LABORATORIUM VOOR OMGEVINGSMETINGEN
LABORATOIRE D'ESSAIS D'ENVIRONNEMENT
ENVIRONMENTAL TEST LABORATORIA

NOTIFIED BODY (NB2758) UNDER EU-DIRECTIVE 2014/30/EU	041-TEST
ACCREDITED FOR NBN EN ISO 17025 BY BELAC 041-T - ISO17025	
RECOGNISED TESTING AUTHORITY FOR AUSTRALIA	
CONFORMITY ASSESSMENT BODY MRA US-EU SECTORAL ANNEX EMC (FCC)	

EMC TESTREPORT

Product	nGrave Zero
Standard	FCC part 15 subpart B
Test Report	PCC-EMC-5205
LDN Number	LDN4265
Date of issue	2021-11-30
Edition	04

Office: Laboratoria De Nayer vzw.
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http://www.labodenayer.be – VAT 415.895.616 – KBC 414-0164451-72

Contents

This Test Report contains 34 pages

SECTION 1: IDENTIFICATION OF THE TEST LABORATORIA

LABORATORIA DE NAYER **Product Certification Centre (PCC)**	
J.De Nayerlaan 9 B-2860 St.-Katelijne-Waver Belgium Tel: +32 (0) 15 30 54 00 Fax: +32 (0) 15 32 1212	Direct phone numbers and e-mail address: (Test engineer) J. De Vos +32(0)15 30 54 04 j.de.vos@labodenayer.be

TEST LABORATORY RESPONSIBILITIES			
Function	**Name(s)**	**Date**	**Signature**
Test Operator	Jan De Vos	2021-11-30	
Author Report	Jan De Vos	2021-11-30	
Technical Expert	dr.ir. Dirk Van Troyen	2021-11-30	

041-TEST – ISO17025

The results refer to the described sample or equipment under test only.

Neither the accredited status of Laboratoria De Nayer v.z.w., nor this test report implies that the sample or equipment under test is approved by BELAC or any other establishment.

In case the customer wants to refer to his appeal to our accredited laboratories, he will use the following orequivalent sentence: “Tested by Laboratoria De Nayer, E.M.C.department, accredited by BELAC for EMC-immunity and EMC-emission under registration number 041-TEST”.

SECTION 2: CUSTOMER INFORMATION AND DATES

CUSTOMER INFORMATION	
Company name:	nGrave
Address:	NGRAVE SPACES - Bloc 6 Rue Picard 7 1000 Brussel Belgium
Contact person:	Xavier Hendrickx
Telephone nr:	+32 (0)475 86 08 25
E-mail:	xavier.hendrickx@ngrave.io

DATES	
Receipt of the EUT:	2020-08-06
Start of tests:	2020-08-06
End of tests:	2020-08-07

SECTION 3: EQUIPMENT UNDER TEST (E.U.T.)

The correctness of the description and identification of the equipment under test, its operating conditions, possible modifications and monitoring of its behaviour during and/ or after the test conditions generated by the De Nayer Environmental Test Laboratory are under the responsibility of the customer.

IDENTIFICATION OF THE E.U.T.

Intended use:	Hardware cryptocurrency wallet
Manufacturer:	nGrave
Marketing name:	nGrave Zero
Model / Type:	Zero
Software Version:	CE/FCC release V0
Maximum internal frequency	800MHz
Serial Number:	DWMB005
AC/DC convertor :	XPpower VEL05US050-EU-BB
FCC-ID number:	2AYXL-ZRO1

Illustrations: (Equipment under test)

Photo : EUT top

Photo : bottom

Photo : AC/DC adapter.

SECTION 4: TEST SPECIFICATIONS AND TEST METHODS

Applied Tests or Technical Standards		
Emission:		
Test or Technical Standard	Title	
FCC CFR47 part 15	Code of Federal Regulations , part 15 , Subpart B , Unintentional Radiators	
ANSI C63.4 (2014)	American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	

(*) if the log is mentioned, the measurement is under accreditation : 041-TEST – ISO17025

MRA : between E.C. and USA : CAB (EMC) [designation number BE0002] date of validation 15.01.2002

Equipment Classifications
Class A digital device : A digital device that is marketed for use in a commercial , industrial or business environment , exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

Class B digital device : A digital device that is marketed for use in a residential environment , notwithstanding use in commercial , industrial or business environments. Examples of such a devices include , but are not limited to , personal computer , calculators and similar electronic devices that are marketed for use by the general public.

Field Strength Calculation.

The field strength is calculated in the receiver , for conducted emission on the mains LISN-2line is selected , for spurious radiated emission the band-CD (30-1000MHz) and LDNRE_FCChigh(>1GHz) is selected

LISN-2line is the Transducer Factor for the LISN (combination of the attenuation of the LISN and cable in the range 150kHz-30MHz)

FCC-RE_HK116 is the Transducer factor for the bicon antenna (combination of the AF of the R&S antenna , pre-amplifier and cables in the range 30MHz-200MHz) .

FCC-RE_HL223 is the Transducer factor for the log antenna (combination of the AF of the R&S antenna , pre-amplifier and cables in the range 200MHz-1000MHz) .

LDNRE_FCChigh is the Transducer factor for the horn antenna (combination of the AF of the horn antenna , pre-amplifier and cables in the range >1GHz.

SECTION 5: OPERATION OF EUT DURING TESTING

The following performance criteria are described in the standard .

Operating modes during emission testing
Special test software on the device for the tests. This software will go through and evaluate all functionalities. The following functions are evaluated - Fingerprint sensor - Camera - Screen with color bar and video

SECTION 6: SUMMARY OF TEST RESULTS

6.1Test results of the emission tests.

emission measurement according to : FCC part 15		
Test	The EUT complies limits	remarks
conducted emissions (0.15 MHz – 30 MHz) mains	yes , class B.	
radiated emissions (30 MHz – 1000 MHz)	yes , class B	
radiated emissions (f > 1GHz)	yes , class B	

Section 15.19 Labelling requirements.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) this device may not cause harmful interference,
and (2) this device must accept any interference received, including interference that may cause undesired operation.

