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Bluetooth Low Energy Template: Release October 22nd, 2022

TEST REPORT

N°: 17465394-785131-B (FILE#3641422)

Version: 01

Subject

Radio spectrum matters
tests according to standards:
47 CFR Part 15.247 & RSS-247 Issue 2 & RSS-Gen Issue 5

Issued to

STMICROELECTRONICS (GRENOBLE 2) SAS
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38000 - GRENOBLE
France

Apparatus under test

- ☞ Product
- ☞ Trade mark
- ☞ Manufacturer
- ☞ Model under test
- ☞ Serial number
- ☞ FCC ID
- ☞ IC

Bluetooth Low Energy module
STMICROELECTRONICS
STMICROELECTRONICS
STM32WB1MMC
Sample 1; Sample 3
YCP-32WB1MMCH01
8976A-32WB1MMCH01

Conclusion

See Test Program chapter

Test date

June 19, 2023 to June 20, 2023

Test location

Moirans

FCC Test site

FR0008 - 197516

ISED Test site

FR0008 - 6500A

Sample receipt date

November 24, 2022

Composition of document

57 pages

Document issued on

October 12, 2023

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PUBLICATION HISTORY

Version	Date	Author	Modification
01	October 12, 2023	Majid MOURZAGH	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
- RSS 247 Issue 2
- RSS Gen Issue 5
- KDB 558074 D01 DTS Meas Guidance v05r02 [fb](#)
- ANSI C63.10-2013

Radio requirement:

Clause (47CFR Part 15.247 & RSS-247 Issue 2 & RSS-Gen Issue 5) Test Description	Test result - Comments
Occupied Bandwidth	☒ PASS ☐ FAIL ☐ NA ☐ NP(1)
6dB Bandwidth	☒ PASS ☐ FAIL ☐ NA() ☐ NP(1)
Duty Cycle	☐ PASS ☐ FAIL ☒ NA ☐ NP(1)
Maximum Conducted Output Power	☒ PASS ☐ FAIL ☐ NA ☐ NP(1)
Power Spectral Density	☒ PASS ☐ FAIL ☐ NA ☐ NP(1)
Conducted Spurious Emission at the Band Edge	☒ PASS ☐ FAIL ☐ NA() ☐ NP(1)
Unwanted Emissions into Non-Restricted Frequency Bands	☒ PASS ☐ FAIL ☐ NA() ☐ NP(1)
AC Power Line Conducted Emission	☒ PASS ☐ FAIL ☐ NA(2) ☐ NP(1)
Unwanted Emissions into Restricted Frequency Bands	☒ PASS ☐ FAIL ☐ NA ☐ NP(1)
Receiver Radiated emissions	☐ PASS ☐ FAIL ☒ NA ☐ NP(1)
This table is a summary of test report, see conclusion of each clause of this test report for detail.	

(1): Limited program

(2): EUT not directly or indirectly connected to the AC Power Public Network

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):

STMICROELECTRONICS STM32WB1MMC

Serial Number: Sample 1



Equipment Under Test

Power supply:

During all the tests, EUT is supplied by V_{nom} : 3VDC

For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply1	☐ AC ☒ DC ☐ Battery	3Vdc	-	-

Voltage table used (for Power Line Conducted Emissions):

Type	Measurement performed:	
☒ AC (power supply, typically)	☒ 120VAC/60Hz	☒ 240VAC/50Hz

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
2	DC	1.5	☐	☐	☒	Used only for all tests in the report



Auxiliary equipment used during test:

Type	Reference	Sn	Comments
LAPTOP	Lenovo	LP2	-
AC power Source	Keysight AC6803A	-	LCIE n° A7043062-

Equipment information:

Bluetooth LE Type:	☐ BLE	☐ v4.1	☐ v4.2	☒ v5.4
Frequency band:	[2400 – 2483.5] MHz			
Spectrum Modulation:	☒ DSSS (Tested like it)			
Number of Channel:	40			
Spacing channel:	2MHz			
Channel bandwidth:	☒ 1MHz		☒ 2MHz	
Antenna Type:	☒ Integral	☐ External		☐ Dedicated
Antenna connector:	☐ Yes	☐ No		☒ Temporary for test
Transmit chains:	1			
	Single antenna			
	Gain: 1.9dBi			
Antenna requirements §15.203	The transmitter uses an integral antenna and it permanently connected			
Type of equipment:	☒ Stand-alone	☐ Plug-in		☐ Combined
Duty cycle:	☒ Continuous duty	☐ Intermittent duty		☐ 100% duty
Equipment type:	☒ Production model		☐ Pre-production model	
Operating temperature range:	Tmin:	☐ -20°C		☐ 0°C
	Tnom:	20°C		
	Tmax:	☐ 35°C		☐ 55°C
Type of power source:	☐ AC power supply		☒ DC power supply	
Operating voltage range:	Vnom:		☐ 230V/50Hz	
			☒ 3Vdc	

CHANNEL PLAN			
Channel	Frequency (MHz)	Channel	Frequency (MHz)
Cmin: 0	2402	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
Cmid: 19	2440	Cmax: 39	2480

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

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
Test mode 2	Permanent reception
Test	Running mode
Occupied Bandwidth	☒ Test mode 1 (1) ☐ Alternative test mode()
6dB Bandwidth	☒ Test mode 1 (1) ☐ Alternative test mode()
Duty Cycle	☒ Test mode 1 (1) ☐ Alternative test mode()
Maximum Conducted Output Power	☒ Test mode 1 (1) ☐ Alternative test mode()
Power Spectral Density	☒ Test mode 1 (1) ☐ Alternative test mode()
Conducted Spurious Emission at the Band Edge	☒ Test mode 1 (1) ☐ Alternative test mode()
Unwanted Emissions into Non-Restricted Frequency Bands	☒ Test mode 1 (1) ☐ Alternative test mode()
AC Power Line Conducted Emission	☒ Test mode 1 (1) ☐ Alternative test mode()
Unwanted Emissions into Restricted Frequency Bands	☒ Test mode 1 (1) ☐ Alternative test mode()

(1) Commands with the specific test software "STM32CubeMonitor RF" are used to set the product:

(2) Hardware information		
Software (if applicable): STM32CubeMonitor RF	V. :	2.8.1

The EUT is set in the following modes during tests:

- Permanent emission with modulation on a fixed channel in the data rate that produced the highest power
- Permanent reception

2.3. EQUIPMENT LABELLING

None

2.4. EQUIPMENT MODIFICATION

☒ None ☐ Modification:

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

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 12+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.

3. OCCUPIED BANDWIDTH

3.1. TEST CONDITIONS

Test performed by : Majid MOURZAGH
Date of test : June 20, 2023
Ambient temperature : 22 °C
Relative humidity : 39 %

3.2. TEST SETUP

- The Equipment under Test is installed:

- ☐ On a table
- ☒ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

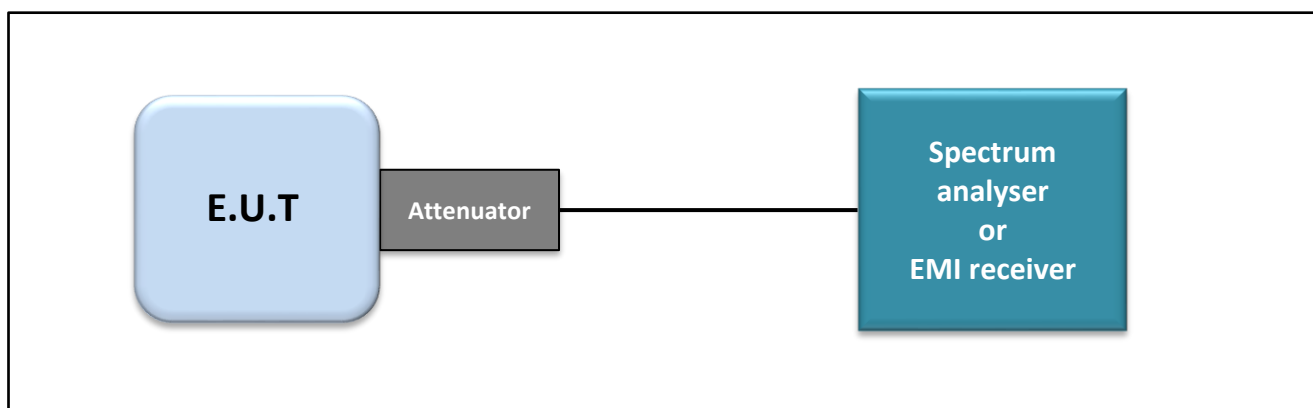
- ☒ Conducted Method
- ☐ Radiated Method

- Test Procedure:

- ☐ RSS-Gen Issue 5 § 6.7
- ☒ ANSI C63.10 § 6.9.2

Measurement Procedure:

- a) RBW shall be in the range of 1% to 5% of the anticipated occupied bandwidth
- b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW
- c) SPAN = Capture all products of the modulation process
- d) Detector = Peak.
- e) Trace mode = max hold.
- f) Sweep = auto couple.
- g) Allow the trace to stabilize.
- h) OBW 99% function of spectrum analyzer used



Test set up of Occupied Bandwidth



Photograph for Occupied bandwidth

3.3. LIMIT

None

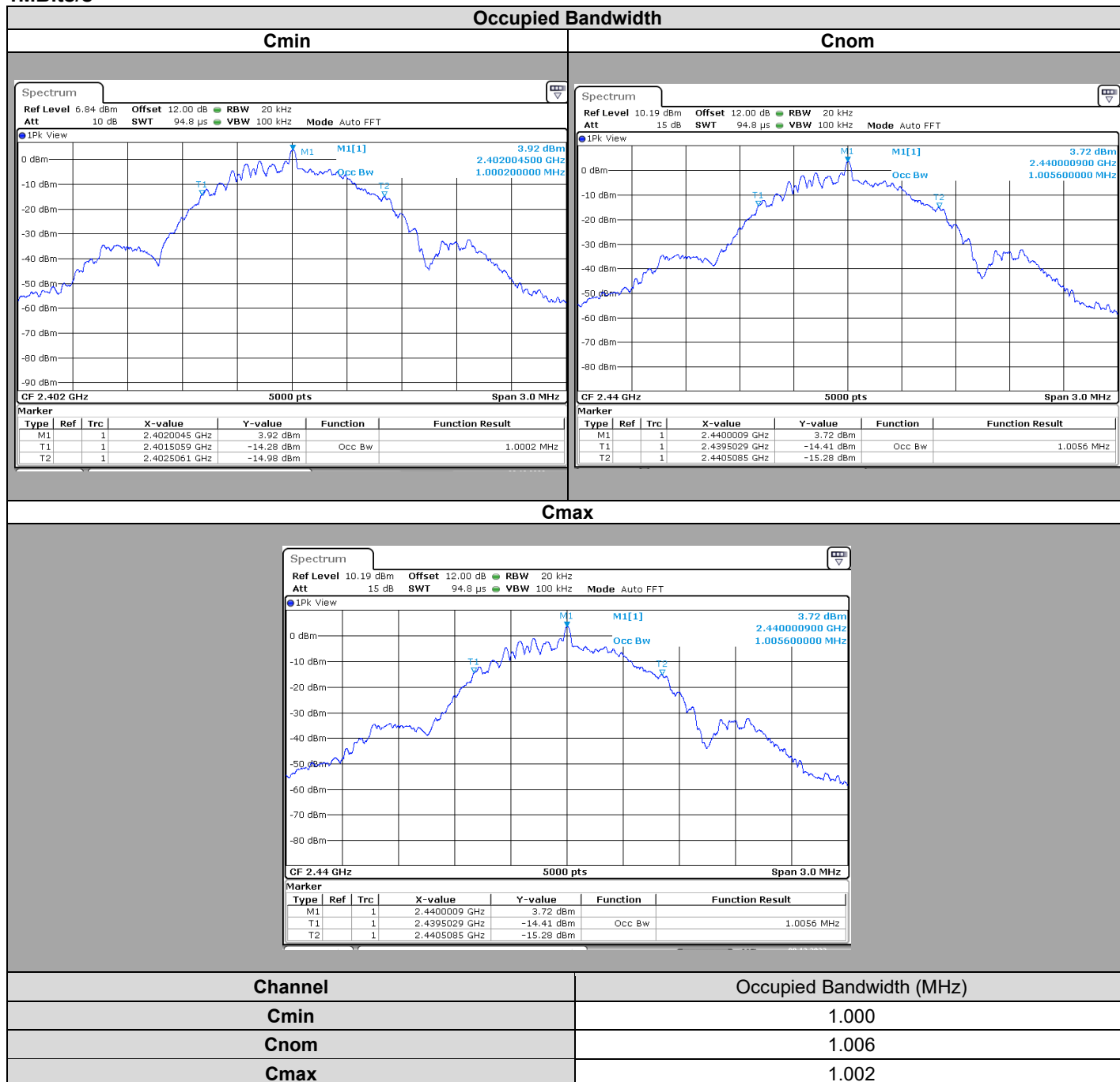
3.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
Power supply DC	METRIX	AX503	A7042307		
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	12/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	02/23
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	03/23

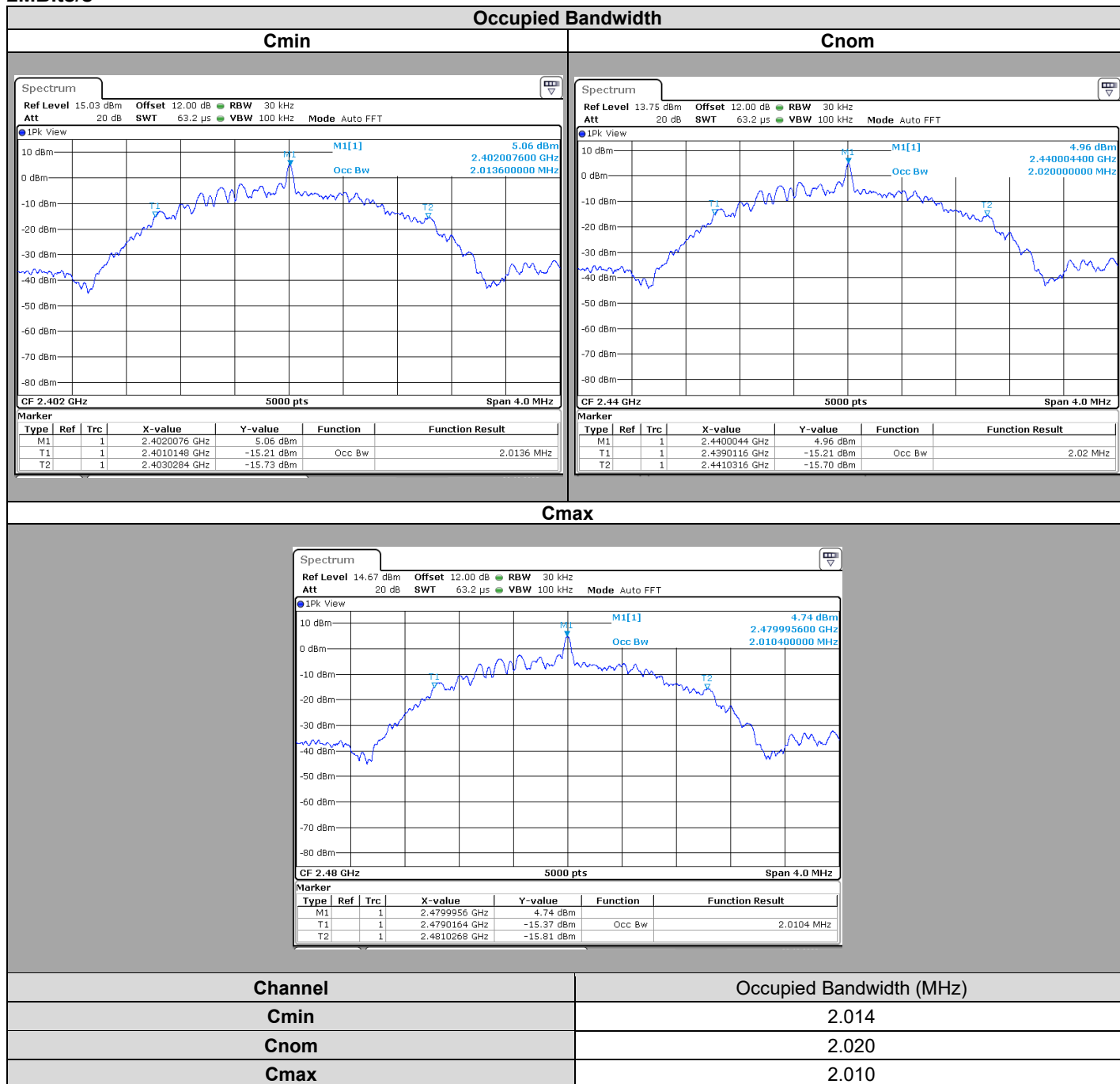
Note: In our quality system, the test equipment calibration due is more & less 2 months

3.5. RESULTS

1Mbits/s



2Mbits/s



3.6. CONCLUSION

Occupied Channel Bandwidth measurement performed on the sample of the product **STMICROELECTRONICS STM32WB1MMC**, SN: **Sample 1**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS-GEN ISSUE 5** limits.

