DEKRA Testing and Certification, S.A.U.
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DEKRA

ilac-MRA ENAC ENSAYOS Nº 51/LE147

FCC LISTED, REGISTRATION NUMBER: 720267

ISED LISTED REGISTRATION NUMBER 4621A-2

Informe de ensayo nº:
Test report No:

NIE: 54121RRF.001

Test report

USA FCC Part 15.249 & 15.209
CANADA RSS-210, RSS-Gen

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, 5725 - 5875 MHz, and 24.0 – 24.25 GHz.

Identificación del objeto ensayado.....: Identification of item tested	BICYCLE LIGHT
Marca .....: Trademark	BLINKERS BY VELOHUB
Modelo y/o referencia tipo .....: Model and /or type reference	BLINKERS
Other identification of the product .....:	FCC ID: 2APKS-BLK
Final HW version .....:	1.0
Final SW version .....:	1.0
Características .....: Features	Not provided data
Solicitante.....: Applicant	VELOHUB AG Dorfstrasse 27 8037, Zürich, Switzerland
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 15.249 10-1-17 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, 5725 - 5875 MHz, and 24.0 – 24.25 GHz. USA FCC Part 15.209 10-1-17 Edition: Radiated emission limits; general requirements. CANADA RSS-210 Issue 9 (August 2016). CANADA RSS-Gen Issue 4 (November 2014). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) .....: Approved by (name / position & signature)	A. Llamas RF Lab. Manager Firmado digitalmente por ALEJANDRO LLAMAS RODRIGUEZ Fecha: 2018.05.31 09:32:34 +02'00'
Fecha de realización .....: Date of issue	2018-05-31
Formato de informe No. .....: Report template No	FDT08_20

Index

Competences and guarantees 3
General conditions 3
Uncertainty 3
Usage of samples 4
Test sample description 4
Identification of the client 4
Testing period 4
Environmental conditions 5
Remarks and comments 6
Testing verdicts 7
Appendix A – Test results 8

Competences and guarantees

DEKRA Testing and Certification is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjuction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

DEKRA Testing and Certification is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: ISED 4621A-2.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

DEKRA Testing and Certification is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification.internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
54121/001	Frontal lightning with integral antenna	BL-1-LB	---	2018-03-20
54121/007	Frontal support	---	---	2018-03-20

1. Sample S/01 has undergone following test(s).

   All radiated tests indicated in appendix A.

Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
54121/004	Back lightning with SMA	BL-1-FB	---	2018-03-20

1. Sample S/02 has undergone following test(s).

   All conducted tests indicated in appendix A.

Test sample description

The sample under test consist of a bicycle light security set, with front and rear light (white and red) and control pad, including turning indicator and brake light (laser proyection if applicable).

Identification of the client

VELOHUB AG
Dorfstrasse 27 8037, Zürich, Switzerland

Testing period

The performed test started on 2018-03-20 and finished on the same day.

The tests have been performed at DEKRA Testing and Certification.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Remarks and comments

1; The tests have been performed by the technical personnel: Carlos Contreras.

2: Used instrumentation:

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Signal and spectrum analyzer R&S FSV40	2017/07	2019/07

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2017/04	2020/04
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2016/11	2019/11
5.	Broadband Horn antenna 18-40 GHz SCHWARZBECK BBHA 9170	2017/03	2020/03
6.	EMI Test Receiver R&S ESU26	2018/02	2020/02
7.	Spectrum analyser Rohde & Schwarz FSW50	2018/02	2020/02
8.	RF pre-amplifier 30 MHz-6 GHz Bonn Elektronik BLNA 0360-01N	2017/07	2018/07
9.	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-3A	2018/03	2020/03
10.	RF pre-amplifier 18-40 GHz NARDA JS44-18004000-33-8P	2018/02	2019/02

Testing verdicts

Not applicable ..... :	N/A
Pass ..... :	P
Fail ..... :	F
Not measured ..... :	N/M

FCC PART 15 PARAGRAPH / RSS-210		VERDICT			
		NA	**P**	**F**	**NM**
FCC 15.249 Subclause (a) / RSS-210 B.10. (a)	Field strength of fundamental and harmonics emissions		P		
FCC 15.249 Subclause (d) / RSS-210 B.10. (b)	Emissions radiated outside of the specific frequency bands		P		

Appendix A – Test results

INDEX

TEST CONDITIONS 10

Occupied Bandwidth 12

Section 15.249 Subclause (a) / RSS-210 B.10. (a) Field strength of Fundamental.....13

Section 15.249 Subclause (a) / RSS-210 B.10 (b) Emissions limitations radiated (Transmitter) 15

TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.7 Vdc

Type of power supply = Battery.

Type of antenna = Integral antenna.

TEST FREQUENCIES:

2433 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is directly connected to the spectrum analyzer.

The DC supply voltage is applied using an internal battery fully charged.

