency band:	[2400 – 2483.5] MHz
Spectrum Modulation:	DSSS
Number of Channel:	16
Spacing channel:	5MHz
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)
Cmin: 11	2405
12	2410
13	2415
14	2420
15	2425
16	2430
17	2435
Cmid: 18	2440
19	2445
20	2450
21	2455
22	2460
23	2465
24	2470
25	2475
Cmax: 26	2480

DATA RATE		
Data Rate (Mbps)	Modulation Type	Worst Case Modulation
0.25	O-QPSK	☒

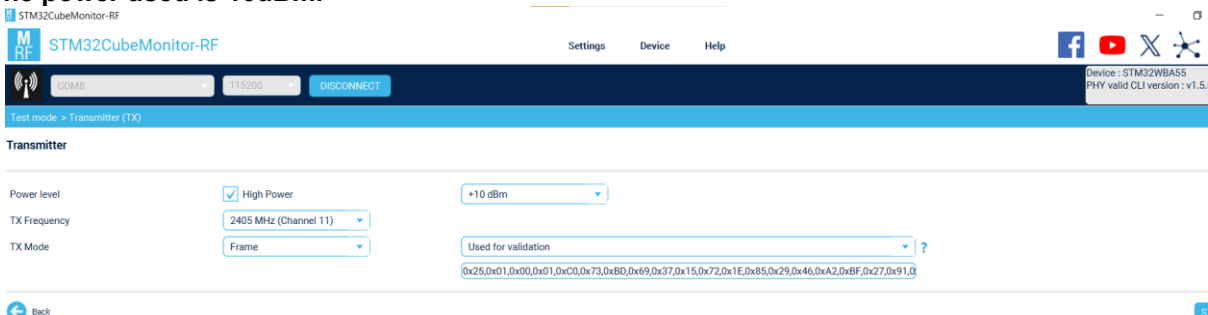


Antenna Characteristic			
Antenna reference	Gain (dBi)	Frequency Band (MHz)	Impedance(Ω)
ethertronics, Part Number : 1001312	1.88	2400 to 2485 MHz	50

Hardware information				
Highest internal frequency (PLL, Quartz, Clock, Microprocessor...):		F _{Highest} :	2500	MHz
Firmware (if applicable):		V:	Device : STM32WBA55 PHY valid CLI version : v1.5.0	
Software (if applicable):		V:		
Equipment 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 10dBm. 

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.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$

The 32 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32\text{dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}.$$

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,

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

Above 30MHz,

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

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

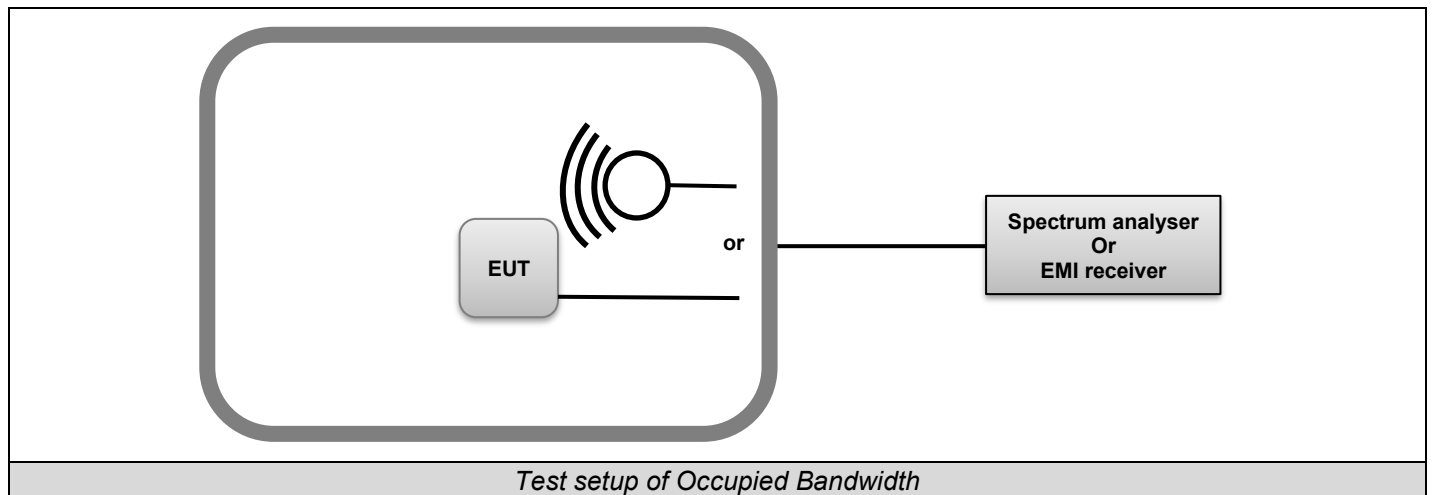
The Equipment Under Test is installed in an anechoic chamber.
Measurement is performed with a spectrum analyzer in conducted method.

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) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = Max Hold.
- Sweep = Auto couple.
- Allow the trace to stabilize.
- OBW 99% function of spectrum analyzer used



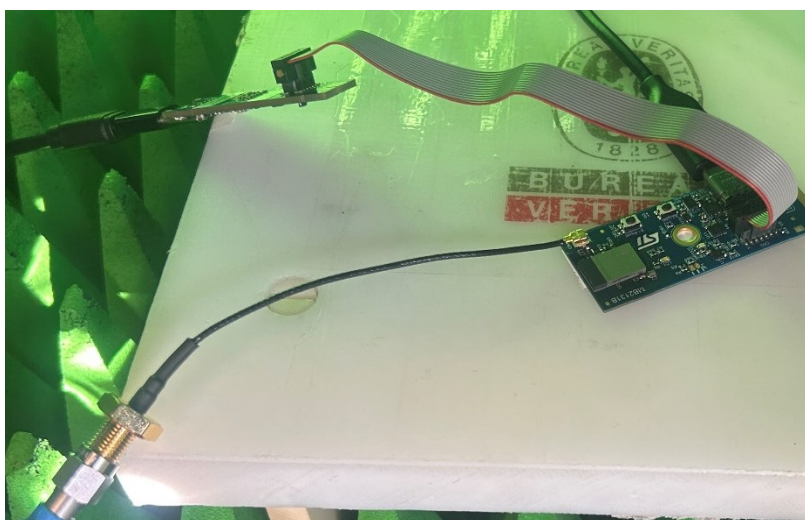


Photo of Occupied bandwidth

3.3. LIMIT

None

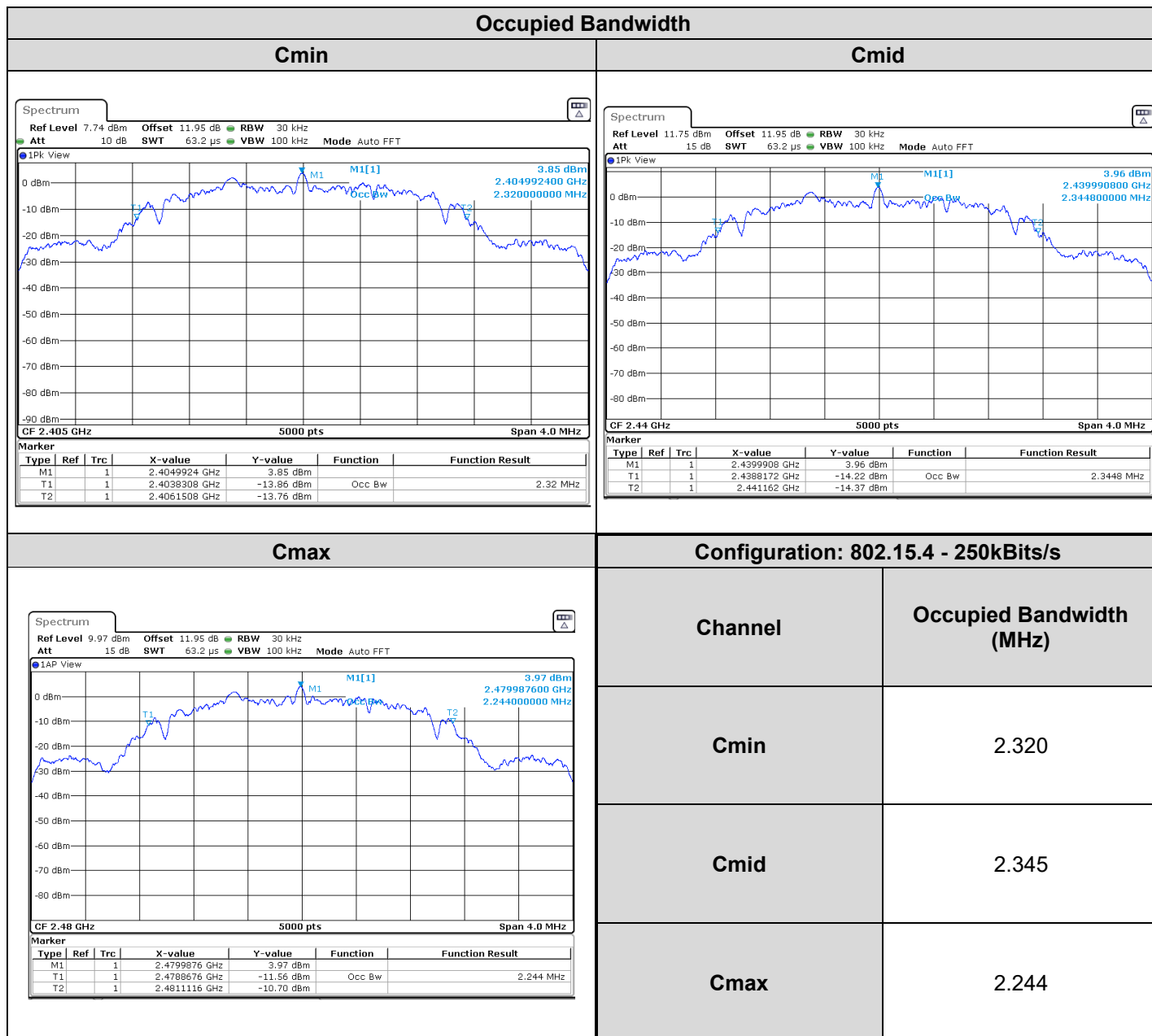
3.4. TEST EQUIPMENT LIST

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



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

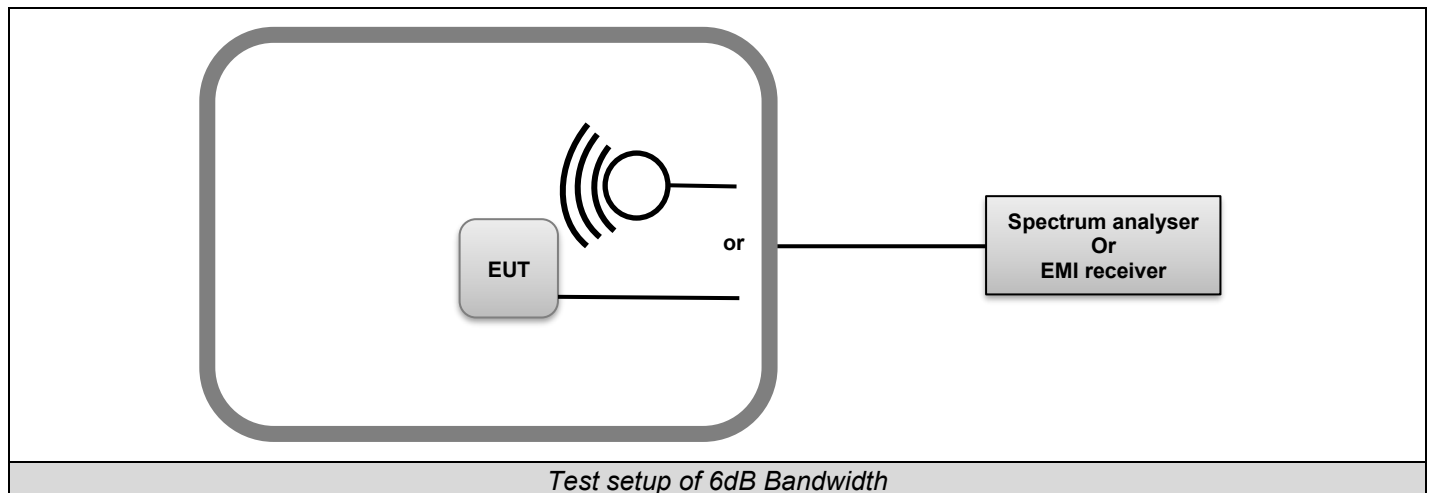
The Equipment Under Test is installed in an anechoic chamber.
 Measurement is performed with a spectrum analyzer in conducted method.