(b) Products subject to authorization under a Declaration of Conformity shall be labeled as follows:
(1) The label shall be located in a conspicuous location on the device and shall contain the unique identification described in Section 2.1074 of this chapter and the following logo:
(i) If the product is authorized based on testing of the product or system; or

SECTION 7: DETAILED TEST RESULTS

7.1. EMISSION TEST

The test has been performed according to the standard: CFR 47 part15 Subpart B.
part : 15.107

part 15.109

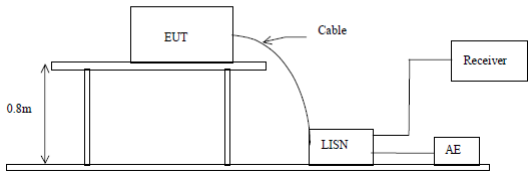
7.1.1 CONDUCTED EMISSION TEST : power

CONDITIONS
The equipment was placed at 80cm above the floor. The test has been performed in a shielded room. The conducted emission level was measured with a LISN according to CISPR16/ANSI C36.4 (0.15 MHz - 30 MHz). Test voltage : 115V /60Hz Specification reference :C.F.R.47 part 15.107 The upper limit line is the quasi-peak limit line . The lower limit line is the average limit line. Test date : 2020-08-06
Test equipment : Receiver: R&S ESU40 , MN :20112350 Limiter : R&S ESH3Z2 , MN : 2006150 LISN : R&S ESH2-Z5 , MN149028

Hardware Setup:	LISN-2line
Receiver:	[ESU 40]
Level Unit:	dBµV
LISN TDF :	Correction Table (Line 0): ESH2-Z5-16A-N
	Correction Table (Line 1): ESH2-Z5-16A-L

Subrange	Step Size	Detectors	IF BW
150 kHz - 30 MHz	5 kHz	PK+; AVG	9 kHz

Test Setup:



Conducted emission L1-PE

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.155000	30.86	65.73	-34.87	0.330000	33.06	49.45	-16.39
0.330000	37.94	59.45	-21.51	1.010000	18.51	46.00	-27.49
0.655000	23.52	56.00	-32.48	2.025000	16.00	46.00	-30.00
0.855000	22.64	56.00	-33.36	2.045000	15.72	46.00	-30.28
0.985000	25.03	56.00	-30.97	4.250000	19.23	46.00	-26.77
4.285000	29.09	56.00	-26.91	4.320000	19.27	46.00	-26.73

fig1 : plot results L1- PE

Conducted emission N-PE

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.155000	32.38	65.73	-33.35	0.155000	22.65	55.73	-33.07
0.330000	35.98	59.45	-23.47	0.330000	33.61	49.45	-15.84
0.680000	24.09	56.00	-31.91	0.685000	18.44	46.00	-27.56
0.685000	24.75	56.00	-31.25	4.245000	18.63	46.00	-27.37
4.270000	25.65	56.00	-30.35	4.250000	18.37	46.00	-27.63
4.280000	25.09	56.00	-30.91	4.310000	18.41	46.00	-27.59

fig2: plot results N- PE

Test result	pass , class B

fig1 Conducted emission L1-PE

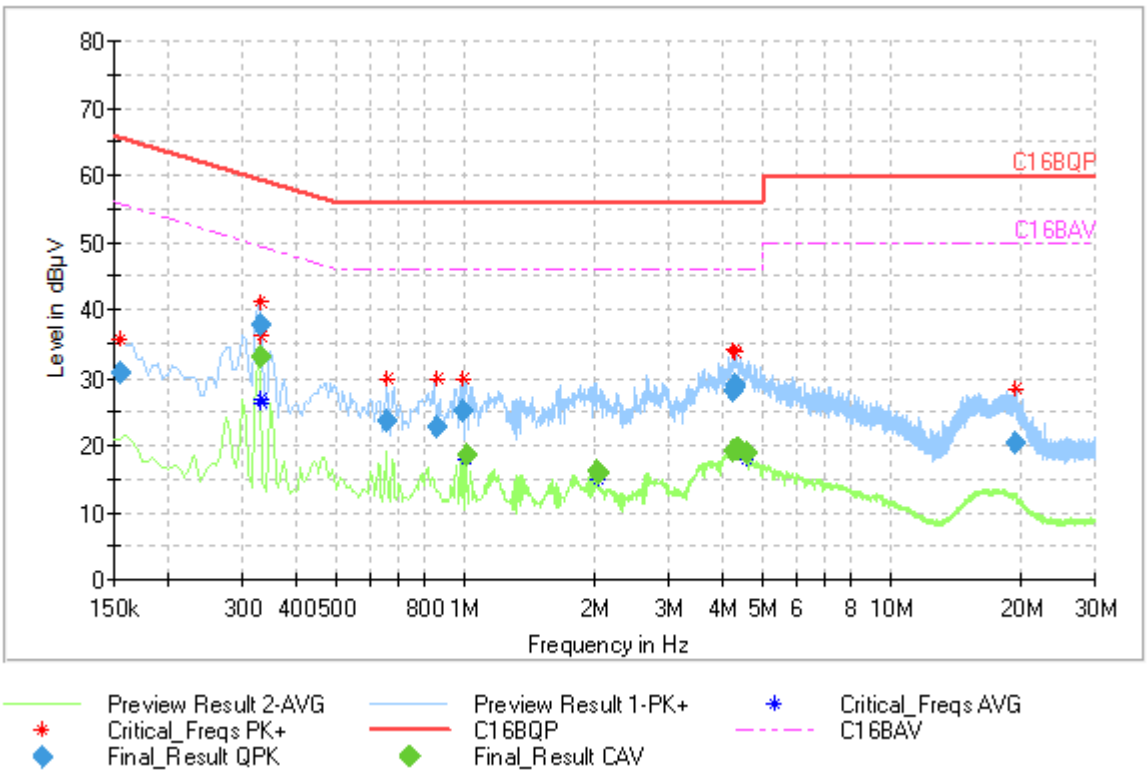
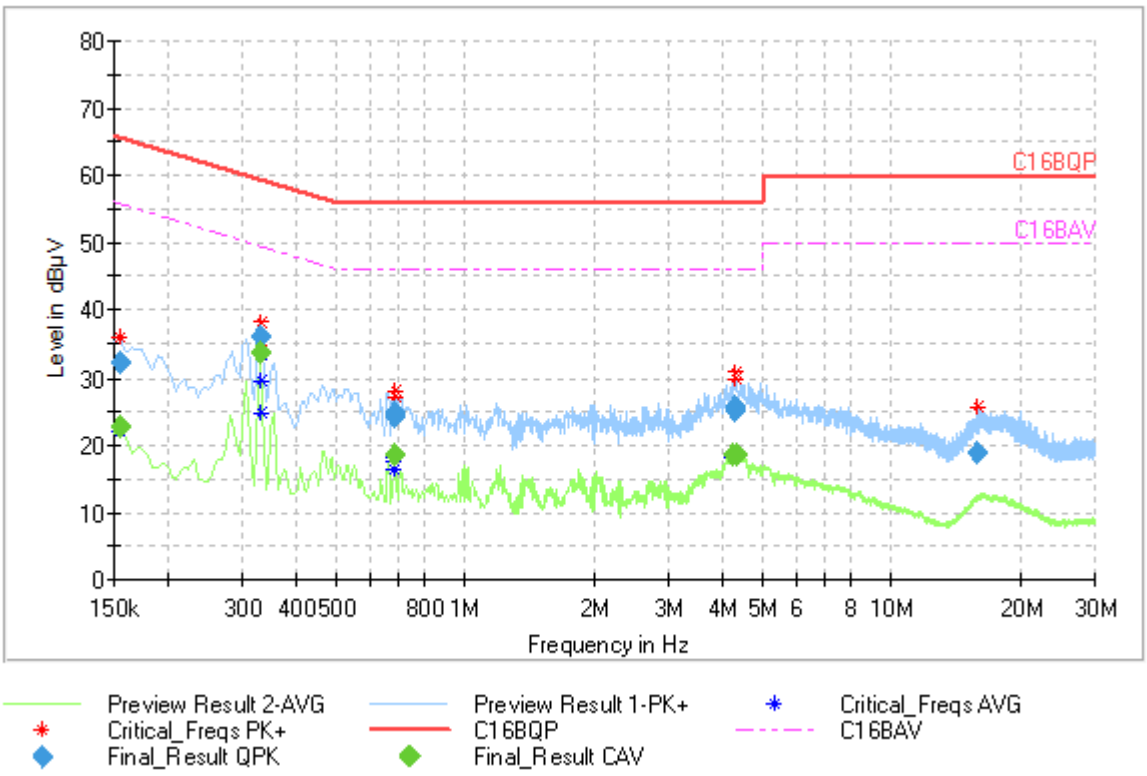


