



LCIE

Bluetooth Low Energy Template: Release September 27, 2019

TEST REPORT

N°: 163396-742286-A(FILE#1012336)

Version : 02

Subject

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

Issued to

KROHNE S.A.S
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26103- Romans sur Isère Cedex
FRANCE

Apparatus under test

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

Liquid Level Switch
DANFOSS
KROHNE
LLS 4000 / LLS 4000U
LLS 4000
Radio 2
Q6BSWSILBT01
1991D-SWSILBT01

Conclusion

See Test Program chapter

Test date

September 23, 2019 to September 27, 2019

Test location

Fontenay Aux Roses

Test Site

6500A-1 & 6500A-3

Sample receipt date

September 23, 2019

Composition of document

42 pages

Document issued on

February 26, 2020

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PUBLICATION HISTORY

Version	Date	Author	Modification
01	October 25, 2019	Gaetan DESCHAMPS	Creation of the document
02	February 26, 2020	Gaetan DESCHAMPS	Adding of FCCID and IC

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 (2020)
- RSS 247 Issue 2
- RSS Gen Issue 5
- KDB 558074 D01 DTS Meas Guidance v05r02
- 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

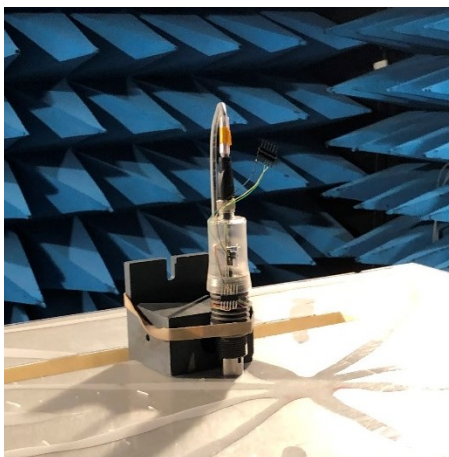
2. EQUIPMENT UNDER TEST: CONFIGURATION (DECLARED BY PROVIDER)

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):
DANFOSS LLS 4000

Serial Number: Radio 2

Difference between LLS 4000 and LLS 4000U is only connector gaz type and type NPT for second.
Electronical is the same, only LLS 4000 is tested.



Equipment Under Test

Power supply:

During all the tests, EUT is supplied by V_{nom} : 24VDC

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

Name	Type	Rating	Reference / Sn	Comments
Supply1	☐ AC ☒ DC ☐ Battery	18 to 30VDC 80mA	-	-

Voltage table used (for Power Line Conducted Emissions):

Type	Measurement performed:	
☒ AC	☒ 120VAC/60Hz	☒ 240VAC/50Hz
☐ DC	☐ +12VDC	☐ -....VDC
☐ Battery	☐ +3.6VDC	☐ -....VDC
☐ USB (Laptop auxiliary)	☐ 120VAC/60Hz (Laptop auxiliary)	☐ 240VAC/50Hz(Laptop auxiliary)

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
1	G 3/4"	2	☐	☐	☒	-

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Laptop	Lenovo L470	-	-
Power Supply DC	TDK-Lambda	GEN150CW	Only used in §9 AC power...Emissions



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: 0.5dBi			
Beam forming gain:	No			
Receiver chains	1			
Type of equipment:	☒ Stand-alone	☐ Plug-in	☐ Combined	
Ad-Hoc mode:	☐ Yes		☒ No	
Adaptivity mode:	☒ Yes (Load Based)	☐ Off mode	☐ No	
	Clear Channel Assessment Time:			Xµs
Duty cycle:	☒ Continuous duty	☐ Intermittent duty	☐ 100% duty	
Equipment type:	☒ Production model		☐ Pre-production model	
Operating temperature range:	Tmin:	☐ -20°C	☐ 0°C	☒ -40°C
	Tnom:	20°C		
	Tmax:	☐ 35°C	☐ 55°C	☒ 65°C
Type of power source:	☐ AC power supply	☒ DC power supply		☐ Battery
Operating voltage range:	Vnom:	☐ 230V/50Hz	☒ 24Vdc	
Geo-location capability:	☐ Yes (The geographical location determined by the equipment is not accessible to the end user as defined in section 4.3.2.12.2 of ETSI EN 300 328 V2.1.1 standard)		☒ No	
Minimum performance criteria for Receiver blocking test:	☒ PER less than or equal to 10%		☐ Alternative performance criteria (4)	

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

DATA RATE		
Data Rate (Mbps)	Modulation Type	Worst Case Modulation
1	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()
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 “HTerm” are used to set the product:

a. – See document “QuicSetup BLE Tests”(provided by customer) for the command used during test.

Hardware information		
Hardware (Sensor board):	V :	BOM 4006345101c
Hardware (Converter board):	V :	BOM 4005515101d
Software EUT (if applicable)	V :	6.0
Test Software (if applicable):HTerm	V. :	0.8.1

QuickSetup_BLL Tests (Mode de compatibilité - Word)

TION MISE EN PA RÉFÉRENCE PUBLIPOST RÉVISION AFFICHAGE IBM CONNE CRÉATION DISPOSITION MOUFI...>

Aa Aa- Récherche

AaBbCc AaBbC AaBbCdd Remplacer

Légende M3 Normal Sélectionner

Paragraphe Style Modification

	Trame à envoyer	Réception
Allumer les leds	31 36 30 30 37 30 30 46 30 0A	ACK\r\n
Eteindre les leds	31 36 30 30 30 37 30 30 30 30 0A	ACK\r\n
HCI Reset	33 32 30 0A	ACK\r\n
Set power BLE level : max	33 34 30 30 11 0A	ACK\r\n
Continuous modulation Tx :	33 33 30 31 01 00 0A	ACK\r\n
TestMode = continuous modulation Channel = 0 Length_of_Test_Data = 0 Packet_payload = 0		
Continuous modulation Tx :	33 33 30 31 01 13 0A	ACK\r\n
TestMode = continuous modulation Channel = 19 Length_of_Test_Data = 0 Packet_payload = 0		
Continuous modulation Tx :	33 33 30 31 01 27 0A	ACK\r\n
TestMode = continuous modulation Channel = 39 Length_of_Test_Data = 0 Packet_payload = 0		
Continuous modulation Tx :	33 33 30 31 04 00 0A	ACK\r\n
TestMode = CW at centerfreq Channel = 00 Length_of_Test_Data = 0 Packet_payload = 0		
Continuous modulation Tx :	33 33 30 31 04 13 0A	ACK\r\n
TestMode = CW at centerfreq Channel = 19 Length_of_Test_Data = 0 Packet_payload = 0		
Continuous modulation Tx :	33 33 30 31 04 27 0A	ACK\r\n
TestMode = CW at centerfreq Channel = 39 Length_of_Test_Data = 0 Packet_payload = 0		
Disable the continuous mode	33 33 30 30 0A	ACK\r\n
Receiver test Channel 00	33 35 30 31 00 0A	ACK\r\n
Receiver test Channel 19	33 35 30 31 13 0A	ACK\r\n
Receiver test Channel 39	33 35 30 31 27 0A	ACK\r\n
End the receiver test	33 35 30 30 0A	ACK\r\n

Sequence Overview

Disconnect Port COM4 R Baud 19200 Data 8 Stop 1 Parity None CTS Flow control

Rx 156 Reset Tx 221 Reset Count 0 17 Reset Hexline at None Show newline characters

Clear received Asc Hex Dec Bin Save output Clear at 0 Newline every ... characters Autocrroll Show errors

Received Data

1 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

NACKwACKw0 wNACKwACKw00 wACKw0000000wACKw0000NACKwACKw0000

Selection (-)

Input control Input options

Clear transmitted Asc Hex Dec Bin Send on enter None Send file DTR RTS

Type HEX | ASend

Transmitted data

1 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

3300w3501w3300w33010uw3501w3300w3501uw3300w33010uw3300w33010w

2.3. EQUIPMENT LABELLING



2.4. EQUIPMENT MODIFICATION

☒ None ☐ Modification:

3. OCCUPIED BANDWIDTH

3.1. TEST CONDITIONS

Test performed by : Gaetan DESCHAMPS
Date of test : September 25, 2019
Ambient temperature : 24 °C
Relative humidity : 38 %

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:

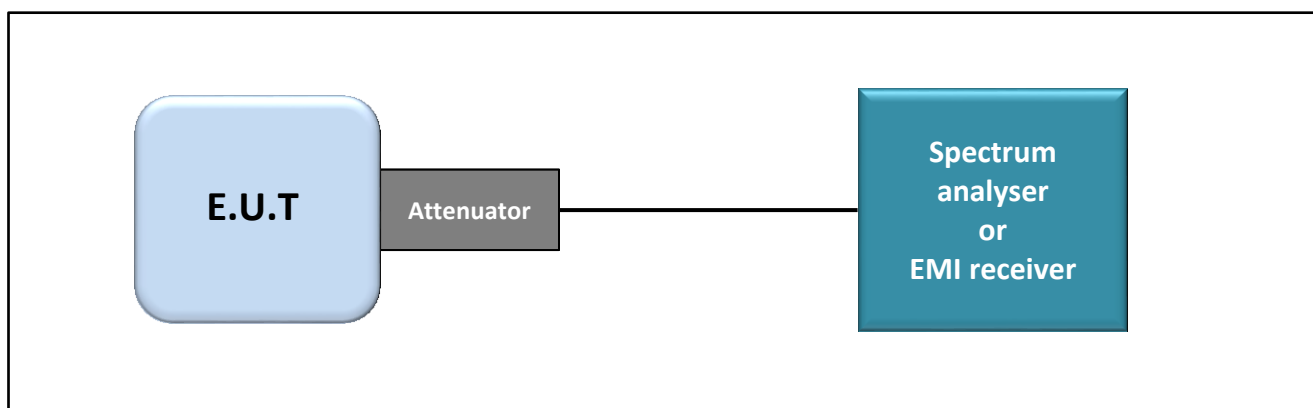
- ☒ Conducted Method
☐ Radiated Method

- 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***

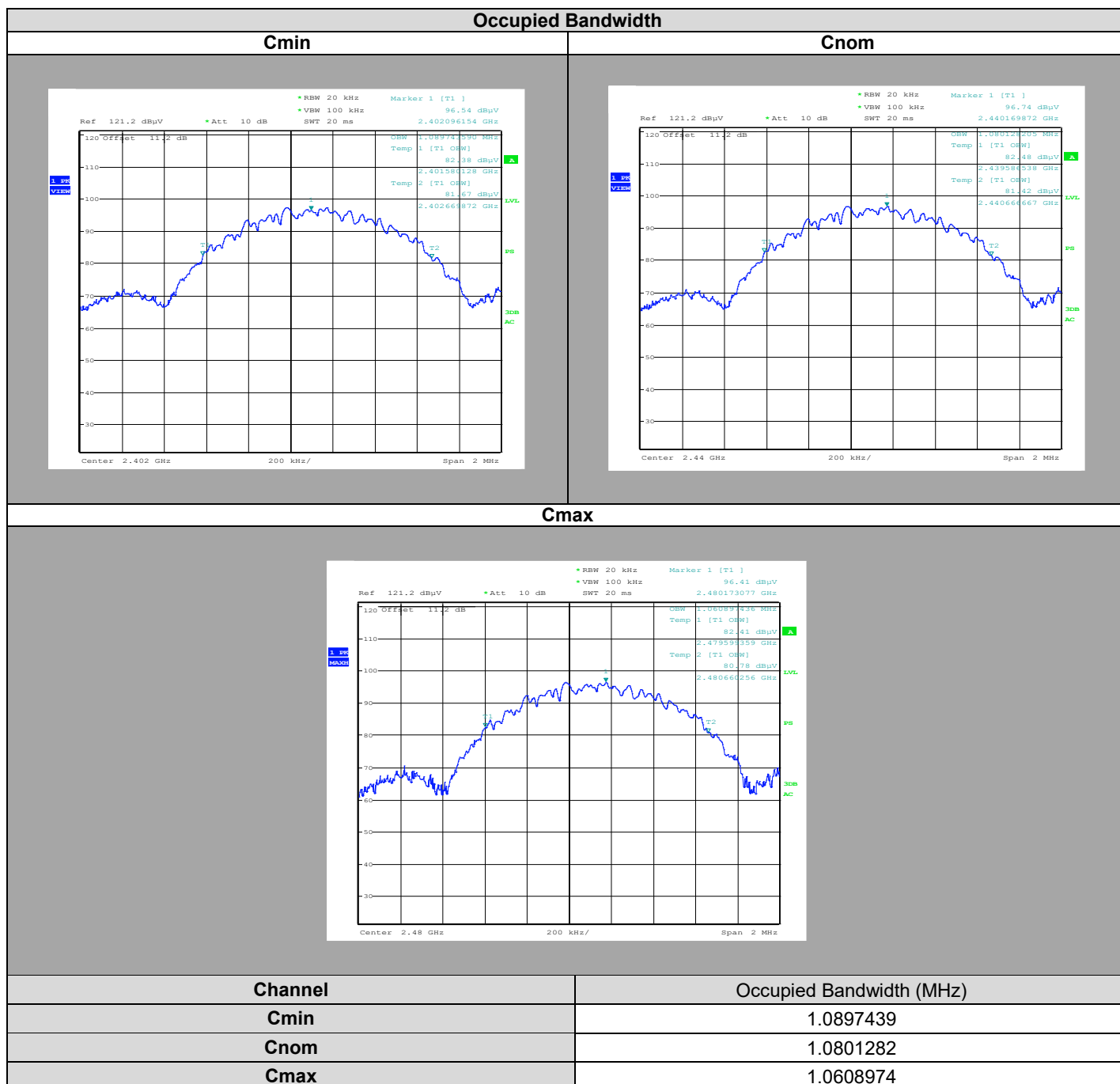
None

3.4. **TEST EQUIPMENT LIST**

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/19
RSCcommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Power supply AC/DC	KEYSIGHT	AC6802A	A7042305	-	-

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

3.5. RESULTS



3.6. CONCLUSION

Occupied Channel Bandwidth measurement performed on the sample of the product **DANFOSS LLS 4000**, SN: **Radio 2**, 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 : Gaetan DESCHAMPS
Date of test : September 25, 2019
Ambient temperature : 24 °C
Relative humidity : 38 %

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:

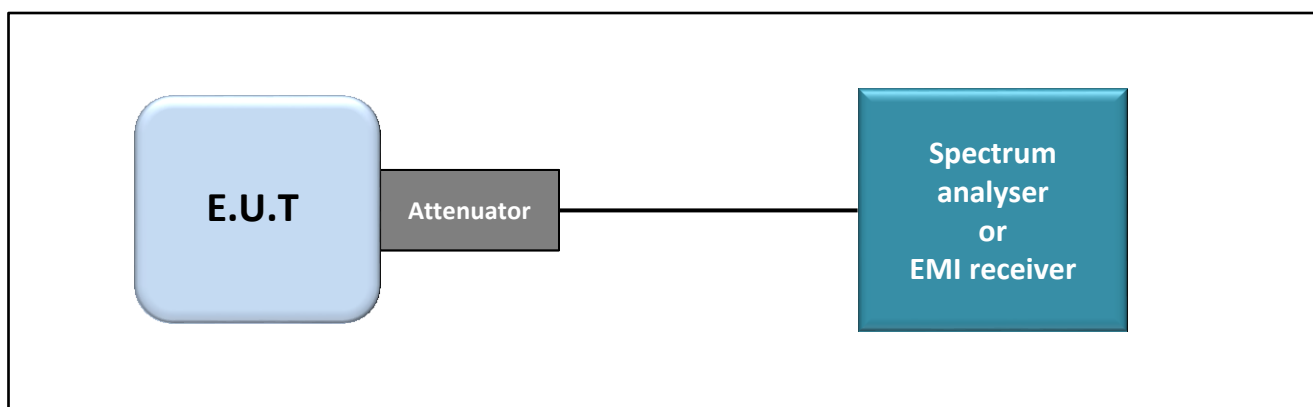
- ☐ Conducted Method
☒ Radiated Method

- Test Procedure:

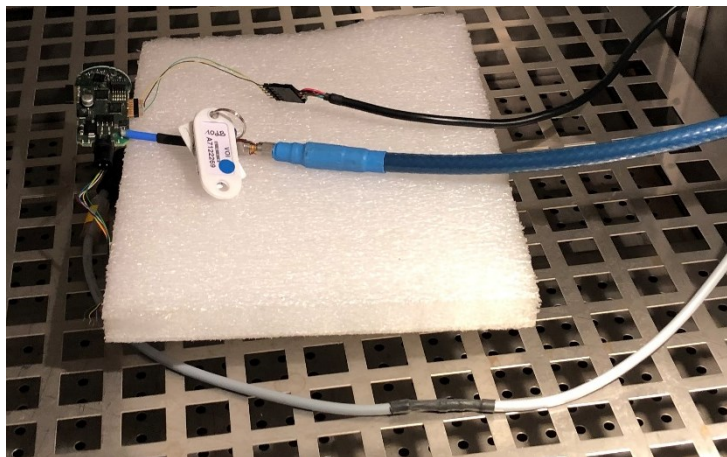
- ☒ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.2

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

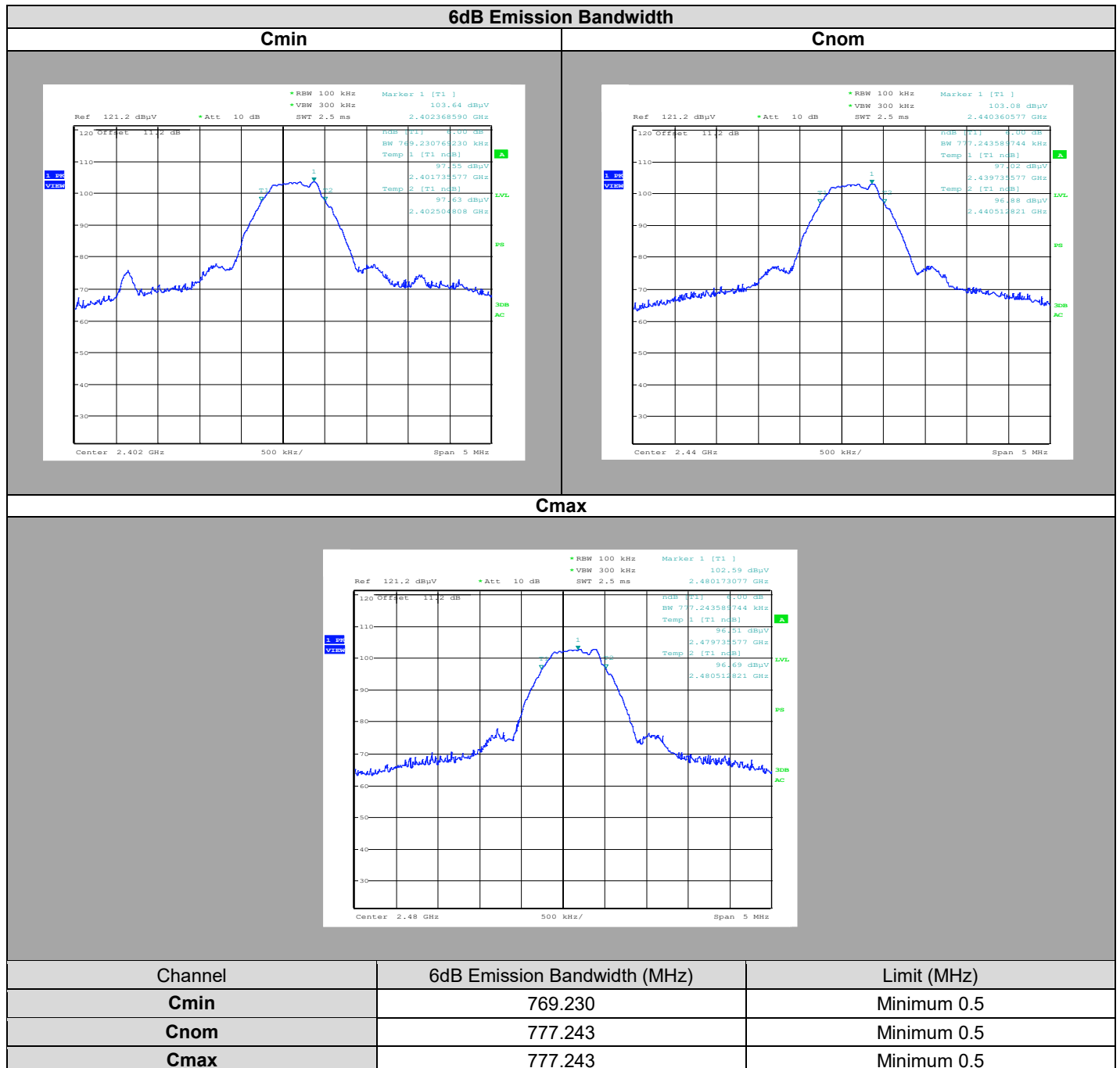
The 6dB bandwidth shall be at least 500kHz

4.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/19
RSCCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Power supply AC/DC	KEYSIGHT	AC6802A	A7042305	-	-

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

4.5. RESULTS



4.6. CONCLUSION

6dB Emission Bandwidth measurement performed on the sample of the product **DANFOSS LLS 4000**, SN: **Radio 2**, 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 : Gaetan DESCHAMPS
Date of test : September 25, 2019
Ambient temperature : 24 °C
Relative humidity : 38 %

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

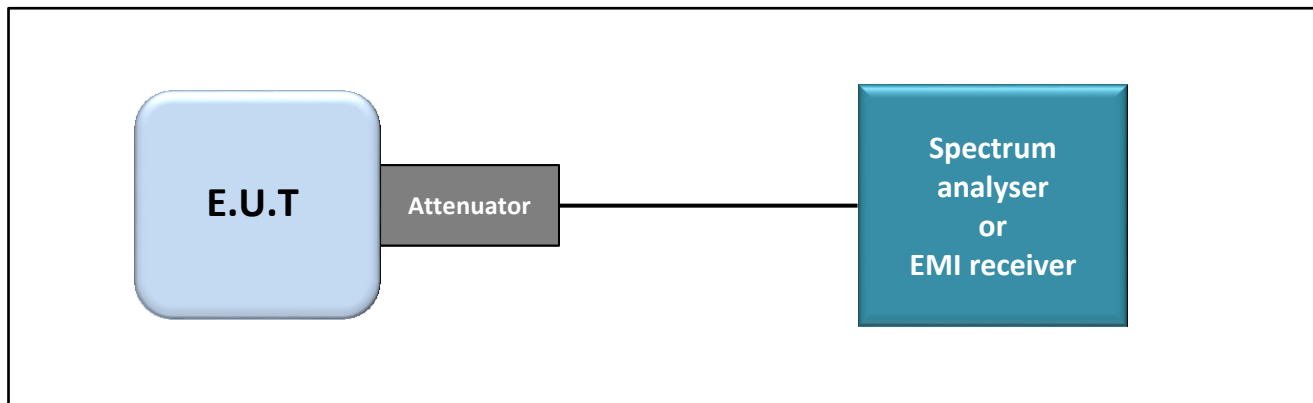
This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- 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.

