



LCIE



Accreditation
N°1-1633
Scope available on
www.cofrac.fr

Bluetooth Low Energy Template: Release October 22nd, 2022

TEST REPORT

N°: 14198293-776033-A(FILE#3899006)

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

SRETT
121 rue d'aguesseau
92100 – Boulogne Billancourt
France

Apparatus under test

- Product
- Trade mark
- Manufacturer
- Family Range (see annex 1)
- Model under test
- Serial number
- FCC ID

Wireless pressure and temperature sensors
BumbleBee
SRETT
P*****32* / 1001910 / T***32**** / 1001920
1001910
071240 / 070070
RDT-1003135

Conclusion

See Test Program chapter

Test date

February 1, 2023 to February 3, 2023

Test location

Moirans

FCC Test site

FR0008 - 197516

Sample receipt date

November 28, 2022

Composition of document

46 pages

Document issued on

February 6, 2023

Written by :
Majid MOURZAGH
Tests operator

Approved by :
Anthony MERLIN
Technical manager



This document shall not be reproduced, except in full, without the written approval of the LCIE. This document contains results related only to the items tested. It does not imply the conformity of the whole production to the items tested. Unless otherwise specified or rule defined by the test method, the decision of conformity doesn't take into account the uncertainty of measures. This document doesn't anticipate any certification decision. The COFRAC accreditation attests the technical capability of the testing laboratory for the only tests covered by the accreditation. If some tests mentioned in this report are carried out outside the framework of COFRAC accreditation, they are indicated by the symbol

LCIE

Laboratoire Central des Industries Electriques
Une société de Bureau Veritas

ZI Centr'alp
170 rue de Chatagnon
38430 Moirans FRANCE

Tél : +33 4 76 07 36 36
contact@lcie.fr
www.lcie.fr



PUBLICATION HISTORY

Version	Date	Author	Modification
01	February 6, 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

1.	TEST PROGRAM	4
2.	EQUIPMENT UNDER TEST: CONFIGURATION (DECLARED BY PROVIDER)	5
3.	OCCUPIED BANDWIDTH.....	11
4.	6DB EMISSION BANDWIDTH	14
5.	MAXIMUM CONDUCTED OUTPUT POWER	17
6.	POWER SPECTRAL DENSITY	21
7.	UNWANTED EMISSIONS INTO NON-RESTRICTED FREQUENCY BANDS AT THE BAND EDGE	24
8.	UNWANTED EMISSIONS INTO NON-RESTRICTED FREQUENCY BANDS.....	27
9.	UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS	30
10.	UNCERTAINTIES CHART	44
11.	ANNEX 1.....	45

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. INFORMATIONS

Tests are performed on the most complete product **BumbleBee** 1001910, SN: **071240** and SN: **070070**
See Table on chapter annex 1 for difference between products.

2.2. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):

BumbleBee 1001910

Serial Number: 071240



Equipment Under Test

Power supply:

During all the tests, EUT is supplied by V_{nom} : 3.6VDC

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


Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Reference
Antenna	Type N	/	/	/		SOLEXY : ANH52
None						

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Laptop	LENOVO L460	/	/

Equipment information:

Bluetooth LE Type:	☐ BLE	☐ v4.1	☐ v4.2	☒ v5.0
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: 2.5dBi			
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		
	Tnom:	20°C		
	Tmax:	☒ 55°C		
Type of power source:	☒ Battery			
Operating voltage range:	Vnom:	☒ 3.6Vdc		



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

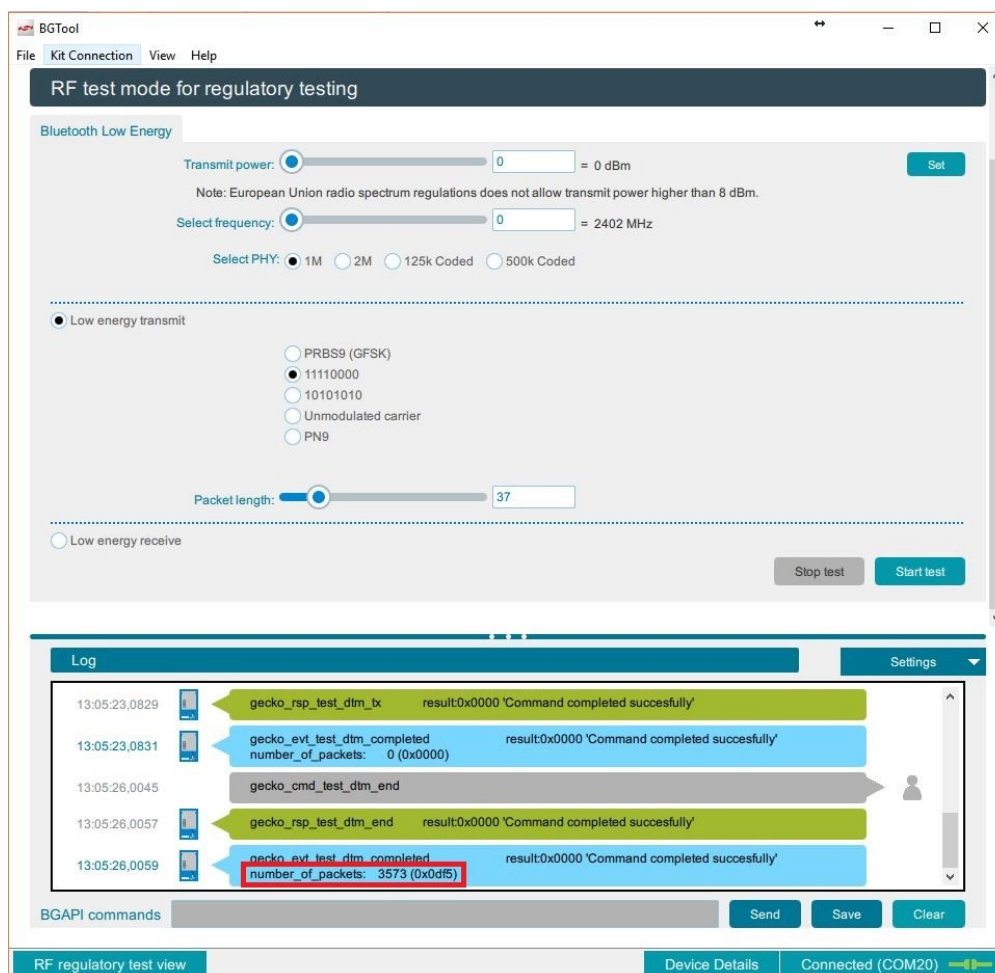
DATA RATE			
Available	Data Rate (Mbps)	Modulation Type	Worst Case Modulation
☐	0.25	GFSK	☐
☒	1	GFSK	☒
☐	2	GFSK	☐

2.3. 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) Following commands with the specific test software “BGTOOL” are used to set the product:

Hardware information		
Software (if applicable):	V. :	BGTOOL SDK build: 2.4.2-2500



Modulated permanent emission

2.4. EQUIPMENT LABELLING

None

2.5. EQUIPMENT MODIFICATION

☒ None ☐ Modification:

2.6. 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 52.5dB μ V 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 dB μ V/m.

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

The 32 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

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

2.7. 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 dB μ V/m

FS_{max} is the measured field strength, expressed in dB μ V/m

d_{measure} is the distance of the measurement point from the EUT

d_{limit} is the reference limit distance

2.8. 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 : February 2, 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:

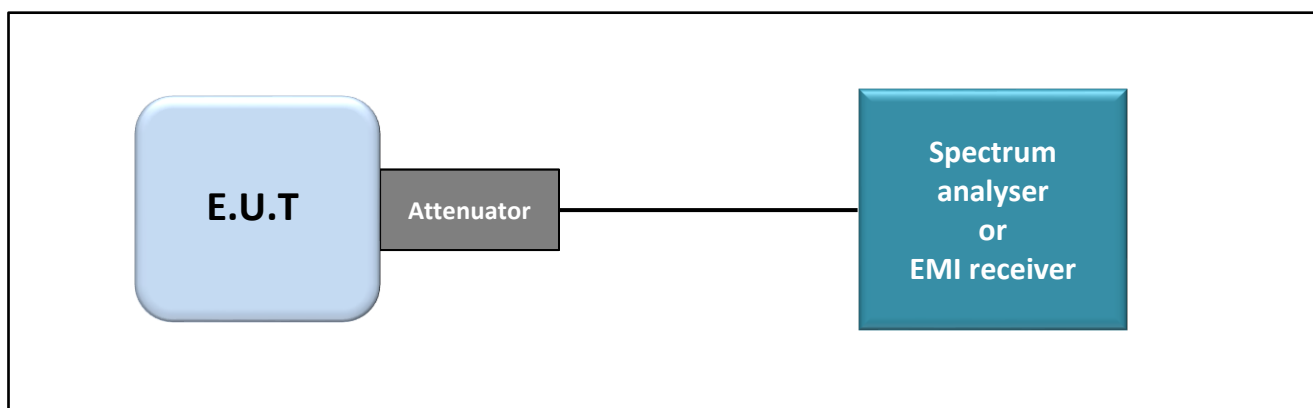
- ☒ Conducted Method
☐ Radiated Method

- Test Procedure:

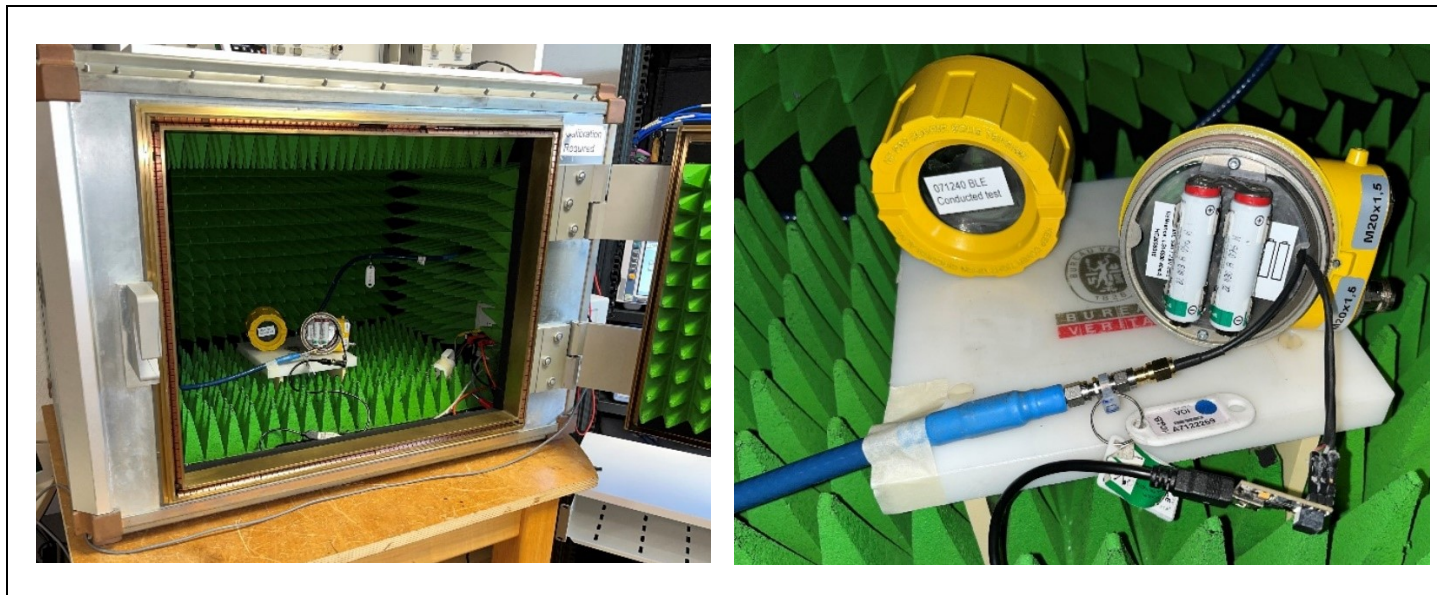
- ☐ RSS-Gen Issue 5 § 6.7
☒ ANSI C63.10 § 6.9.2

Measurement Procedure:

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



Test set up of Occupied Bandwidth



Photograph for Occupied bandwidth

3.3. LIMIT

None

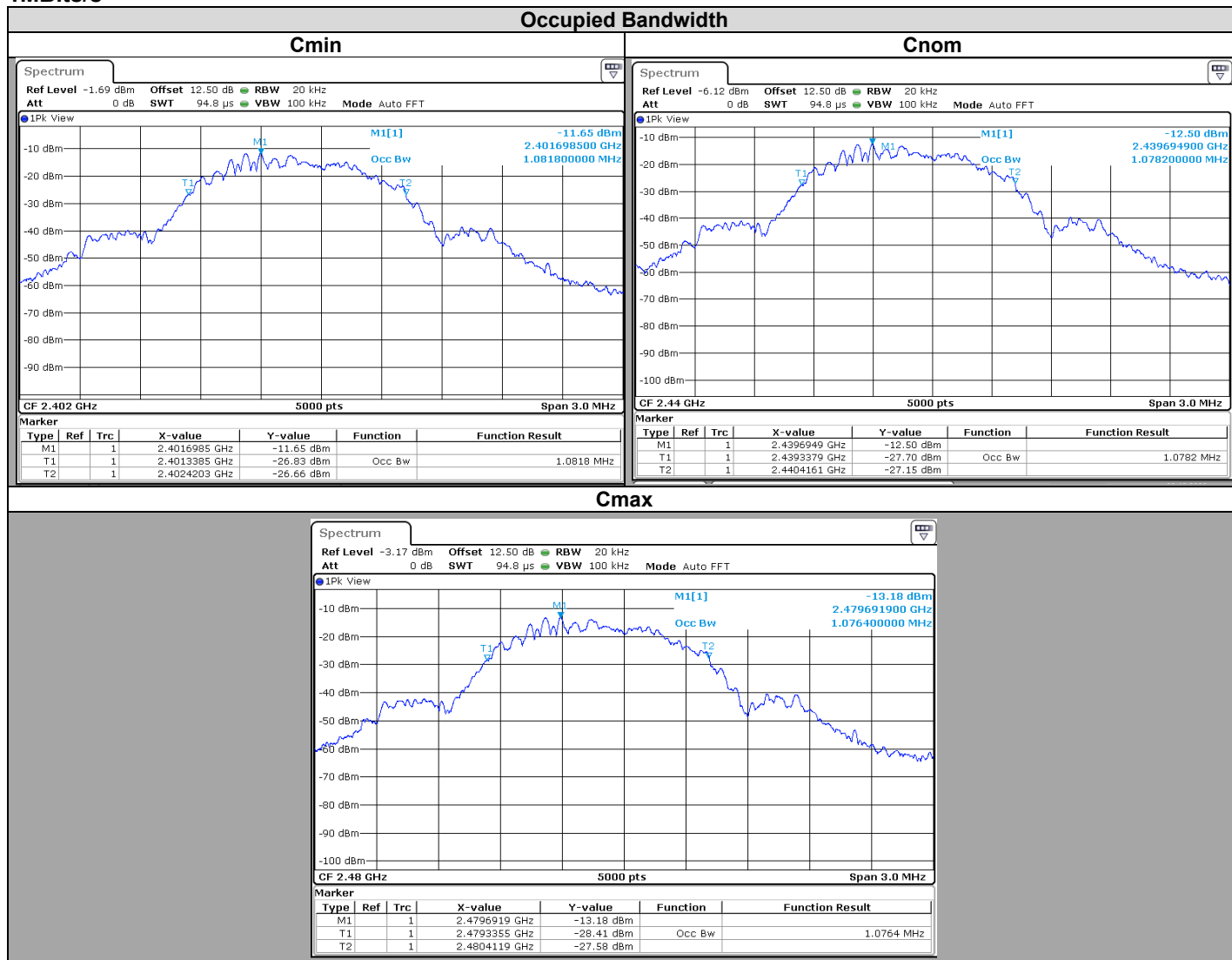
3.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	01/23
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	11/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	12/22
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23

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

3.5. RESULTS

1Mbits/s



Channel	Cmin	Cmid	Cmax
Occupied Channel bandwidth (MHz)	1.082	1.078	1.076
Lowest frequency (MHz)	2401.3385	2439.3379	2479.3355
Highest frequency (MHz)	2402.4203	2440.4161	2480.4119

3.6. CONCLUSION

Occupied Channel Bandwidth measurement performed on the sample of the product **BumbleBee 1001910**, SN: **071240**, 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 : February 2, 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:

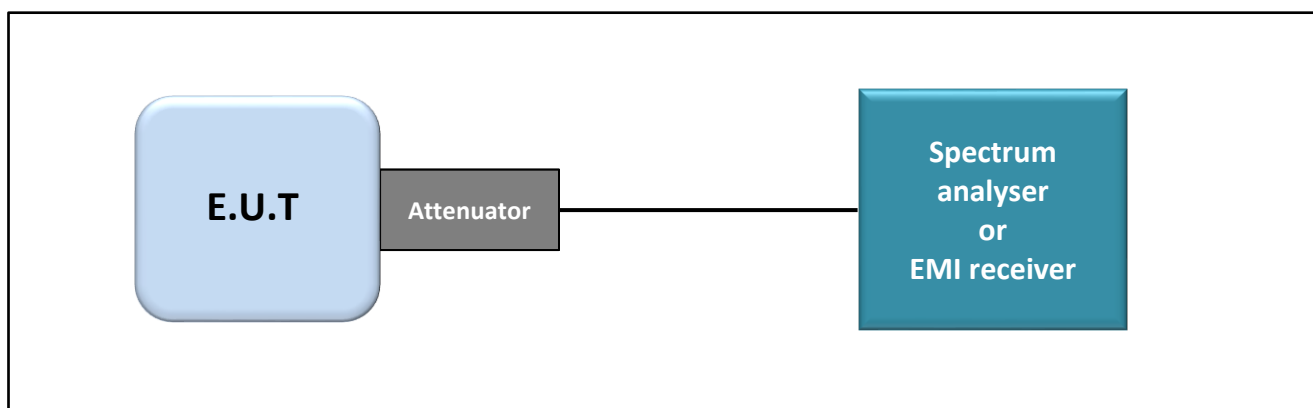
- ☒ Conducted Method
- ☐ Radiated Method

- Test Procedure:

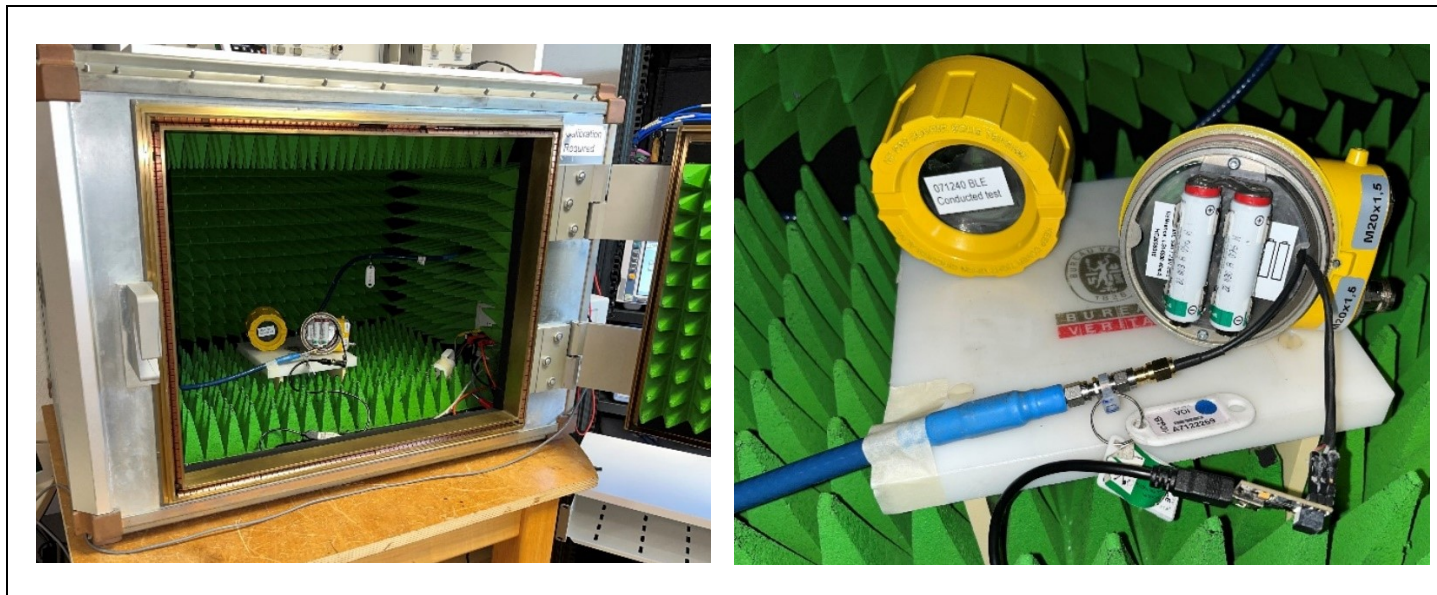
- ☒ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.2

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

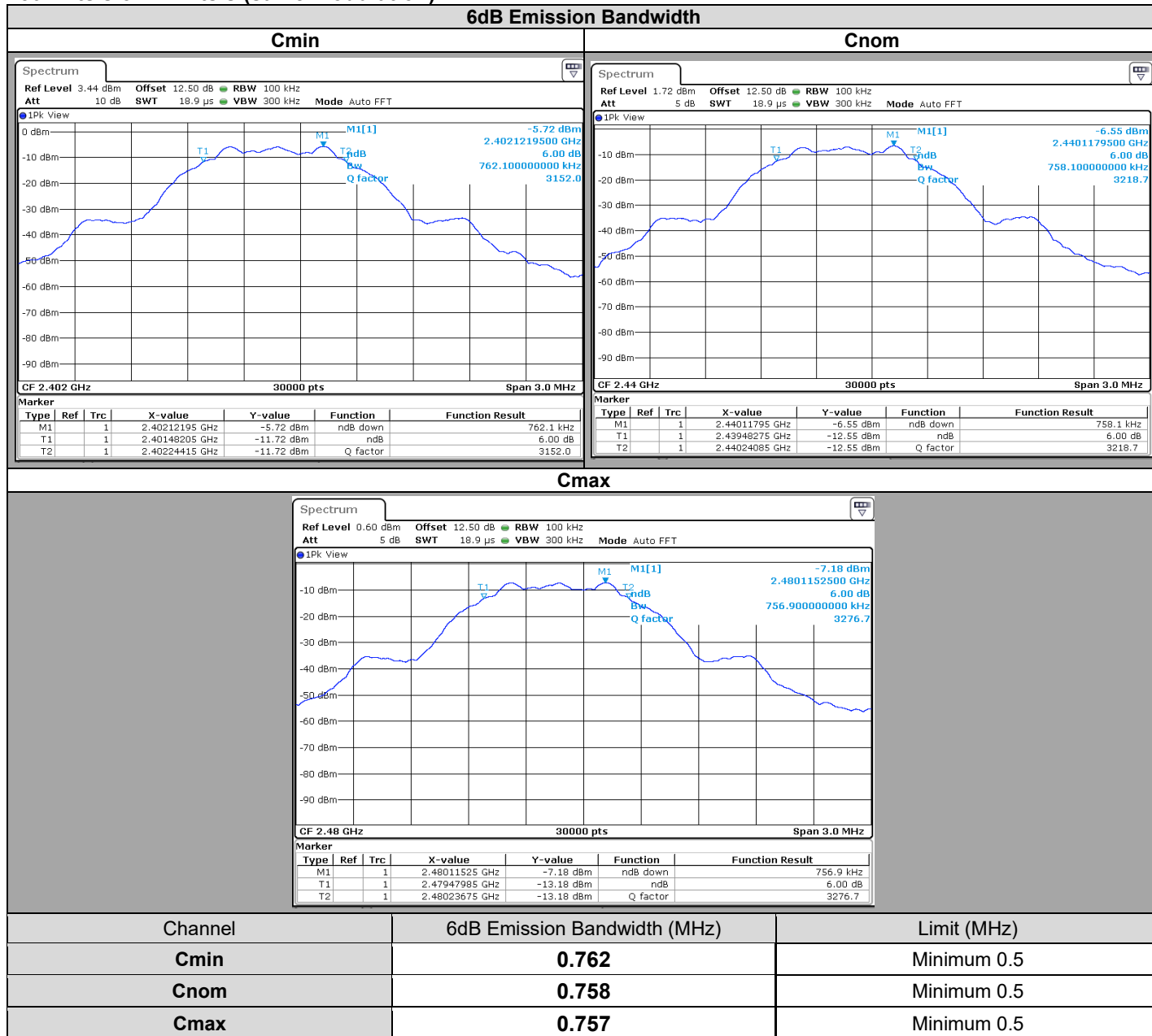
4.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	01/23
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	11/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	12/22
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23

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

4.5. RESULTS

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



4.6. CONCLUSION

6dB Emission Bandwidth measurement performed on the sample of the product **BumbleBee 1001910**, SN: **071240**, 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 : February 2, 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

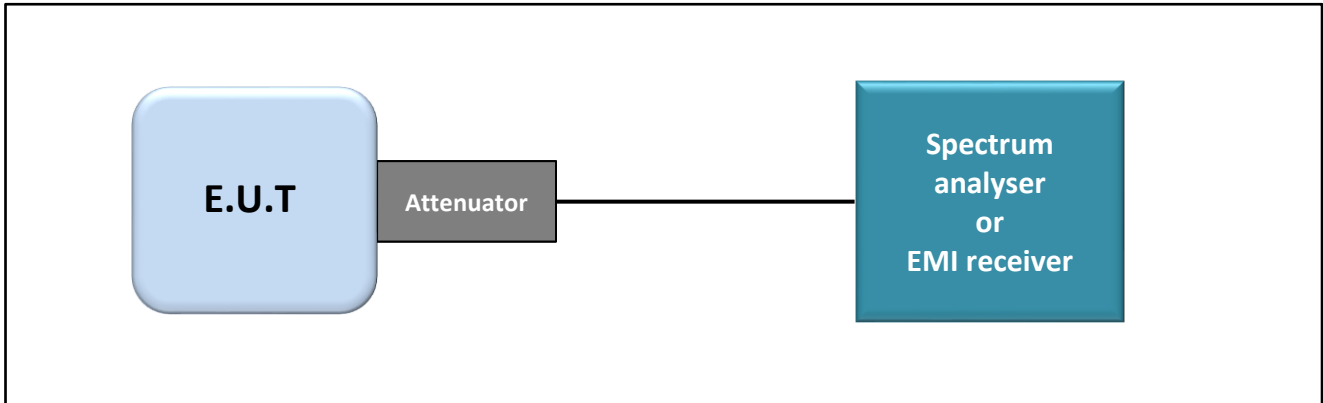
This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- 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.