fig2 Conducted emission N-PE



7.1.2 RADIATED EMISSION TEST

CONDITIONS
The equipment was placed as a table equipment in a semi anechoic room (10x6x6) with metal groundplane on the floor. The chamber complies with the ANSI C63.4/5 and CISPR 16. The radiated emission level was measured with a bicon antenna (30-200MHz) log antenna (200-1000MHz) and a horn antenna (f>1GHz) . The distance between antenna and EUT is 3m (30-6000MHz) and the EUT is placed on a table of 80cm height. Absorbers on the floor were placed for f >1GHz . For the final measurement the antenna height was adjusted (1-4m) and the EUT was rotated (359º) to find the maximum emission . Test voltage : 115Vac/60Hz Specification reference :C.F.R.47 part 15.109 The limit line 1 is the quasi-peak limit line . Test date : 2020-08-07
Test equipment : Receiver: R&S ESU40 , MN : 20112350 Antenna : R&S HK116 , MN : 2006057 Antenna : R&S HL223 , MN :2006058 Preamp : LDN PAM-1, MN : 20111408 Preamp : LDN PAM-2 , MN : Antenna : R&S HF906 , MN : 2006053 6dB attenuator : MN 201800 Antenna mast : RSM 010 Turntable : RST 073 Controller : RSC 02 Cables : IR03 , IR196 , IR197 ,IR198

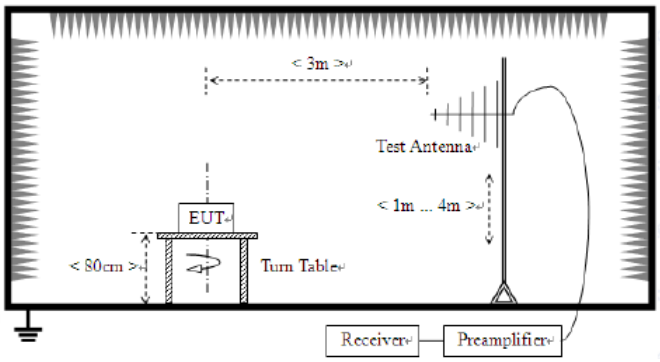
Measurement results Radiated emission :

Hardware Setup:	FCC-RE_HK116
Receiver:	[ESU 40]
Level Unit:	dBµV/m
TDF :	Correction Table (vertical): HK116ansi
	Correction Table (horizontal): HK116ansi

Subrange	Step Size	Detectors	IF BW
30 MHz – 200MHz	62.5 kHz	PK+	120 kHz

Hardware Setup:	FCC-RE_HL223
Receiver:	[ESU 40]
Level Unit:	dBµV/m
TDF :	Correction Table (vertical): HL223-LDN
	Correction Table (horizontal): HL223-LDN

Subrange	Step Size	Detectors	IF BW
200 MHz – 1000MHz	62.5 kHz	PK+	120 kHz



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
32.640000	20.79	40.00	-19.21	1000.0	120.000	100.0	V	0.0
32.880000	20.52	40.00	-19.48	1000.0	120.000	100.0	V	0.0
43.040000	29.10	40.00	-10.90	1000.0	120.000	100.0	V	135.0
43.360000	28.16	40.00	-11.84	1000.0	120.000	100.0	V	135.0
124.320000	21.26	43.50	-22.24	1000.0	120.000	175.0	H	135.0
126.080000	22.30	43.50	-21.20	1000.0	120.000	175.0	H	135.0

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
271.600000	17.78	46.00	-28.22	1000.0	120.000	125.0	H	180.0
277.040000	17.10	46.00	-28.90	1000.0	120.000	125.0	H	180.0
335.120000	17.34	46.00	-28.66	1000.0	120.000	100.0	H	45.0
353.680000	16.46	46.00	-29.54	1000.0	120.000	125.0	H	45.0
372.480000	16.94	46.00	-29.06	1000.0	120.000	100.0	H	45.0
427.520000	17.27	46.00	-28.73	1000.0	120.000	100.0	H	135.0

