

TEST REPORT

Title 47-Telecommunication

Chapter I - Federal Communications Commission - Subchapter A - General

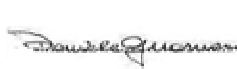
Part 15 - Radio Frequency Devices

Subpart C - Intentional radiators

Subpart E - Unlicensed national information infrastructure devices

Report Reference No.: 340239TRFFCC

Tested by
(name, function and signature): P. Barbieri (project handler) 

Approved by
(name, function and signature): D. Guarnone (verifier) 

Date of issue: 2018-01-02

Testing Laboratory: **Nemko Spa**

Address: Via del Carroccio, 4 – 20853 Biassono (MB) – Italy

Testing location: Nemko Spa

Address: Via del Carroccio, 4 – 20853 Biassono (MB) – Italy

Registration number:: 481407

Applicant's name: **Paradox Engineering SA**

Address: Via Passeggiata, 7 – CH-6883 Novazzano – Switzerland

Test specification:

Standard: FCC CFR 47 Part 15 Subpart C and Subpart E

§15.205 – Restricted bands of operation ☒

§15.207 – Conducted emission ☒

§15.209 – Radiated emission limits; general requirements ☒

§15.407 (b) – Undesirable emission limits ☒

Test procedure: Nemko WM L0077, WM L0177 and WM L1002

Test Report Form No.: FCCTRF

TRF Originator: Nemko Spa

Master TRF: 2014-03

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Test item description: **Gateway**

Trade Mark: 

Manufacturer: Paradox Engineering SA

Address of manufacturer: Via Passeggiata, 7 – CH-6883 Novazzano – Switzerland

Model: PE.AMI-GW920

Ratings: 100-240 V ~ 50/60 Hz

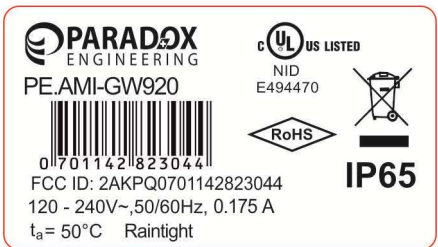
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The test report merely corresponds to the tested sample.

The phase of sampling / collection of equipment under test is carried out by the customer.

This Test Report, when bearing the Nemko name and logo is only valid when issued by a Nemko laboratory, or by a laboratory having special agreement with Nemko.

Test Report No. :	340239TRFFCC	2018-01-02
		Date of issue

Short description of the EuT	Copy of marking plate
The EUT is a gateway equipped with following radio modules: 1) Mikrotiks SIA FCC ID: TV7RB953GS5HNTM with 5 GHz 18 dBi panel antenna MT-485001 (5745-5825 MHz) 2) Compex Systems Pte Ltd FCC ID: TK4WLE600VX with 2.4 GHz 5 dBi omni-antenna OM24580703 (2412-2462 MHz) 3) Compex Systems Pte Ltd FCC ID: TK4WLE600VX with 5 GHz 18 dBi panel antenna MT 485001 (5745-5825 MHz) 4)Paradox Eng.SA FCC ID: 2AKPQ0701142823044 with 920 MHz 2.5 dBi $\lambda/2$ antenna MEGWX-1551SAAX-920 (radio narrowband 902-928 MHz)	 FCC ID: 2AKPQ0701142823044 Contains: FCC ID: TK4WLE600VX FCC ID: TV7RB953GS5HNTM This device complies with Part 15 of the FCC rules subject to the following two conditions: 1) This device may not cause harmful interference. 2) This device must accept all interference received, including interference that may cause undesired operation.
Number of tested samples:	1
Serial number:	1742PE00130
Device type:	Pale Mounting
Accessories and detachable parts included:	The EUT is composed by a single unit with four antennas
Other options included:	-
Testing	
Date of receipt of test sample:	2017-10-25
Testing commenced on:	2017-12-20
Testing concluded on:	2018-01-02
Possible test case verdicts:	
test case does not apply to the test object:	N (Not applicable)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)
Symbols used in this test report	
☒ The crossed square indicates that the listed condition or equipment is applicable for this report. ☐ The empty square indicates that the listed condition or equipment is not applicable for this report.	
The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.	

Verdict according to the standards listed at page 5:	Pass
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PROJECT HISTORY		
Report number	Modification to the report / comments	Date
340239TRFFCC	First release	2018-01-02
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REMARKS		

PRODUCT VARIANTS		
Variant model	Difference against the main model	Additional test performed
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REMARKS		

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1 TEST STANDARDS

The tests were performed according to following standards and procedures.

NEMKO WM L0177: General routines for using instruments at Nemko

NEMKO WM L1002: Measurement Uncertainty - Policy and Statement

NEMKO WM L0077: General routines to perform EMC tests

FCC CFR 47 Part 15 Subpart C

Code of Federal Regulations – Title 47 – Part 15 Radio Frequency Devices – Subpart C Intentional radiation

FCC CFR 47 Part 15 Subpart E

Code of Federal Regulations – Title 47 – Part 15 Radio Frequency Devices – Subpart E Unlicensed national information infrastructure devices

The main standard above contains references to other standards, which are listed below.

ANSI C63.10 (2013)

American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2 SUMMARY OF TEST RESULTS

FCC Part 15 Subpart B requirements			
Part	Test description	Frequency range	Verdict
§15.205	Restricted bands of operation	30 MHz to 40 GHz	P
§15.207	Conducted emission	150 kHz to 30 MHz	P
§15.209	Radiated emission limits; general requirements	30 MHz to 40 GHz	P
§15.407 (b)	Undesirable emission limits	30 MHz to 40 GHz	P
GENERAL REMARKS			

3 EQUIPMENT UNDER TEST

3.1 Power supply system utilised

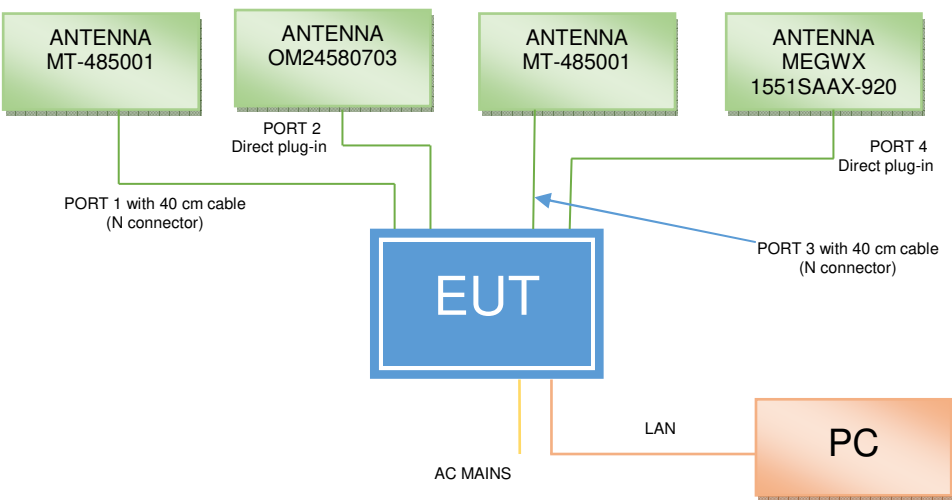
Power supply voltage:	☐	230V/50 Hz / 1 ϕ	☒	115V/60Hz / 1 ϕ
	☐	400V/50 Hz 3PE	☐	400V/50 Hz 3NPE
	☐	12 VDC	☐	24 VDC

3.2 EuT operation modes

Mode	Description
2	TX mode with PORT 2 set at 2437 MHz 802.11b 1 Mbps, PORT 1 and 3 set at 5785 MHz 802.11a 6 Mbps and PORT 4 set at 915 MHz

3.3 EuT configuration modes

The EuT was configured to measure its highest possible radiation level. The test modes selected are according to EuT instruction manual.

Mode	Description
1	

3.4 Input/Output Ports

Port	Name	Type*	Cable Max. >3m	Cable Shielded	Description
0	ENCLOSURE	N/E	—	—	—
1	AC MAINS	AC	☐	☐	Three wires cable
2	LAN	TP	☒	☐	Standard cable with RJ 45 connector
3	ANTENNA PORT 1	ANT	☒	☒	Coaxial cable with N connector
4	ANTENNA PORT 2	ANT	☒	☒	Direct plug-in with N connector
5	ANTENNA PORT 3	ANT	☒	☒	Coaxial cable with N connector
6	ANTENNA PORT 4	ANT	☐	☐	Direct plug-in with SMA connector

*Note:

AC = AC Power Port

DC = DC Power Port

N/E = Non-Electrical

I/O = Signal/Control Input or Output Port

TP = Telecommunication Port

ANT = Antenna Port

3.5 Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
AE	PC	HP	Compaq 6510b	—

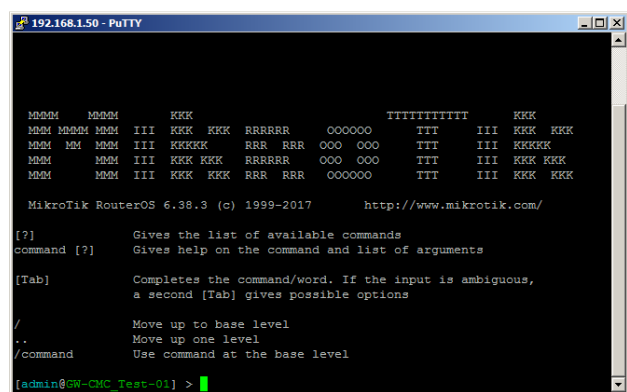
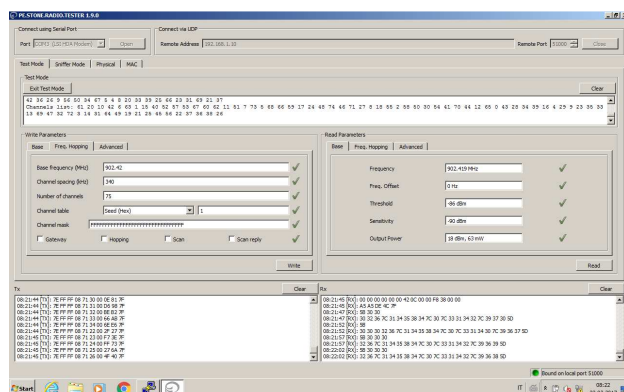
Note: * Use

EUT - Equipment Under Test

AE - Auxiliary/Associated Equipment (Not Subjected to Test)

SIM - Simulator (Not Subjected to Test)

3.6 Software Used During Test



4 TEST ENVIRONMENT

4.1 Address of the test laboratory

Nemko Spa
Via del Carroccio, 4
20853 Biassono (MB) - Italy

Tests site/benches are in accordance with applicable standard/s, and have been utilized by Nemko Spa testing engineer(s).

