

RADIO TEST REPORT

No. 1620866STO-001, Ed. 1

RF Performance

EQUIPMENT UNDER TEST

Equipment: Electric Sander
Type/Model: Deros 650X
Additional type/model*: Deros 625X, Deros 680X, Deros 550X, Deros SP 550X, Deos 343X, Deos 353X and Deos 383X
Manufacturer: KWH Mirka OY AB
Tested by request of: KWH Mirka OY AB

*See opinions and interpretations clause 2.5

SUMMARY

Referring to the emission limits, and the operating mode during the tests specified in this report, the equipment complies with the requirements according to the following standards:

47 CFR Part 15 (2015): Subpart C: Intentional radiators. Section 15.247

47 CFR Part 15 (2015): Subpart B: Unintentional radiators

RSS-GEN Issue 4 (2014): General requirements of compliance of radio apparatus (2014)

RSS-247 Issue 1 (2015): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

For details, see clause 2 – 4.

Date of issue: 2017-01-17

Tested by:


Robert Hietala
Tester

Approved by:


Matti Virkki
Reviewer

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Revision History

Edition	Date	Description	Changes
1	2017-01-17	First release	

Version 1.00

CONTENTS

	Page
1 Client Information	4
2 Equipment under test (EUT).....	4
2.1 Identification of the EUT	4
2.2 Additional information about the EUT	5
2.3 Test signals and operation modes	5
2.4 Opinions and interpretations	5
3 Test Specifications	6
3.1 Standards	6
3.2 Additions, deviations and exclusions from standards and accreditation	6
3.3 Test site.....	6
4 Test Summary	7
5 Conducted continuous disturbances in the frequency-range 0.15 to 30 MHz	8
5.1 Test set-up and test procedure	8
5.2 Requirement.....	8
5.3 Test results.....	9
6 Radiated rf Emission in the frequency-range 30 MHz to 26 GHz	10
6.1 Test set-up and test procedure.	10
6.2 Test conditions	10
6.3 Requirements.....	11
6.4 Test results 30 MHz – 1000 MHz, TX	11
6.5 Test results 30 MHz – 1000 MHz, RX.....	14
6.6 Test results 1 GHz – 26 GHz, TX	15
6.7 Test results 1 GHz – 13 GHz, RX	22
7 Conducted band edge measurement.....	23
7.1 Test set-up and test procedure.	23
7.2 Test conditions	23
7.3 Requirement.....	23
7.4 Test results.....	24
8 Peak conducted output power.....	26
8.1 Test set-up and test procedure.	26
8.2 Test conditions	26
8.3 Requirements.....	26
8.4 Test results.....	27
9 Occupied 6 dB bandwidth	29
9.1 Test set-up and test procedure.	29
9.2 Test conditions	29
9.3 Requirements.....	29
9.4 Test results.....	30
10 Peak power spectral density	32
10.1 Test set-up and test procedure.	32
10.2 Test conditions	32
10.3 Requirements.....	32
10.4 Test results.....	33
11 Transmitter duty cycle declaration.....	35
11.1 Test set-up and test procedure	35
11.2 Duty cycle declaration	35
11.3 Duty cycle correction factor.....	35
12 Test equipment.....	36
13 Measurement uncertainty.....	37
14 Test set up and EUT photos.....	37

1 CLIENT INFORMATION

The EUT has been tested by request of

Company KWH Mirka OY AB
Pensalavägen 210
668 50 Jeppo
Finland

Name of contact Caj Nordström
Phone +358 40 822 19 57

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT

Equipment: Electric Sander with Bluetooth Low Energy
Type/Model: Deros 650
Brand name: Deros
Serial number: --
Manufacturer: KWH Mirka OY AB

Transmitter frequency range: 2402 – 2480 MHz
Receiver frequency range: 2402 – 2480 MHz
Frequency agile or hopping: Yes No
Antenna: Internal antenna External antenna
Antenna connector: None, internal antenna Yes
Antenna gain: -0.85 dBi*
Rating RF output power: 0.0 dBm (measured conducted)
Type of modulation: GFSK
Temperature range: Category I (General): -20°C to +55°C
 Category II (Portable equipment): -10°C to +55°C
 Category III (Equipment for normal indoor use): +5°C to +35°C
 Other: +10°C to +35°C

Transmitter standby mode supported: Yes No

*Maximum antenna gain for the specific antenna type according to the manufacturer

2.2 Additional information about the EUT

The EUT consists of the following units:

Unit	Type	Comment
Unit 1	Electric Sander	With temporary antenna connector
Unit 2	Electric Sander	With internal antenna
Unit 3	Electric Sander	For conducted emission measurement

During the tests the EUT supported following software:

Software	Version	Comment
Bluetooth Direct Test Mode	--	--

2.3 Test signals and operation modes

Continuous signal with a duty cycle of about 70 % were used during testing. See section 10 for further information on peak-to-average duty cycle correction factor calculations.

2.4 Opinions and interpretations

The following types/type are/is also included as additional types/type in this test report:

Deros 625X, Deros 680X, Deros 550X, Deros SP 550X, Deos 343X, Deos 353X and Deos 383X

The difference as compared to the tested type is (according to the manufacturer):

Different sizes of the sander pad and different mechanical solutions relating to the sander pad. The circuit boards, including the radio circuit board and electronics are identical in every model.

The difference is considered not to imply different radio-characteristics when compared to the tested type. Therefore, this type is/these types are not tested, but considered to have the same radio-characteristics as the tested type(s).

3 TEST SPECIFICATIONS

3.1 Standards

Requirements:

47 CFR Part 15 (2015): Subpart C: Intentional radiators. Section 15.247

47 CFR Part 15 (2015): Subpart B: Unintentional radiators

RSS-GEN Issue 4 (2014): General requirements of compliance of radio apparatus (2014).

RSS-247 Issue 1 (2015): Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test methods:

ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3.2 Additions, deviations and exclusions from standards and accreditation

No additions, deviations or exclusions have been made from standards and accreditation.

3.3 Test site

Measurements were performed at:

Intertek Semko AB.
Torshamnsgatan 43,
Box 1103
SE-164 22 Kista

Intertek Semko AB is a FCC listed test site with site registration number 90913
Intertek Semko AB is a FCC accredited conformity assessment body with designation number SE0002
Intertek Semko AB is an Industry Canada listed test facility with IC assigned code 2042G

Measurement chambers

Measurement Chamber	Type of chamber	IC Site filing #
STORA HALLEN	Semi-anechoic 10 m and 3 m	2042G-2

4 TEST SUMMARY

The results in this report apply only to sample tested:

Requirement	Description	Result
FCC §15.203 RSS-GEN 8.3	Antenna requirement The EUT has integrated non detachable antenna which can't be remove without breaking the EUT.	PASS
FCC §15.207, 15.107 RSS-GEN 8.8 table 3	Conducted continuous emission in the frequency range 150 kHz to 30 MHz, AC Power input port The EUT complies with the limits. The margin to the limit was at least 0.6 dB at 16.986 MHz. See clause 5.3. The measured result is below the upper limit, but by a margin less than half of the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance is more probable than non-compliance.	PASS
FCC §15.247 (d), 15.209(a) RSS-GEN 8.9 RSS-247 5.5	Radiated emission of electromagnetic fields in the frequency range 30 – 1000 MHz The EUT complies with the limits. The margin to the limit was at least 7.1 dB at 381.120 MHz. See clause 6.4 – 6.5.	PASS
FCC §15.247(d), 15.209(a) RSS-GEN 8.9 RSS-247 5.5	Radiated emission of electromagnetic fields in the frequency range above 1 GHz The EUT complies with the limits. The margin to the limit was at least 4.7 dB at 4803.6 MHz. See clause 6.6 – 6.7.	PASS
FCC §15.247(a)(2) RSS-GEN 6.6 RSS-247 5.2(1)	Occupied bandwidth The EUT complies with the limits. The margin to the limit is at least 201.9 kHz See clause 9.4.	PASS
FCC §15.247(b) RSS-247 5.4(4)	Conducted output power The EUT complies with the limits. The margin to the limit was at least 30 dB at 2480 MHz. See clause 8.4.	PASS
FCC §15.247(e) RSS-247 5.2(2)	Peak power spectral density The EUT complies with the limits. The margin to the limit was at least 9.4 dB at 2480 MHz. See clause 10.4.	PASS
FCC §15.247(e) RSS-247 5.5	Band edge The EUT complies with the limits. The margin to the limit was at least 21.8 dB at 2483.7 MHz. See clause 7.4.	PASS

5 CONDUCTED CONTINUOUS DISTURBANCES IN THE FREQUENCY-RANGE 0.15 TO 30 MHZ

Date of test:	2017-02-20	Test location:	BUR 1
EUT Serial:	--	Ambient temp:	22 °C
Tested by:	Robert Hietala	Relative humidity:	30 %
Test result:	Pass	Margin:	0.6 dB

5.1 Test set-up and test procedure

The test method is in accordance with ANSI C63.10-2013 section 6.2.

The EUT was connected to the power via Artificial Mains Networks AMN.

The EUT was placed on an insulating support 0.8 m above the floor, 0.4 m from the vertical reference ground plane (RGP) and 0.8 m from the AMN/ISN.

Overview sweeps were performed for each lead.

During the tests the EUT was operated in normal mode and 120 V, 60 Hz.

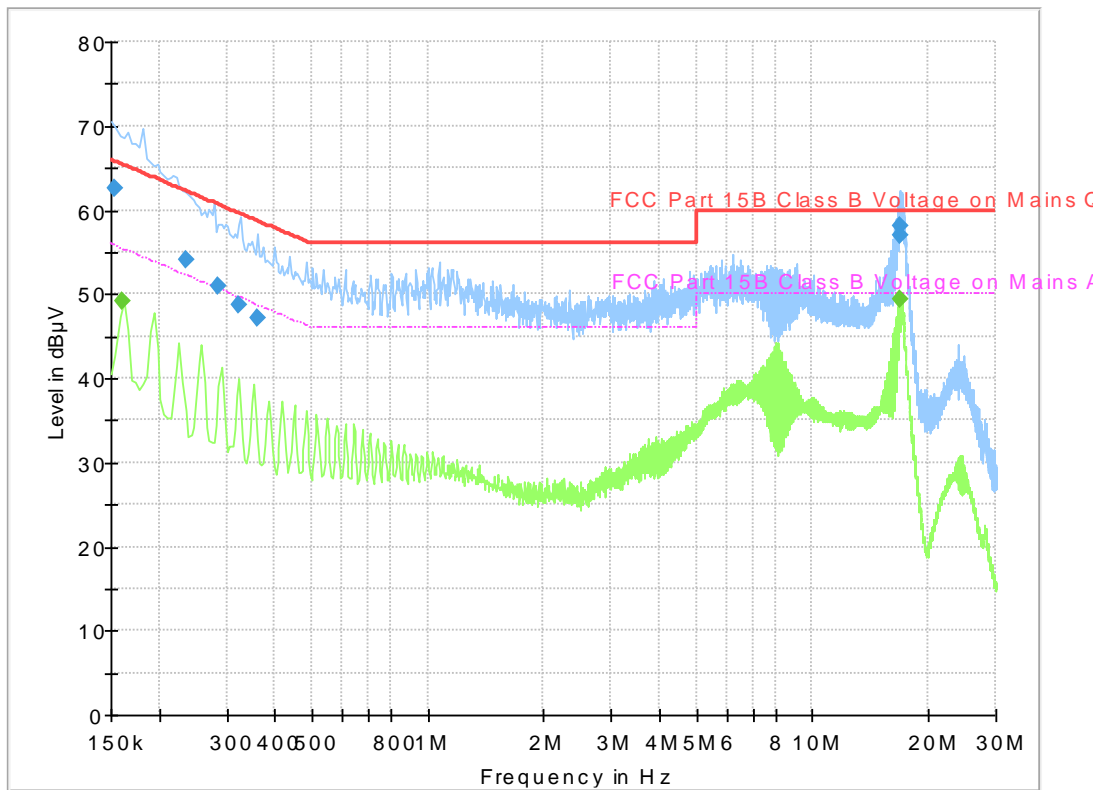
5.2 Requirement**Limits for conducted emission from AC mains**

The EUT shall meet the limits for the standards.