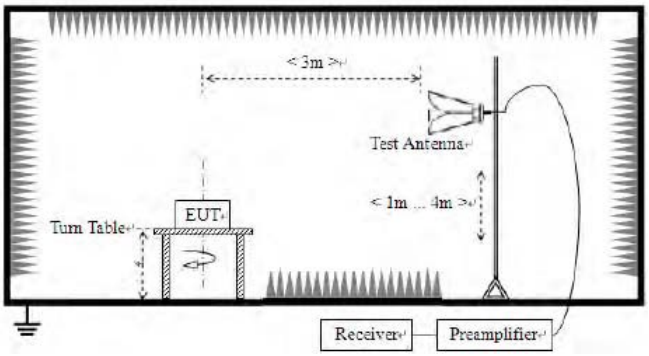
Range : 1-6GHz

Hardware Setup:	LDNRE_FCChigh
Level Unit:	dBµV/m
TDF :	Correction Table (vertical): HF906-3m-JAN
	Correction Table (horizontal): HF906-3m-JAN

Subrange	Step Size	Detectors	IF BW
1 GHz- 6 GHz	400kHz	AV	1MHz

Range 6-10GHz

Hardware Setup:	FCC-RE-6_18
Level Unit:	dBµV/m
TDF :	Correction Table (vertical): HF906-3m-JAN
	Correction Table (horizontal): HF906-3m-JAN



Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1224.000000	27.37	54.00	-26.63	10	1000.0	100.0	V
1599.200000	33.12	54.00	-20.88	10	1000.0	100.0	V
1224.000000	33.71	54.00	-20.29	10	1000.0	100.0	H
2033.200000	28.23	54.00	-25.77	10	1000.0	100.0	H

Remark Margin value : a positive number is the value below the limit , a negative number is a fail .

Test result	pass , class B

Measurement results Radiated emission :

Fig : Radiated emission (30-200MHz)

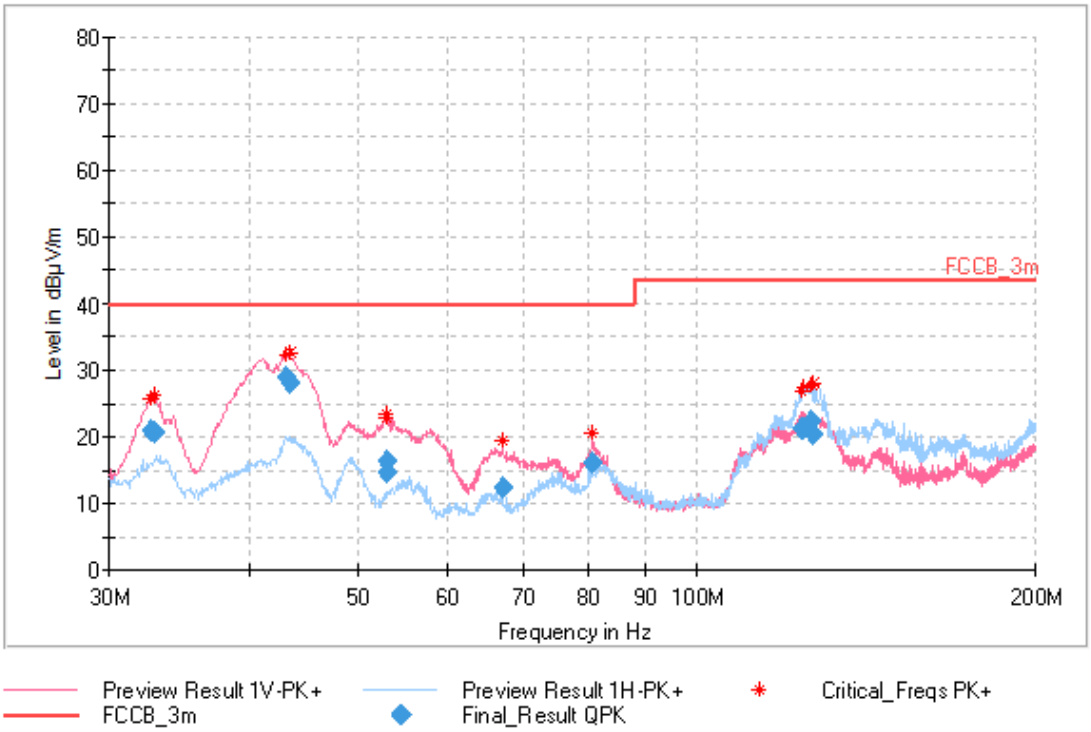


Fig : Radiated emission (200-1000MHz)