4. 6dB EMISSION BANDWIDTH

4.1. TEST CONDITIONS

Test performed by : Majid MOURZAGH
Date of test : June 20, 2023
Ambient temperature : 22 °C
Relative humidity : 39 %

4.2. TEST SETUP

- The Equipment under Test is installed:

- ☐ On a table
- ☒ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

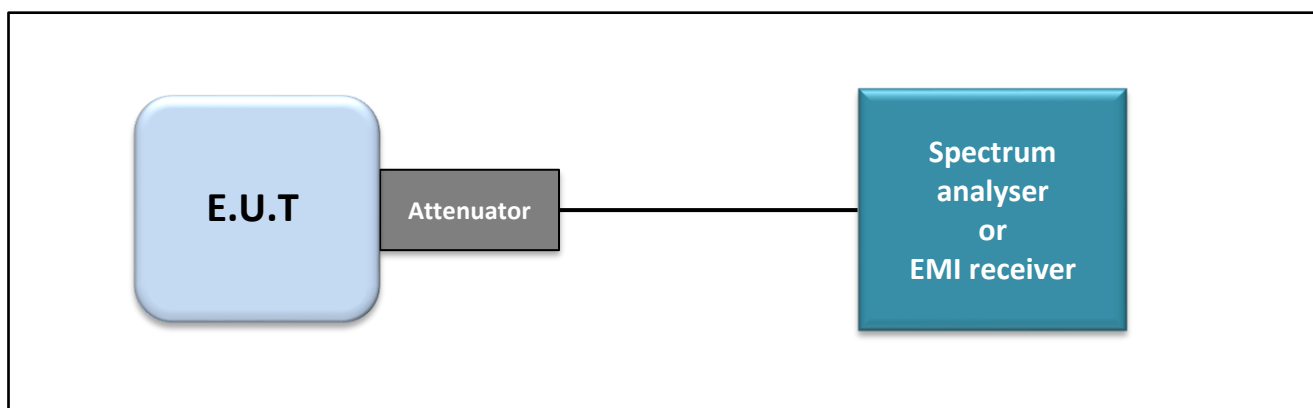
- ☒ Conducted Method
- ☐ Radiated Method

- Test Procedure:

- ☒ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.2

Measurement Procedure:

1. Set resolution bandwidth (RBW) = 100kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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 set up of 6dB Emission Bandwidth



Photograph for 6dB emission bandwidth

4.3. LIMIT

The 6dB bandwidth shall be at least 500kHz

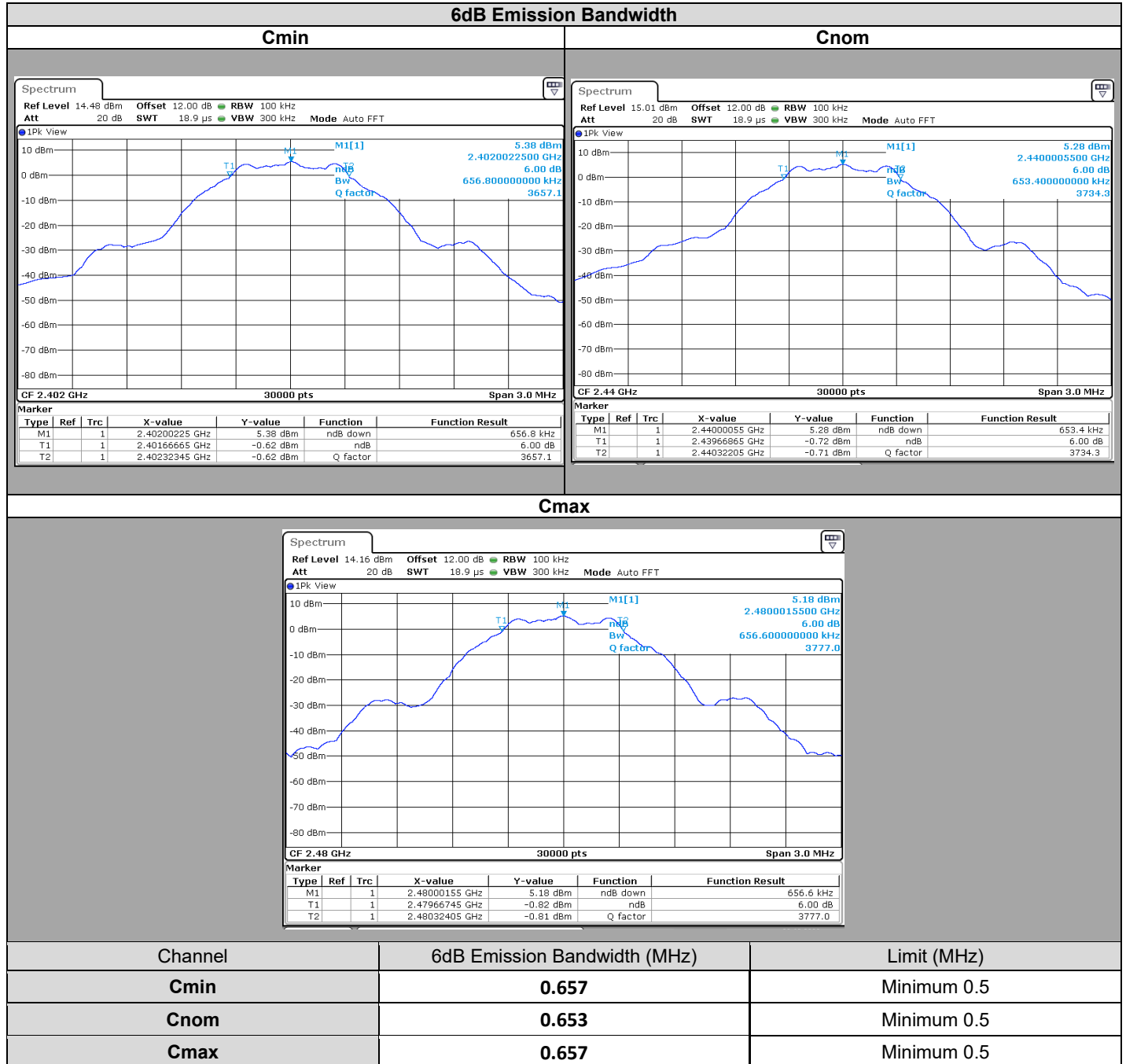
4.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
Power supply DC	METRIX	AX503	A7042307		
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	12/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	02/23
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	03/23

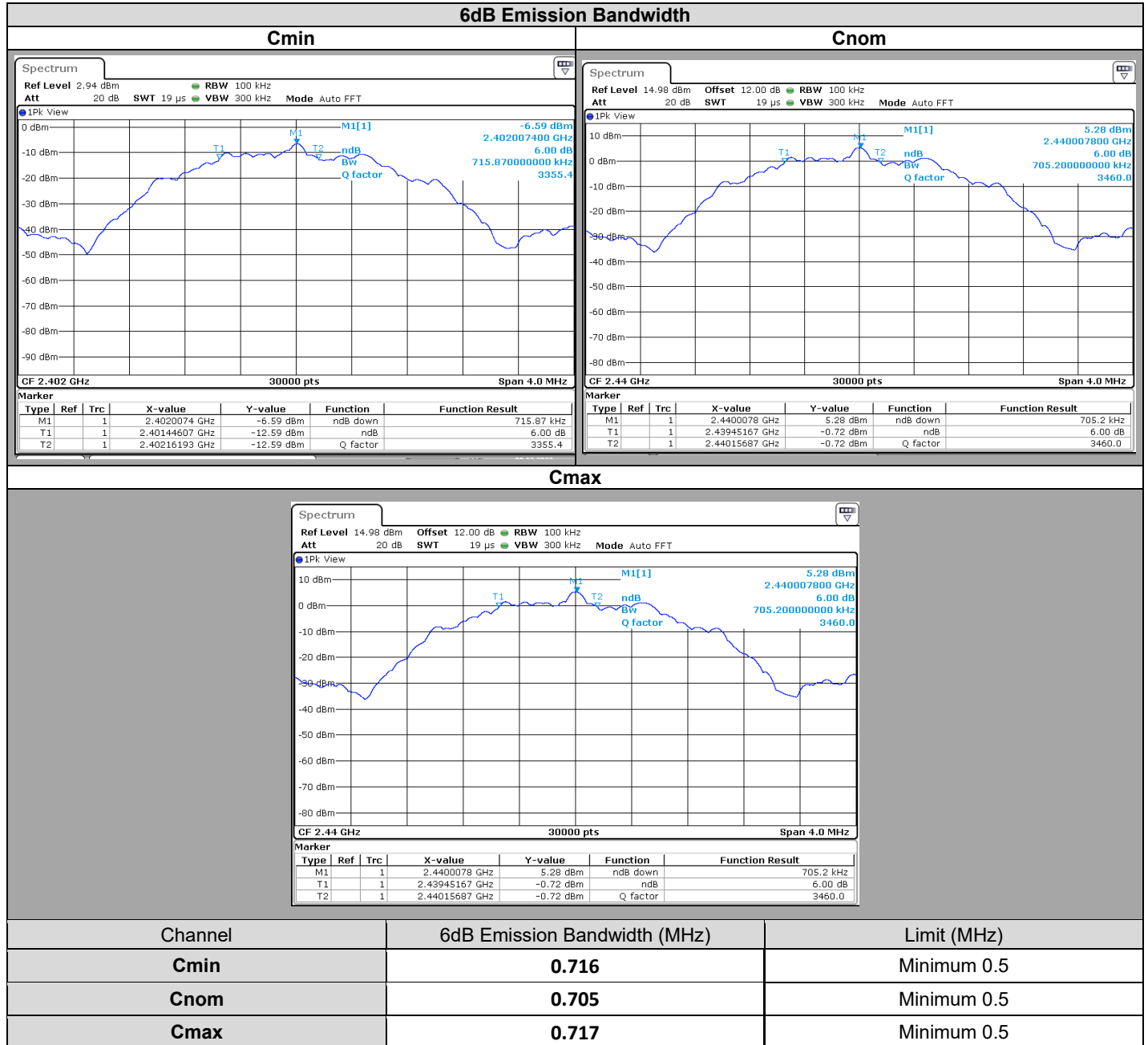
Note: In our quality system, the test equipment calibration due is more & less 2 months

4.5. RESULTS

1Mbits/s



2Mbits/s



4.6. CONCLUSION

6dB Emission Bandwidth measurement performed on the sample of the product **STMICROELECTRONICS STM32WB1MMC**, SN: **Sample 1**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 2** limits.



5. MAXIMUM CONDUCTED OUTPUT POWER

5.1. TEST CONDITIONS

Test performed by : Majid MOURZAGH
Date of test : June 20, 2023
Ambient temperature : 22 °C
Relative humidity : 39 %

5.2. TEST SETUP

- The Equipment under Test is installed:

- ☐ On a table
- ☒ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

- ☒ Conducted Method
- ☐ Radiated Method

- Test Procedure:

- ☒ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.3.1.1

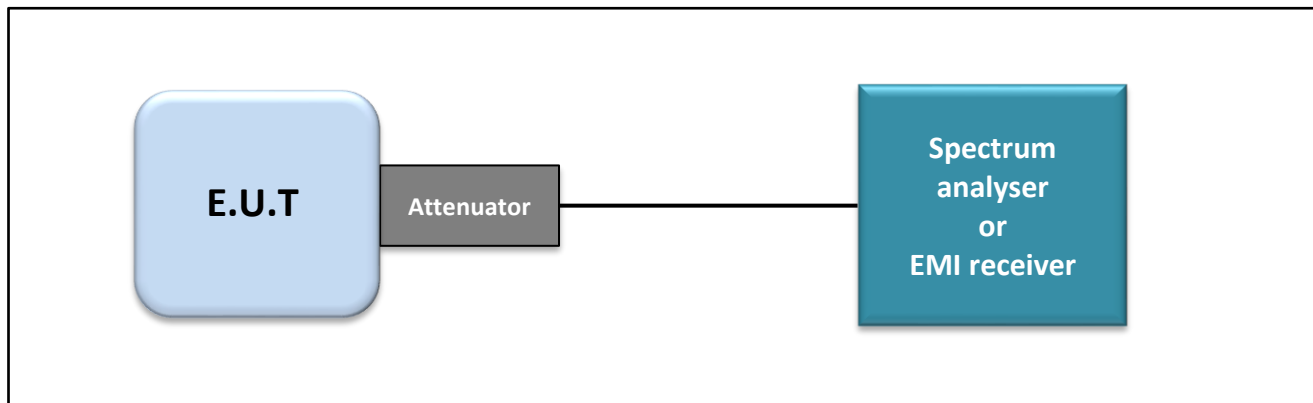
This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- a) Set the RBW $\geq$ DTS bandwidth.
- b) Set VBW $\geq 3 \times$ RBW.
- c) Set span $\geq 3 \times$ RBW
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

- ☐ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.3.1.2

This procedure may be used when the maximum available RBW of the measurement instrument is less than the DTS bandwidth.

- a) Set the RBW = 1 MHz.
- b) Set the VBW $\geq 3 \times$ RBW
- c) Set the span $\geq 1.5 \times$ DTS bandwidth.
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges



Test set up of Maximum Conducted Output Power



Photograph for Maximum Conducted Output Power

5.3. LIMIT

Maximum Conducted Output power:
 2400MHz-2483.5MHz: Shall not exceed 30dBm
 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
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
Power supply DC	METRIX	AX503	A7042307		
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	12/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	02/23
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	03/23

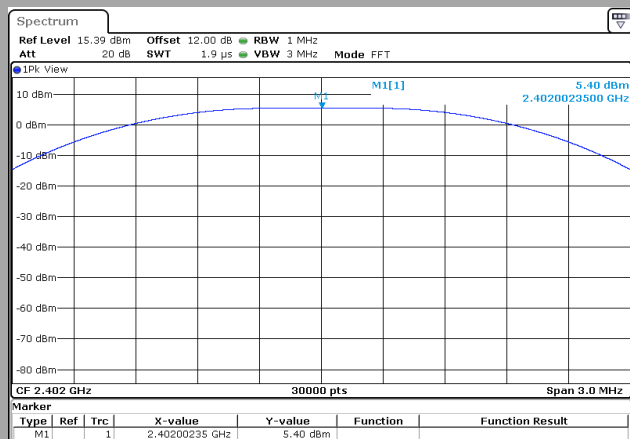
Note: In our quality system, the test equipment calibration due is more & less 2 months