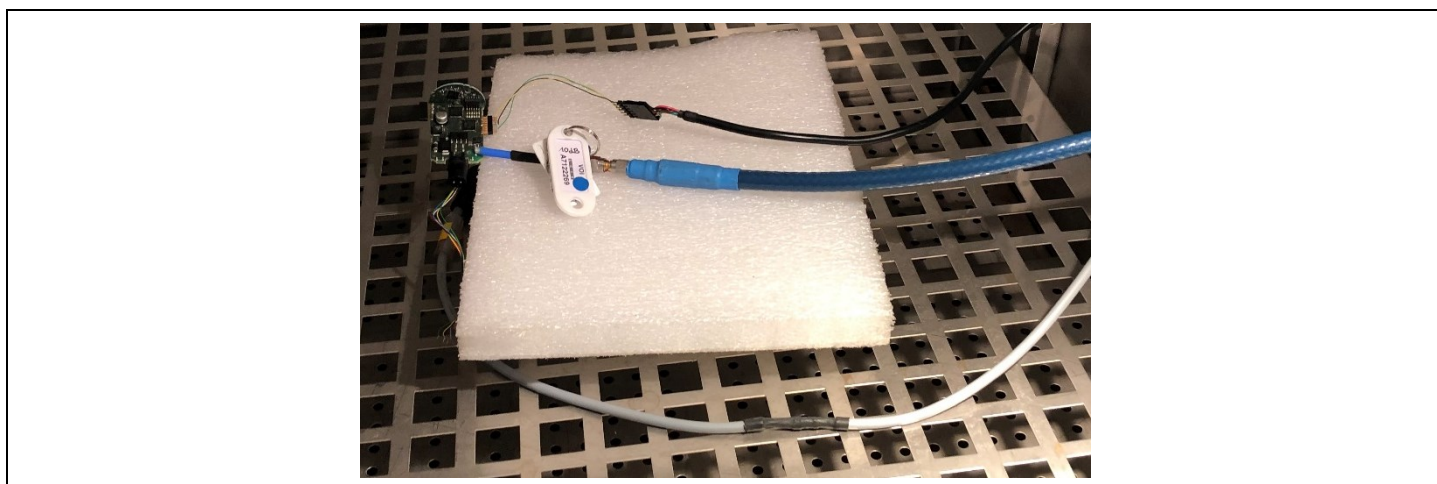
- ☐ KDB 558074 D01 DTS Meas Guidance v05r02 § 8.3.1.2

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

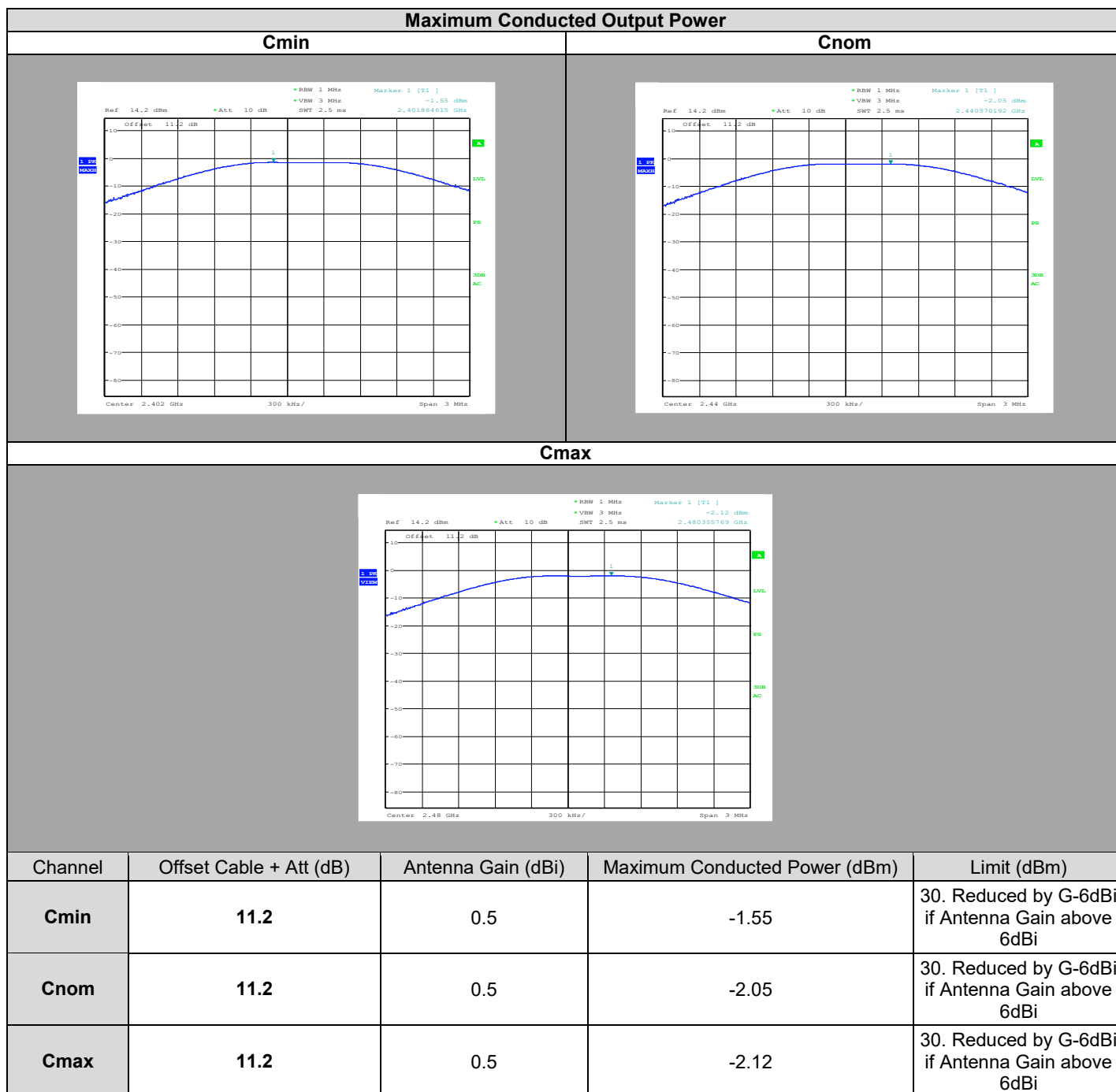
Maximum Conducted Output power:
 2400MHz-2483.5MHz: Shall not exceed 30dBm
 Limits are reduced by G-6dBi if Overall Antenna Gain above 6dBi

5.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/19
RSCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Power supply AC/DC	KEYSIGHT	AC6802A	A7042305	-	-

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

5.5. RESULTS



5.6. CONCLUSION

Maximum Conducted Output Power measurement performed on the sample of the product **DANFOSS LLS 4000**, SN: **Radio 2**, 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 : Gaetan DESCHAMPS
Date of test : September 25, 2019
Ambient temperature : 24 °C
Relative humidity : 38 %

6.2. TEST SETUP

- The Equipment Under Test is installed:

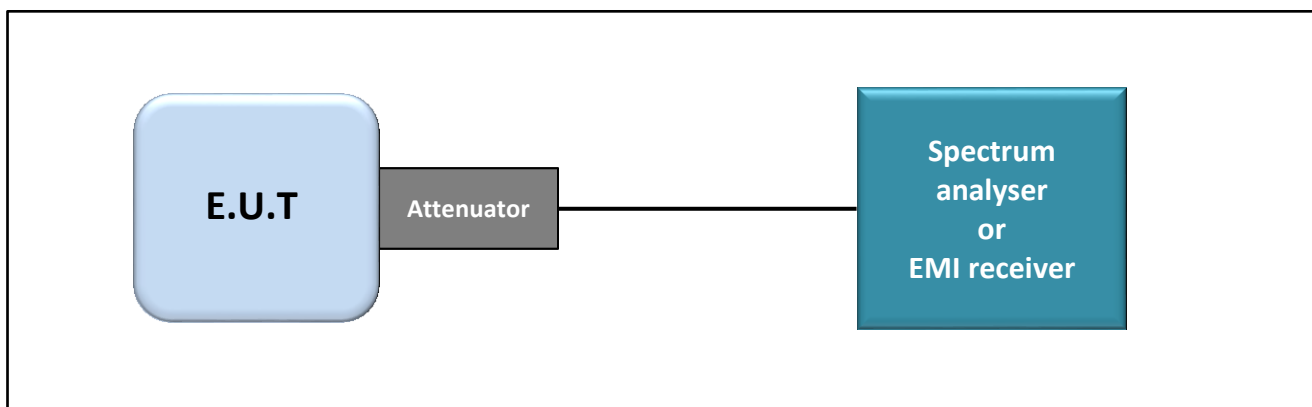
- ☒ On a table
☐ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

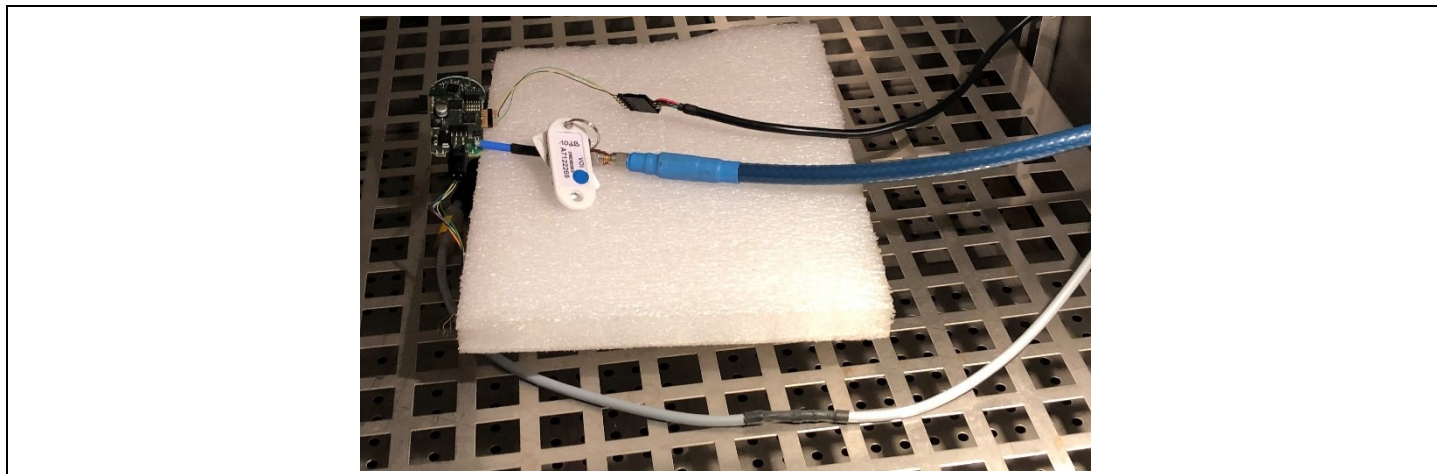
- ☒ Conducted Method
☐ Radiated Method

- Test Procedure:

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



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

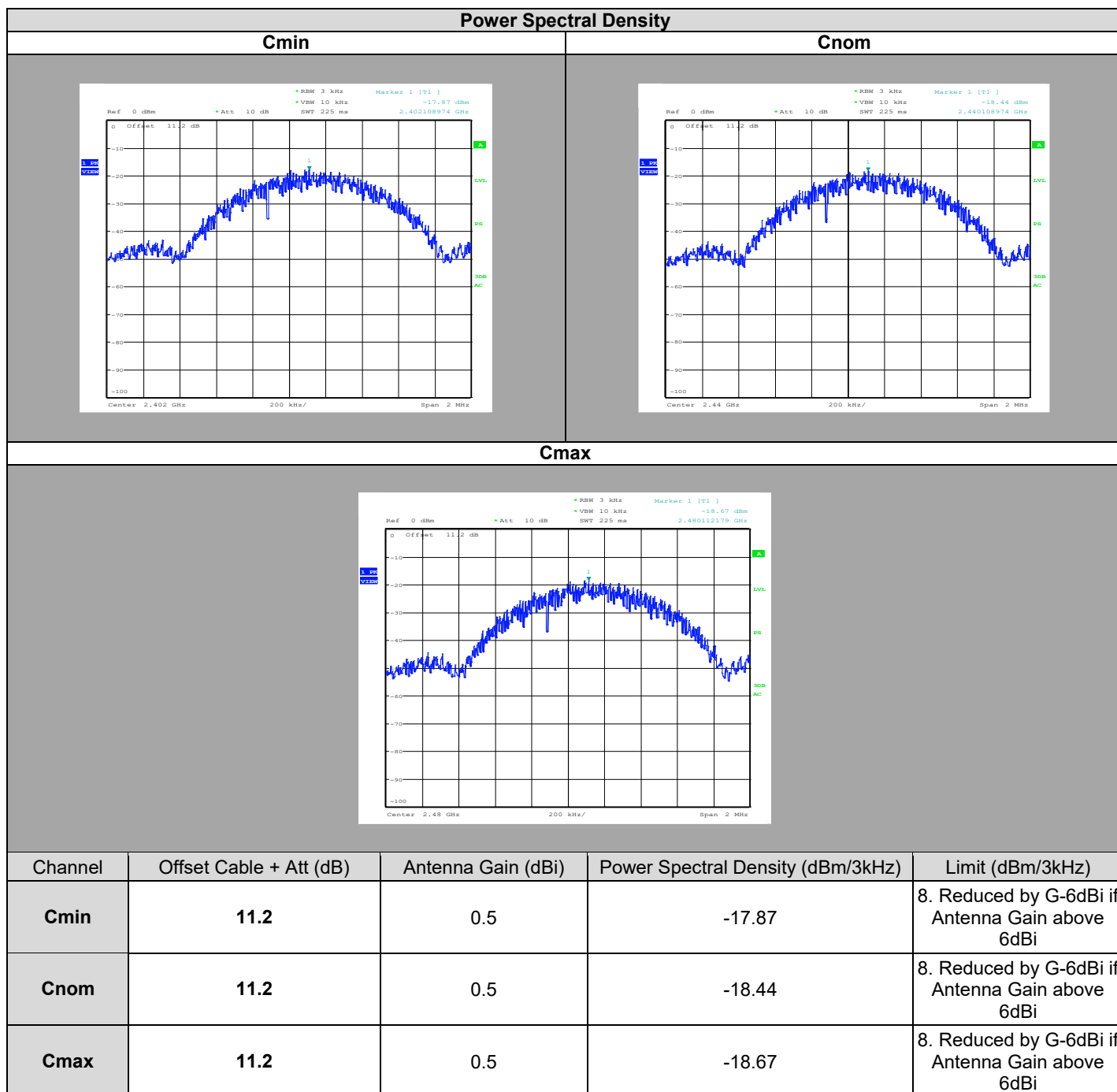
Limits are reduced by G-6dBi if Overall Antenna Gain above 6dBi

6.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/19
RSCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Power supply AC/DC	KEYSIGHT	AC6802A	A7042305	-	-

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

6.5. RESULTS



6.6. CONCLUSION

Power Spectral Density measurement performed on the sample of the product **DANFOSS LLS 4000**, SN: **Radio 2**, 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 : Gaetan DESCHAMPS
Date of test : September 25, 2019
Ambient temperature : 24 °C
Relative humidity : 38 %

7.2. TEST SETUP

- The Equipment Under Test is installed:

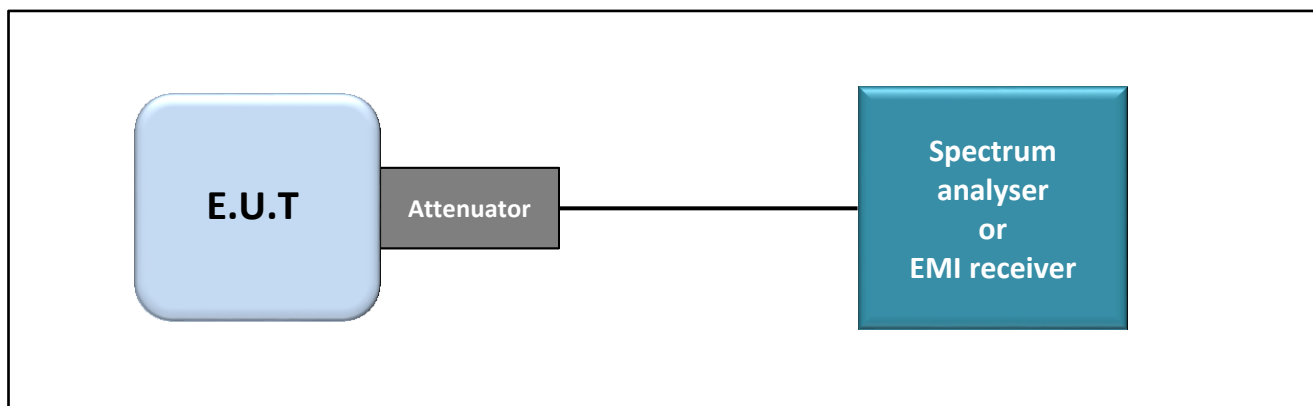
- ☒ On a table
- ☐ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

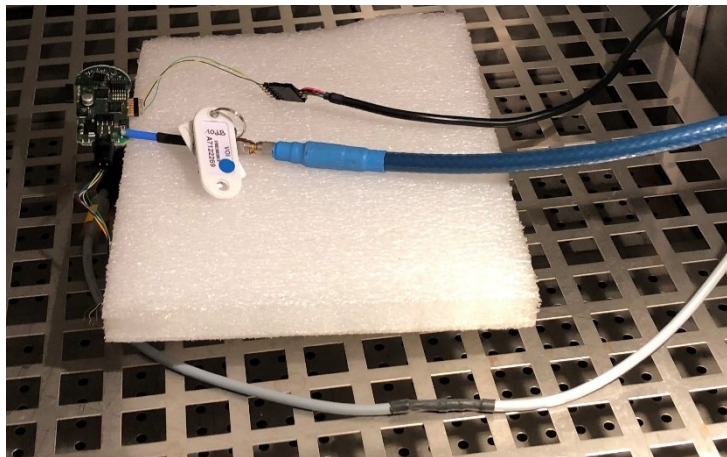
- ☒ Conducted Method
- ☐ Radiated Method

- 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

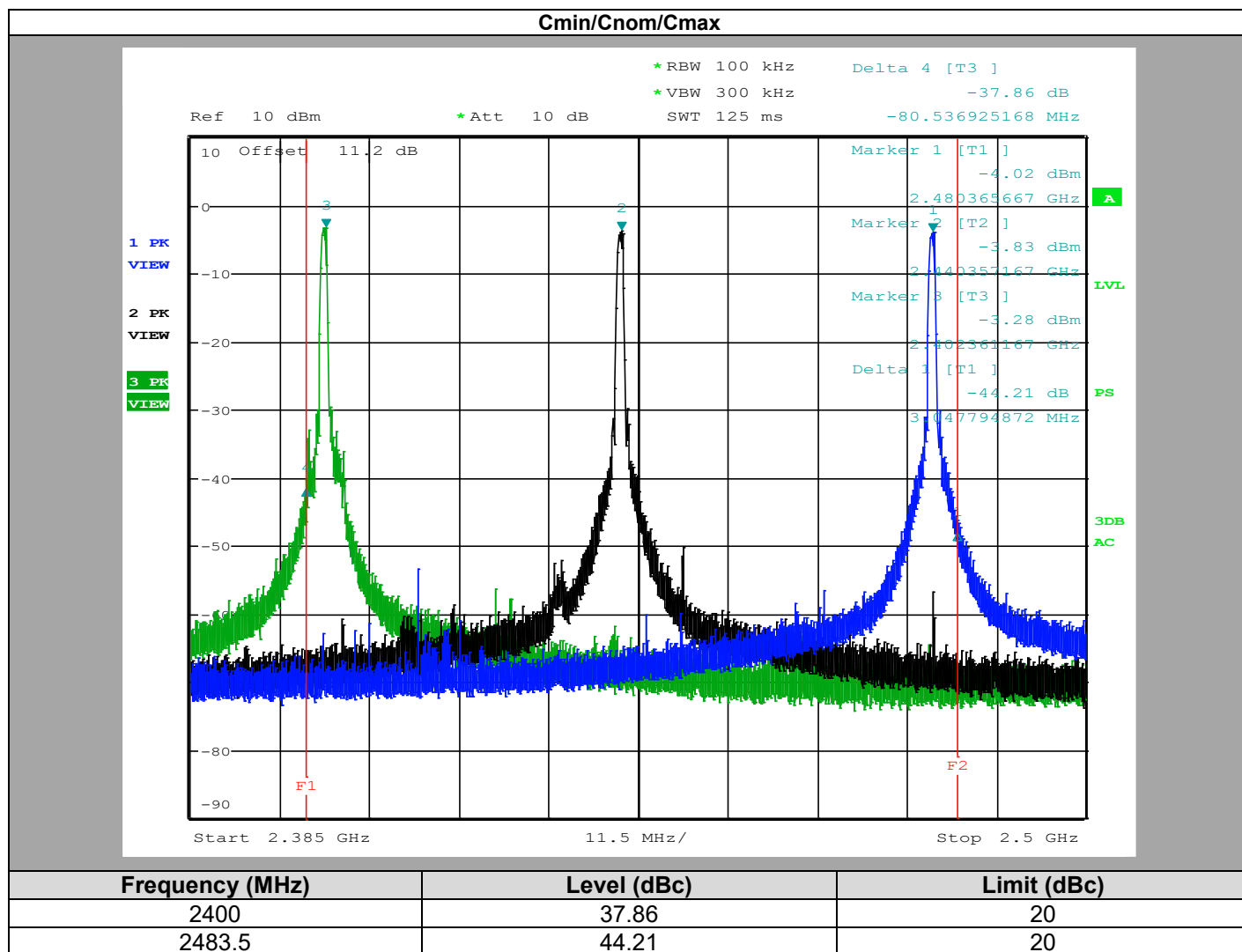
All Spurious Emissions must be at least 20dB below the Fundamental Radiator Level at the Band Edge Edge "2400MHz & 2483,5MHz"

7.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/19
RSCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Power supply AC/DC	KEYSIGHT	AC6802A	A7042305	-	-

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

7.5. RESULTS



7.6. CONCLUSION

Unwanted Emission into non-restricted frequency bands at the band edge measurement performed on the sample of the product **DANFOSS LLS 4000**, SN: **Radio 2**, 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 : Gaetan DESCHAMPS
Date of test : September 25, 2019
Ambient temperature : 24 °C
Relative humidity : 38 %

8.2. TEST SETUP

- The Equipment Under Test is installed:

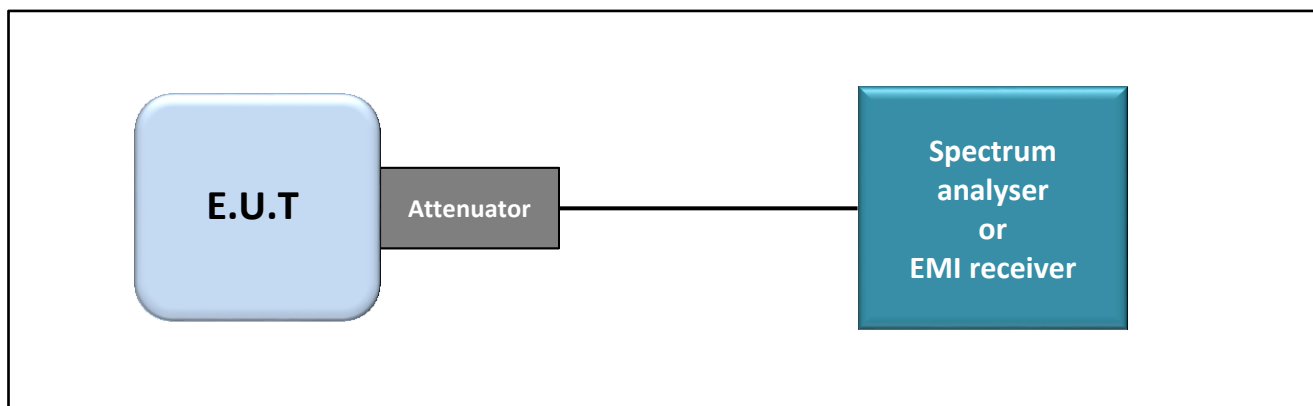
- ☒ On a table
- ☐ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:

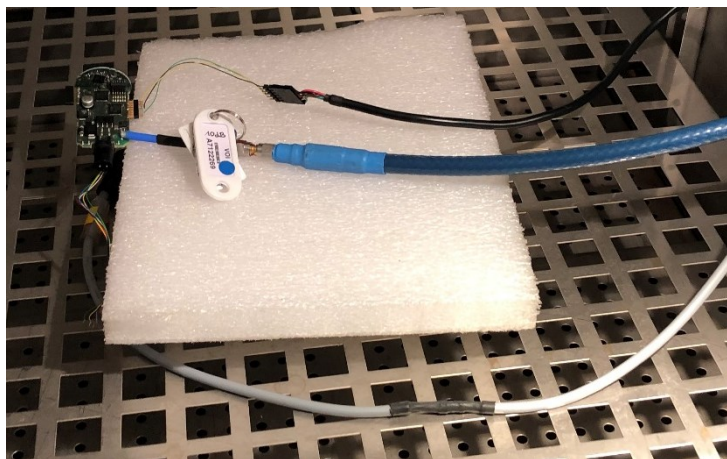
- ☒ Conducted Method
- ☐ Radiated Method

- 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

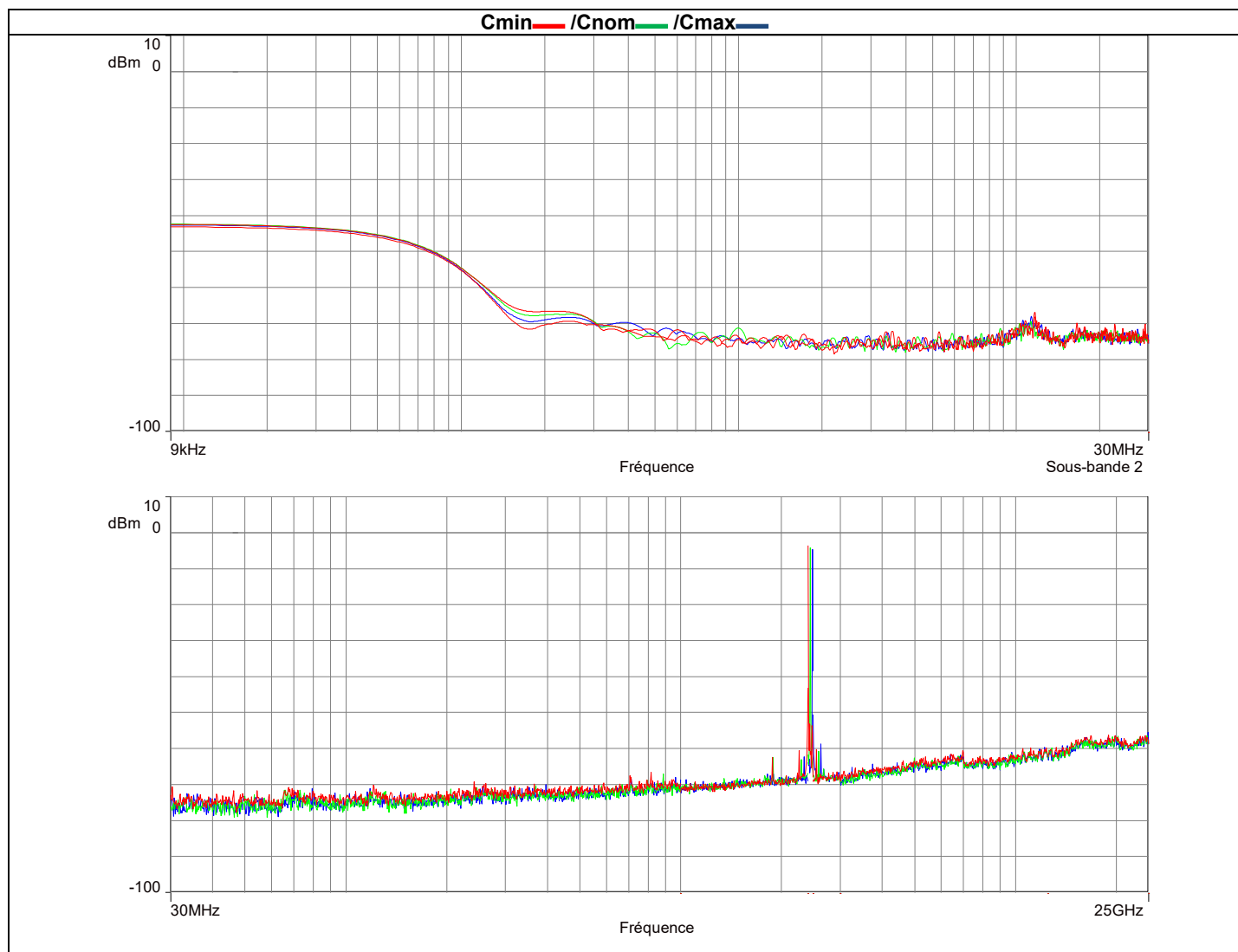
All Spurious Emissions must be at least 20 below the Fundamental Radiator Level

8.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/19
RSCommander	R&S	v1.6.4	L1000116	-	-
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Attenuator 10dB	AEROFLEX	-	A7122269	12/17	12/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Power supply AC/DC	KEYSIGHT	AC6802A	A7042305	-	-

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

8.5. RESULTS



Frequency (MHz)	Level (dBm)	Level (dBc)	Limit (dBc)
2402.00	-3.51		
1883.54	-62.37	58.86	20
2258.22	-60.62	57.11	20
2546.20	-60.28	56.77	20
2442.00	-4.26		
1886.71	-62.27	58.01	20
2296.16	-60.62	56.36	20
2584.37	-60.68	56.42	20
2480.00	-4.70		
1897.21	-67.13	62.43	20
2336.20	-62.26	57.56	20
2624.14	-58.80	54.10	20



8.6. CONCLUSION

Unwanted Emission into non-restricted frequency bands measurement performed on the sample of the product **DANFOSS LLS 4000**, SN: **Radio 2**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 2** limits.

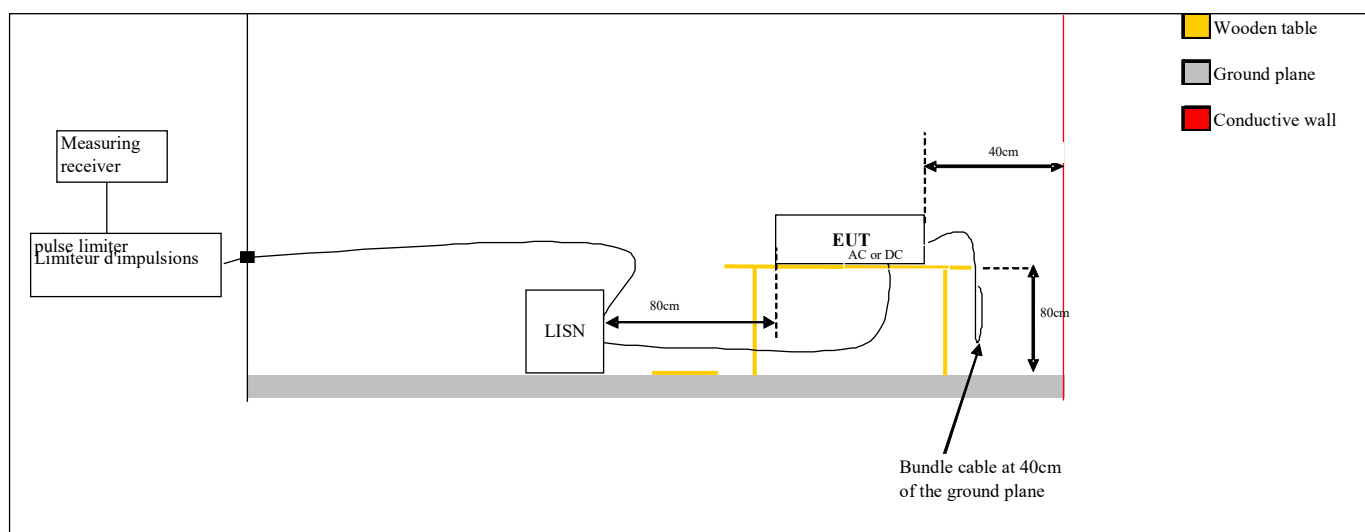
9. AC POWER LINE CONDUCTED EMISSIONS

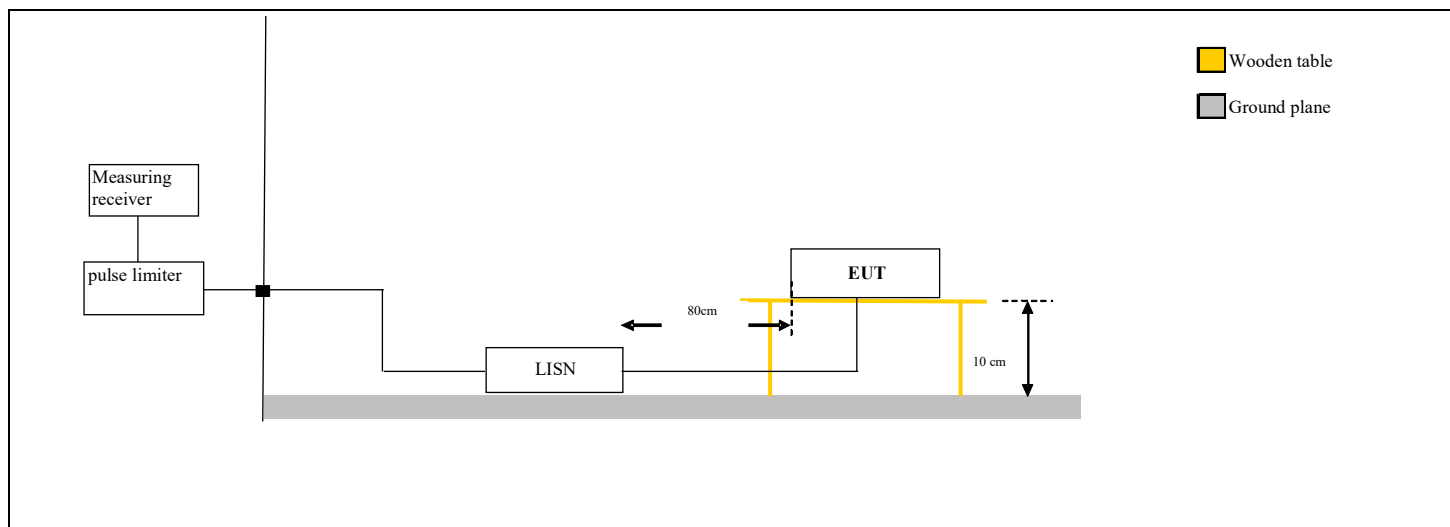
9.1. TEST CONDITIONS

Test performed by : Gaetan DESCHAMPS
 Date of test : September 25, 2019
 Ambient temperature : 24 °C
 Relative humidity : 38 %