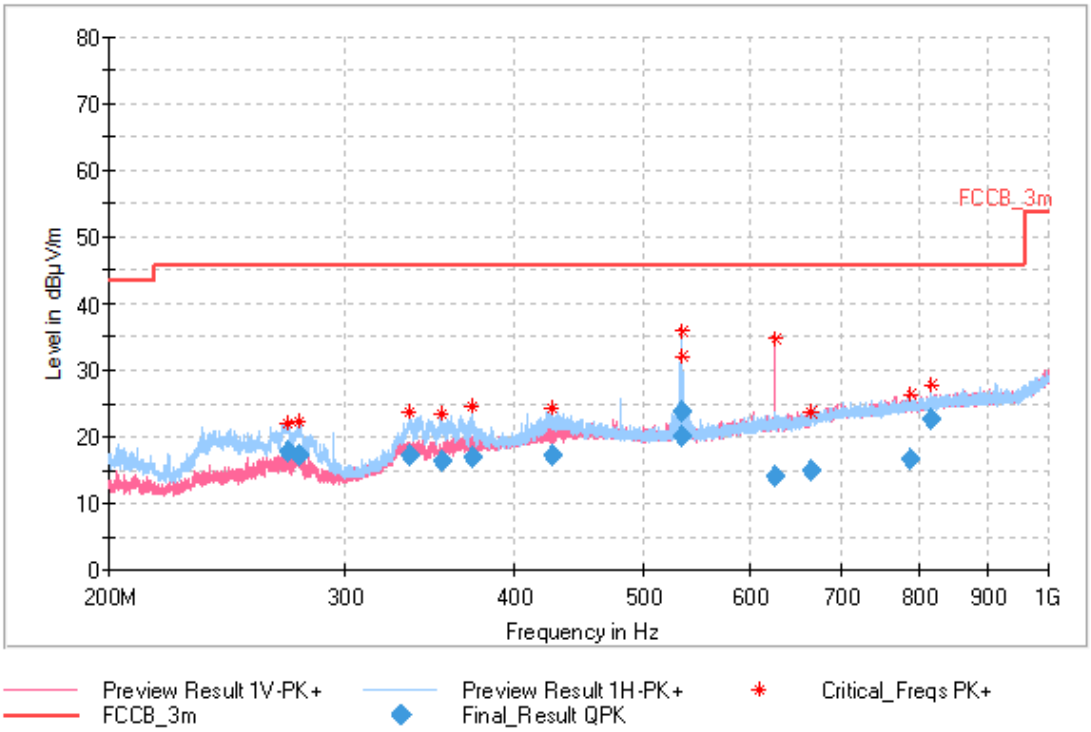


Fig : Radiated emission (1-6GHz) hor pol

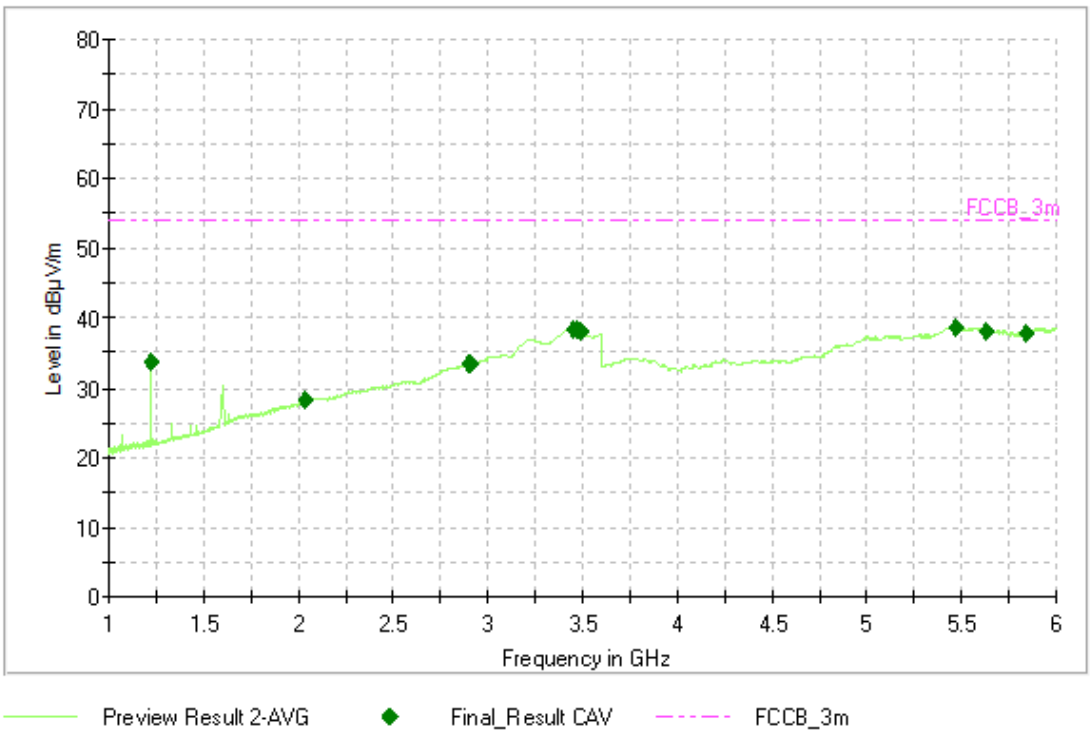
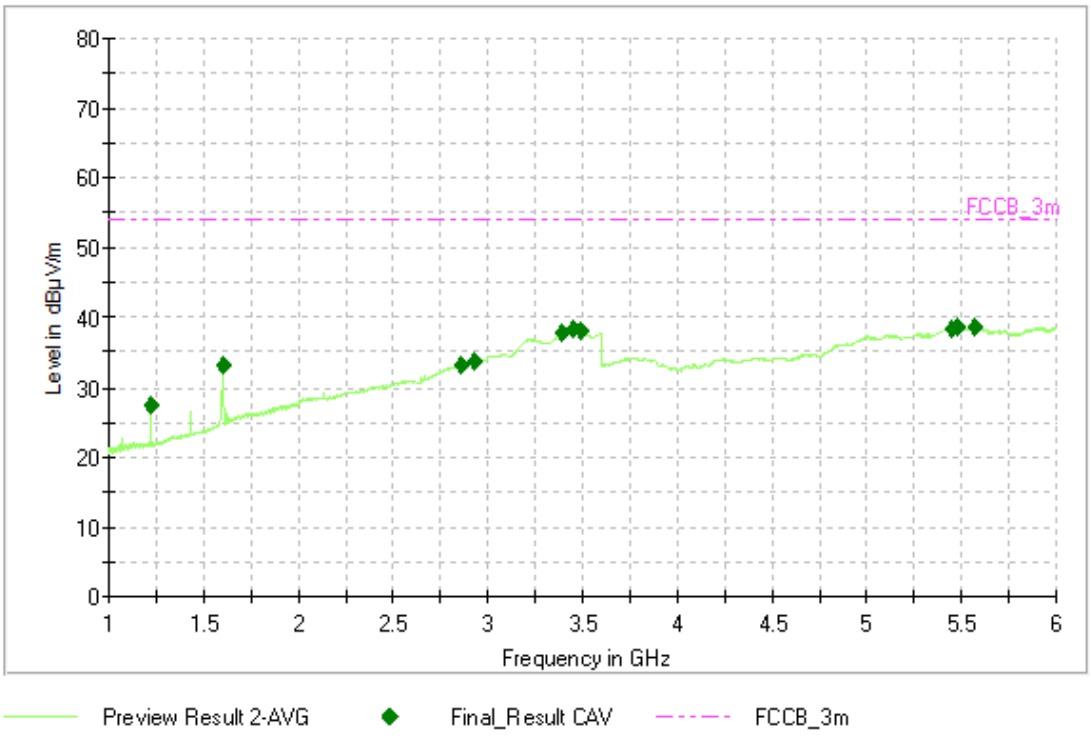


fig : Radiated emission (1-6GHz) ver pol



7.2. limits

Table : CE on mains (classB)

frequency (MHz)	QP (dBµV)	AV (dBµV)
0.15-0.50	66 to 56	56 to 46
0.50-5.0	56	46
5.0-30	60	50

