

Radio test report

20124202300

based on:

FCC part 15; subpart C; section 15.247 (ed. 10-1-11); FCC part 15, subpart B, section 15.109 (ed. 10-1-11); IC RSS 210, Annex 8 (issue 8); IC RSS-Gen (issue 3)

Battery operated window opener
VELUX
3SM S01 WW

Contents

MAIN MODULE.....3

1.....INTRODUCTION3

2.....PRODUCT4

3.....TEST SCHEDULE4

4.....PRODUCT DOCUMENTATION.....5

5.....OBSERVATIONS AND COMMENTS5

6.....MODIFICATIONS TO THE SAMPLE.....5

7.....SUMMARY.....5

8.....CONCLUSIONS6

TEST RESULTS MODULE.....7

1.....GENERAL INFORMATION7

 1.1 Equipment information7

 1.2 Tested channels.....7

2.....EMISSION TESTS8

 2.1 Maximum conducted output power.....8

 2.2 Minimum 6 dB bandwidth9

 2.3 99% emission bandwidth10

 2.4 TX unwanted emissions attenuation (conducted, 0.03 - 26 GHz).....11

 2.5 Power spectral density conducted to the antenna.....12

 2.6 Average factor13

 2.7 TX unwanted emissions in the restricted bands14

 2.8 RX unwanted emissions (radiated, 0.03 - 1 GHz).....15

 2.9 RX unwanted emissions (radiated, 1 - 13 GHz).....17

USED TEST EQUIPMENT MODULE.....19

CROSS REFERENCE TABLE.....20

REVISION HISTORY21

This report comprises of three modules. The total number of pages is: 21

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). The contents of this test report, if reproduced, shall be copied in full, unless special consent in writing for reproduction in part is granted by Telefication. Copyright of this test report is reserved to Telefication.

Ordering party:

Company name : VELUX A/S
Address : Bækgaardsvej 40
Zipcode : 6900
City/town : Skjern
Country : Denmark
Date of order : 5 October 2012

Main module

2 Product

A sample of the following product was submitted for testing:

Product description	:	Battery operated window opener
Manufacturer	:	Velux A/S
Trade mark	:	VELUX
Type designation	:	3SM S01 WW
FCC ID	:	XSG832876
IC ID	:	8642B-832876
Hardware version	:	--
Serial number	:	--
Firmware release	:	--

Variant (for small windows)

Product description	:	Battery operated window opener
Manufacturer	:	Velux A/S
Trade mark	:	VELUX
Type designation	:	3SM S02 WW
FCC ID	:	XSG832876
IC ID	:	8642B-832876
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:

- 11 October 2012

Tests are carried out between:

- 16 and 23 November 2012

4 Product documentation

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

Identification:	Date:
3SM S01 principle.pdf	2012-11-15
452672-2011-06_KLR-100_US.pdf	2012-10-11
Add on to the user guide.docx	2012-10-11

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

The EUT was able to transmit or receive continuously on one out of three channels.

Furthermore the EUT was able to operate in normal (intermittent) mode.

FCC part15 section 2.15: not tested

The EUT is deemed to meet the requirements because of the frequency space between the band edges and the lowest and highest operating channels.

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):

FCC part 15; subpart C; section 15.247 (ed. 10-1-11); FCC part 15, subpart B, section 15.109 (ed. 10-1-11); IC RSS 210, Annex 8 (issue 8); IC RSS-Gen (issue 3)

8 Conclusions

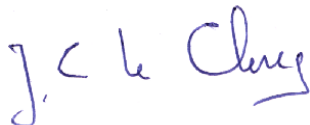
The samples of the product showed **NO NON-COMPLIANCES** to the specification stated in chapter 7 of this report:

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. J.C. le Clercq


function : Test Engineer

signature : 

Review of test report by:

name : ing. P.A. Suringa

function : Senior Test Engineer


signature : 

The above conclusions have been verified by the following signatory:

date : 29 November 2012

name : ing. A. van der Valk

function : Manager Laboratory

signature : 

Test results module

1 General information

1.1 Equipment information

Type of equipment	Power operated window opener using IEEE 802.15.4 (Zigbee)	
Modulation	O-QPSK	
Spreading type	DSSS	
Bit rate	250 kb/s	
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 (conducted)	
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)
Method of test : FCC KDB publication No. 558074
Ambient temperature : 23 °C
Relative humidity : 40 %

Test results :