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) $\geq 3 \times$ 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.



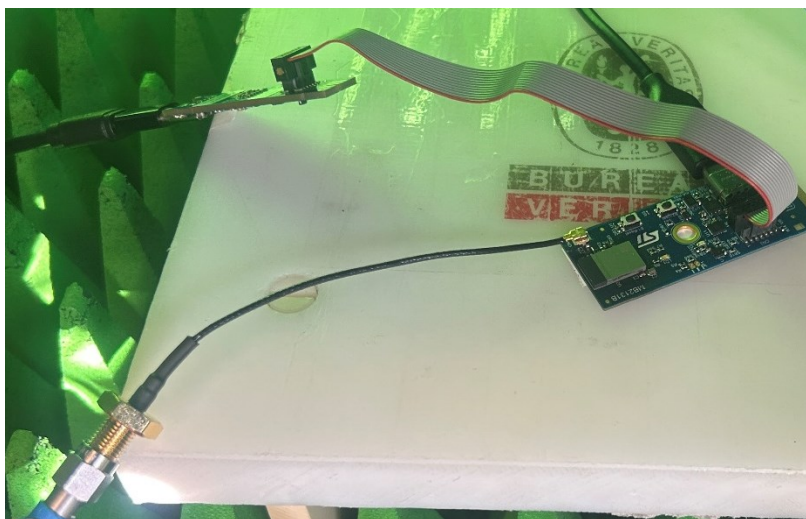


Photo of 6dB bandwidth

4.3. **LIMIT**

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



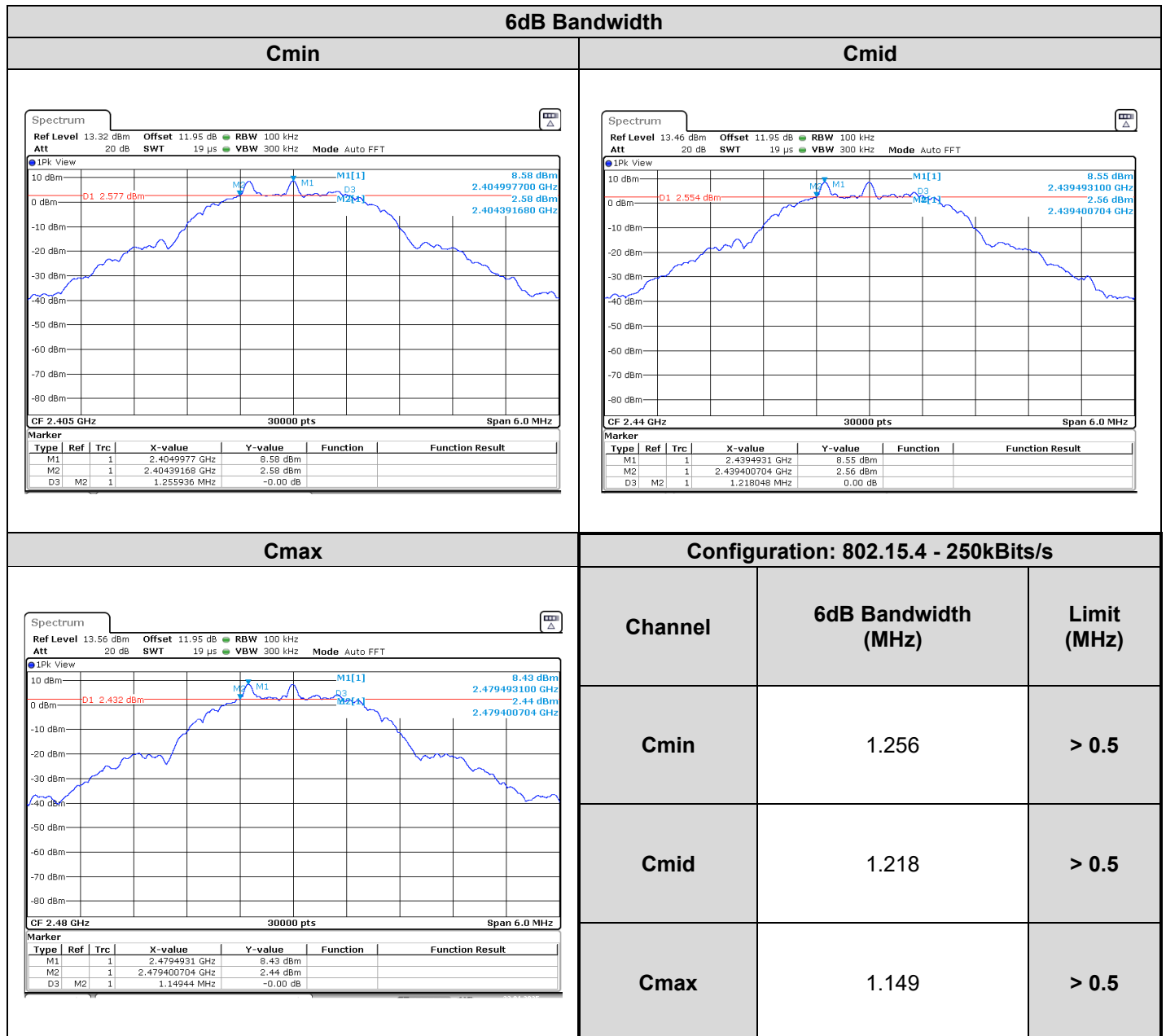
4.4. TEST EQUIPMENT LIST

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



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.

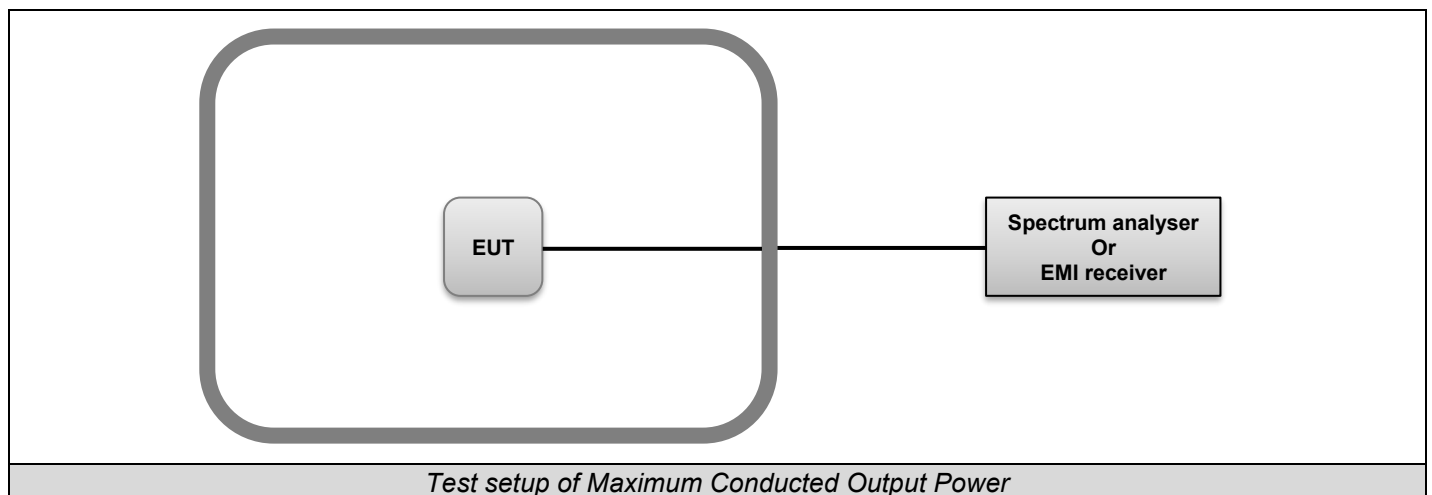
The EUT is turned ON, the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

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 $\geq$ DTS bandwidth.
- Set VBW $\geq 3 \times$ RBW.
- Set span $\geq 3 \times$ 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.