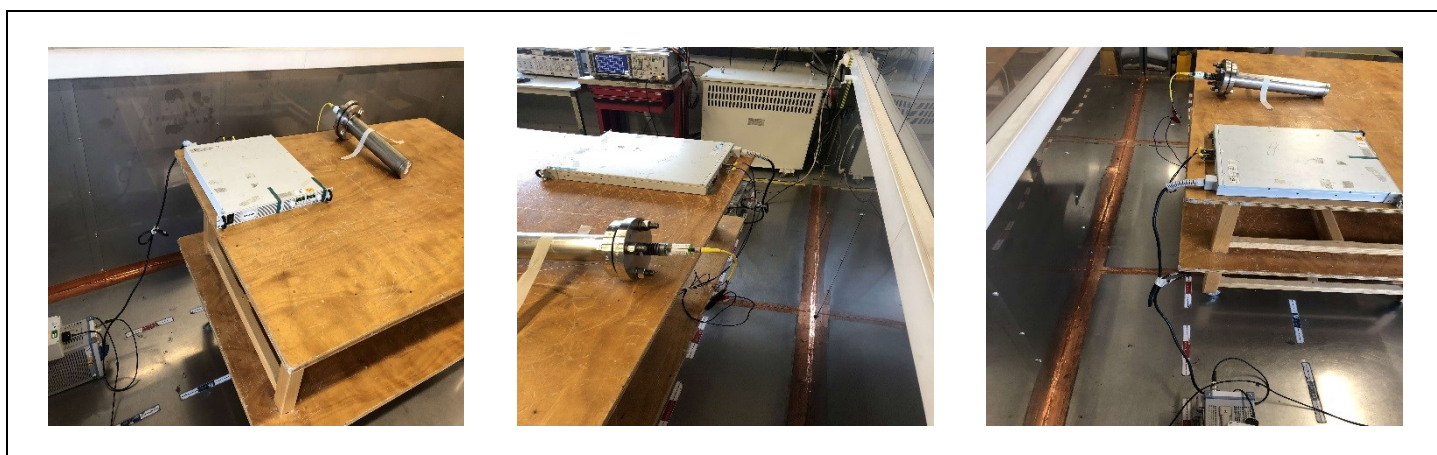
9.2. TEST SETUP

The product has been tested according to ANSI C63.10 (2013) method. The EUT is placed on the ground reference plane, at 80cm from the LISN. The distance between the EUT and the vertical ground plane is 40cm. Auxiliaries are powered by another LISN. The cable has been shorted to 1meter length. The EUT is powered through the LISN. 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. The LISN (measure) is 50 Ω / 50 μ H. Interconnecting cables and equipment's were moved to position that maximized emission.





Test set up of AC Power Line Conducted Emissions



Photograph for AC Power Line Conducted Emissions (Front view)

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

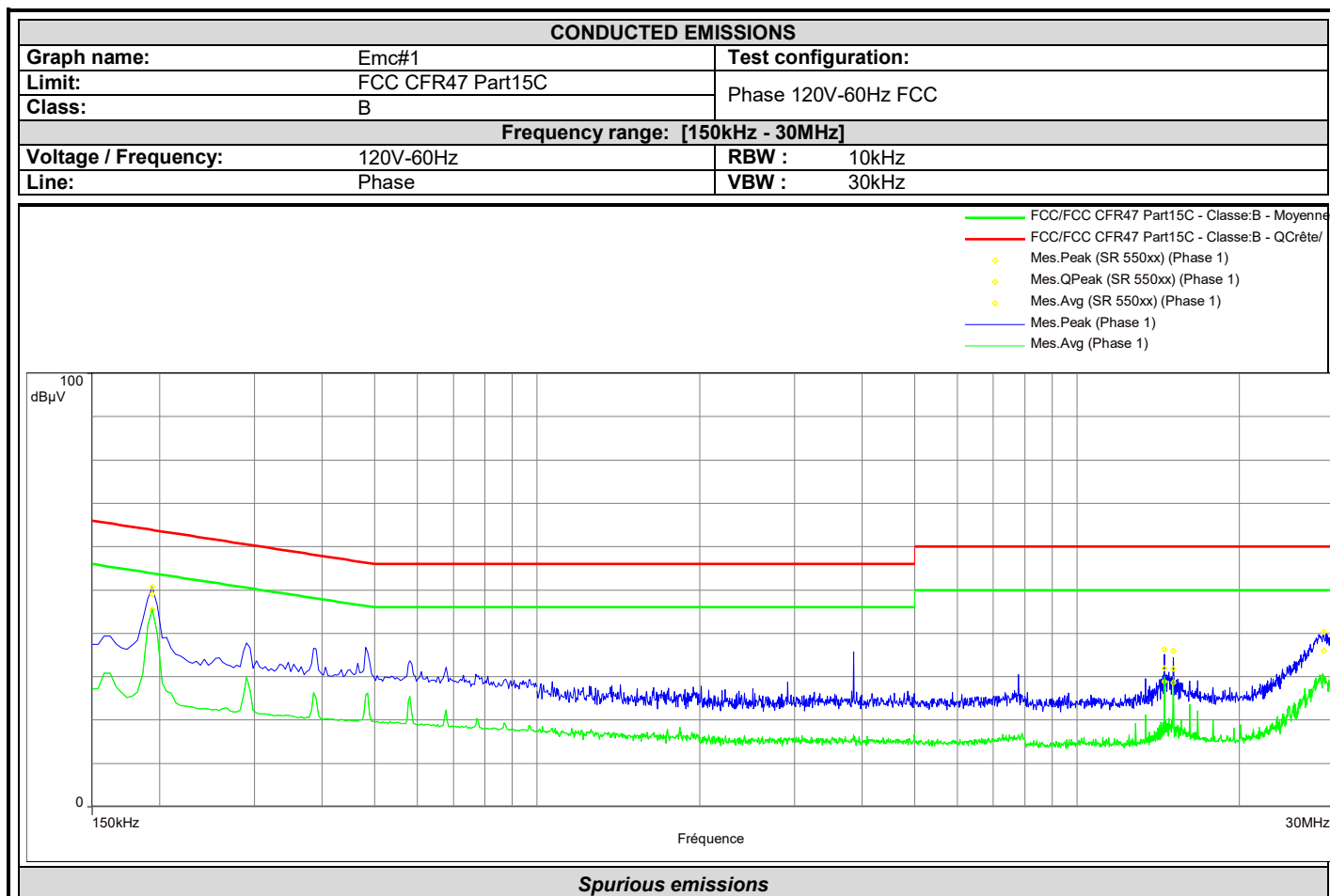
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Cable + self	-	-	A5329578	10/18	10/19
LISN	RHODE & SCHWARZ	ENV216	C2320291	02/19	02/20
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/19
Power Supply DC	TDK-Lambda	GEN150CW	A7044055	-	-
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20

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 ☐ Divergence:

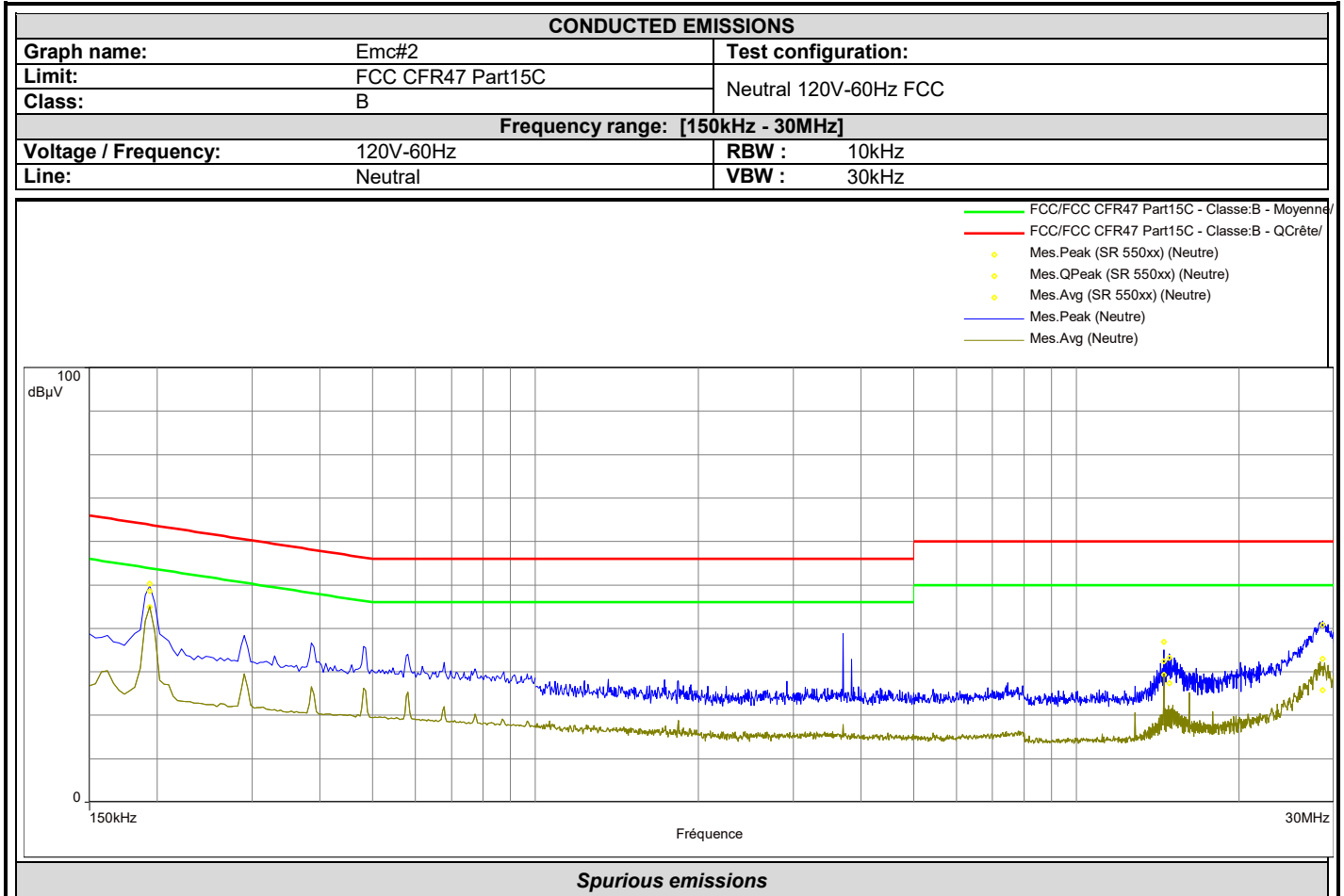
9.6. RESULTS



Frequency (MHz)	Mes.Peak (dBμV)	Mes.QPeak (dBμV)	LimQP (dBμV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBμV)	LimAvg (dBμV)	Mes.Avg-LimAvg (dB)	Line	Correction (dB)
0.194	50.8	49.0	63.9	-14.8	45.4	53.9	-8.4	Phase 1	19.5
14.508	36.3	32.0	60.0	-28.0	28.8	50.0	-21.2	Phase 1	20.6
15.068	36.0	31.8	60.0	-28.2	28.7	50.0	-21.3	Phase 1	20.6
28.620	40.4	36.0	60.0	-24.0	29.4	50.0	-20.6	Phase 1	21.4