4.2 Environmental conditions

Unless different values are declared in the test case, following ambient conditions apply for the tests:

Ambient temperature: 18÷33 °C

Relative Humidity: 30÷60 %

Atmospheric pressure: 980÷1060 hPa

4.3 Test equipment used for the monitoring of the environmental conditions

Equipment	Manufacturer	Model	Serial N°
Thermohygrometer data loggers	Testo	175-H2	20012380/305
Thermohygrometer data loggers	Testo	175-H2	38203337/703
Barometer	MSR	MSR145B	330080

4.4 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements" and is documented in the Nemko Spa Technical Procedure WML1002. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device. Hereafter the best measurement capability for Nemko Spa laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Disturbance 3m, 10m Chamber	Antenna distance 1m, 3m, 10m (30÷200) MHz	5.0 dB	(1)
	Antenna distance 1m, 3m, 10m (0.2÷6) GHz	5.2 dB	(1)
	Antenna distance 1m, 3m (6÷18) GHz	5.8 dB	(1)
	Antenna distance 1m, 3m (18÷40) GHz	7.2 dB	(1)
Conducted Disturbance	9 kHz ÷ 150 kHz with AMN	3.8 dB	(1)
	150 kHz ÷ 30 MHz with AMN	3.4 dB	(1)
	150 kHz ÷ 30 MHz with AAN	4.6 dB	(1)
	9 kHz ÷ 30 MHz with voltage probe	2.9 dB	(1)
	9 kHz ÷ 30 MHz with current probe	2.9 dB	(1)

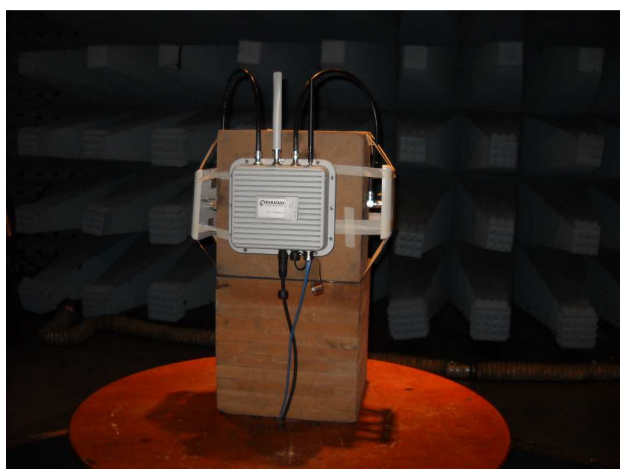
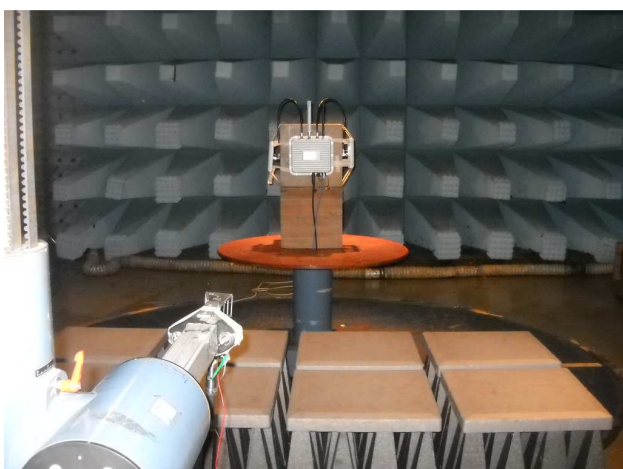
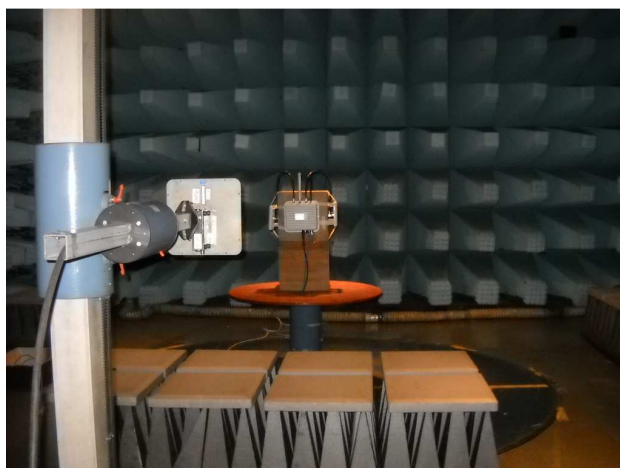
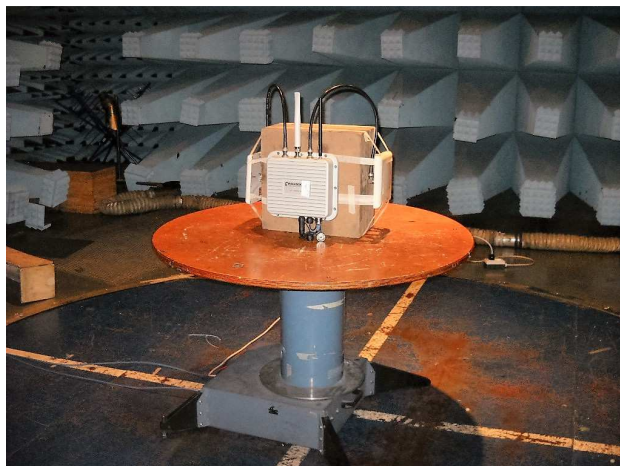
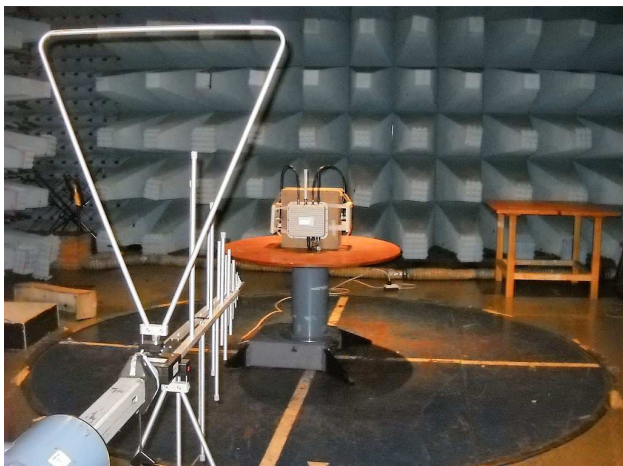
NOTES:

(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$ which has been derived from the assumed normal probability distribution with infinite degrees of freedom and for a coverage probability of 95 %;

5 TEST CONDITIONS AND RESULTS

5.1 Radiated emissions

5.1.1 Photo documentation of the test set-up



5.1.2 Test method

Measurements were made on a semi anechoic chamber. Preliminary measurements were performed at an antenna to EUT separation distance of 3 meters with the receive antenna located at a fixed height (from 1 to 4 meter) in both horizontal and vertical polarities. Final measurements were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.

5.1.3 Limits for enclosure

The field strength of emissions from intentional radiators shall not exceed the following:

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

The above field strength limits are specified at a distance of 3 meters. Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector.