Reference: 47 CFR §15.207
RSS-GEN, section 8.8 table 3

Frequency range [MHz]	Limits [dB μ V]	
	Quasi-Peak	Average
0.15 – 0.50	66 – 56	56 – 46
0,50 – 5.00	56	46
5.00 – 30.0	60	50

5.3 Test results



Diagram, Peak and Average overview sweep

Measurement results, Quasi-peak

Frequency [MHz]	Level [dBµV]	Limit [dBµV]	Line L/N	Margin [dB]
0.154	62.5	65.8	L1	3.3
0.235	54.1	62.3	L1	8.1
0.284	51.0	60.7	L1	9.7
0.323	48.8	59.6	L1	10.8
0.360	47.2	58.7	N	11.5
16.927	57.0	60.0	N	3.0
16.981	58.0	60.0	N	2.0

Measurement results, Average

Frequency [MHz]	Level [dBµV]	Limit [dBµV]	Line L/N	Margin [dB]
0.161	49.2	55.4	N	6.2
16.986	49.4	50.0	L1	0.6*

NOTE:* The measured result is below the upper limit, but by a margin less than half of the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance is more probable than non-compliance.

Result [dBµV] = Analyser reading [dBµV] + cable loss [dB] + LISN insertion loss [dB]

6 RADIATED RF EMISSION IN THE FREQUENCY-RANGE 30 MHz TO 26 GHz

Date of test:	2017-01-17	Test location:	Stora Hallen / Radiohallen
EUT Serial:	--	Ambient temp:	19 °C
Tested by:	Robert Hietala	Relative humidity:	20 %
Test result:	Pass	Margin:	4.7 dB

6.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013.
The EUT was set up in order to emit maximum disturbances.

The EUT was placed on an insulating support 0.8 and 1.5 m above the turntable which is part of the reference ground plane.

Overview sweeps were performed with the measurement receiver in max-hold mode and the peak detector activated in the frequency-range 30 – 1000 MHz. Above 1 GHz additionally the average detector was activated.

Exploratory pre scans was performed in two orthogonal EUT orientations while the EUT was transmitting. The worst-case orientation was identified and used for final scan on three channels which is presented in this report.

Worst-case channel EUT orientation identified during TX tests was used for RX tests.

6.2 Test conditions

Test set-up:

30 MHz to 1000 MHz

Test receiver set-up:

Preview test: Peak, RBW 120 kHz VBW 1 MHz

Final test: Quasi-Peak, RBW 120 kHz VBW 1 MHz

EUT height above ground plane: 0.8 m

Measuring distance: 3 m

Measuring angle: 0 – 359°

Antenna

Height above ground plane: 1 – 4 m

Polarisation: Vertical and Horizontal

Type: Bilog

Test set-up:

1 GHz – 26.5 GHz

Test receiver set-up:

Preview test: Peak, RBW 1 MHz VBW 3 MHz

Average, RBW 1 MHz VBW 3 MHz

Final test: Peak, RBW 1 MHz VBW 3 MHz

Average, RBW 1 MHz VBW 3 MHz

EUT height above ground plane: 1.5 m

Measuring distance: 3 m

Measuring angle: 0 – 359°

Antenna

Height above ground plane: 1 – 4 m

Polarisation: Vertical and Horizontal

Type: Horn

Antenna tilt: Activated

6.3 Requirements

Within restricted bands and receive mode:
Reference: CFR 47 §15.209, §15.109, RSS-Gen section 8.9

Field strength of emissions must comply with limits shown in table below

Frequency range [MHz]	Field strength at 3 m (dBµV/m)	Field strength at 10 m (dBµV/m)	Detector (dBµV/m)
30 – 88	40.0	29.5	Quasi Peak
88 – 216	43.5	33.0	Quasi Peak
216 – 960	46.0	35.5	Quasi Peak
960 – 1000	54.0	43.5	Quasi Peak
Above 1000	54.0 / 74.0	43.5 / 63.5	Average / Peak

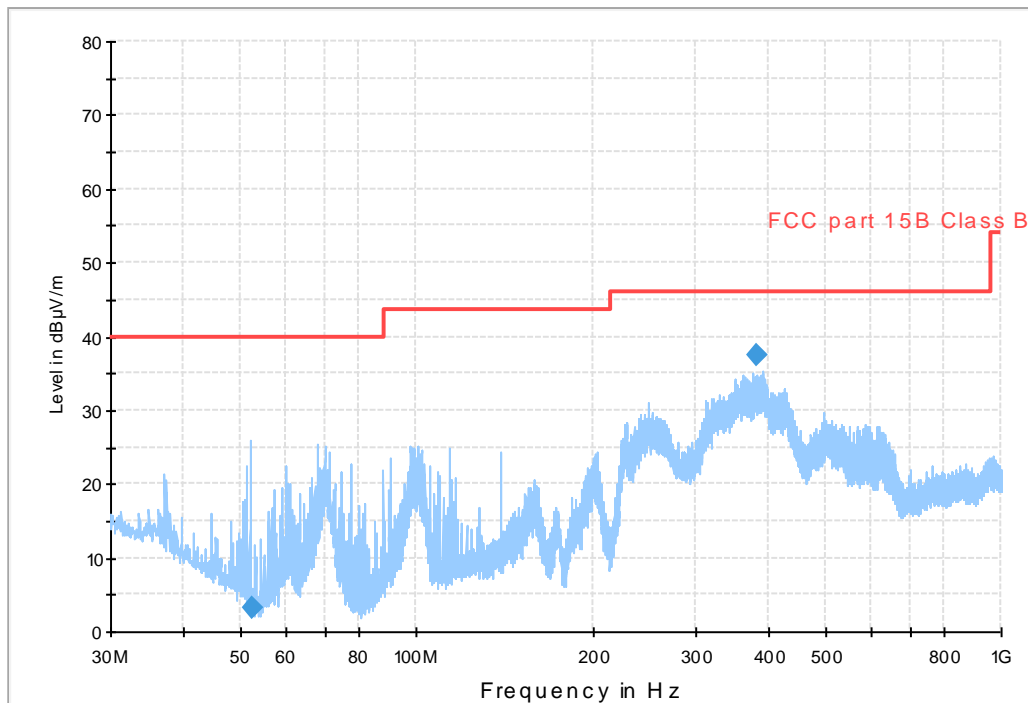
The values for 10 m measuring distance are calculated by subtracting 10.5 dB from the 3 m limit. (i.e. an extrapolation factor of 20 dB/decade according to CFR 47 §15.31(f)(1))

Outside the restricted bands:
Reference: CFR 47 §15.247(d), RSS-247 5.5,

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

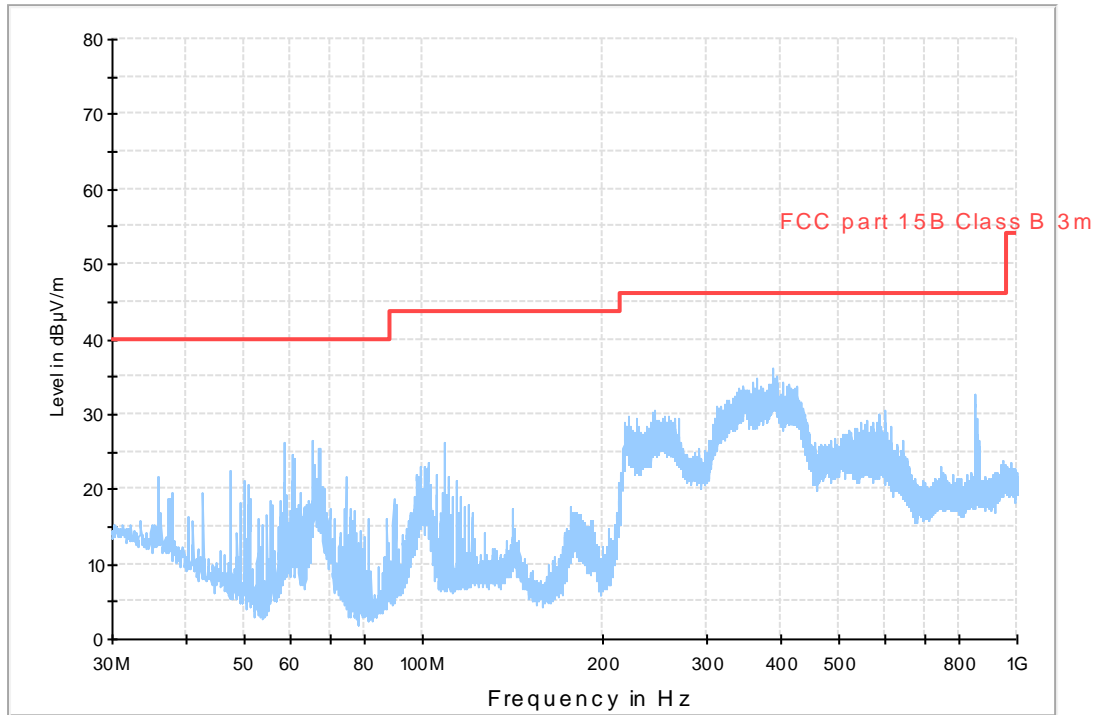
6.4 Test results 30 MHz – 1000 MHz, TX

Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



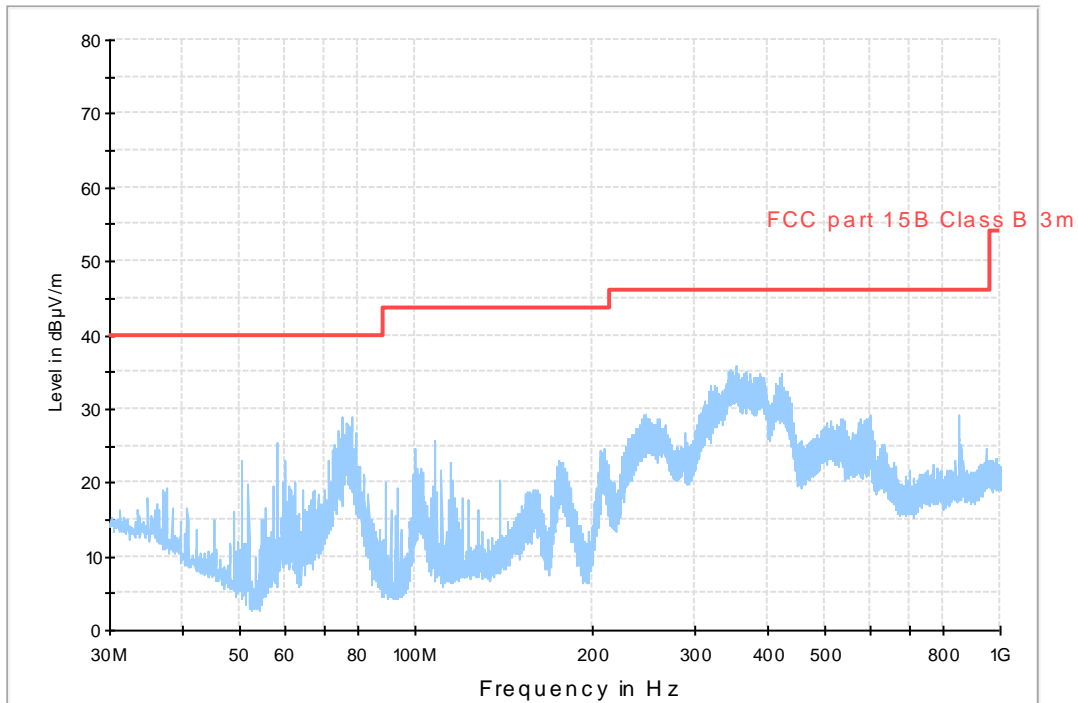
Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX low channel, EUT orientation X.

Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



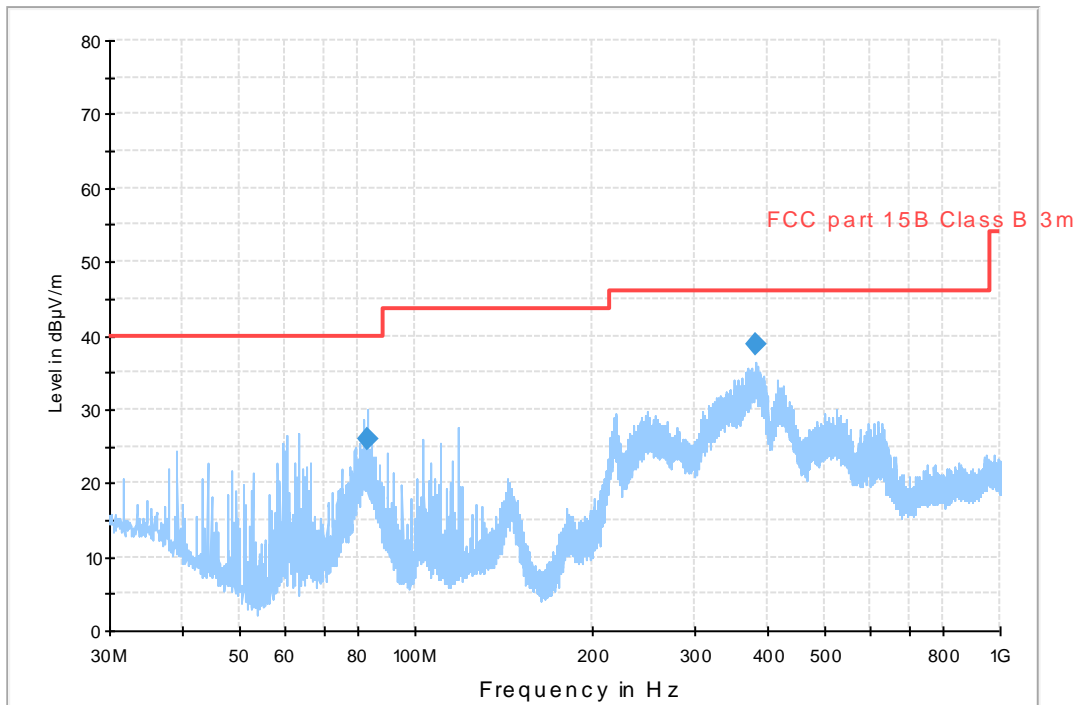
Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX low channel, EUT orientation Y.

Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX mid channel, EUT orientation X.

Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX high channel, EUT orientation X.

Measurement results, Quasi Peak, Low Channel

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Position	Margin [dB]
52.299	3.1	40.0	V	X	36.9
382.047	37.3	46.0	H	X	8.7

Measurement results, Quasi Peak, High Channel

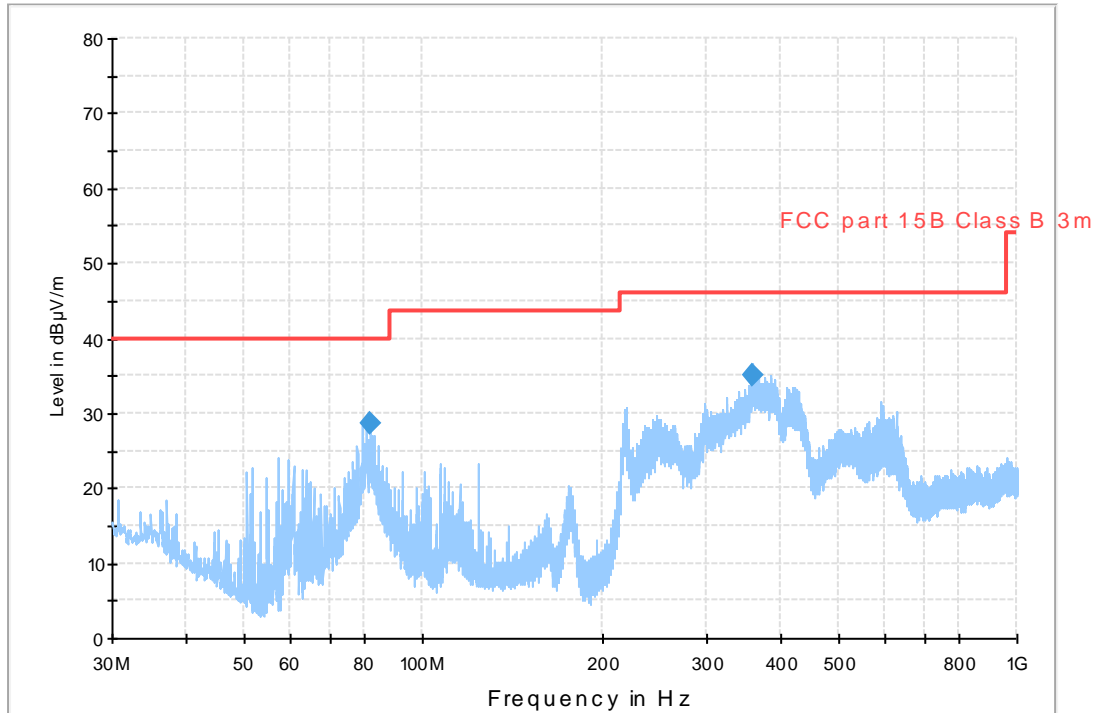
Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Position	Margin [dB]
82.922	26.0	40.0	V	X	14.0
381.120	38.9	46.0	H	X	7.1

All other measured disturbances have a margin of more than 20 dB to the limits.

Result [dBµV/m] = Analyser reading [dBµV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

6.5 Test results 30 MHz – 1000 MHz, RX

Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. RX high channel, EUT orientation X.

Measurement results, Quasi Peak, High channel

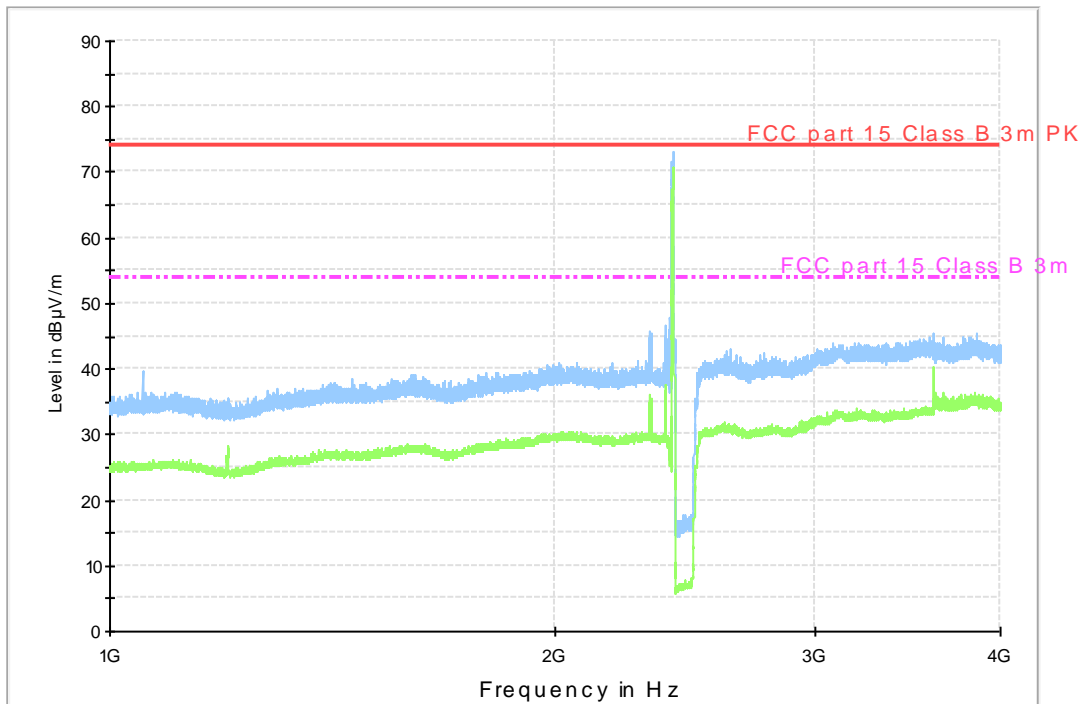
Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Position	Margin [dB]
81.693	28.6	40.0	V	X	11.4
360.152	35.0	46.0	H	X	11.0

All other measured disturbances have a margin of more than 20 dB to the limits.

Result [dBµV/m] = Analyser reading [dBµV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

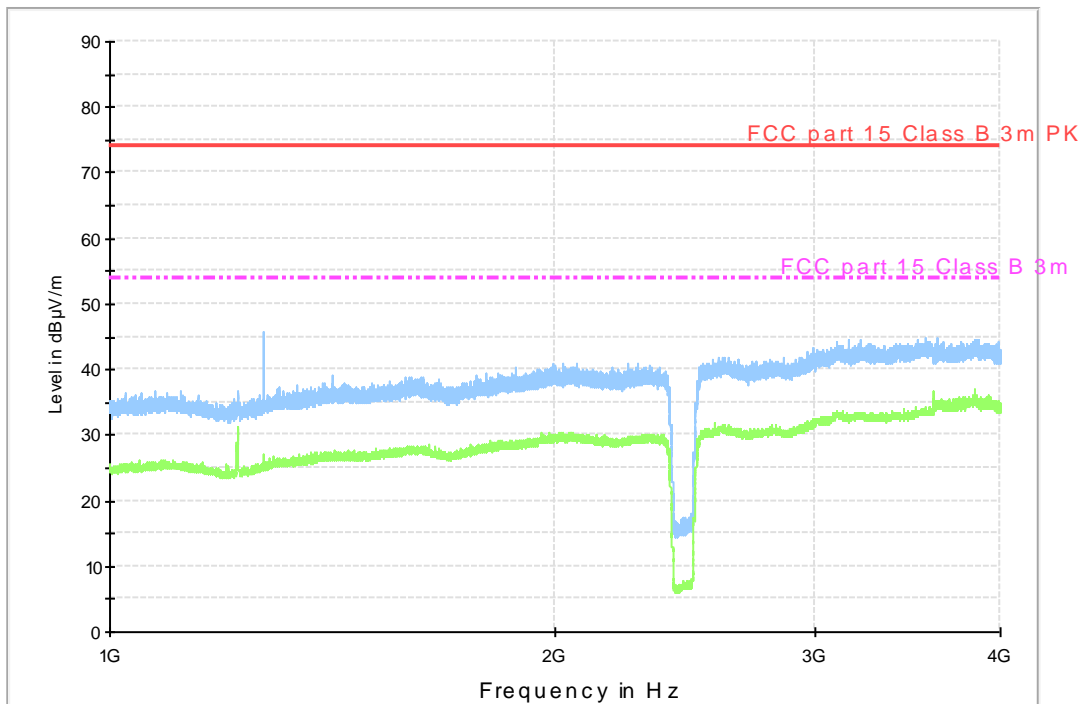
6.6 Test results 1 GHz – 26 GHz, TX

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



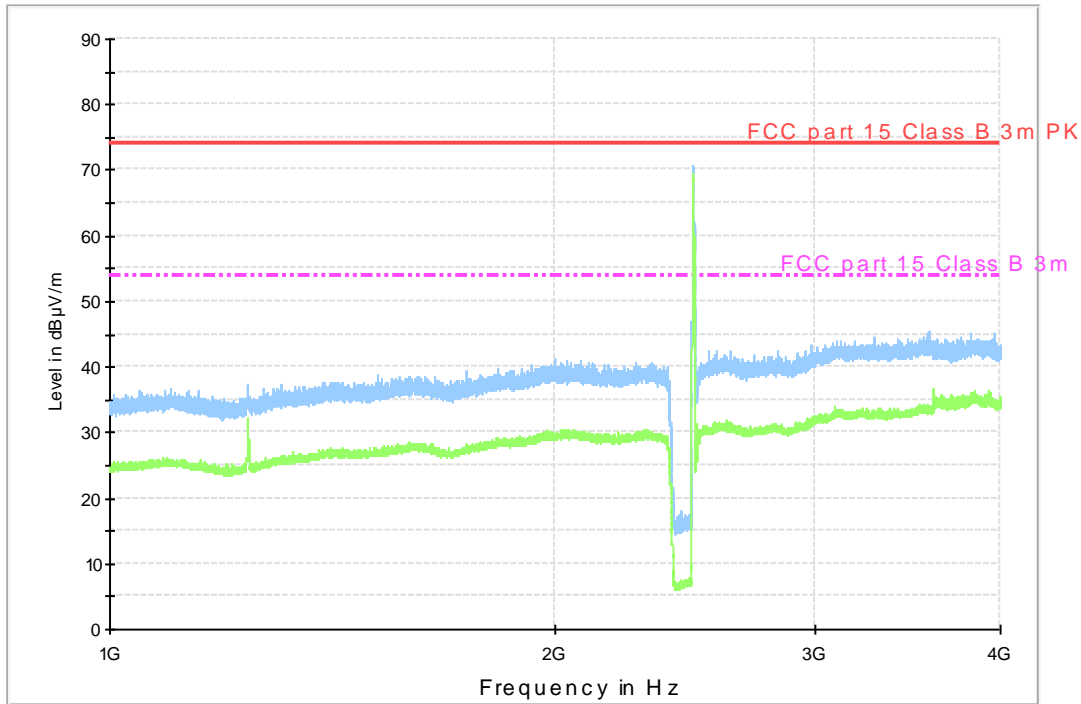
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel, EUT orientation X. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



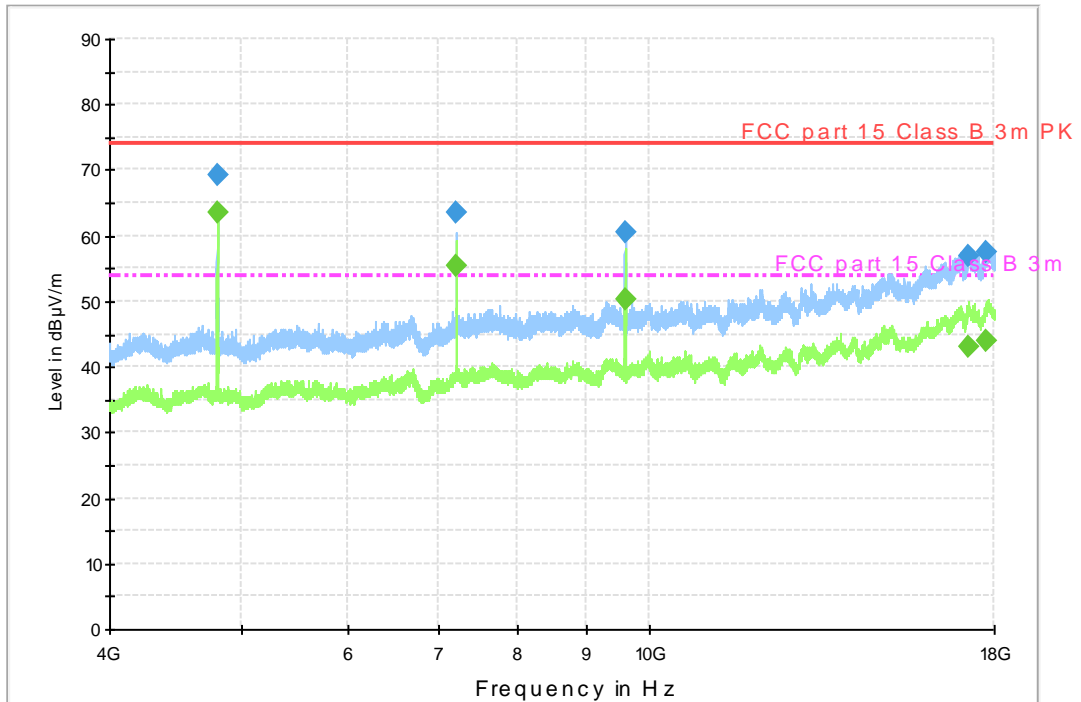
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX mid channel, EUT orientation X. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



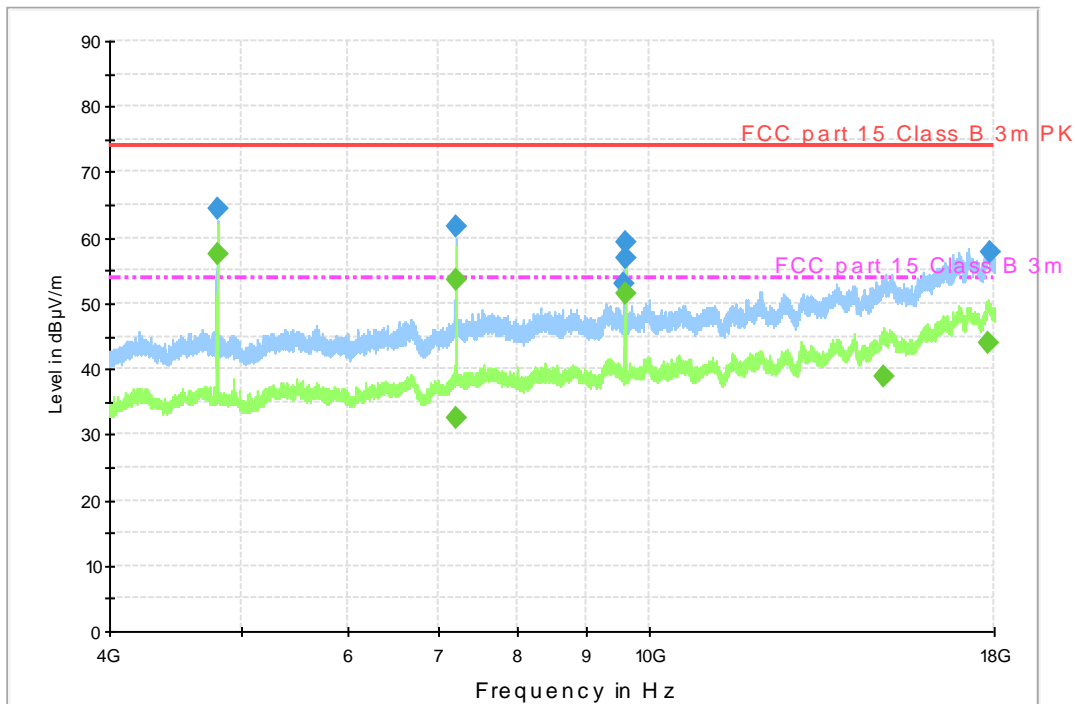
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX high channel, EUT orientation X. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



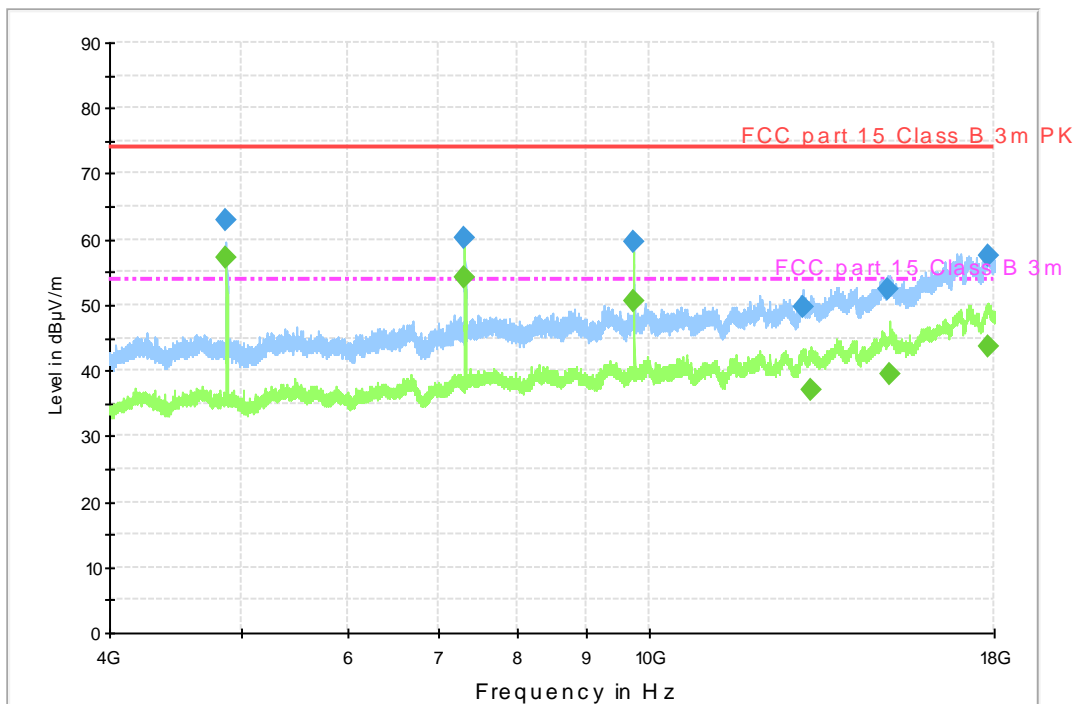
Diagram, Peak overview sweep, 4– 18 GHz at 3 m distance. TX low channel, EUT orientation X. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



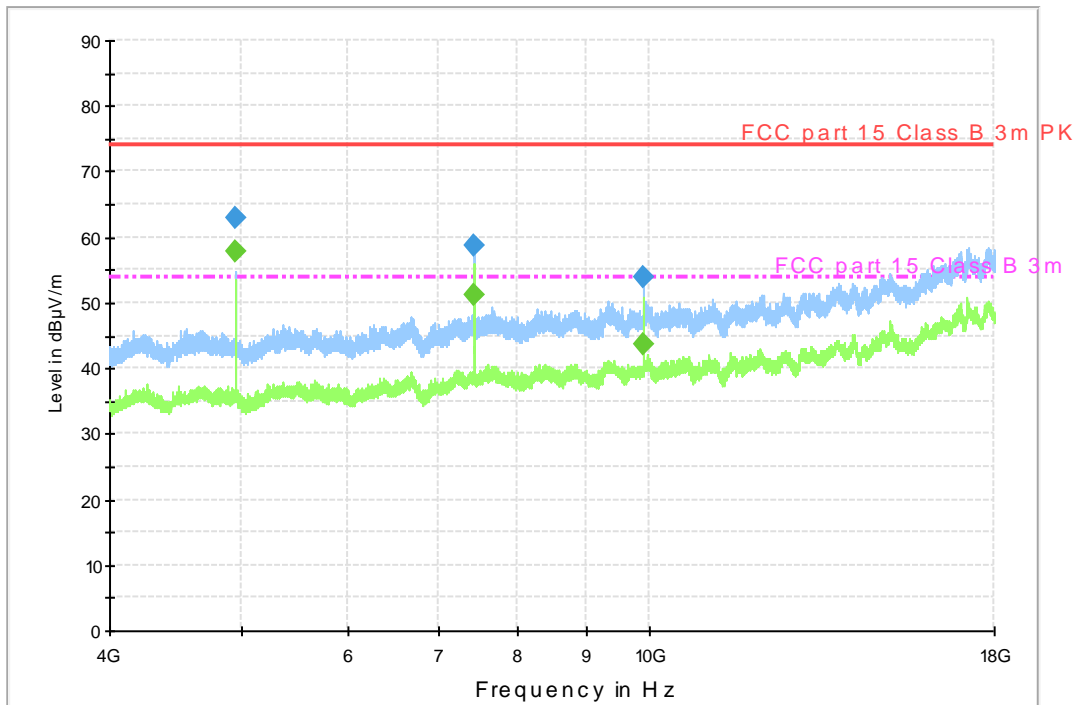
Diagram, Peak overview sweep, 4– 18 GHz at 3 m distance. TX low channel, EUT orientation Y. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