5.5. RESULTS

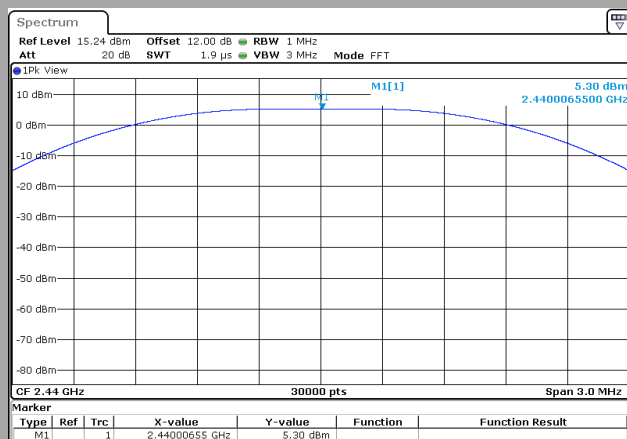
1Mbits/s

Maximum Conducted Output Power

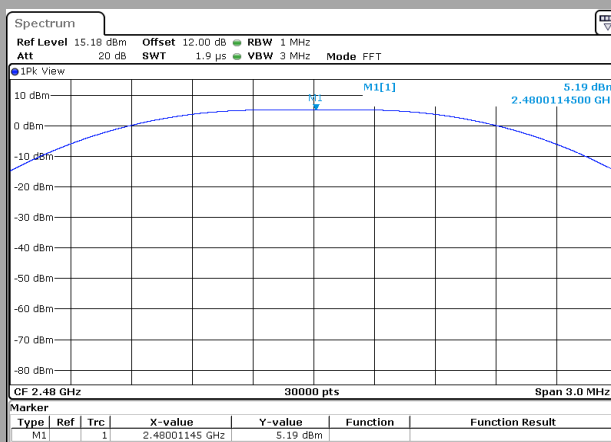
Cmin



Cnom



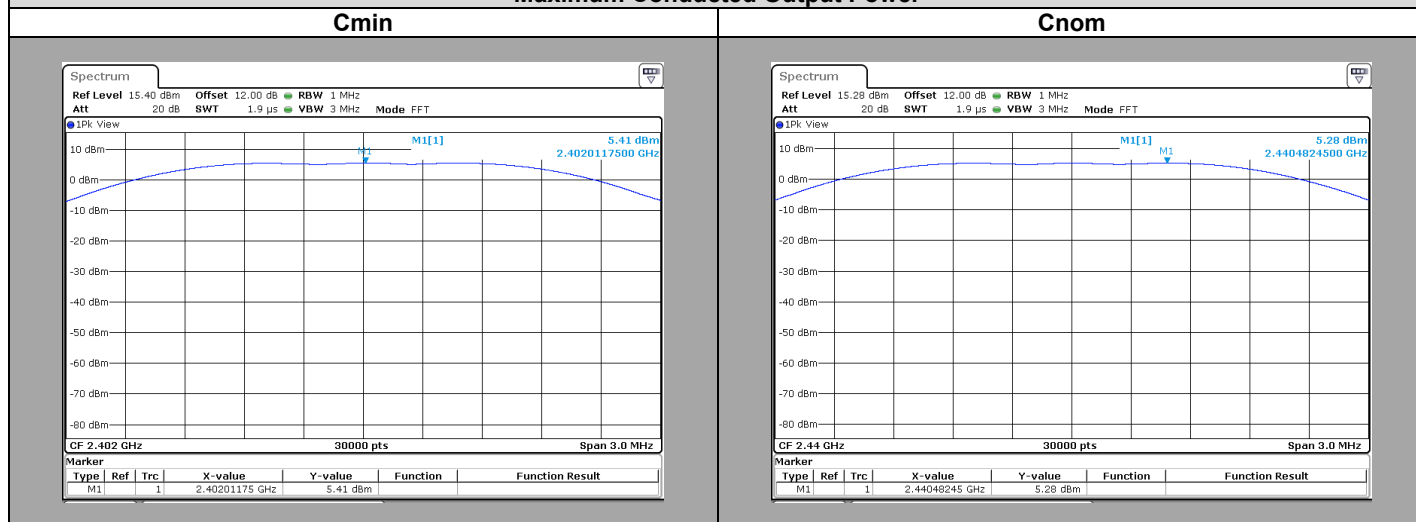
Cmax



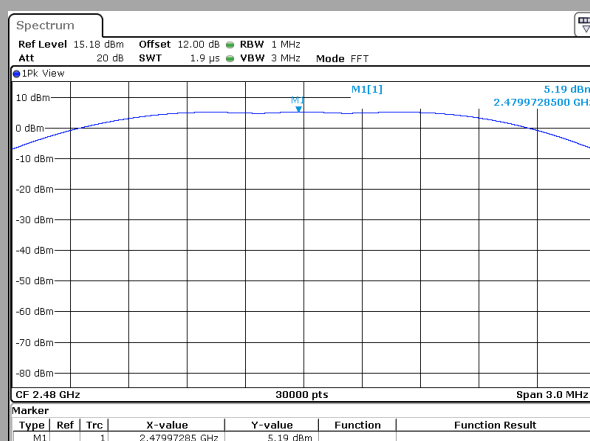
Channel	Offset Cable + Att (dB)	Antenna Gain (dBi)	Maximum Conducted Power (dBm)	Limit (dBm)
Cmin	12	1.9	5.40	30. Reduced by G-6dBi if Antenna Gain above 6dBi
Cnom	12	1.9	5.30	30. Reduced by G-6dBi if Antenna Gain above 6dBi
Cmax	12	1.9	5.19	30. Reduced by G-6dBi if Antenna Gain above 6dBi

2Mbits/s

Maximum Conducted Output Power



Cmax



Channel	Offset Cable + Att (dB)	Antenna Gain (dBi)	Maximum Conducted Power (dBm)	Limit (dBm)
Cmin	12	1.9	5.41	30. Reduced by G-6dBi if Antenna Gain above 6dBi
Cnom	12	1.9	5.28	30. Reduced by G-6dBi if Antenna Gain above 6dBi
Cmax	12	1.9	5.19	30. Reduced by G-6dBi if Antenna Gain above 6dBi

5.6. CONCLUSION

Maximum Conducted Output Power measurement performed on the sample of the product **STMICROELECTRONICS STM32WB1MMC**, SN: **Sample 1**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 2** limits.

6. POWER SPECTRAL DENSITY

6.1. TEST CONDITIONS

Test performed by : Majid MOURZAGH
Date of test : June 20, 2023
Ambient temperature : 22 °C
Relative humidity : 39 %

6.2. TEST SETUP

- The Equipment Under Test is installed:

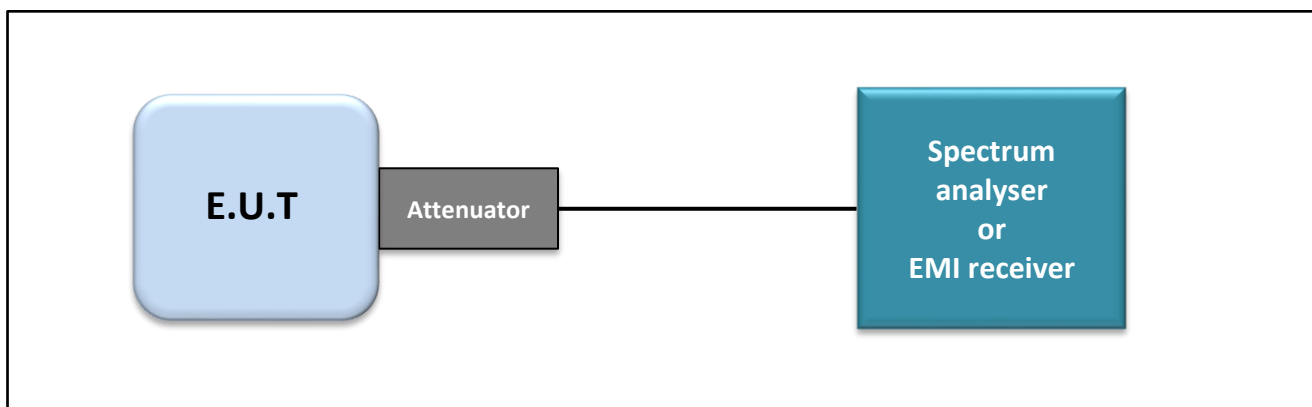
- ☐ On a table
- ☒ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

- ☒ Conducted Method
- ☐ Radiated Method

- Test Procedure:

- ☒ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.4 (Method PKPSD)
 - a) Set analyzer center frequency to DTS channel center frequency.
 - b) Set the span to 1.5 times the DTS bandwidth.
 - c) Set the RBW to: 3 kHz.
 - d) Set the VBW $\geq 3 \times$ RBW.
 - e) Detector = peak.
 - f) Sweep time = auto couple.
 - g) Trace mode = max hold.
 - h) Allow trace to fully stabilize.
 - i) Use the peak marker function to determine the maximum amplitude level within the RBW.
 - j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test set up of Power Spectral Density



Photograph for Power Spectral Density

6.3. LIMIT

Power Spectral Density:
 2400MHz-2483.5MHz: Shall not exceed 8dBm/3kHz
 Limits are reduced by G-6dBi if Overall Antenna Gain above 6dBi

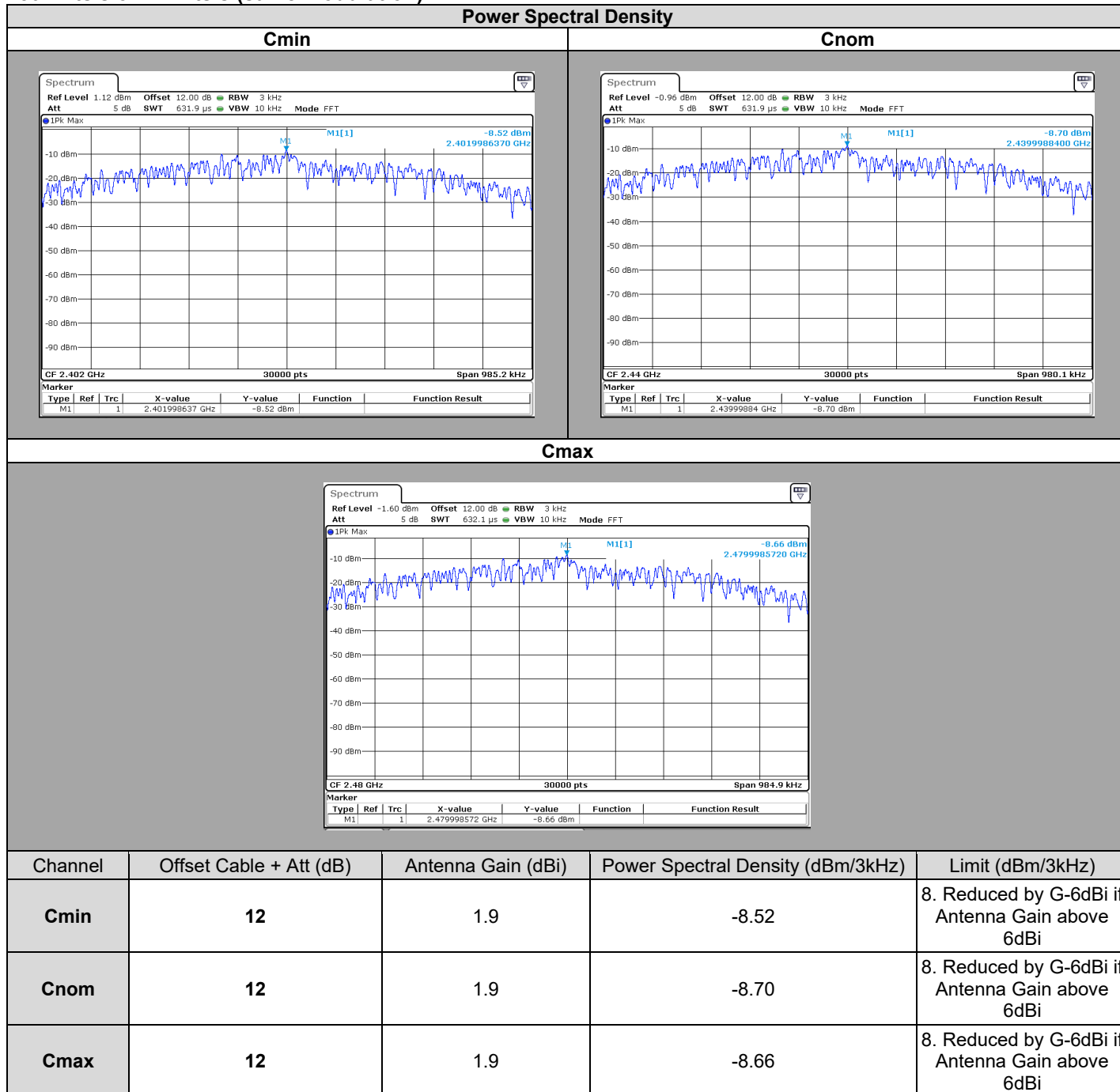
6.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
Power supply DC	METRIX	AX503	A7042307		
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	12/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	02/23
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	03/23

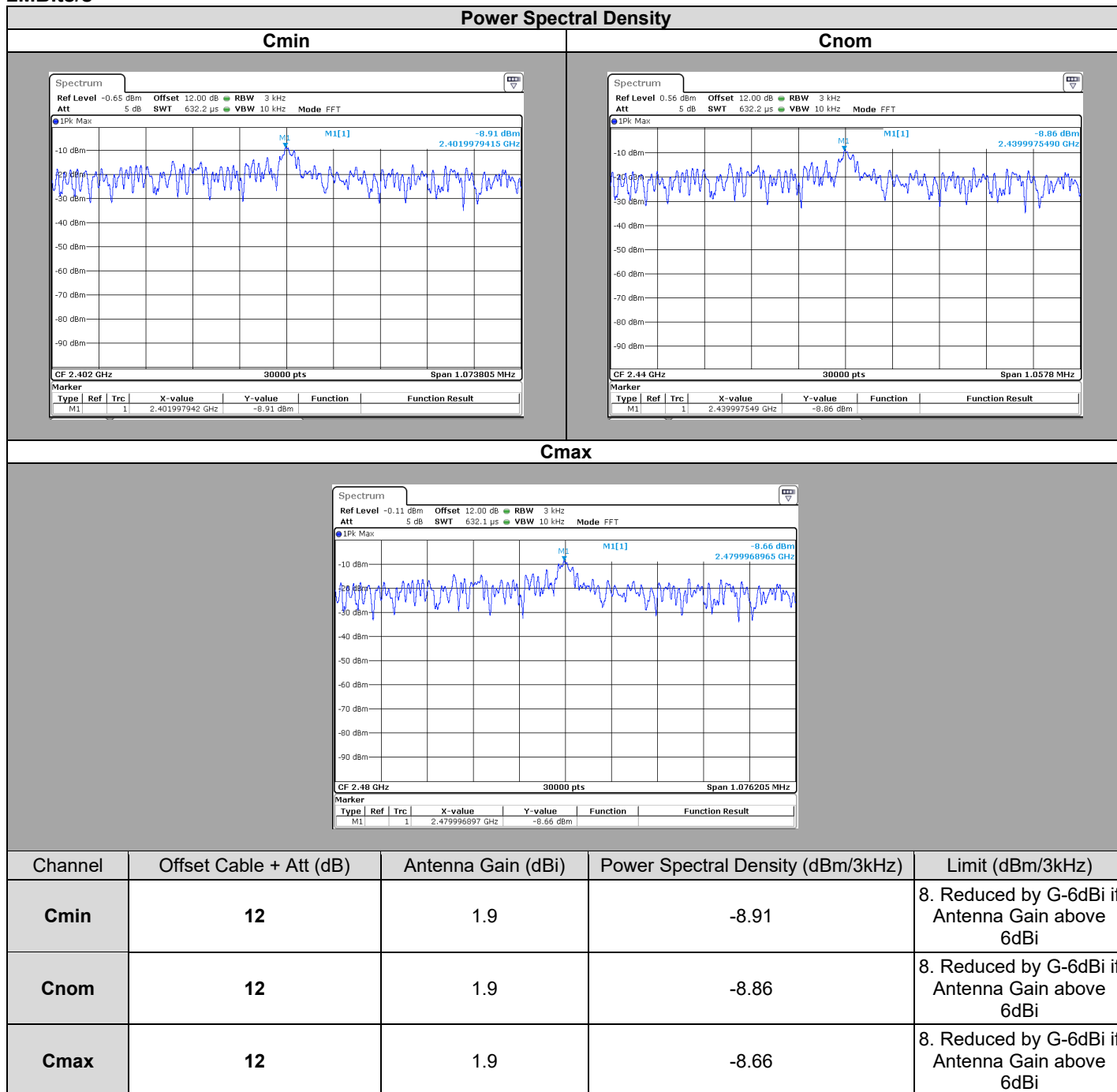
Note: In our quality system, the test equipment calibration due is more & less 2 months

6.5. RESULTS

250kBits/s or 1Mbits/s (same modulation)



2Mbits/s



6.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product **STMICROELECTRONICS STM32WB1MMC**, SN: **Sample 1**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 2** limits.

7. UNWANTED EMISSIONS INTO NON-RESTRICTED FREQUENCY BANDS AT THE BAND EDGE

7.1. TEST CONDITIONS

Test performed by : Majid MOURZAGH
Date of test : June 20, 2023
Ambient temperature : 22 °C
Relative humidity : 39 %

7.2. TEST SETUP

- The Equipment Under Test is installed:

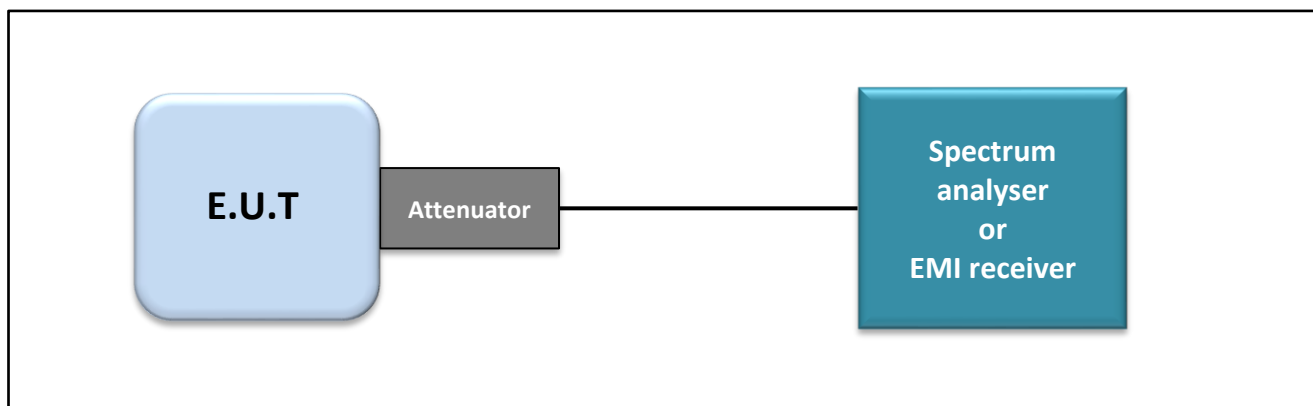
- ☐ On a table
☒ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

- ☒ Conducted Method
☐ Radiated Method

- Test Procedure:

- ☒ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.5



Test set up of Unwanted Emissions into Non-Restricted Frequency Bands at the Band Edge



Photograph for Unwanted Emission into non-restricted frequency bands at the band edge

7.3. LIMIT

All Spurious Emissions must be at least 20dB below the Fundamental Radiator Level at the Band Edge Edge "2400MHz & 2483,5MHz"