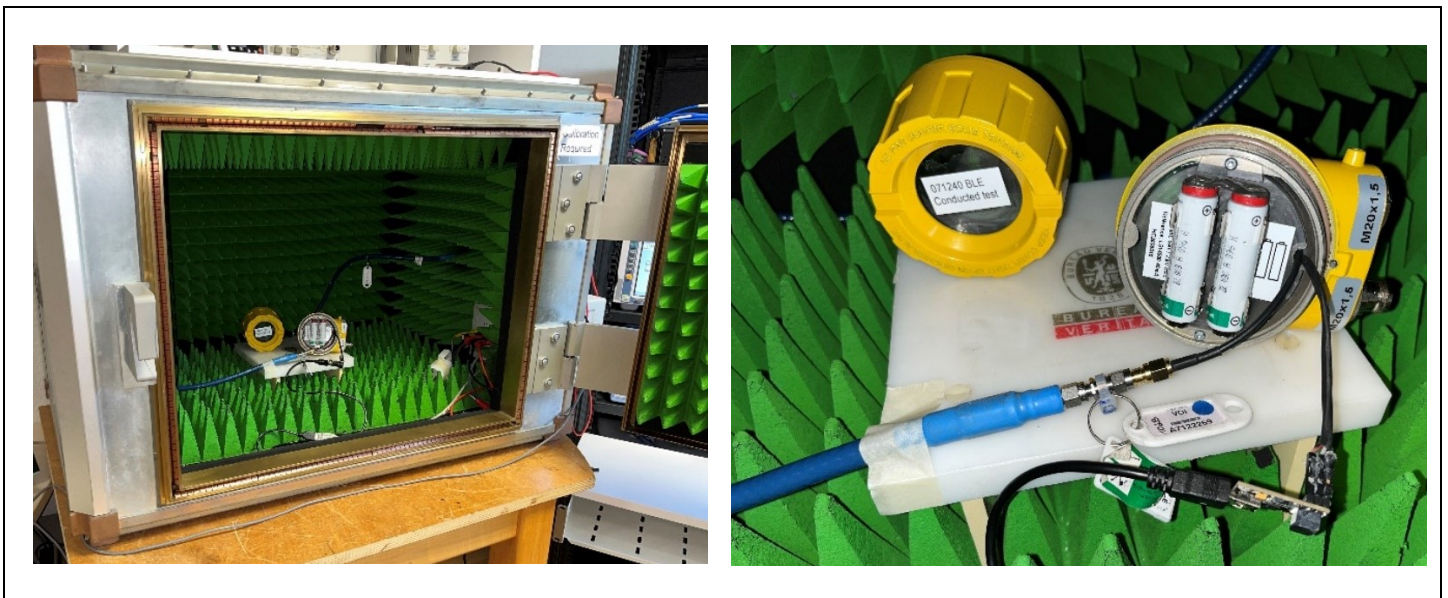
- ☐ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.3.1.2

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



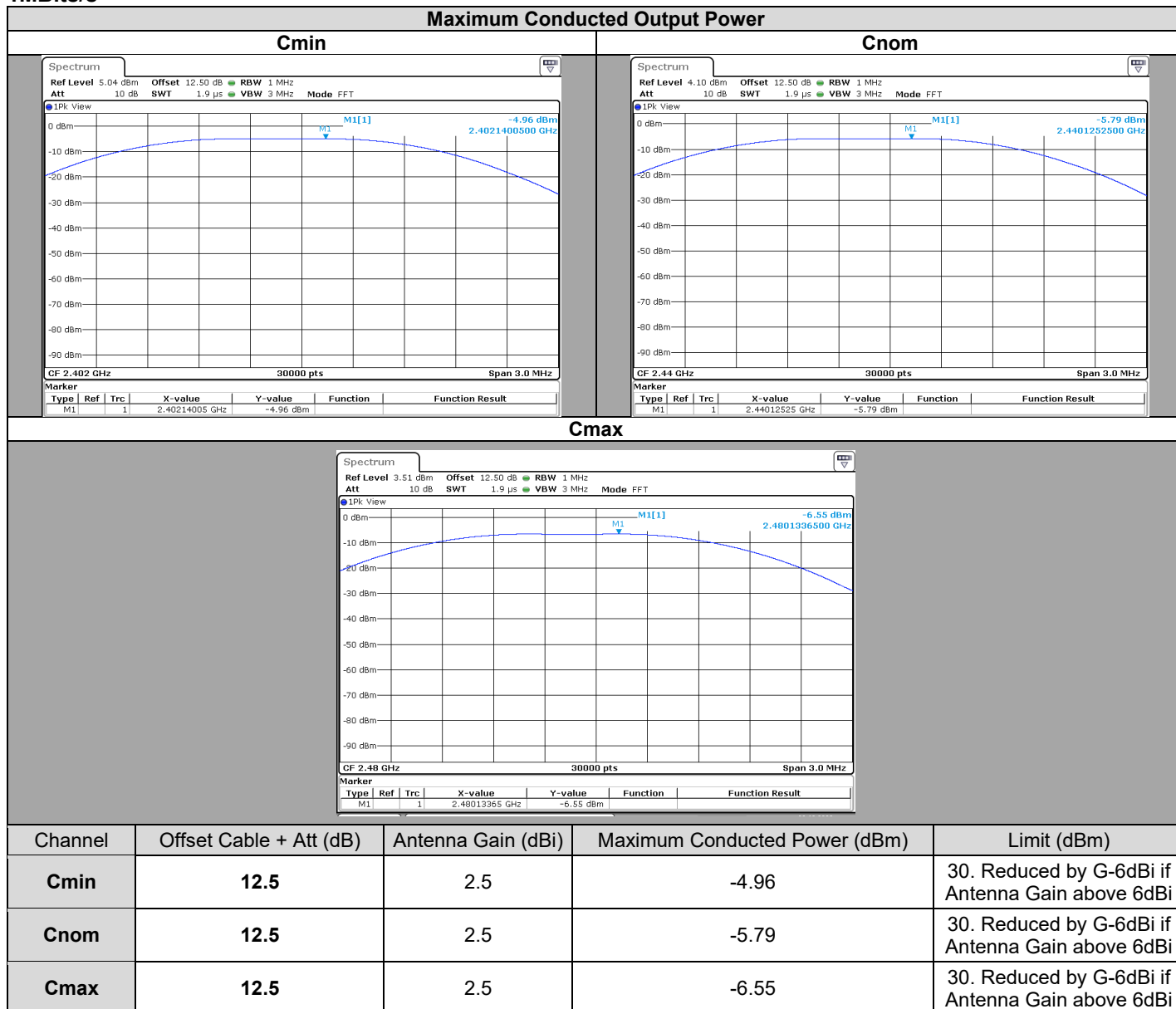
5.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	01/23
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	11/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	12/22
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23

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

5.5. RESULTS

1Mbits/s



5.6. CONCLUSION

Maximum Conducted Output Power measurement performed on the sample of the product **BumbleBee 1001910**, SN: **071240**, 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 : February 2, 2023
Ambient temperature : 22 °C
Relative humidity : 39 %

6.2. TEST SETUP

- The Equipment Under Test is installed:

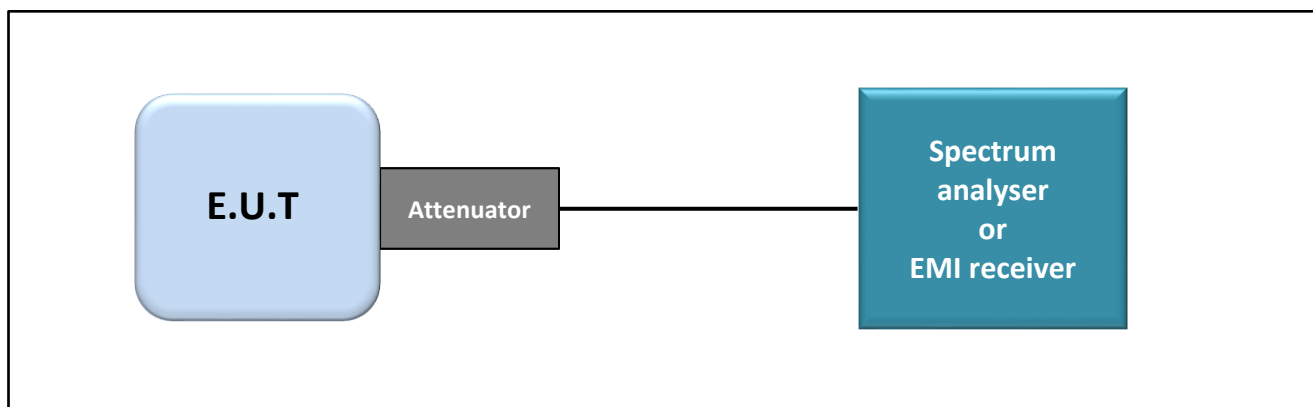
- ☐ On a table
- ☒ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

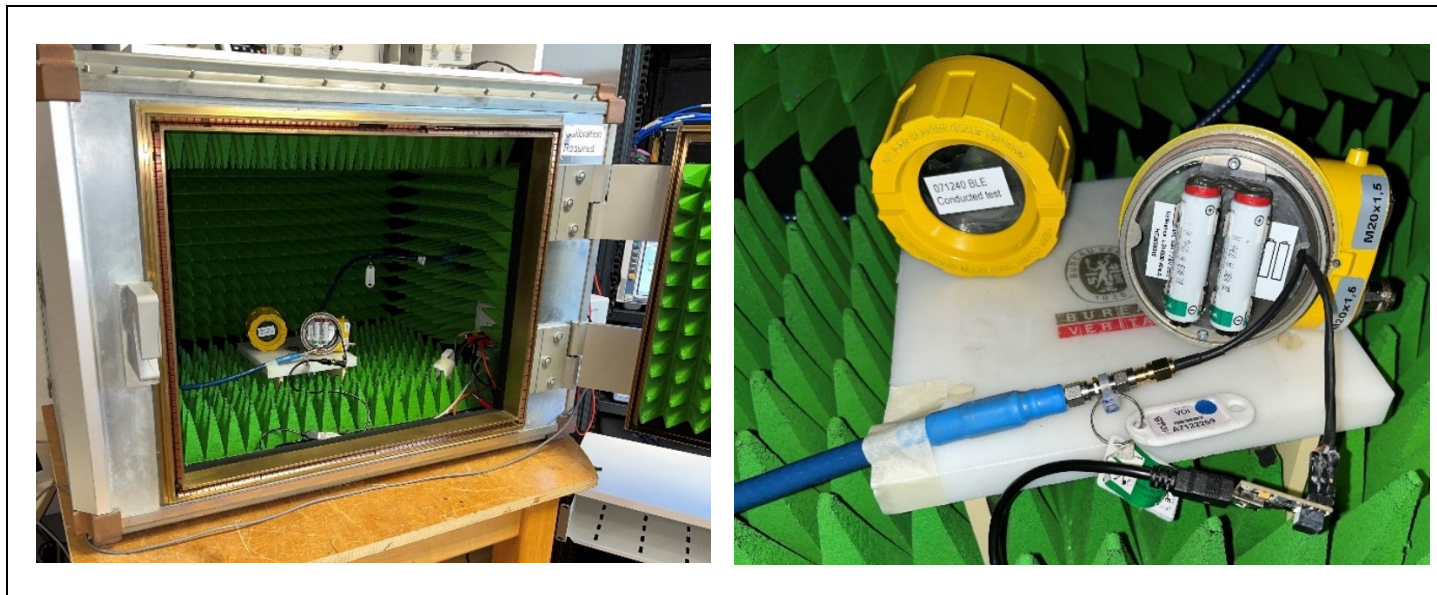
- ☒ Conducted Method
- ☐ Radiated Method

- 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

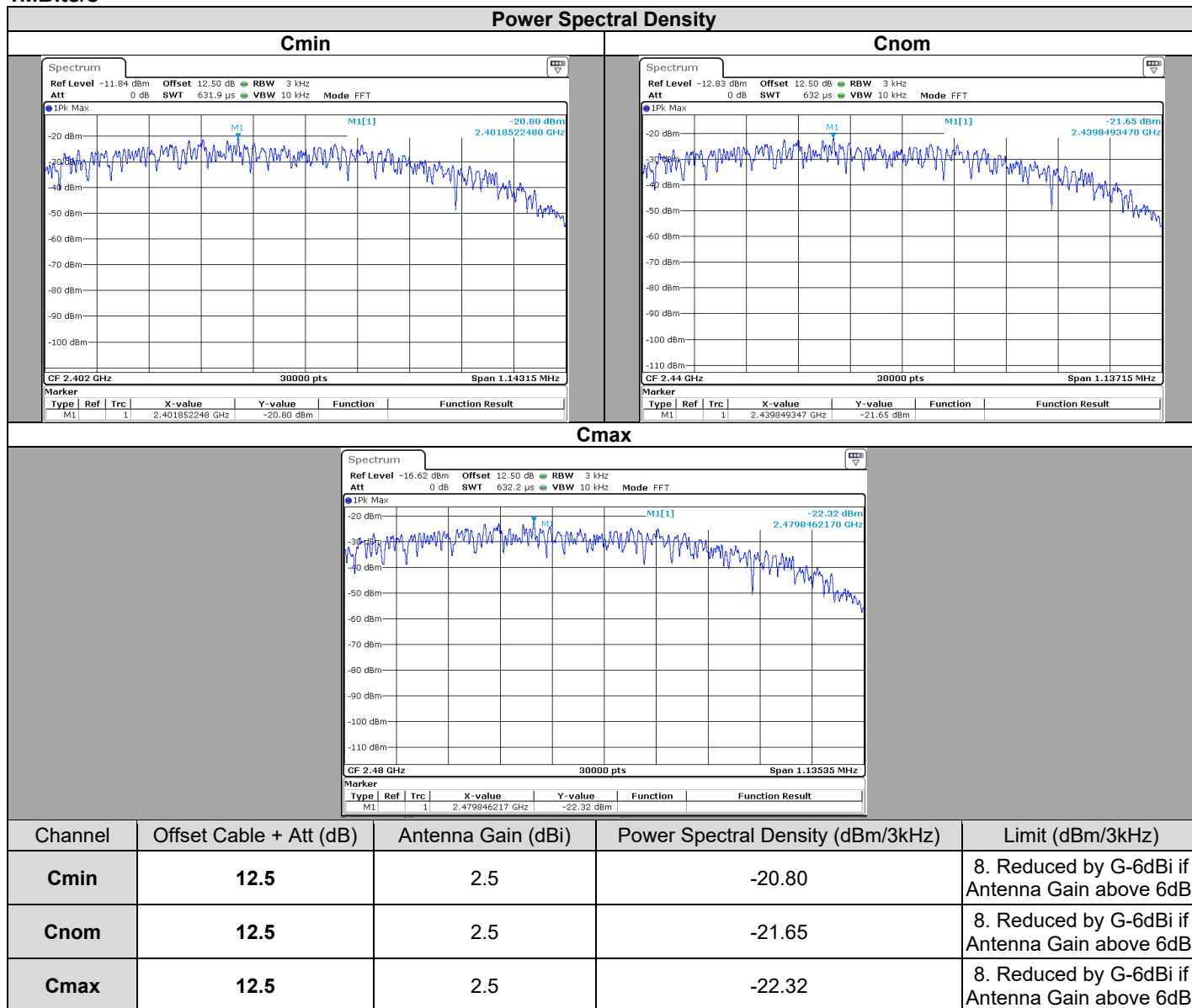
6.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	01/23
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	11/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	12/22
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23

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

6.5. RESULTS

1Mbits/s



6.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product **BumbleBee 1001910**, SN: **071240**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 2** limits.