RADIATED MEASUREMENTS

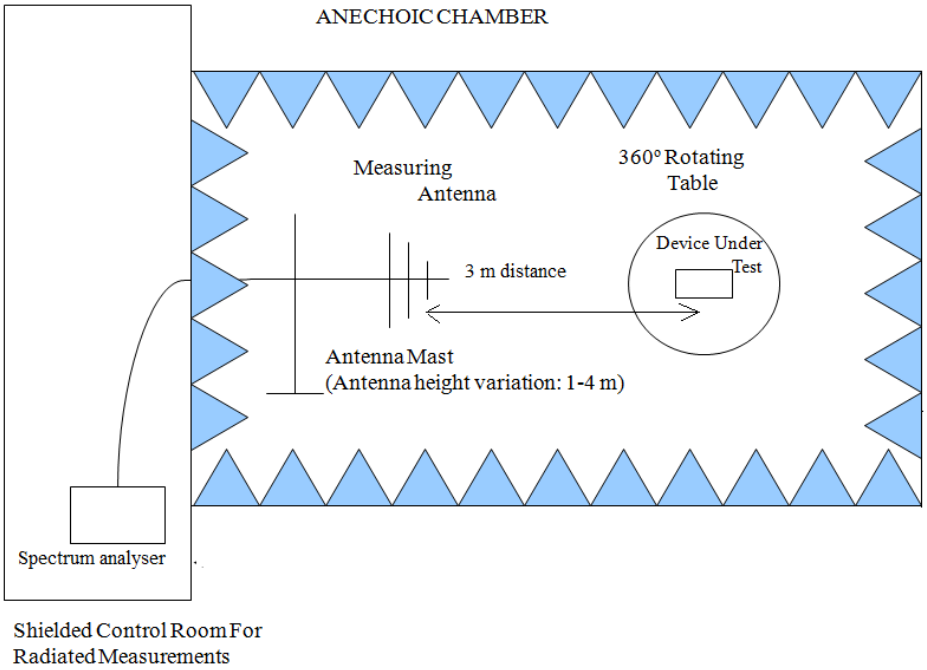
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-25 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-25 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

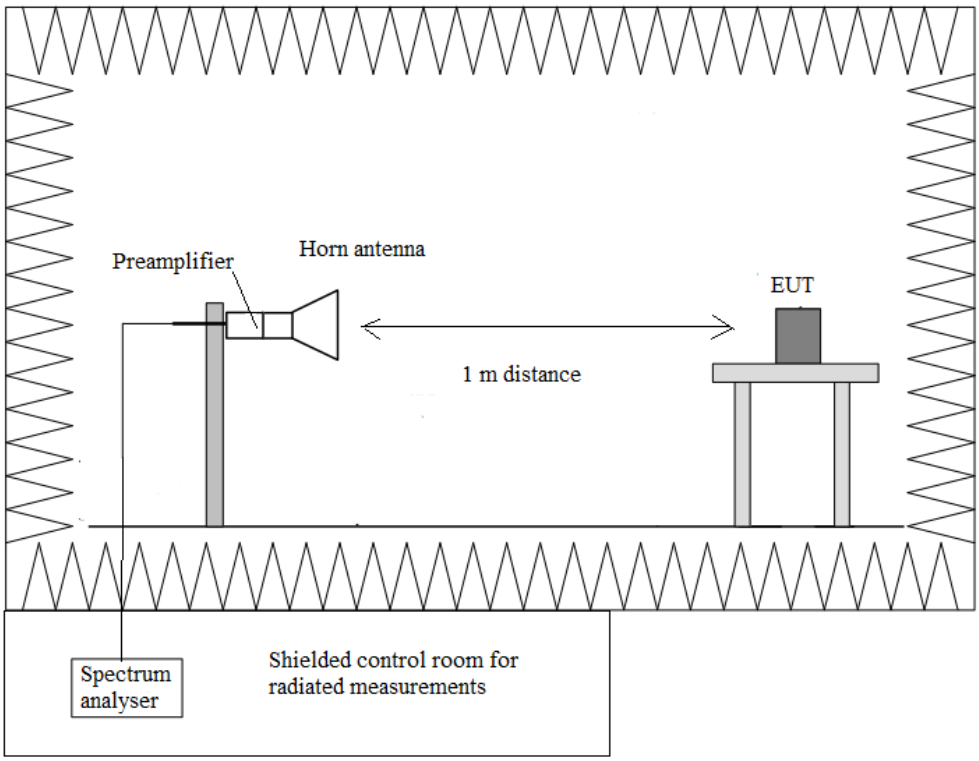
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