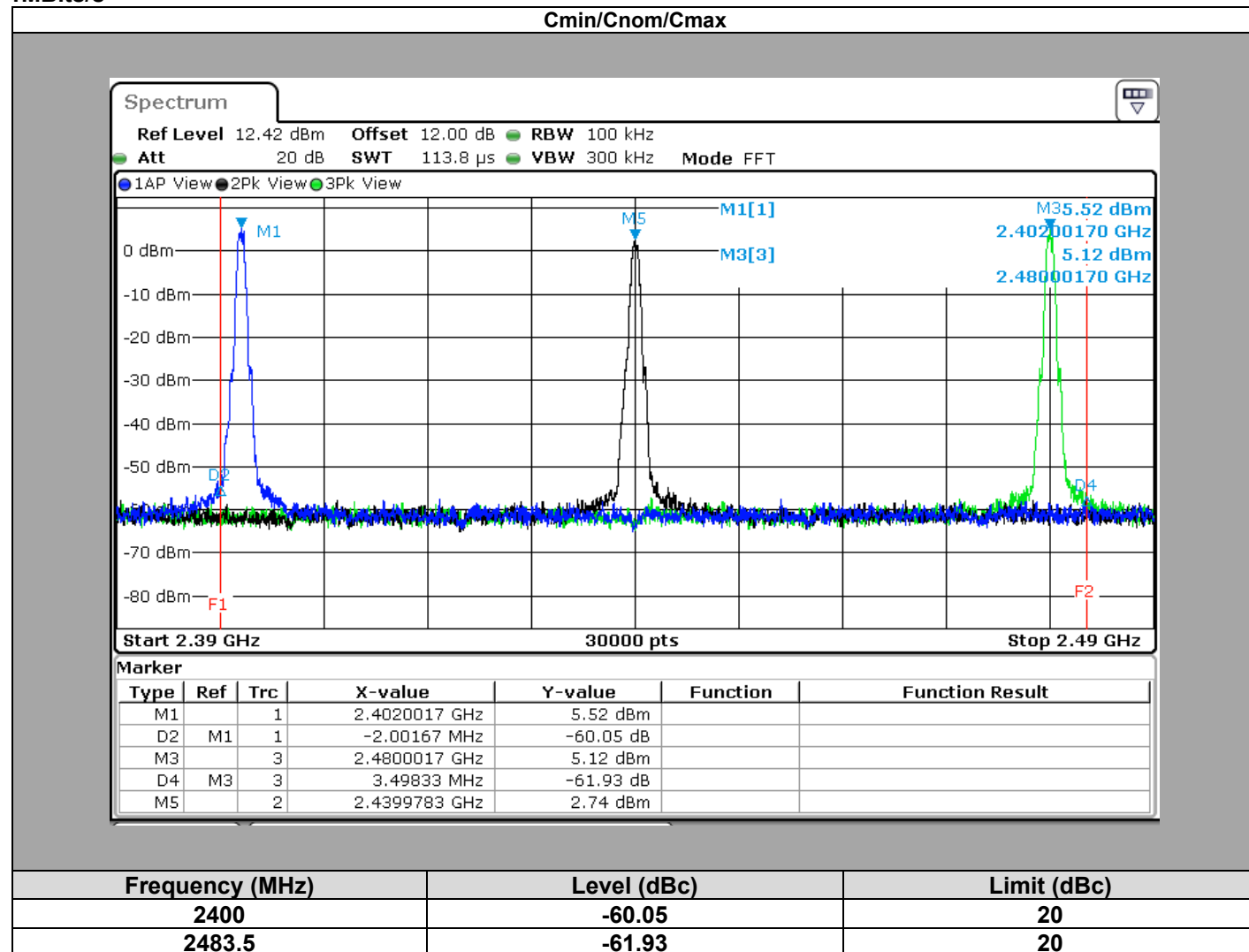
7.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
Power supply DC	METRIX	AX503	A7042307		
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	12/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	02/23
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	03/23

Note: In our quality system, the test equipment calibration due is more & less 2 months

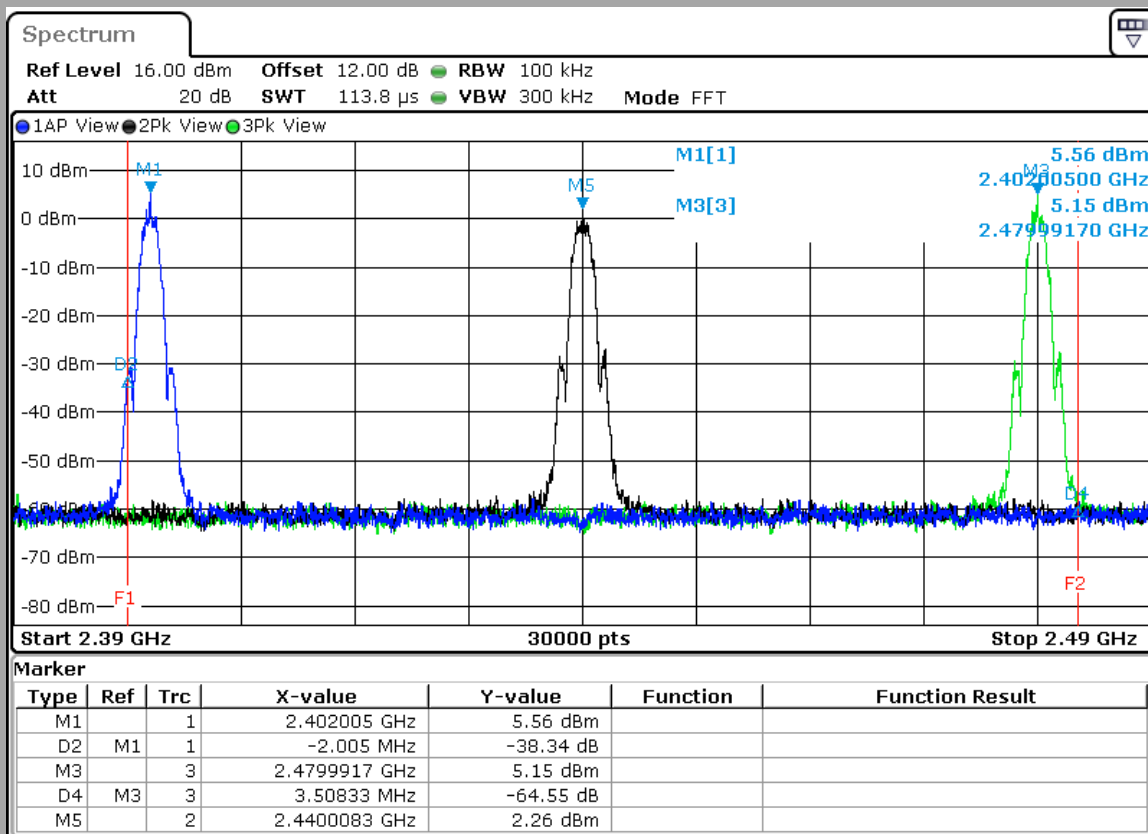
7.5. RESULTS

1Mbits/s



2Mbits/s

Cmin/Cnom/Cmax



Frequency (MHz)	Level (dBc)	Limit (dBc)
2400	-38.34	20
2483.5	-64.55	20

7.6. CONCLUSION

Unwanted Emission into non-restricted frequency bands at the band edge measurement performed on the sample of the product **STMICROELECTRONICS STM32WB1MMC**, SN: **Sample 1**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 2** limits.

8. UNWANTED EMISSIONS INTO NON-RESTRICTED FREQUENCY BANDS

8.1. TEST CONDITIONS

Test performed by : Majid MOURZAGH
Date of test : June 20, 2023
Ambient temperature : 22 °C
Relative humidity : 39 %

8.2. TEST SETUP

- The Equipment under Test is installed:

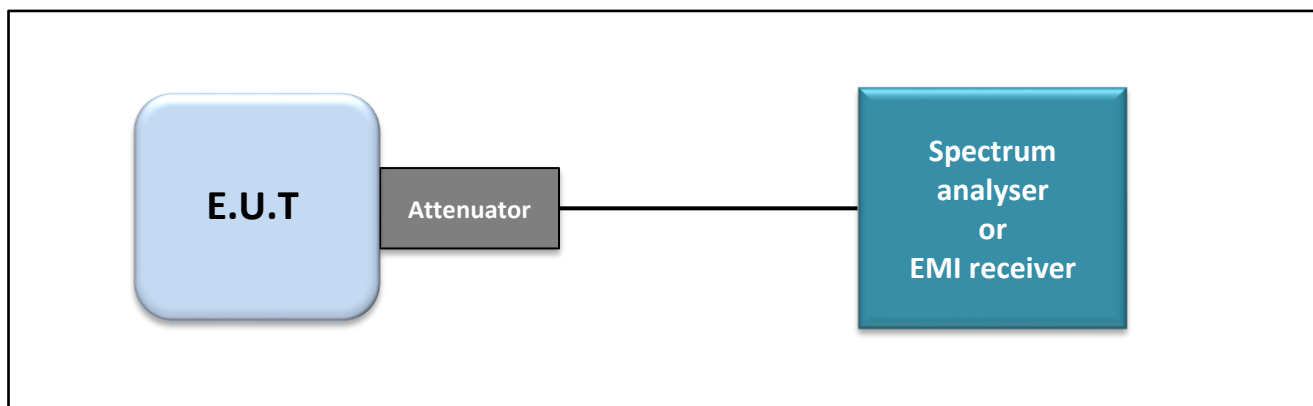
- ☐ On a table
- ☒ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

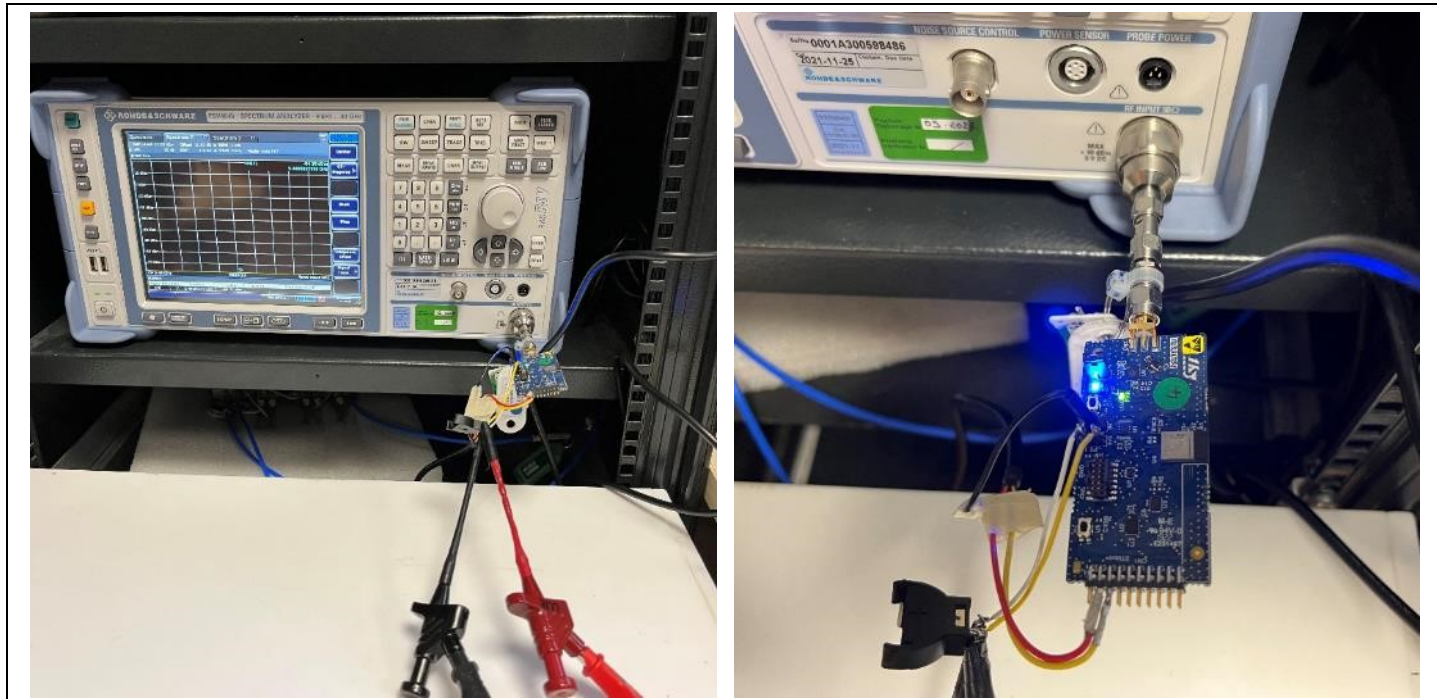
- ☒ Conducted Method
- ☐ Radiated Method

- Test Procedure:

- ☒ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.5



Test set up of Unwanted Emissions into Non-Restricted Frequency Bands



Photograph for Unwanted Emission into non-restricted frequency bands

8.3. LIMIT

All Spurious Emissions must be at least 20 below the Fundamental Radiator Level

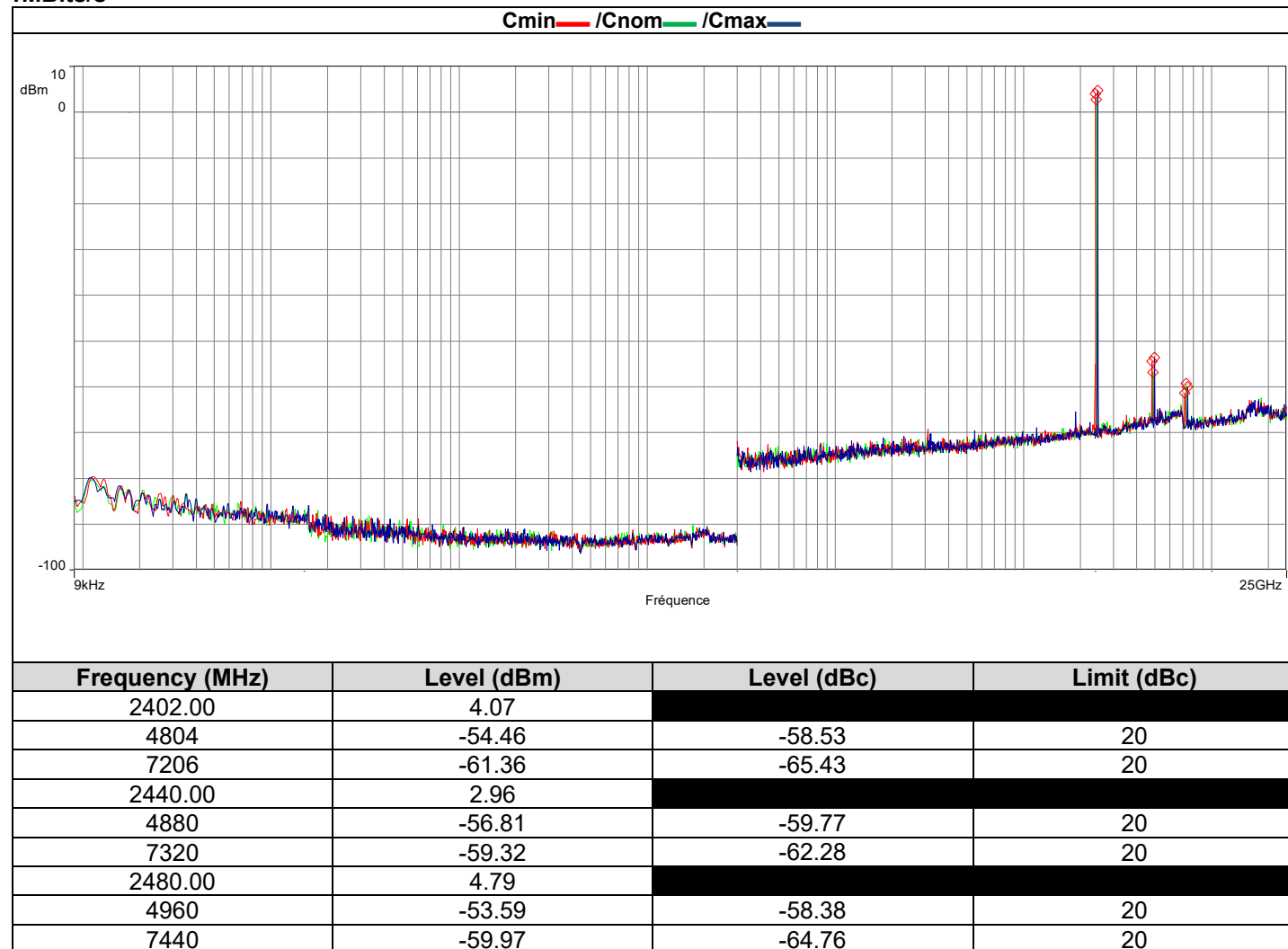
8.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
Power supply DC	METRIX	AX503	A7042307		
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	12/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	02/23
Attenuator 10dB	AEROFLEX	_	A7122269	09/20	03/23