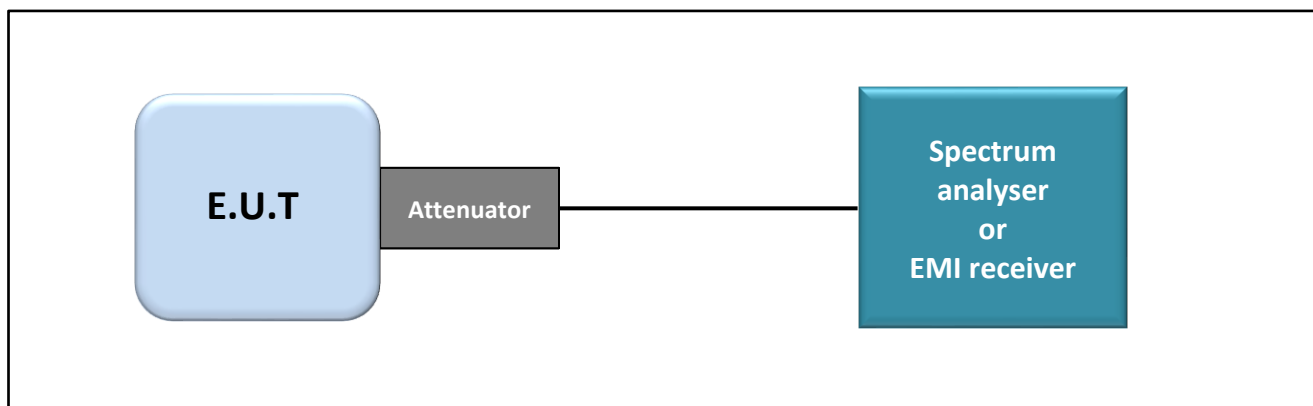
7. UNWANTED EMISSIONS INTO NON-RESTRICTED FREQUENCY BANDS AT THE BAND EDGE

7.1. TEST CONDITIONS

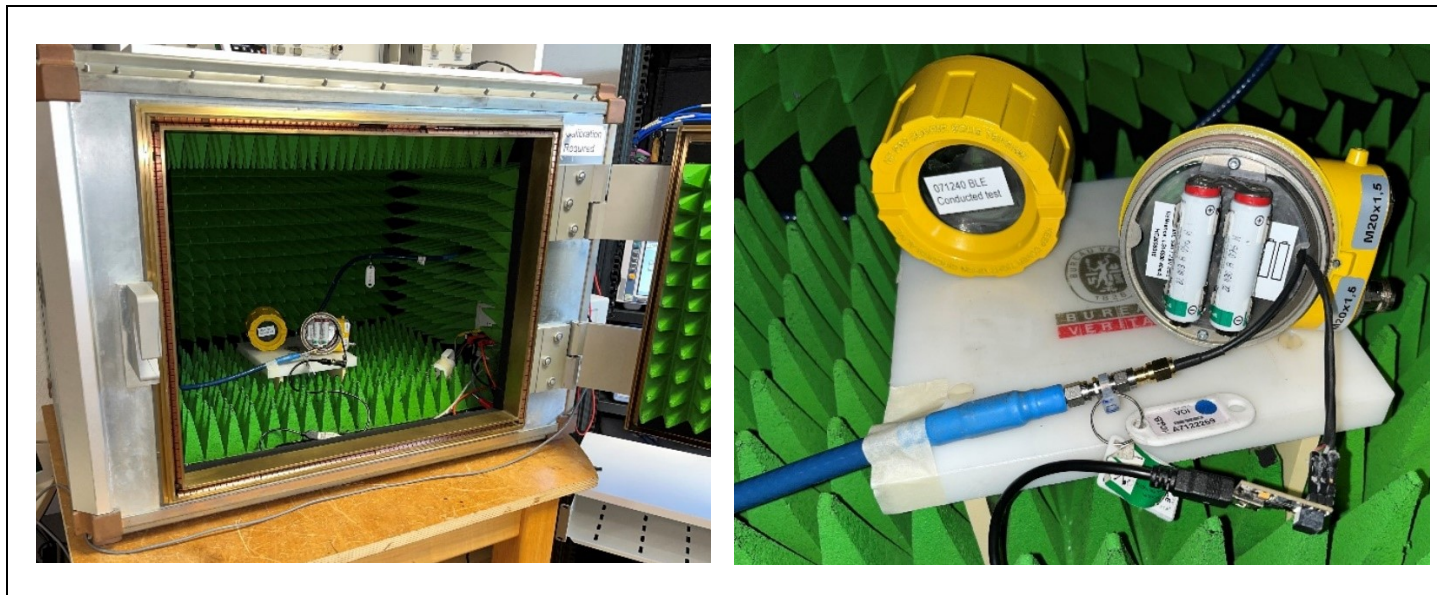
Test performed by : Majid MOURZAGH
Date of test : February 2, 2023
Ambient temperature : 22 °C
Relative humidity : 39 %

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”

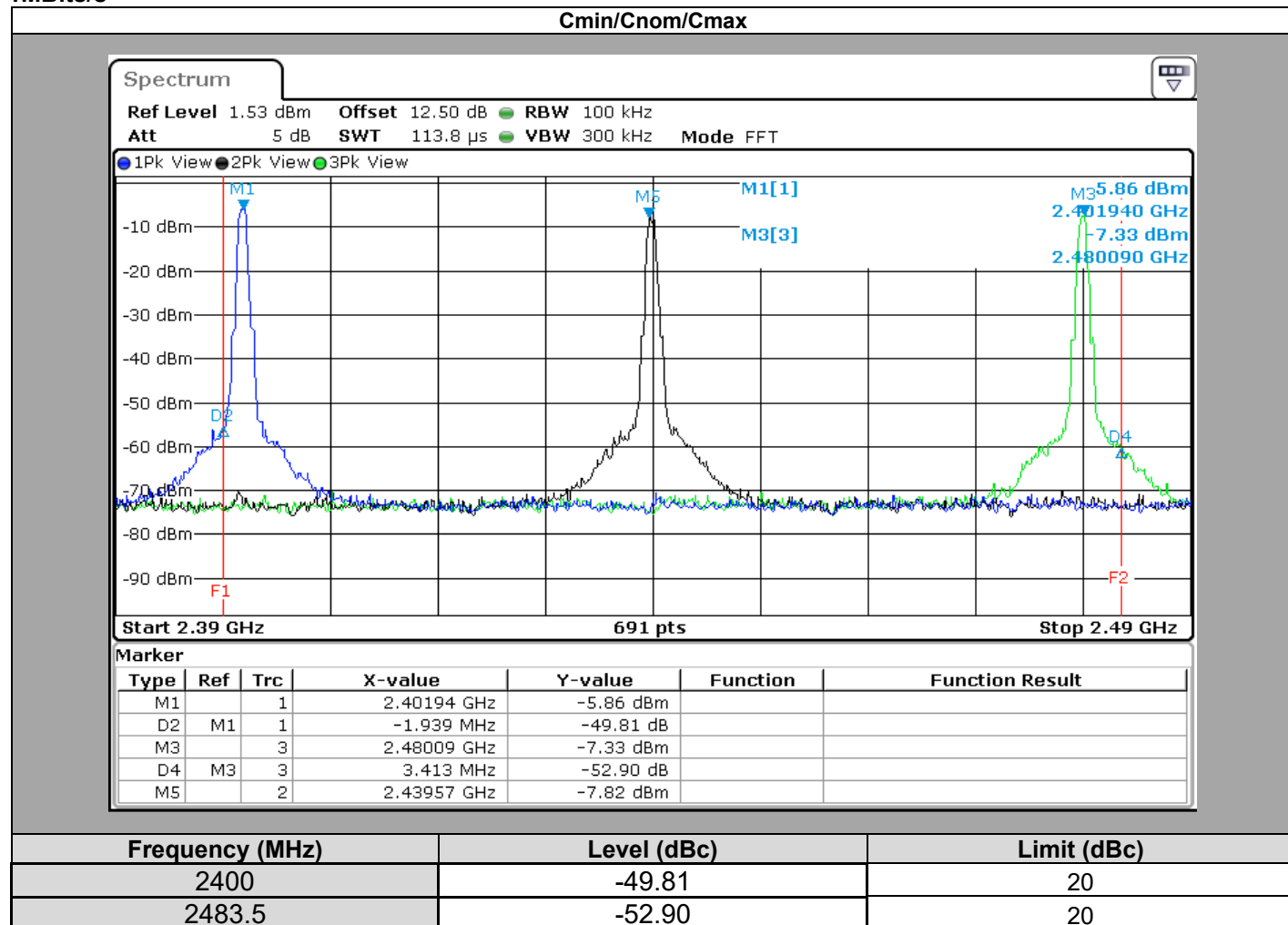
7.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	01/23
Full Anechoic Room	SIEPEL	—	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
SMA 1.5m	SUCOFLEX	18GHz	A5329863	05/22	05/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	11/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	12/22
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23

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

7.5. RESULTS

1Mbits/s



7.6. CONCLUSION

Unwanted Emission into non-restricted frequency bands at the band edge measurement performed on the sample of the product **BumbleBee 1001910**, SN: **071240**, 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 : February 3, 2023
Ambient temperature : 22 °C
Relative humidity : 41 %

8.2. TEST SETUP

- The Equipment under Test is installed:

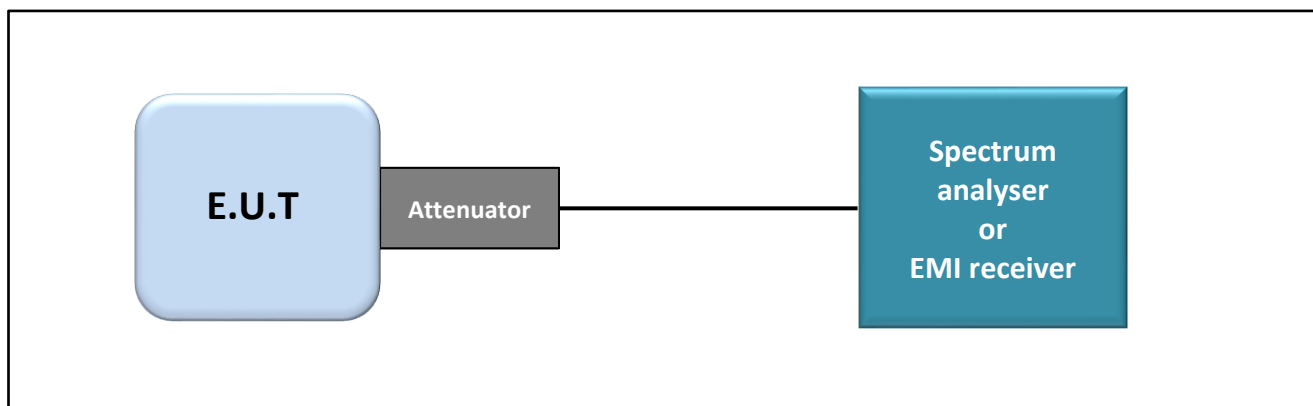
- ☒ On a table
- ☐ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