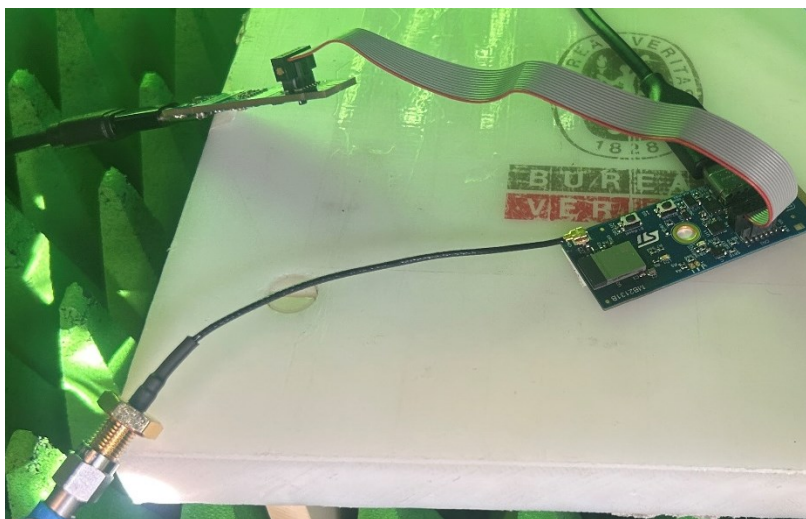


Photo of Maximum Conducted Output Power



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

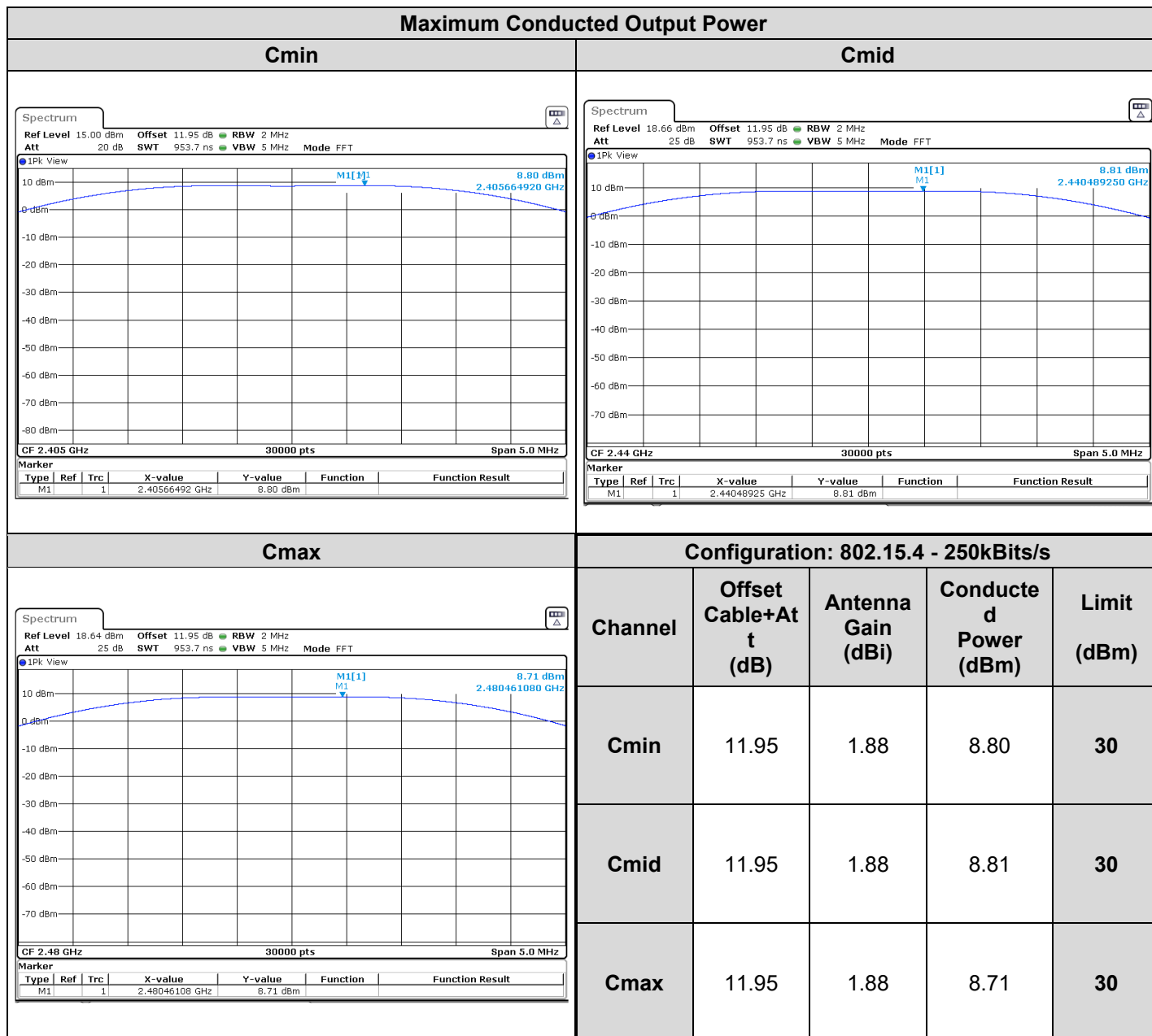
5.4. TEST EQUIPMENT LIST

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



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.

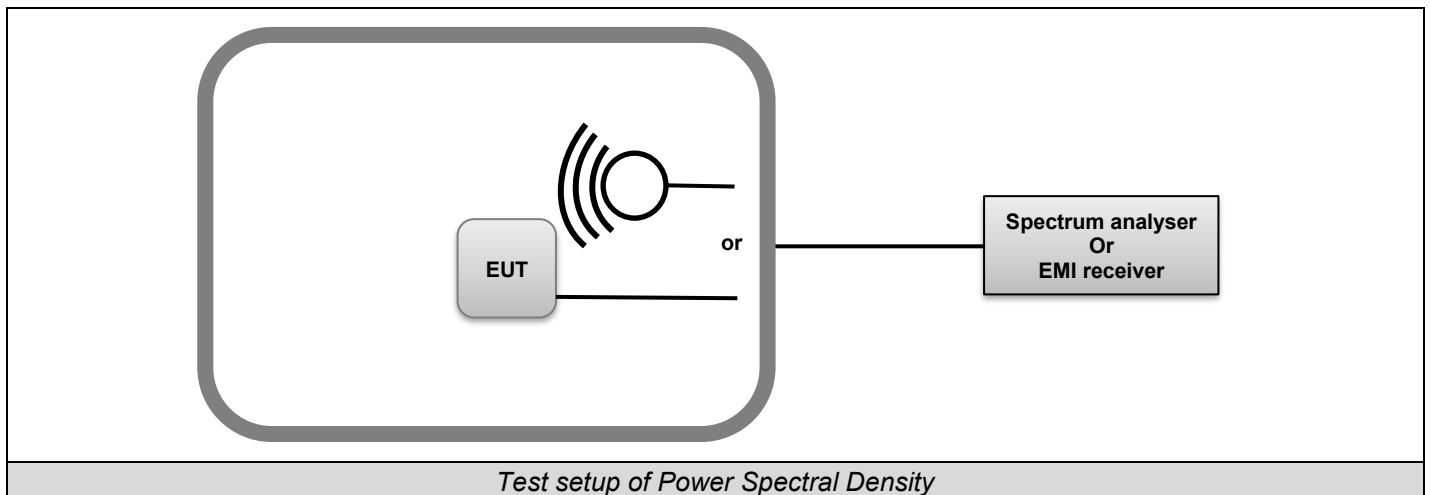
The EUT is turned ON, the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

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 $\geq 3 \times$ 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.



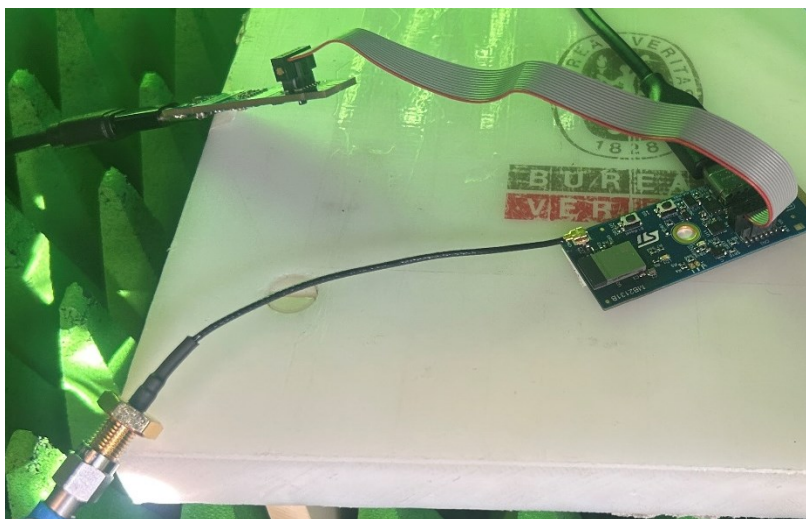


Photo of Power Spectral Density



6.3. LIMIT

Frequency range	Power Spectral Density
2400MHz to 2483.5MHz	$\leq 8\text{dBm} / 3\text{kHz}^*$

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

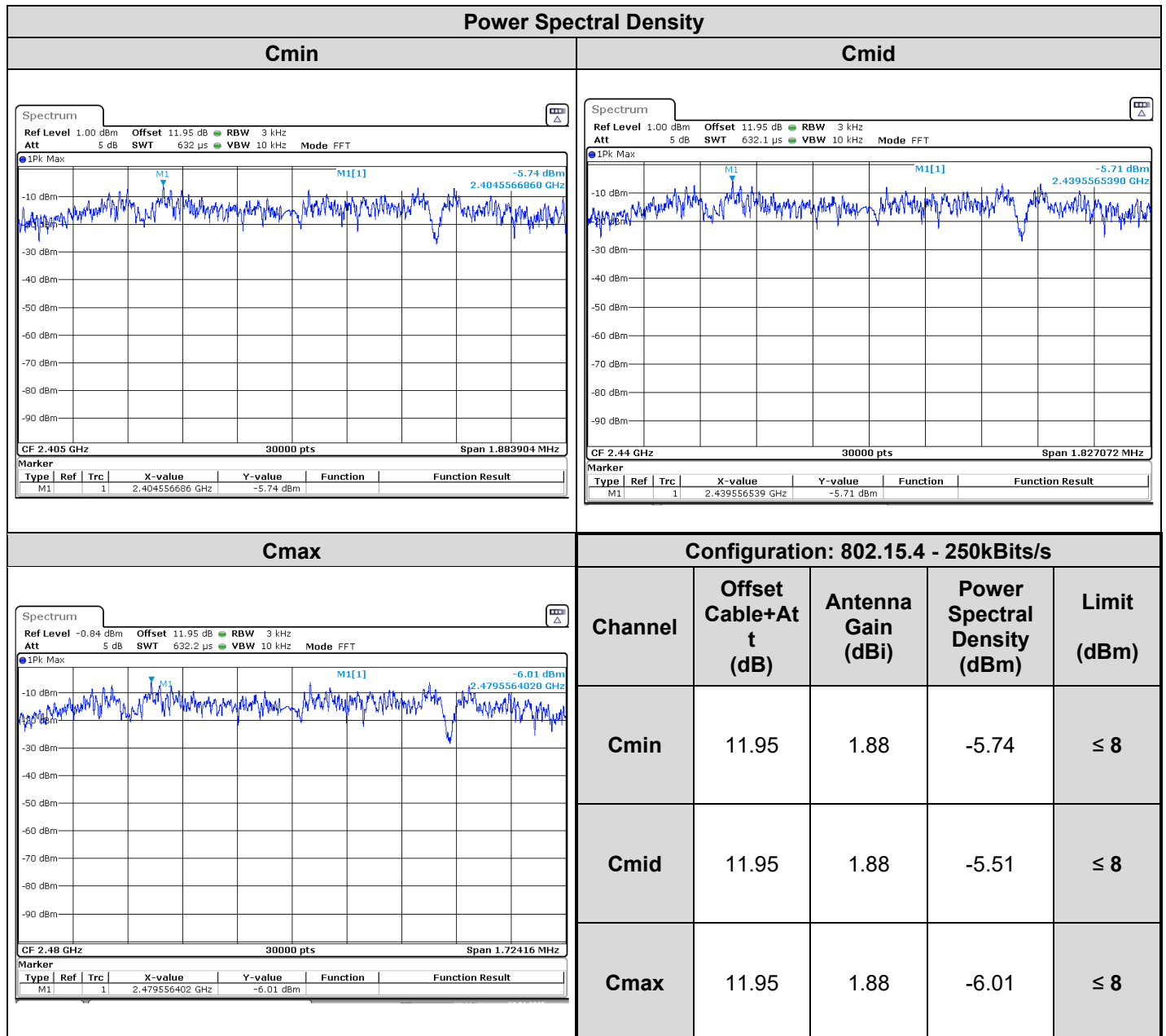
6.4. TEST EQUIPMENT LIST

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



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

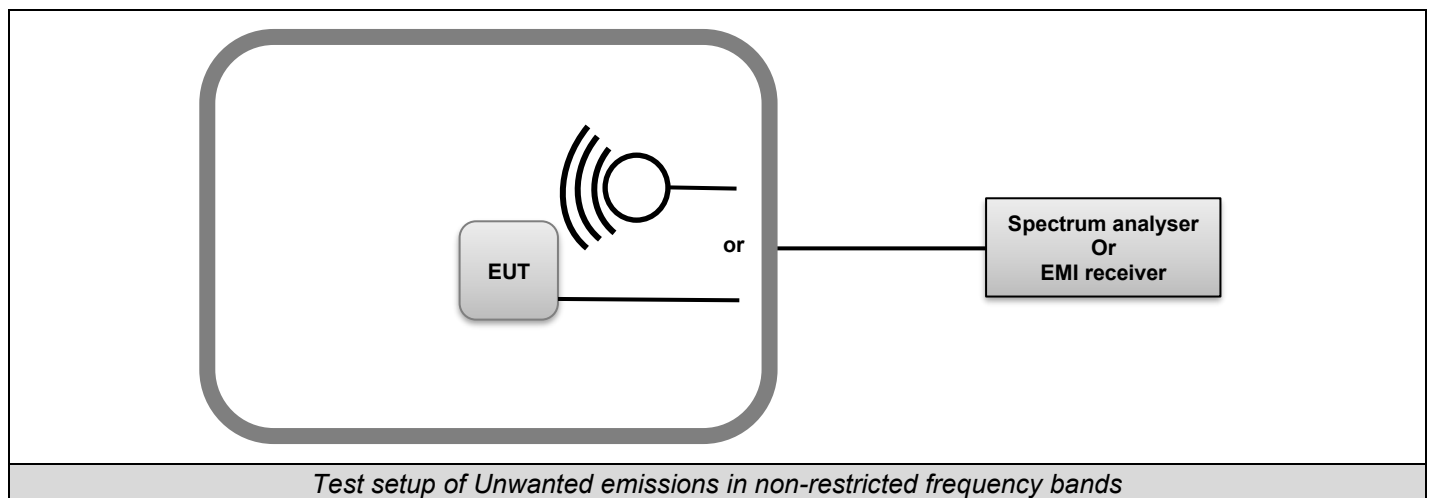
Date of test : December 04, 2024
Test performed by : Akram HAKKARI
Relative humidity (%) : 43
Ambient temperature (°C) : 23

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



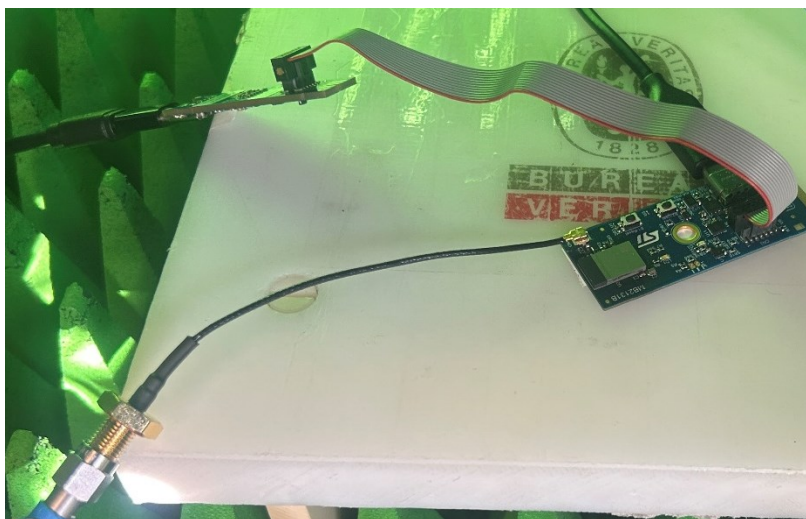


Photo of Unwanted emissions in non-restricted frequency bands



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

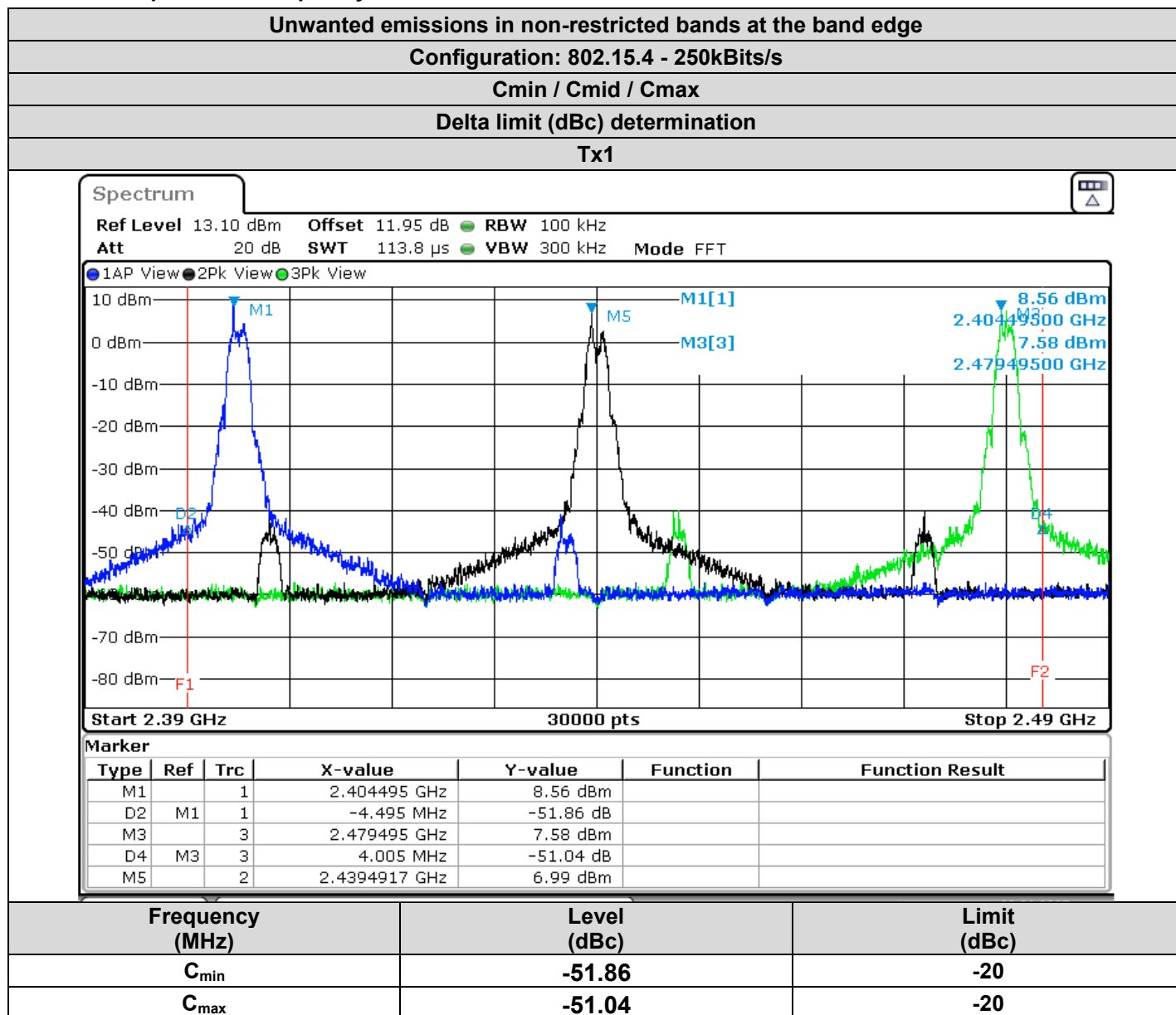
TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Cable SMA UFL	—	—	A5329762	07/23	07/25
Attenuator 10dB	AEROFLEX	—	A7122267	10/23	10/25
Full Anechoic Room	SIEPEL	—	D3044024	-/-	-/-
SMA 1.5m	SUCOFLEX	18GHz	A5329863	08/24	08/25
SMK 1.2m (Ampl <-> chamber)	HUBER-SUHNER	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

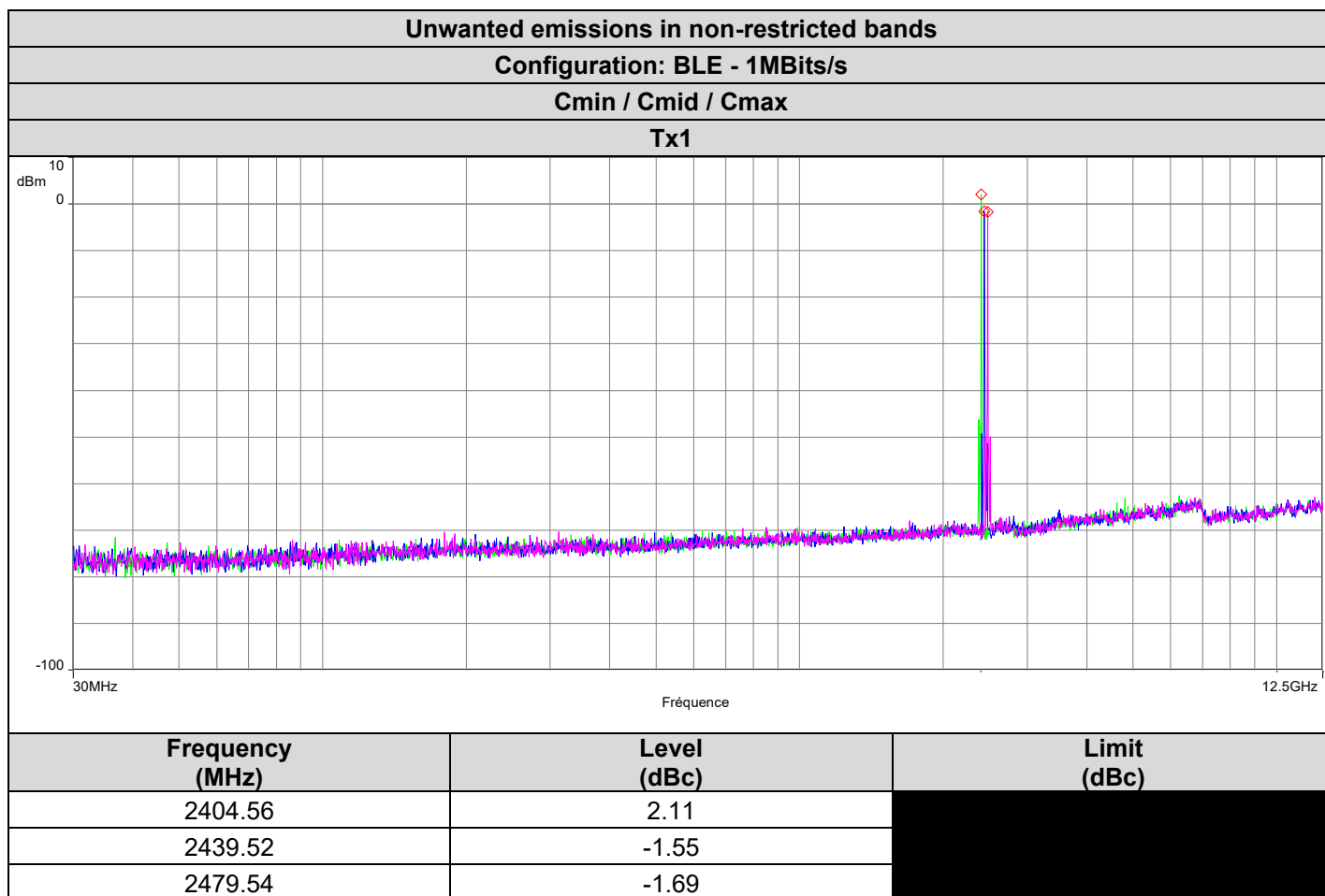
None

7.6. RESULTS

7.6.1. Operational frequency band



7.6.2. Non restricted frequency bands



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

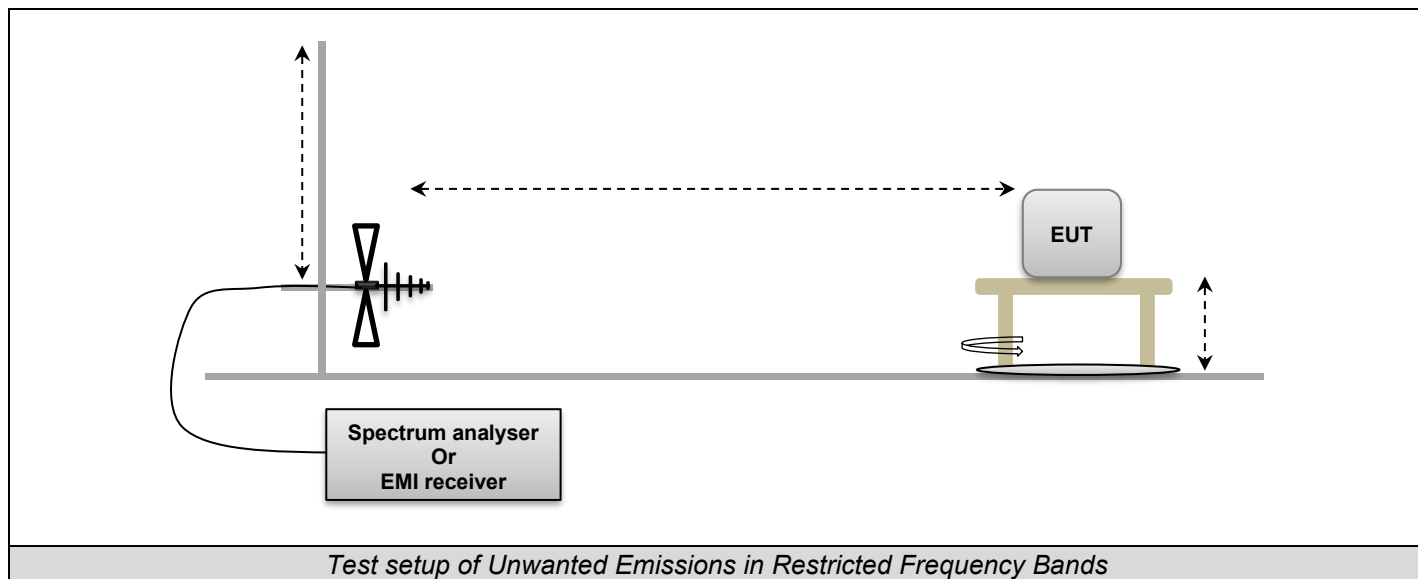




Photo of Unwanted Emissions in Restricted Frequency Bands



8.3. LIMIT

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

8.4. 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

8.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

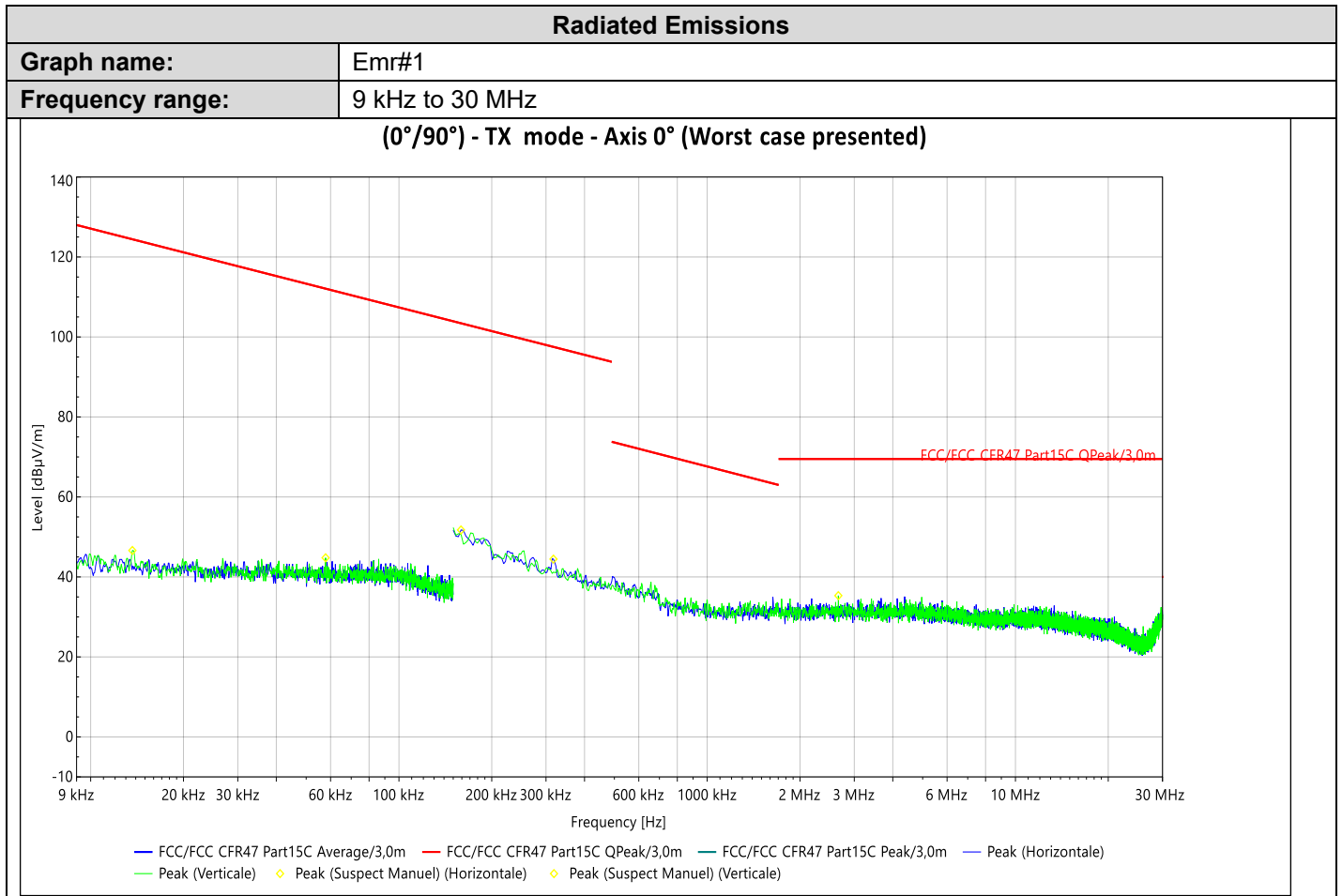
8.6. RESULTS

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

8.6.1. 9kHz to 30MHz

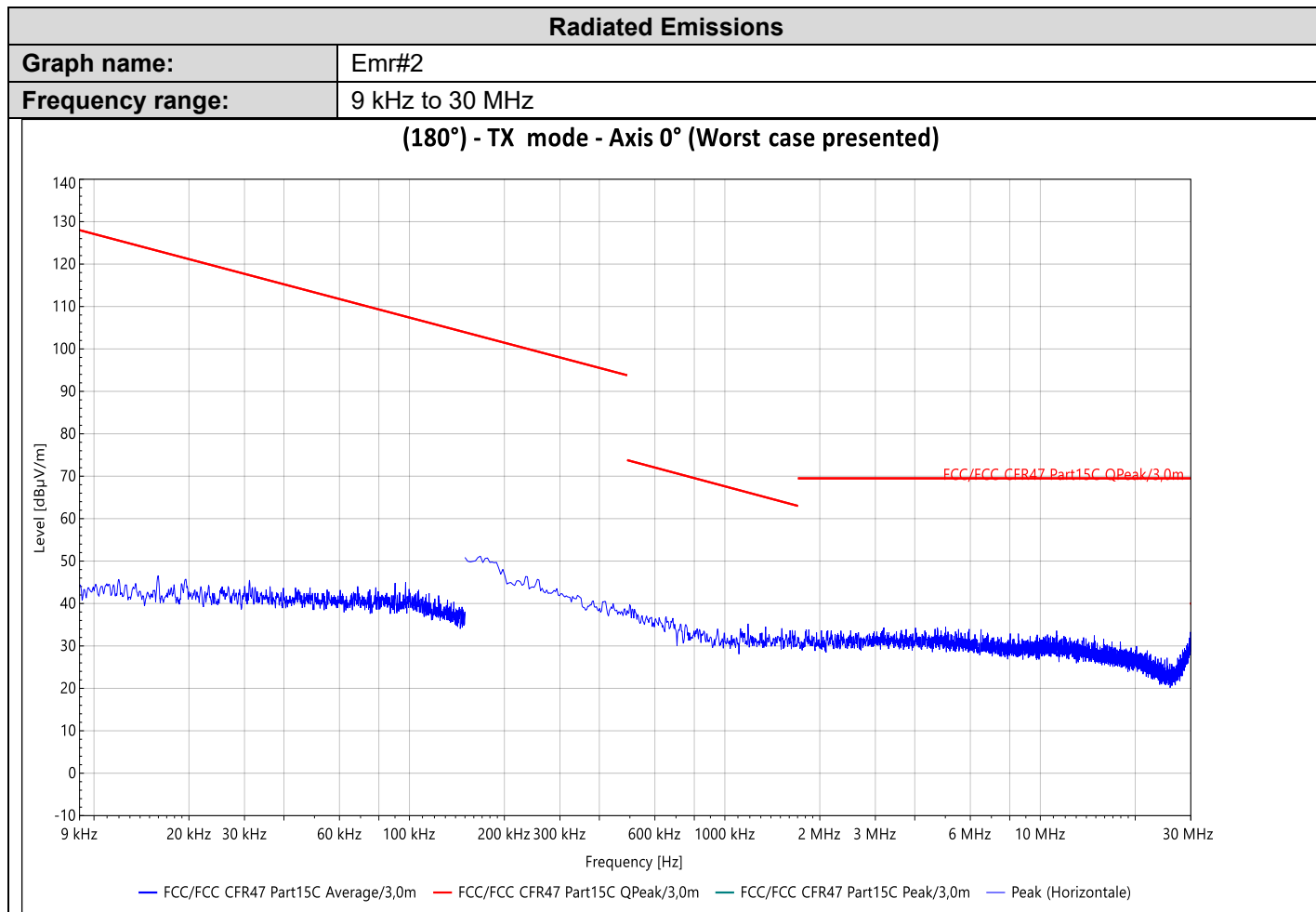
Graphs – Pre characterization:

Graph identifier	Polarization	Mode	Channel	EUT position	Comments
Emr# 1	H/V	TX	Cmid	Axis XY	See the following results
Emr# 2	H/V	TX	Cmid	Axis Z	See the following results



Frequency	PK Level (dBμV/m)	Lim.QP (dBμV/m)	Angle (°)	Polar.	Correct. (dB)
158.954 kHz	51.75	103.43	327	H	56.27
317.16 kHz	44.46	97.52	11	H	50.51
13.652 kHz	46.62	124.43	136	V	60.38
57.814 kHz	44.79	112.09	287	V	60.15
2.66337 MHz	35.33	69.50	74	V	40.43

No significant frequency observed

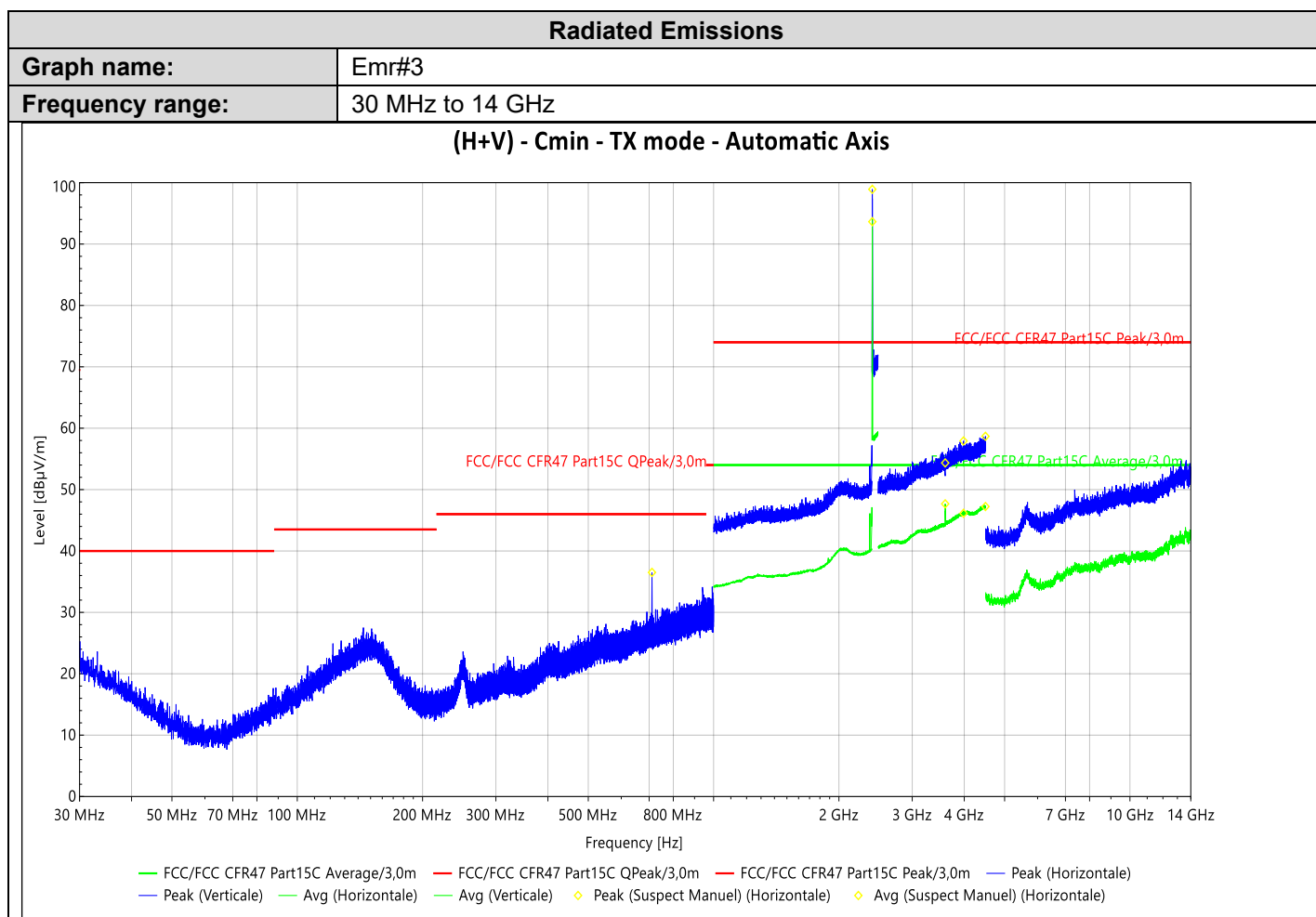


No significant frequency observed

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

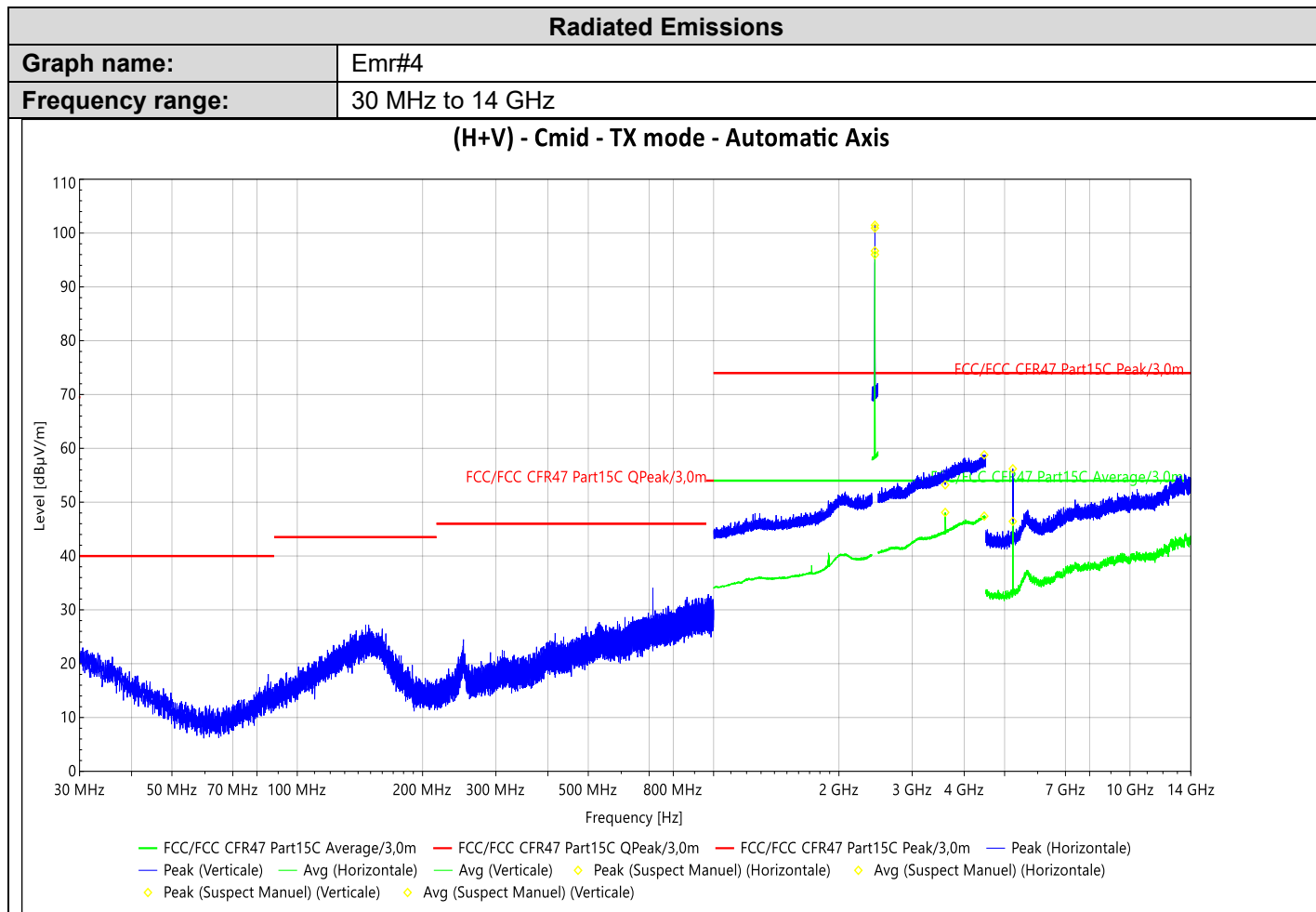


Pre-Characterization:

Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Lim.QP (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
2.40546925 GHz*	98.92	/	93.64	/		155	H	34.21
711.2795 MHz	36.51				46.00	0	H	25.60
3.599834399 GHz	54.35	74.00	47.68	54.00		108	H	37.65
3.983776 GHz	57.92	74.00	46.14	54.00		325	H	39.25
4.4975802 GHz	58.68	74.00	47.24	54.00		199	H	40.34

*Carrier frequency

No significant frequency observed

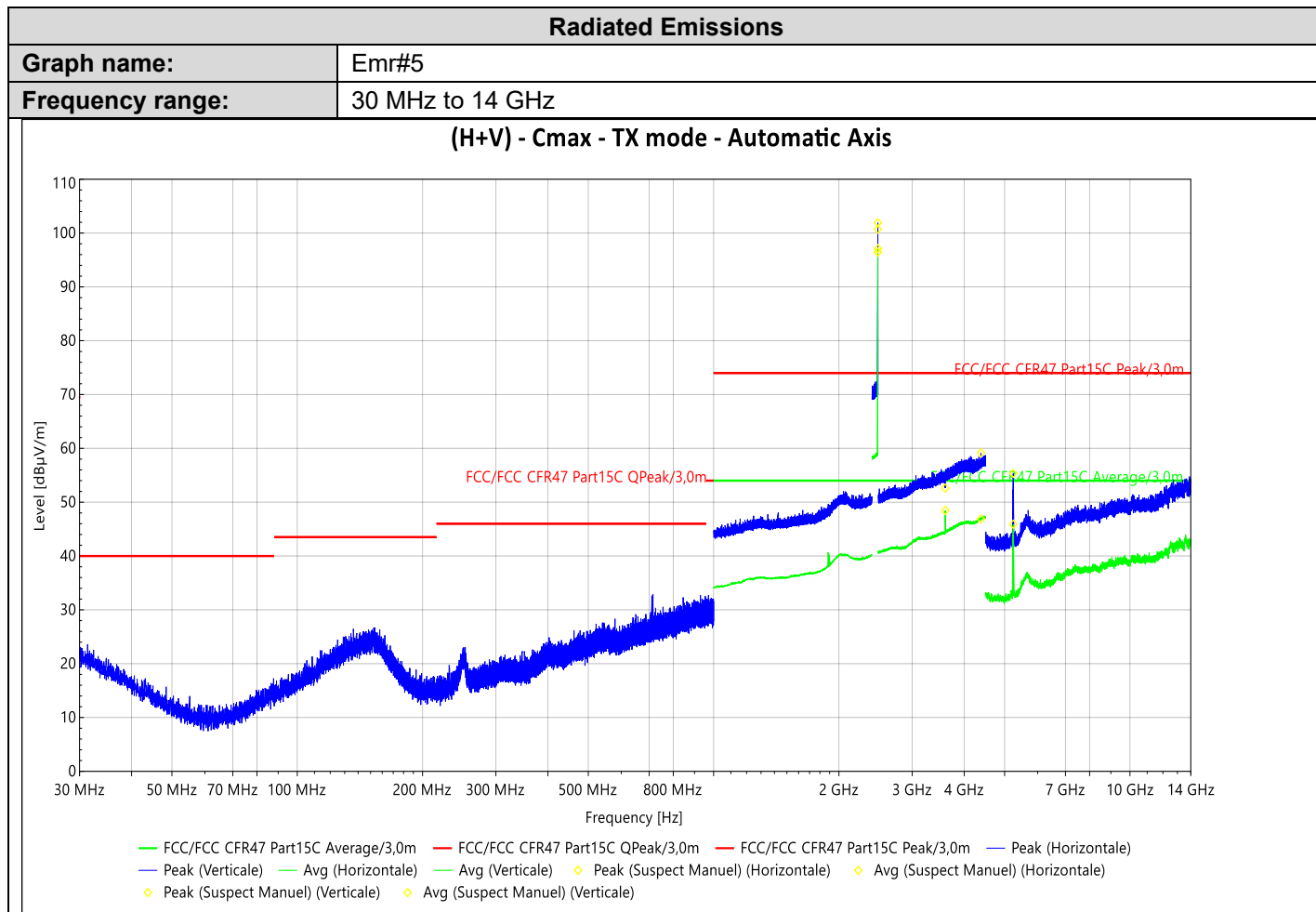


Pre-Characterization:

Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
2.4403305 GHz*	100.93	/	96.68	/	154	H	34.36
2.44045575 GHz*	101.45	/	96.00	/	85	V	34.36
5.23245 GHz	56.21	74.00	46.43	54.00	86	V	-20.21
3.599834399 GHz	53.22	74.00	48.10	54.00	0	H	37.65
4.4673327 GHz	58.79	74.00	47.41	54.00	85	V	40.34

*Carrier frequency

No significant frequency observed



Pre-Characterization:

Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
2.48028525 GHz*	100.72	/	97.10	/	156	H	34.57
2.480494 GHz*	101.91	/	96.45	/	194	H	34.57
5.2467 GHz	55.35	74.00	45.90	54.00	0	H	-20.17
3.599834399 GHz	52.62	74.00	48.46	54.00	167	H	37.65
4.3866727 GHz	59.15	74.00	46.88	54.00	19	V	40.20

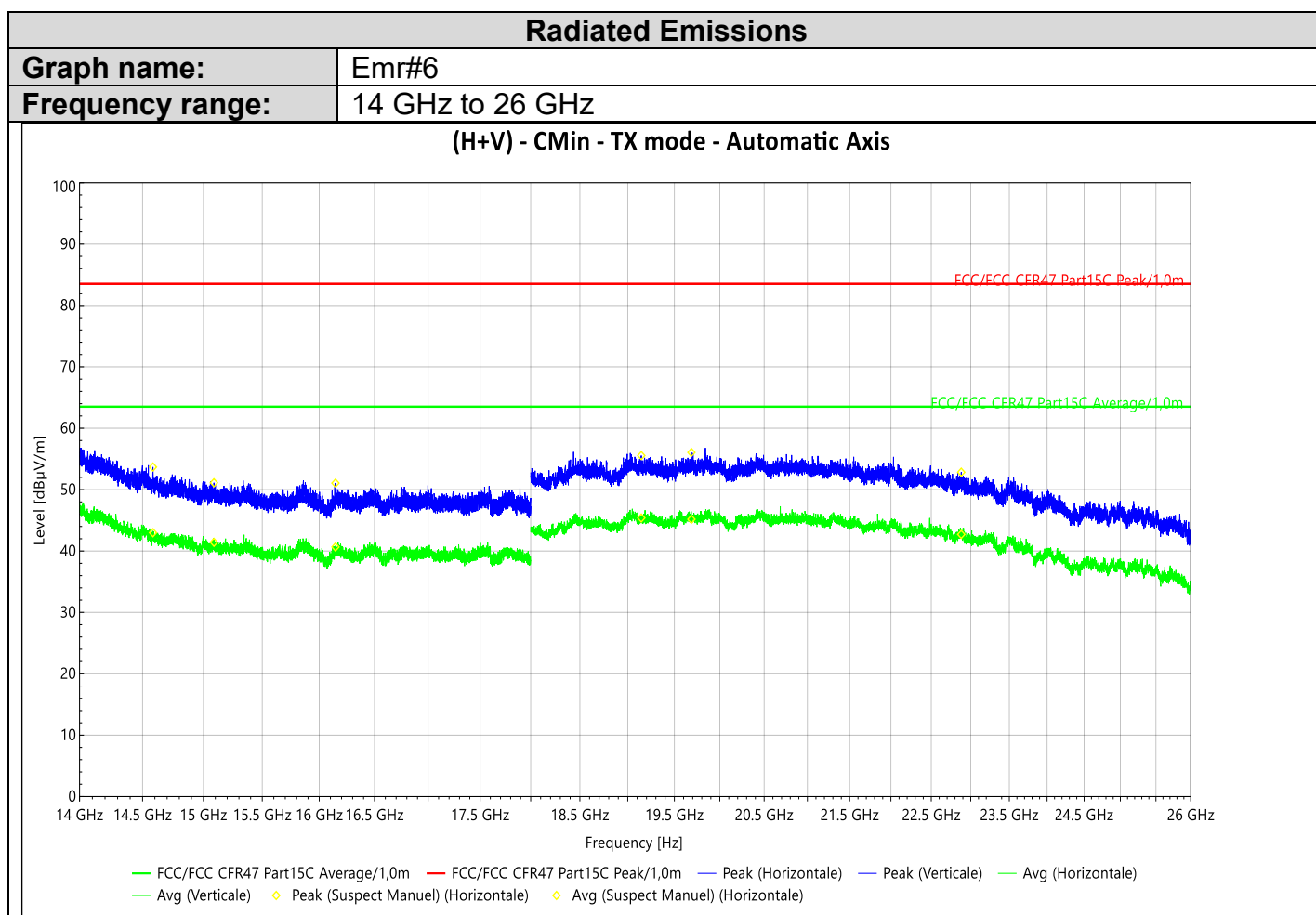
*Carrier frequency

No significant frequency observed

8.6.3. 14GHz to 2G5Hz

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



Pre-Characterization:

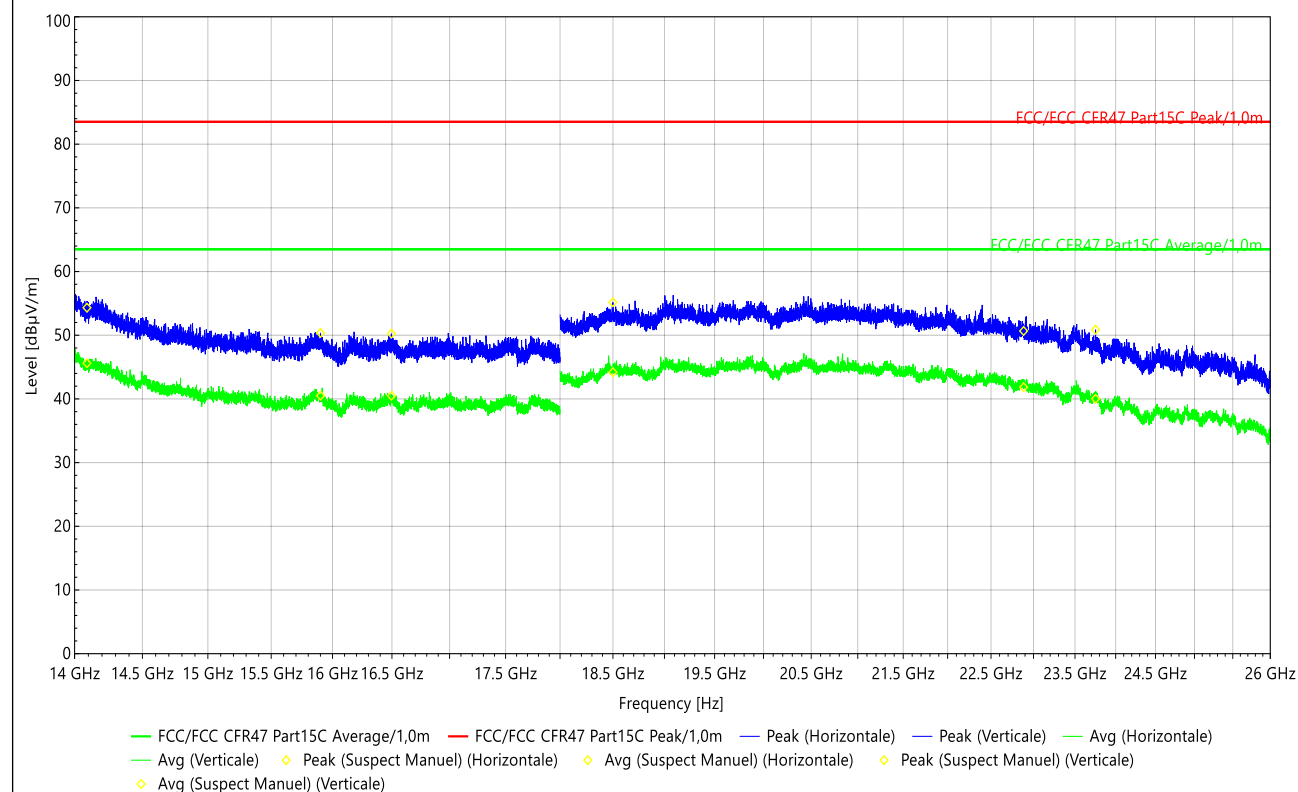
Frequency	PK Level (dBμV/m)	Lim.PK (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Angle (°)	Polar.	Correct. (dB)
14.5845 GHz	53.68	83.50	42.98	63.50	11	H	-0.62
15.088 GHz	51.12	83.50	41.42	63.50	119	H	-2.36
16.145 GHz	51.06	83.50	40.66	63.50	113	H	-4.22
19.144 GHz	55.55	83.50	45.38	63.50	177	H	1.39
19.686 GHz	56.06	83.50	45.17	63.50	270	H	1.49
22.879 GHz	52.84	83.50	42.70	63.50	321	H	0.44

No significant frequency observed

Radiated Emissions

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

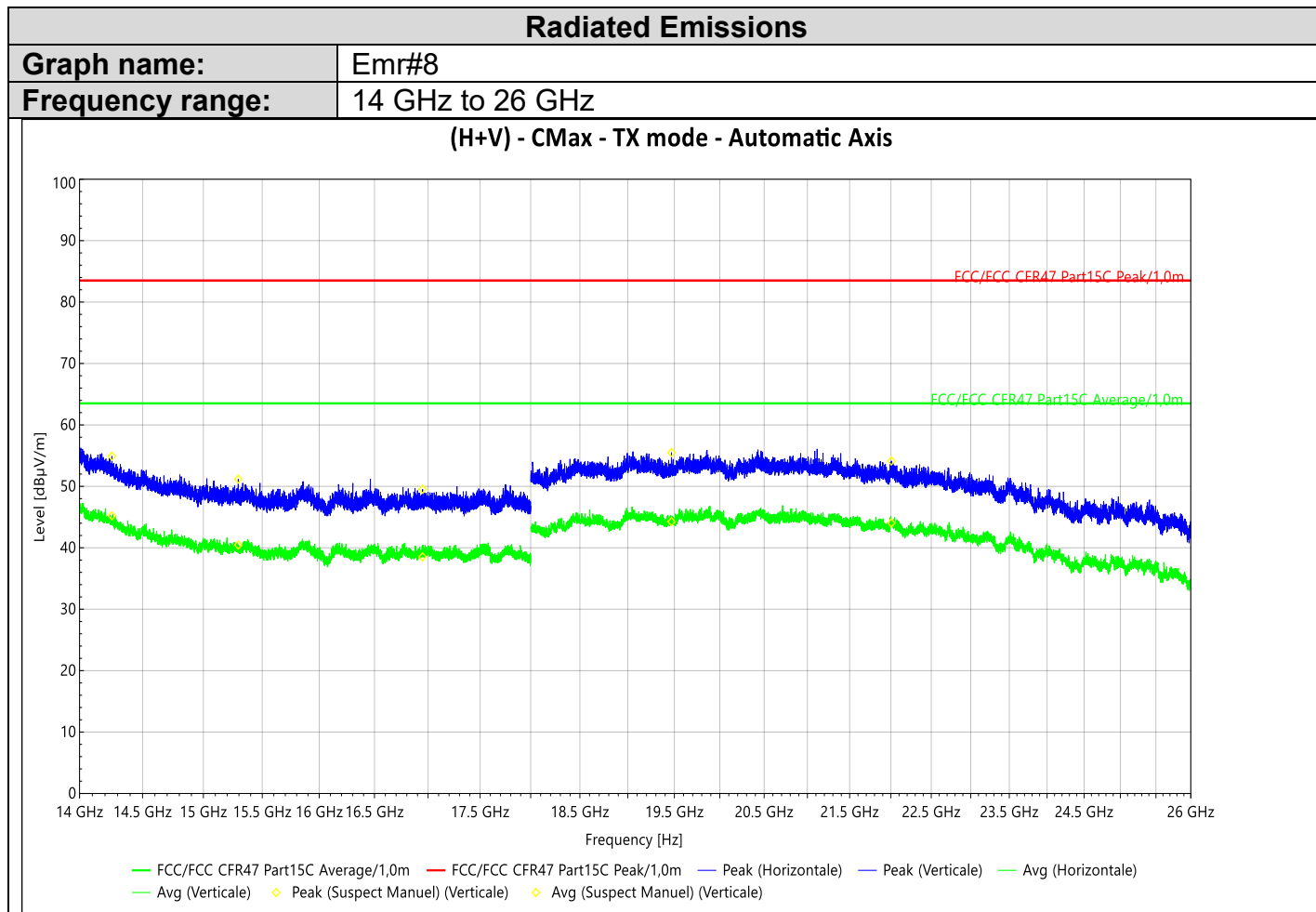
(H+V) - CMid - TX mode - Automatic Axis



Pre-Characterization:

Frequency	PK Level (dBμV/m)	Lim.PK (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Angle (°)	Polar.	Correct. (dB)
14.09 GHz	54.32	83.50	45.60	63.50	222	H	3.03
15.9005 GHz	50.36	83.50	40.52	63.50	124	H	-4.35
16.4955 GHz	50.24	83.50	40.50	63.50	256	H	-4.85
18.5 GHz	55.17	83.50	44.19	63.50	177	V	1.23
22.883 GHz	50.67	83.50	41.83	63.50	271	V	0.43
23.752 GHz	50.87	83.50	40.02	63.50	157	V	0.57