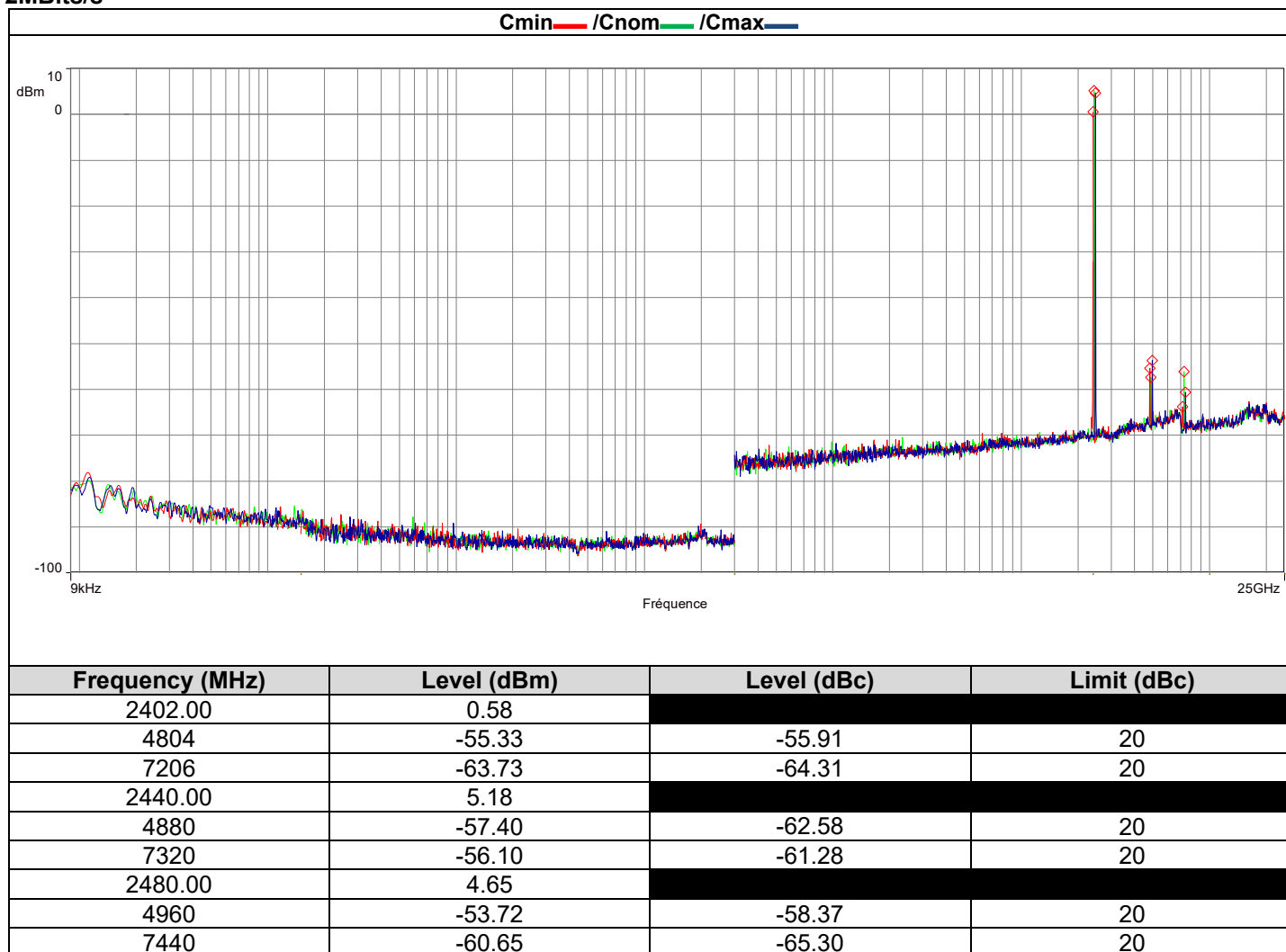
Note: In our quality system, the test equipment calibration due is more & less 2 months

8.5. RESULTS

1Mbits/s



2Mbits/s



8.6. CONCLUSION

Unwanted Emission into non-restricted frequency bands measurement performed on the sample of the product **STMICROELECTRONICS STM32WB1MMC**, SN: **Sample 1**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 2** limits.

9. AC POWER LINE CONDUCTED EMISSIONS

9.1. TEST CONDITIONS

Date of test : June 19, 2023
 Test performed by : Majid MOURZAGH
 Relative humidity (%) : 40
 Ambient temperature (°C) : 21

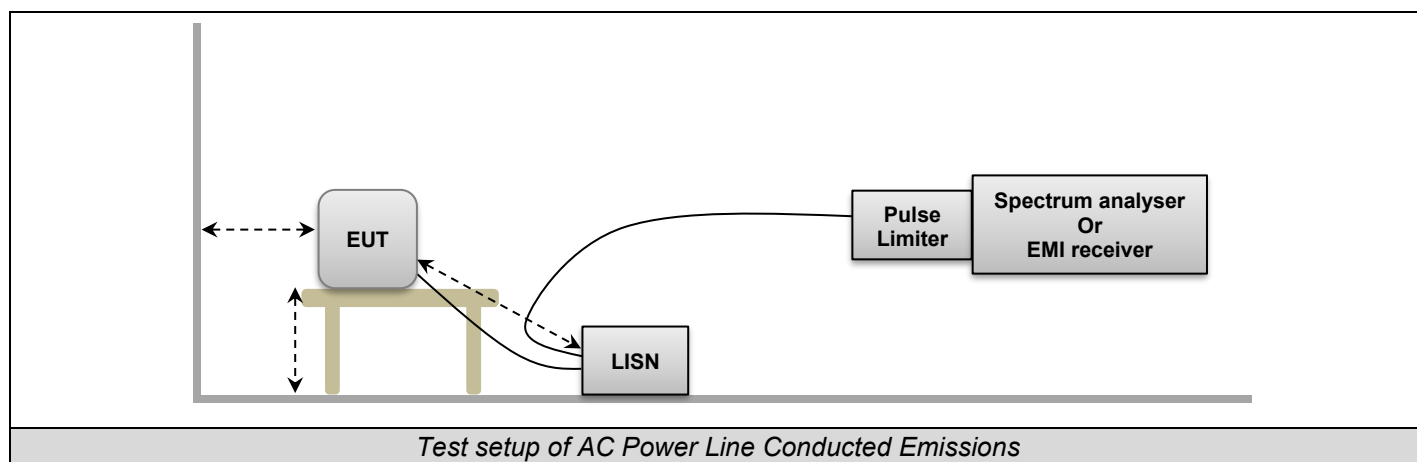
9.2. TEST SETUP

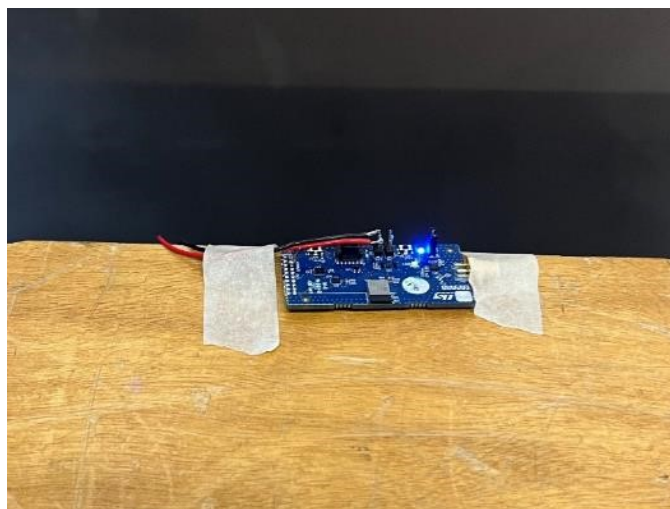
Test procedure:

☒ ANSI C63.10 & FCC Part 15 subpart C

The EUT and auxiliaries are set 80cm above the ground on the non-conducting table (Table-top equipment) at 80cm from the LISN, the cable has been shorted to 1meter length. The distance between the EUT and the vertical ground plane is 40cm. Measurement is made with a receiver in peak mode. This was followed by a Quasi-Peak, i.e. CISPR measurement for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. Interconnecting cables and equipment's were moved to position that maximized emission. The EUT is powered like specified in following table, through a LISN (measure); auxiliaries are powered by another LISN.

Type	Measurement performed:	
☒ AC / ☐ DC (Auxiliary used)	☒ 120VAC/60Hz	☒ 240VAC/50Hz
☐ USB (Laptop auxiliary)	☐ 120VAC/60Hz (Laptop auxiliary)	☐ 240VAC/50Hz (Laptop auxiliary)





Photograph of AC Power Line Conducted Emissions

9.3. LIMIT

Frequency range	Level	Detector
0,15kHz to 0,5MHz	66dB μ V to 56 μ V*	QPeak
	56dB μ V to 46 μ V*	Average
0,5MHz to 5MHz	56dB μ V	QPeak
	46dB μ V	Average
5MHz to 30MHz	60B μ V	QPeak
	50dB μ V	Average

*Decreases with the logarithm of the frequency

9.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
BAT EMC	NEXIO	v3.21.0.32	L1000115		
Cable + self	—	—	A5329578	05/22	05/23
EMC comb generator	LCIE SUD EST	—	A3169098		
LISN	ROHDE & SCHWARZ	ENV216	C2320291	08/22	08/23
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	10/20	02/23
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	01/21	03/23
Transient limiter	ROHDE & SCHWARZ	ESH3-Z2	A7122204	08/22	08/24

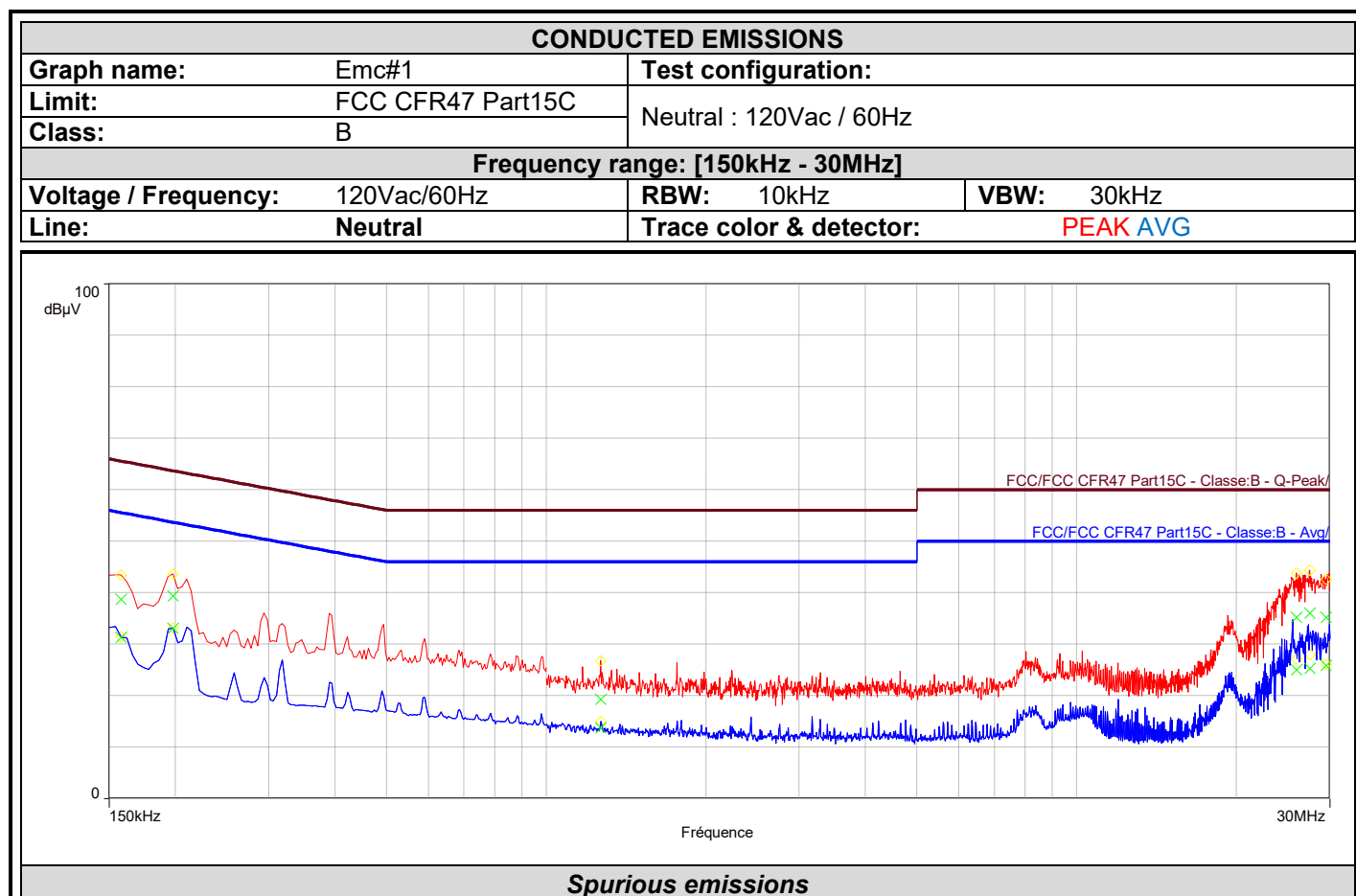
Note: In our quality system, the test equipment calibration due is more & less 2 months