Mode	Level (dBm)		
	CH 1	CH 2	CH 3
Continuously transmitting	1.53	1.41	1.31

Measurement uncertainty: + 1.6 /- 1.9 dB

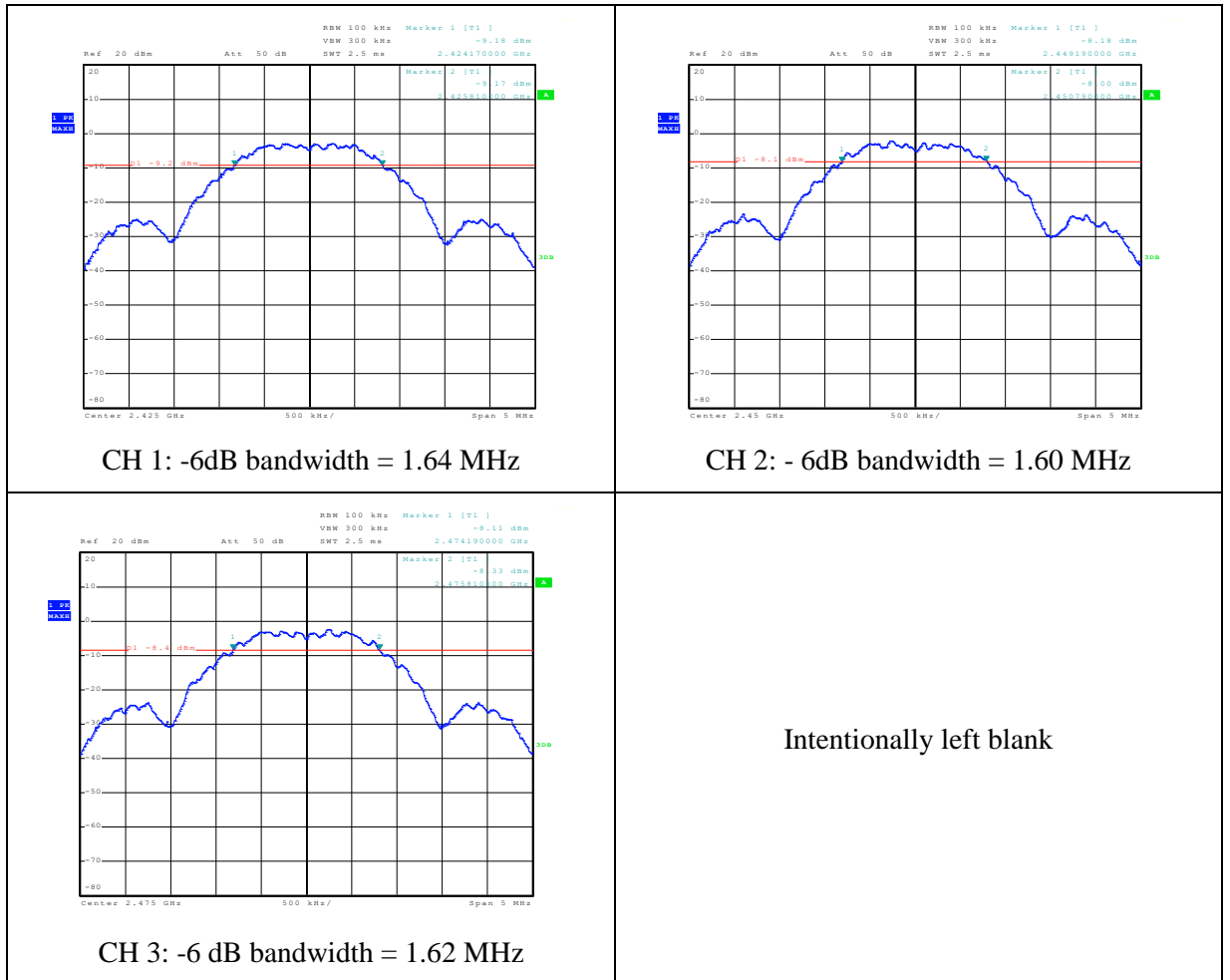
Limit:

Maximum conducted output power	≤ 30 dBm (antenna gain < 6 dBi)
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2.2 Minimum 6 dB bandwidth

Compliance standard : FCC part 15, subpart C, section 15.247 (a) (2)
 Method of test : FCC KDB publication No. 558074
 Ambient temperature : 23 °C
 Relative humidity : 40 %

Test results :



Measurement uncertainty: +/- 2 kHz

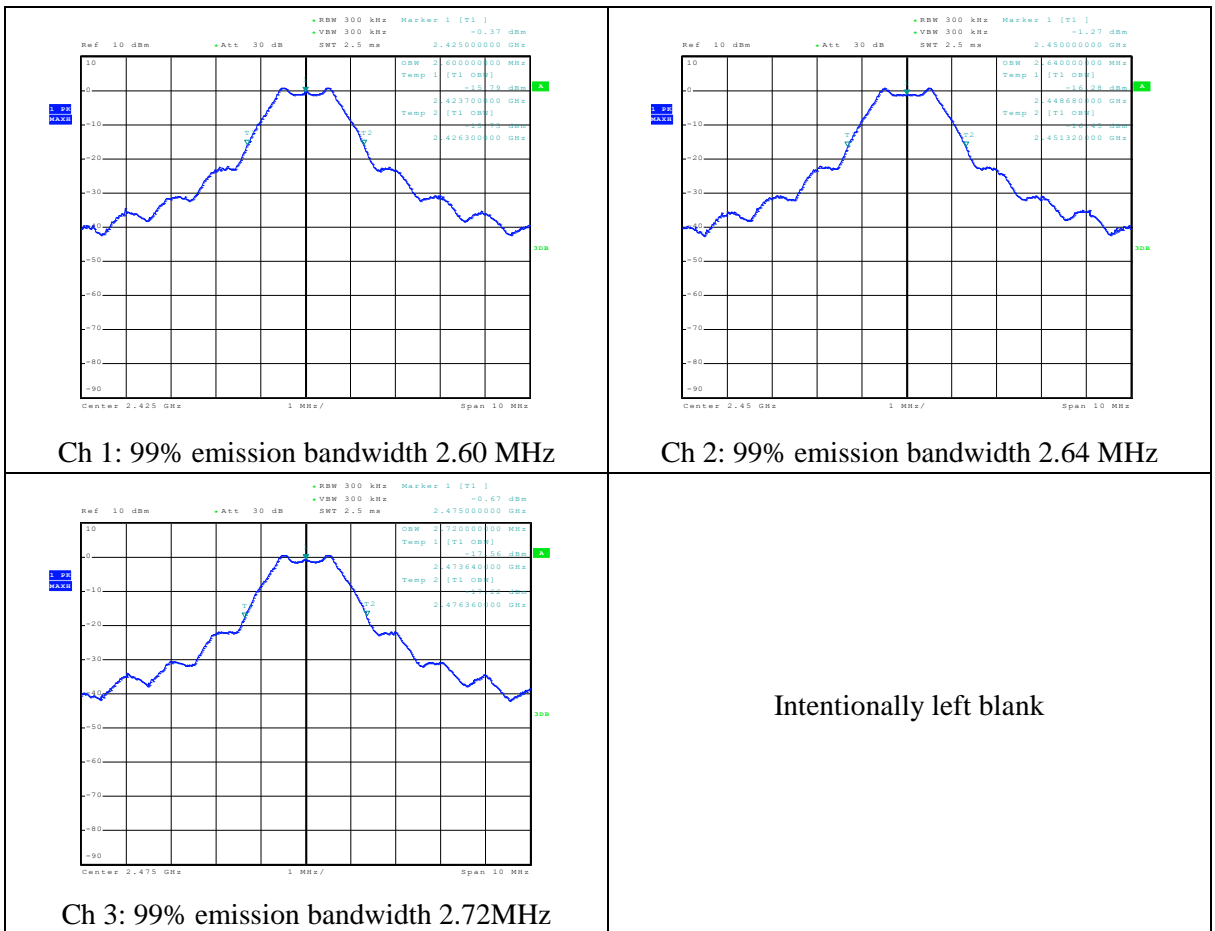
Limit:

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 : 40 %



Measurement uncertainty: +/- 2 kHz

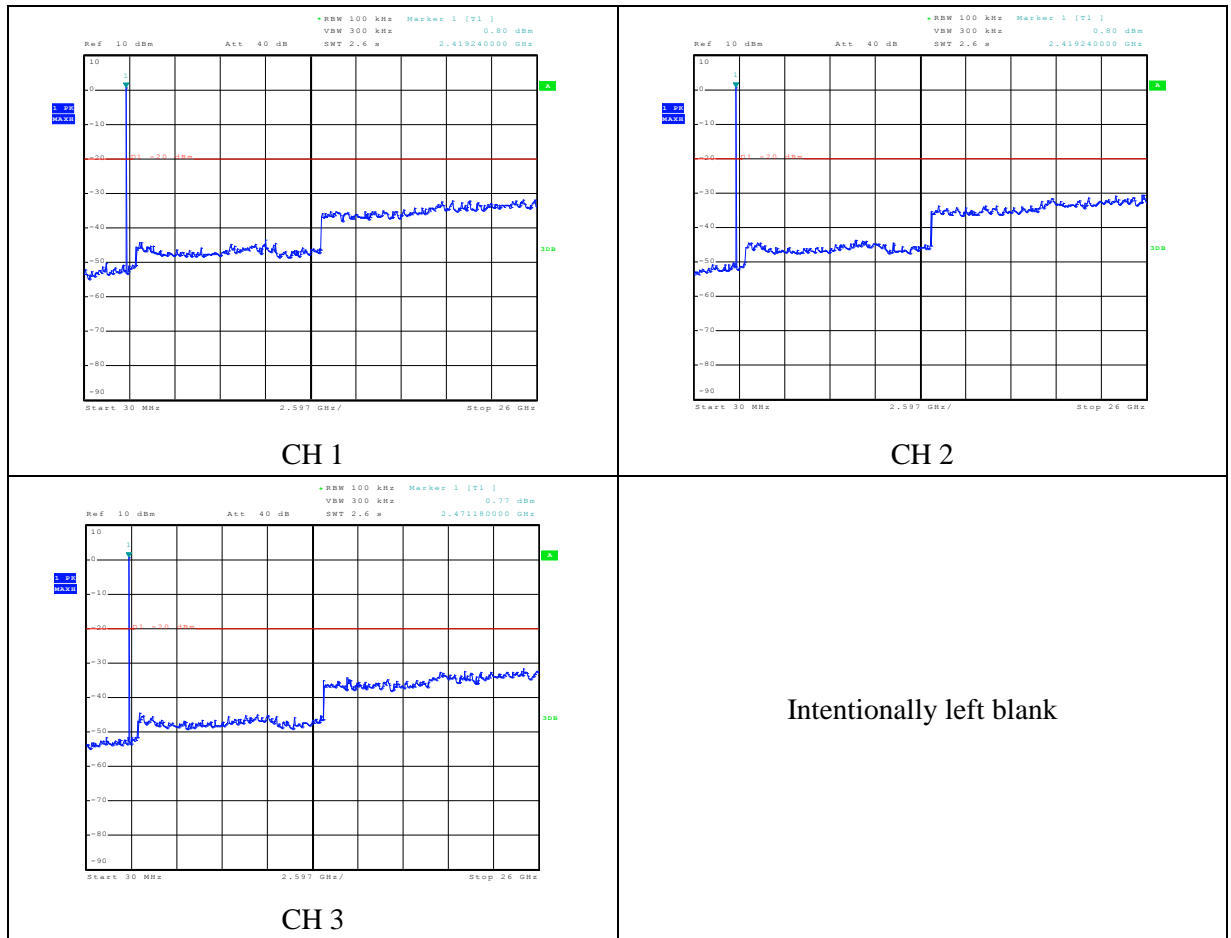
Limit:

99% emission bandwidth	Not applicable
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2.4 TX unwanted emissions attenuation (conducted, 0.03 - 26 GHz)

Compliance standard : FCC part 15, subpart C, section 15.247(d)
 Method of test : FCC KDB publication No. 558074
 Ambient temperature : 23 °C
 Relative humidity : 40 %

Test results :