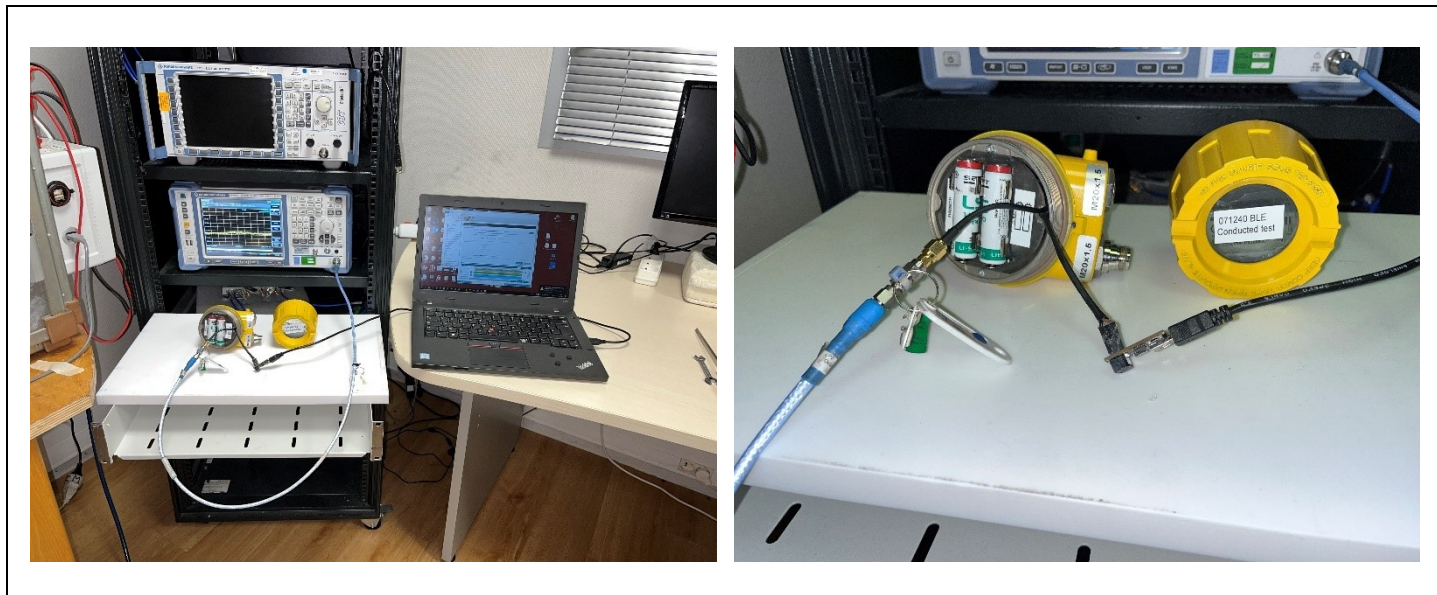
- ☒ Conducted Method
- ☐ Radiated Method

- 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

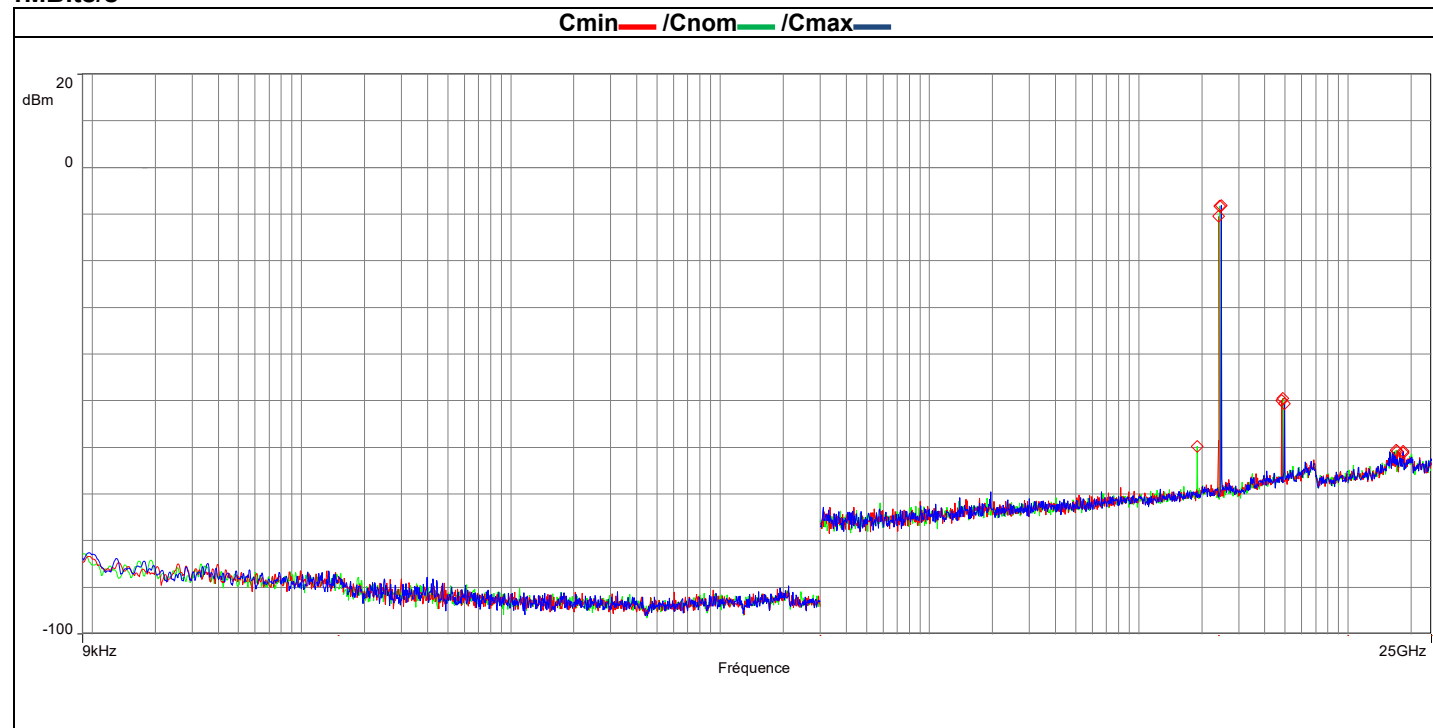
8.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Attenuator 10dB	AEROFLEX	—	A7122269	09/20	01/23
Cable Measure	—	36G	A5329604	09/22	09/23
Multimeter - CEM	FLUKE	87	A1240251	03/21	03/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	11/23
Thermo-hygrometer	TESTO	608-H1	B4204120	12/20	12/22
BAT EMC	NEXIO	v3.21.0.32	L1000115		

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

8.5. RESULTS

1Mbits/s



Frequency (MHz)	Level (dBm)	Level (dBc)	Limit (dBc)
1897	-59.8	51.5	20
2402	-10.5		
4803	-50.0	39.5	20
17154	-60.8	50.4	20
18324	-61.2	50.7	20
2440	-8.3		
4880	-49.5	41.2	20
16963	-60.6	52.3	20
2480	-8.1		
4960	-50.7	42.6	20
18314	-60.8	52.6	20

8.6. CONCLUSION

Unwanted Emission into non-restricted frequency bands measurement performed on the sample of the product **BumbleBee 1001910**, SN: **071240**, 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. UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS

9.1. TEST CONDITIONS

Test performed by : Majid MOURZAGH
 Date of test : February 1, 2023
 Ambient temperature : 21 °C
 Relative humidity : 40 %

9.2. TEST SETUP

Test procedure:

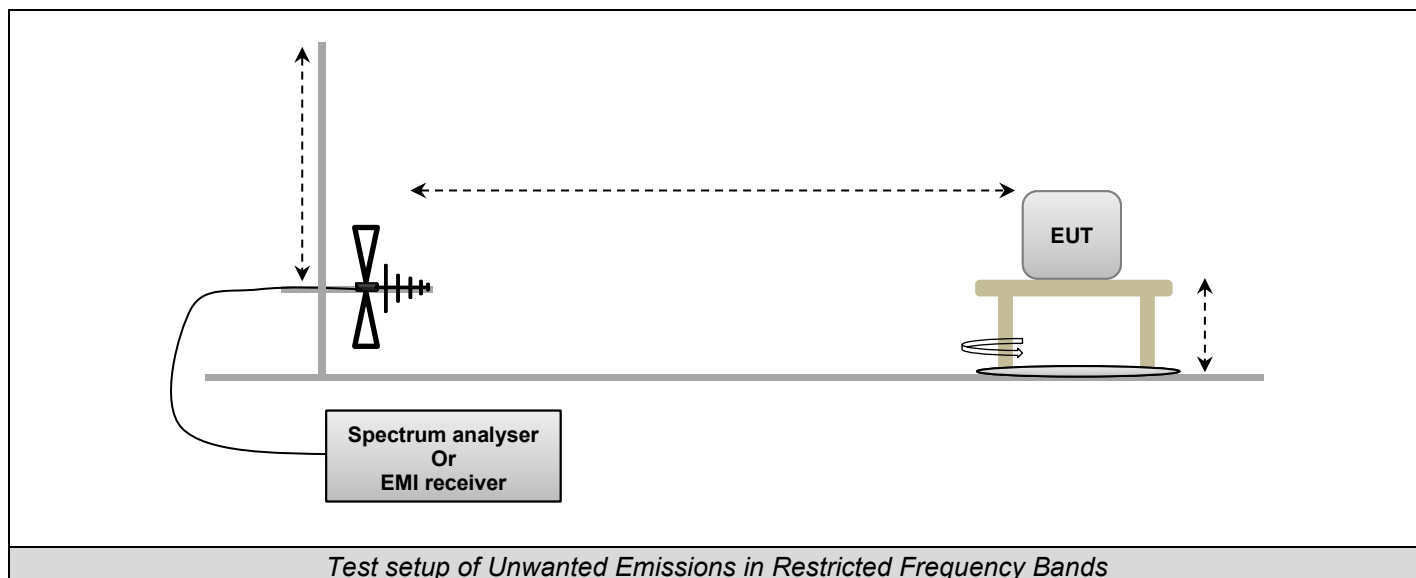
☒ ANSI C63.10 & FCC Part 15 subpart C

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

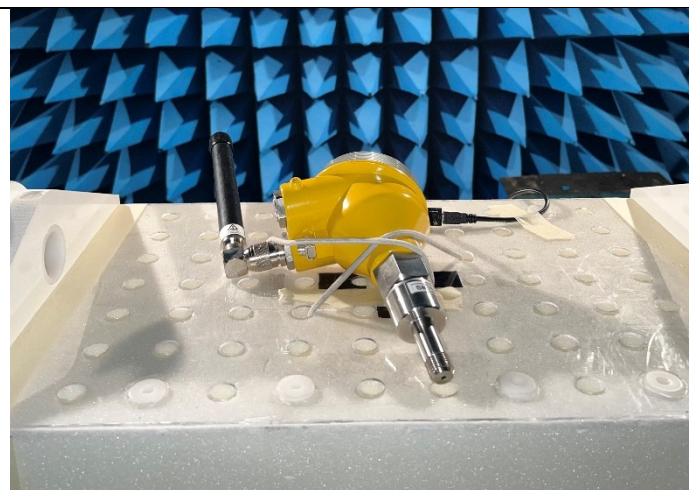
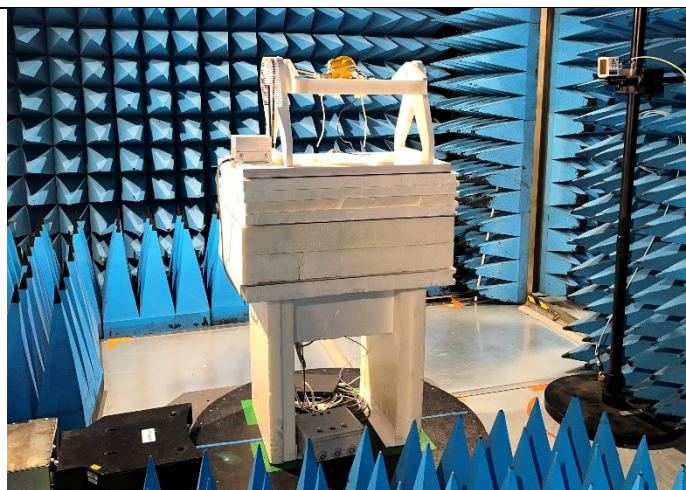
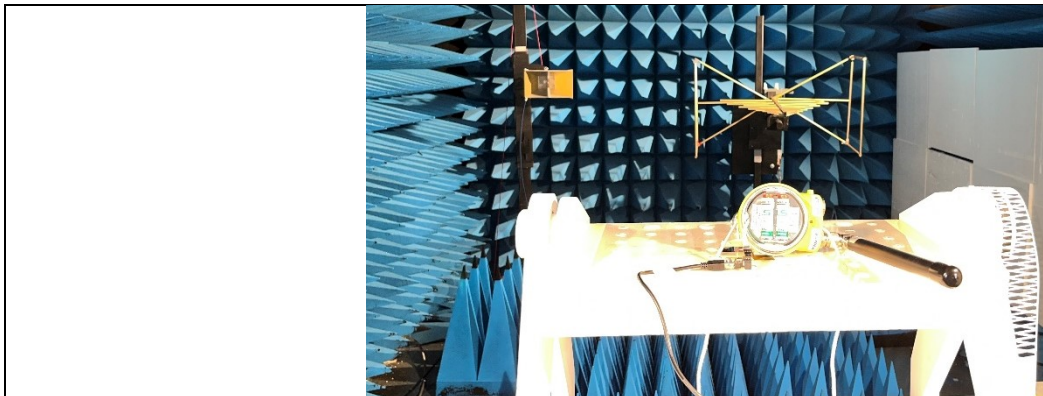
Frequency range:	9kHz to 30MHz	
Test:	Pre-Characterization	Qualification
Antenna Polarization:	Parallel, Perpendicular and Ground parallel	
Antenna Height:	1m	1m
Antenna Type:	Loop	
RBW Filter:	200Hz below 150kHz / 9kHz above 150kHz	
Maximization:	Turntable rotation of 360 degrees range	
EUT height:	1.5m	0.8m
Test site:	Full Anechoic Chamber	Open Area 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	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Full Anechoic Chamber
Distance EUT - Antenna:	3m	3m
Detector:	Peak	QPeak

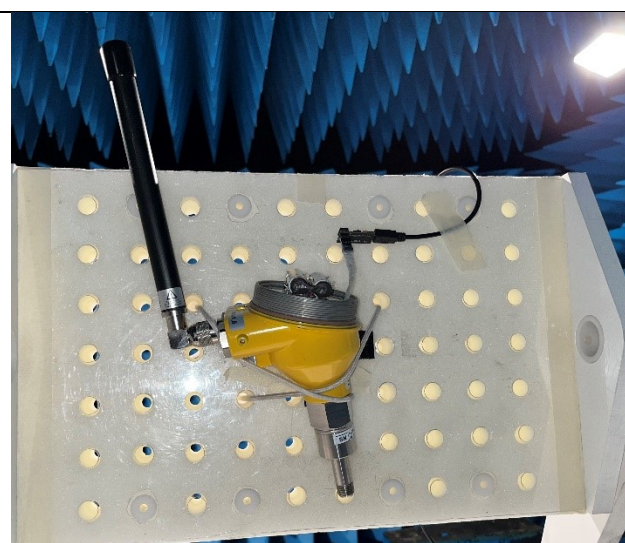
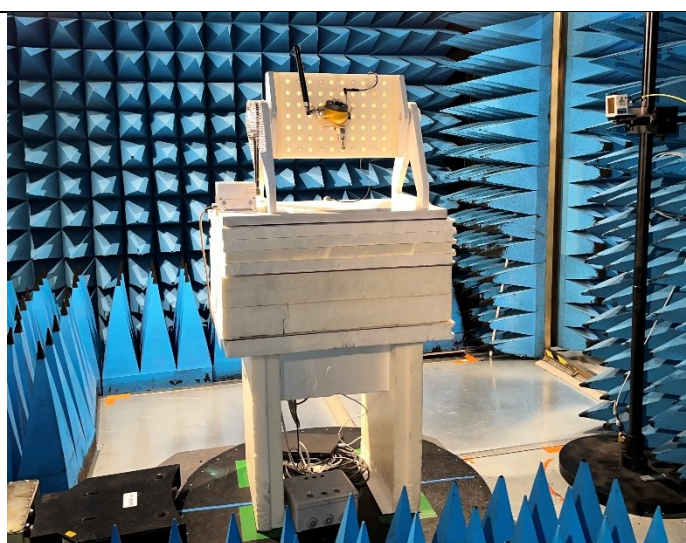
Frequency range:	1GHz to 25GHz	
Test:	Pre-Characterization	Qualification
Antenna Polarization:	Horizontal and Vertical	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	Centered on EUT (§6.6.5 ANSI C63-10)
Antenna Type:	Bi-Log	
RBW Filter:	120kHz	
Maximization:	Turntable rotation of 360 degrees range	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Full Anechoic Chamber
Distance EUT - Antenna:	3m	3m
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.