9.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

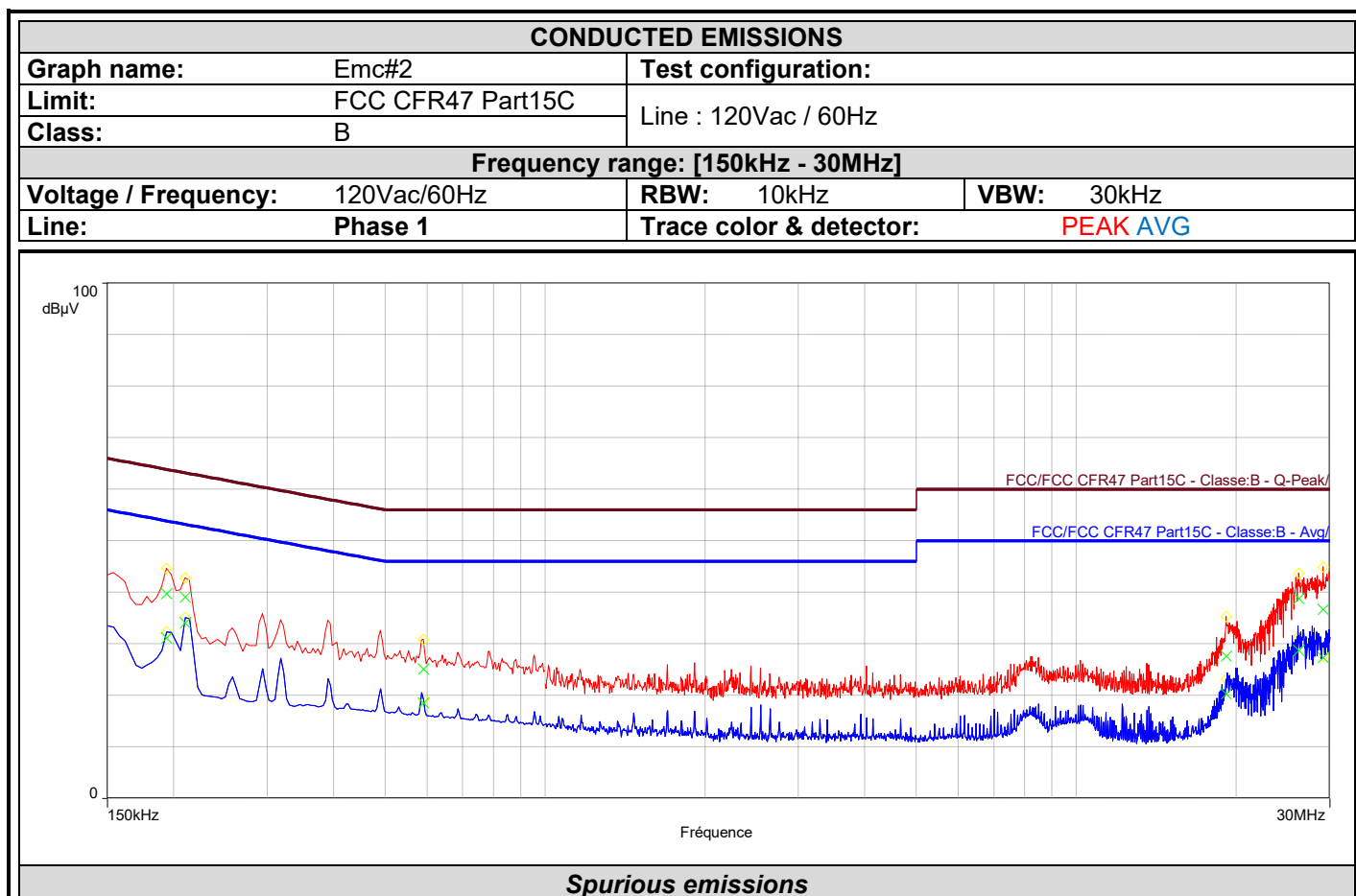
None

9.6. TEST RESULTS

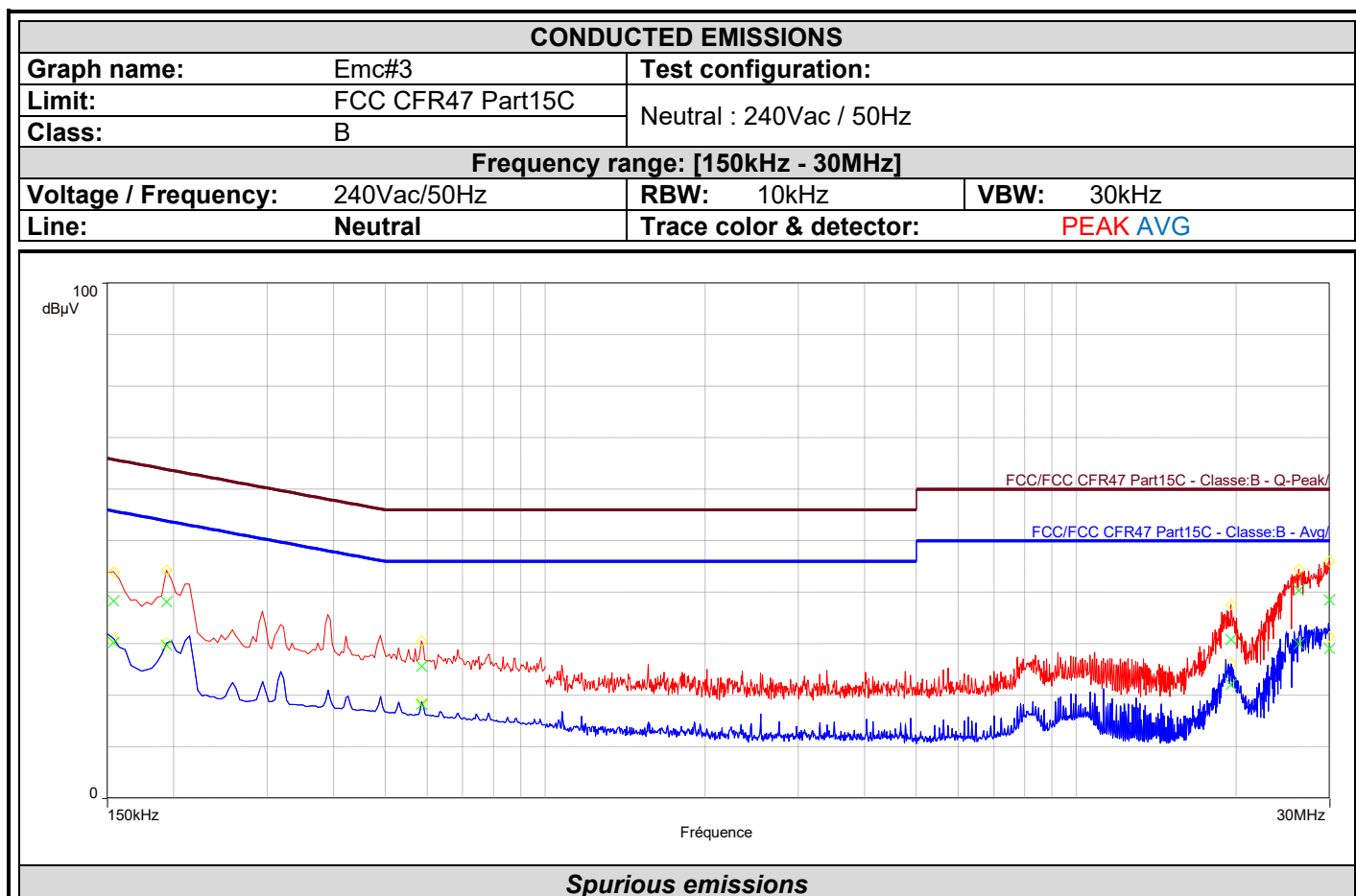
Measurements are performed on the phase (L1) and neutral (N) of the power line.



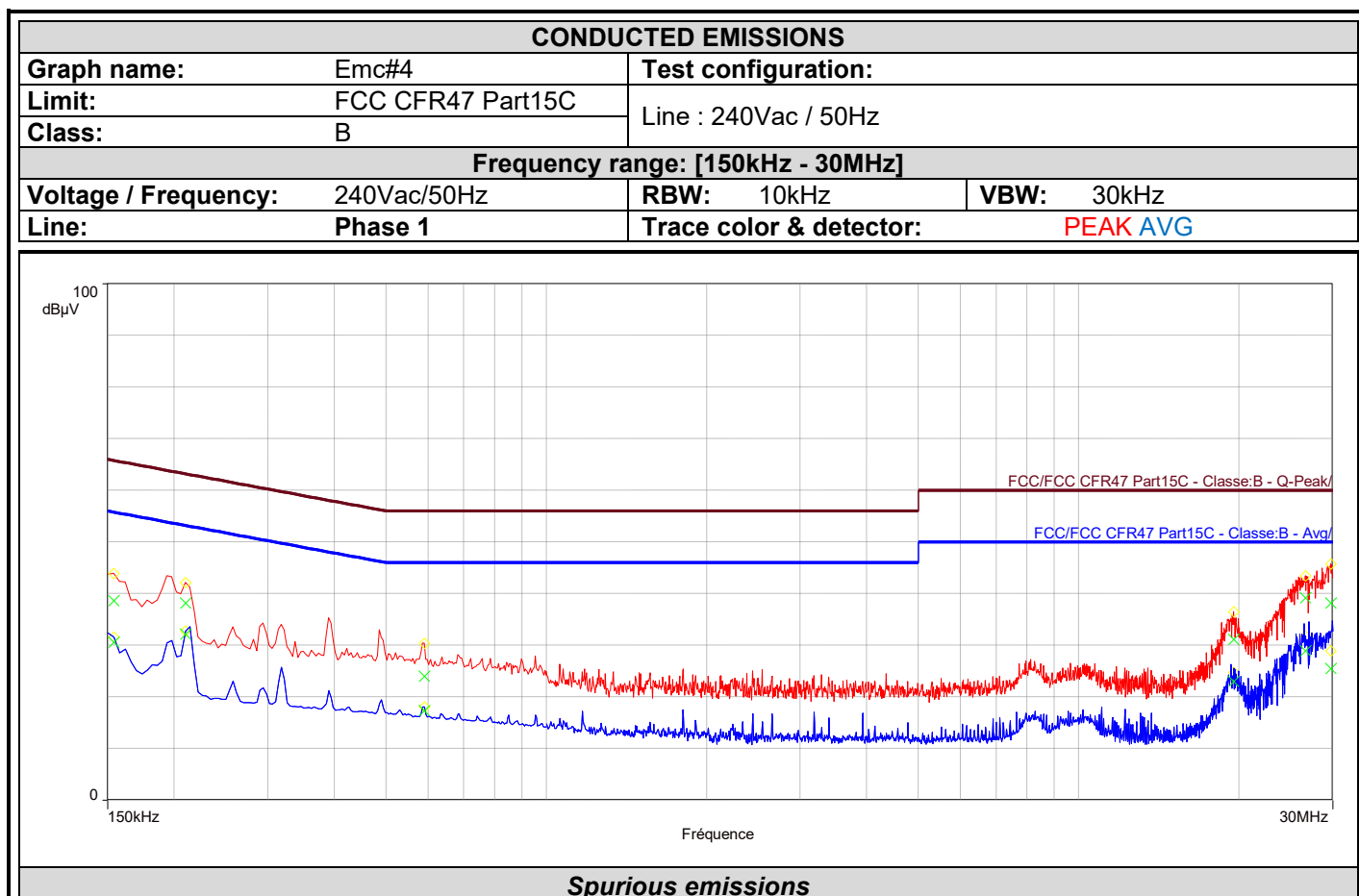
Frequency (MHz)	QPeak (dBµV)	Lim.QPeak (dBµV)	QPeak-Lim.QPeak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)
0.158	38.7	65.6	-26.9	31.3	55.6	-24.3
0.198	39.4	63.7	-24.4	33.0	53.7	-20.6
1.268	19.2	56.0	-36.8	13.7	46.0	-32.3
25.952	35.2	60.0	-24.8	25.0	50.0	-25.0
27.528	36.0	60.0	-24.0	25.3	50.0	-24.7
29.496	35.2	60.0	-24.8	25.8	50.0	-24.2



Frequency (MHz)	QPeak (dBµV)	Lim.QPeak (dBµV)	QPeak-Lim.QPeak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)
0.194	39.7	63.9	-24.2	31.1	53.9	-22.8
0.210	39.1	63.2	-24.1	34.0	53.2	-19.2
0.590	25.1	56.0	-30.9	18.5	46.0	-27.5
19.164	27.6	60.0	-32.4	20.3	50.0	-29.7
26.212	38.8	60.0	-21.2	28.8	50.0	-21.2
29.164	36.7	60.0	-23.3	27.3	50.0	-22.7



Frequency (MHz)	QPeak (dBµV)	Lim.QPeak (dBµV)	QPeak-Lim.QPeak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)
0.154	38.3	65.8	-27.5	30.3	55.8	-25.5
0.194	38.1	63.9	-25.7	29.8	53.9	-24.1
0.586	25.7	56.0	-30.3	18.3	46.0	-27.7
19.544	30.9	60.0	-29.1	22.1	50.0	-27.9
26.220	40.4	60.0	-19.6	30.0	50.0	-20.0
29.940	38.6	60.0	-21.4	29.1	50.0	-20.9



Frequency (MHz)	QPeak (dBµV)	Lim.QPeak (dBµV)	QPeak-Lim.QPeak (dB)	CISPR.AVG (dBµV)	Lim.CISPR.AVG (dBµV)	CISPR.AVG-Lim.CISPR.AVG (dB)
0.154	38.6	65.8	-27.2	30.6	55.8	-25.2
0.210	38.1	63.2	-25.1	32.1	53.2	-21.1
0.590	24.0	56.0	-32.0	17.4	46.0	-28.6
19.532	31.2	60.0	-28.8	23.0	50.0	-27.0
26.648	39.2	60.0	-20.8	28.9	50.0	-21.1
29.756	38.2	60.0	-21.8	25.5	50.0	-24.5

9.7. CONCLUSION

AC Power Line Conducted Emission measurement performed on the sample of the product **STM32WB1MMC**, Sn : **Sample 1**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15 & RSS Gen** limits.

10. UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS

10.1. TEST CONDITIONS

Date of test : June 19, 2023
 Test performed by : Majid MOURZAGH
 Relative humidity (%) : 40
 Ambient temperature (°C) : 21

10.2. 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:

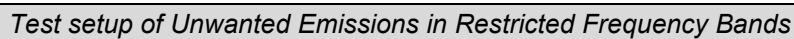
Frequency range:	9kHz to 30MHz	
Test:	Pre-Characterization	Qualification
Antenna Polarization:	Parallel, Perpendicular and Ground parallel	
Antenna Height:	1m	1m
Antenna Type:	Loop	
RBW Filter:	200Hz below 150kHz / 9kHz above 150kHz	
Maximization:	Turntable rotation of 360 degrees range	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Open Aera Test Site
Distance EUT - Antenna:	3m	3m
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:	Biconical & Bi-Log	
RBW Filter:	120kHz	
Maximization:	Turntable rotation of 360 degrees range	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Open Aera Test Site
Distance EUT - Antenna:	3m	3m
Detector:	Peak	QPeak

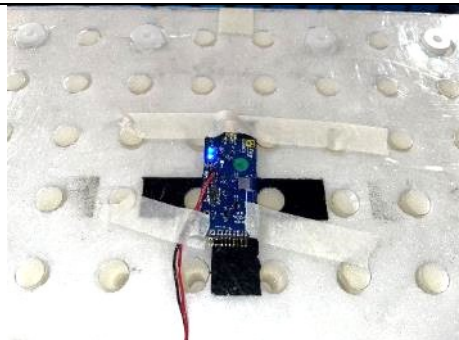


Frequency range:	1GHz to 14GHz	
Test:	Pre-Characterization	Qualification
Antenna Polarization:	Horizontal and Vertical	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	Varied from 1m to 4m
Antenna Type:	Horn	
RBW Filter:	1MHz	
Maximization:	Turntable rotation of 360 degrees range	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Semi-Anechoic Chamber
Distance EUT - Antenna:	3m	3m
Detector:	Peak & Average	Peak & Average

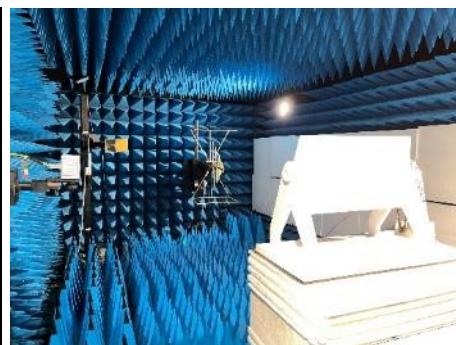
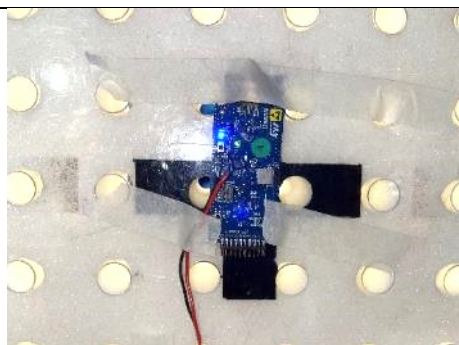
Frequency range:	14GHz to 26GHz	
Test:	Pre-Characterization	Qualification
Antenna Polarization:	Horizontal and Vertical	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	Varied from 1m to 4m
Antenna Type:	Horn	
RBW Filter:	1MHz	
Maximization:	Turntable rotation of 360 degrees range	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Semi-Anechoic Chamber
Distance EUT - Antenna:	1m	1m
Detector:	Peak & Average	Peak & Average



Same setup is used in semi anechoic chamber during pre-characterization, with a distance of 3m between EUT and antenna.



Axis XY on FAR

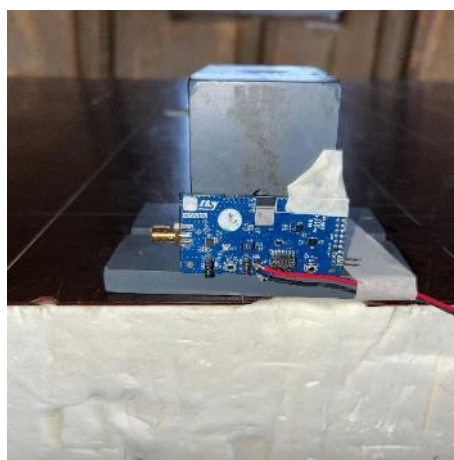


Axis Z on FAR

Photograph of Unwanted Emissions in Restricted Frequency Bands



Axis XY on OATS



Axis Z on OATS

Photograph of Unwanted Emissions in Restricted Frequency Bands

10.3. 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	35.5dB 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

10.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Amplifier 9kHz - 40GHz	LCIE SUD EST	—	A7102082	05/22	05/24
Antenna Bi-log	AH System	SAS-521-7	C2040180	02/21	02/23
Antenna horn 18GHz	EMCO	3115	C2042029	03/22	03/25
BAT EMC	NEXIO	v3.21.0.32	L1000115		
CABLE	TELEDYNE	R82-0404-8M	A5330008	02/22	02/24
Cable 0.75m	-	18GHz	A5329900	08/22	08/24
Cable 1m	HUBER & SUHNER	18GHz	A5329705	08/21	08/23
Cable 1m	HUBER & SUHNER	18GHz	A5329706	08/21	08/23
Cable SMA 40GHz 40cm	WITHWAVE	W101-SM1-0.4M	A5329979	04/21	04/23
Comb EMR HF	YORK	CGE01	A3169114		
CONTROLLER	INNCO	CO3000	D3044034		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/23
Emission Cable (SMA 3.3m)	TELEDYNE	26GHz	A5329875	08/22	08/23
Filter Matrice	LCIE SUD EST	Combined filters	A7484078	09/20	03/23
Multimeter - CEM	FLUKE	189	A1240171	09/21	09/23
Rehausse Table C3	LCIE	—	F2000507		
Rehausse Table C3	LCIE	—	F2000511		
Semi-Anechoic chamber #3 (BF)	SIEPEL	—	D3044017_BF	04/22	04/25
Semi-Anechoic chamber #3 (VSWR)	SIEPEL	—	D3044017_VSWR	04/22	04/25
Spectrum analyzer	ROHDE & SCHWARZ	FSU 26	A4060058	09/21	09/23
Table C3	LCIE	—	F2000461		
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	01/21	03/23
TILT	INNCO	TILT	D3044033		
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371		
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444		
Antenna Bi-log	CHASE	CBL6111A	C2040172	04/22	04/24
Antenna Mat (OATS)	ETS Lingren	2071-2	F2000392		
Cable (OATS)	—	1GHz	A5329623	09/22	09/23
Emission Cable	RADIALEX		A5329061	08/22	08/23
Emission Cable	MICRO-COAX	1GHz	A5329656	08/22	08/23
OATS	—	—	F2000409	07/22	07/23
Receiver 20-1000MHz	ROHDE & SCHWARZ	ESVS30	A2642006	05/22	05/24

Note: In our quality system, the test equipment calibration due is more & less 2 months

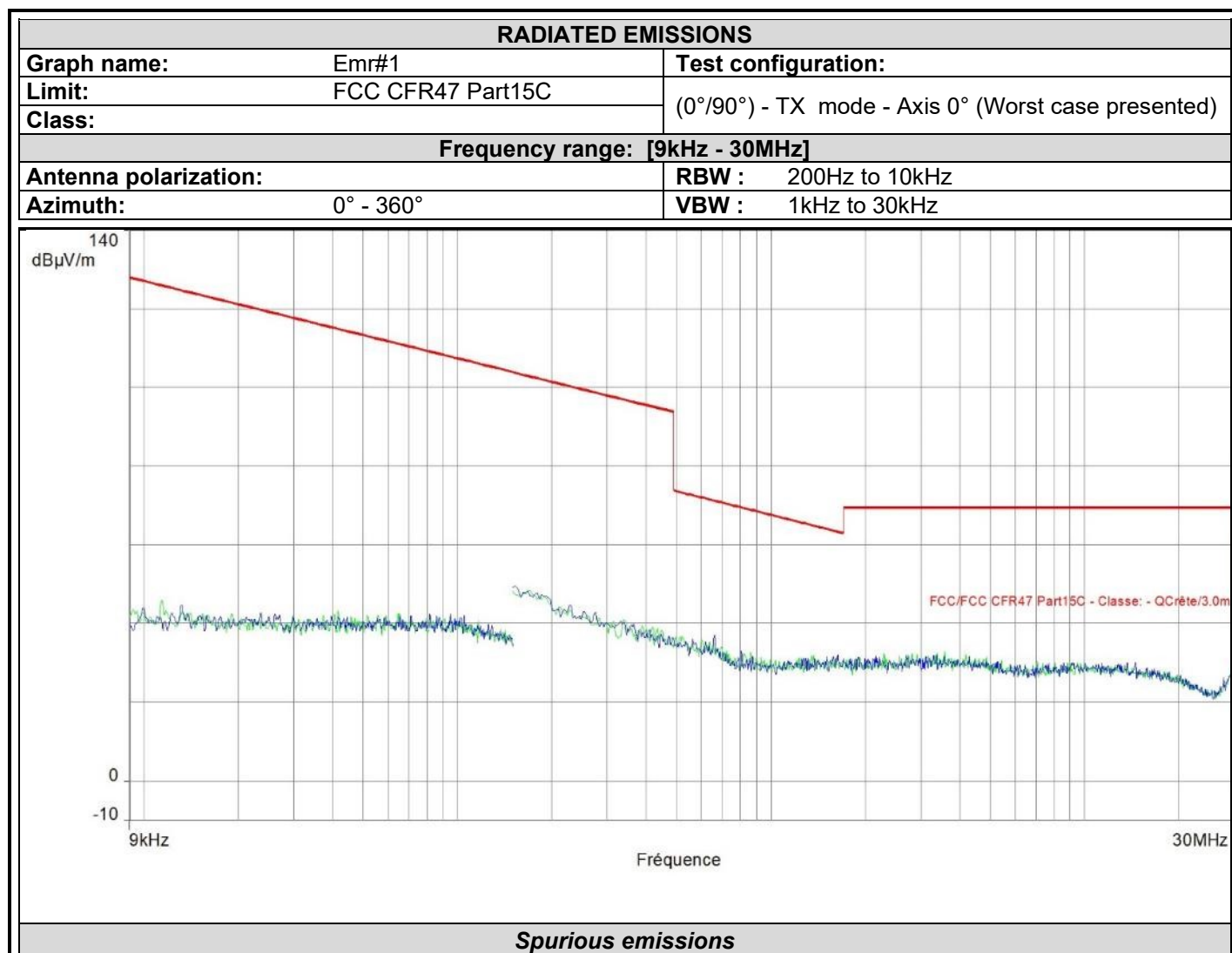
10.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

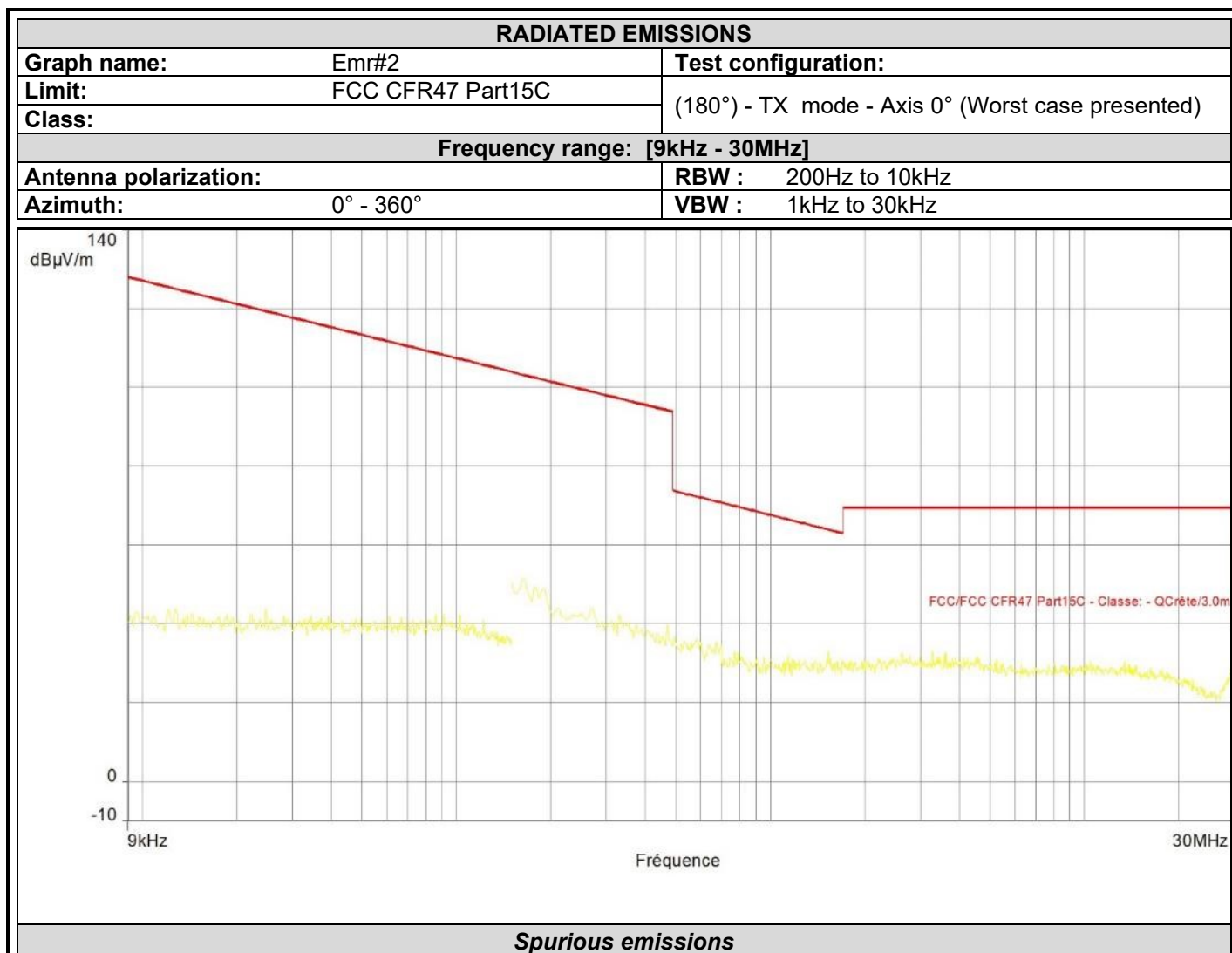
10.6. RESULTS

10.6.1. 9kHz to 30MHz

Graphs – Pre characterization:



No significant frequency observed



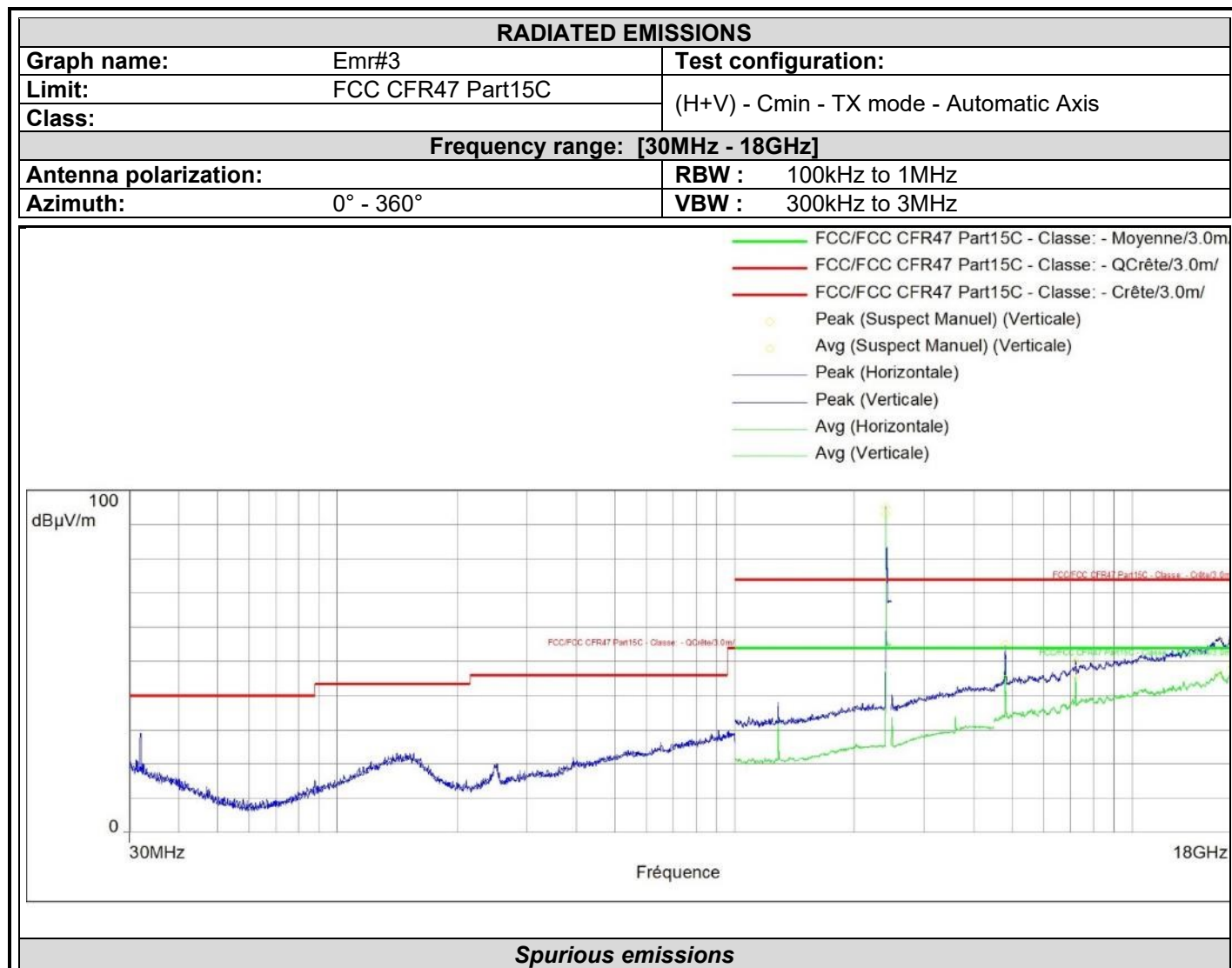
No significant frequency observed

Final measurement:

9kHz to 30MHz					
Polarization	Frequency (MHz)	Peak Level (dBµV/m)	QPeak Level (dBµV/m)	Limit (dBµV/m)	Margin QPeak (dBµV/m)
No significant frequency observed					

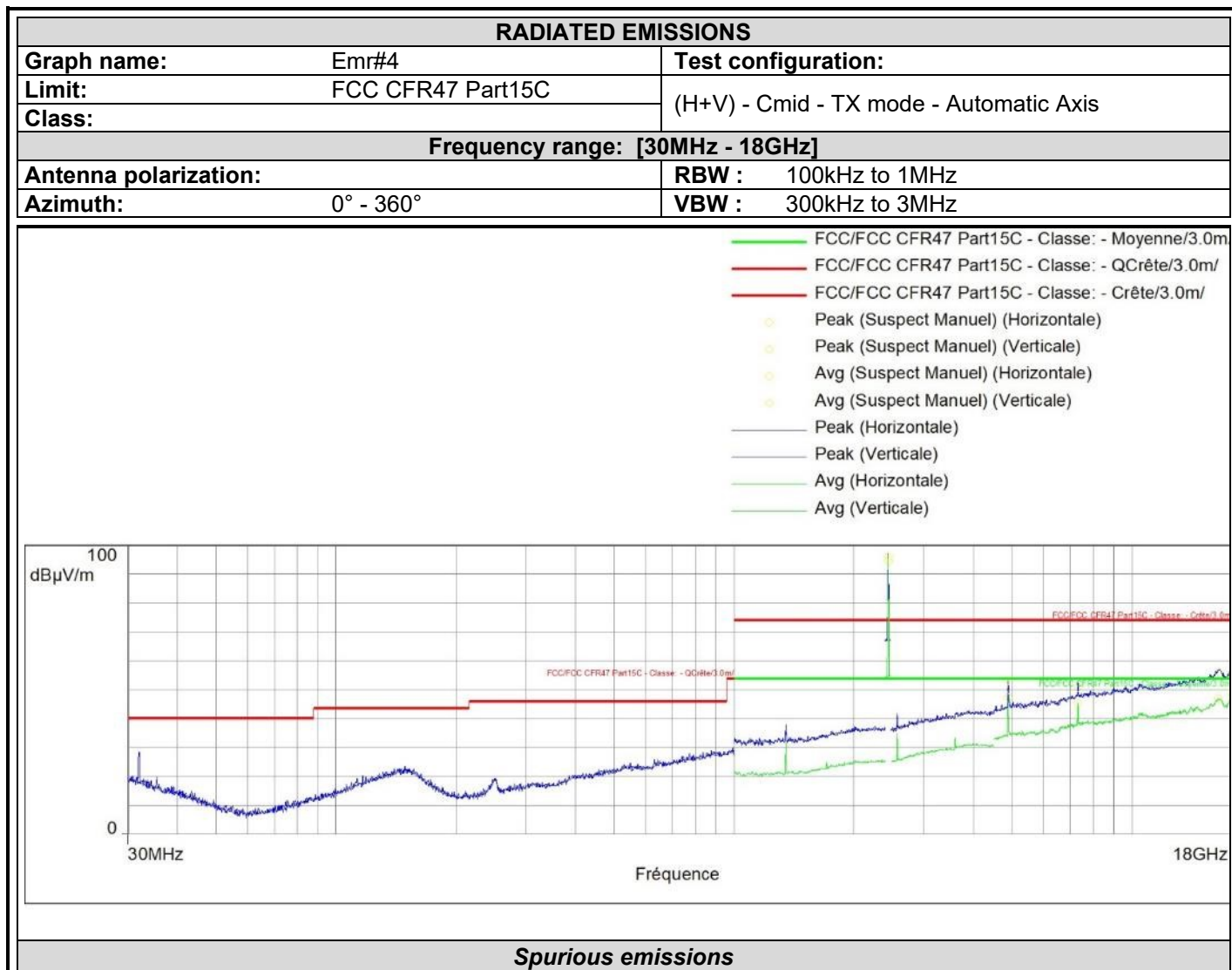
10.6.2. 30MHz to 1GHz

Graphs – Pre characterization:



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
2402.171*	95.4	-	93.1	-	Vertical	30.2
4802.906	54.9	74.0	44.9	54.0	Vertical	-14.0
7205.906	50.0	74.0	45.6	54.0	Vertical	-10.0
16493.906	56.1	74.0	46.8	54.0	Vertical	4.2
17943.469	56.8	74.0	48.5	54.0	Vertical	6.8

*: carrier frequency

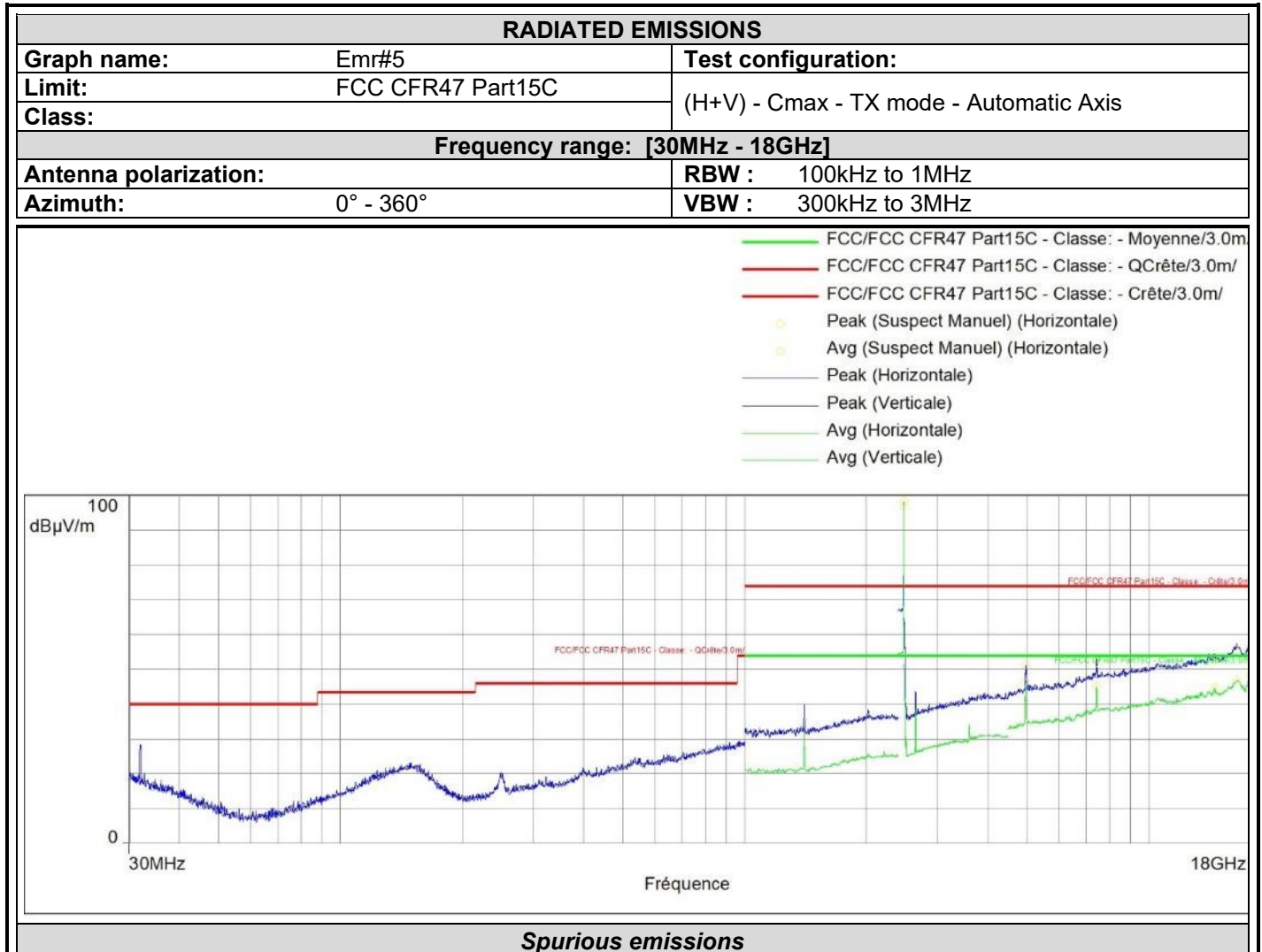


Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
2441.959*	96.2	-	94.5	-	Vertical	30.2
4883.062	53.3	74.0	47.4	54.0	Horizontal	-13.8
7325.719	50.8	74.0	45.5	54.0	Horizontal	-9.8
16511.625	56.0	74.0	47.0	54.0	Horizontal	4.2
17967.094	56.2	74.0	48.5	54.0	Horizontal	6.9

*: carrier frequency



L C I E



Frequency (MHz)	Peak (dBµV/m)	Lim.Peak (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Polarization	Correction (dB)
2479.993*	98.4	-	97.2	-	Horizontal	30.2
4959.844	51.2	74.0	46.4	54.0	Horizontal	-13.7
7439.625	52.0	74.0	45.1	54.0	Horizontal	-9.5
14559.188	52.6	74.0	44.8	54.0	Horizontal	-0.5
16510.781	55.9	74.0	47.0	54.0	Horizontal	4.2
17872.594	56.8	74.0	48.8	54.0	Horizontal	6.4

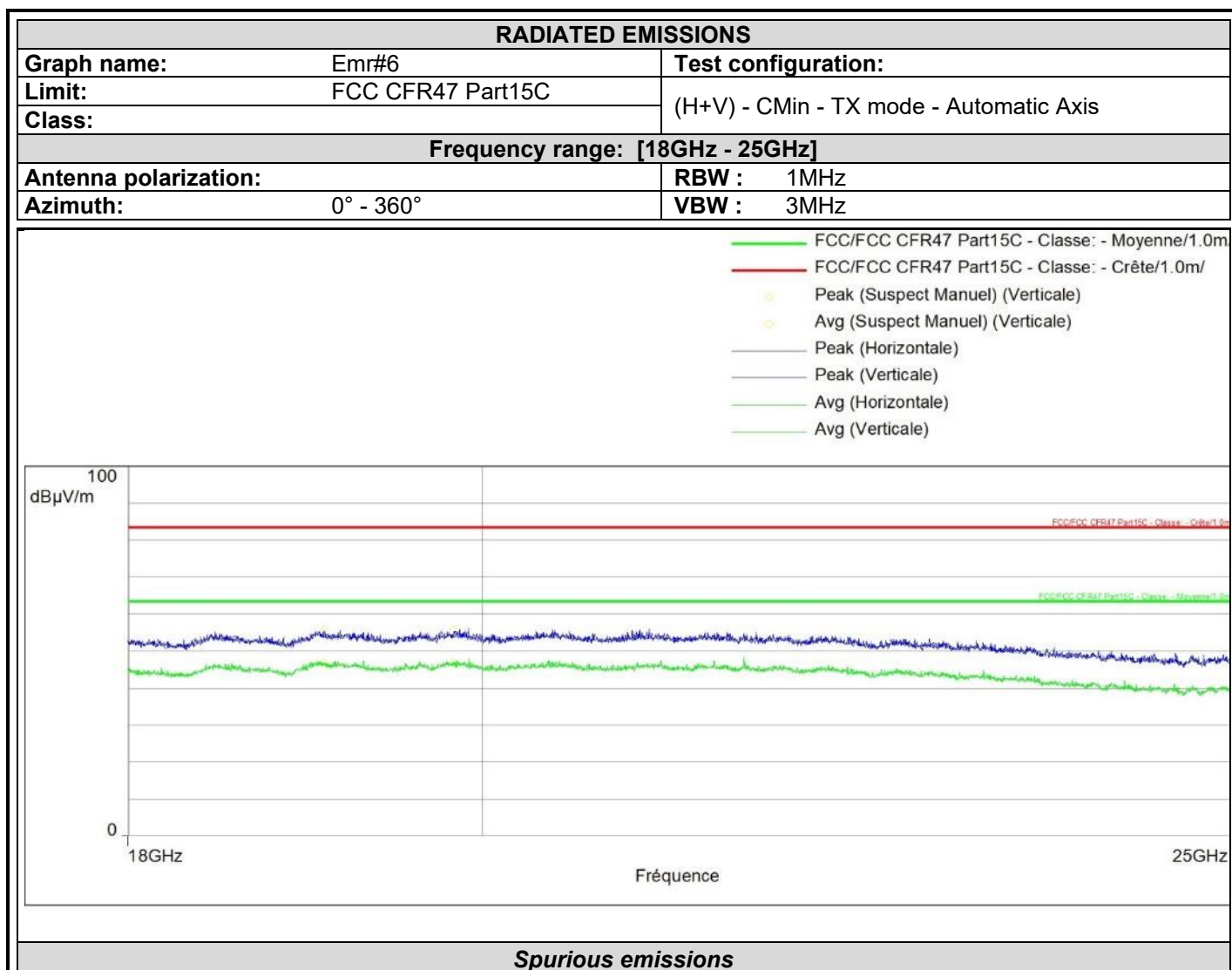
*: carrier frequency

Final measurement:

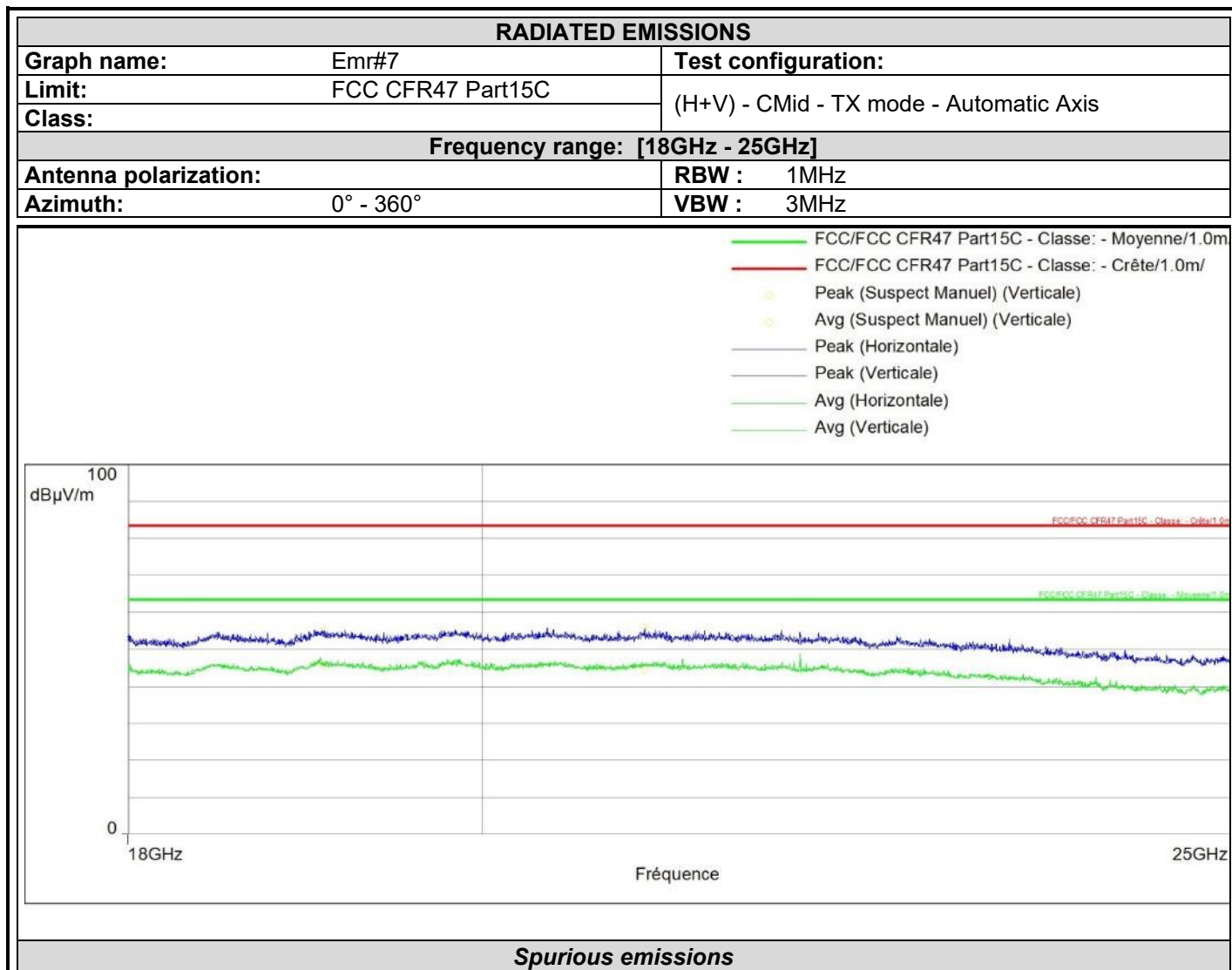
30MHz to 1GHz					
Polarization	Frequency (MHz)	Peak Level (dBµV/m)	QPeak Level (dBµV/m)	Limit (dBµV/m)	Margin QPeak (dBµV/m)
No significant frequency observed					

10.6.3. 1GHz to 25GHz

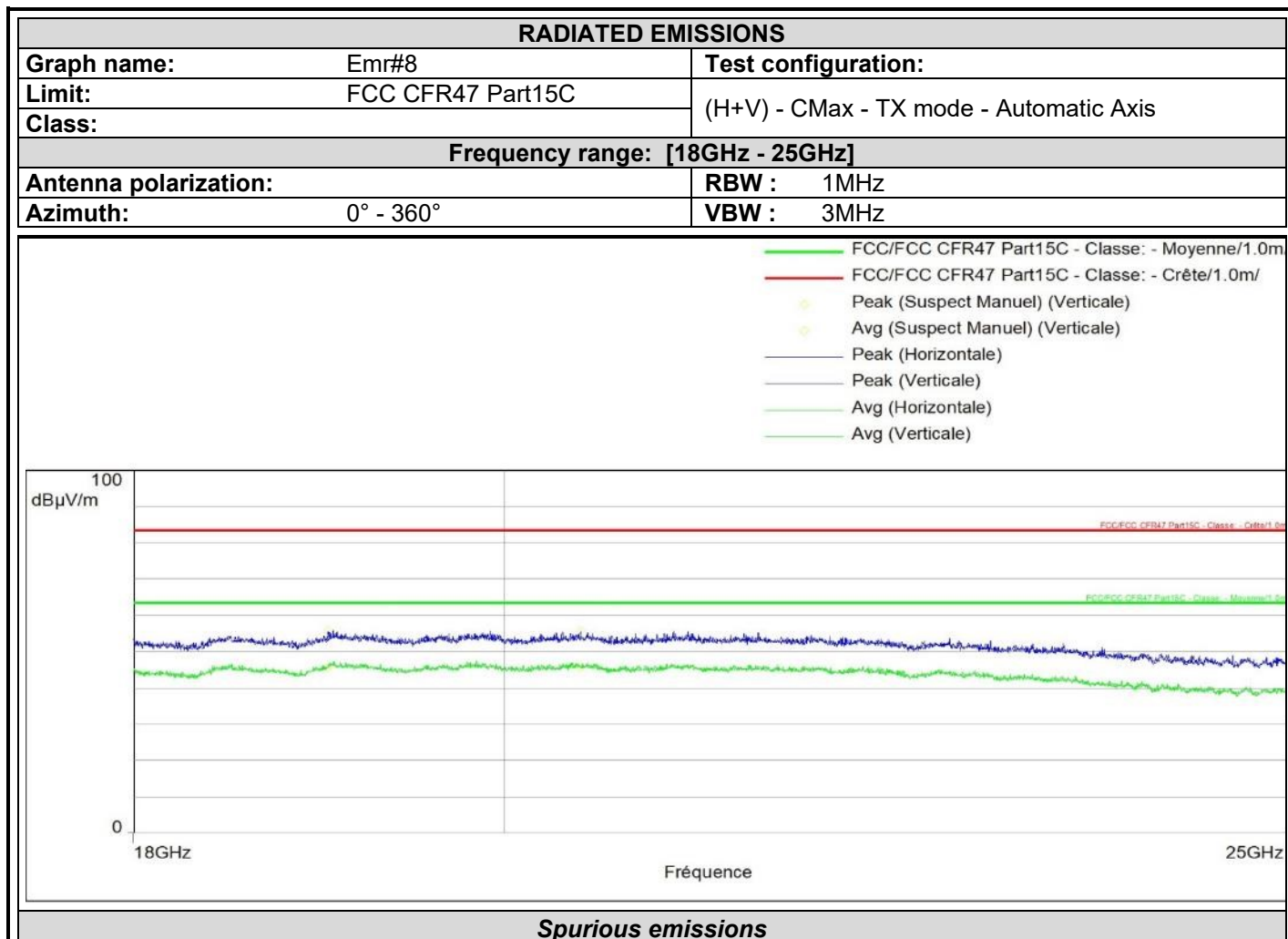
Graphs – Pre characterization:



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
19079.750	55.6	83.5	47.0	63.5	Vertical	2.9
19833.125	55.6	83.5	46.8	63.5	Vertical	2.7



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
19077.125	55.1	83.5	45.7	63.5	Vertical	3.0
20989.875	55.9	83.5	44.8	63.5	Vertical	2.1



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
19021.125	55.6	83.5	45.6	63.5	Vertical	2.9
20438.625	55.8	83.5	45.7	63.5	Vertical	2.5

Final measurement:

Test Frequency (MHz)	Meter Reading dB(μV)	Detector (Pk/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Remark
No significant frequency observed										

10.7. CONCLUSION

Unwanted Emissions in Restricted Frequency Bands measurement performed on the sample of the product **STM32WB1MMC**, Sn : **Sample 1**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.209 & RSS-Gen** limits.

11. UNCERTAINTIES CHART

Type de mesure / Kind of measurement	Incertitude élargie laboratoire / Wide uncertainty laboratory (k=2) ± x	Incertitude limite du CISPR / CISPR uncertainty limit ± y
Measurement of conducted disturbances in voltage on the power port	3.29dB	3.4 dB
Measurement of conducted disturbances in voltage on the telecommunication port.	3.26 dB	5dB
Measurement of discontinuous conducted disturbances in voltage	3.33 dB	3.4 dB
Measurement of conducted disturbances in current	2.67 dB	2.9dB
Spurious emission, radiated (Semi anechoic chamber & open test site)	5.60 dB	6 dB
Spurious emission, radiated (Full anechoic chamber above 1GHz)	±3.8 dB	±6 dB
Occupied Channel Bandwidth	±2.8 %	±5 %
RF power, conducted	±1.2 dB	±1.5 dB
Power Spectral Density, Conducted	±1.7 dB	±3 dB
Spurious emission, conducted	±2.3 dB	±3 dB
Temperature	±0.75 °C	±3 °C
Supply Voltages	±1.7 %	±3 %

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par la norme, la conformité de l'échantillon est établie directement par les niveaux limites applicables. / 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 limits values.