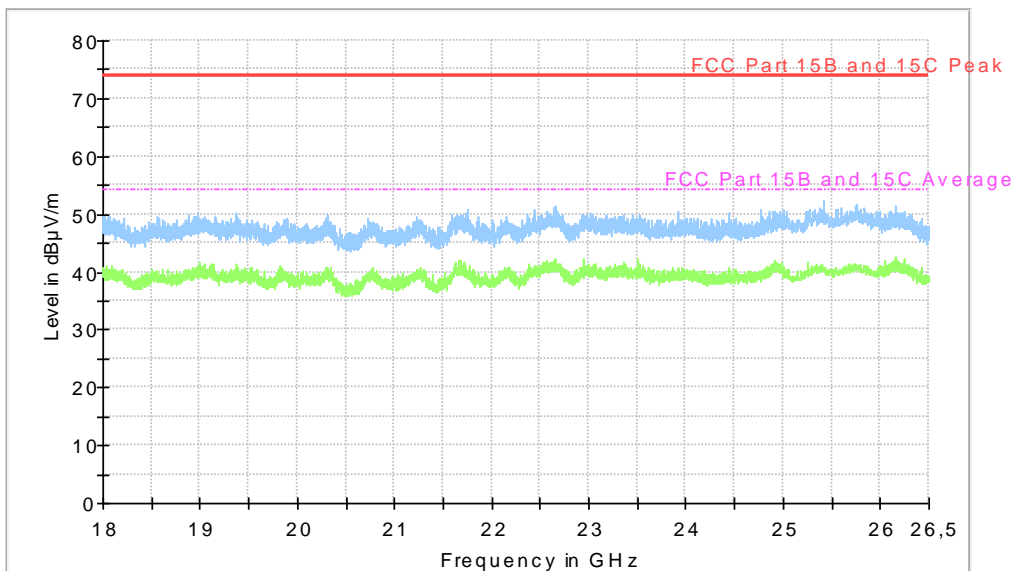
Diagram, Peak overview sweep, 4– 18 GHz at 3 m distance. TX mid channel, EUT orientation X. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



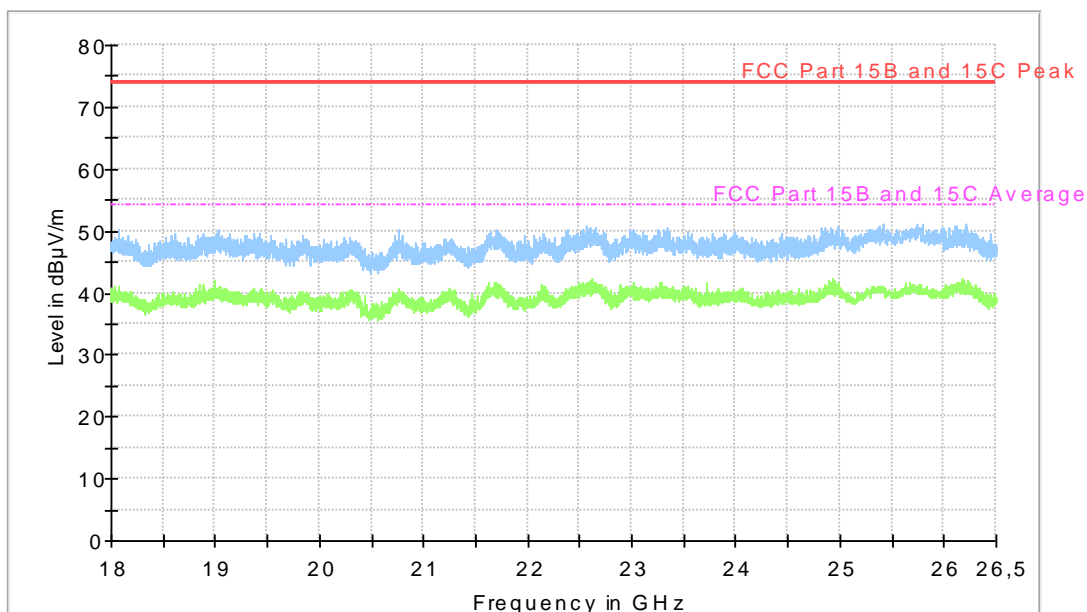
Diagram, Peak overview sweep, 4– 18 GHz at 3 m distance. TX high channel, EUT orientation X. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.

Full Spectrum



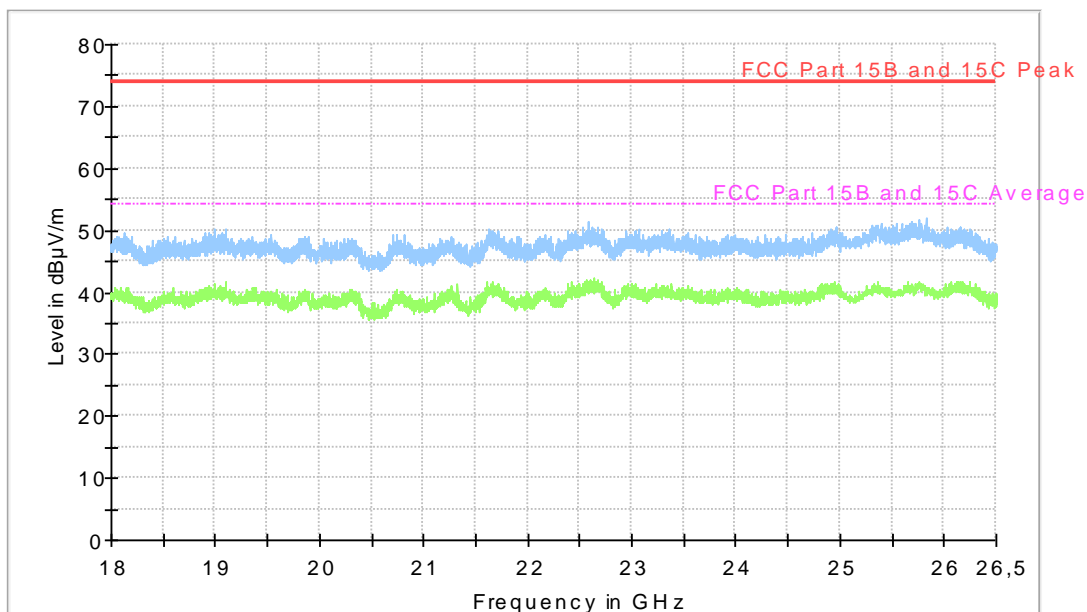
Diagram, Peak overview sweep, 18 – 26 GHz at 3 m distance. TX low channel, EUT orientation X.

Full Spectrum



Diagram, Peak overview sweep, 18 – 26 GHz at 3 m distance. TX mid channel, EUT orientation X.

Full Spectrum



Diagram, Peak overview sweep, 18 – 26 GHz at 3 m distance. TX high channel, EUT orientation X.

Measurement results, Peak, TX low channel

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
4803.6	69.3	74.0	X	H	4.7
4803.6	64.5	74.0	Y	H	9.5
7206.5	63.6	74.0	X	H	10.4
7206.5	61.8	74.0	Y	H	12.2
9601.4	52.9	74.0	Y	H	21.1
9607.9	60.5	74.0	X	V	13.5
9609.3	59.3	74.0	Y	H	14.7
9613.1	57.0	74.0	Y	H	17.0
17210.4	57.0	74.0	X	H	17.0
17750.8	57.4	74.0	X	V	16.6
17876.8	57.7	74.0	Y	H	16.3

Measurement results, Average, TX low channel

Frequency [MHz]	Meas. Pk. Level [dB μ V/m]	Duty Cycle Corr. Factor* [dB]	Average Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
4803.6	69.3	-45.8	23.5	54.0	X	H	30.5
7206.5	63.6	-45.8	17.8	54.0	X	H	36.2
9607.5	60.5	-45.8	14.7	54.0	X	V	39.3
17210.4	57.0	-45.8	11.2	54.0	X	H	42.8
17750.8	57.4	-45.8	11.6	54.0	X	V	42.4

NOTE: *Duty cycle correction factor, see section 10.

Measurement results, Peak, TX middle channel

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
4879.7	63.0	74.0	X	H	11.0
7319.9	60.3	74.0	X	H	13.7
9760.5	59.7	74.0	X	V	14.3
13004.8	49.6	74.0	X	V	24.4
15021.7	52.2	74.0	X	H	21.8
17797.9	57.5	74.0	X	V	16.5

Measurement results, Average, TX middle channel

Frequency [MHz]	Meas. Pk. Level [dB μ V/m]	Duty Cycle Corr. Factor* [dB]	Average Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
4879.7	63.0	-45.8	17.2	54.0	X	H	36.8
7319.9	60.3	-45.8	14.5	54.0	X	H	39.5
9760.5	59.7	-45.8	13.9	54.0	X	V	40.1
13004.8	49.6	-45.8	3.8	54.0	X	V	50.2
15021.7	52.2	-45.8	6.4	54.0	X	H	47.6
17797.9	57.5	-45.8	11.7	54.0	X	V	42.3

NOTE: *Duty cycle correction factor, see section 10.

Measurement results, Peak, TX high channel

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
2484.0	60.7	74.0	X	H	13.3
4959.5	62.9	74.0	X	H	11.1
7439.3	58.8	74.0	X	H	15.2
9919.7	53.8	74.0	X	V	20.2

Measurement results, Average, TX high channel

Frequency [MHz]	Meas. Pk. Level [dB μ V/m]	Duty cycle Corr. Factor* [dB]	Average Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
2484.0	60.7	-45.8	14.9	54.0	X	H	39.1
4959.5	62.9	-45.8	17.7	54.0	X	H	63.3
7439.3	58.8	-45.8	13.0	54.0	X	H	41.0
9919.7	53.8	-45.8	8.0	54.0	X	V	46.0

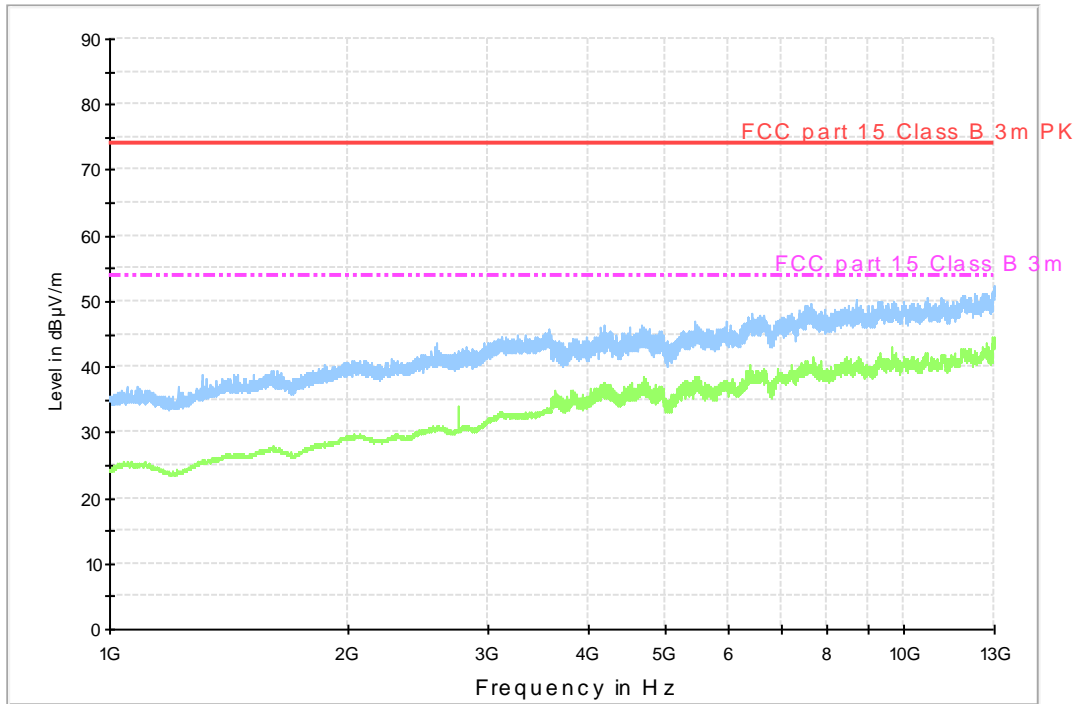
NOTE: *Duty cycle correction factor, see section 10.

All other measured disturbances have a margin of more than 20 dB to the limits.

Result [dB μ V/m] = Analyser reading [dB μ V] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

6.7 Test results 1 GHz – 13 GHz, RX

FCC 1 G - 15 G class B 3m ESU40 Continuous TT rotation



Diagram, Peak overview sweep, 1 – 13 GHz at 3 m distance. RX low channel, EUT orientation X.

No emissions are found above noise floor or closer than 20 dB from limit.

7 CONDUCTED BAND EDGE MEASUREMENT

Date of test:	2017-01-16	Test location:	Wireless Center
EUT Serial:	--	Ambient temp:	19 °C
Tested by:	Robert Hietala	Relative humidity:	20 %
Test result:	Pass	Margin:	> 10 dB

7.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 6.10.4.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

The EUT was set up in order to emit maximum disturbances.

7.2 Test conditions

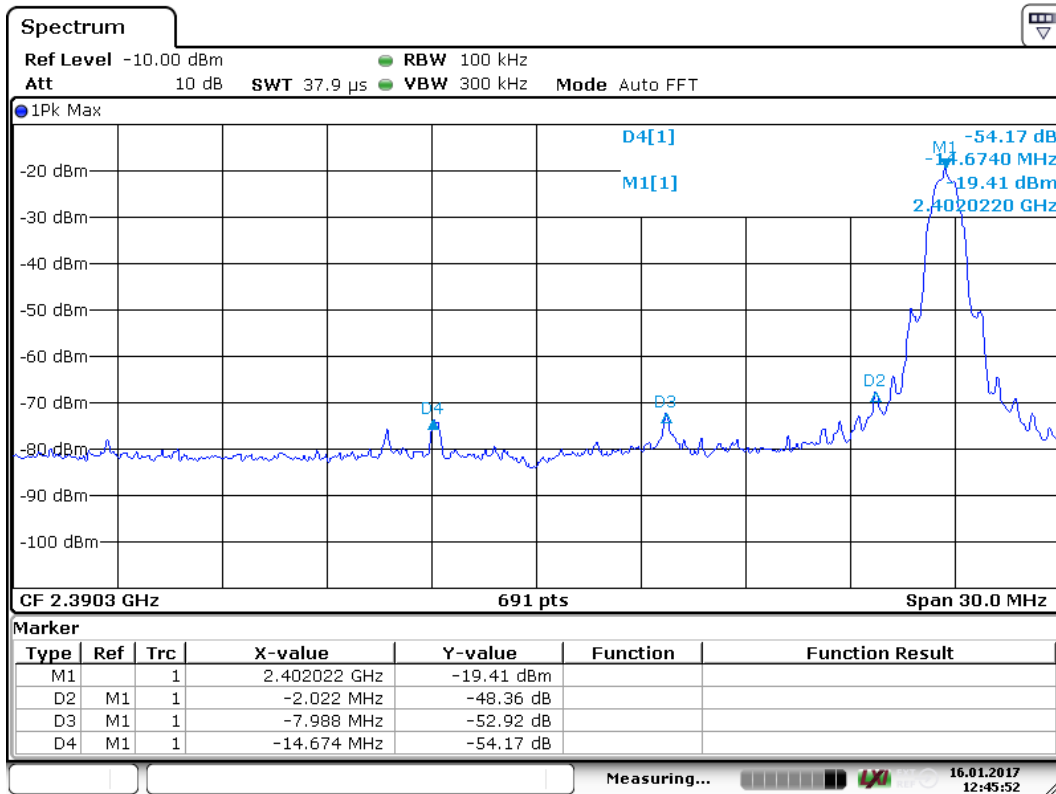
Detector: Peak,
 RBW: 100 kHz
 VBW: 300 kHz
 Span: 30 MHz

7.3 Requirement

Reference: CFR 47 §15.247(d), RSS-247 5.5,

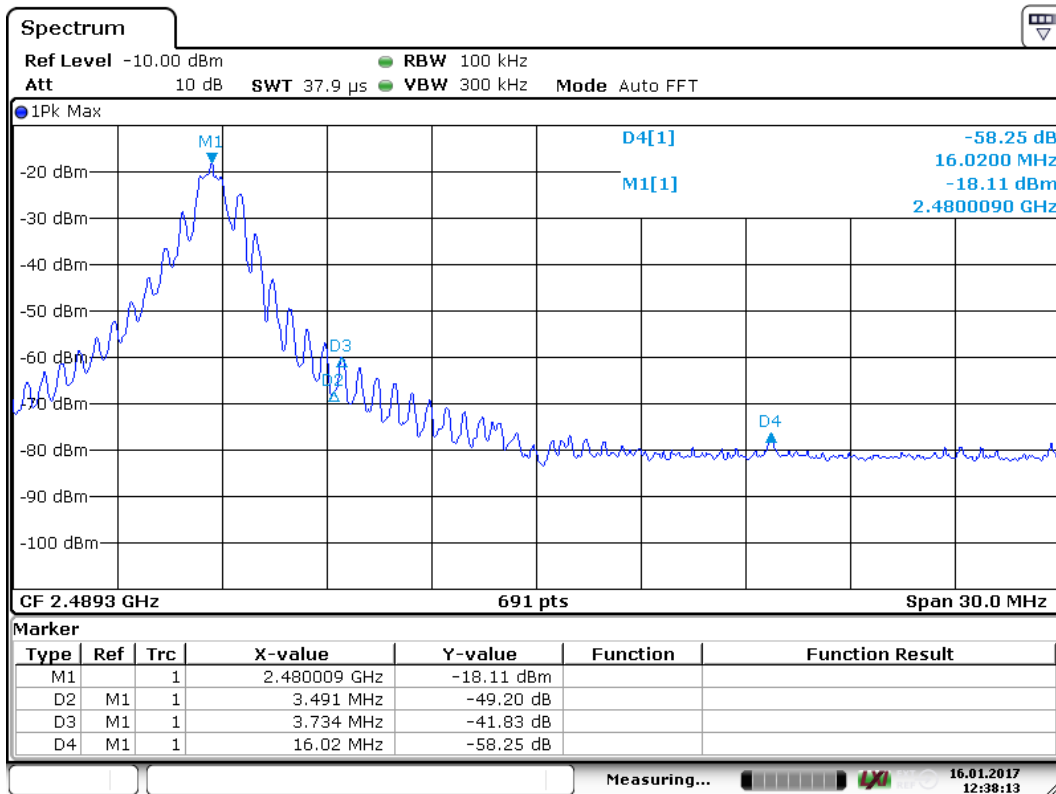
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

7.4 Test results



Date: 16 JAN 2017 12:45:52

Screenshot: Lower band edge sweep, single channel



Date: 16 JAN 2017 12:38:13

Screenshot: Upper band edge sweep, single channel

Test results

Band edge	Delta [dBc]	Limit [dBc]	Margin [dB]
Lower	48.4	20.0	28.4
Upper	41.8	20.0	21.8

8 PEAK CONDUCTED OUTPUT POWER

Date of test:	2017-01-16	Test location:	Wireless Center
EUT Serial:	--	Ambient temp:	19 °C
Tested by:	Robert Hietala	Relative humidity:	20 %
Test result:	Pass	Margin:	> 10 dB

8.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 11.9.1.1.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

8.2 Test conditions

Detector: Peak,
RBW: \geq OBW
VBW: 3 x RBW
Span: \geq 3 x OBW

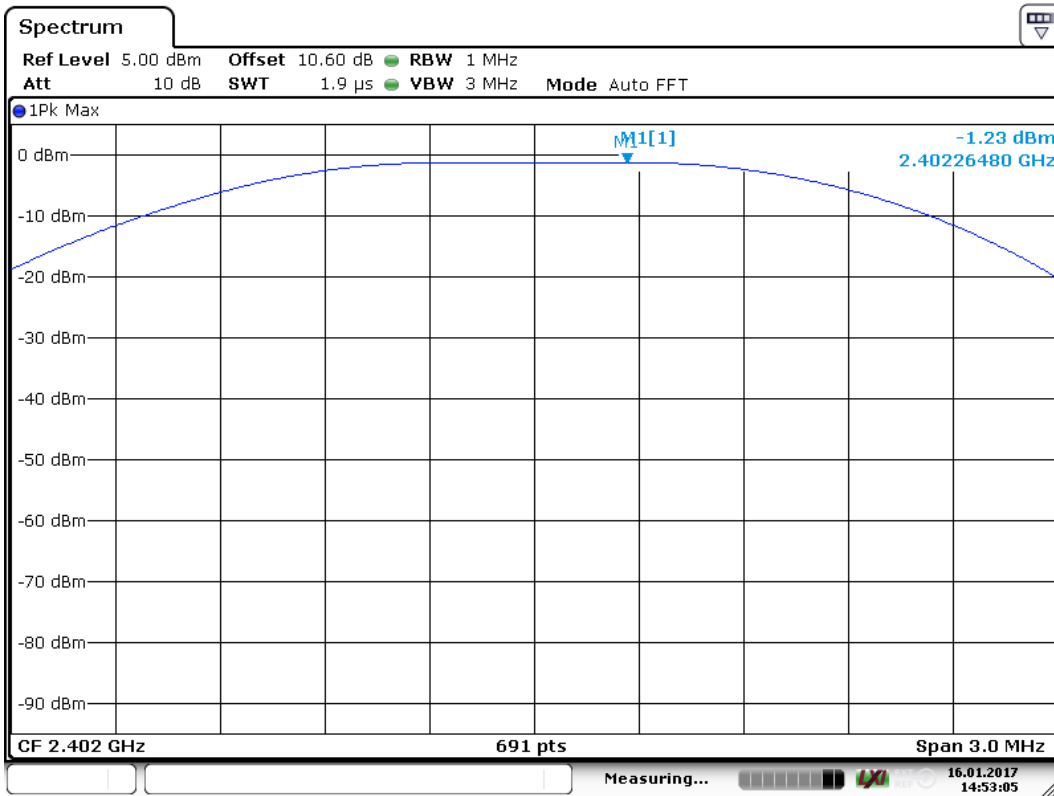
The EUT was set up in order to emit maximum disturbances.