Radiated measurements setup f < 1 GHz



Radiated measurements setup f > 1 GHz

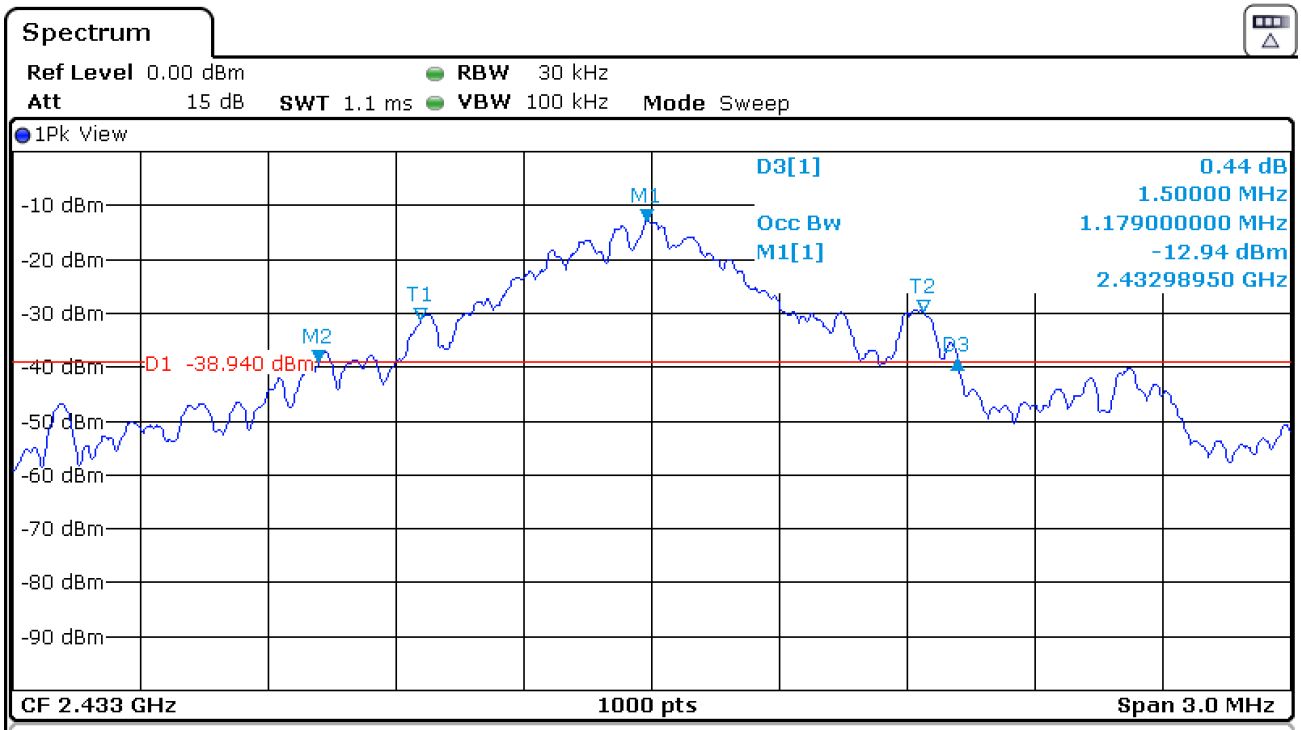


Occupied Bandwidth

RESULTS

(see next plot).

	Transmission frequency 2433 MHz
99% bandwidth (MHz)	1.179
-26 dBc bandwidth (MHz)	1.500
Measurement uncertainty (kHz)	<± 5.00



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4329895 GHz	-12.94 dBm		
T1		1	2.4324585 GHz	-31.37 dBm	Occ Bw	1.179 MHz
T2		1	2.4336375 GHz	-29.87 dBm		
M2		1	2.4322185 GHz	-38.97 dBm		
D3	M2	1	1.5 MHz	0.44 dB		

Section 15.249 Subclause (a) / RSS-210 B.10. (a) Field strength of Fundamental

SPECIFICATION

The field strength of emissions from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 – 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000-24250	250	107.96	3

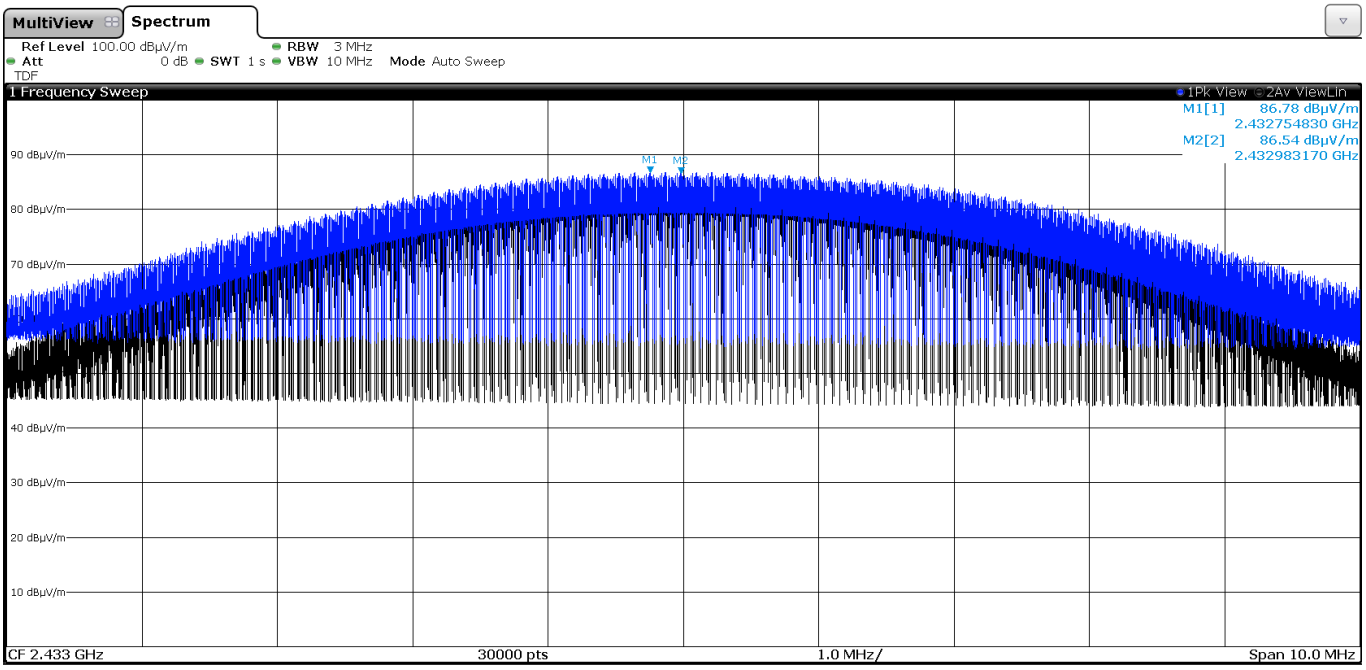
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS

	Transmission frequency 2433 MHz
Field strength (dBµV/m) average	86.54
Field strength (dBµV/m) peak	86.78
Measurement uncertainty (dB)	<±3.88

Verdict: PASS

FIELD STRENGTH



Section 15.249 Subclause (a) / RSS-210 B.10 (b) Emissions limitations radiated (Transmitter)

SPECIFICATION

The field strength of harmonics from intentional radiators shall comply with the following

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/m)	Measurement distance (m)
902 - 928	500	54	3
2400 – 2483.5	500	54	3
5725 - 5875	500	54	3
24000-24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

RESULTS:

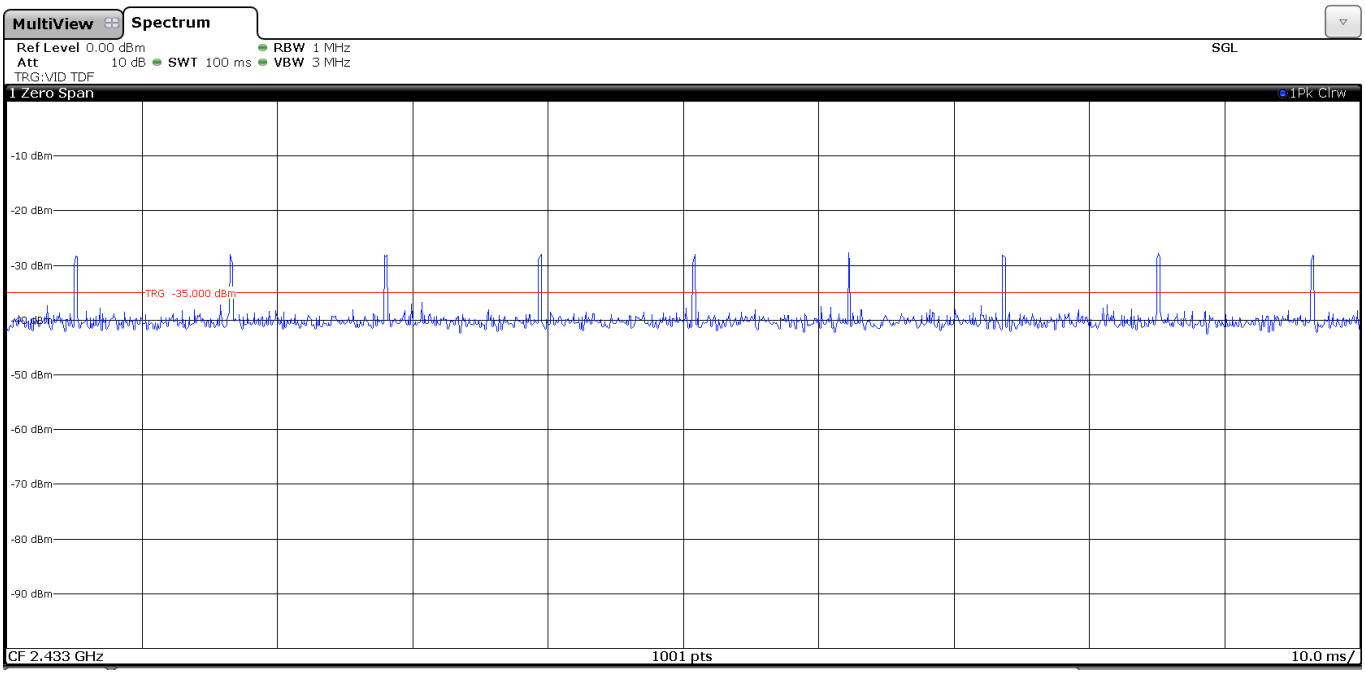
The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

