

RADIO TEST REPORT

No. 1610783STO-004, Ed. 1

RF Performance

EQUIPMENT UNDER TEST

Equipment: Gateway
Type/Model: E1526 Trådfri
Manufacturer: IKEA of Sweden
Tested by request of: IKEA of Sweden

SUMMARY

Referring to the emission limits, and the operating mode during the tests specified in this report, the 2.4 GHz ZigBee radio 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: 2016-09-05

Tested by:


Matti Virkki

Approved by:


Stefan Andersson

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

Intertek Semko AB

Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden

Telephone +46 8 750 00 00, Fax +46 8 750 60 30

www.intertek.se

Registered in Sweden: No: SE556024059901, Registered office: As address

Revision History

Edition	Date	Description	Changes
1	2016-09-05	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 Peripheral equipment.....	5
2.4 Test signals and operation modes	5
2.5 Modifications made to improve EMC-characteristics	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 25 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.....	11
6.5 Test results 1 GHz – 25 GHz, TX	14
6.6 Test results 1 GHz – 13 GHz, RX	21
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.....	23
8 Peak conducted output power.....	25
8.1 Test set-up and test procedure.....	25
8.2 Test conditions	25
8.3 Requirements.....	25
8.4 Test results.....	25
9 Occupied 6 dB bandwidth	28
9.1 Test set-up and test procedure.....	28
9.2 Test conditions	28
9.3 Requirements.....	28
9.4 Test results.....	28
10 Peak power spectral density	31
10.1 Test set-up and test procedure.....	31
10.2 Test conditions	31
10.3 Requirements.....	31
10.4 Test results.....	31
11 Test equipment.....	34
12 Measurement uncertainty.....	35
13 Test set up and EUT photos.....	35

1 CLIENT INFORMATION

The EUT has been tested by request of

Company: IKEA of Sweden AB
Box 702
343 81 Älmhult
Sweden

Name of contact: Daniel Lind

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT

Equipment: Gateway
Type/Model: E1526 Trådfri
Brand name: IKEA
Serial number: No visible serial number on EUT
Manufacturer: IKEA of Sweden AB
Transmitter frequency range: 2405 – 2480 MHz
Receiver frequency range: 2405 – 2480 MHz
Frequency agile or hopping: Yes No
Antenna: Internal antenna External antenna
Antenna connector: None, internal antenna Yes
Antenna gain: 0 dBi
Rating RF output power: 12 dBm (conducted)
Type of modulation: OQPSK
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: <-20°C to +55°C
Transmitter standby mode supported: Yes No

2.2 Additional information about the EUT

The gateway is part of the TRÅDFRI platform from IKEA of Sweden and contain;

- 802.15.4 ZigBee radio
- 802.11 b/g/n/a Wi-Fi radio.
- Ethernet

This report covers tests of the ZigBee radio parts.

During the tests the EUT supported following software:

Software	Version	Comment
Test software	Beta6	For continuous transmitter test
User firmware	0.7.0	

2.3 Peripheral equipment

Peripheral equipment is equipment needed for correct operation of the EUT, but not included as part of the testing and evaluation of the EUT.

Equipment	Type / Model	Manufacturer	Serial no.
AC / DC adaptor PC	KMW-050-050-NA-U T450s	IKEA of Sweden Lenovo	

2.4 Test signals and operation modes

Continuous signal with 100 % duty cycle and OQPSK modulation

Continuous signal with 24 % duty cycle and OQPSK modulation

Continuous Rx mode

Tests were performed on following frequencies 2405 MHz, 2445 MHz and 2480 MHz

2.5 Modifications made to improve EMC-characteristics

The EUT was not modified during the testing.

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,
P.O. 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 margin to the limit was at least 12.3 dB at 0.174 MHz. See clause 5.3.	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 0.5 dB at 133.449 MHz. See clause 6. 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 above 1 GHz The EUT complies with the limits. The margin to the limit was at least 3.4 dB at 4959 MHz. See clause 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 1.14 MHz 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 18.4 dB. 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 11.8 dB. See clause 11.4.	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 26.5 dB. See clause 7.4.	PASS

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

Date of test:	2016-07-04	Test location:	FCC-mätplats
EUT Serial:	--	Ambient temp:	23 °C
Tested by:	Matti Virkki	Relative humidity:	48 %
Test result:	Pass	Margin:	12.3 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 according to the mode of operation mentioned in clause 2.4.

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

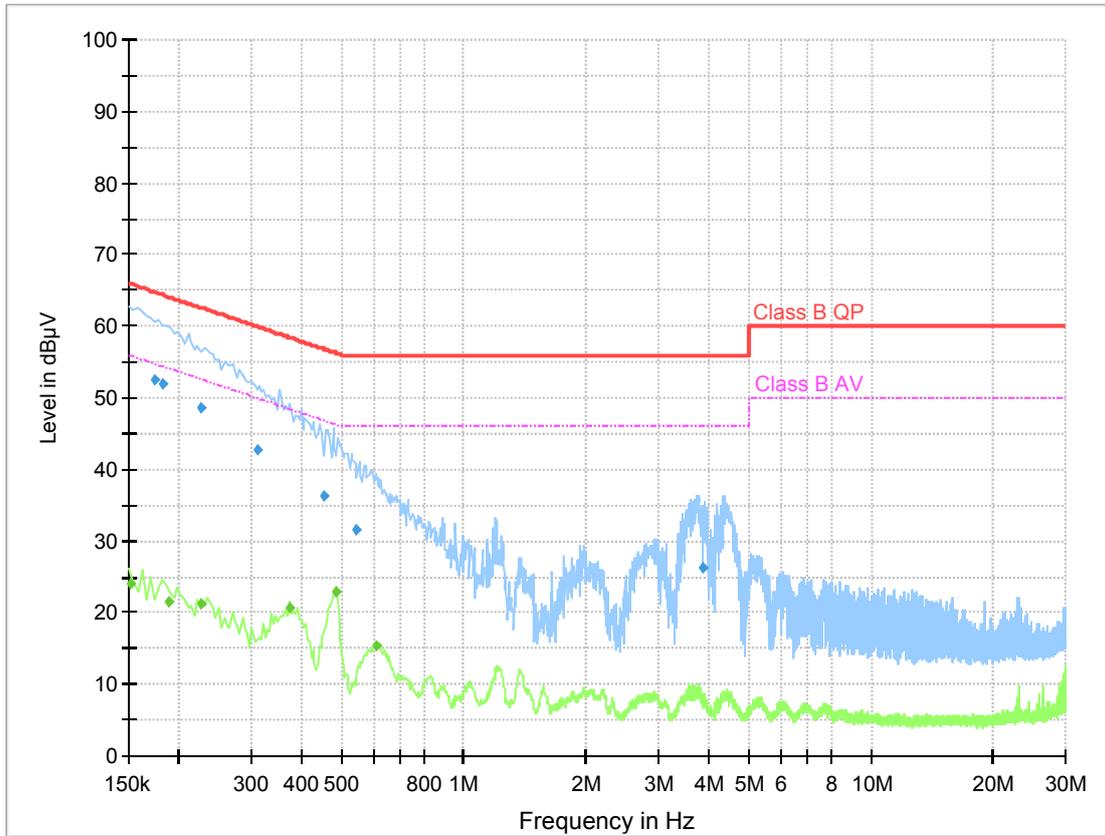
The EUT shall meet the limits for the standards.

Reference: 47 CFR §15.207

RSS-GEN, section 8.8 table 3

Frequency range [MHz]	Limits [dBµV]	
	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]
0.174	52.5	64.8	L	12.3
0.183	51.9	64.4	N	12.5
0.225	48.6	62.6	N	14.0
0.310	42.8	60.0	L	17.2
0.452	36.2	56.8	N	30.6
0.545	31.6	56.0	L	28.4
3.858	26.3	56.0	N	39.7

Measurement results, Average

Frequency [MHz]	Level [dBµV]	Limit [dBµV]	Line L/N	Margin [dB]
0.152	24.2	55.9	L	31.7
0.189	21.6	54.1	N	32.5
0.227	21.1	52.6	N	31.5
0.374	20.7	45.4	L	24.7
0.484	23.0	46.3	L	23.3
0.611	15.3	46.0	L	30.7

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

6 RADIATED RF EMISSION IN THE FREQUENCY-RANGE 30 MHZ TO 25 GHZ

Date of test:	2016-05-26 / 2016-06-10	Test location:	Stora Hallen
EUT Serial:	No serial on EUT	Ambient temp:	22 – 24 °C
Tested by:	Matti Virkki Robert Hietala	Relative humidity:	27 – 36 %
Test result:	Pass	Margin:	0.5 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.

On each frequency the worst case EUT orientation is reported.

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:

10 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))

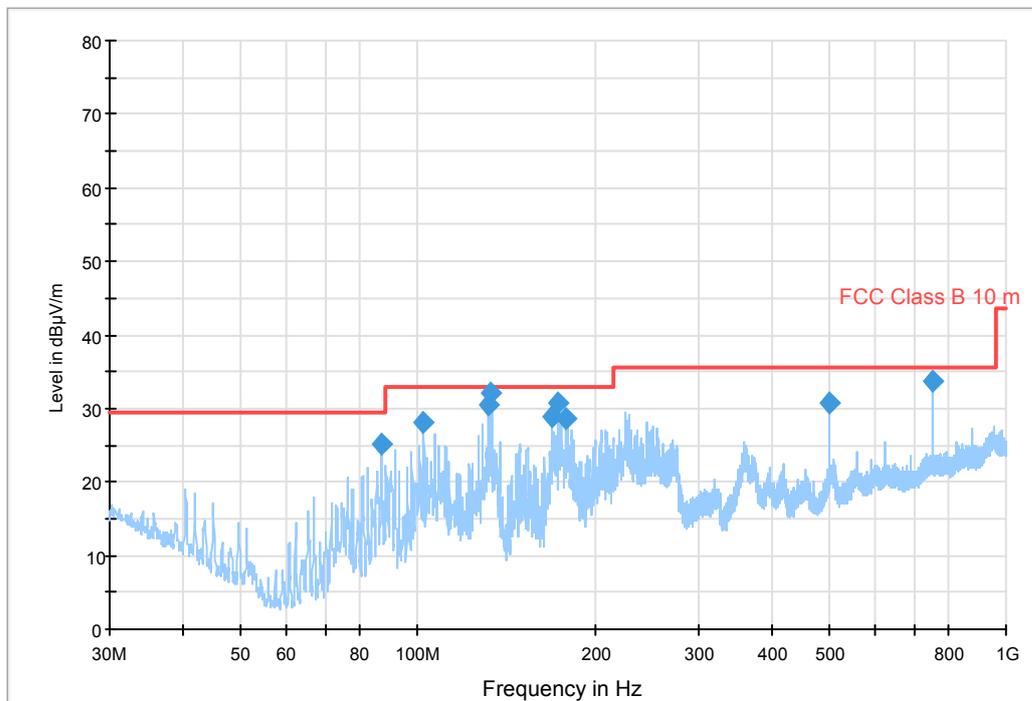
Outside the restricted bands:

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.

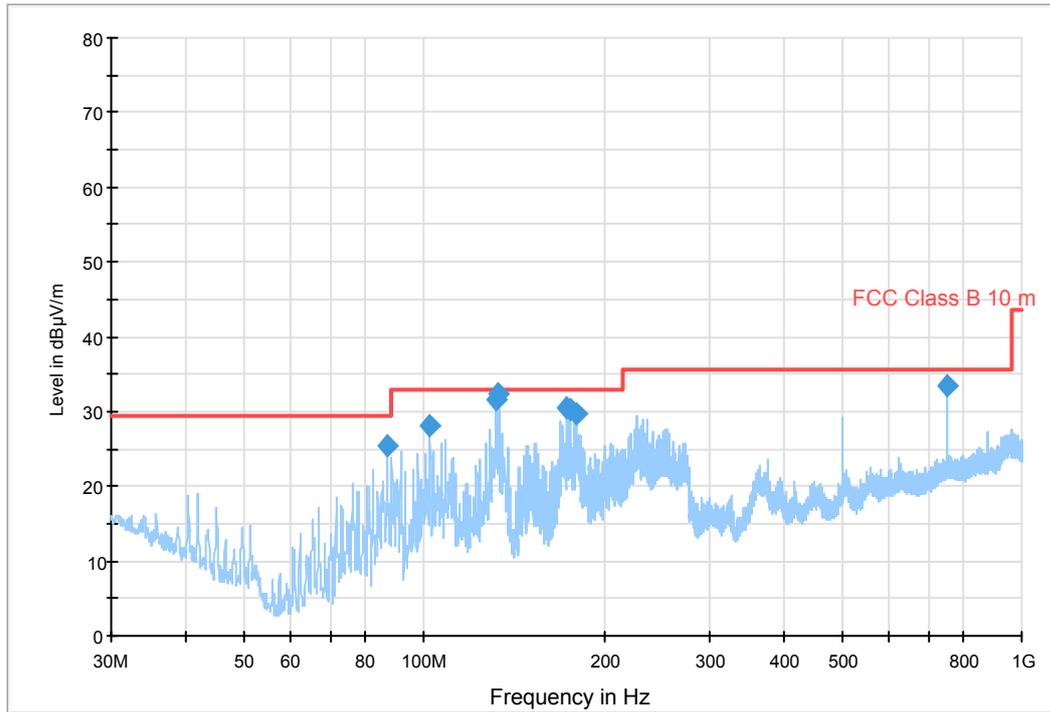
6.4 Test results 30 MHz – 1000 MHz

FCC 30 - 1000 MHz FCC class B 10m



Diagram, Peak overview sweep, 30 – 1000 MHz at 10 m distance. EUT orientation 1.

FCC 30 - 1000 MHz FCC class B 10m



Diagram, Peak overview sweep, 30 – 1000 MHz at 10 m distance., EUT orientation 2.

Measurement results, Quasi Peak. EUT orientation 1

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
86.888	25.2	29.5	V	4.3
102.416	28.0	33.0	V	5.0
131.938	30.4	33.0	V	2.6*
133.464	32.0	33.0	V	1.0*
169.148	29.0	33.0	V	4.0
173.784	30.6	33.0	V	2.4*
178.475	28.6	33.0	V	4.4
500.016	30.8	35.6	H	4.8
750.010	33.8	35.6	H	1.8*

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

*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.

Measurement results, Quasi Peak. EUT orientation 2.

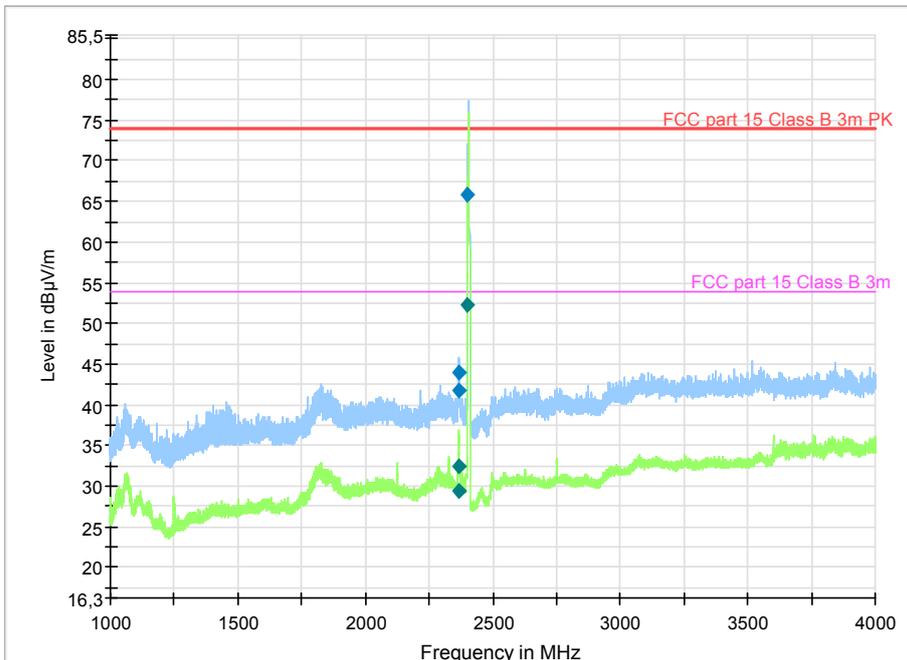
Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
86.903	25.3	29.5	V	4.2
102.407	28.1	33.0	V	4.9
131.874	31.4	33.0	V	1.6*
133.449	32.5	33.0	V	0.5*
173.815	30.4	33.0	V	2.6*
175.340	30.1	33.0	V	2.9*
179.985	29.7	33.0	V	3.3*
750.009	33.5	35.6	H	2.1*

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

*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.

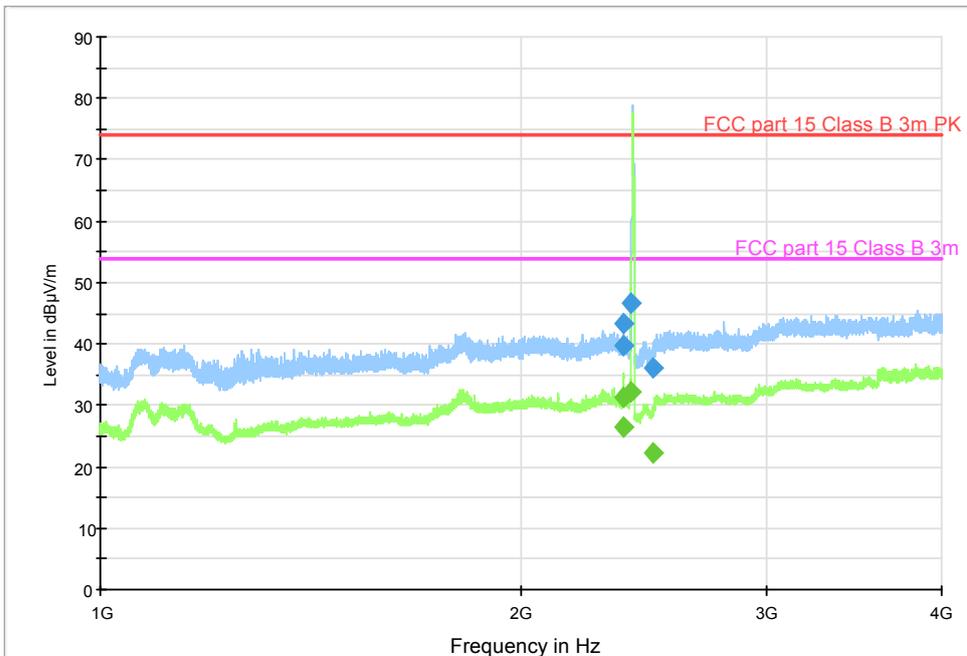
6.5 Test results 1 GHz – 25 GHz, TX

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



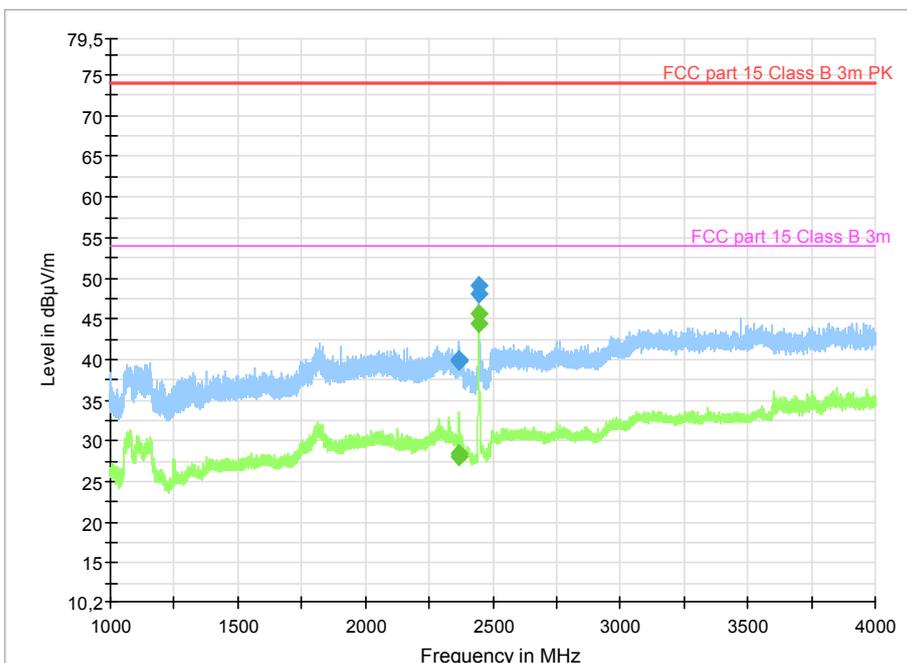
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel, EUT orientation 1. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.

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



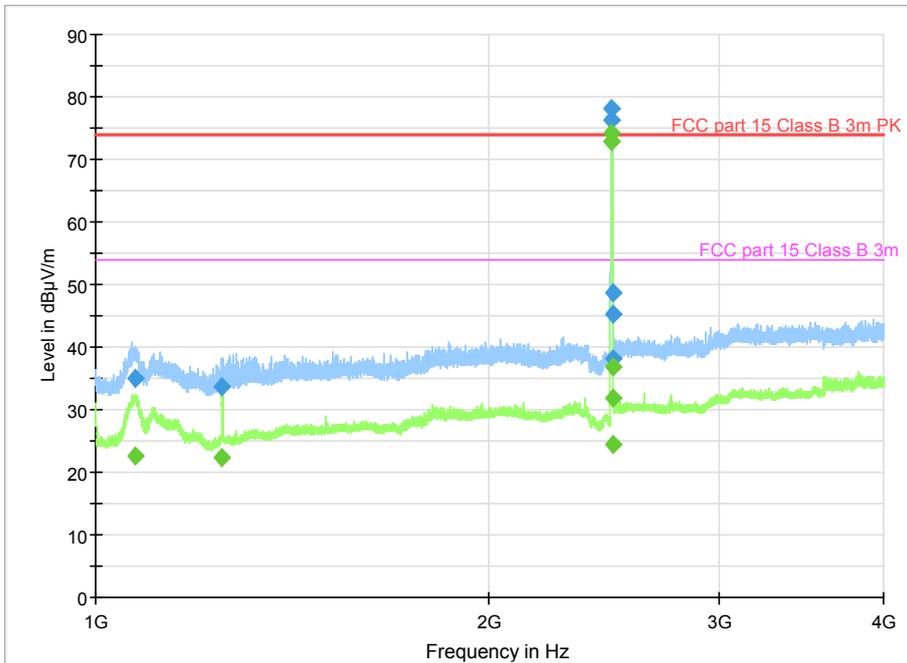
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel, EUT orientation 2. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.

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



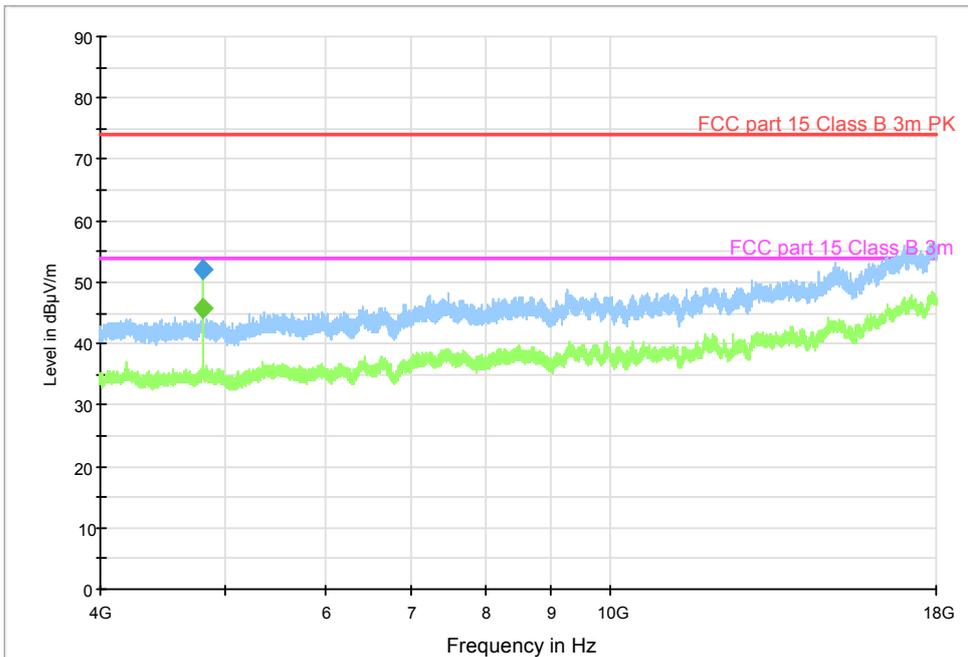
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX middle channel, EUT orientation 2. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.

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



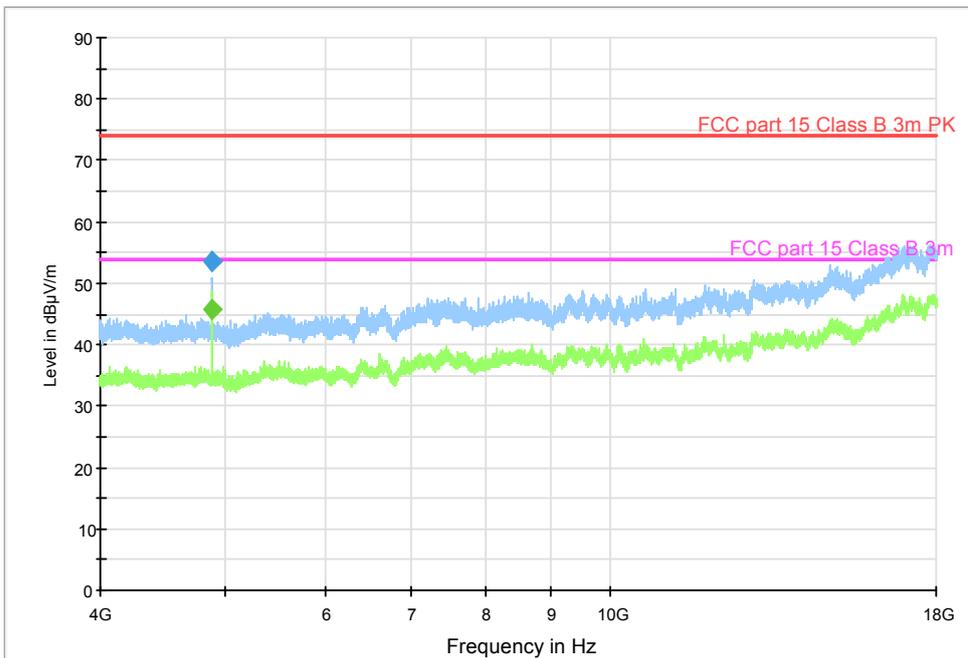
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX high channel, EUT orientation 1. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.

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



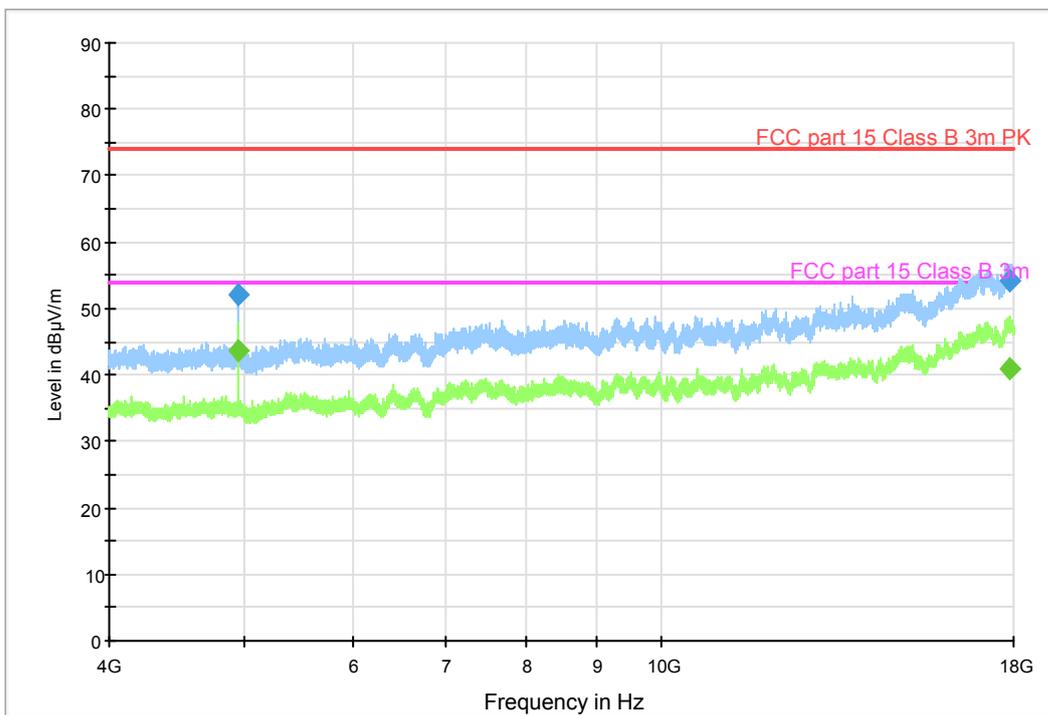
Diagram, Peak overview sweep, 4– 18 GHz at 3 m distance. TX low channel, EUT orientation 2. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.

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



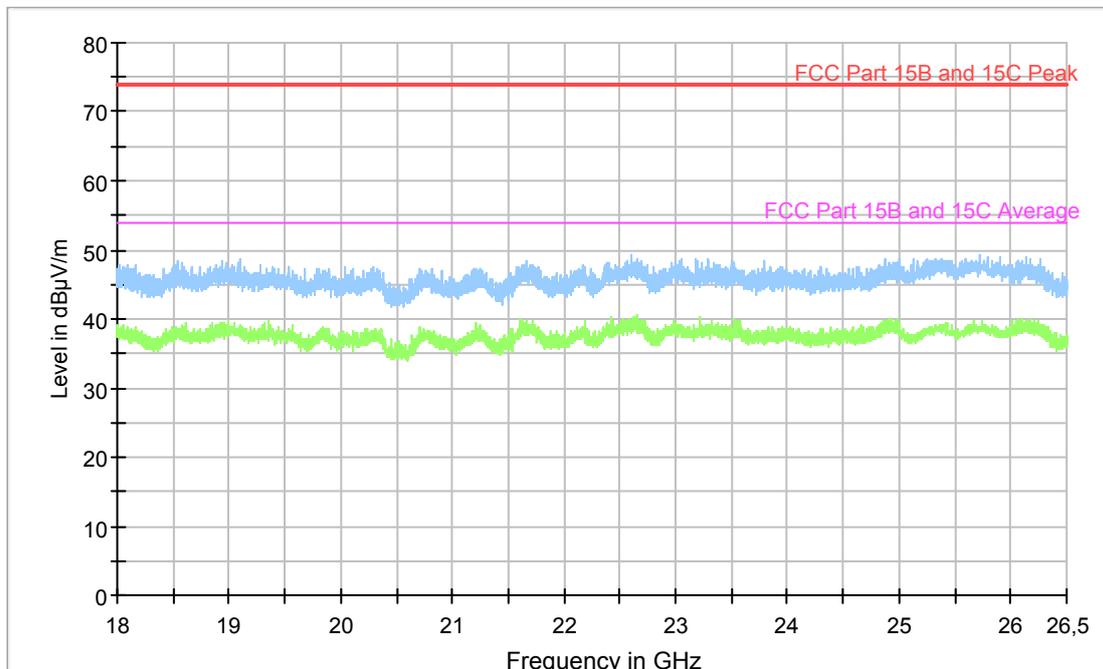
Diagram, Peak overview sweep, 4– 18 GHz at 3 m distance. TX middle channel, EUT orientation 1. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.

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



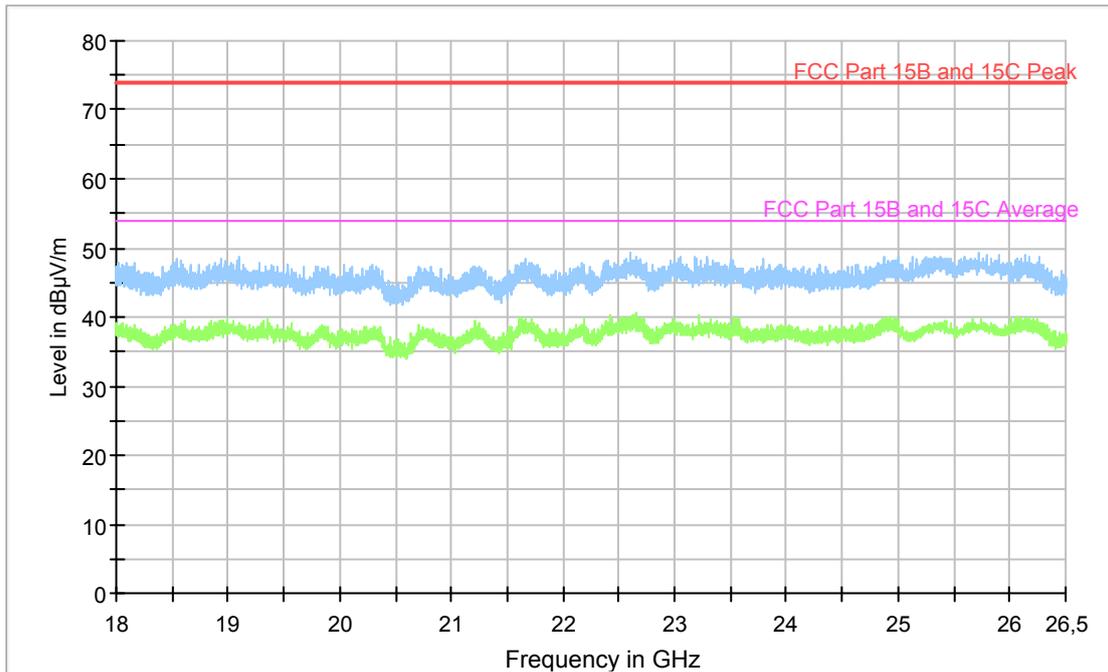
Diagram, Peak overview sweep, 4– 18 GHz at 3 m distance. TX high channel, EUT orientation 1. Emissions below 4000 MHz are attenuated by high-pass filter K&L 4410-X4500/18000-0.

Full Spectrum



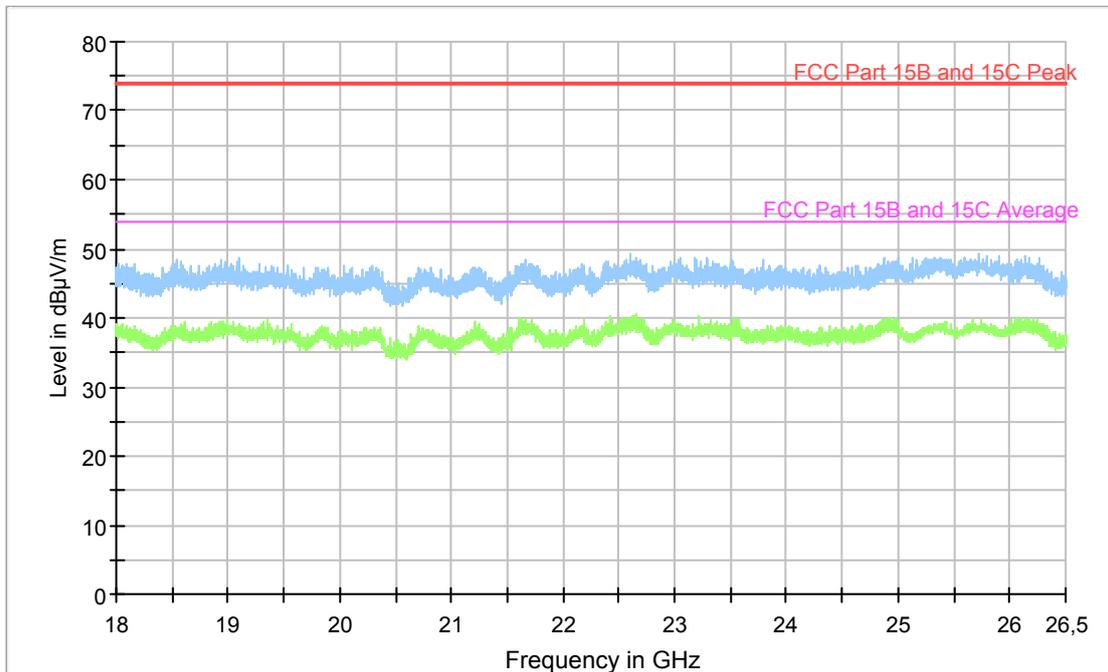
Diagram, Peak overview sweep, 18-26.5 GHz at 3 m distance. TX low channel, EUT orientation 1.

Full Spectrum



Diagram, Peak overview sweep, 18-26.5 GHz at 3 m distance. TX middle channel, EUT orientation 1.

Full Spectrum



Diagram, Peak overview sweep, 18-26.5 GHz at 3 m distance. TX high channel, EUT orientation 1.

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
2366.8	41.8	74	1	H	32.6
2366.9	44.1	74	1	H	30.4
2400.0	65.8	74	1	H	8.2
2404.3	108.4*	--*	1	H	--
2404.6	109.0*	--*	1	H	--
4811.1	52.0	74	2	V	22.0

*Transmitting frequency

Measurement results, Average, TX low channel

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
2366.8	29.0	54.0	1	H	25.0
2366.9	32.1	54.0	1	H	21.9
2400.0	31.0	54.0	1	H	23.0
2404.3	72.1*	--*	1	H	--
2404.6	73.8*	--*	1	H	--
4811.1	45.6	54.0	2	V	9.4

*Transmitting frequency

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]
2367.7	39,75	74	2	V	34,3
4891.8	53.5	74	1	V	20.5

Measurement results, Average, TX middle channel

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
2367.7	28.1	54	2	V	25.9
4891.8	48.8	54	2	H	5.2

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]
1071.7	35.1	74.0	1	H	38.9
1250.0	33.7	74.0	1	V	40.1
2480.0	93.0*	--*	1	H	--
2480.6	93.8*	--*	1	H	--
2483.5	59.6	74.0	1	H	14.4
2484.1	55.3	74.0	1	H	18.7
2484.3	47.8	74.0	1	H	26.2
4959.5	55.5	74.0	2	V	18.5
17853.0	54.2**	74.0	1	V	19.8

*Transmitting frequency

** Test system noise floor

Measurement results, Average, TX high channel

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	EUT orientation	Polarization H/V	Margin [dB]
1071.7	22.7	54.0	1	H	31.3
1250.0	22.6	54.0	1	V	31.4
2480.0*	90.9*	--*	1	H	--
2480.6*	88.5*	--*	1	H	--
2483.5	47.7	54.0	1	H	6.3
2484.1	41.8	54.0	1	H	12.2
2484.3	34.0	54.0	1	H	20.0
4959.0	50.6	54.0	2	H	3.4
17853.0**	41.0*	54.0	1	V	15.0

*Transmitting frequency

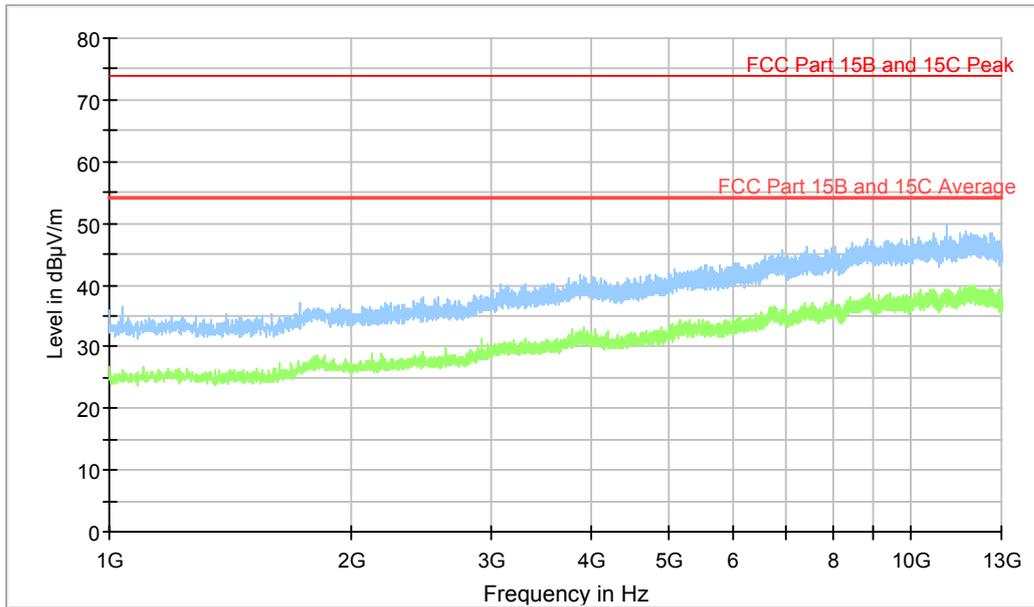
** Test system noise floor

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] + band reject filter loss [dB]

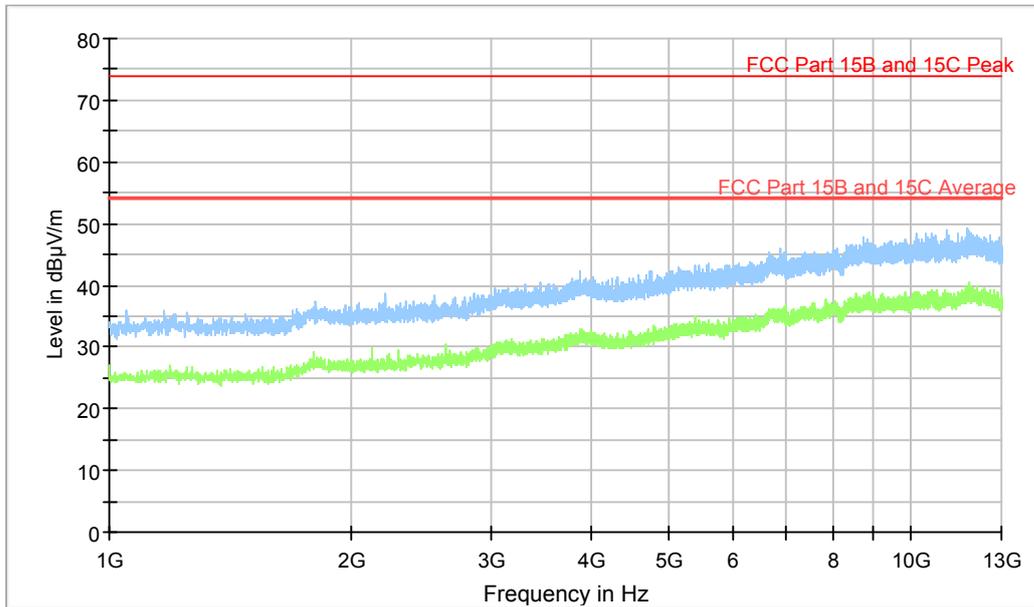
6.6 Test results 1 GHz – 13 GHz, RX

Full Spectrum



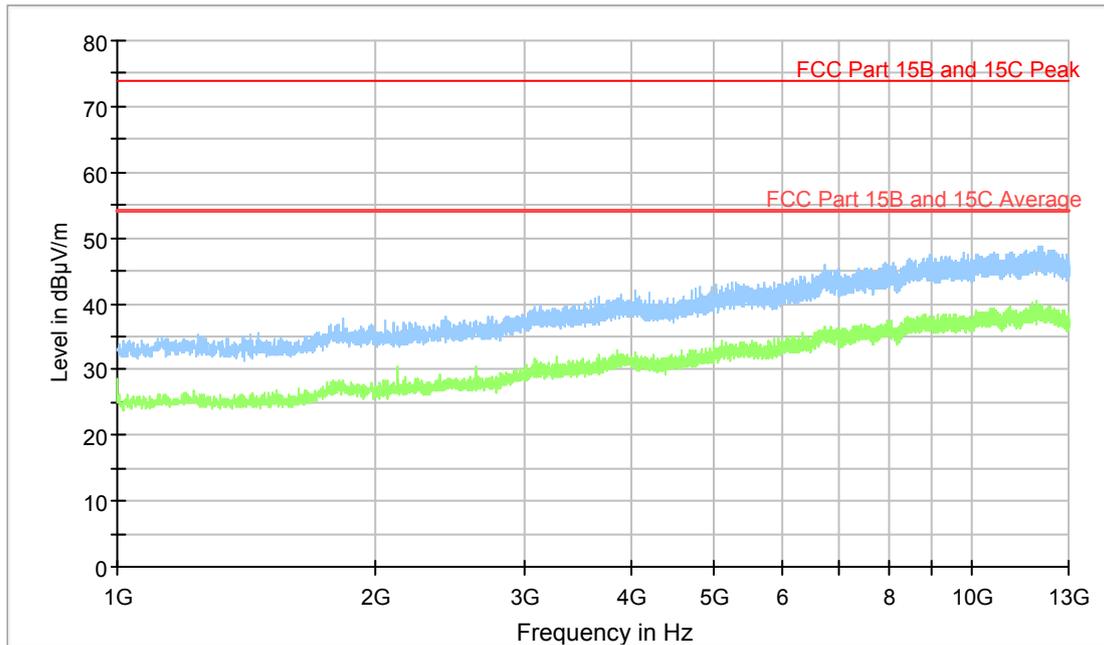
Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX low channel.

Full Spectrum



Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX middle channel.

Full Spectrum



Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX high channel.

Measurement results, Peak, RX low channel

No emissions are found above noise floor. Margin to noise floor is > 20 dB.

Measurement results, Average, RX low channel

No emissions are found above noise floor or closer than 20 dB from limit. Margin to noise floor is at least 14 dB.

Measurement results, Peak, RX middle channel

No emissions are found above noise floor. Margin to noise floor is > 20 dB.

Measurement results, Average, RX middle channel

No emissions are found above noise floor or closer than 20 dB from limit. Margin to noise floor is at least 14 dB.

Measurement results, Peak, RX high channel

No emissions are found above noise floor. Margin to noise floor is > 20 dB.

Measurement results, Average, RX high channel

No emissions are found above noise floor or closer than 20 dB from limit. Margin to noise floor is at least 14 dB.

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

7 CONDUCTED BAND EDGE MEASUREMENT

Date of test:	2016-06-14	Test location:	Wireless center
EUT Serial:	-	Ambient temp:	21 °C
Tested by:	Matti Virkki	Relative humidity:	44 %
Test result:	Pass	Margin:	26.5

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 10dB 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: 10 MHz

7.3 Requirement

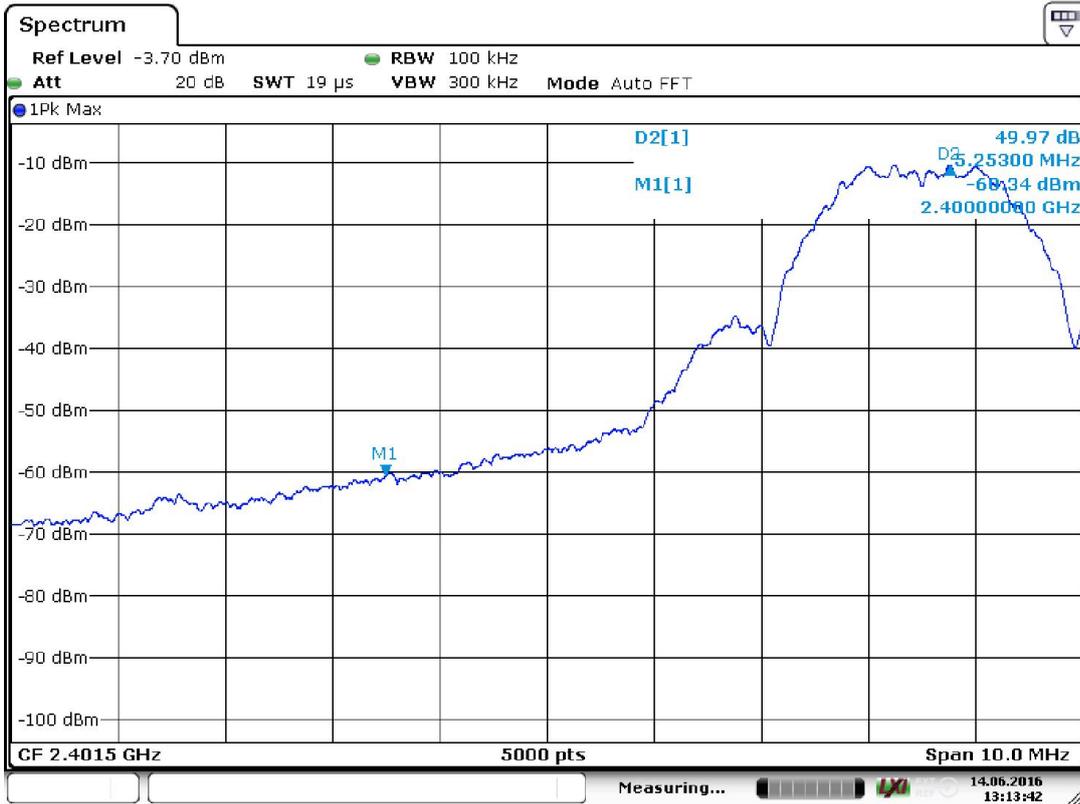
Reference: CFR 47 §15.247(d), RSS-247 5.5,

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

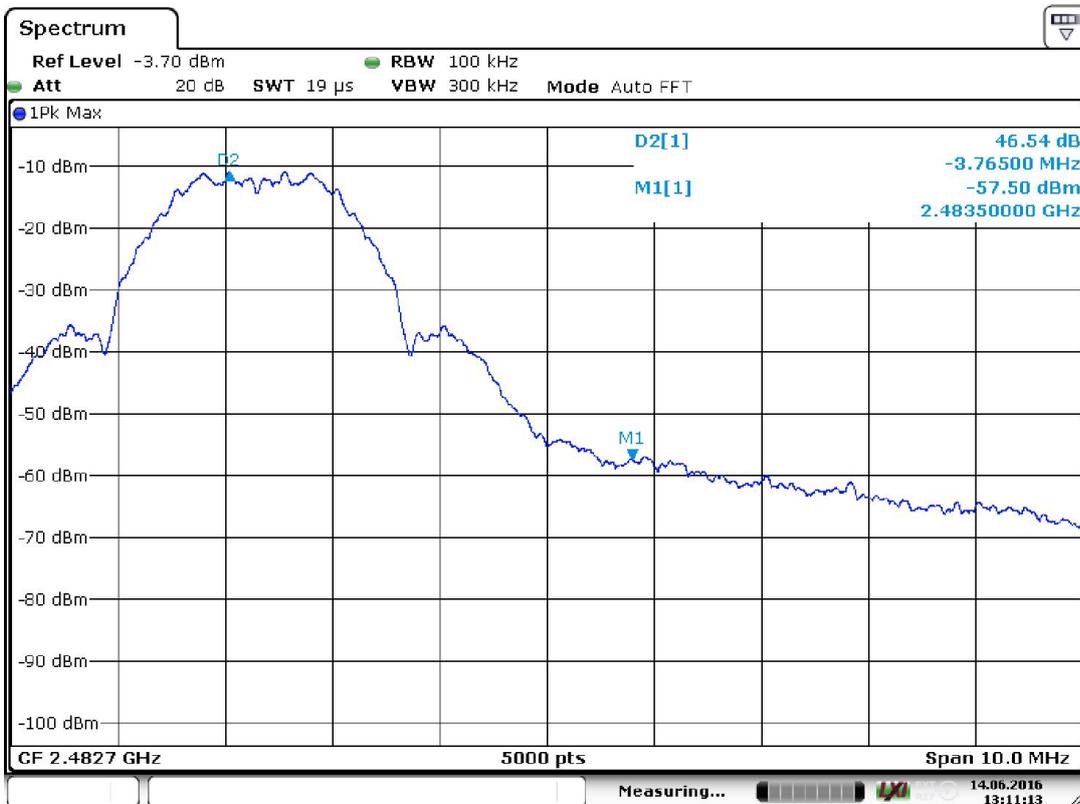
Test results

Band edge	Delta [dBc]	Limit [dBc]	Margin [dB]
Lower	50.0	20.0	30.0
Upper	46.5	20.0	26.5



Date: 14 JUN 2016 13:13:41

Screenshot: Lower band edge sweep, single channel



Date: 14 JUN 2016 13:11:14

Screenshot: Upper band edge sweep, single channel

8 PEAK CONDUCTED OUTPUT POWER

Date of test:	2016-06-14	Test location:	Stora Hallen
EUT Serial:	-	Ambient temp:	21 °C
Tested by:	Matti Virkki	Relative humidity:	44 %
Test result:	Pass	Margin:	18.4

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: >OBW
 VBW: 3 x RBW
 Span: >3 x OBW

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

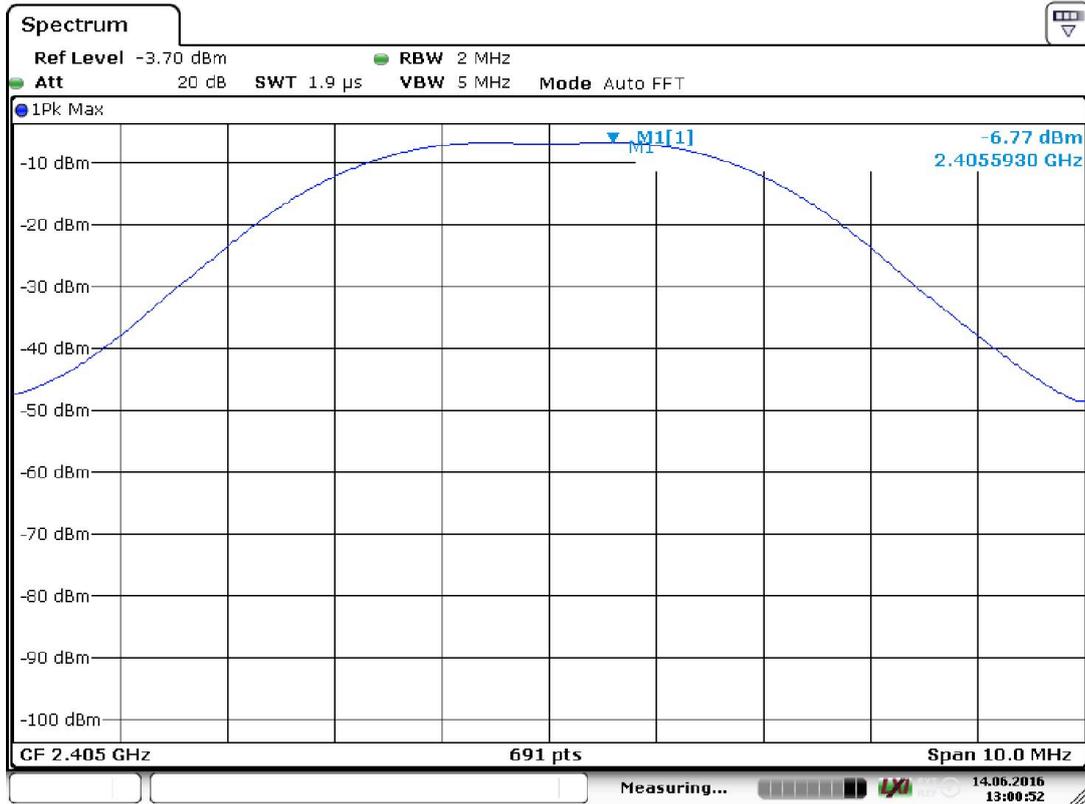
8.3 Requirements

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

For DTSSs 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 1W.

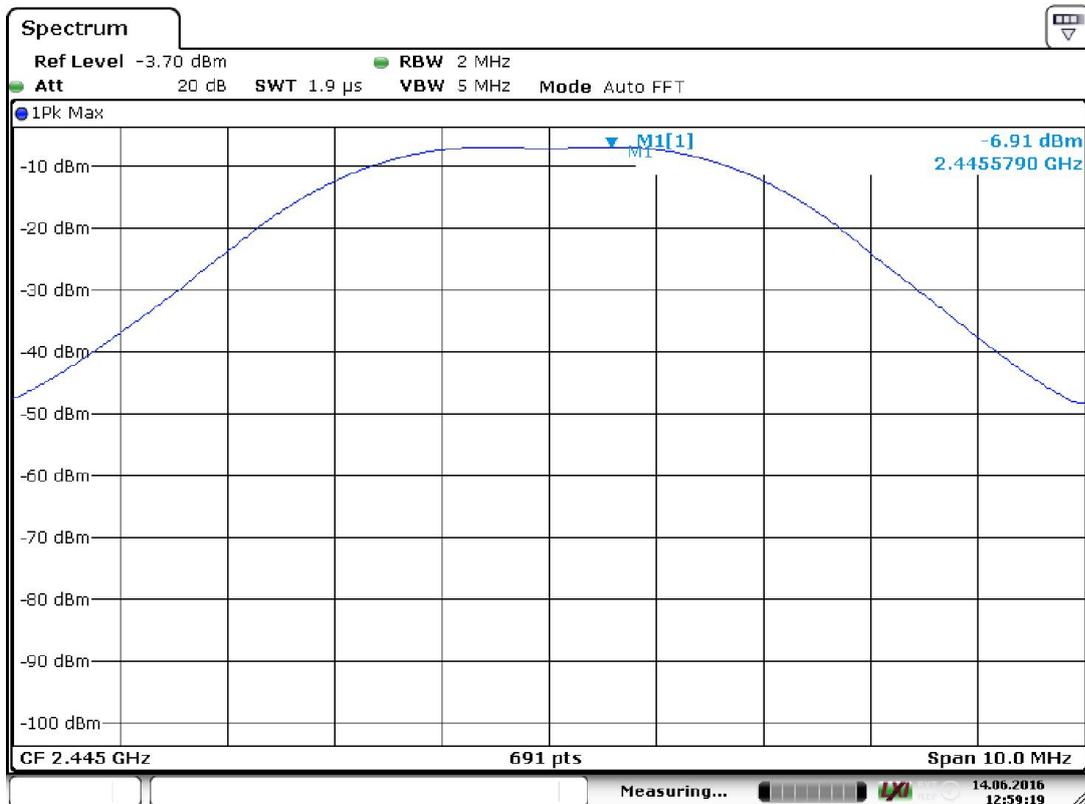
8.4 Test results

Channel [MHz]	SA reading [dBm]	Path loss [dB]	Output power [dBm]	Limit [dBm]	Margin [dB]
2405	-6.77	18.4	11.6	30.0	18.4
2445	-6.91	18.4	11.5	30.0	18.5
2480	-7.38	18.4	11.0	30.0	19.0



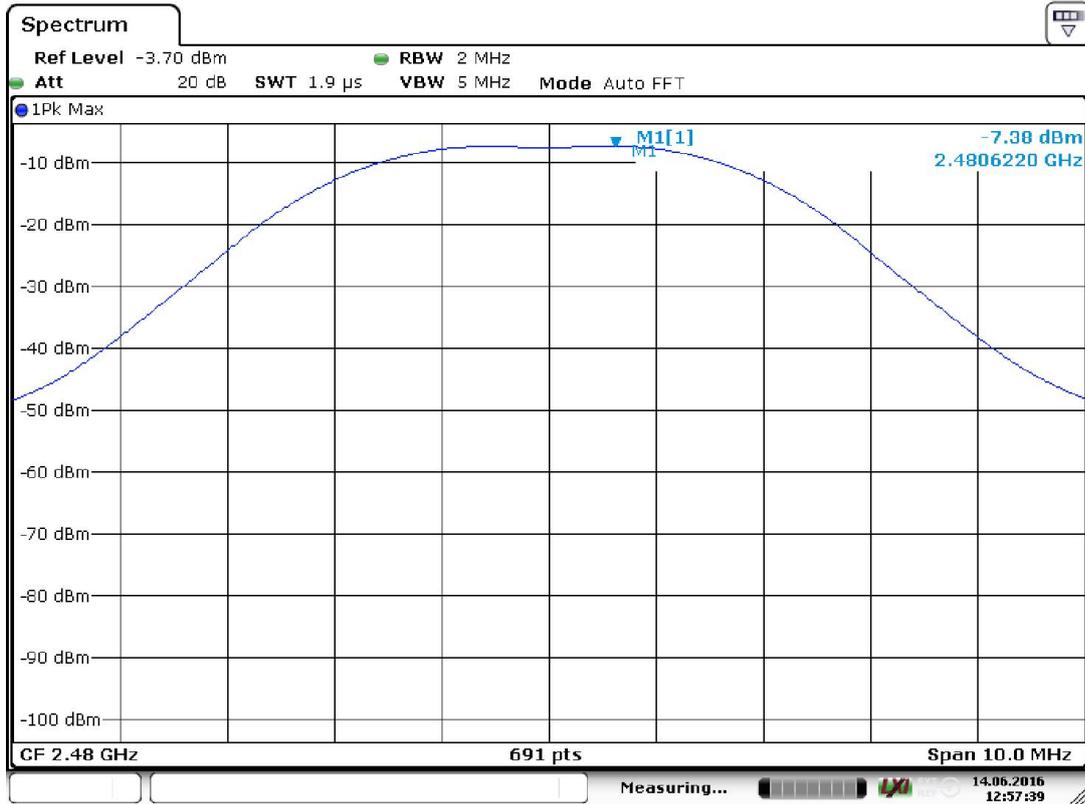
Date: 14 JUN 2016 13:00:52

Screenshot: Output power, low channel



Date: 14 JUN 2016 12:59:19

Screenshot: Output power, middle channel



Date: 14 JUN 2016 12:57:40

Screenshot: Output power, high channel

9 OCCUPIED 6 DB BANDWIDTH

Date of test:	2016-06-14	Test location:	Stora Hallen
EUT Serial:	-	Ambient temp:	21 °C
Tested by:	Matti Virkki	Relative humidity:	44 %
Test result:	Pass	Margin:	1140 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.