No significant frequency observed

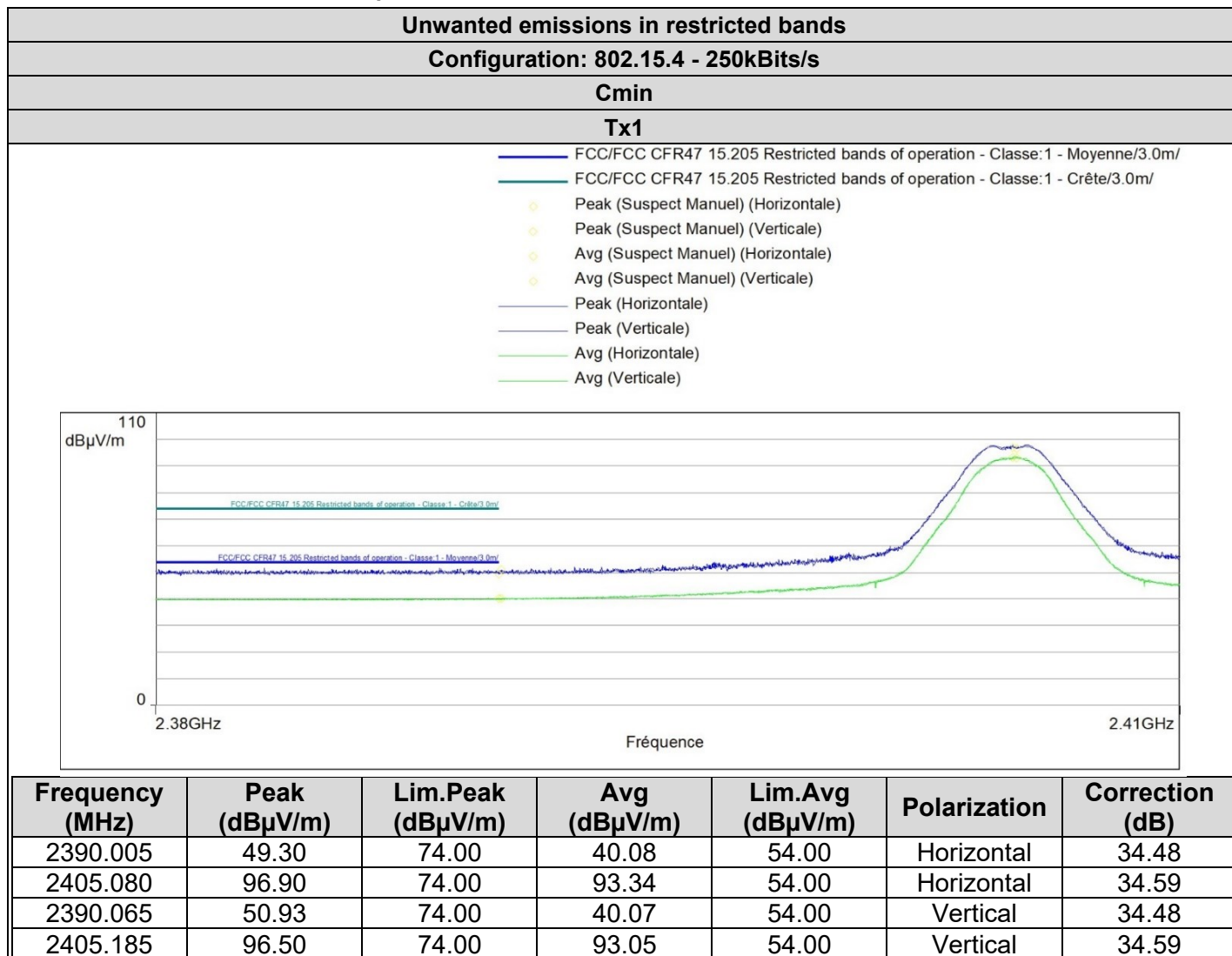


Pre-Characterization:

Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
14.2545 GHz	54.91	83.50	45.21	63.50	97	V	1.54
15.294 GHz	51.17	83.50	40.45	63.50	221	V	-3.82
16.948 GHz	49.54	83.50	38.52	63.50	325	V	-5.10
19.468 GHz	55.51	83.50	44.25	63.50	58	V	0.31
22.005 GHz	54.14	83.50	44.03	63.50	275	V	-0.25

No significant frequency observed

8.6.4. Restricted bands of operation



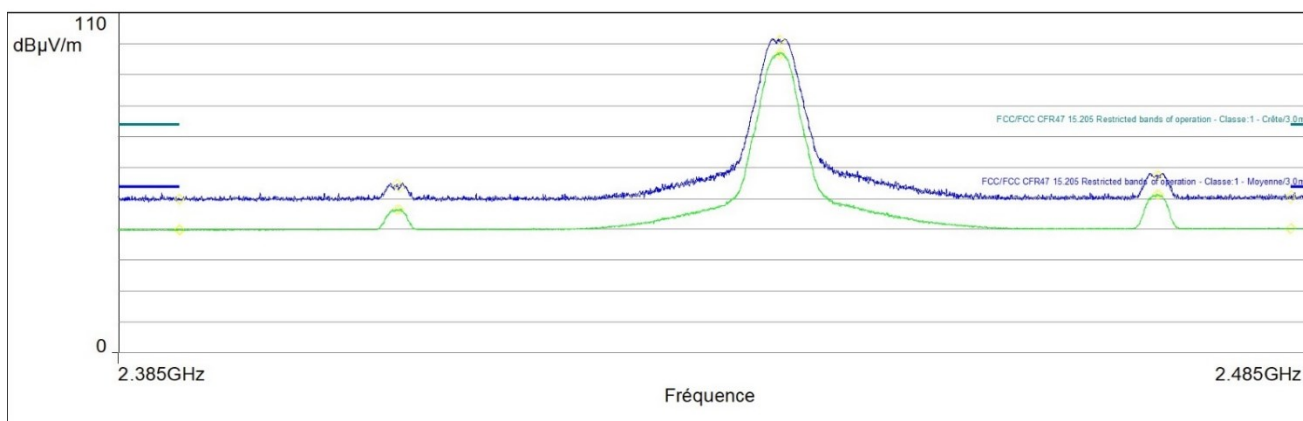
Unwanted emissions in restricted bands

Configuration: 802.15.4 - 250kBits/s

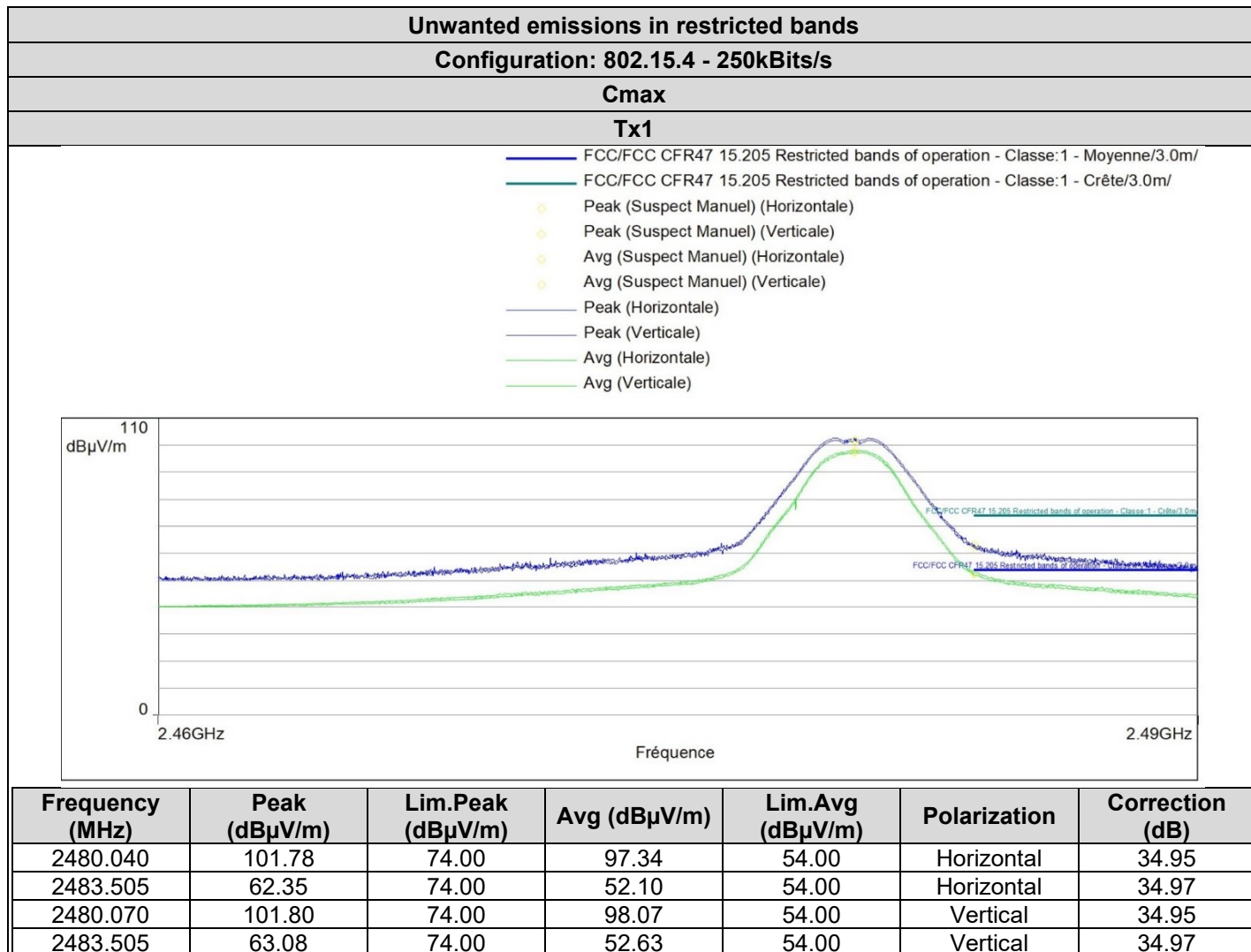
Cmid

Tx1

- FCC/FCC CFR47 15.205 Restricted bands of operation - Classe:1 - Moyenne/3.0m/
- FCC/FCC CFR47 15.205 Restricted bands of operation - Classe:1 - Crête/3.0m/
- Peak (Suspect Manuel) (Horizontale)
- Peak (Suspect Manuel) (Verticale)
- Avg (Suspect Manuel) (Horizontale)
- Avg (Suspect Manuel) (Verticale)
- Peak (Horizontale)
- Peak (Verticale)
- Avg (Horizontale)
- Avg (Verticale)



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
2390.000	49.82	74.00	39.79	54.00	Horizontal	34.48
2408.050	54.78	74.00	46.45	54.00	Horizontal	34.61
2440.050	101.40	74.00	96.36	54.00	Horizontal	34.75
2472.050	57.49	74.00	51.20	54.00	Horizontal	34.90
2483.500	49.86	74.00	40.20	54.00	Horizontal	34.97
2390.000	49.38	74.00	39.73	54.00	Vertical	34.48
2408.250	53.64	74.00	46.39	54.00	Vertical	34.61
2440.150	101.01	74.00	97.13	54.00	Vertical	34.75
2472.250	57.20	74.00	51.11	54.00	Vertical	34.90
2483.550	50.93	74.00	40.31	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

<i>Kind of measurement</i>	<i>Wide uncertainty laboratory</i>
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.