5.1.4 Restricted bands of operation

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	--	--	--

5.1.5 Test result

Verdict:	☒ P ☐ F ☐ N
Frequency range:	30MHz – 40 GHz
Kind of test site:	Semi anechoic chamber
Measurement distance:	3 m
Remarks:	

5.1.6 Test equipment used

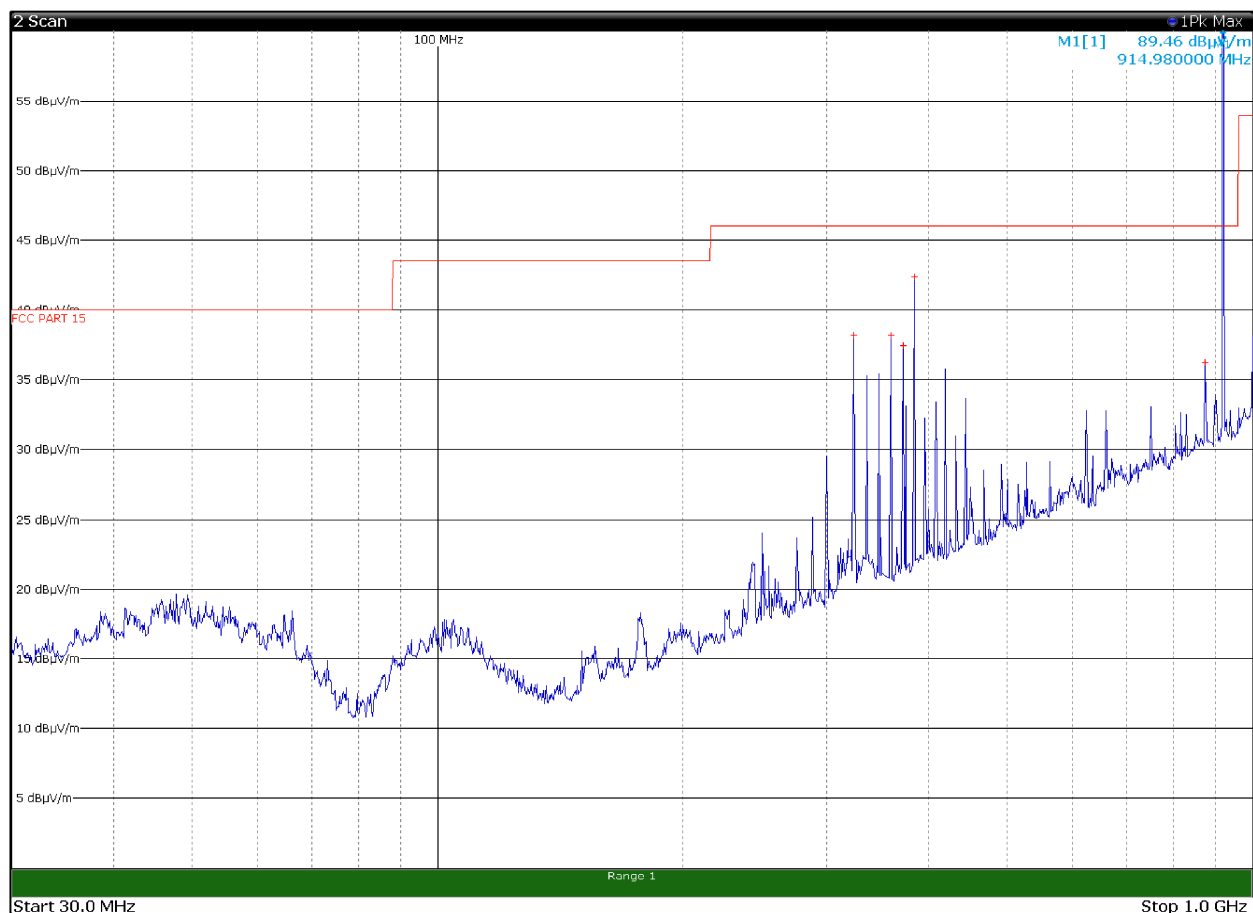
Equipment	Manufacturer	Model	Serial N°	Cal Date	Due Date
Trilog Antenna (25 ÷ 8000 MHz)	Schwarzbeck	VULB 9162	9162-025	2015-07	2018-07
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148-123	9148-123	2015-06	2018-06
Horn antenna (4 ÷ 40 GHz)	RFSpin	DRH40	061106A40	2017-02	2020-02
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718	9718-137	2017-12	2018-12
Preamplifier (18 ÷ 40 GHz)	Miteq	JS44-18004000-35-8P-R	1.627	2017-12	2018-12
EMI receiver (2 Hz ÷ 44 GHz)	R&S	ESW44	101620	2017-04	2018-04
Turning-table	R&S	HCT	835 803/03	NCR	NCR
Antenna mast	R&S	HCM	836 529/05	NCR	NCR
Controller	R&S	HCC	836 620/7	NCR	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	2016-10	2018-10
Shielded room	Siemens	10m control room	1947	NCR	NCR

NCR = no calibration required

5.1.7 Test protocol

Antenna polarization: Horizontal
Operation mode: 1
Configuration mode: 1
Remarks: Frequency range: 30 to 1000 MHz

Verdict: Pass



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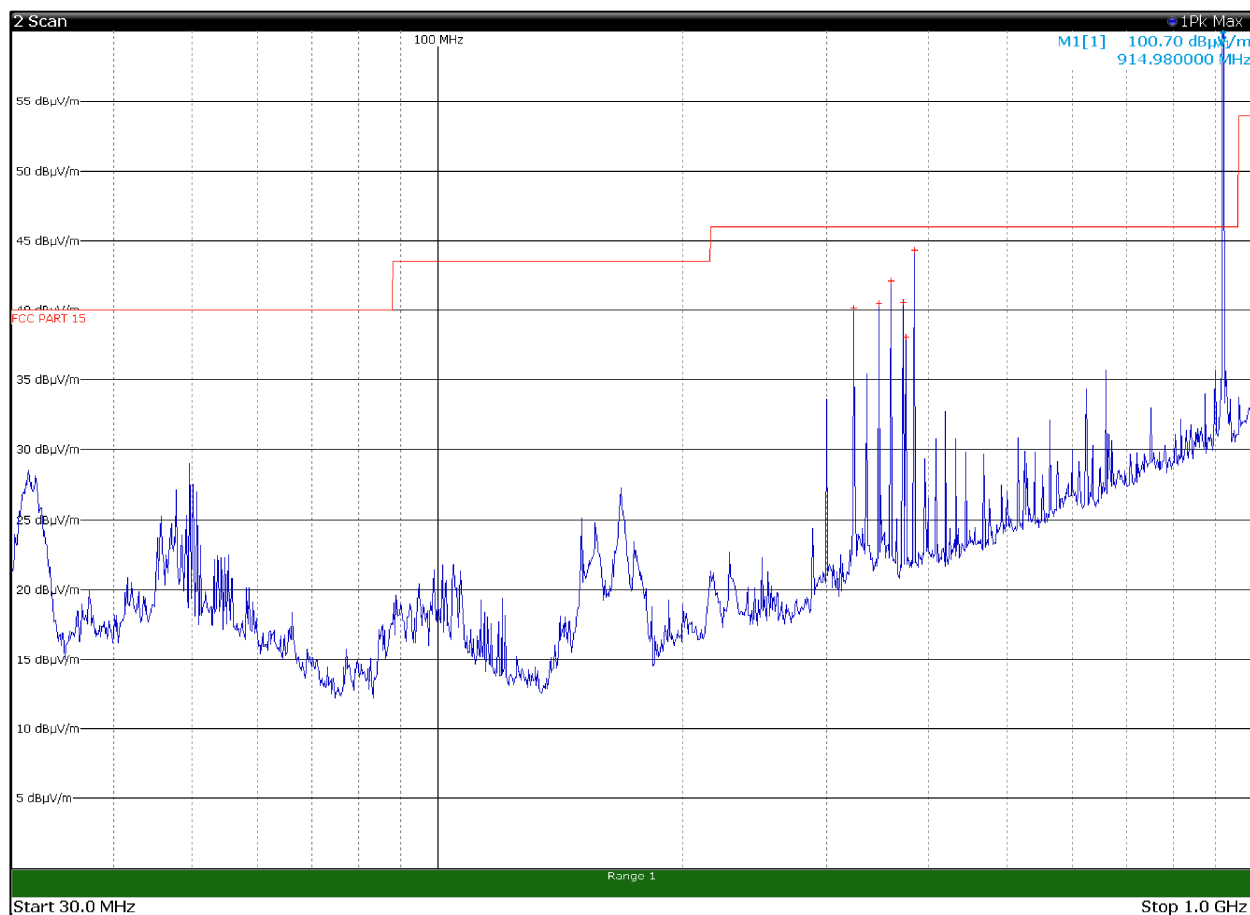
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Limit exceeded by the carrier

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
324.0000	38.2	46.0	-7.9	QP
360.0300	38.2	46.0	-7.8	QP
372.0300	37.4	46.0	-8.6	QP
384.0300	42.4	46.0	-3.6	QP
874.9500	36.2	46.0	-9.8	QP

Antenna polarization: Vertical
Operation mode: 1
Configuration mode: 1
Remarks: Frequency range: 30 to 1000 MHz