8.3 Requirements

Reference: CFR 47§15.247(b)(3), RSS-247 5.4

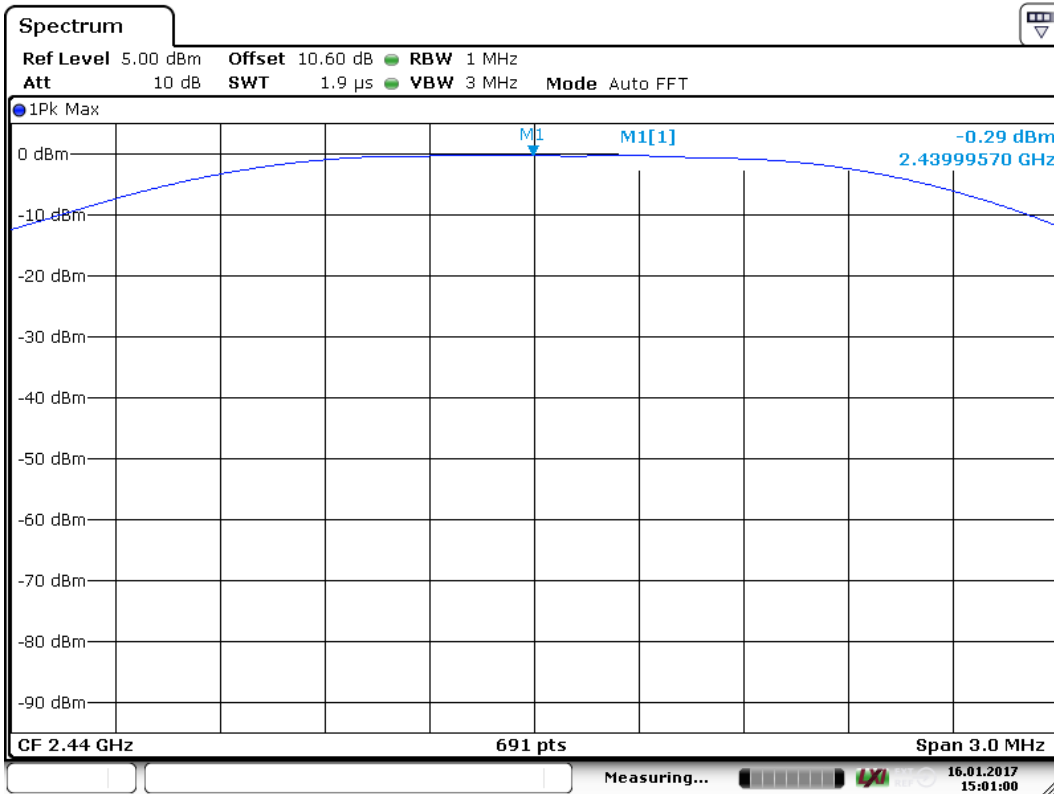
For DTSs employing digital modulation techniques operating in the bands 902 – 128 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

8.4 Test results



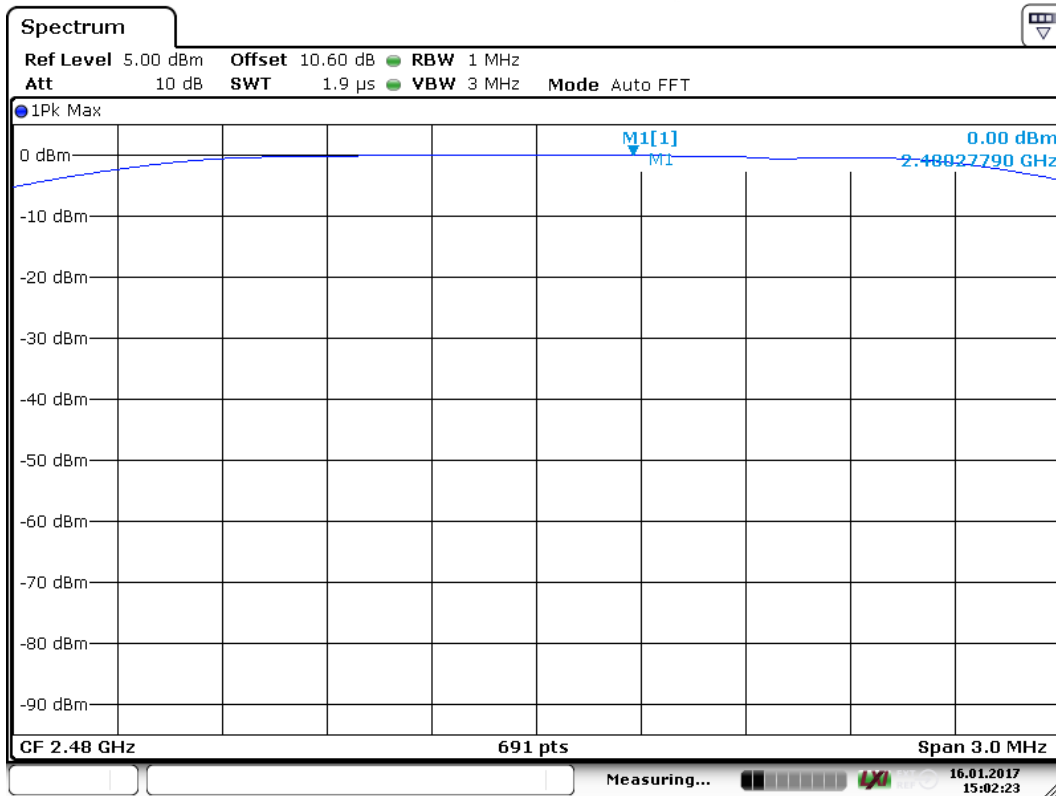
Date: 16 JAN 2017 14:53:06

Screenshot: Output power, low channel



Date: 16 JAN 2017 15:01:00

Screenshot: Output power, middle channel



Date: 16 JAN 2017 15:02:23

Screenshot: Output power, high channel

Test result

Channel [MHz]	Output power [dBm]
2402	-1.2
2440	-0.3
2480	0.0

9 OCCUPIED 6 DB BANDWIDTH

Date of test:	2017-01-16	Test location:	Wireless Center
EUT Serial:	--	Ambient temp:	19 °C
Tested by:	Robert Hietala	Relative humidity:	20 %
Test result:	Pass	Margin:	201.9 kHz

9.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 11.8.1.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

9.2 Test conditions

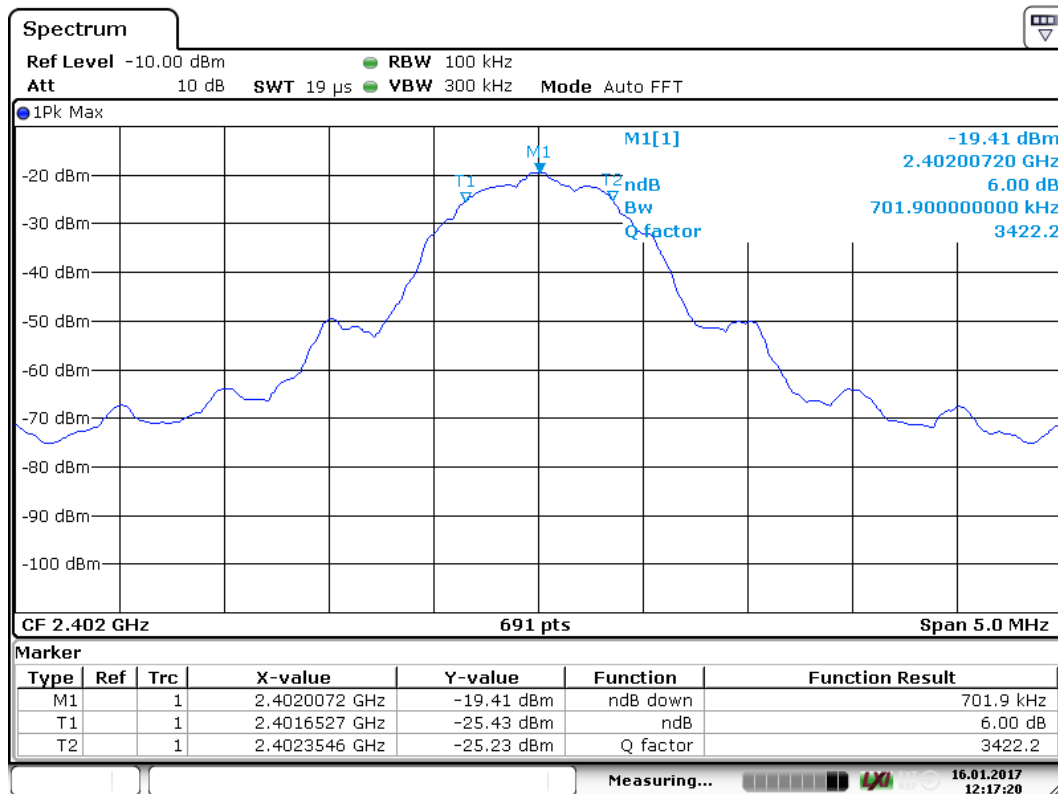
Detector: Peak,
RBW: 100 kHz
VBW: 3 x RBW
Span: >1.5 x OBW

The EUT was set up in order to emit maximum disturbances.

9.3 Requirements

Reference: CFR 47§15.247(a)(2), RSS-247 5.2(1)
The minimum 6 dB bandwidth shall be 500 kHz.

9.4 Test results



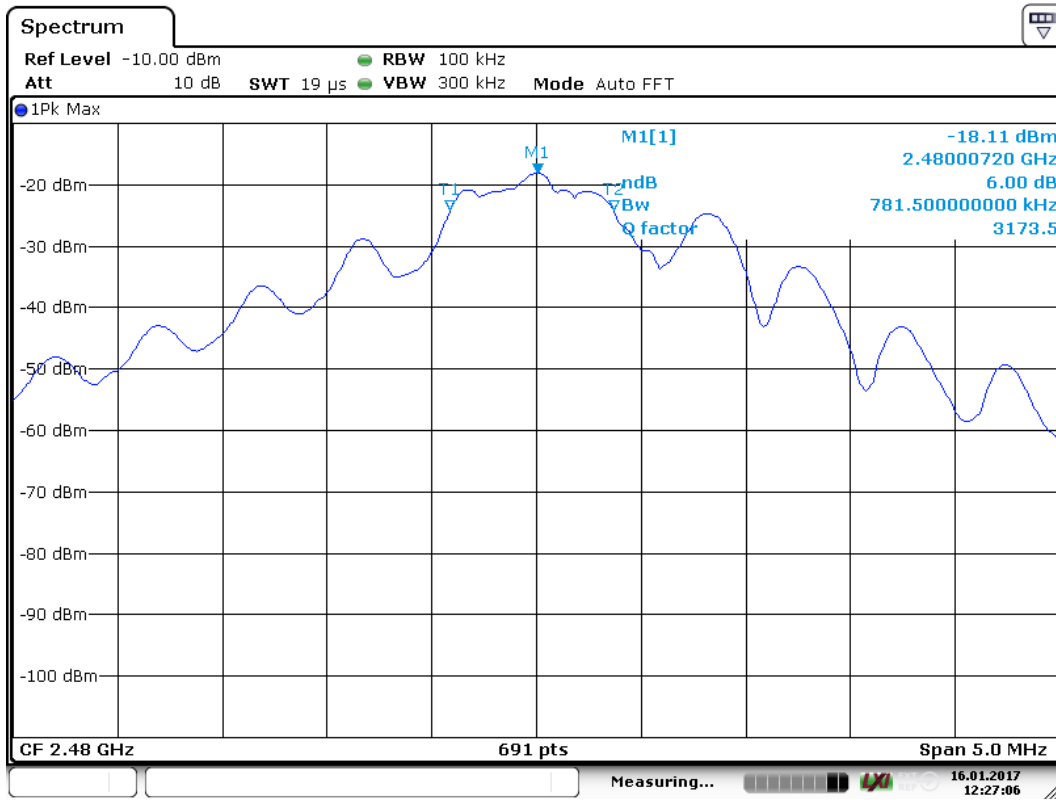
Date: 16 JAN 2017 12:17:20

Screenshot: Occupied 6 dB bandwidth Measurement, low channel



Date: 16 JAN 2017 12:23:50

Screenshot: Occupied 6 dB bandwidth Measurement, middle channel



Date: 16 JAN 2017 12:27:07

Screenshot: Occupied 6 dB bandwidth Measurement, high channel

Test result

Channel [MHz]	6 dB BW [kHz]
2405	701.9
2440	752.5
2480	781.5

10 PEAK POWER SPECTRAL DENSITY

Date of test:	2017-01-16	Test location:	Wireless Center
EUT number:	--	Ambient temp:	19 °C
Tested by:	Robert Hietala	Relative humidity:	20 %
Test result:	Pass	Margin:	9.4 dB