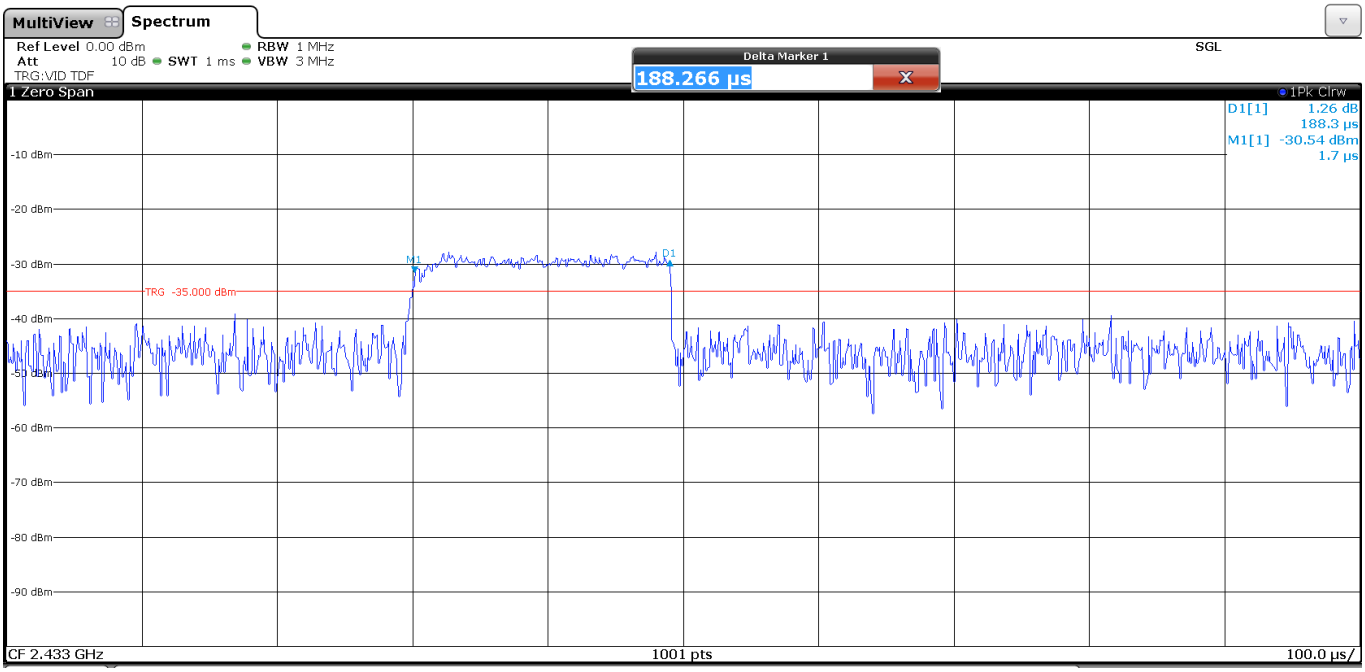
All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1 m for the frequency range 1 GHz-25 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Computation of duty-cycle correction factor



Number of pulses within 100 ms: 9



Pulse duration (Tx ON): 188.266 µs

Duty cycle correction factor δ = 20 * log (Tx ON (ms) * Number of pulses within 100 ms) / 100 ms

δ = 20 log (0.188266 * 9) / 100 = -35.42 dB.

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals where detected at less than 20 dB from the limit.

Frequency range 1 GHz-25 GHz

The results in the next tables show the maximum measured levels in the 1-25 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

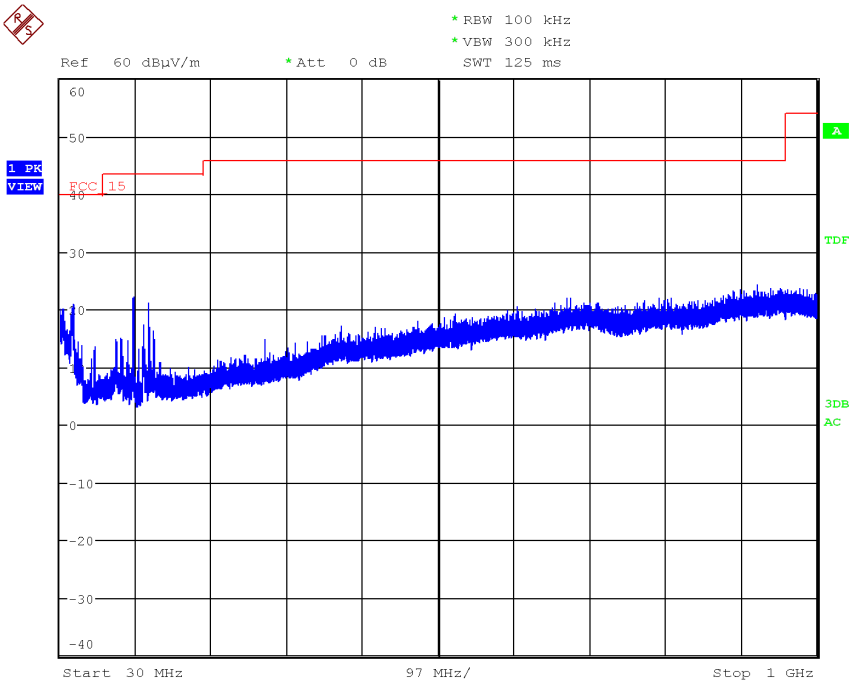
For spurious signals with peak levels above the average limit (54 dBµV/m at 3 m), the average level is calculated from the peak level using the duty cycle correction factor δ for checking compliance with the average limit.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2.78276	H	Peak	49.02	± 4.87
4.86575	V	Peak	59.66	± 4.87
		Avg (*)	24.24	± 4.87