Verdict: Pass



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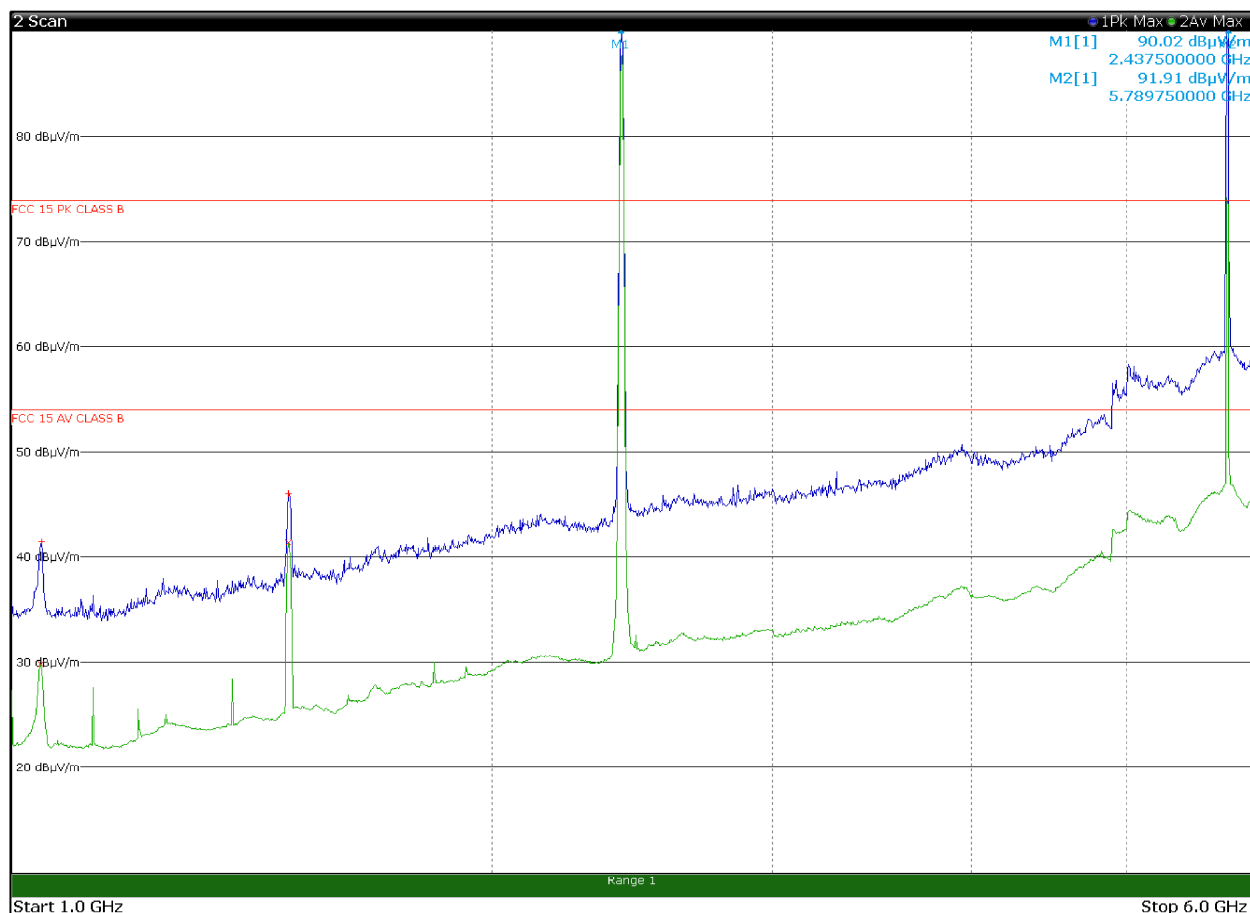
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Limit exceeded by the carrier

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
324.0000	40.1	46.0	-5.9	QP
348.0300	40.5	46.0	-5.5	QP
360.0300	42.1	46.0	-3.9	QP
372.0300	40.6	46.0	-5.4	QP
375.0000	38.0	46.0	-8.0	QP
384.0300	44.3	46.0	-1.7	QP

Antenna polarization: Horizontal
Operation mode: 1
Configuration mode: 1
Remarks: Frequency range: 1 to 6 GHz

Verdict: Pass



09:14:53 22.12.2017

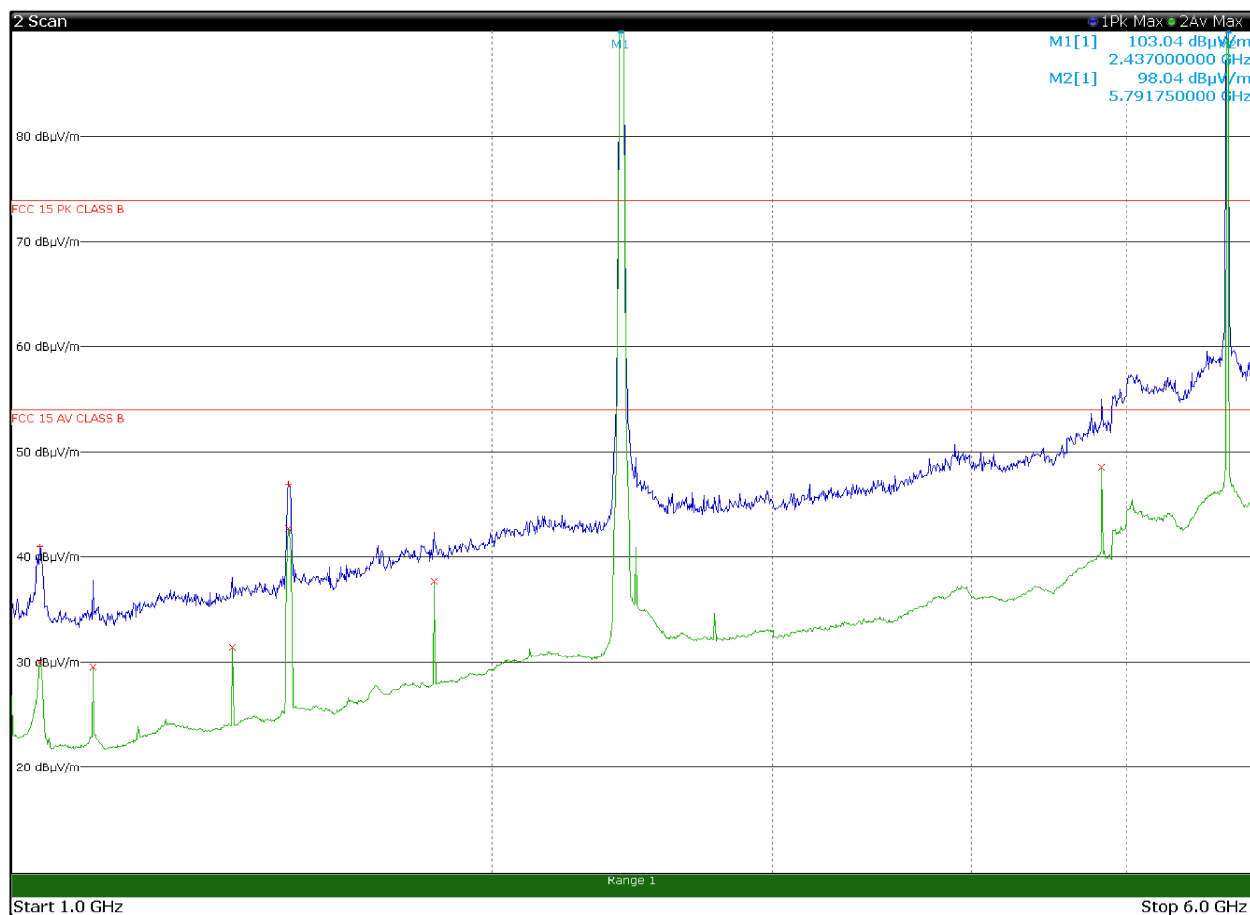
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Limit exceeded by the carrier

Frequency (GHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1.0425	29.8	54.0	-24.2	AV
1.0435	41.6	74.0	-32.5	PK
1.4903	41.4	54.0	-12.6	AV
1.4913	46.1	74.0	-27.9	PK

Antenna polarization: Vertical
Operation mode: 1
Configuration mode: 1
Remarks: Frequency range: 1 to 6 GHz

Verdict: Pass



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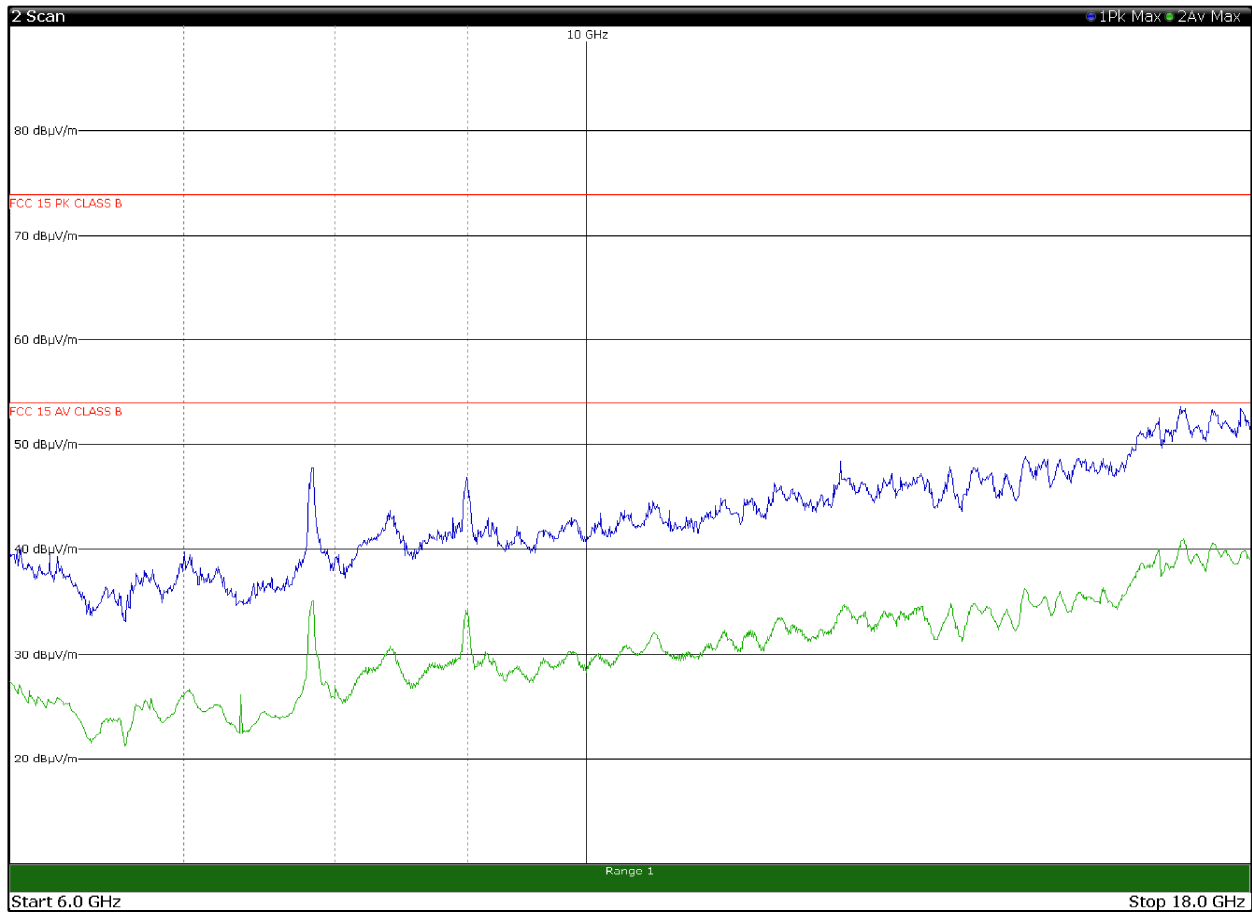
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Limit exceeded by the carrier