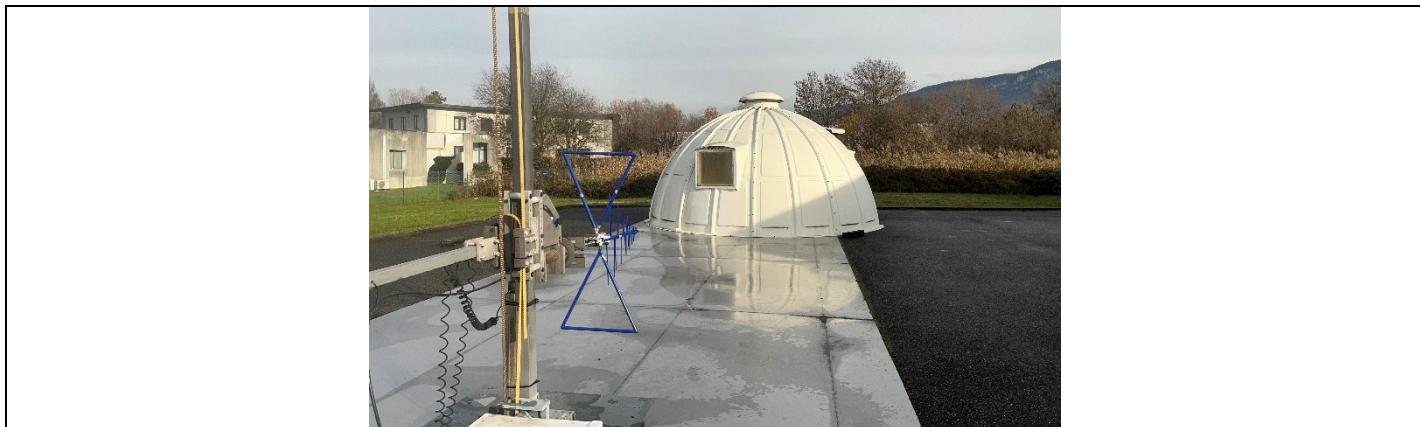


Axis XY on FAR



Axis Z on FAR

Photograph of Unwanted Emissions in Restricted Frequency Bands



Axis XY on OATS



Axis Z on OATS

9.3. 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

9.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
BAT EMC	NEXIO	v3.21.0.32	L1000115		
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
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	01/23
Multimeter - CEM	FLUKE	189	A1240171	09/21	09/23
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
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	01/23
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
SMA 1.5m	SUCOFLEX	18GHz	A5329864	09/22	09/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	11/23

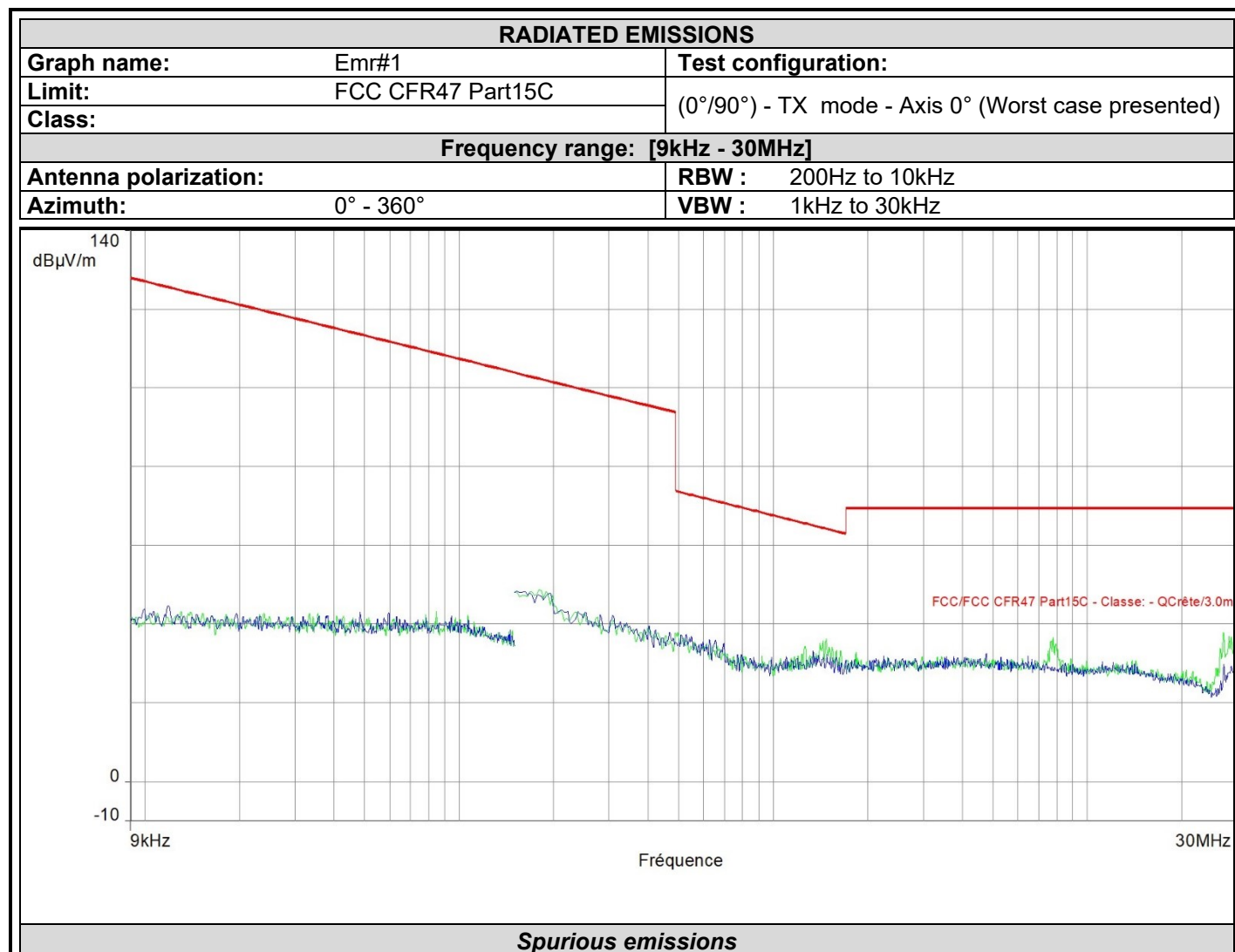
9.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

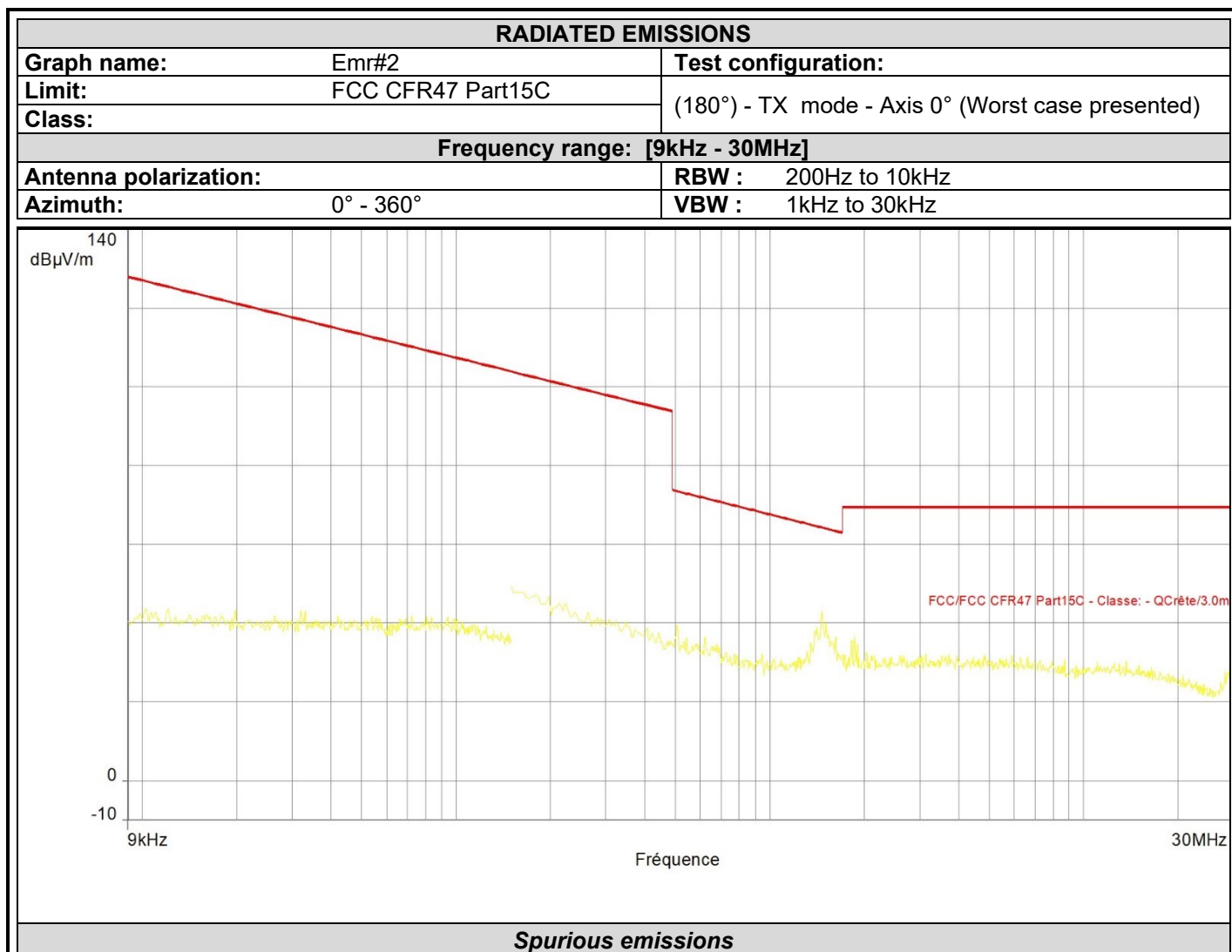
9.6. RESULTS

9.6.1. 9kHz to 30MHz

Graphs – Pre characterization:



No significant frequency observed



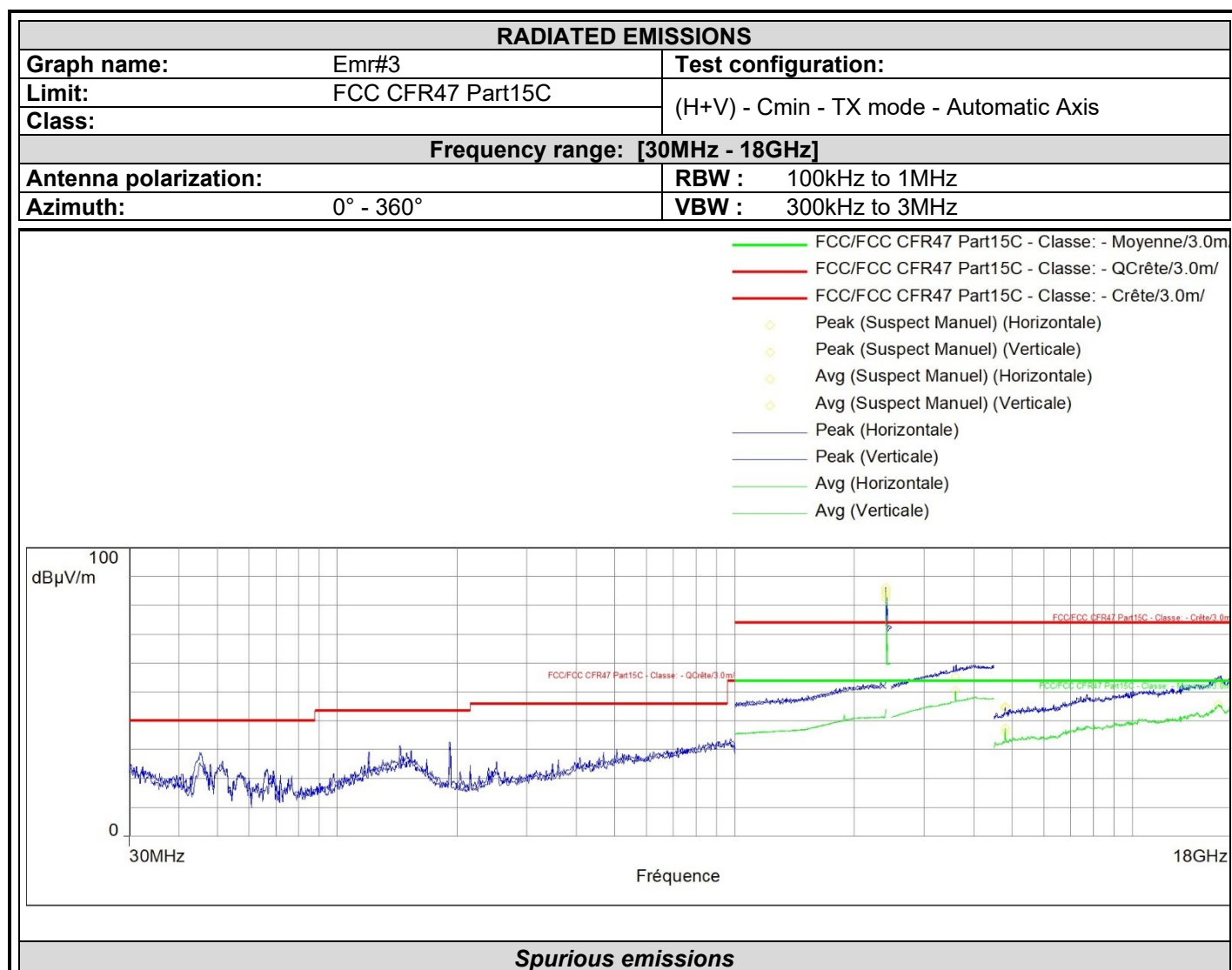
No significative frequency observed

Final measurement:

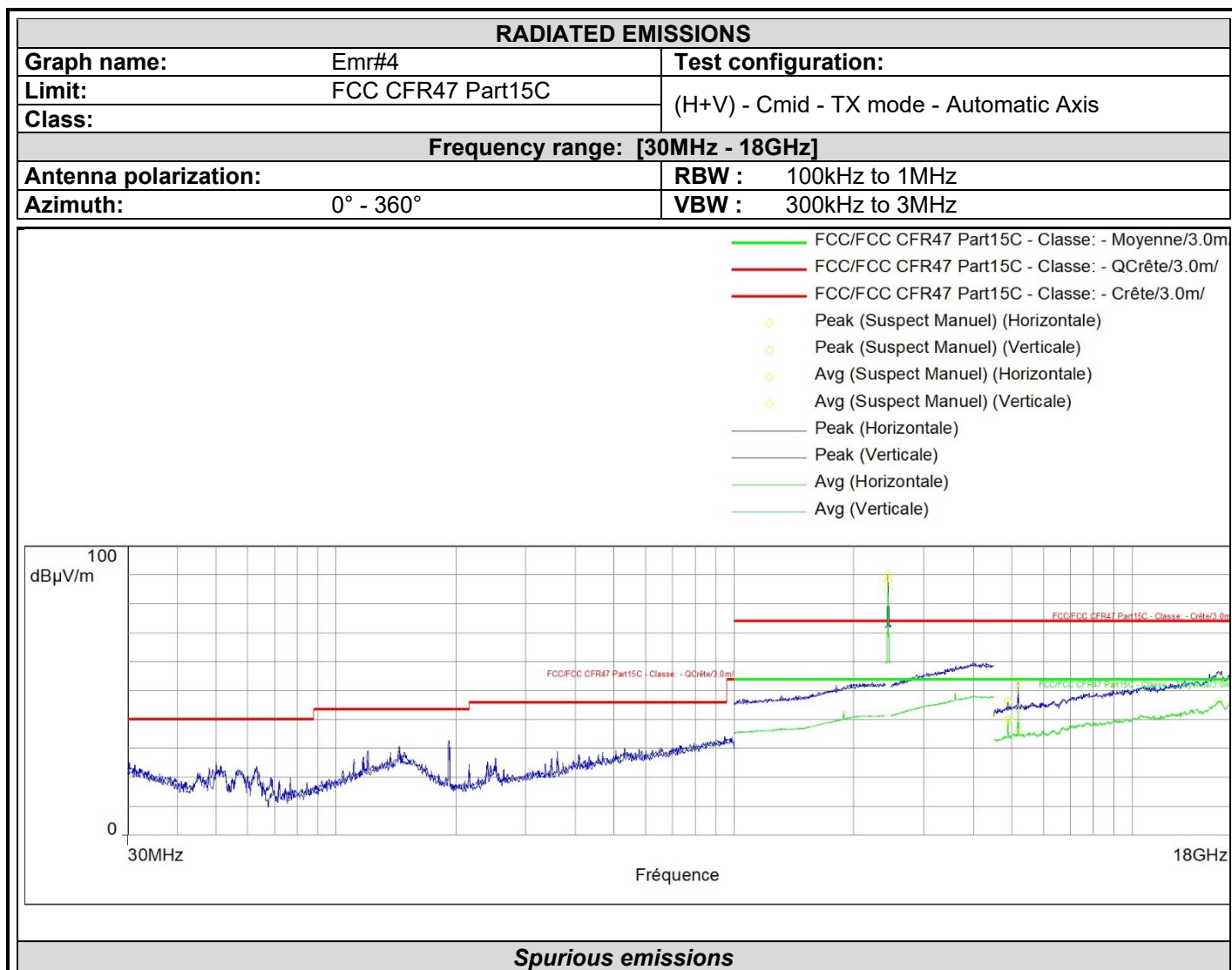
9kHz to 30MHz					
Polarization	Frequency (MHz)	Peak Level (dBµV/m)	QPeak Level (dBµV/m)	Limit (dBµV/m)	Margin QPeak (dBµV/m)
all emissions were greater than 20 dB below the limit					

9.6.2. 30MHz to 18GHz

Graphs – Pre characterization:



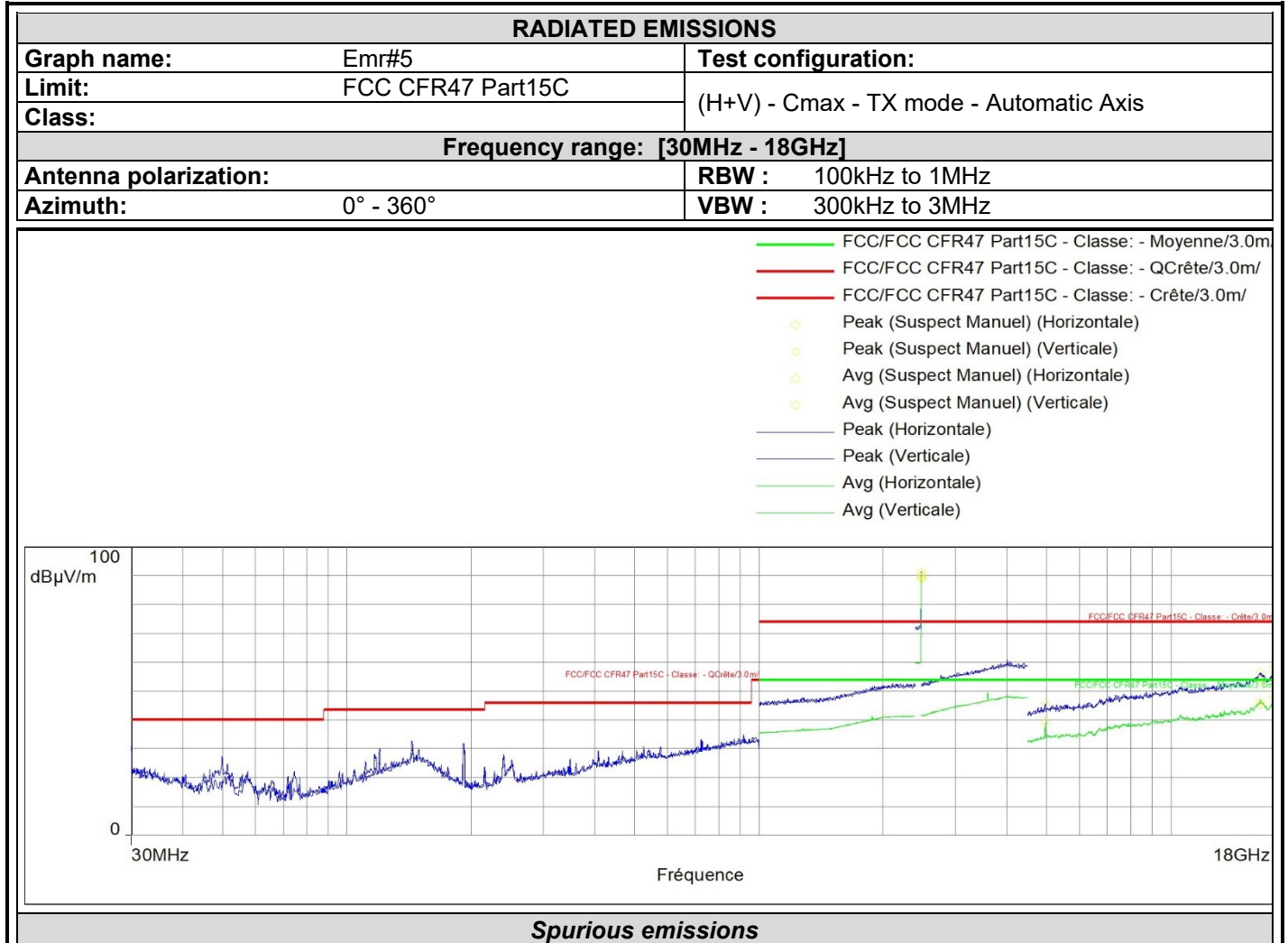
Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Lim.Q-Peak (dBμV/m)	Polarization	Correction (dB)
2402.004	86.1	/	84.0	/	/	Horizontal	35.4
3599.834	55.1	74.0	50.5	54.0	/	Horizontal	39.9
4005.151	59.3	74.0	47.7	54.0	/	Horizontal	41.2
4803.750	44.3	74.0	37.5	54.0	/	Horizontal	-15.1
16467.750	54.0	74.0	45.7	54.0	/	Horizontal	2.9
4803.750	44.8	74.0	36.0	54.0	/	Vertical	-15.1
17952.750	55.5	74.0	47.2	54.0	/	Vertical	4.9
2401.962	85.1	/	82.5	/	/	Vertical	35.4



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Lim.Q-Peak (dBμV/m)	Polarization	Correction (dB)
2439.996	90.0	/	87.9	/	/	Horizontal	35.4
3988.212	59.5	74.0	47.6	54.0	/	Horizontal	41.1
4879.688	46.2	74.0	40.1	54.0	/	Horizontal	-13.8
16499.812	55.0	74.0	46.4	54.0	/	Horizontal	4.2
17941.781	55.9	74.0	48.7	54.0	/	Horizontal	6.8
4879.688	46.4	74.0	39.8	54.0	/	Vertical	-13.8
5178.375	50.4	74.0	43.6	54.0	/	Vertical	-13.5
5179.219	53.2	74.0	36.3	54.0	/	Vertical	-13.5
2439.955	88.4	/	85.2	/	/	Vertical	35.4