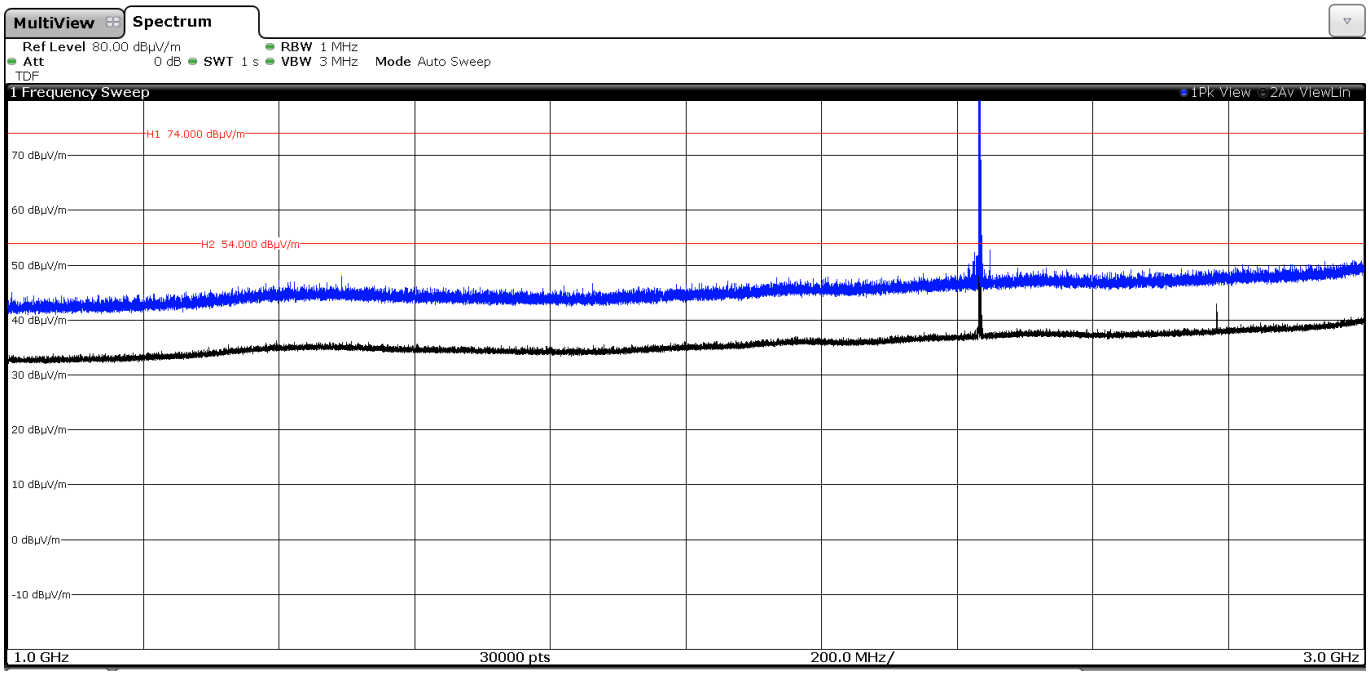
(*) AVG value was calculated using Duty cycle correction factor δ.

Verdict: PASS

FREQUENCY RANGE 30 MHz-1000 MHz.

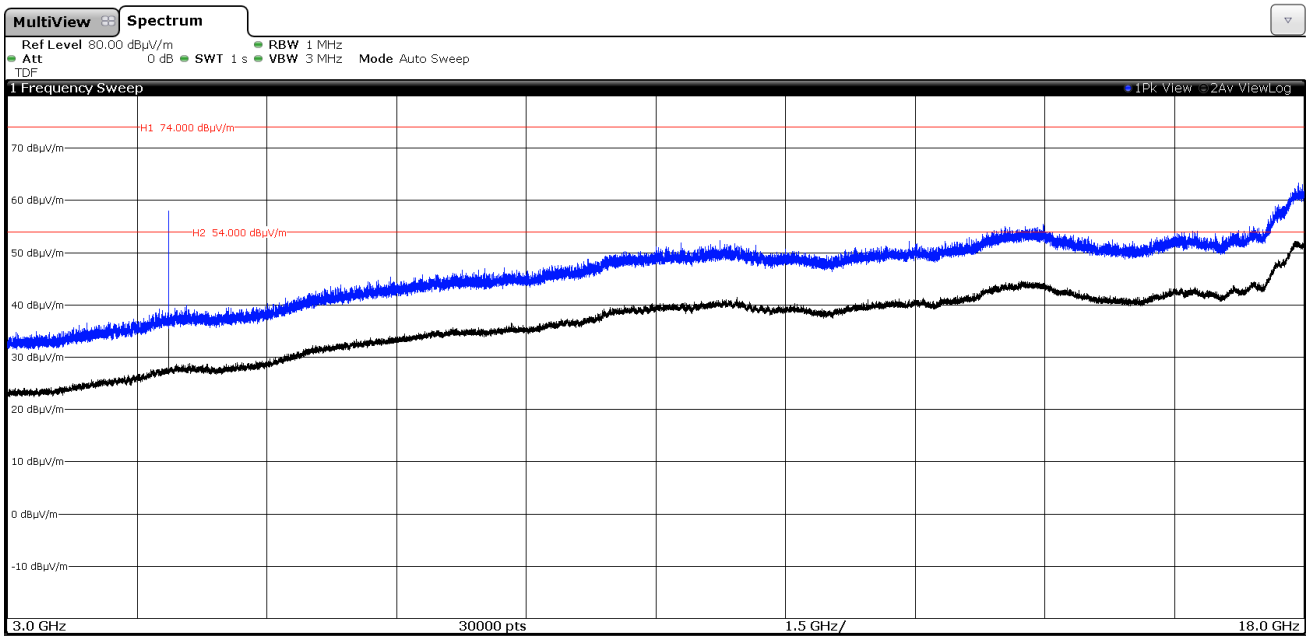


FREQUENCY RANGE 1 GHz to 3 GHz.