Frequency (GHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1.0415	30.0	54.0	-24.0	AV
1.0418	41.0	74.0	-33.0	PK
1.1250	29.6	54.0	-24.4	AV
1.3750	31.6	54.0	-22.4	AV
1.4910	47.0	74.0	-27.0	PK
1.4913	42.8	54.0	-11.2	AV
1.8400	37.7	54.0	-16.3	AV
4.8240	48.5	54.0	-5.5	AV

Antenna polarization: Horizontal
 Operation mode: 1
 Configuration mode: 1
 Remarks: Frequency range: 6 to 18 GHz

Verdict: Pass

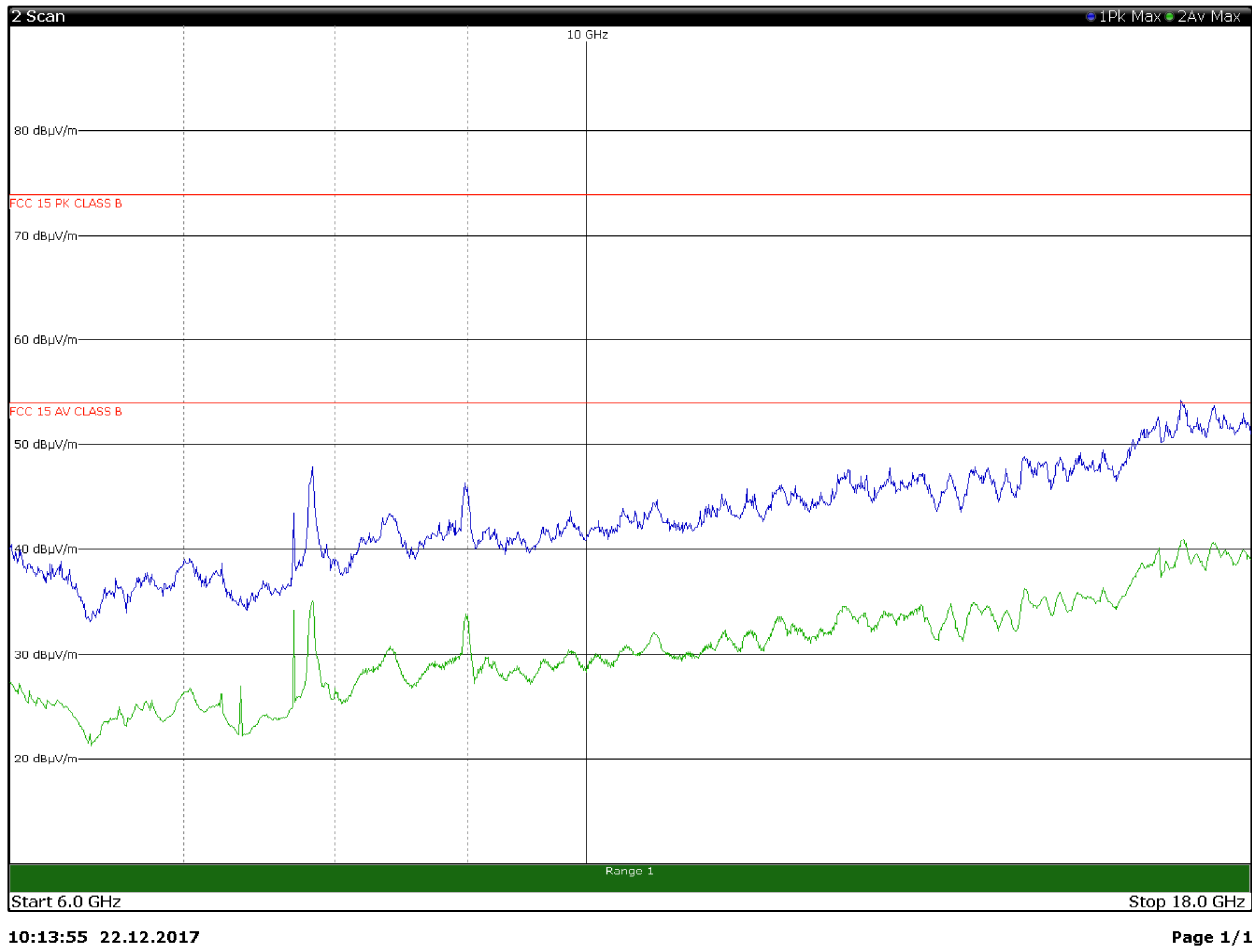


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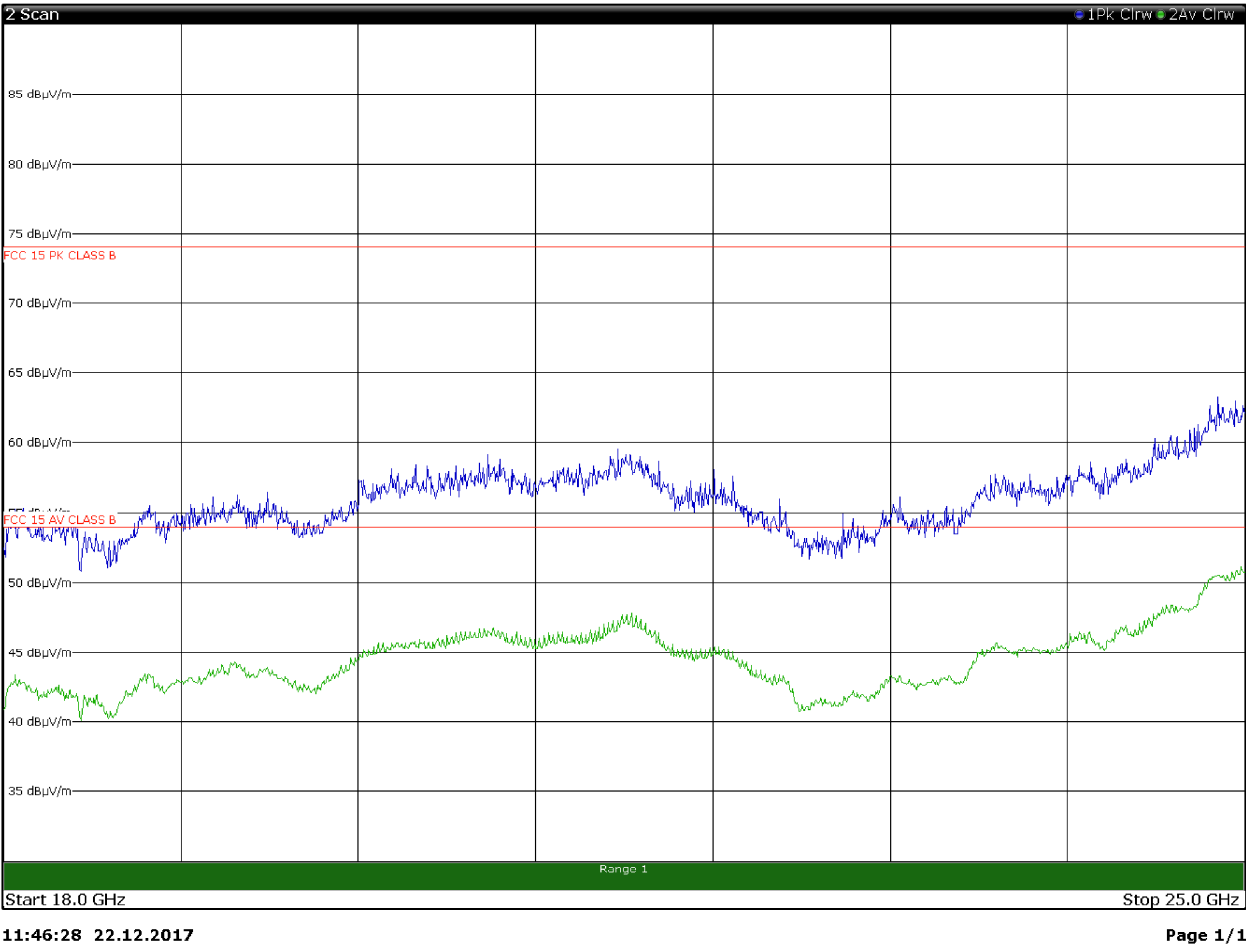
Antenna polarization: Vertical
 Operation mode: 1
 Configuration mode: 1
 Remarks: Frequency range: 6 to 18 GHz