L C I E



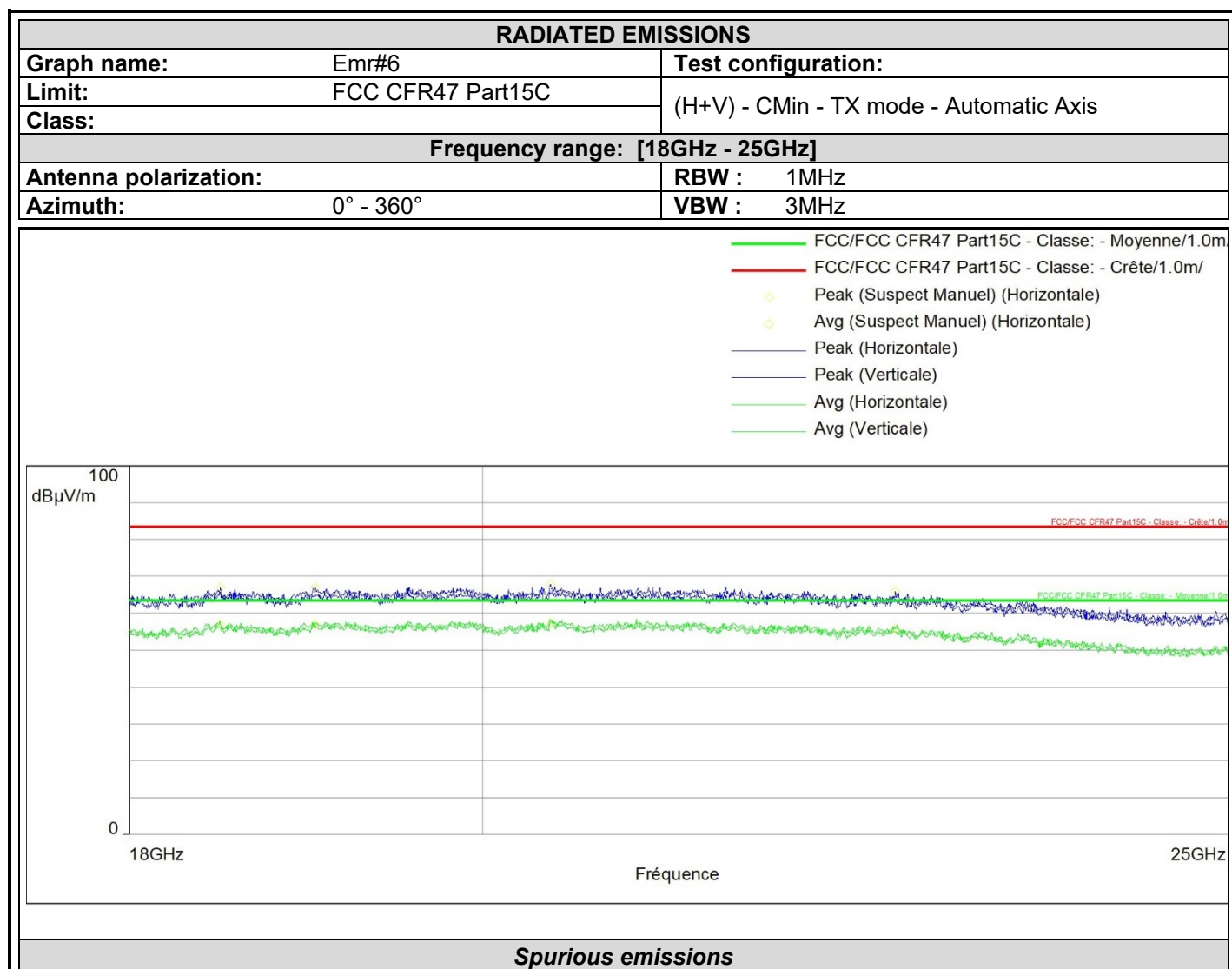
Frequency (MHz)	Peak (dBµV/m)	Lim.Peak (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Lim.Q-Peak (dBµV/m)	Polarization	Correction (dB)
2480.035	91.4	/	89.4	/	/	Horizontal	35.4
4011.200	60.7	74.0	47.9	54.0	/	Horizontal	41.2
4959.844	45.7	74.0	39.3	54.0	/	Horizontal	-13.7
16496.438	53.9	74.0	46.2	54.0	/	Horizontal	4.2
17943.469	56.8	74.0	48.3	54.0	/	Horizontal	6.8
16469.438	56.6	74.0	45.3	54.0	/	Vertical	4.1
17834.625	58.4	74.0	47.8	54.0	/	Vertical	6.2
2479.993	90.3	/	88.9	/	/	Vertical	35.4

Final measurement:

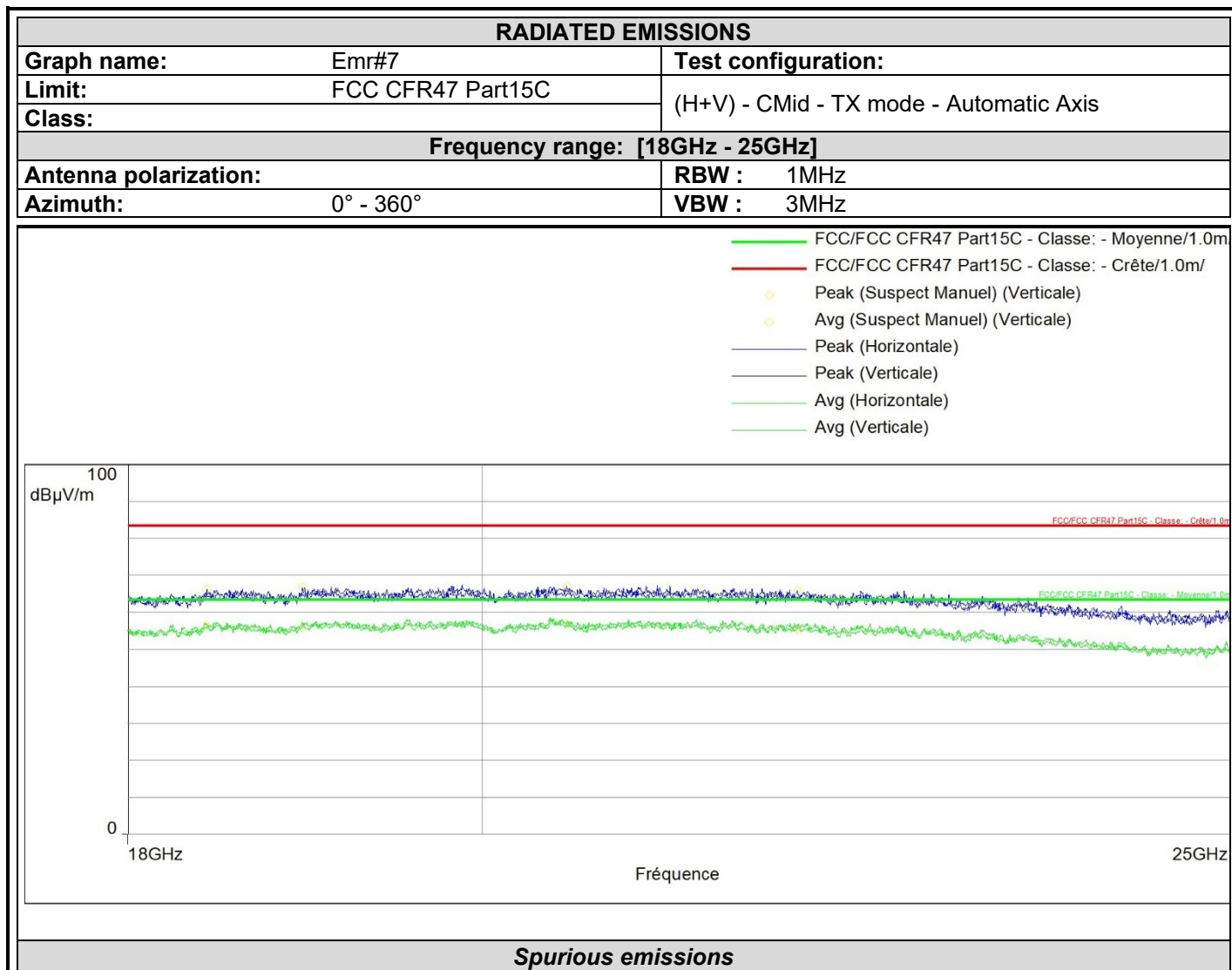
30MHz to 18GHz					
Polarization	Frequency (MHz)	Peak Level (dBµV/m)	QPeak Level (dBµV/m)	Limit (dBµV/m)	Margin QPeak (dBµV/m)
all emissions were below the limit					

9.6.3. 18GHz to 25GHz

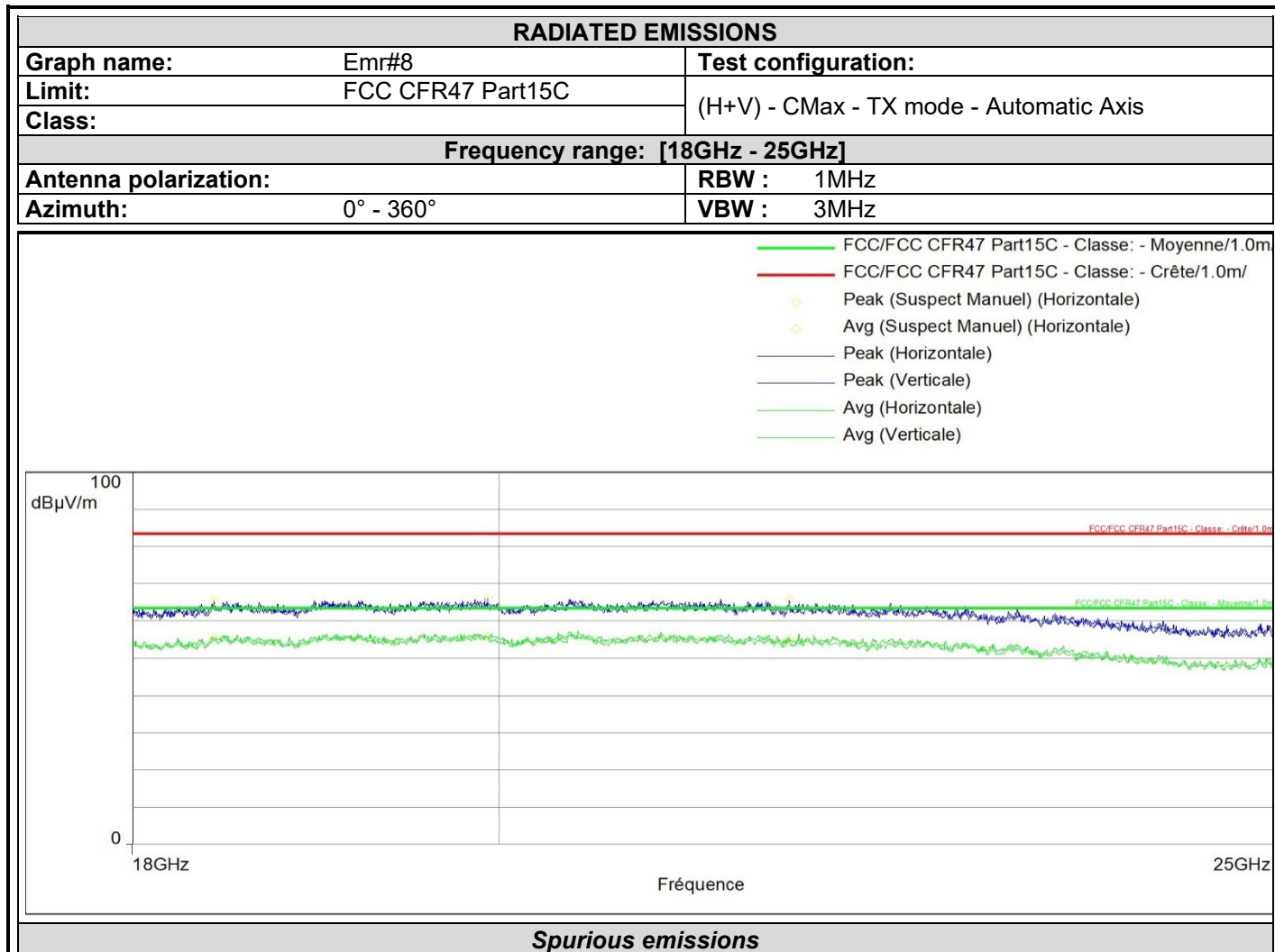
Graphs – Pre characterization:



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
18493.500	66.9	83.5	57.1	63.5	Horizontal	3.2
19024.625	67.0	83.5	57.0	63.5	Horizontal	3.8
20406.250	67.8	83.5	57.4	63.5	Horizontal	3.6
22613.000	66.0	83.5	55.9	63.5	Horizontal	2.6



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
18424.375	66.3	83.5	56.6	63.5	Vertical	3.0
18957.250	66.9	83.5	55.9	63.5	Vertical	3.2
20506.875	67.2	83.5	56.9	63.5	Vertical	3.3
21958.500	66.1	83.5	55.4	63.5	Vertical	2.2



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Polarization	Correction (dB)
18425.250	65.5	83.5	55.6	63.5	Horizontal	1.6
19931.125	66.1	83.5	55.9	63.5	Horizontal	1.7
21737.125	65.6	83.5	55.3	63.5	Horizontal	1.2

Final measurement:

18GHz to 25GHz					
Polarization	Frequency (MHz)	Peak Level (dBμV/m)	QPeak Level (dBμV/m)	Limit (dBμV/m)	Margin QPeak (dBμV/m)
all emissions were below the limit					

9.7. CONCLUSION

Unwanted Emissions in Restricted Frequency Bands measurement performed on the sample of the product 1001910, Sn : 070070 in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.209 & RSS-Gen** limits.

10. 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.



L C I E

11. ANNEX 1

Bumblebee Pressure products are ordered following a series of Letter and Numbers.
The part Number is that will be used as a SN is the first 7 characters. The last 2 characters is only related to accessories.

Détails de la gamme / Range details									
P	*	*	*	*	*	*	*	*	*
Emballage / Packing									
1 = Pelicase / Pelicase									
2 = Carton / Cardboard									
Adapteur / Adaptor									
1 = Aucun / None									
2 = 1/2 NPT 316L									
3 = 1/2 NPT Inconel									
4 = Autre (A préciser) / Other (to be specified)									
Certificat / Certificate									
1 = Aucun / None									
2 = ATEX / IECEx / UKCA									
3 = US									
Antenne / Antenna									
1 = EU – Europe / EU – Europe									
2 = Monde / World									
3 = EU – Europe Déporté / EU – Europe Deported									
4 = Monde Dépoté / World Deported									
Région d'Installation / Installation Region									
1 = EU – Europe / EU – Europe									
2 = AS – Asia / AS – Asia									
3 = US – Amérique du Nord / US – North America									
4 = AU – Australie / AU – Australia									
5 = Autre / Other									
Boîtier / Housing									
1 = Al couleur Signal Yellow / Al Signal Yellow Color									
2 = Al couleur White Alu / Al White Alu Color									
3 = 316 L pas de couleur / 316 L no color									
4 = Al couleur spécifique / Aluminum Specific color									
Type de Capteur / Sensor Type									
1 = Standard / Standard									
2 = Effleurant / Flush									
3 = Pression Différentielle / Differential Pressure									
4 = NA									
Environnement / Environment									
1 = H2 : Application Hydrogène / Hydrogen application									
2 = Application Standard / Standard application									
Pression d'Opération / Operating Pressure									
1 = 0 - 10 bar									
2 = 0 - 100 bar									
3 = 0 - 200 bar									
4 = 0 - 400 bar									
5 = 0 - 1000 bar									
6 = 0 - 600 bar									
7 = NA									
8 = NA									
9 = -0.3 - 0.3 bar									
Matériel en contact avec le Fluide / Material in contact with fluid									
1 = SS 316 L									
2 = Inconel / Hastelloy C-276									
Type du produit / Product Type									
P = Pression / Pressure									