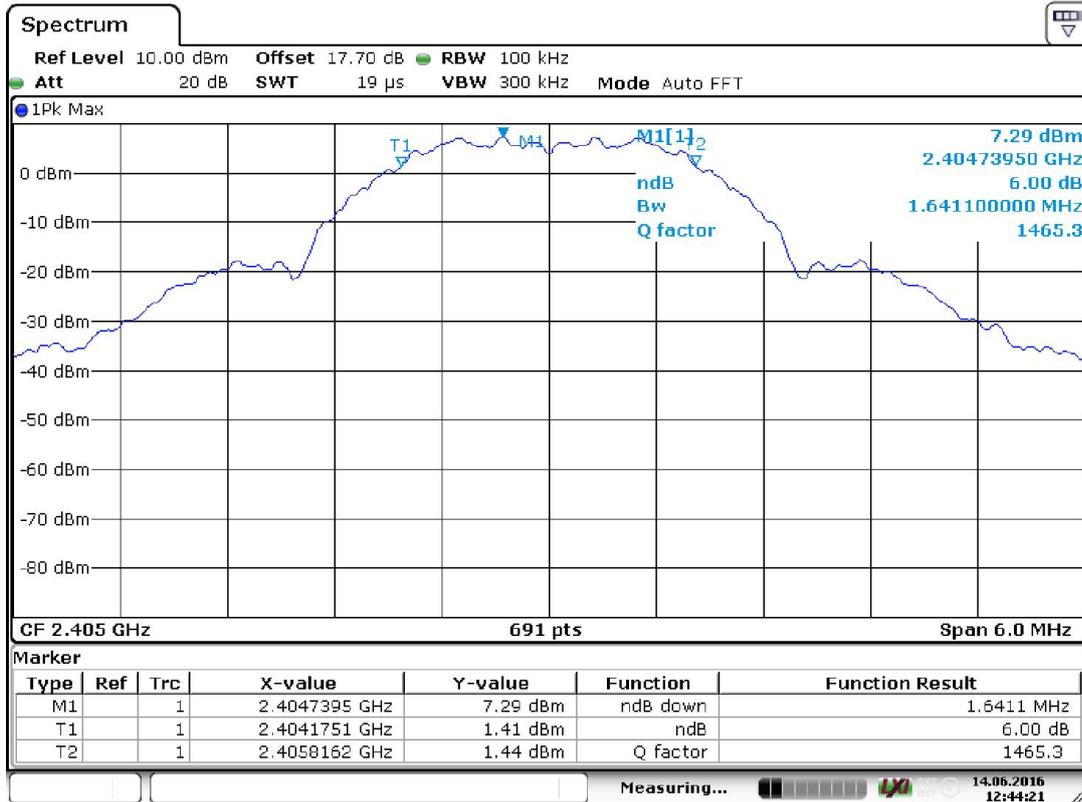
9.3 Requirements

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

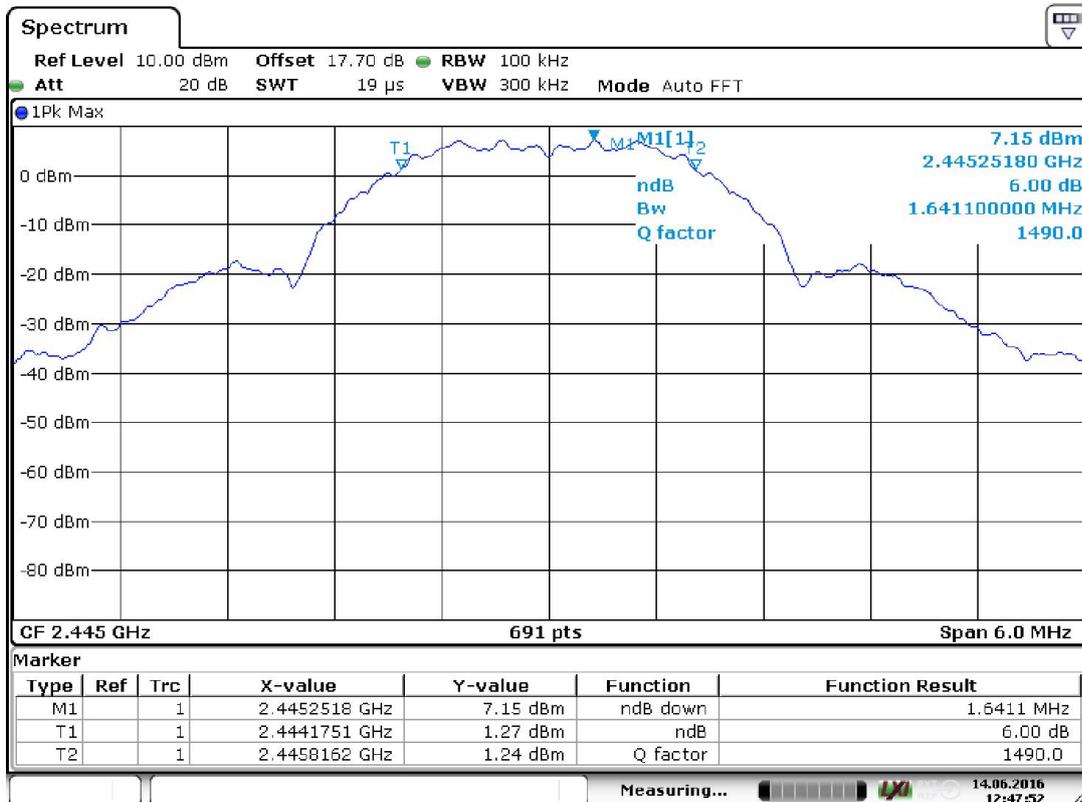
Test result

Channel [MHz]	6 dB BW [MHz]	Limit [kHz]	Margin [kHz]
2405	1.640	500	1140
2445	1.641	500	1141
2480	1.641	500	1141



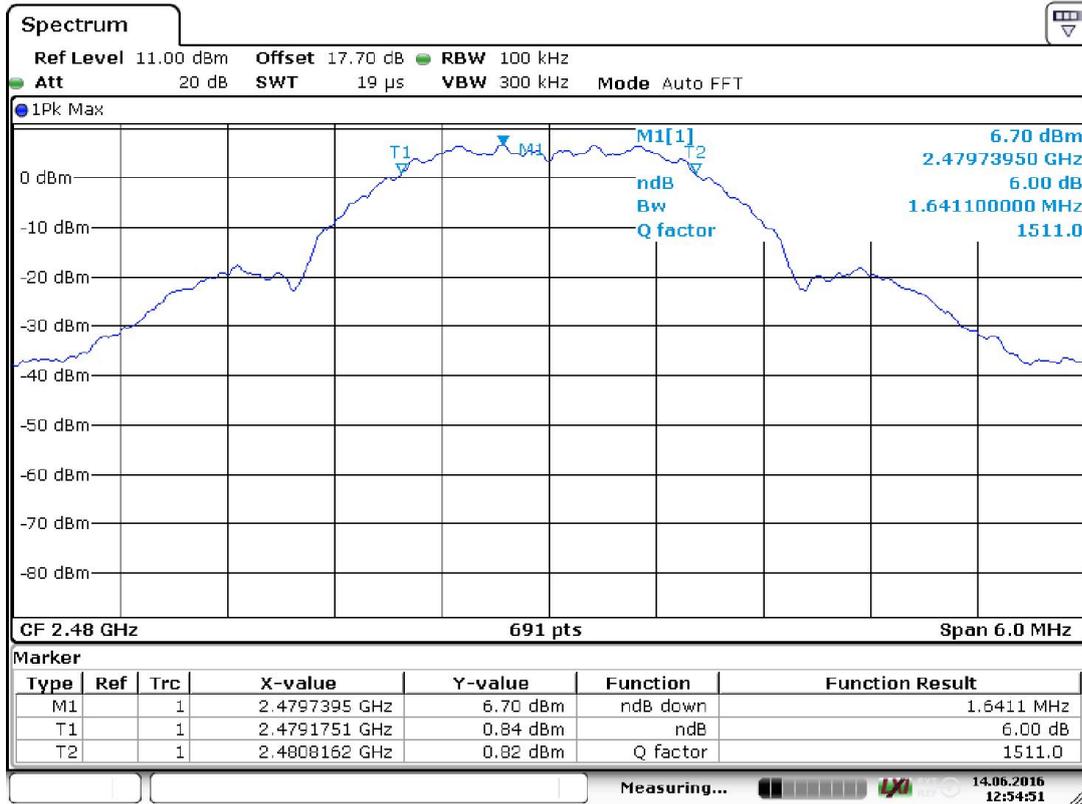
Date: 14 JUN 2016 12:44:22

Screenshot: Occupied 6 dB bandwidth Measurement, low channel



Date: 14 JUN 2016 12:47:52

Screenshot: Occupied 6 dB bandwidth Measurement, middle channel



Date: 14 JUN 2016 12:54:51

Screenshot: Occupied 6 dB bandwidth Measurement, high channel

10 PEAK POWER SPECTRAL DENSITY

Date of test:	2016-06-14	Test location:	Stora Hallen
EUT number:	-	Ambient temp:	21 °C
Tested by:	Matti Virkki	Relative humidity:	44 %
Test result:	Pass	Margin:	11.8 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.

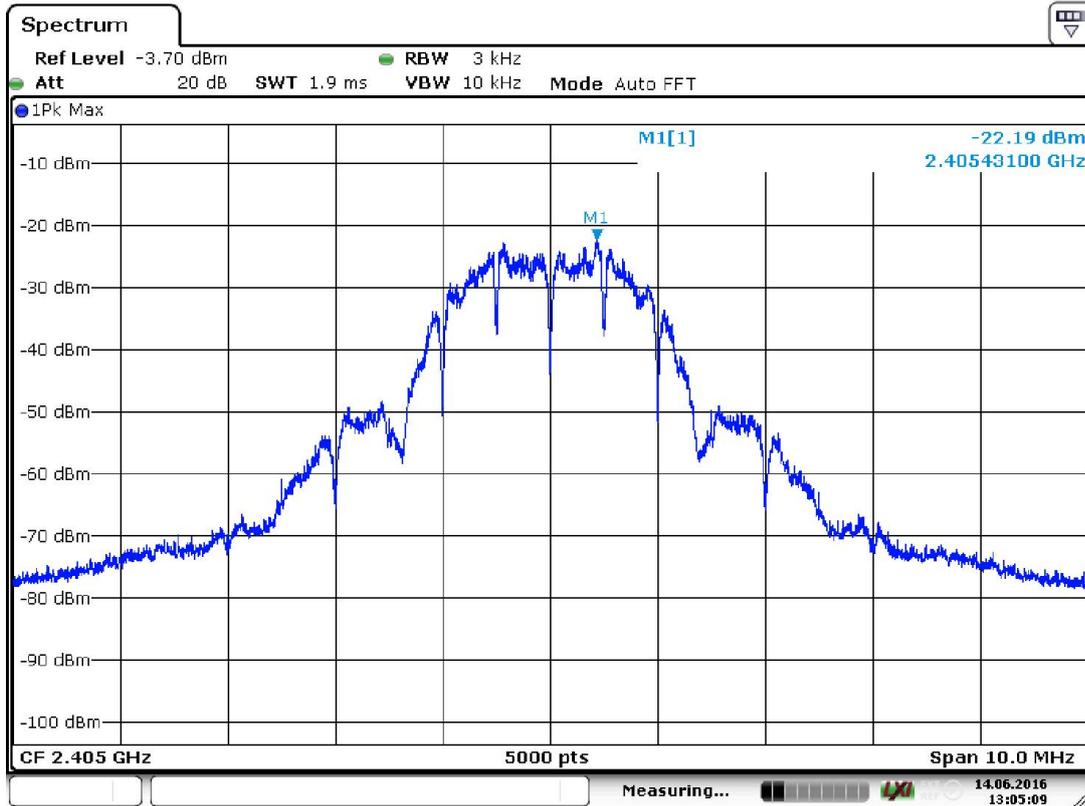
10.3 Requirements

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.

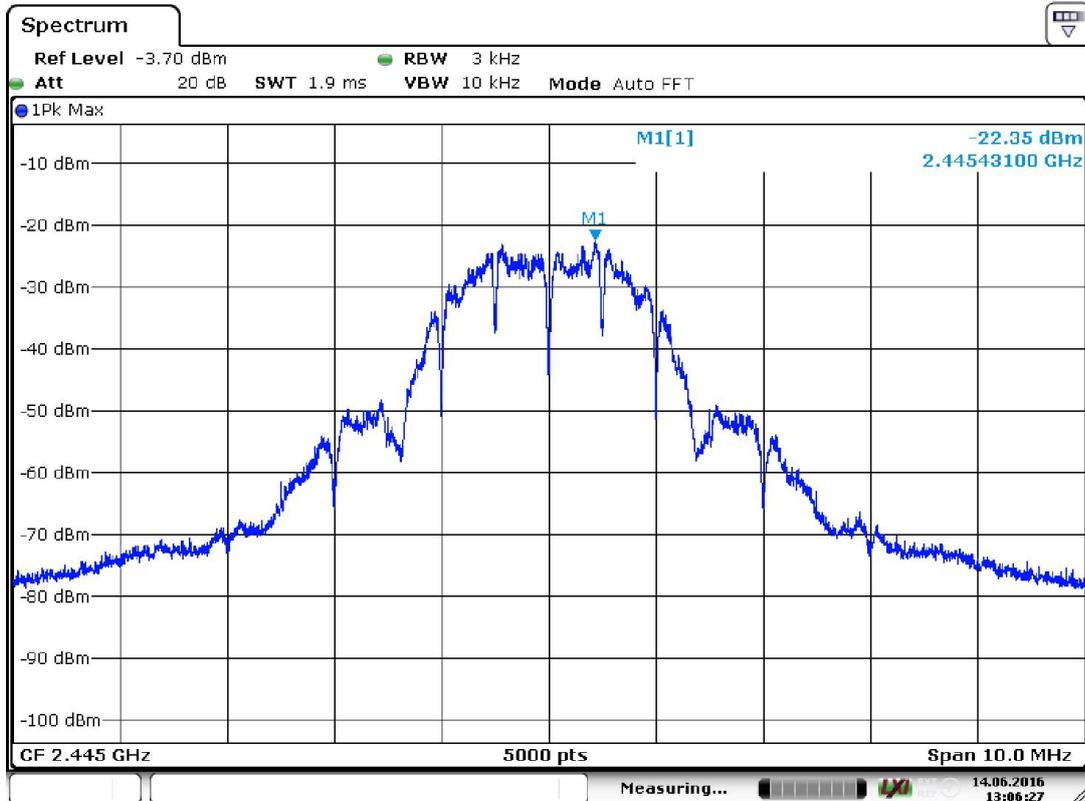
10.4 Test results

Channel [MHz]	SA reading [dBm]	Path loss [dB]	PSD [dBm/3kHz]	Limit [dBm]	Margin [dB]
2405	-22.19	18.4	-3.8	8	11.8
2445	-22.35	18.4	-3.9	8	11.9
2480	-22.78	18.4	-4.4	8	12.4



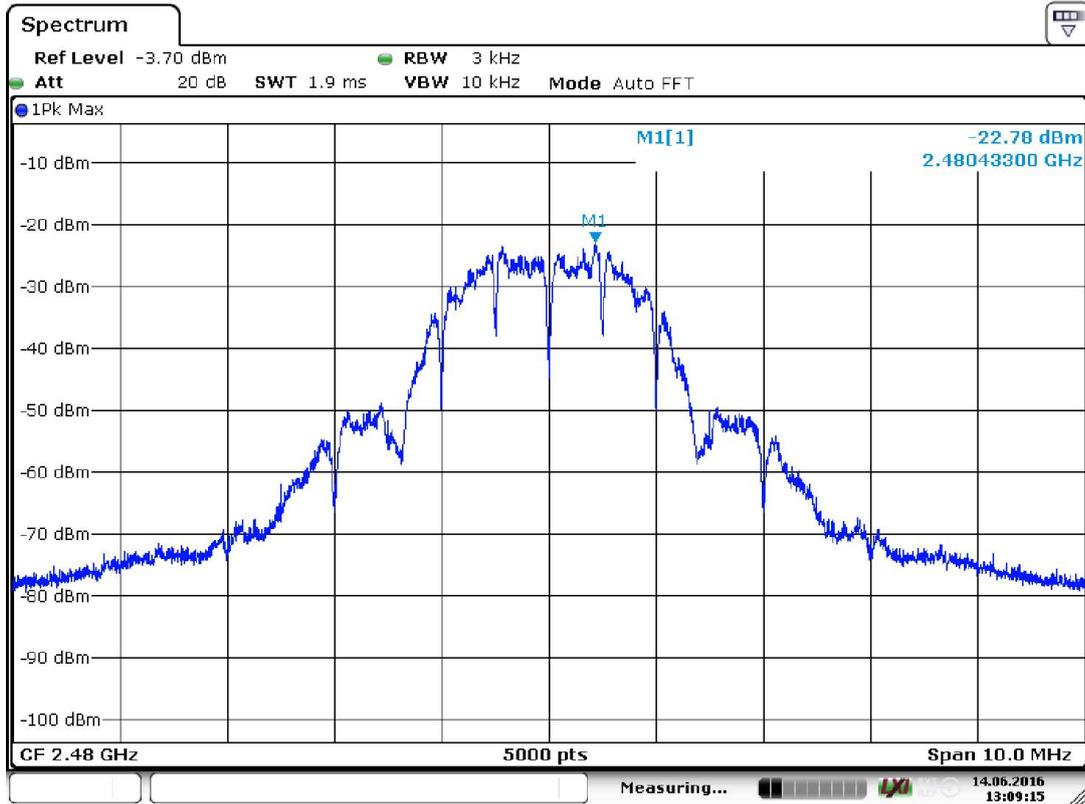
Date: 14 JUN 2016 13:05:09

Screenshot: Peak power spectral density, low channel



Date: 14 JUN 2016 13:06:28

Screenshot: Peak power spectral density, middle channel



Date: 14 JUN 2016 13:09:15

Screenshot: Peak power spectral density, high channel

11 TEST EQUIPMENT

Conducted emission test site BUR 3

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - Version 8.51	--	--	--
Receiver	Rohde & Schwarz	ESCI	31686	2015-07-04	1 year
AMN / LISN	Rohde & Schwarz	ESH3-Z5	2727	7/2014	3 years

Stora Hallen

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - 8.51	--	--	--
Receiver	Rohde & Schwarz	ESU 8	12866	7/2015	1 year
Receiver	Rohde & Schwarz	ESU 40	13178	7/2015	1 year
BiLog antenna	Chase	CBL6110A	971	7/2015	3 years
Preamplifier	Semko	AM1331	30366	6/2016	1 year
Horn antenna	Rohde & Schwarz	HF907	31245	11/2013	3 years
Preamplifier	BONN	BLMA 0118-M	31246	7/2015	1 year
2,4 GHz band reject filter:	K&L MICROWAVE INC	6N45-2450/T100-0/0	12389	7/2015	1 year
4 GHz high pass filter	K&L MICROWAVE INC	4410-X4500/18000-0/0	5133	7/2015	1 year

Wireless Center and 3m FAC

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - Version	--	--	--
Signal analyzer	Rohde & Schwarz	FSIQ 40	12793	7/2015	1 year
Measurement cable	Huber+Suhner	Sucoflex 104 PE	39070	7/2015	1 year
Measurement cable	Huber+Suhner	Sucoflex 104 PE	39079	7/2015	1 year
Measurement cable	Huber+Suhner	Sucoflex 104	5191	7/2015	1 year
Pre amplifier	Sangus	00101400-23-10P -6-S ; AFS44-12002400-32-10P -44	12335	7/2015	1 year
Horn antenna	EMCO	3160-09	30101	8/2013	3 years
Signal analyzer:	Rohde & Schwarz	FSV	32594	7/2015	1 year
Signal analyzer	Rohde & Schwarz	FSIQ 40	12793	7/2015	1 year
10 dB Attenuator:	Huber+Suhner	5910_N-50-010	32696	7/2015	1 year

12 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 %.

13 TEST SET UP AND EUT PHOTOS

EUT photos are in separate document 1610783STO-004 Annex 1.

Test set up photos are in separate document 1610783STO004 Annex 2.