Verdict: Pass



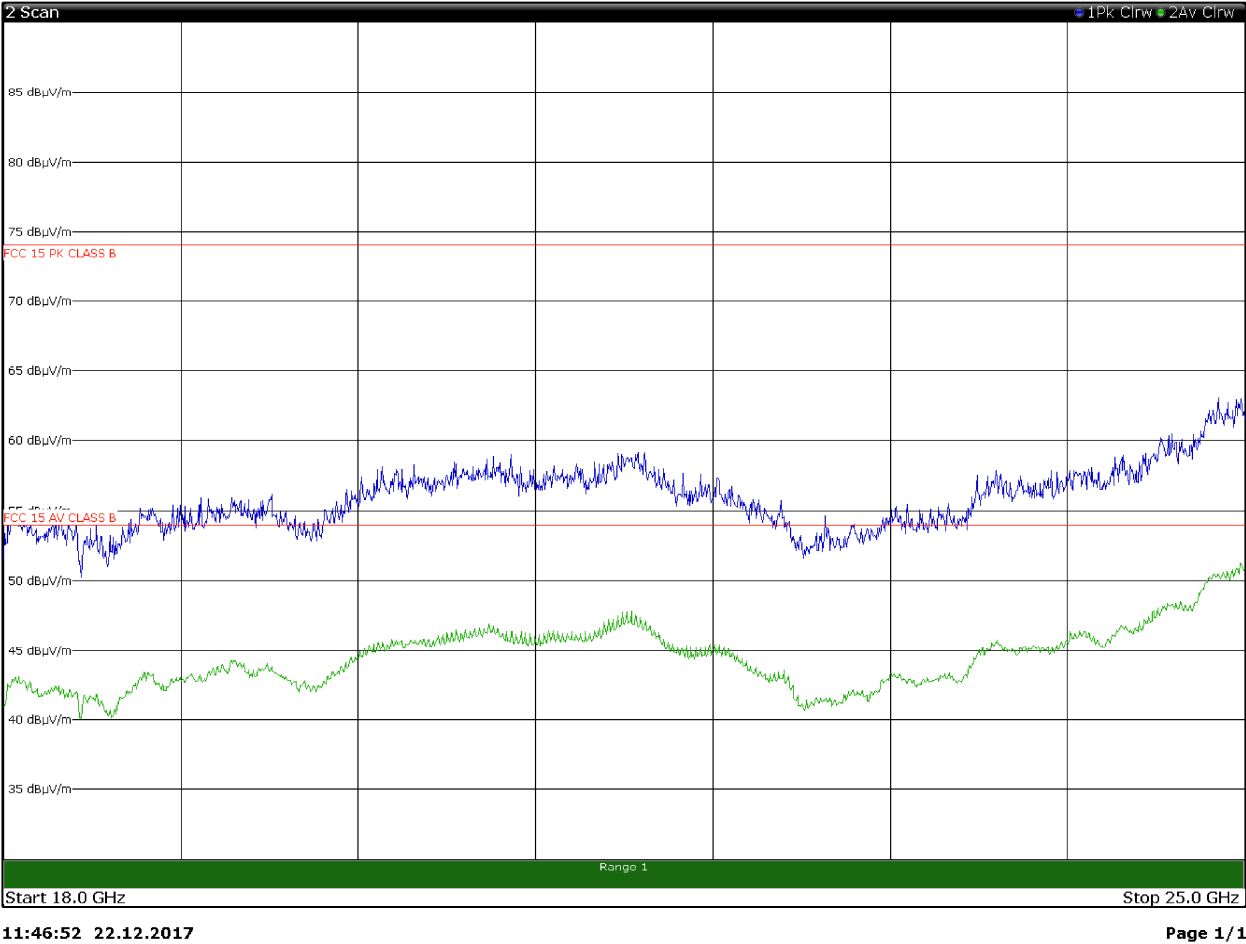
Antenna polarization: Horizontal
Operation mode: 1
Configuration mode: 1
Remarks: Frequency range: 18 to 25 GHz

Verdict: Pass



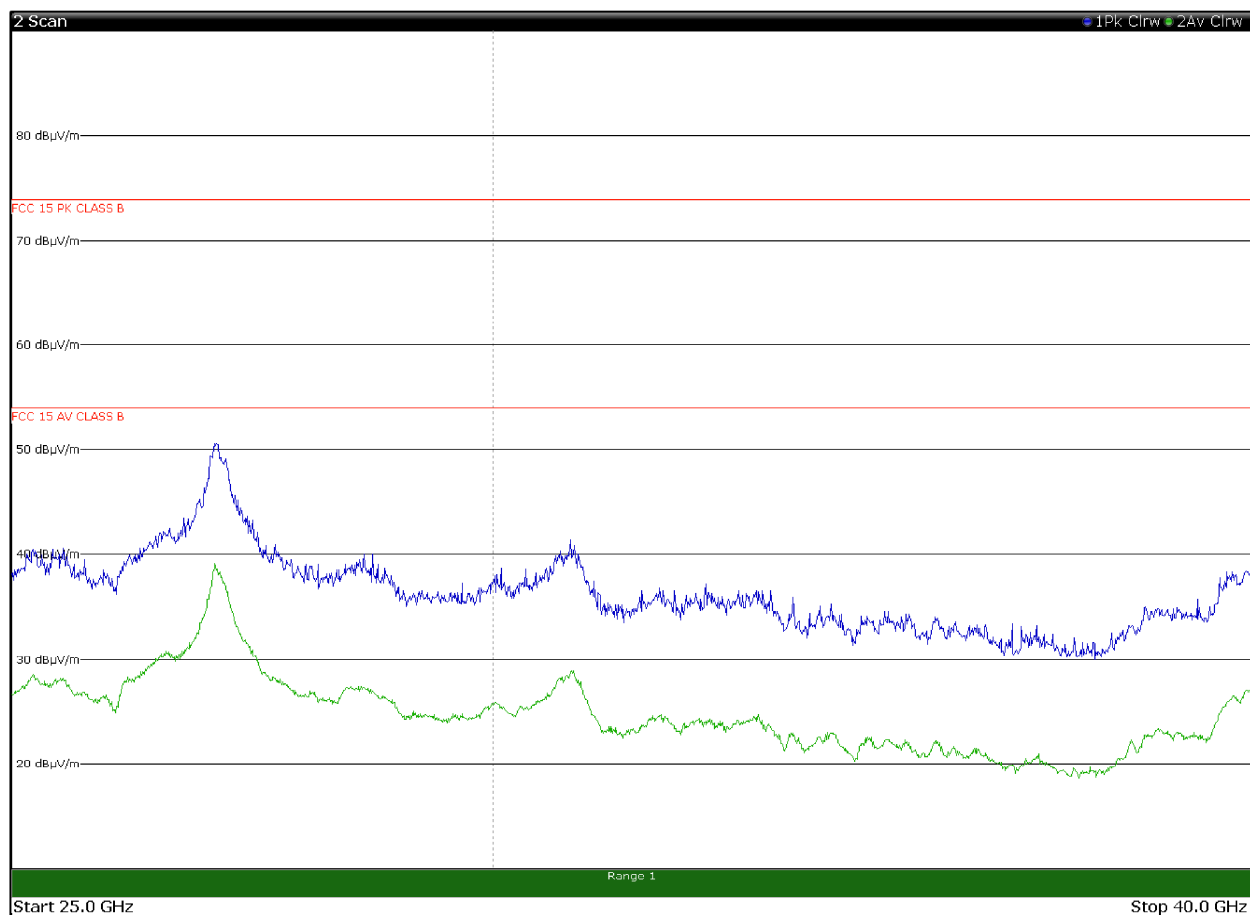
Antenna polarization: Vertical
Operation mode: 1
Configuration mode: 1
Remarks: Frequency range: 18 to 25 GHz

Verdict: Pass



Antenna polarization: Horizontal
 Operation mode: 1
 Configuration mode: 1
 Remarks: Frequency range: 25 to 40 GHz