10.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 11.10.2.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

10.2 Test conditions

Detector: Peak,
RBW: 3 kHz
VBW: >3 x RBW
Span: 1.5 x 6 dB bandwidth

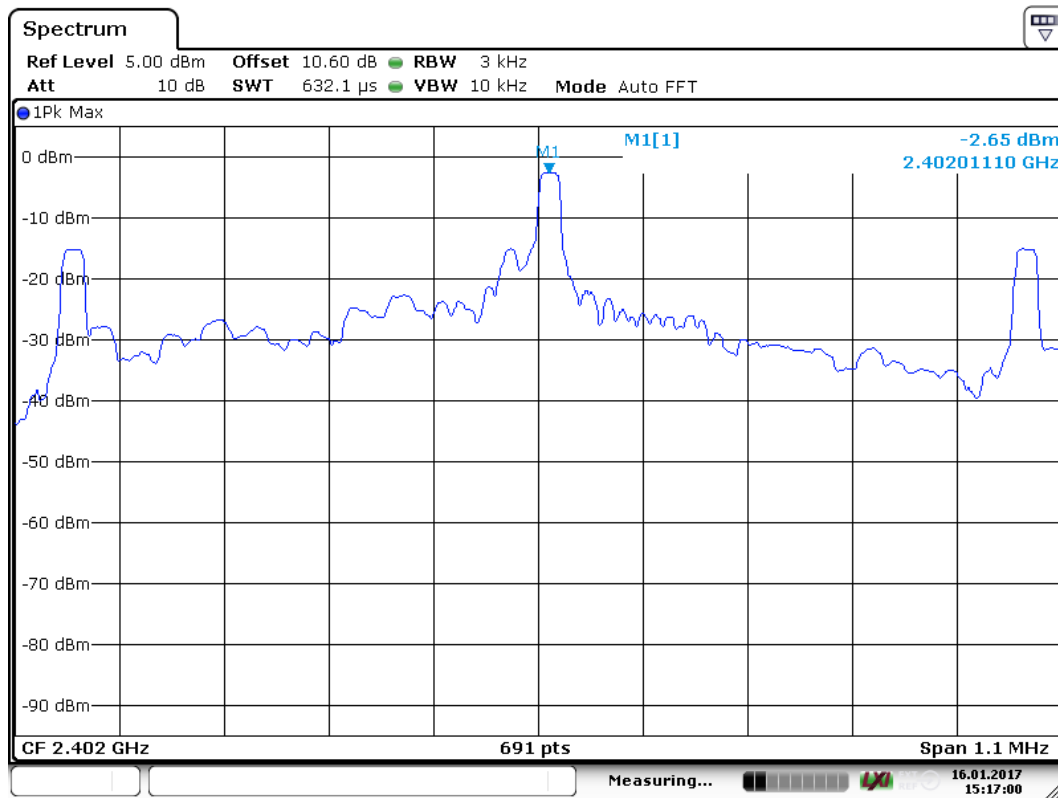
The EUT was set up in order to emit maximum disturbances.

10.3 Requirements

Reference: CFR 47§15.247(3), RSS-247 5.2(2)

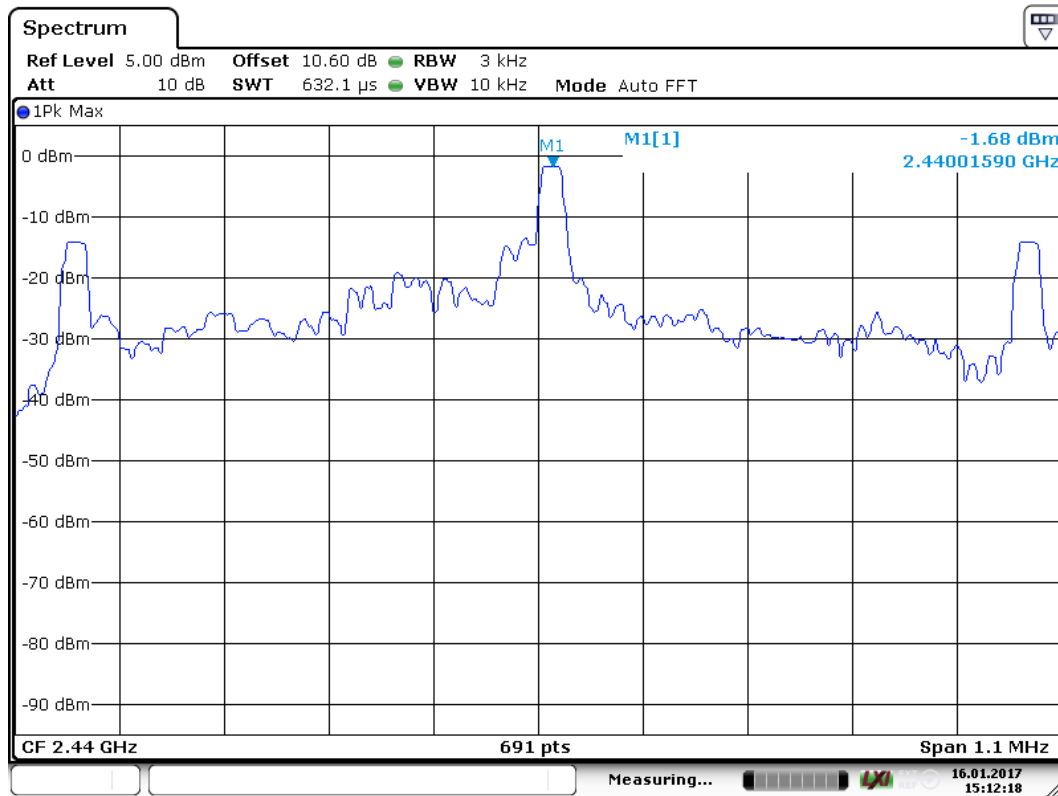
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.4 Test results



Date: 16 JAN 2017 15:17:00

Screenshot: Peak power spectral density, low channel



Date: 16 JAN 2017 15:12:18

Screenshot: Peak power spectral density, middle channel



Date: 16 JAN 2017 15:13:53

Screenshot: Peak power spectral density, high channel

Test result

Channel [MHz]	PSD [dBm/3kHz]
2405	-2.7
2440	-1.7
2480	-1.4

11 TRANSMITTER DUTY CYCLE DECLARATION

Date of test:	2017-01-18	Test location:	--
EUT Serial:	--	Ambient temp:	--
Tested by:	Robert Hietala	Relative humidity:	--
Test result:	--	Margin:	--

11.1 Test set-up and test procedure

The test method is in accordance with ANSI C63.10-2013 section 7.5.

11.2 Duty cycle declaration

The duty cycle has been declared by the manufacturer as follows.

Prerequisites:

- Two cases
 - o Advertising mode occurs with 375 ms interval
 - o Five (5) UUID is read/transmitted every 250 ms
- Send and receive buffer has the same size, 32 bytes
- Assumes that the whole buffer, send and receive, is fully utilized each time
- Maximum transmission speed is 1 Mbps

Duty cycle for advertising:

Data per message = 32 byte x 8 bit/byte == 256 bit
 Bits per second = 256 bit / 375 ms == 683 bit/s
 Duty cycle = 683 / 1 000 000 == 0.00039

Duty cycle during worst-case scenario for transmission:

Data per message = 32 byte x 8 bit/byte == 256 bit
 Bits per second = (5 x 256) / 250 ms == 5120 bit/s
 Duty cycle = 5120 / 1 000 000 == 0.00512

11.3 Duty cycle correction factor

Correction factor is calculated δ (dB) = 20 log (duty cycle).

This gives a duty cycle correction factor for the worst-case scenario:

$$\delta \text{ (dB)} = 20 \log (0.00512) ; \delta = -45.8 \text{ dB}$$

Duty cycle = 0.512 %
 Correction factor = -45.8 dB

12 TEST EQUIPMENT

Stora Hallen

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - Version 8.51.0	--	--	--
Receiver	Rohde & Schwarz	ESU 8	12866	07-2016	1 year
Receiver	Rohde & Schwarz	ESU 40	13178	07-2016	1 year
BiLog antenna	Chase	CBL6110A	971	07-2015	3 years
Preamplifier	BONN	BLMA 0118-M	31246	07-2016	1 year
Horn antenna	Rohde & Schwarz	HF907	32296	12-2016	1 year
Attenuator, 20 dB	Huber+Suhner	5920_N-50-010/199_NE	32697	06-2016	1 year
2,4 GHz band reject filter:	K&L MICROWAVE INC	6N45-2450/T100-0/0	12389	03-2016	1 year
4 GHz high pass filter	K&L MICROWAVE INC	4410-X4500/18000-0/0	5133	08-2016	1 year

Wireless Center and 3m FAC

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - Version 9.21.0	--	--	--
Pre amplifier	Sangus	00101400-23-10P -6-S ; AFS44-12002400-32-10P -44	12335	11-2016	1 year
Horn antenna	EMCO	3160-09	30101	10-2016	3 years
Signal analyzer:	Rohde & Schwarz	FSV	32594	07-2016	1 year
Signal analyzer	Rohde & Schwarz	FSIQ 40	12793	07-2016	1 year
2,4 GHz band reject filter:	K&L MICROWAVE INC	6N45-2450/T100-0/0	12389	03-2016	1 year
4 GHz high pass filter	K&L MICROWAVE INC	4410-X4500/18000-0/0	5133	08-2016	1 year
Power supply	Oltronix	B60-1T	7234	--	--
Multimeter	Fluke	179	33105	10-2016	1 year

13 MEASUREMENT UNCERTAINTY

Continuous conducted disturbances with AMN in the frequency range 9 kHz to 30 MHz ± 3.7 dB

Measurement uncertainty for radiated disturbance

Uncertainty for the frequency range 30 to 1000 MHz at 3 m	± 5.1 dB
Uncertainty for the frequency range 30 to 1000 MHz at 10 m	± 5.0 dB
Uncertainty for the frequency range 1.0 to 18 GHz at 3 m	± 4.7 dB
Uncertainty for the frequency range 18 to 26 GHz at 3 m	± 4.8 dB
Uncertainty for the frequency range 26 to 40 GHz at 3 m	± 5.7 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2:2011.

The measurement uncertainty is given with a confidence of 95 %.

14 TEST SET UP AND EUT PHOTOS

EUT photos are in separate document 1620866STO-001 Annex 1.

Test set up photos are in separate document 1620866STO-001 Annex 2.