Table : RE @ 3m (class B)

Frequency (MHz)	QP (dBµV/m)	AV (dBµV/m)
30-88	40	--
88-216	43.5	--
216-960	46	--
960-1000	54	--
1000-40000	--	54

7.3. Test dates and Climate conditions.

date	2020-08-06 and 07
ambient temperature	24/25ºC
relative humidity	43/50%
atmospheric pressure	1019/1020 hPa

7.4. Used equipment

Equipment

type	MN	Last cal	due
ESU40	20112350	2019-11-12	2020-11-12
ESH2-Z5	149028	2018-10-02	2020-10-02
ESH3-Z2	2006150	2020-01-15	2021-01-15
HK116	2006057	2018-01-31	2021-01-31
HL223	2006058	2018-07-17	2021-07-17
HF906	2006053	2018-01-30	2021-01-30
PAM-1	20111408	2020-01-13	2021-01-13
PAM-2	201112559	2020-01-13	2021-01-13

SECTION 8: MEASUREMENT UNCERTAINTIES

MEASUREMENT	FREQ. RANGE	SITE	APPLICABILITY	UNCERTAINTY
Radiated emission CISPR16 NIS81	30-200 MHz 200-1000 MHz >1000 MHz	SAR SAR SAR	3m 3m 3m	3.9 dB 3.9 dB 5.0 dB
Conducted emission CISPR16 NIS81	9 – 150 kHz 150 kHz-30 MHz 150kHz-30 MHz 150 kHz – 30 MHz	- - - -	LISN on AC/DC LISN on AC/DC T-network/CDN Current probe	2.6 dB 2.4 dB 2.8 dB 3.7 dB

Remark : When a statement of conformity is made the laboratory does not take the measurement uncertainty into account

SECTION 9: PHOTOGRAPHS OF EQUIPMENT AND TEST SET-UP

Photo : conducted emission

Photo : radiates emission (30-200MHz)

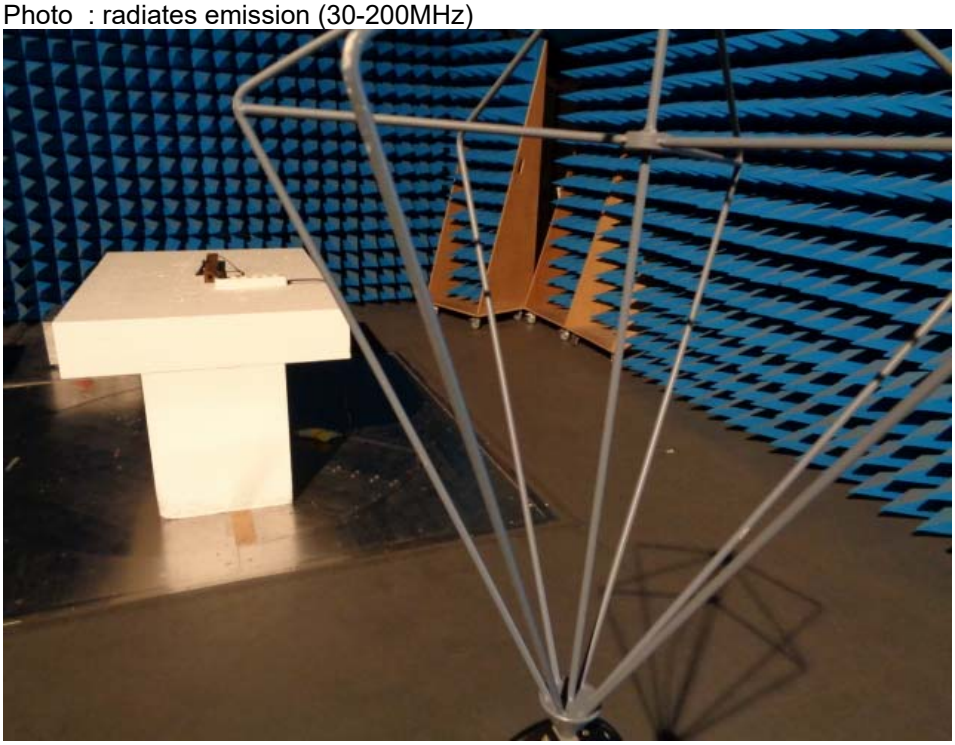


Photo : radiates emission (200-1000MHz)

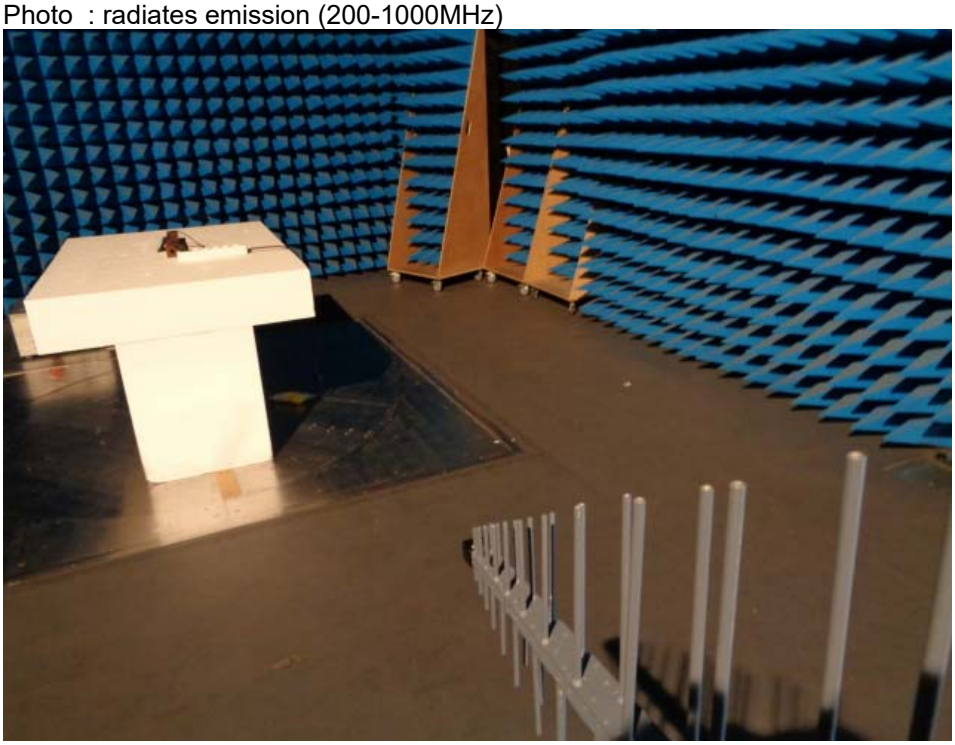


Photo : radiates emission (1-6GHz)

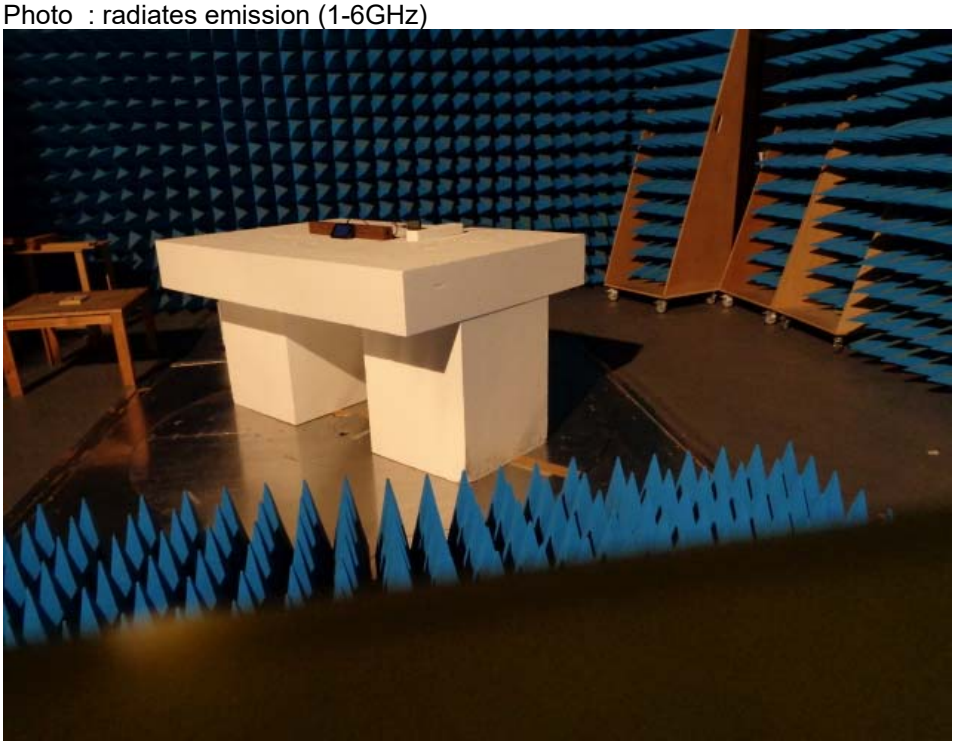
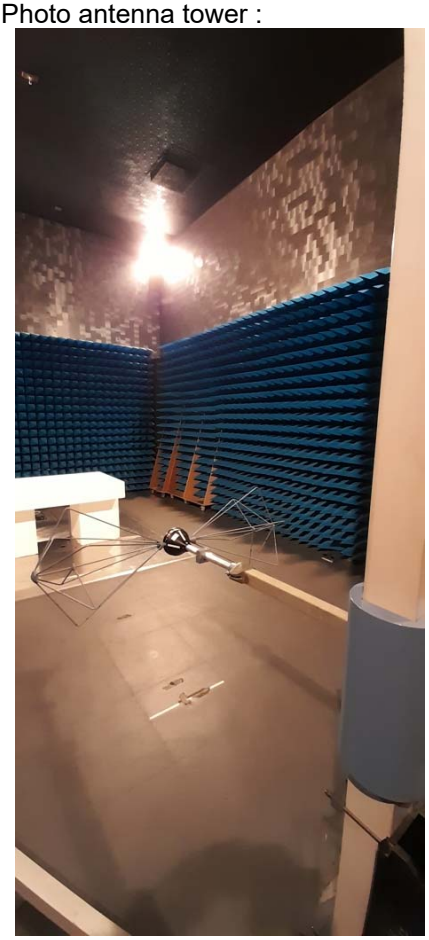
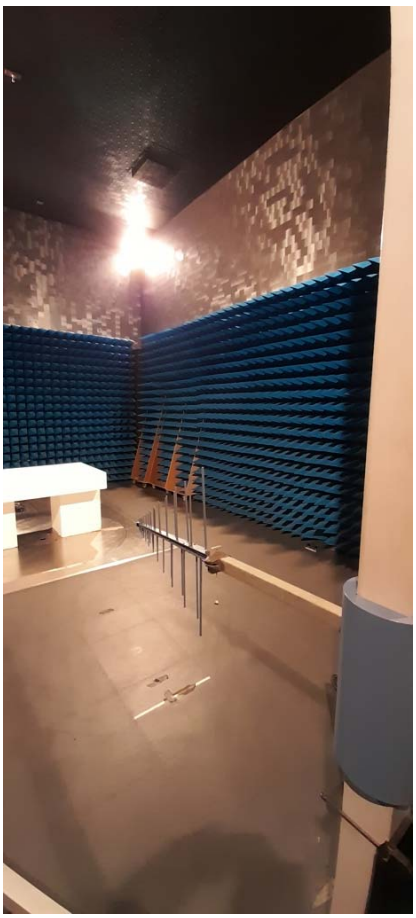


Photo antenna tower :





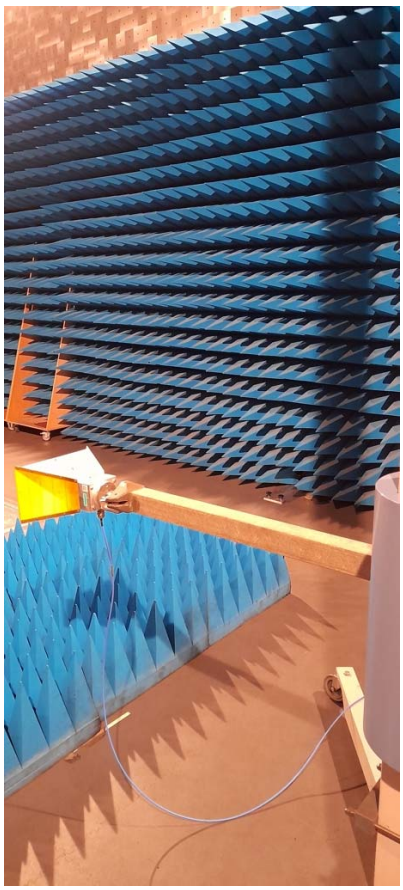
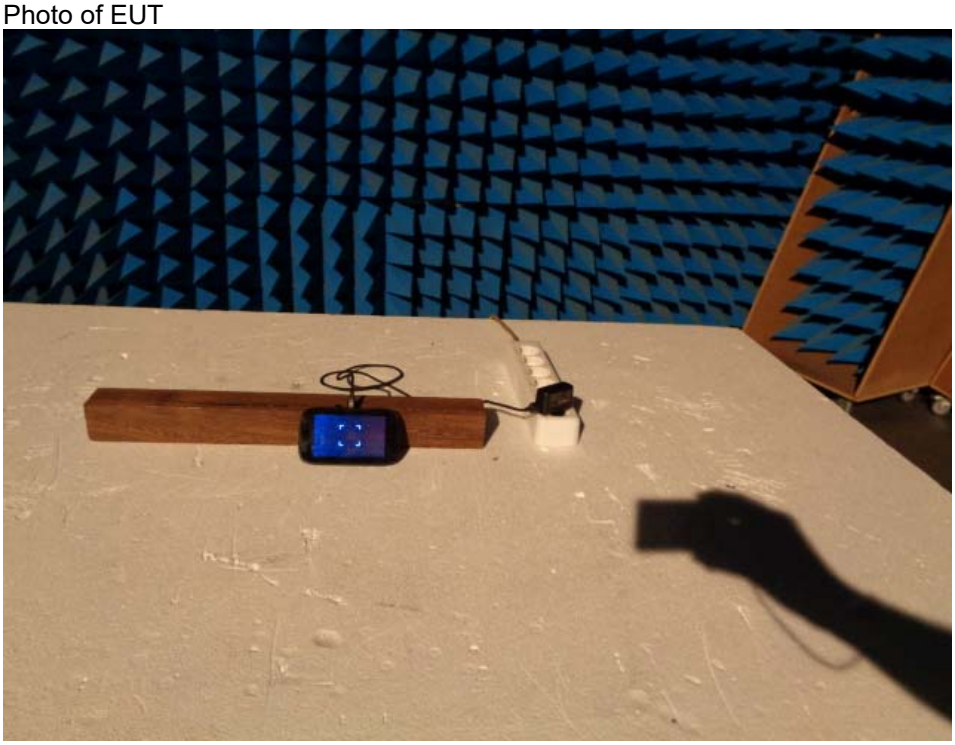


Photo of EUT



SECTION 10: ADDITIONAL INFORMATION GIVEN BY THE CUSTOMER

Applicant's role during testing
none

EUT information given by the customer

Auxiliary equipment connected during testing
none

Cables
none

SECTION 11: MODIFICATIONS OF EUT

MODIFICATIONS OF EUT : --

SECTION 12: HISTORY OF THE TEST REPORT

HISTORY OF THE TEST REPORT (EDITION)

Edition	Adjustment (reason for up-grade)
PCC-EMC-5205_ed.0	Draft
PCC-EMC-5205_ed.1	Original
PCC-EMC-5205_ed.2	Adding FCC-ID in report
PCC-EMC-5205_ed.3	adding extra info and photo antenna tower
PCC-EMC-5205_ed.4	adding extra info and photo antenna tower

SECTION 13: ACCREDITATION CERTIFICATE

Organisme belge d'Accréditation
Belgische Accreditatieinstelling
Belgische Akkreditierungsstelle
Belgian Accreditation Body

Signatory to EA, ILAC and IAF Multilateral Agreements

Accreditation Certificate No. 041-TEST

In compliance with the provisions of the Royal Decree of 31 January 2006 setting up BELAC, the Accreditation Board hereby declares, that the test laboratory

LABORATORIA DE NAYER VZW
J.P De Nayerlaan, 9
2860 SINT-KATELIJNE-WAVER - Belgium

has the competence to perform the tests as described in the annex which is an integral part of the present certificate, in accordance with the requirements of the standard EN ISO/IEC 17025:2005. The present accreditation is the subject of regular surveillance in order to confirm the compliance with the accreditation conditions.

The Chair of the Accreditation Board BELAC,

Issue date : **2018-12-13**

Validity date : **2024-01-07**

Nicole MEURÉE-VANLAETHEM

Original version of this certificate is in Dutch.

.be

FCC :

FEDERAL COMMUNICATIONS COMMISSION
Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

To: Tina Vounasi
SPF Economie, PME, Classes moyennes et Energie
GROW-NANDO-ADMINISTRATOR@ec.europa.eu
From: George Tannahill
George.Tannahill@fcc.gov
Date: April 03, 2020

Test Firm Name: Laboratoria De Nayer
Designation Number: BE0002
Test Firm Registration Number: 963303

Subject: FCC recognition of accreditation for Laboratoria De Nayer

We have been notified by SPF Economie, PME, Classes moyennes et Energie that Laboratoria De Nayer has been accredited as a testing laboratory.

At this time Laboratoria De Nayer is hereby recognized to perform compliance testing on equipment subject to the Commission's Declaration Of Conformity (DOC) and Certification rules for the following scope(s):

Unintentional Radiators - FCC Part15, Subpart B
Industrial, Scientific, and Medical Equipment - FCC Part 18
Intentional Radiators - FCC Part 15 Subpart C

This recognition will expire upon expiration of the accreditation or notification of withdrawal of Commission's recognition.

Any questions about this recognition should be submitted as an inquiry to the FCC Knowledge Database at www.fcc.gov/kdb.