Verdict: Pass

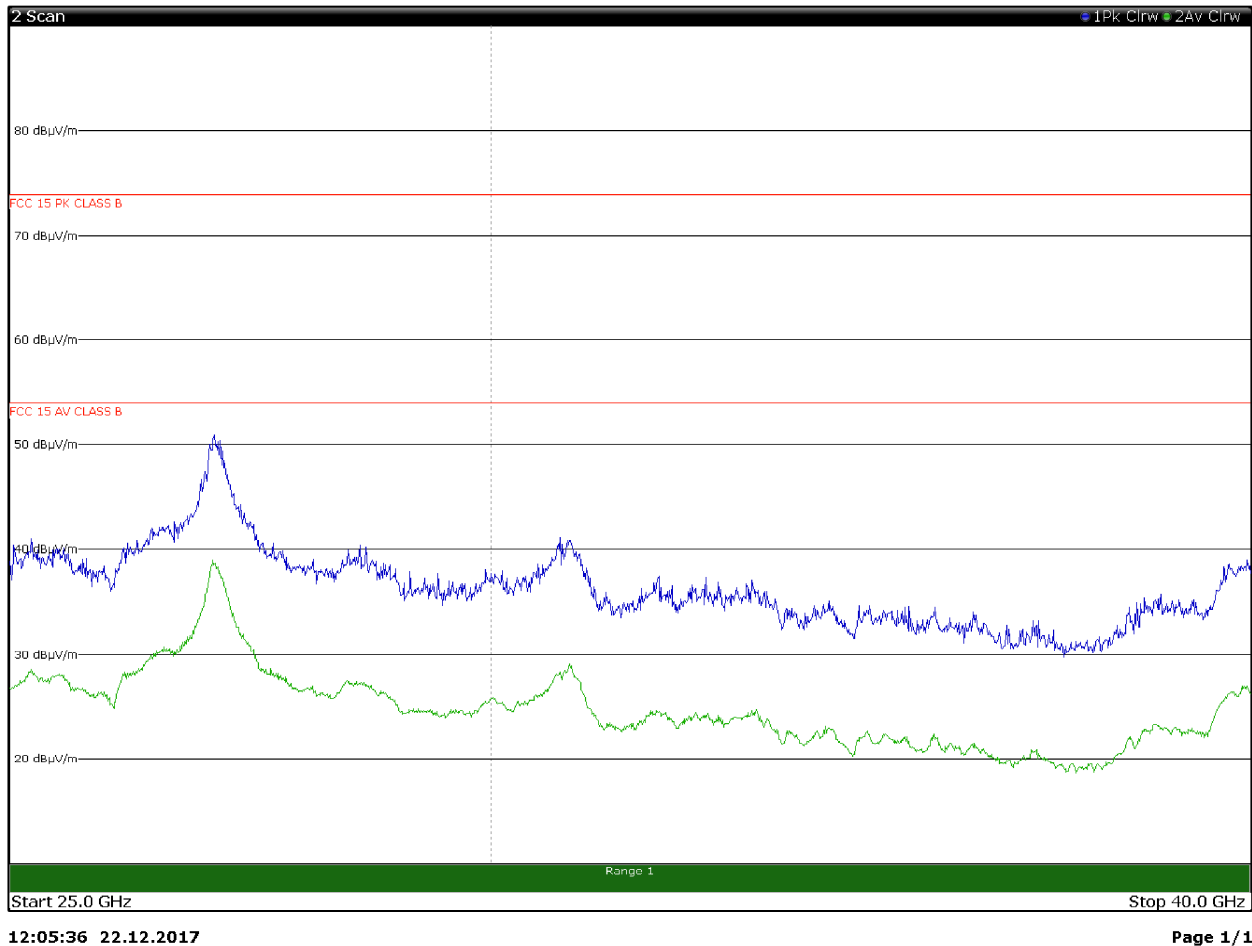


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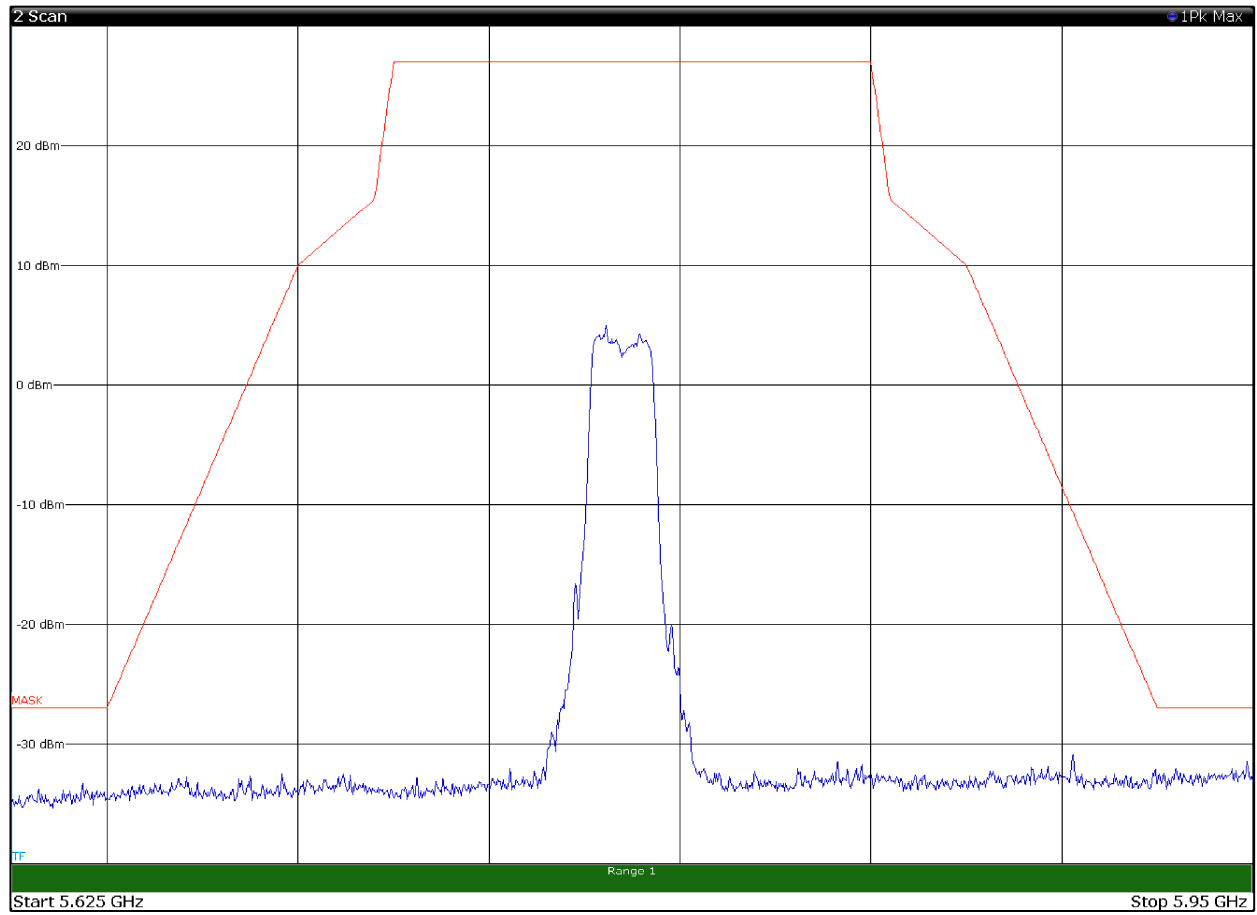
Antenna polarization: Vertical
Operation mode: 1
Configuration mode: 1
Remarks: Frequency range: 25 to 40 GHz

Verdict: Pass



Antenna polarization: Horizontal
Operation mode: 1
Configuration mode: 1
Remarks: Clause 15.407(b) mask

Verdict: Pass

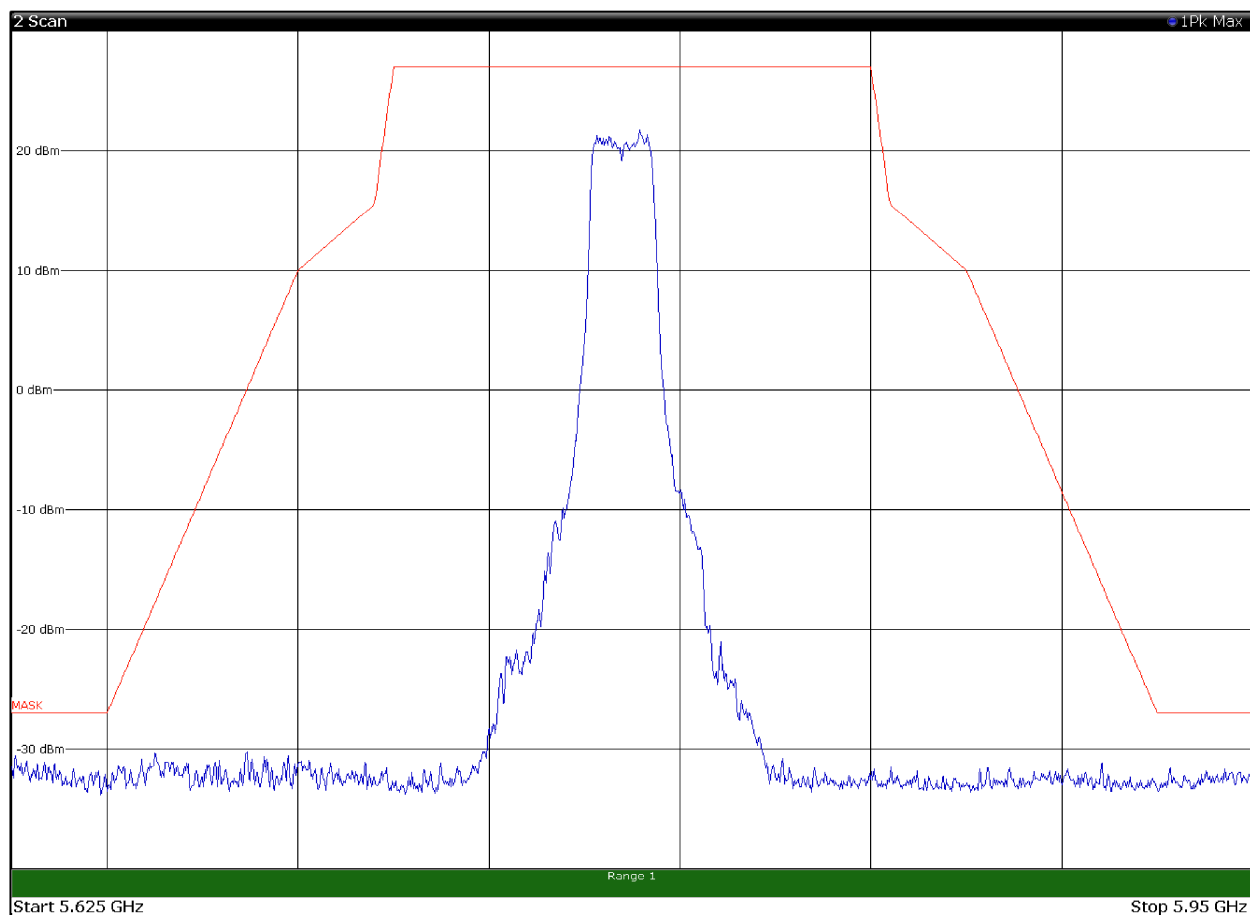


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Antenna polarization: Vertical
 Operation mode: 1
 Configuration mode: 1
 Remarks: Clause 15.407(b) mask

Verdict: Pass



12:30:00 22.12.2017

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5.2 Conducted emission

5.2.1 Photo documentation of the test set-up



5.2.2 Test method

Measurements were made on a ground plane that extends 1-meter minimum beyond all sides of the system under test. All power was connected to the system through Line Impedance Stabilization Networks (LISN). Conducted voltage measurements on mains lines were made at the output of the LISN.