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

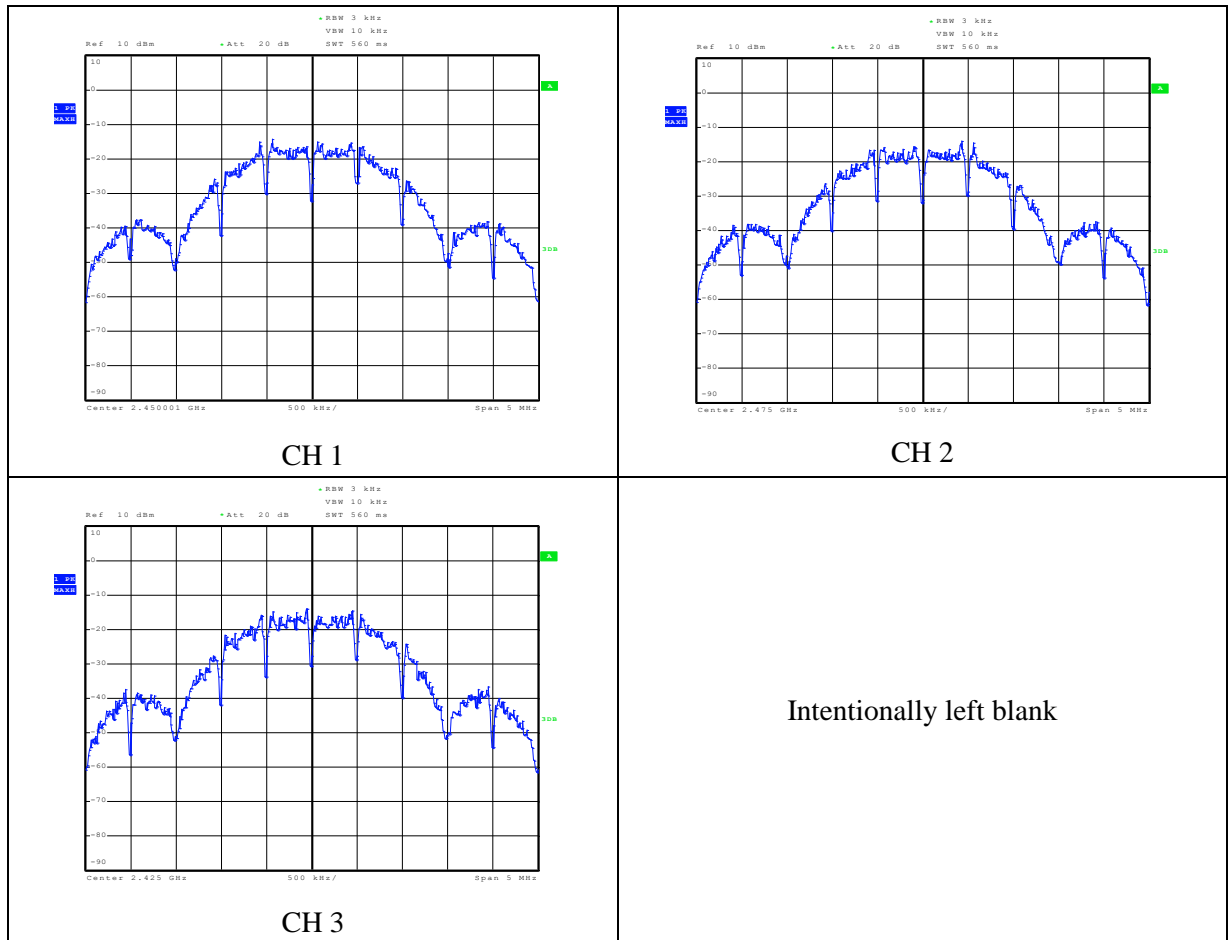
Limit:

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.
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2.5 Power spectral density conducted to the antenna

Compliance standard : FCC part 15, subpart C, section 15.247(e)
 Method of test : FCC KDB publication No. 558074
 Ambient temperature : 23 °C
 Relative humidity : 40 %

Test results :



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 continuous transmission
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2.6 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	:	

Due to the long preamble section of 510 ms in the first frame in a LPM session only one communication session can be made within 100 ms. A session with an actuator consists of maximum two frames which may be made up to 41 bytes (328 bit), which gives a transmission time of: $2 \times 328 \text{ bit} / 250 \text{ kbps} = 2.62 \text{ ms}$. From this the duty cycle can be calculated to:

$$2.62 \text{ ms} / 100 \text{ ms} = 2.62 \%$$

In RF power this gives the following difference in dB between peak and average:

$$20 \log_{10} 0.0262 = -31.6 \text{ dB}$$

2.7 TX unwanted emissions in the restricted bands

Compliance standard : FCC part 15, subpart C, section 15.247(d)
 Method of test : FCC KDB publication No. 558074
 Ambient temperature : 23 °C
 Relative humidity : 23 %

Test results :

Frequency (MHz)	Test results peak (dBm eirp)		Average factor (dB)	Test results average (dBm eirp)		Resolution bandwidth (kHz)	Average Limit (dBm eirp)*)	Peak limit (dBm eirp)
	V	H		V	H			
4850	-53.2	≤ -60	-31.6	-84.8	≤ -91.6	1000	-41.2	-21.2
4900	-52.2	≤ -60	-31.6	-83.8	≤ -91.6	1000	-41.2	-21.2
4950	-54.0	≤ -60	-31.6	-85.6	≤ -91.6	1000	-41.2	-21.2
7275	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2
7350	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2
7425	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2
12125	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2
12250	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2
12375	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2
19400	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2
19600	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2
19800	≤ -60	≤ -60	-31.6	≤ -91.6	≤ -91.6	1000	-41.2	-21.2

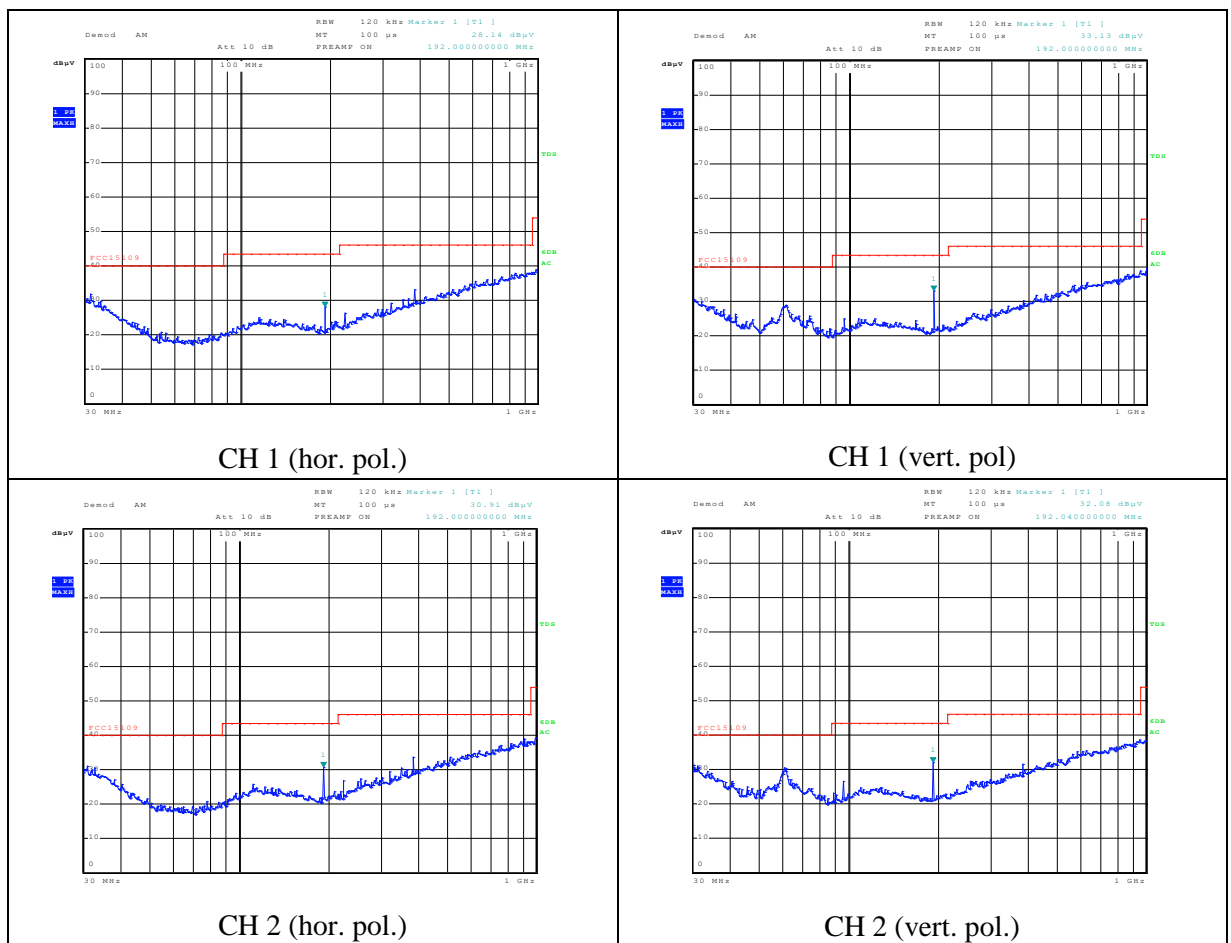
*⁾ derived from the expression $EIRP_{dBm} = E_{dB\mu V/m} - 95.2_{dB}$
 (Max. field strength at band edge: 500 $\mu V/m$ @ 3 m distance (equivalent to 54 $dB\mu V/m$))

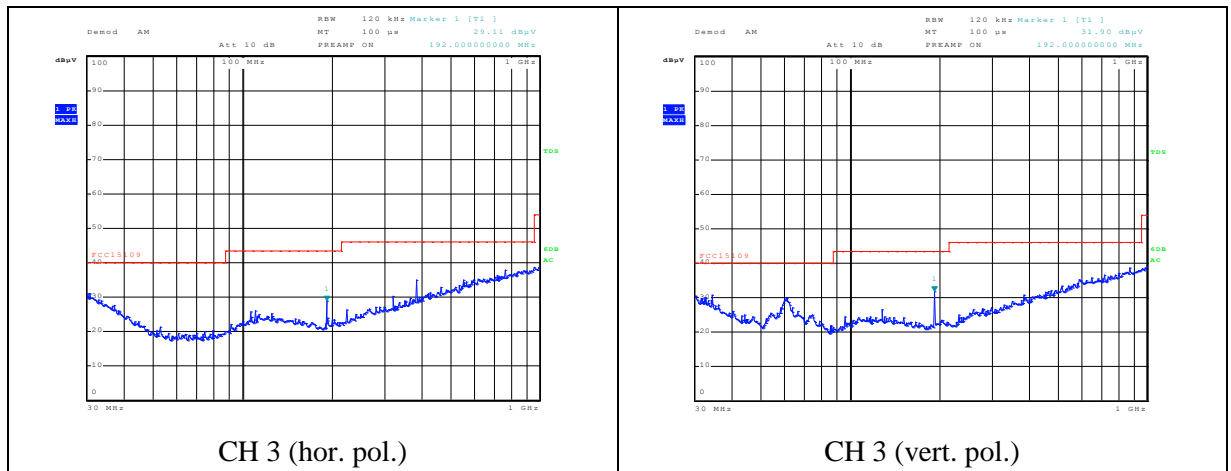
Measurement uncertainty: +4.5 / -6.1 dB

2.8 RX unwanted emissions (radiated, 0.03 - 1 GHz)

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

Test results :





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

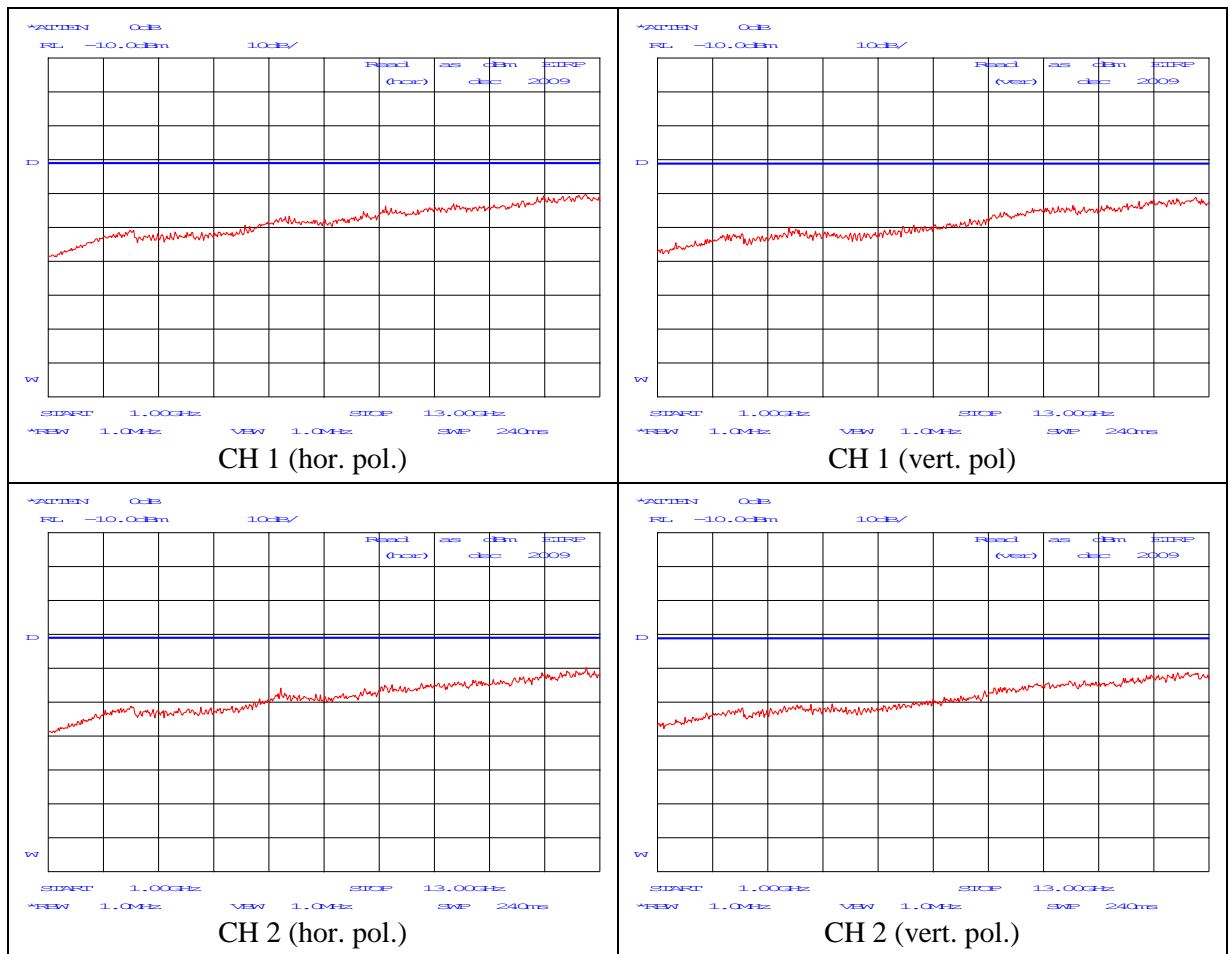
Limit:

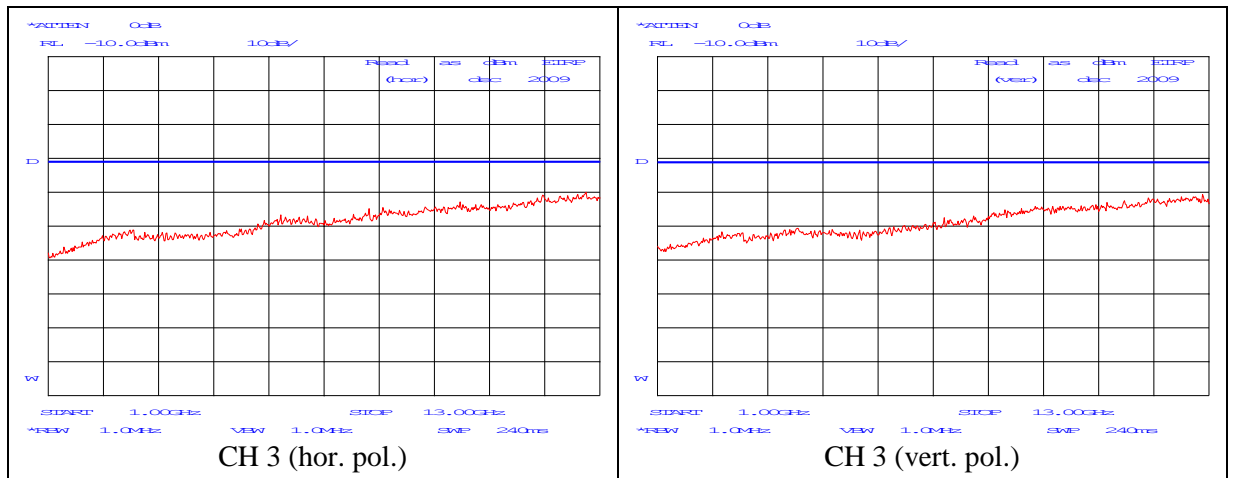
Field strength at 3 meter distance	30 – 88 MHz: ≤ 40 dBμV/m; 88 – 216 MHz: ≤ 43.5 dBμV/m; 216 – 960 MHz: ≤ 46 dBμV/m; Above 960 MHz: ≤ 54 dBμV/m
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2.9 RX unwanted emissions (radiated, 1 - 13 GHz)

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

Test results :





Measurement uncertainty: +4.5 / -6.1 dB

Limit:

Radiated power	Above 1 GHz: ≤ -41.2 dBm eirp ^{*)}
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^{*)} derived from the expression $EIRP_{dBm} = E_{dB\mu V/m} - 95.2_{dB}$

Used test equipment module

Description	Telef. ID	Manufacturer	Model	Used at par.
Spectrum Analyzer	TE 11125	Rohde & Schwarz	FSP 40	2.2, 2.3, 2.4, 2.5, 2.7
Power meter	TE 00354	Hewlett Packard	437B	2.1
Power sensor	TE 00355	Hewlett Packard	8481A	2.1
Spectrum analyzer	TE 00099	Hewlett Packard	8562E	2.9
Pre amplifier	TE 00092	Hewlett Packard	8449B	2.7, 2.9
Horn antenna	TE 00531	EMCO	3115	2.7, 2.9
Anechoic chamber	TE 01064	Euroshield	RFD-F-100	2.7, 2.9
Semi anechoic chamber	TE 00861	Comtest	--	2.8
EMI test receiver	TE 00481	Rohde & Schwarz	ESCI	2.8
Biconilog	TE 00967	Chase	CBL6112A	2.8

Cross reference table

Transmitter	
IC RSS-210 Issue 8, Annex 8	FCC 47 CFR Ch. 1 part 15, subpart C (10-1-11 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 (10-1-11 Edition)
§ 4.6.1	--
Receiver	
IC RSS-Gen Issue 3	FCC 47 CFR Ch. 1 part 15, subpart B (10-1-11 Edition)
§ 7.2.3	§ 15.109

Revision history

REVISION	DATE	REMARKS
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