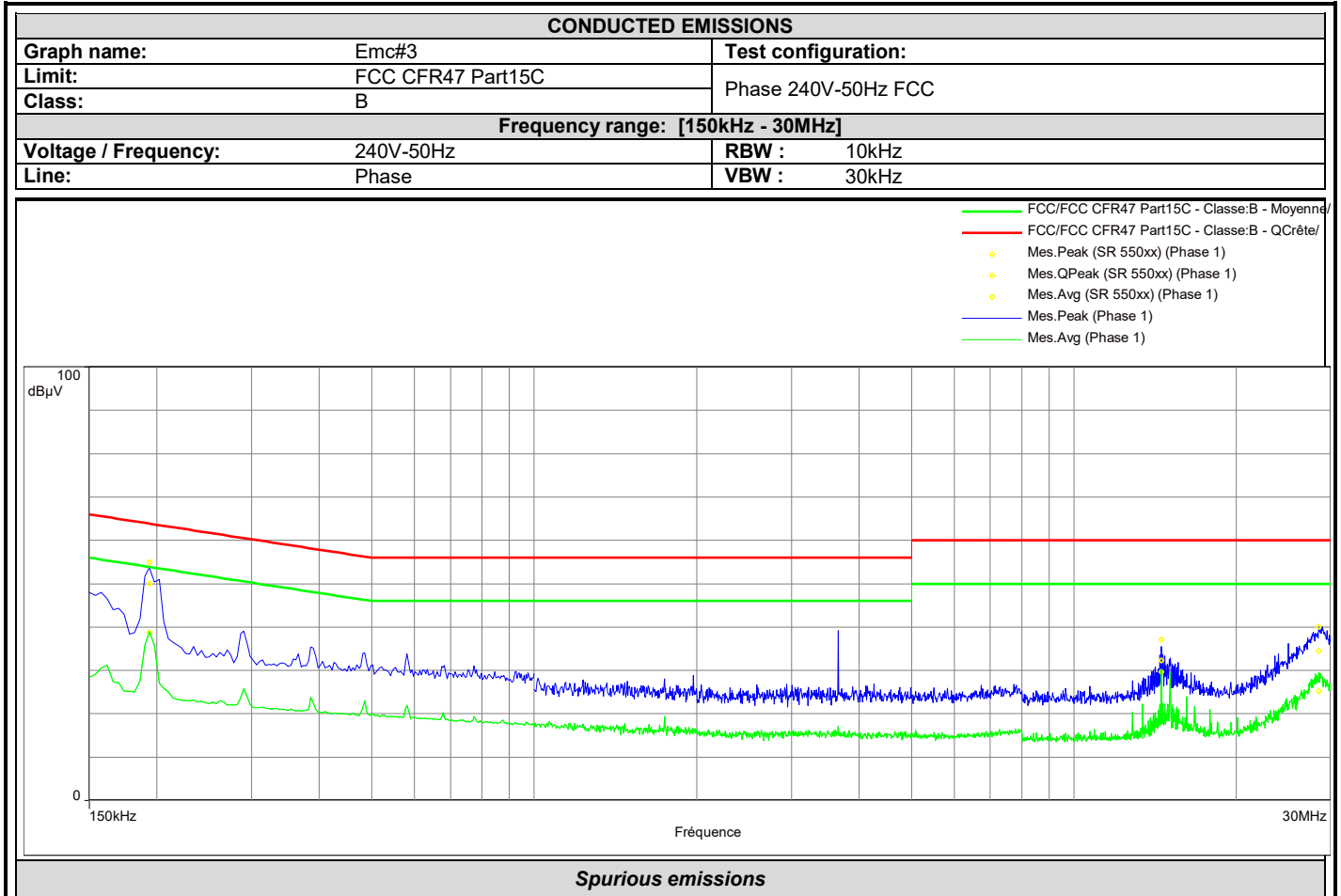
L C I E



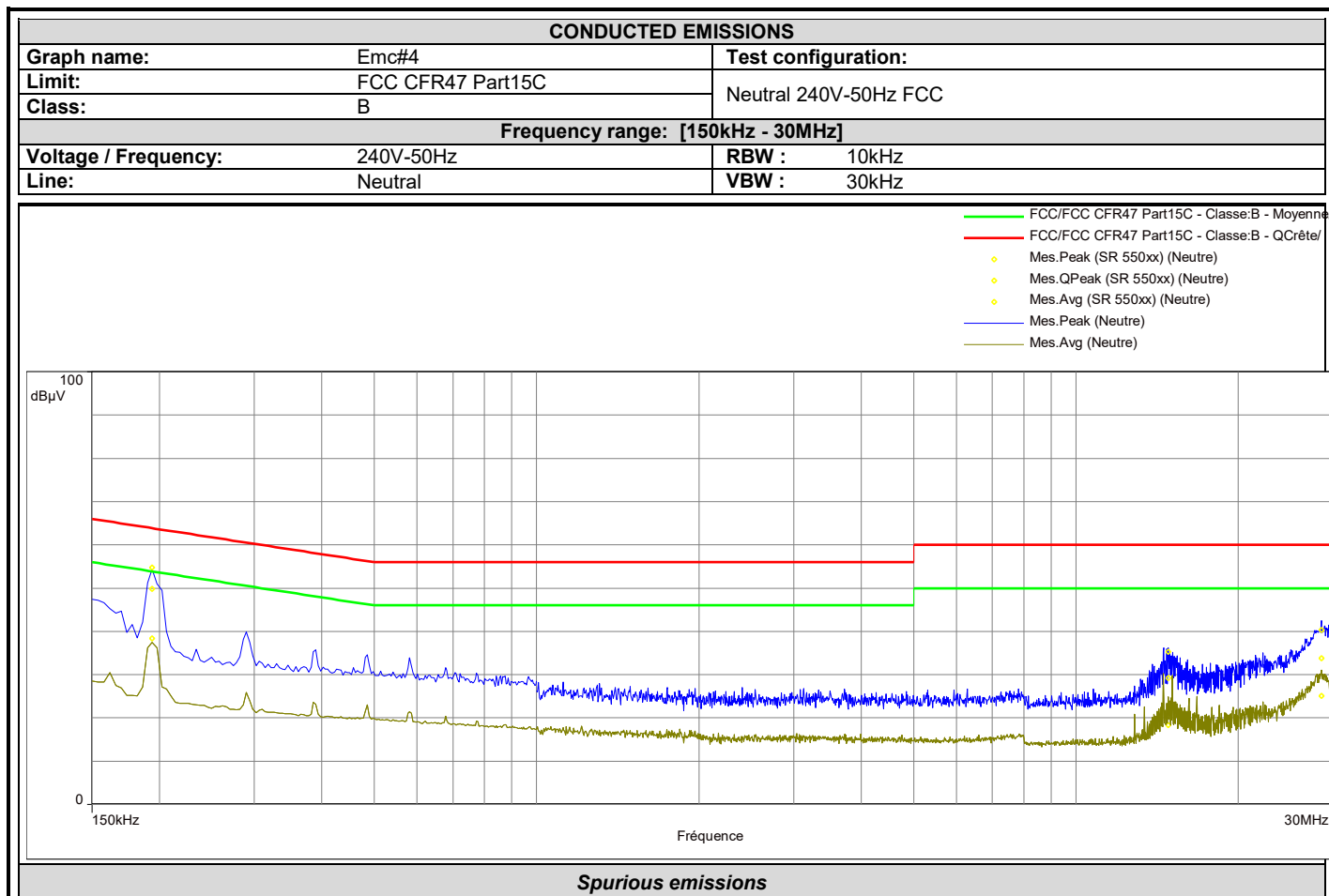
Frequency (MHz)	Mes.Peak (dBμV)	Mes.QPeak (dBμV)	LimQP (dBμV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBμV)	LimAvg (dBμV)	Mes.Avg-LimAvg (dB)	Line	Correction (dB)
0.194	50.3	48.6	63.9	-15.3	44.9	53.9	-8.9	Neutre	19.5
14.512	36.8	32.4	60.0	-27.6	29.4	50.0	-20.6	Neutre	20.6
14.868	33.2	27.4	60.0	-32.6	19.6	50.0	-30.4	Neutre	20.6
28.492	40.8	33.0	60.0	-27.0	25.8	50.0	-24.2	Neutre	21.4



L C I E



Frequency (MHz)	Mes.Peak (dBμV)	Mes.QPeak (dBμV)	LimQP (dBμV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBμV)	LimAvg (dBμV)	Mes.Avg-LimAvg (dB)	Line	Correction (dB)
0.194	55.0	50.0	63.9	-13.8	38.7	53.9	-15.1	Phase 1	19.5
14.512	37.1	32.3	60.0	-27.7	29.7	50.0	-20.3	Phase 1	20.6
28.400	40.1	34.5	60.0	-25.5	25.2	50.0	-24.8	Phase 1	21.4



Frequency (MHz)	Mes.Peak (dBμV)	Mes.QPeak (dBμV)	LimQP (dBμV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBμV)	LimAvg (dBμV)	Mes.Avg-LimAvg (dB)	Line	Correction (dB)
0.194	54.8	49.9	63.9	-14.0	38.4	53.9	-15.5	Neutre	19.5
14.832	35.3	29.2	60.0	-30.8	18.4	50.0	-31.6	Neutre	20.6
28.500	40.3	33.8	60.0	-26.2	25.1	50.0	-24.9	Neutre	21.4

9.7. CONCLUSION

Ac Power Line Conducted Emission measurement performed on the sample of the product **DANFOSS LLS 4000**, SN: **Radio 2**, in configuration and description presented in this test report, show levels **compliant** to the 47 CFR PART 15.247 & RSS 247 ISSUE 2 limits.

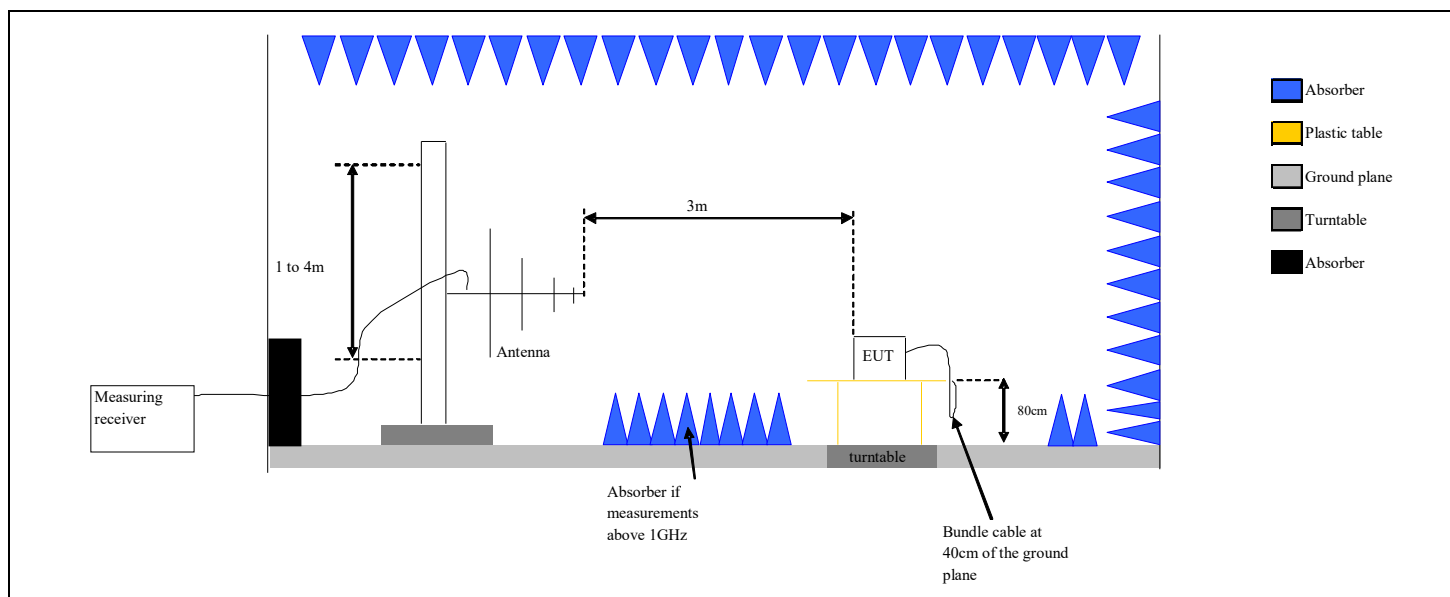
10. UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS

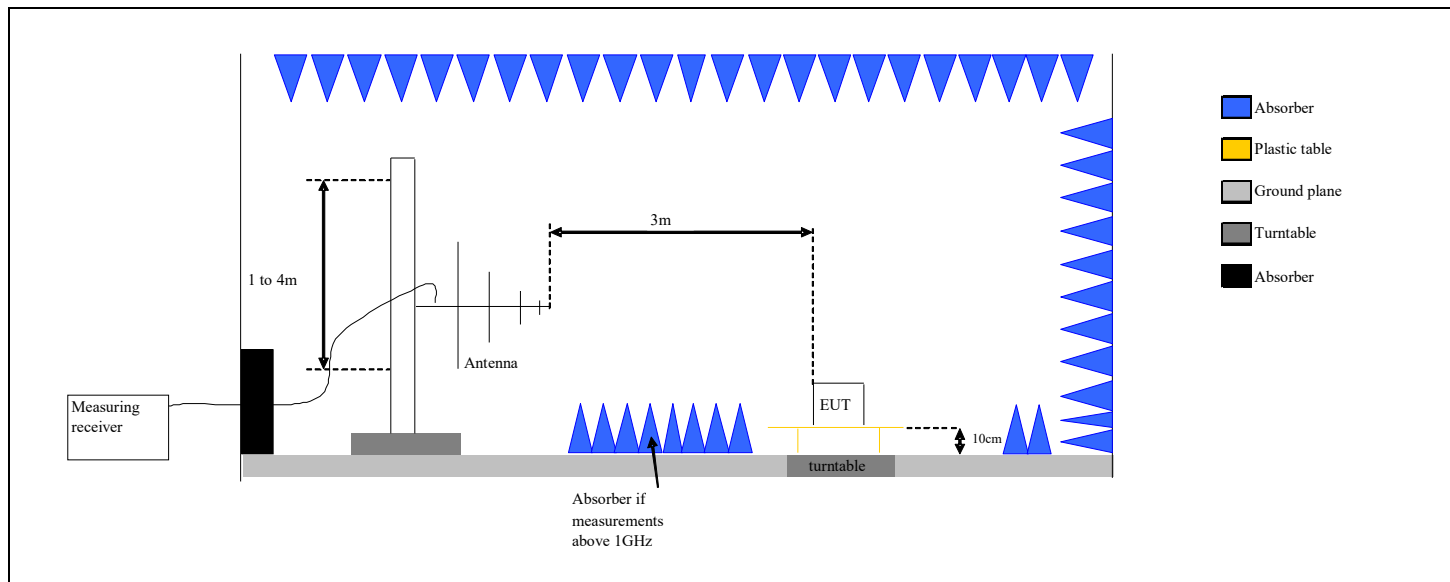
10.1. TEST CONDITIONS

Test performed by : Gaetan DESCHAMPS
 Date of test : September 26, 2019
 Ambient temperature : 24 °C
 Relative humidity : 35 %

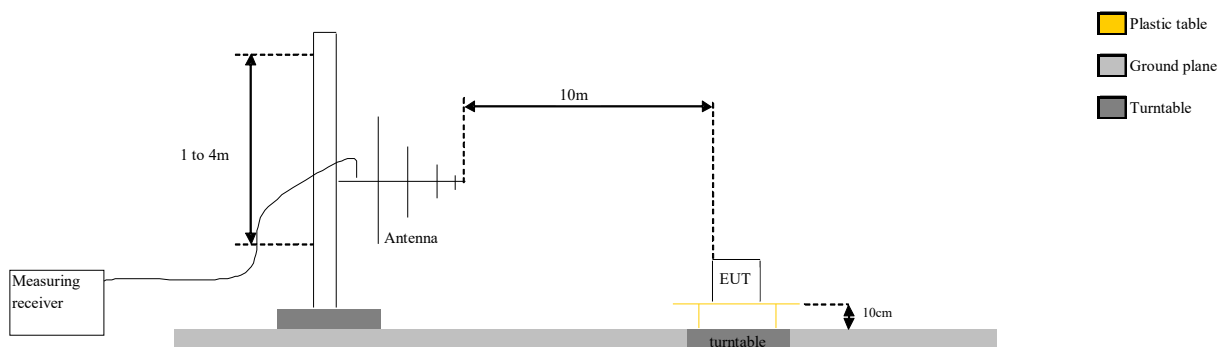
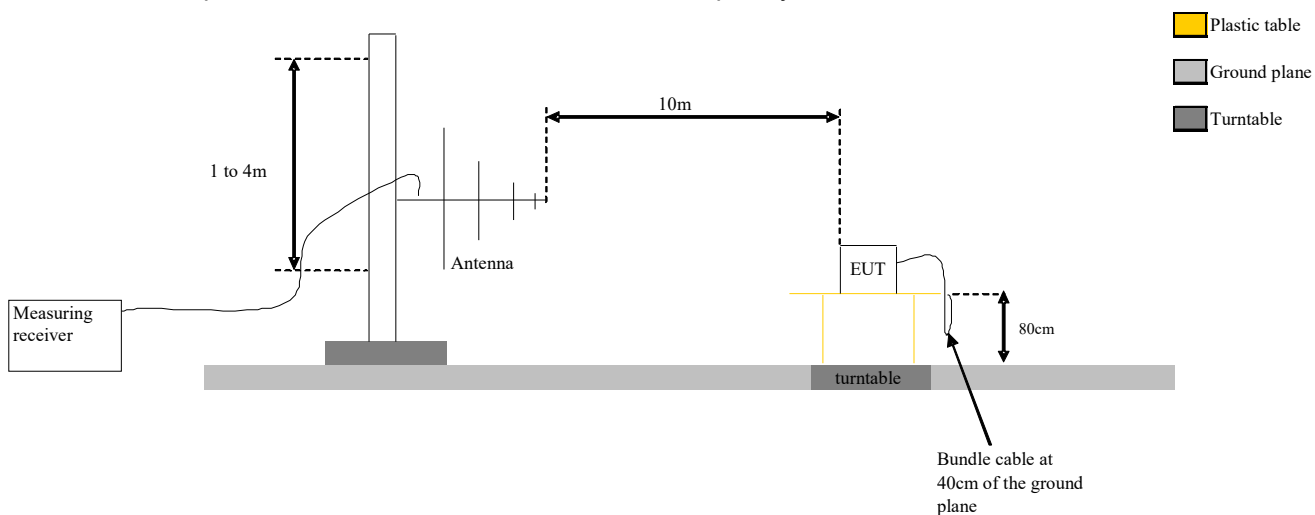
10.2. TEST SETUP

The product has been tested according to ANSI C63.10 (2013) and FCC part15 subpart C. Test is performed in horizontal (H) and vertical (V) polarization with **bilog** between 30MHz & 1GHz and with a horn antenna above 1GHz. Measurement bandwidth was 120kHz below 1GHz and 1MHz above 1GHz. The level has been maximised by the turntable rotation of 360 degrees range on the 3 axis of EUT. Antenna height search was performed from 1 to 4m. The EUT is place at 1.5m high above 1GHz and at 0.8m high under 1GHz. The EUT is placed **in a full anechoic chamber** above 1GHz and **on an open area test site** from 30MHz to 1GHz. Distance between measuring antenna and the EUT is **3m**.

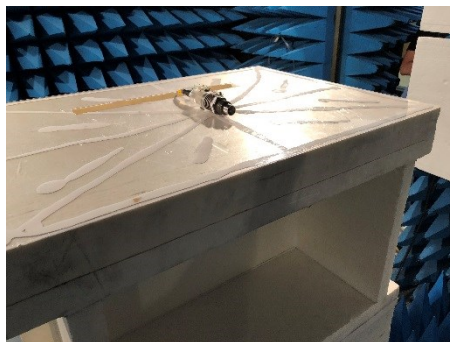




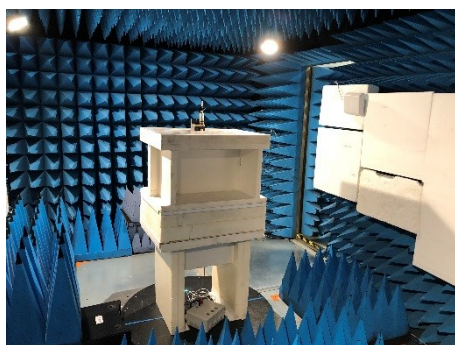
Test set up of Unwanted Emissions in Restricted Frequency Bands in semi anechoic chamber



Test Set up for radiated measurement in open area test site



Test setup in Axis XY (worst case position):



Test setup in Axis Z (worst case position):

Photograph for Unwanted Emission 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

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Amplifier 9kHz - 40GHz	LCIE SUD EST	—	A7102082	10/18	10/19
Antenna horn 18GHz	EMCO	3115	C2042029	09/18	09/20
Antenna horn 18GHz	AINFO	LB	C2042055	09/18	09/20
Attenuator 10dB	TECHNIWAVE	-	A7122273	06/18	06/20
Emission Cable C3	-	6GHz	A5329069	11/18	11/19
Cable SMA - Substitution C3	-	-	A5329352	10/18	10/19
Emission Cable C3	-	6GHz	A5329637	02/19	02/20
Semi-Anechoic chamber #3	SIEPEL	-	D3044017	03/17	03/20
High Pass (4.8-18GHz)	BL Microwave	SH4800-1800	A7484034	08/19	08/21
Frequency generator 10MHz - 27GHz	RHODE & SCHWARZ	SMR 27	A5442045	10/18	10/19
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	03/18	03/20
BAT EMC	NEXIO	v3.17.0.10	L1000115	-	-
RADIO ERP_EIRP	LCIE	V4	L2000034	-	-
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	10/18	10/20
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-	-
Table C3	LCIE	-	F2000461	-	-
Rehausse Table C3	LCIE	-	F2000511	-	-
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444	-	-

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 ☐ Divergence:

10.6. RESULTS

See Test results in §8.5 (Band edge measurement):

Test Frequency (MHz)	Meter Reading dB(μV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Gain/Loss Factor (dB)	Transducer Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Remark
2258.220	70.6	Pk	V	0	150	-	-31.8	38.8	74.0	-35.2	Axis Z
2258.220	58.0	Av	V	0	150	-	-31.8	26.2	54.0	-27.8	Axis Z
2296.160	70.7	Pk	V	0	150	-	-31.8	38.9	74.0	-35.1	Axis Z
2296.160	58.2	Av	V	0	150	-	-31.8	26.4	54.0	-27.6	Axis Z
2336.200	70.8	Pk	V	0	150	-	-31.8	39.0	74.0	-35.0	Axis Z
2336.200	58.4	Av	V	0	150	-	-31.8	26.6	54.0	-27.4	Axis Z
4804.000	70.8	Pk	V	220	150	-	-26.0	44.8	74.0	-29.2	Axis Z
4804.000	58.4	Av	V	220	150	-	-26.0	32.4	54.0	-21.6	Axis Z
4884.000	69.6	Pk	V	90	150	-	-25.9	43.7	74.0	-30.3	Axis Z
4884.000	59.5	Av	V	90	150	-	-25.9	33.6	54.0	-20.4	Axis Z
4960.000	70.8	Pk	V	90	150	-	-25.8	45.0	74.0	-29.0	Axis Z
4960.000	60.0	Av	V	90	150	-	-25.8	34.2	54.0	-19.8	Axis Z
5181.625	74.0	Pk	V	90	150	-	-25.2	48.8	74.0	-25.2	Axis Z
5181.625	55.0	Av	V	90	150	-	-25.2	29.8	54.0	-24.2	Axis Z
12740.000	54.6	Pk	V	0	150	-	-1.4	53.2	74.0	-20.8	Axis Z
12740.000	40.4	Av	V	0	150	-	-1.4	39.0	54.0	-15.0	Axis Z

10.7. CONCLUSION

Unwanted Emission in restricted frequency bands measurement performed on the sample of the product **DANFOSS LLS 4000**, SN: **Radio 2**, in configuration and description presented in this test report, show levels **compliant** to the 47 CFR PART 15.247 & RSS 247 ISSUE 2 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
Mesure des perturbations conduites en tension sur le réseau d'énergie <i>Measurement of conducted disturbances in voltage on the power port</i>	3.51 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication <i>Measurement of conducted disturbances in voltage on the telecommunication port.</i>	3.26 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension <i>Measurement of discontinuous conducted disturbances in voltage</i>	3.45 dB	3.6 dB
Mesure des perturbations conduites en courant <i>Measurement of conducted disturbances in current</i>	3.09 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans <i>Measurement of radiated electric field on the Moirans open area test site</i>	5.20 dB	6.3 dB