5.2.3 Limits for AC mains port

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-Peak	Average
0.15 to 0.50	66 to 56*	59 to 46*
0.50 to 5	56	46
5 to 30	60	50

*The limits decrease linearly with the logarithm of the frequency

5.2.4 Test result

Verdict:	☒ P ☐ F ☐ N
Frequency range:	0.15MHz - 30MHz
Kind of test site:	Shielded room
Remarks:	

5.2.5 Test equipment used

Equipment	Manufacturer	Model	Serial N°	Cal Date	Due Date
EMI receiver	R&S	ESU8	100202	2017-11	2018-11
LISN	R&S	ESH2-Z5	872 460/041	2017-09	2018-09
Shielded room	Siemens	Conducted emission test room	1862	NCR	NCR

NCR = no calibration required

5.2.6 Test protocol

Test point: Neutral line
 Operation mode: 1
 Configuration mode: 1
 Remarks: -

Verdict: Pass

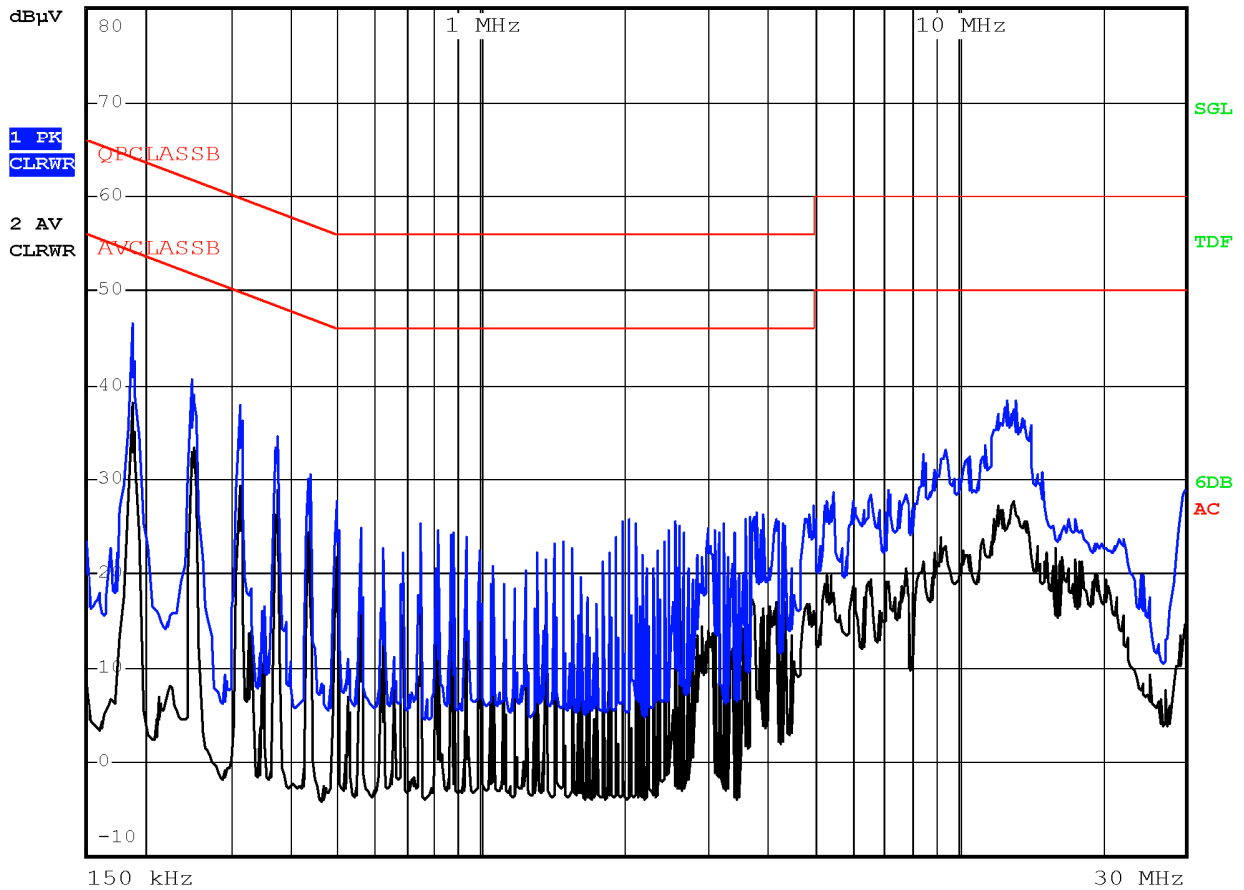


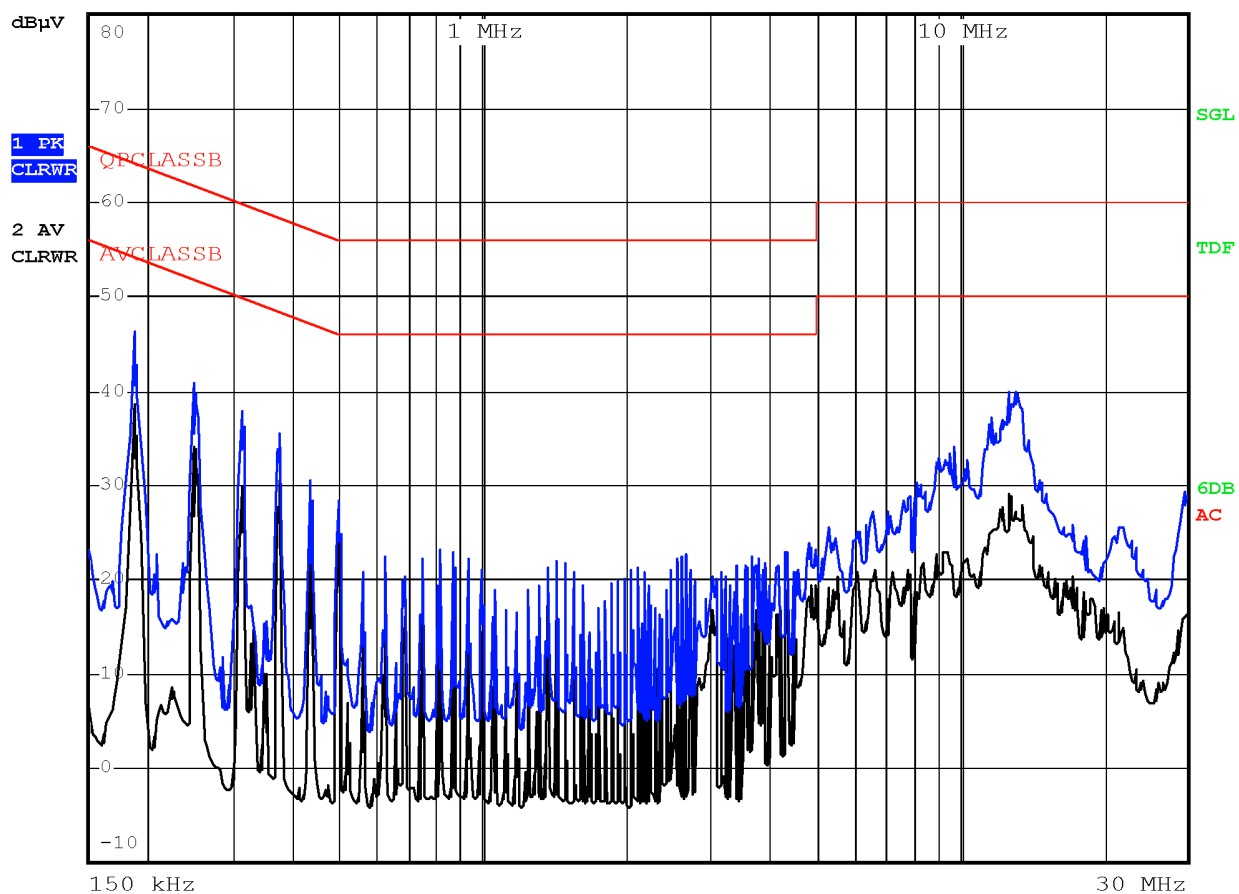
RBW 9 kHz

MT 1 s

Att 0 dB AUTO

PREAMP OFF





6 EUT PHOTOS



End of report