telefication bv
The Netherlands
Chamber of Commerce
51565536
www.telefication.com

telefication

Radio test report
20143960300-Ver 2.00

based on:

CFR Title 47 Part 15 sections 15.247 and 15.109 (10-01-13 Edition);
RSS 210 (issue 8); RSS Gen (issue 3)

Battery operated blind
Velux
2014-IA001-01

Revision history

REVISION	DATE	REMARKS	REVISED BY
Ver 2.00	20-01-2015	99% Occupied bandwidth added on pages 8 and 11	A.Ibrahim
Ver 1.00	11-11-2014	Initial release	P.A. Suringa
Ver 0.50	11-11-2014	Version for peer review	P.A. Suringa

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Main module

1 Introduction

This report contains the result of tests performed by:

Telefication B.V.
Edisonstraat 12a
6902 PK Zevenaar
The Netherlands

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2005. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Telefication is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Registration Number is: 282250.

The Industry Canada number for the Open Area Test Site of Telefication is: 4173A-1.

Ordering party:

Company name	:	VELUX A/S
Address	:	Baekgaardsvej 40
Zipcode	:	6900
City/town	:	Skjern
Country	:	Denmark
Date of order	:	5 June 2014

2 Product

A sample of the following product was submitted for testing:

Product description	:	Battery operated blind
Manufacturer	:	Velux A/S
Trade mark	:	Velux
Type designation	:	2014-IA001-01
FCC ID	:	XSG865480
IC ID	:	8642A-865480
Hardware version	:	--
Serial number	:	--
Firmware release	:	--

3 Test schedule

Tests are carried out in accordance with the specification detailed in chapter 7 “Summary” of this report.

Tests are carried out at the following location:

- Telefication, Zevenaar

The sample of the product is received on:

- 15 June 2014

Tests are carried out between:

- 12 and 18 October 2014

4 Product documentation

For production of this report the following product documentation has been used:

Identification:	Date:
Test user guide.pdf	09-07-2014

The above-mentioned documentation will be filed at Telefication for a period of 10 years following the issue of this test report.

5 Observations and comments

By test mode, the EUT was able to transmit or receive continuously on one out of three channels.

The highest emissions were measured with the test antenna in horizontal polarization and the EUT oriented as shown in the pictures in the test setup photographs module.
Therefore only results valid for horizontal polarization are given in this report.

6 Modifications to the sample

No modifications are made to the sample.

7 Summary

The product is intended for use in the following application area(s):

INTENTIONAL RADIATOR OPERATING IN THE FREQUENCY BAND 2400 - 2483.5 MHz

The sample is tested according to the following specification(s):

CFR Title 47 Part 15 sections 15.247 and 15.109 (10-01-13 Edition);
RSS 210 (issue 8); RSS Gen (issue 3)

8 Conclusions

The samples of the product showed **NO NON-COMPLIANCES** to the specification stated in chapter 7 of this report:

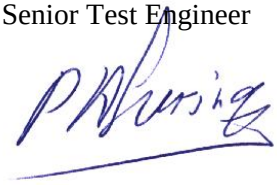
The results of the tests as stated in this report are exclusively applicable to the product item as identified in this report. Telefication accepts no responsibility for any stated properties of product items in this test report, which are not supported by the tests as specified in section *7 "Summary"*.

All tests are performed by:

name : ing. P.A. Suringa

function : Senior Test Engineer

signature :

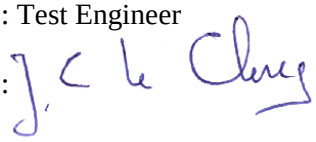


Review of test report by:

name : ing. J.C. le Clercq

function : Test Engineer

signature :



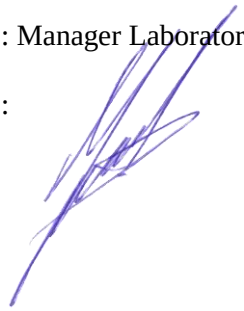
The above conclusions have been verified by the following signatory:

date : 20 January 2015

name : ing. A.G.B. van Zwieten

function : Manager Laboratory a.i.

signature :



Test results module

1 General information

1.1 Equipment information

Type of equipment	Battery operated window opener using IEEE 802.15.4 (Zigbee)	
Modulation	O-QPSK	
Spreading type	DSSS	
Bit rate	250 kbps	
99% occupied bandwidth (measured)	2.66 MHz	
Operating frequencies (channel set)	**Channel**	**Freq (GHz)**
	1	2.425
	2	2.450
	3	2.475
Rated RF antenna power density	0.7 mW/MHz	
Type of antenna	PCB antenna, F type	
Antenna gain	-3.5 dBi (max.)	

1.2 Tested channels

Operating frequencies as stated in 1.1 (equipment information).

2 Emission tests

2.1 Maximum conducted output power

Compliance standard : FCC part 15, subpart C, section 15.247 (b) (3);
RSS 210 section A8.4 (4)
Method of test : FCC OET publication No. 558074 D01 V03r02, section 9.1.1
Ambient temperature : 23 °C
Relative humidity : 23 %

Test results :

Mode	Level (dBm)		
	CH 1	CH 2	CH 3
Continuously transmitting	10.81	10.60	10.51

Measurement uncertainty: + 1.6 /- 1.9 dB

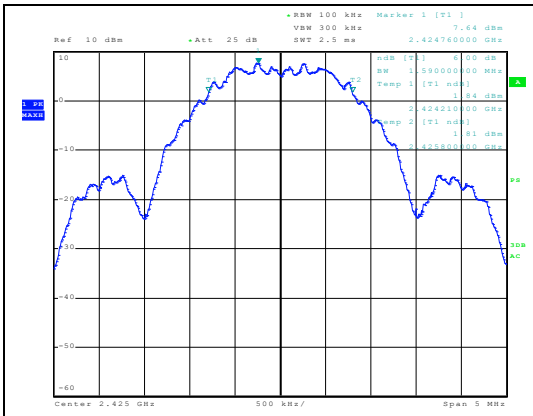
Limit:

Maximum conducted output power	≤ 30 dBm (antenna gain < 6 dBi)

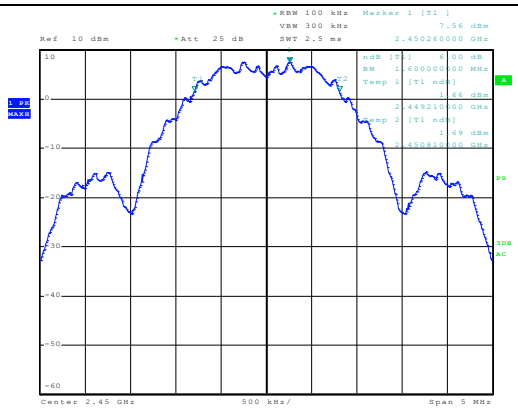
2.2 Minimum 6 dB bandwidth

Compliance standard	:	FCC part 15, subpart C, section 15.247 (a) (2); RSS 210 section A8.2 (a)
Method of test	:	FCC OET publication No. 558074 D01 V03r02, section 8.1
Ambient temperature	:	23 °C
Relative humidity	:	23 %

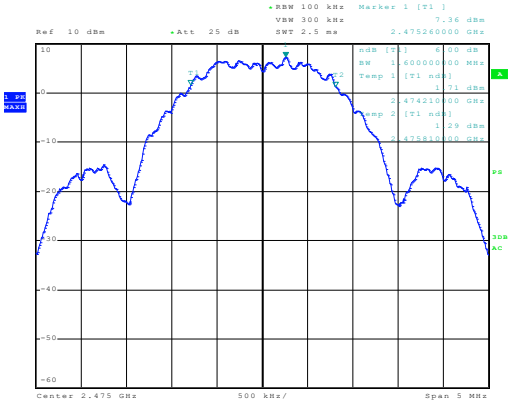
Test results :



CH 1: - 6dB bandwidth = 1.59 MHz



CH 2: -6 dB bandwidth = 1.60 MHz



CH 3: -6dB bandwidth = 1.60 MHz

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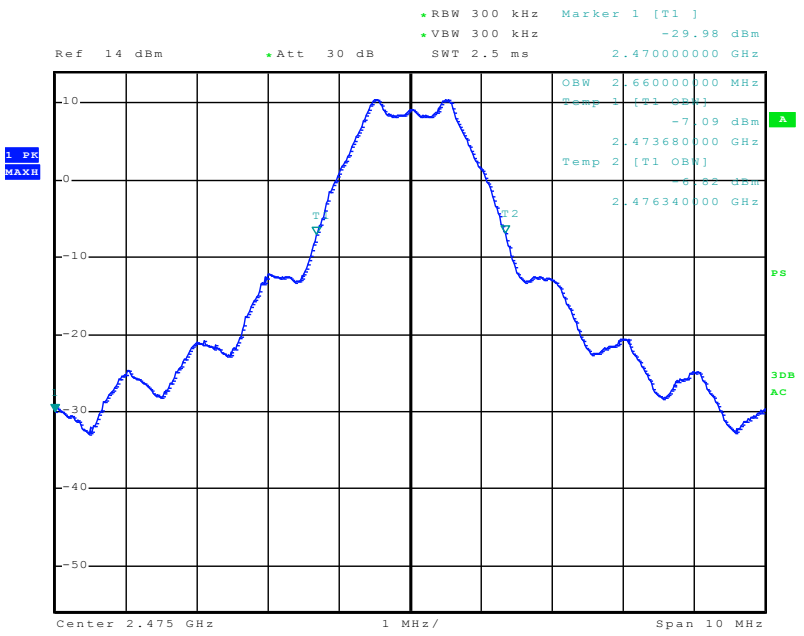
Measurement uncertainty: + /- 2 kHz

Limit:

Minimum 6 dB bandwidth	at least 500 kHz

2.3 99% emission bandwidth

Compliance standard	:	IC RSS-Gen, section 4.6.1
Method of test	:	IC RSS-Gen, section 4.6.1
Ambient temperature	:	23 °C
Relative humidity	:	23 %



Ch 3: 99% emission bandwidth 2.66 MHz

Measurement uncertainty: + /- 2 kHz

Limit:

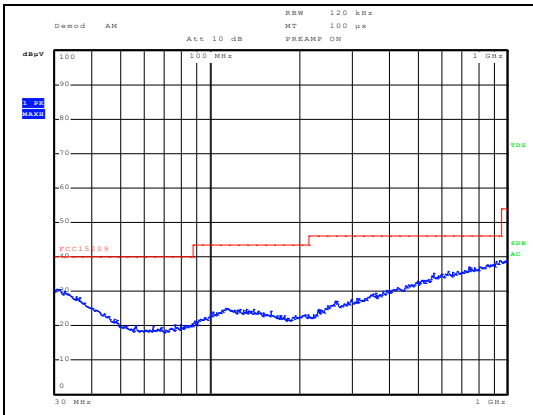
99% emission bandwidth	Not applicable

2.4 TX unwanted emissions attenuation (radiated, 0.03 – 1 GHz)

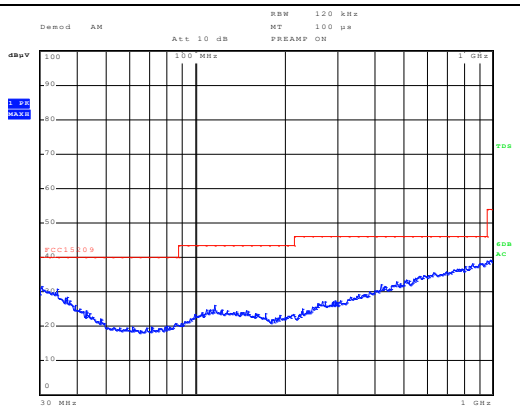
Compliance standard	:	FCC part 15, subpart C, section 15.247(d); RSS 210 section A8.5
Method of test	:	FCC OET publication No. 558074 D01 V03r02, section 11.0
Ambient temperature	:	23 °C
Relative humidity	:	23 %

Test results :

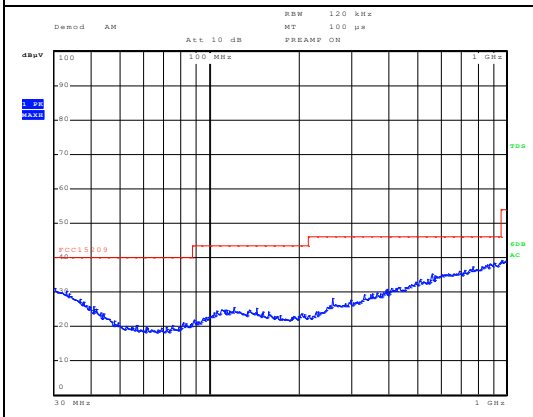
Horizontal polarization



CH 1



CH 2



CH 3

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Measurement uncertainty: < 2 GHz: + 1.7/- 1.9 dB;
≥ 2 GHz: +2.4/-2.7 dB

Limit:

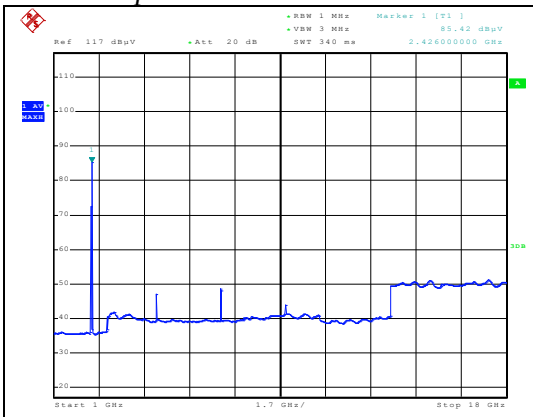
In any 100 kHz bandwidth	at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz bandwidth.

2.5 TX unwanted emissions attenuation (radiated, 1 – 18 GHz)

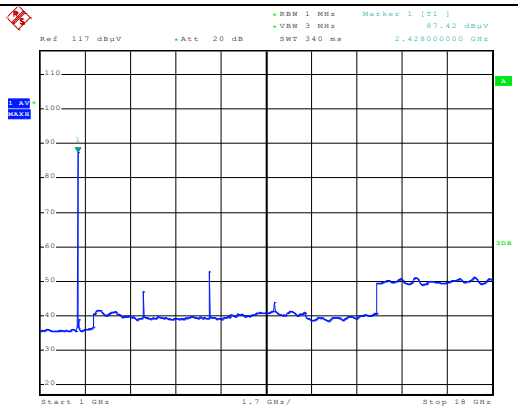
Compliance standard	:	FCC part 15, subpart C, section 15.247(d); RSS section A8.5
Method of test	:	FCC OET publication No. 558074 D01 V03r02, section 11.0
Ambient temperature	:	23 °C
Relative humidity	:	23 %

Test results :

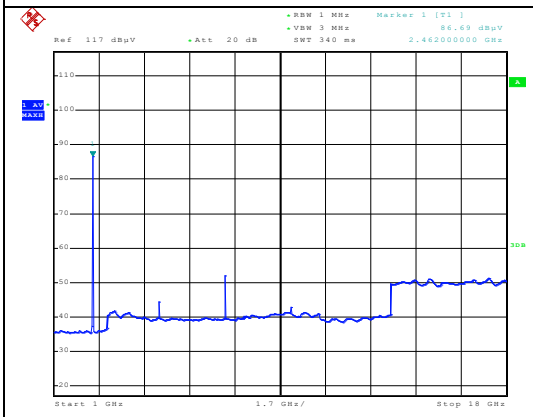
Horizontal polarization



CH 1



CH 2



CH 3

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Remark: emission values are bare values i.e. without any correction for antenna factor, cable attenuation and amplifier gain. The difference of the sum of these factors between the 1st and 3rd harmonics is 9 dB. Together with the (worst case) attenuation shown above (35 dB), the result is at least 26 dB attenuation.

Measurement uncertainty: < 2 GHz: + 1.7/- 1.9 dB;
≥ 2 GHz: +2.4/-2.7 dB

Limit:

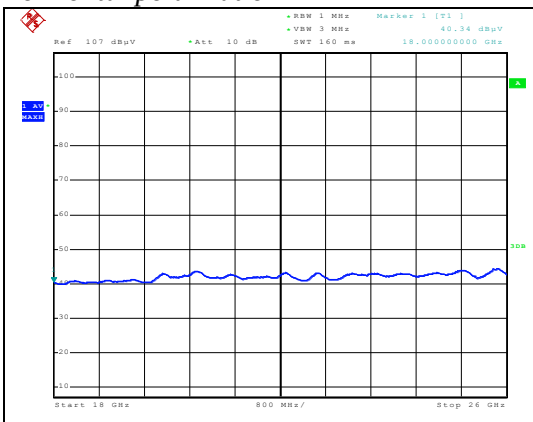
In any 100 kHz bandwidth	at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz bandwidth.

2.6 TX unwanted emissions attenuation (radiated, 18 – 26 GHz)

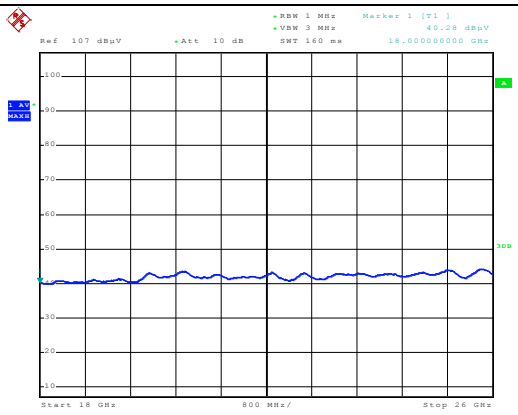
Compliance standard	:	FCC part 15, subpart C, section 15.247(d); RSS section A8.5
Method of test	:	FCC OET publication No. 558074 D01 V03r02, section 11.0
Ambient temperature	:	23 °C
Relative humidity	:	23 %

Test results :

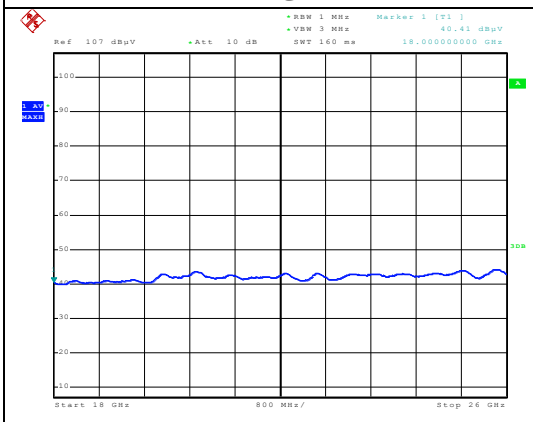
Horizontal polarization



CH 1



CH 2



CH 3

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Remark: emission values are bare values i.e. without any correction for antenna factor, cable attenuation and amplifier gain. The difference of the sum of these factors between the 1st harmonic and the noise level shown above is 26 dB. Together with the difference of the previous page and this page levels (≥ 46 dB), the result is at least 20 dB attenuation.

Measurement uncertainty: < 2 GHz: + 1.7/- 1.9 dB;
≥ 2 GHz: +2.4/-2.7 dB

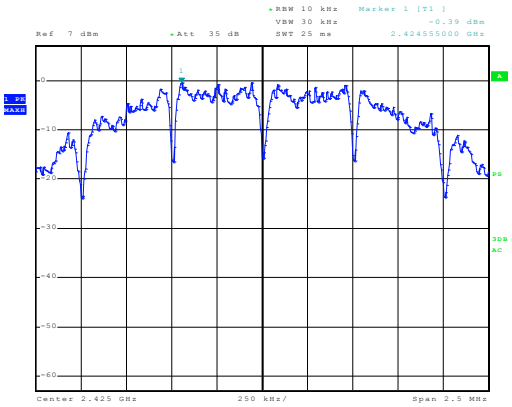
Limit:

In any 100 kHz bandwidth	at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz bandwidth.

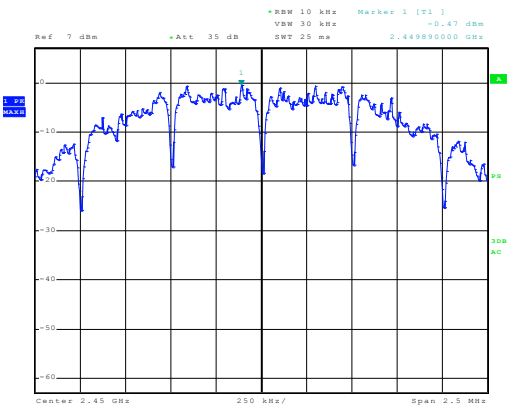
2.7 Power spectral density conducted to the antenna

Compliance standard : FCC part 15, subpart C, section 15.247(e);
RSS 210 section A8.2 (b)
Method of test : FCC OET publication No. 558074 D01 V03r02, section 10.2
Ambient temperature : 23 °C
Relative humidity : 23 %

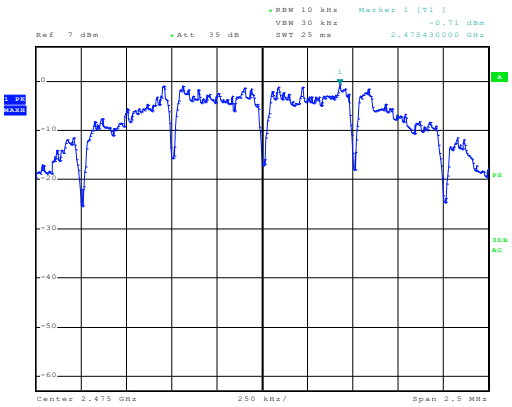
Test results :



CH 1: - 0.39 dBm



CH 2: - 0.47 dBm



CH 3: - 0.71 dBm

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Measurement uncertainty: < 2 GHz: + 1.7/- 1.9 dB;
≥ 2 GHz: + 2.4/- 2.7 dB

Limit:

In any 3 kHz band	Not greater than 8 dBm during any time of continous transmission

2.8 Average factor

Compliance standard	:	--
Method of test	:	FCC part 15, subpart C, section 15.35 (b) and (c)
Ambient temperature	:	23 °C
Relative humidity	:	23 %
Test results	:	n.a.

The EUT communicates with a controller using a protocol which is a mix of I/O-home control protocol and the ZigBee protocol.
A session consists of maximum two communication frames of each 328 bit.
With a transmission rate of 250 kbps this gives 2x328 bit/250 kbps = 2.62 msec.
In 100 msec the duty cycle calculates to 2.62 msec/100 msec= 2.6 %.
The average factor in dB's is: 20log0.026 = -31.6 dB.

2.9 TX unwanted emissions in the restricted bands

Compliance standard : FCC part 15, subpart C, section 15.247(d);
RSS Gen section 7.2.2 (b)
Method of test : FCC OET publication No. 558074 D01 V03r02, section 12.1
Ambient temperature : 23 °C
Relative humidity : 23 %

Test results :

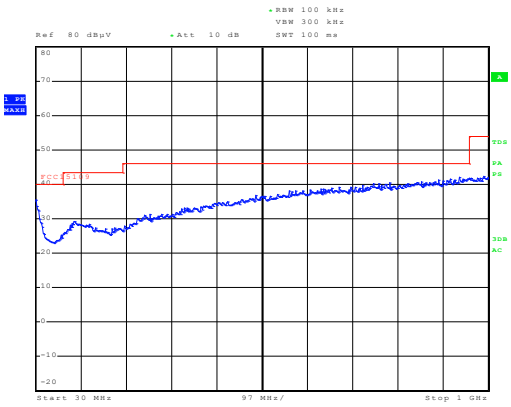
Frequency (MHz)	Test results peak (dBµV/m)	Average factor (dB)	Test results average (dBµV/m)	Resolution bandwidth (MHz)	Average Limit (dBµV/m)	Peak limit (dBµV/m)
4850	51.4	-31.6	19.8	1	54	74
4900	51.6	-31.6	20.0	1	54	74
4950	48.5	-31.6	16.9	1	54	74
7275	57.6	-31.6	26.0	1	54	74
7350	61.4	-31.6	29.8	1	54	74
7425	61.5	-31.6	29.9	1	54	74
12125	≤53.9	-31.6	≤22.3	1	54	74
12250	≤54.0	-31.6	≤22.4	1	54	74
12375	≤53.9	-31.6	≤22.3	1	54	74
19400	≤61.2	-31.6	≤ 29.6	1	54	74
19600	≤61.4	-31.6	≤ 29.8	1	54	74
19800	≤61.4	-31.6	≤ 29.8	1	54	74

Measurement uncertainty: +4.5 / -6.1 dB

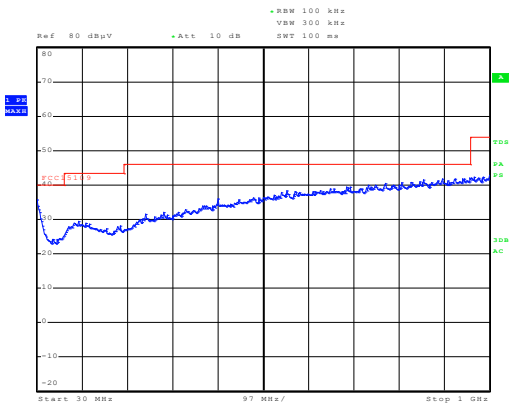
2.10 RX unwanted emissions (radiated, 0.03 – 1 GHz)

Compliance standard	:	FCC part 15, subpart B, section 15.109; RSS Gen section 6.1
Method of test	:	ANSI C63.10-2009, section 6.5.4.2
Ambient temperature	:	23 °C
Relative humidity	:	23 %

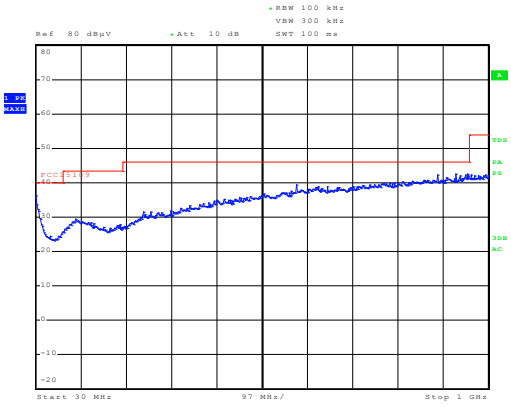
Test results :



CH 1 (hor. pol.)



CH 2 (hor. pol)



CH 3 (hor. pol.)

Intentionally left blank

Measurement uncertainty:

Horizontal polarization	
30 – 200 MHz	4.5 dB
200 – 1000 MHz	3.6 dB
Vertical polarization	
30 – 200 MHz	5.4 dB
200 – 1000 MHz	4.6 dB

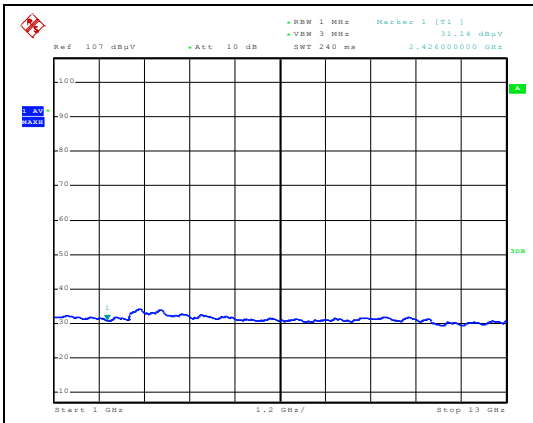
Limit:

Field strength at 3 meter distance	30 – 88 MHz: ≤ 40 dBµV/m; 88 – 216 MHz: ≤ 43.5 dBµV/m; 216 – 960 MHz: ≤ 46 dBµV/m; Above 960 MHz: ≤ 54 dBµV/m

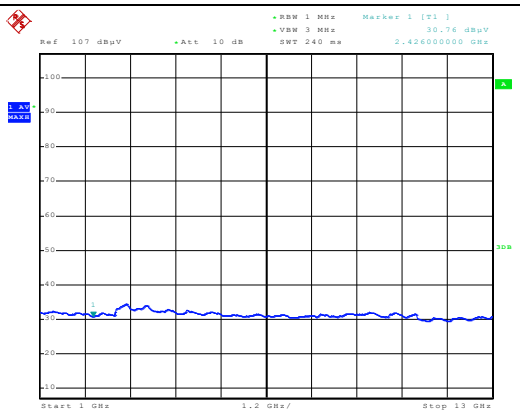
2.11 RX unwanted emissions (radiated, 1 – 13 GHz)

Compliance standard	:	FCC part 15, subpart B, section 15.109; RSS Gen section 6.1
Method of test	:	ANSI C63.10-2009: section 6.6
Ambient temperature	:	23 °C
Relative humidity	:	23 %

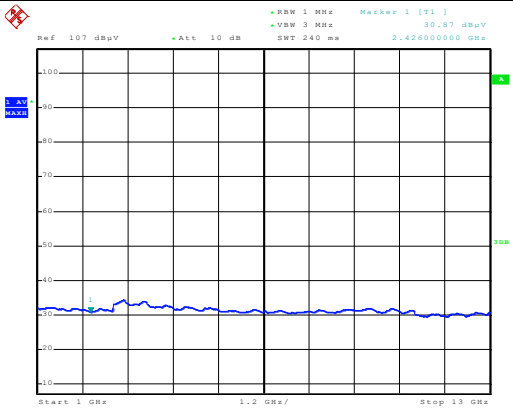
Test results :



CH 1 (hor. pol.)



CH 2 (hor. pol)



CH 3 (hor. pol.)

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Remark: emission values are bare values i.e. without any correction for antenna factor, cable attenuation and amplifier gain. The corrected worst case limit to be applied in the plots above is the limit corrected for the highest antenna factor, highest cable attenuation and amplifier gain in the measurement range (at 13 GHz), i.e.40 dBµV.

Measurement uncertainty: +4.5 / -6.1 dB

Limit:

Field strength at 3 meter distance	Above 1 GHz: ≤ 54 dBµV/m

3 Used test equipment module

Description	Telef. ID	Manufacturer	Model	Used at par.
Spectrum Analyzer	TE 11125	Rohde & Schwarz	FSP 40	2.3, 2.5, 2.6, 2.9, 2.11
Horn antenna	TE 00531	EMCO	3115	2.5, 2.11
Standard gain horn	TE 00818	Flann microwave	20240-25	2.6
Semi anechoic chamber	TE 01064	Euroshield	RFD-F-100	2.4, 2.5, 2.6, 2.9, 2.10, 2.11
EMI test receiver	TE 11128	Rohde & Schwarz	ESCI	2.1, 2.2, 2.7, 2.10
Biconilog	TE 00967	Chase	CBL6112A	2.4, 2.10
Pre amplifier	TE 11131	Miteq	JS4-18004000	2.5, 2.11
Pre amplifier	TE 11132	Miteq	AFS42-041001800	2.6

Cross reference table

Transmitter	
IC RSS-210 Issue 8, Annex 8	**FCC 47 CFR Ch. 1 part 15, subpart C (10-1-13 Edition)**
A8.2 (a)	§ 15.247 (a) (2)
A8.4 (4)	§ 15.247 (b) (3)
A8.2 (b)	§ 15.247 (e)
A8.5	§ 15.247 (d)
IC RSS-Gen Issue 3	**FCC 47 CFR Ch. 1 part 15, subpart C (10-1-13 Edition)**
§ 4.6.1	--
Receiver	
IC RSS-Gen Issue 3	**FCC 47 CFR Ch. 1 part 15, subpart B (10-1-13 Edition)**
§ 7.2.3	§ 15.109