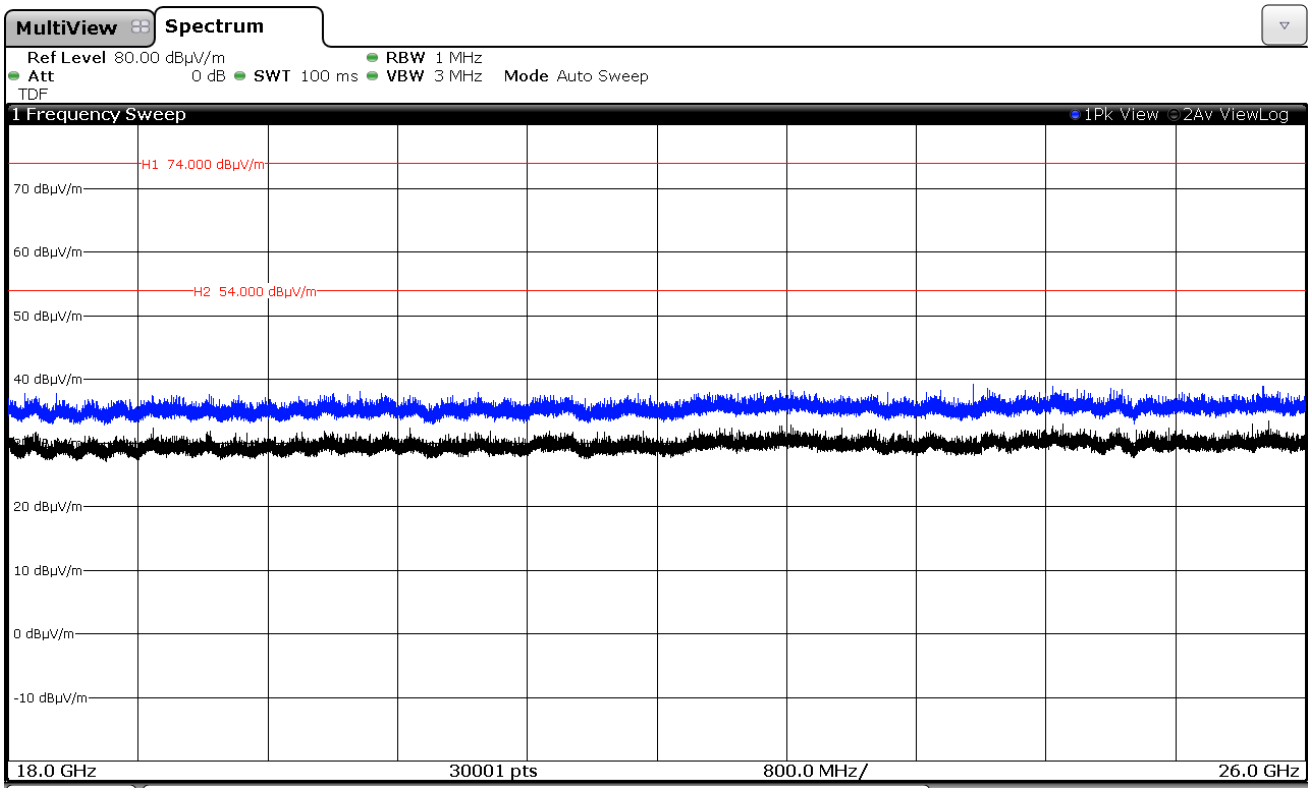


Note: The peak shown in the plot above the limit is the carrier frequency.

