

RADIO TEST REPORT

No. 1518308STO-001, Ed. 2

RF Performance

EQUIPMENT UNDER TEST

Equipment: Remote control
Type/Model: YH-KZQ-FS
Manufacturer: IKEA of Sweden AB
Tested by request of: IKEA of Sweden AB

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 (2014): Subpart C: Intentional radiators. Section 15.249

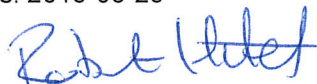
RSS-GEN Issue 4 (2014): General requirements of compliance of radio apparatus (2014).

RSS-210 Issue 8 Licence-exempt Radio Apparatus (All Frequency Bands):
Category I Equipment (2010) Annex 2.9

For details, see clause 2 – 4.

Date of issue: 2016-05-26

Tested by:



Robert Hietala

Approved by:



Matti Virkki

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Revision History

Edition	Date	Description	Changes
1	2016-02-25	First release	
2	2016-05-26	Second release	Updated information regarding band edge compliance.

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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 Stefan Backlund
Phone +46 476 88 756

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT

Equipment: Remote control
Type/Model: YH-KZQ-FS
Brand name: IKEA
Serial number: --
Manufacturer: IKEA of Sweden AB

Transmitter frequency: 2436 MHz
Receiver frequency: --
Frequency agile or hopping: ☐ Yes ☒ No
Antenna: ☒ Internal antenna ☐ External antenna
Antenna connector: ☒ None, internal antenna ☐ Yes
Antenna gain: 3.3 dBi
Rating RF output power: 0 dBm
Type of modulation: MSK
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 EUT consists of the following units:

Unit	Type	Serial number
Unit 1	Remote control	--

2.3 Test signals and operation modes

Continuous signal with 37 % duty cycle and MSK modulation on one channel.

3 TEST SPECIFICATIONS

3.1 Standards

Requirements:

47 CFR Part 15: Radio frequency device, Subpart C: Unintentional radiators (2014).

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

RSS-210 Issue 8 Licence-exempt Radio Apparatus (All Frequency Bands):
Category I Equipment (2010)

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

The EUT operated with a duty cycle of 37 % during the tests.

No other 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 Part 15.203	Antenna requirement	PASS
RSS-GEN, section 8.8 table 3	The EUT has integrated non detachable antenna which can't be remove without breaking EUT	
FCC Part 15.207	Conducted continuous emission in the frequency range 150 kHz to 30 MHz, AC Power input port	NA
RSS-GEN, section 8.8 table 3		
FCC Part 15.249(a)(e)	Field strength of fundamental	PASS
RSS-210 A2.9	The EUT complies with the limits. The margin to the limit was at least 7 dB at 2436 MHz See clause 5.4.	
FCC Part 15.249(a)(d)(e), 15.209(a)	Radiated emission of electromagnetic fields in the frequency range 30 – 1000 MHz	PASS
RSS-210 A2.9	The EUT complies with the limits. The margin to the limit was at least 9.9 dB at 597.988 MHz See clause 6.4.	
FCC Part 15.249(a)(d)(e), 15.209(a)	Radiated emission of electromagnetic fields in the frequency range above 1 GHz	PASS
RSS-210 A2.9	The EUT complies with the limits. The margin to the limit was at least 5.8 dB at 7308.4 MHz See clause 6.5.	
RSS-GEN, section 8.6 table 4	Occupied bandwidth	PASS

NA = Not applicable

NT = Not tested

5 FIELD STRENGTH OF FUNDAMENTAL

Date of test:	2016-01-20	Test location:	Stora Hallen
EUT Serial:	--	Ambient temp:	23 °C
Tested by:	Robert Hietala	Relative humidity:	12 %
Test result:	Pass	Margin:	7 dB

5.1 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 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.

Pre scan was made in three orthogonal EUT orientations.

5.2 Test conditions

Test set-up:

Test receiver set-up:

Preview test:

Final test:

30 MHz to 1000 MHz

Peak, RBW 120 kHz. VBW 1 MHz

Quasi-Peak, RBW 120 kHz

Measuring distance:

3 m

Measuring angle:

0 – 359°

EUT height above ground plane:

0.8 m

Antenna

Height above ground plane:

1 – 4 m

Polarisation:

Vertical and Horizontal

Type:

BiLog

Test set-up:

Test receiver set-up:

Preview test:

Final test:

1 GHz – 26 GHz

Peak, RBW 1 MHz. VBW 3 MHz

Peak, RBW 1 MHz

Average Peak value + 20 x LOG (Duty cycle)

Measuring distance:

3 m

Measuring angle:

0 – 359°

EUT height above ground plane:

1.5 m

Antenna

Height above ground plane:

1 – 4 m

Polarisation:

Vertical and Horizontal

Type:

Horn

Antenna tilt:

Activated

5.3 Requirement

The EUT shall meet the following limits.

Reference: 47 CFR §15.209, 15.249(a)(c)(d)(e)
RSS-gen section 8.9 table 4

Fundamental frequency

Fundamental frequency [MHz]	Field strength at 3 m (mV/m)	Field strength at 3 m (dB μ V/m)	Detector (dB μ V/m)
902-928	50	94	Quasi Peak
2400-2483.5	50	94 / 114	Average / Peak
5725-5875	50	94 / 114	Average / Peak
24000-24250	250	108 / 114	Average / Peak

5.4 Test results

Measurement results

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	Detector	EUT Orientation	Polarization H/V	Margin [dB]
2436	96.7 / 87.0	114 / 94	Pk / Av	--	V	17.3 / 7

6 RADIATED RF EMISSION IN THE FREQUENCY-RANGE 30 MHZ TO 26 GHZ

Date of test:	2016-01-14	Test location:	Stora Hallen
EUT Serial:	--	Ambient temp:	24 °C
Tested by:	Robert Hietala	Relative humidity:	9 %
Test result:	Pass	Margin:	> 10 dB

6.1 Test set-up and test procedure.

Same as 5.2

6.2 Test conditions

Same as 5.3

6.3 Radiated Emission requirements

Transmitter harmonics

Fundamental frequency [MHz]	Field strength at 3 m (μV/m)	Field strength at 3 m (dBμV/m)	Detector (dBμV/m)
902-928	500	54	Average / Peak
2400-2483.5	500	54 / 74	Average / Peak
5725-5875	500	54 / 74	Average / Peak
24000-24250	2500	68 / 88	Average / Peak

Outside restricted bands

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits, whichever is the lesser attenuation.

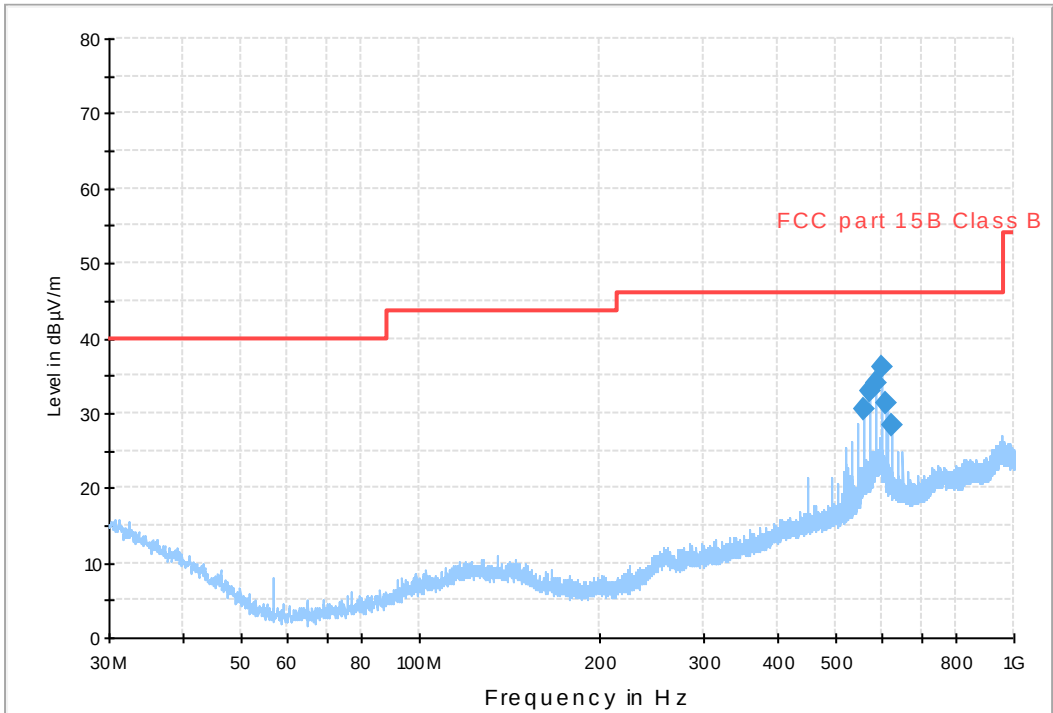
General radiated emission limit within restricted bands

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 §15.31(f)(1))

6.4 Test results 30 MHz – 1000 MHz

FCC 30 - 1000 MHz FCC class B 3m



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance.

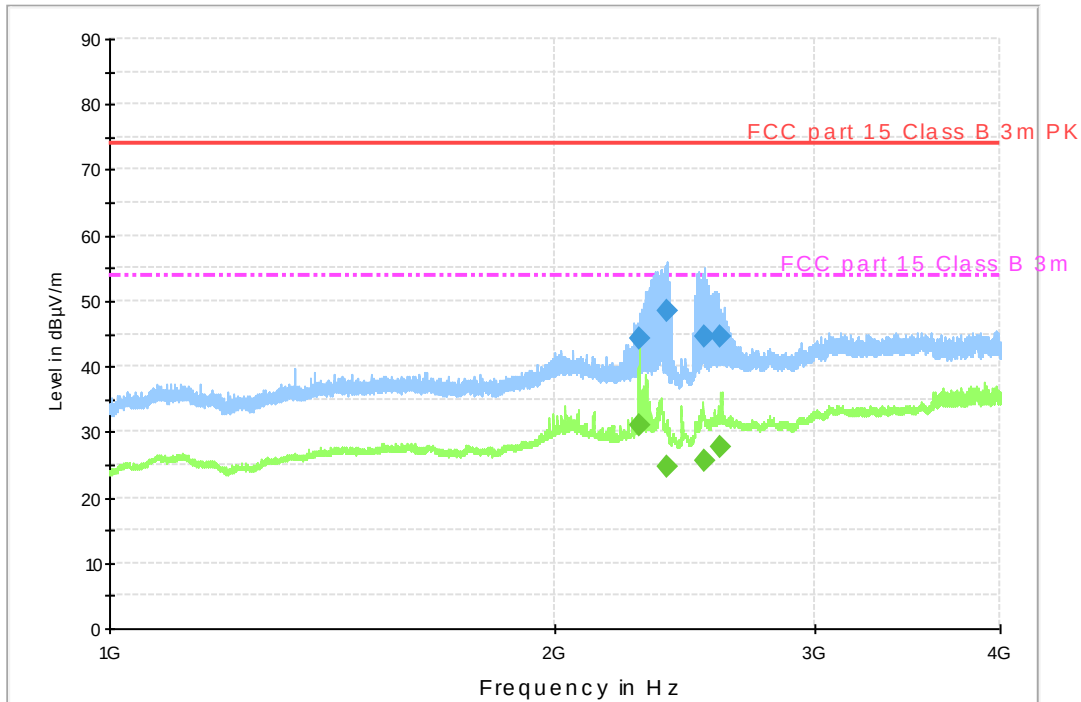
Measurement results, Quasi Peak

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Polarization H/V	Margin [dB]
559.009	36.6	46.0	H	15.4
571.994	32.9	46.0	H	13.1
585.003	34.0	46.0	H	12.0
597.988	36.1	46.0	H	9.9
611.012	31.4	46.0	H	14.6
623.981	28.5	46.0	H	17.5

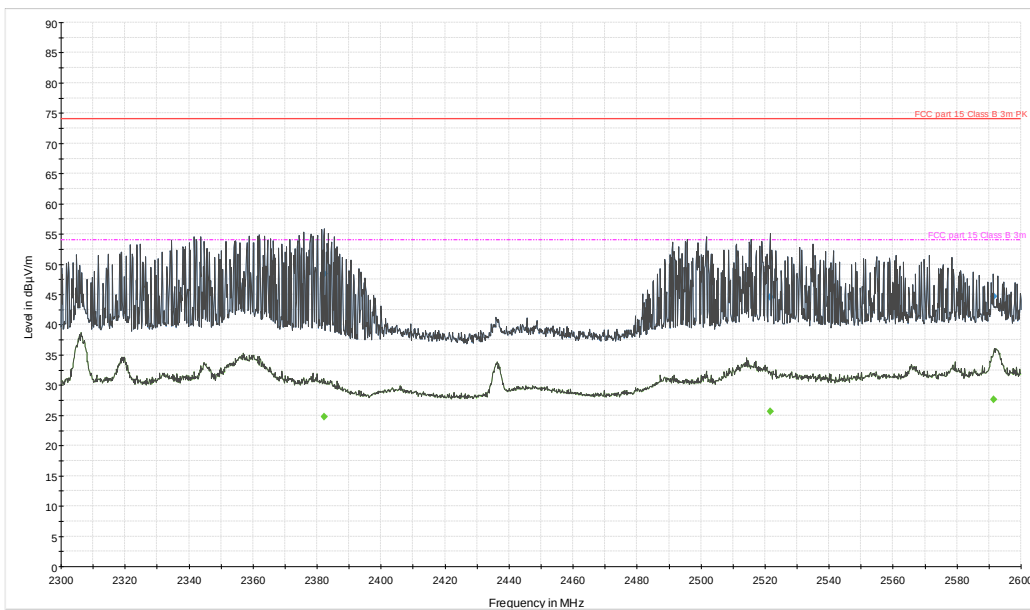
Result [dBµV/m] = Analyser reading [dBµV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

6.5 Test results 1 GHz – 26 GHz

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



Diagram, Peak overview sweep, 1 – 4 GHz at 3 m distance.



Diagram, band edge overview, with filter correction in the 2.4 -2.5 GHz band.

Measurement results, Peak detector

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	EUT orientation	Polarization H/V	Margin [dB]
2279.5	44.3	74.0	--	V	29.7
2382.3	48.4	74.0	--	V	25.6
2521.6	44.6	74.0	--	V	29.4
2591.5	44.6	74.0	--	V	29.4

Measurement results, Average detector

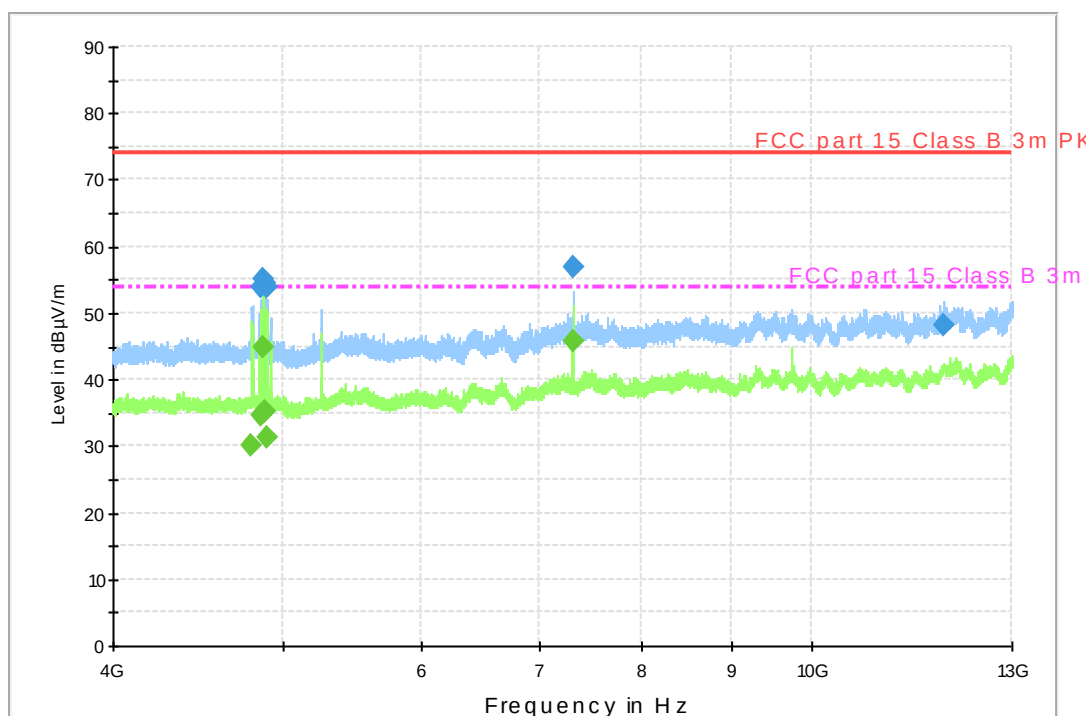
Frequency [MHz]	Corr. factor* [dB]	Meas. Level [dBμV/m]	Corr. Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
2279.5	-8.6	44.3	35.7	54.0	V	18.3
2382.3	-8.6	48.4	39.8	54.0	V	14.2
2521.6	-8.6	44.6	36.0	54.0	V	18.0
2591.5	-8.6	44.6	36.0	54.0	V	18.0

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

*Correction factor, see section 8.

The EUT transmits on one channel, with a narrow channel bandwidth, in the middle of the band. Pre-sweeps shows good margin to band edges and fulfils 15.209 requirements and therefore no further band edge measurements were performed.

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



Diagram, Peak overview sweep, 4 – 13 GHz at 3 m distance.

Measurement results, Peak detector

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	EUT orientation	Polarization H/V	Margin [dB]
4856.5	53.8	74.0	--	V	20.2
4872.5	55.1	74.0	--	V	18.9
4886.0	54.4	74.0	--	V	19.6
4893.3	53.9	74.0	--	V	20.1
7308.1	56.8	74.0	--	H	17.2
11889.1	48.1	74.0	--	V	25.9

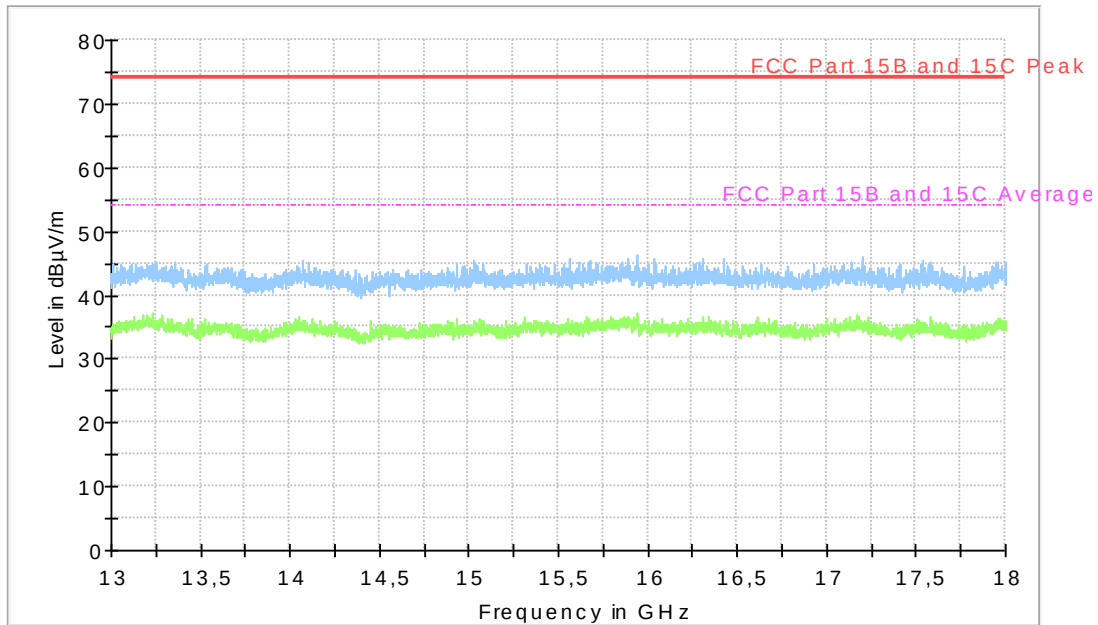
Measurement results, Average detector

Frequency [MHz]	Corr. Factor* [dB]	Meas. Level [dBμV/m]	Corr. Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
4856.1	-8.6	53.8	45.2	54.0	V	8.8
4872.3	-8.6	55.1	46.5	54.0	V	7.5
4885.7	-8.6	54.4	45.8	54.0	V	8.2
4893.1	-8.6	53.9	45.3	54.0	V	8.7
7308.4	-8.6	56.8	48.2	54.0	H	5.8

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

*Correction factor, see section 8.

Full Spectrum



Diagram, Peak overview sweep, 13 – 18 GHz at 3 m distance.

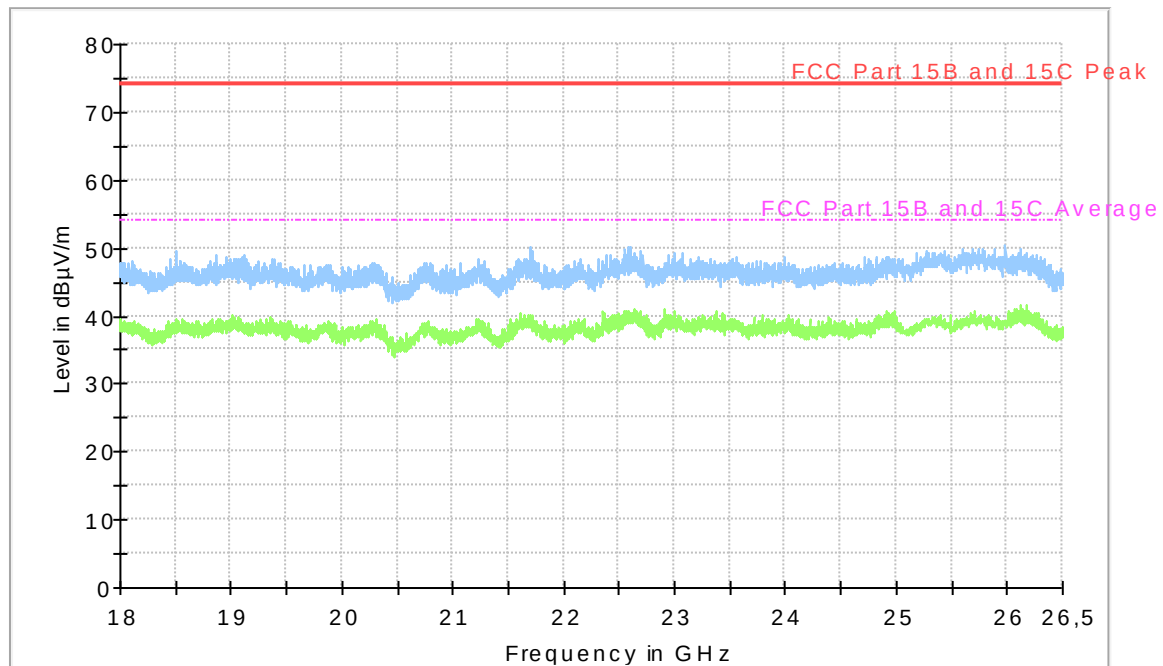
Measurement results, Peak detector

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

Measurement results, Average detector

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

Full Spectrum



Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance.

Measurement results, Peak detector

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

Measurement results, Average detector

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

7 OCCUPIED BANDWIDTH

Date of test:	2016-01-20	Test location:	Stora Hallen
EUT Serial:	--	Ambient temp:	22 °C
Tested by:	Robert Hietala	Relative humidity:	13 %
Test result:	Pass	Margin:	--

7.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013, section 6.9.2 and RSS-GEN, section 6.6.

Spectrum analyser with occupied bandwidth measurement function is used to determine the occupied bandwidth.

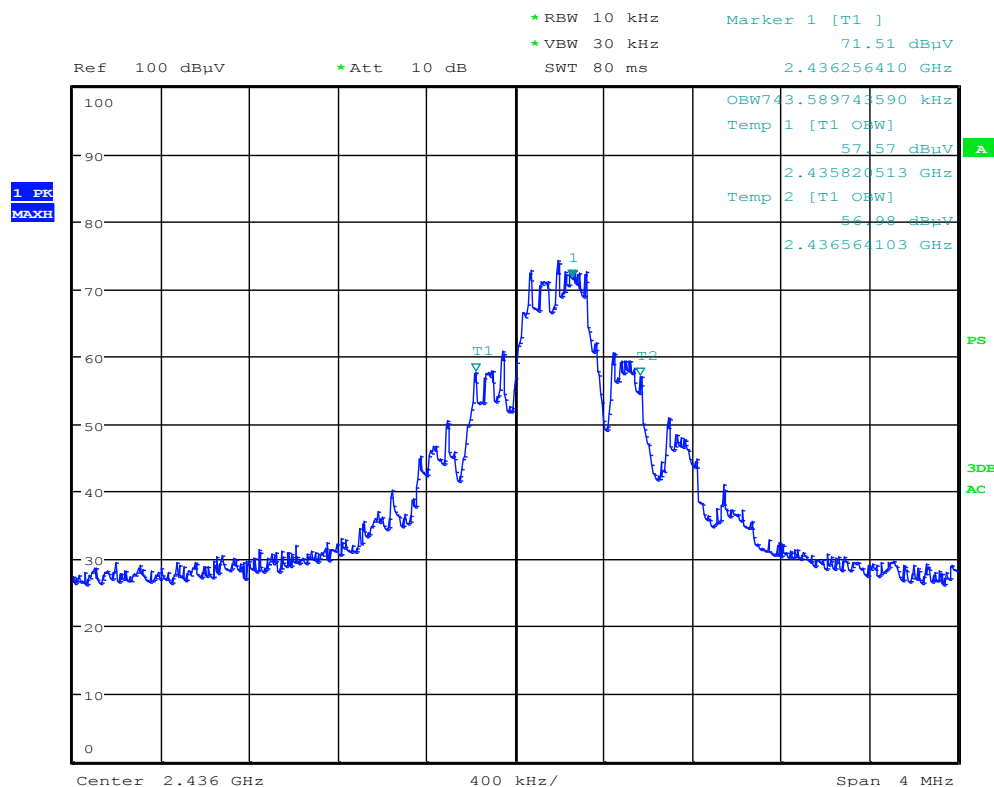
7.2 Test conditions

Detector:	Peak / Sample
RBW:	1 – 5 % of OBW
VBW:	3 x RBW
Span:	1.5 x OBW

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

7.3 Test results

Occupied bandwidth: 743.6 kHz



Screenshot: Occupied bandwidth Measurement

8 TRANSMITTER DUTY CYCLE FOR PULSED TRANSMISSIONS

Date of test:	2016-02-04	Test location:	Wireless Center
EUT Serial:	--	Ambient temp:	20 °C
Tested by:	Robert Hietala	Relative humidity:	22 %
Test result:	Pass	Margin:	--

8.1 Test set-up and test procedure.

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

Spectrum analyser is used to determine the transmitter duty cycle.

8.2 Test conditions

Detector: Peak
RBW 3 MHz
VBW 3 MHz
Span 0 Hz
Sweep time 10 ms

8.3 Requirement

CFR 47 15.35(c) and RSS-GEN section 6.10

8.4 Test results

Duty cycle is calculated $\delta = t_{on} / T$, where t_{on} is pulse on time and T is pulse width.

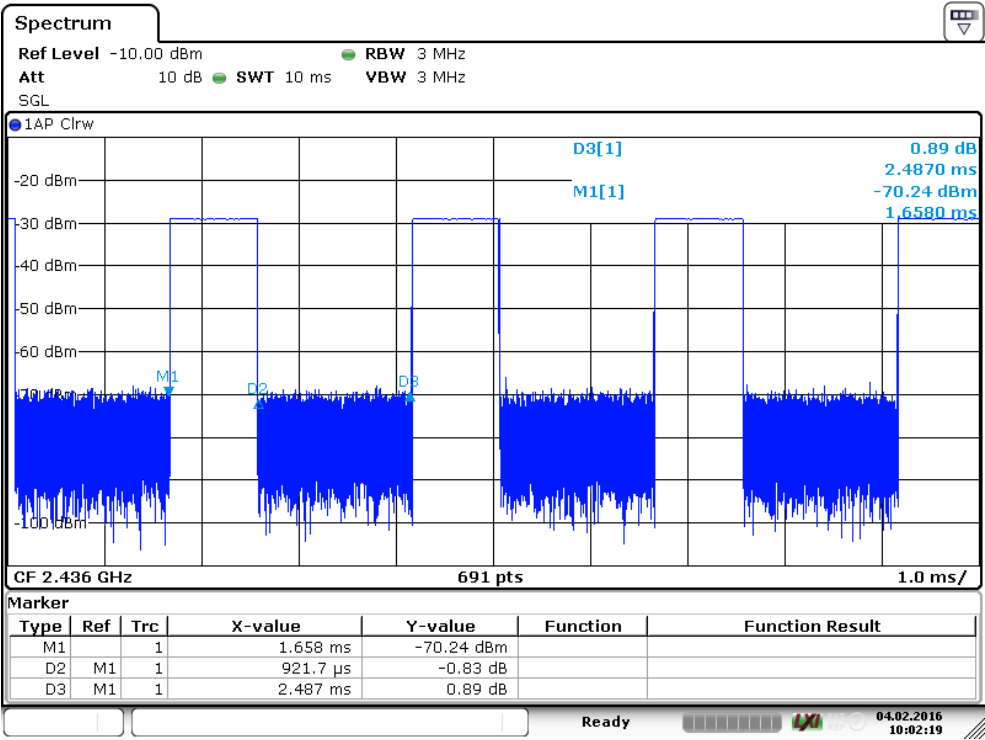
$$\delta = 921.7 \mu s / 2.487 ms ; \delta = 0.37$$

Correction factor is calculated $\delta \text{ (dB)} = 20 \log (\text{duty cycle})$

$$\delta \text{ (dB)} = 20 \log (0.37) ; \delta = -8.6 \text{ dB}$$

Duty cycle = 37 %

Correction factor = -8.6 dB



Date: 4.FEB.2016 10:02:20

Screenshot: Duty cycle measurement

9 TEST EQUIPMENT

Stora Hallen

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - 8.5.1	--	--	--
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
Measurement cable	Huber+Suhner	Sucoflex 104PEA	9957	7 / 2015	1 year
Preamplifier	Semko	Am1331	7992	7 / 2015	1 year
Preamplifier	Bonn	BLMA 0118-M	31246	7 / 2015	1 year
Horn antenna	Rohde & Schwarz	HF907	31245	11 / 2013	3 years
Measurement cable	Huber+Suhner	Sucoflex 106	39078	7 / 2015	1 year
Measurement cable	Huber+Suhner	RG 214	9506	7 / 2015	1 year
Measurement cable	Huber+Suhner	Sucoflex 104	39033	7 / 2015	1 year
Measurement cable	Huber+Suhner	Sucoflex 104	40036	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
20 dB attenuator	Huber+Suhner	5920_N-50-010	32697	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 - V9.21.00	--	--	--
Measurement receiver	Rohde & Schwarz	ESI 26	32288	7 / 2015	1 year
Signal analyzer	Rohde & Schwarz	FSIQ 40	12793	7 / 2015	1 year
BiLog antenna	Chase	CBL 6111	12474	3 / 2013	3 years
Preamplifier	Mitec	AMF-6F-260400-40-8P	12647 + 12982	7 / 2015	1 year
Measurement cable	Huber+Suhner	Sucoflex 104	5191	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
Horn antenna	Emco	3160-08	30099	10 / 2013	3 years
Horn antenna	Emco	3160-09	30101	10 / 2013	3 years
Signal analyzer:	Rohde & Schwarz	FSV	32594	7 / 2015	1 year
Open switch and control platform:	Rohde & Schwarz	OSP-B157	32595	7 / 2015	1 year
Signal generator:	Rohde & Schwarz	SMB100A	32592	7 / 2015	1 year
Vector signal generator:	Rohde & Schwarz	SMBV100A	32593	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
Temperature meter	Vaisala	HM40	32873	1 / 2015	1 year

10 MEASUREMENT UNCERTAINTY

Continuous conducted disturbances with AMN in the frequency range 9 kHz to 30 MHz ± 3.6 dB

Measurement uncertainty for radiated disturbance

Uncertainty for the frequency range 30 to 1000 MHz at 3 m	± 4.9 dB
Uncertainty for the frequency range 30 to 1000 MHz at 10 m	± 4.8 dB
Uncertainty for the frequency range 1.0 to 18 GHz at 3 m	± 5.4 dB
Uncertainty for the frequency range 18 to 26 GHz at 3 m	± 5.5 dB
Uncertainty for the frequency range 26 to 40 GHz at 3 m	± 5.6 dB

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

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

11 TEST SET UP AND EUT PHOTOS

EUT photos are in separate document 1518308STO-001, Annex 1.

Test set up photos are in separate document 1518308STO-001, Annex 2.