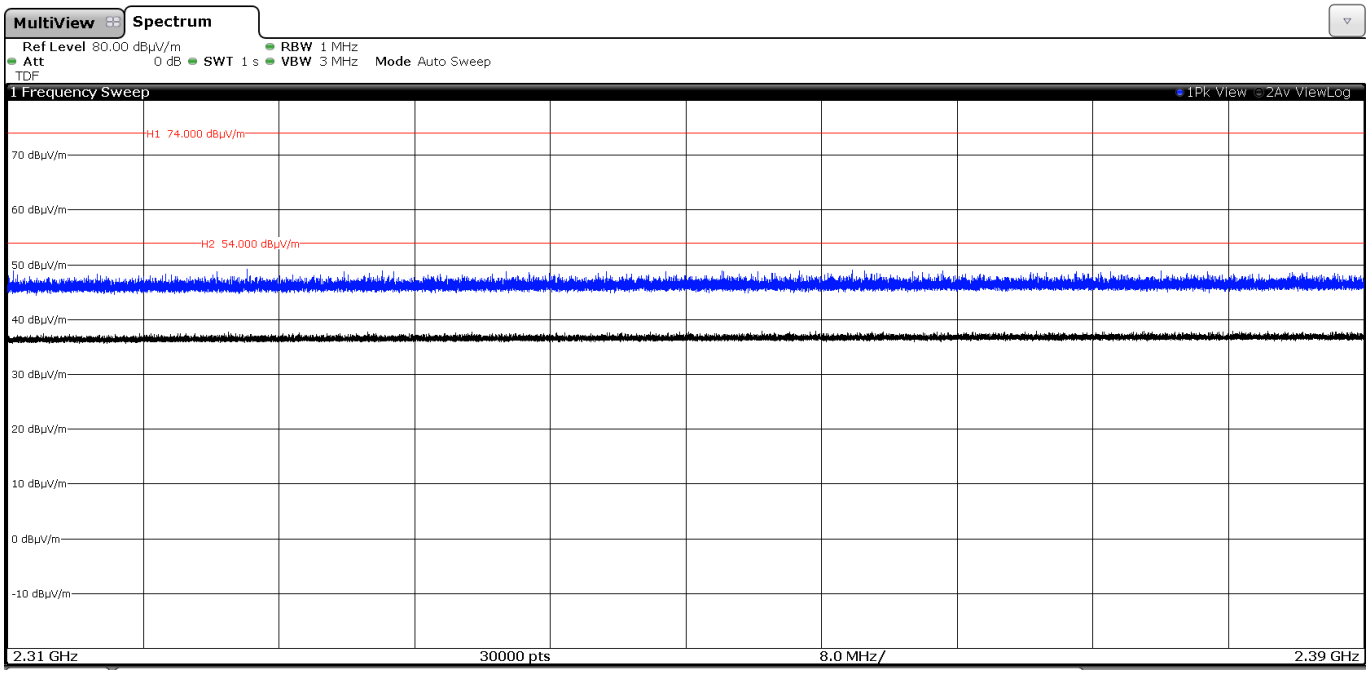
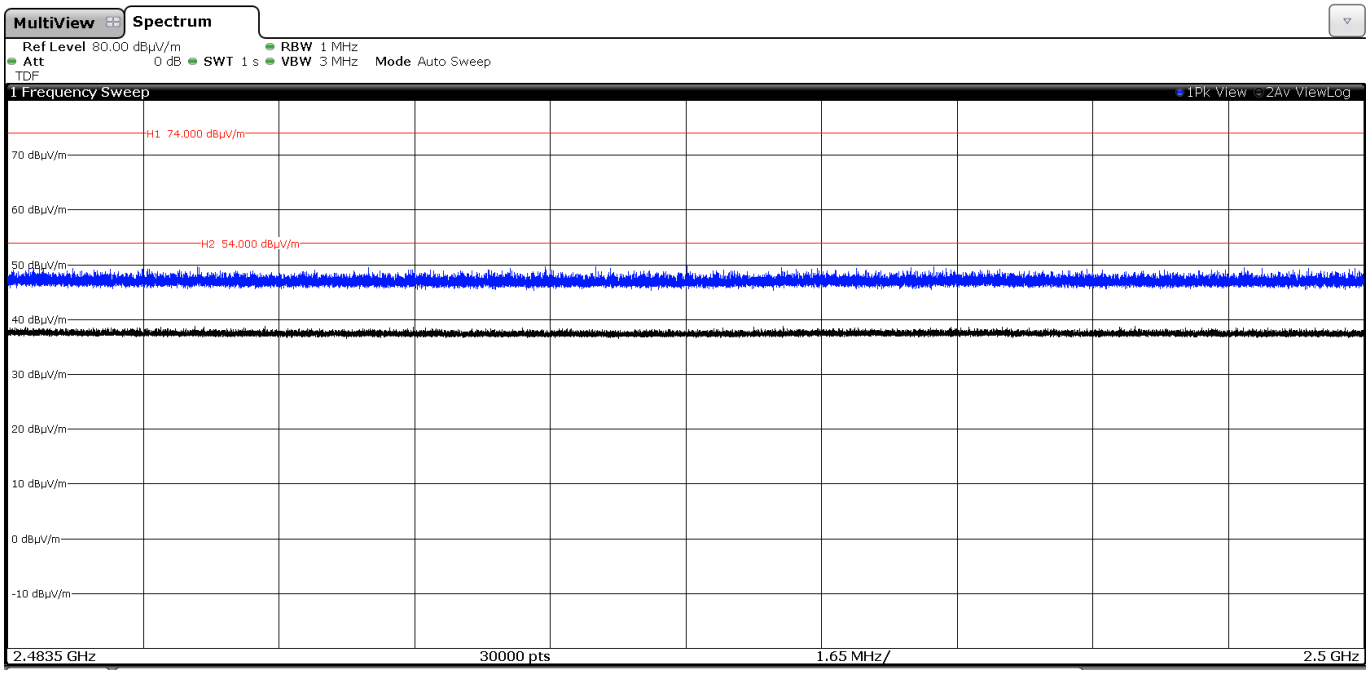
FREQUENCY RANGE 3 GHz to 18 GHz.



FREQUENCY RANGE 18 GHz to 26 GHz.



FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)



FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND).