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

telefication

# Radio test report
## 20145012300-Ver 1.00

based on:

FCC part 15; subpart C; section 15.247 (ed. 10-1-14);
FCC part 15, subpart B, section 15.109 (ed. 10-1-14);
IC RSS 210, Annex 8 (issue 8); IC RSS-Gen (issue 4)

Remote Control
VELUX
2014-RC003-02

# Revision history

| REVISION | DATE | REMARKS | REVISED BY |
|---|---|---|---|
| Ver 1.00 | 25 February 2015 | Version for first release | ing. J.C. le Clercq |
| Ver 0.50 | 12 February 2015 | Version for peer review | ing. J.C. le Clercq |

# Contents

# 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 | : | 13 November 2014 |

# 2 Product

A sample of the following product was submitted for testing:

| | | |
|---|---|---|
| Product description | : | Remote Control |
| Manufacturer | : | Velux A/S |
| Trade mark | : | VELUX |
| Type designation | : | 2014-RC003-02 |
| FCC ID | : | XSG835403 |
| IC ID | : | 8642A-835403 |
| Serial number | : | -- |
| Hardware release | : | -- |
| Software 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:

- 6 January 2015

Tests are carried out between:

- 6 and 10 February 2015

# 4 Product documentation

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

| Identification: | Date: |
|---|---|
| 3LR A12 exploded view.pdf | 09-02-2015 |
| 3LR A12 PCB layout.pdf | 09-02-2015 |
| 3LR A12 Quick guide 453065-2012-11.pdf | 09-02-2015 |
| 3LR A12 US BOM.xlsx | 09-02-2015 |
| 3LR A12 User guide 453347-2014-01.pdf | 09-02-2015 |
| 3LR A12 WW BOM.xlsx | 09-02-2015 |
| 3LR_A12_US schematic.pdf | 10-02-2015 |
| Communication Duty Cycles.pdf | 10-02-2015 |
| KLR200 US range and antenna.pdf | 10-02-2015 |
| RF Test Modes.pdf | 10-02-2015 |

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 15.215: 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. 10-1-14); FCC part 15, subpart B, section 15.109 (ed. 10-1-14);
- IC RSS 210, Annex 8 (issue 8); IC RSS-Gen (issue 4)

# 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

Review of test report by:

name : ing. P.A. Suringa

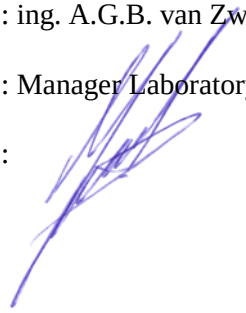
The above conclusions have been verified by the following signatory:

date : 25 February 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 | Remote Control using IEEE 802.15.4 (Zigbee) | |
| Modulation | O-QPSK | |
| Spreading type | DSSS | |
| Chip rate | 2Mbit/s | |
| Data rate | 38.4 Kbit/s | |
| Emission designator | 2M50M1D | |
| Operating frequencies (channel set) | **Channel** | **Freq (GHz)** |
| | 1 | 2.425 |
| | 2 | 2.450 |
| | 3 | 2.475 |
| Rated RF antenna power density | 20 mW/MHz (conducted) | |
| Type of antenna | 2 PCB antennas, F type | |

The 2014-RC003-02 Remote Control has three wired ports:
Power port, USB port and debug port.

None of these ports is for the end user. They are only for production purposes, if e.g. the software needs to be updated.

### 1.2 Tested channels

Operating frequencies as stated in clause 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 D01 v03r01
Ambient temperature : 23 °C
Relative humidity : 36 %

Test results :

| Mode | Level (dBm) | | |
|---|---|---|---|
| | CH 1 | CH 2 | CH 3 |
| Continuously transmitting | 13.50 | 13.44 | 13.41 |

Measurement uncertainty: + 1.6 /- 1.9 dB

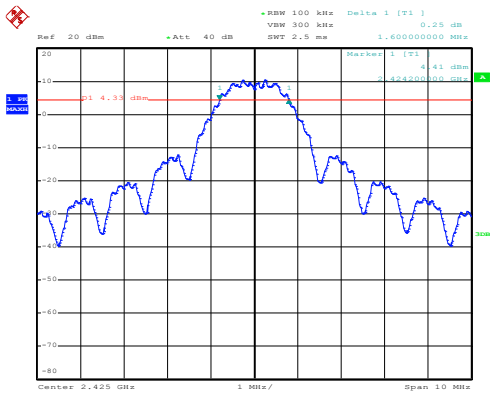
**Limit:**

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

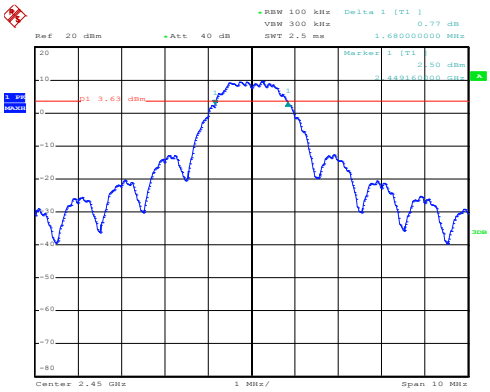
## 2.2 Minimum 6 dB bandwidth

Compliance standard : FCC part 15, subpart C, section 15.247 (a) (2)
Method of test : FCC KDB publication No. 558074 D01 v03r01
Ambient temperature : 23 °C
Relative humidity : 36 %

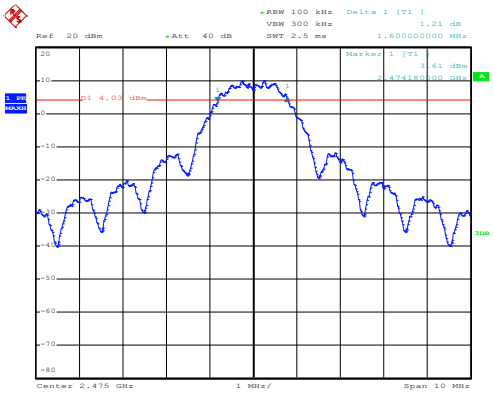
Test results :



CH 1: -6dB bandwidth = 1.60 MHz



CH 2: - 6dB bandwidth = 1.60 MHz



CH 3: -6 dB bandwidth = 1.60 MHz

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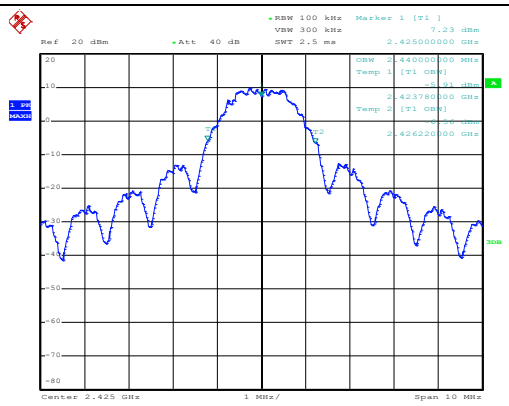
Measurement uncertainty: + /- 2 kHz

**Limit:**

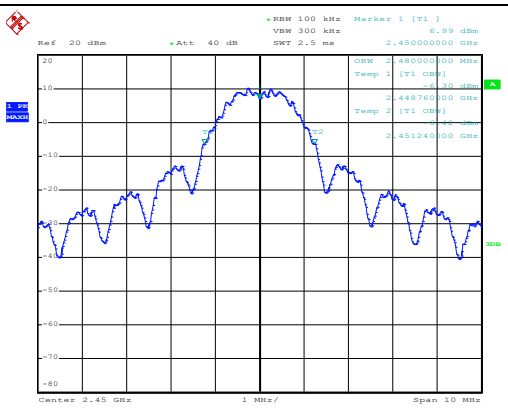
| | |
|---|---|
| Minimum 6 dB bandwidth | at least 500 kHz |

## 2.3 99% emission bandwidth

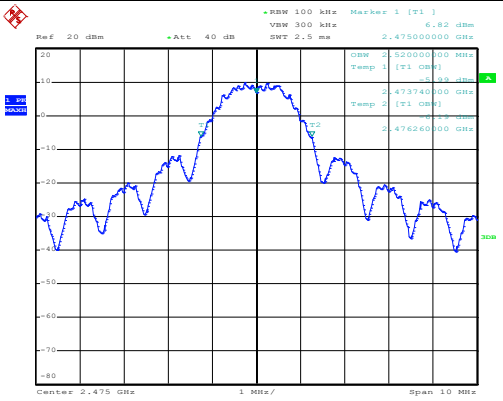
Compliance standard : IC RSS-Gen, section 4.6.1
Method of test : IC RSS-Gen, section 4.6.1
Ambient temperature : 23 °C
Relative humidity : 36 %



Ch 1: 99% emission bandwidth 2.44 MHz



Ch 2: 99% emission bandwidth 2.48 MHz



Ch 3: 99% emission bandwidth 2.47MHz

Intentionally left blank

Measurement uncertainty: + /- 2 kHz

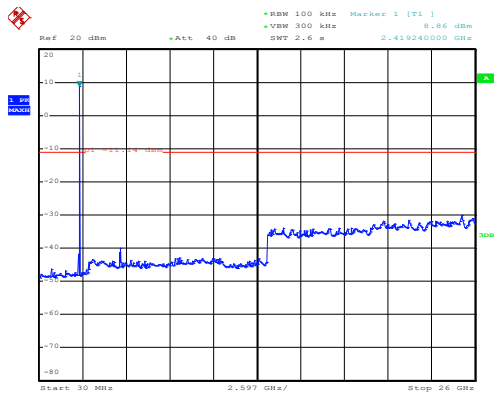
**Limit:**

| | |
|---|---|
| 99% emission bandwidth | Not applicable |

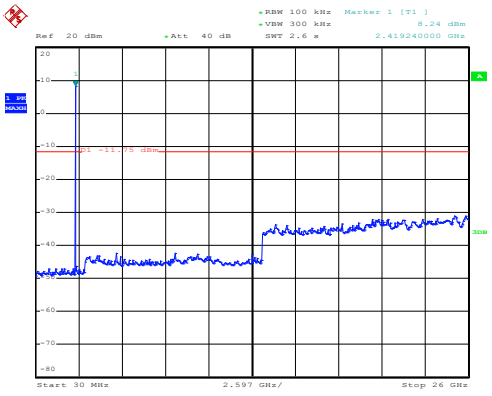
## 2.4 TX unwanted emissions attenuation (conducted, 0.03 - 26 GHz)

Compliance standard : FCC part 15, subpart C, section 15.247(d)
Method of test : FCC KDB publication No. 558074 D01 v03r01
Ambient temperature : 23 °C
Relative humidity : 36 %

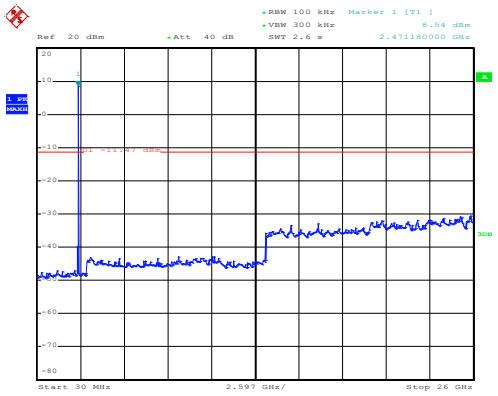
Test results :




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

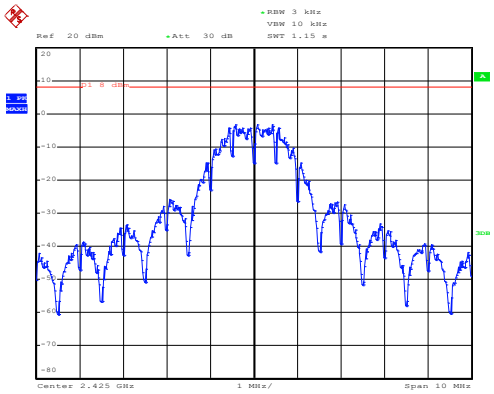
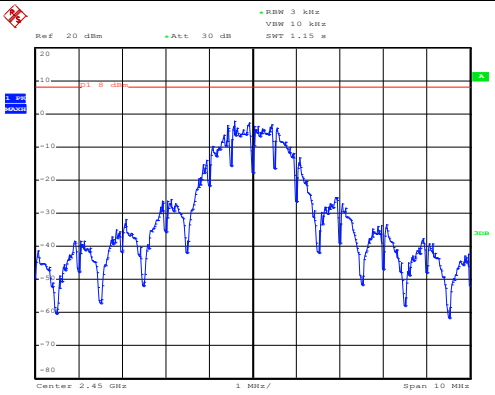
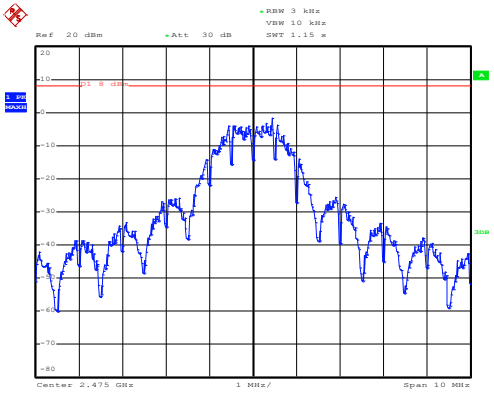
**Limit:**

| | |
|---|---|
| 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 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 D01 v03r01
Ambient temperature : 23 °C
Relative humidity : 36 %

Test results :

<table>
<tr>
<td>  <br>CH 1, -3.2 dBm/MHz</td>
<td>  <br>CH 2, -3.0 dBm/MHz</td>
</tr>
<tr>
<td>  <br>CH 3, -2.9 dBm/MHz</td>
<td>Intentionally left blank</td>
</tr>
</table>

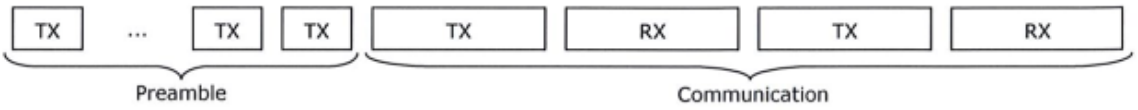
Measurement uncertainty: < 2 GHz: + 1.7/- 1.9 dB;
≥ 2 GHz: + 2.4/- 2.7 dB

**Limit:**

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

## 2.6 Average factor

| | | |
|---|---|---|
| Compliance standard | : | -- |
| Method of test | : | FCC part 15, subpart C, section 15.35 (b) and (c) |
| Ambient temperature | : | 23 °C |
| Relative humidity | : | 36 % |
| Test results | : | |




**Communication session.**

Worst case controller duty cycle in 100 ms is when communicating with a low power (LPM) actuator where a preamble frame are sent each ms for 510 ms. Each preamble frame has a length of 11 bytes (88 bit), which gives a transmission time of; 88 bit/250kbps = 352 µs. In 1 ms this equals a duty cycle of 352 µs/1 ms = 35.2 %

In RF power this gives the following difference in dB between peak and average:
$20 \log_{10} 0.352 = -9.0$ 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. No. 558074 D01 v03r01
Ambient temperature : 23 °C
Relative humidity : 36 %

Test results :

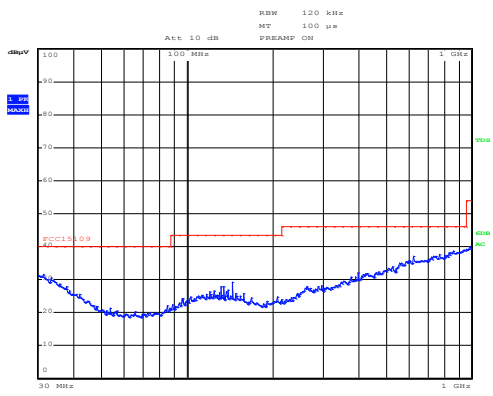
| Frequency (MHz) | Test results peak (dBµV/m) | | Average factor (dB) | Test results average (dBµV/m) | | Resolution bandwidth (kHz) | Peak limit (dBµV/m) | Average limit (dBµV/m) |
|---|---|---|---|---|---|---|---|---|
| | *@ 3m* | | | *@3m* | | | *@3m* | *@3m* |
| | V | H | | V | H | | | |
| 4850 | 61.2 | 59.8 | -9.0 | 52.2 | 50.8 | 1000 | 74 | 54 |
| 4900 | 61.2 | 61.4 | -9.0 | 52.2 | 52.4 | 1000 | 74 | 54 |
| 4950 | 60.7 | 60.4 | -9.0 | 51.7 | 51.4 | 1000 | 74 | 54 |
| 7275 | 59.7 | 55.1 | -9.0 | 50.7 | 46.1 | 1000 | 74 | 54 |
| 7350 | 62.7 | 53.5 | -9.0 | 53.7 | 44.5 | 1000 | 74 | 54 |
| 7425 | 50.0 | 53.6 | -9.0 | 41.0 | 44.6 | 1000 | 74 | 54 |
| 9600 | 53.3 | 47.5 | -9.0 | 44.3 | 38.5 | 1000 | 74 | 54 |
| 9700 | 51.8 | 47.0 | -9.0 | 42.8 | 38.0 | 1000 | 74 | 54 |
| 9800 | 45.4 | 46.9 | -9.0 | 36.4 | 37.9 | 1000 | 74 | 54 |
| 12125 | 62.4 | 53.3 | -9.0 | 53.4 | 44.3 | 1000 | 74 | 54 |
| 12250 | 62.3 | 56.3 | -9.0 | 53.3 | 47.3 | 1000 | 74 | 54 |
| 12375 | 61.6 | 56.2 | -9.0 | 52.6 | 47.2 | 1000 | 74 | 54 |

Measurement uncertainty: +4.5 / -6.1 dB

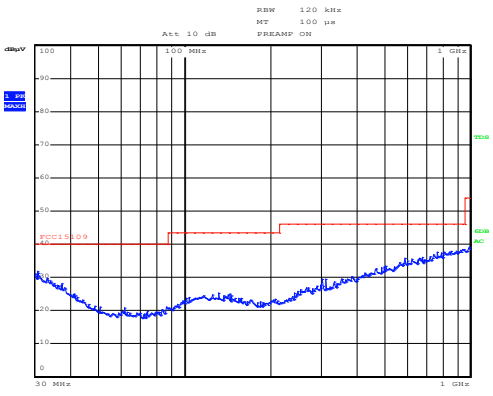
## 2.8 RX unwanted emissions (radiated, 0.03 - 1 GHz)

| | | |
|---|---|---|
| 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 | : | 36 % |

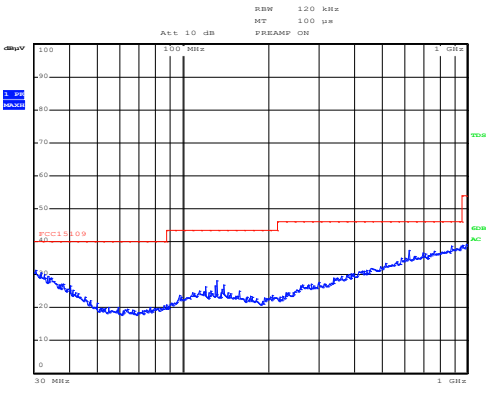
Test results :



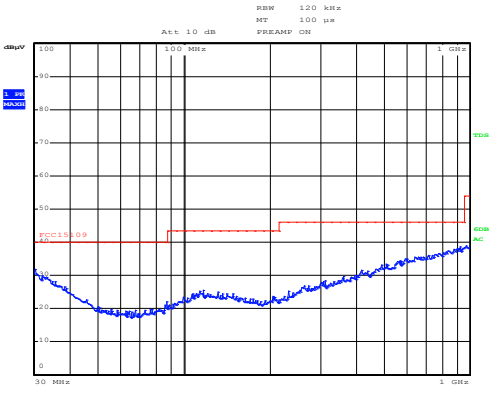
CH 1 (hor. pol.)



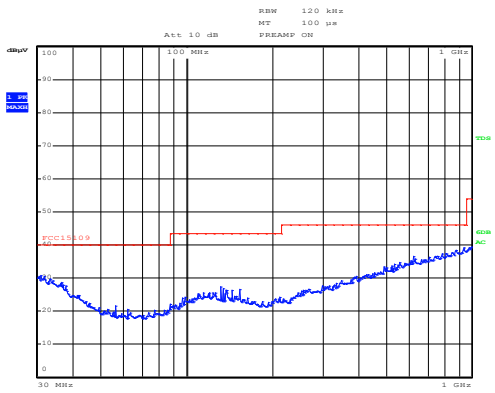
CH 1 (vert. pol)



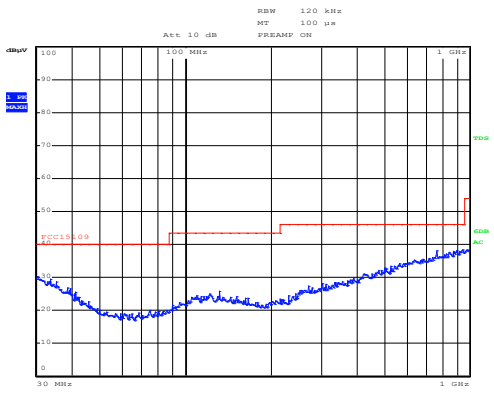
CH 2 (hor. pol.)



CH 2 (vert. pol.)



CH 3 (hor. pol.)



CH 3 (vert. pol.)

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 |

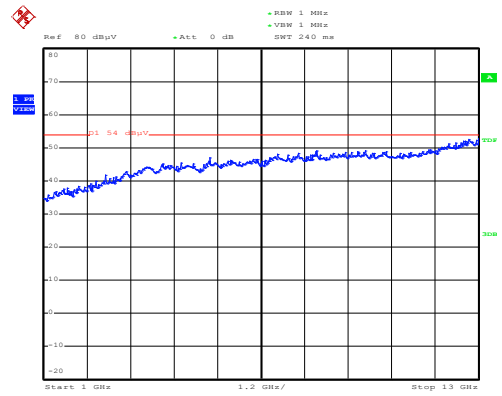
**Limit:**

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

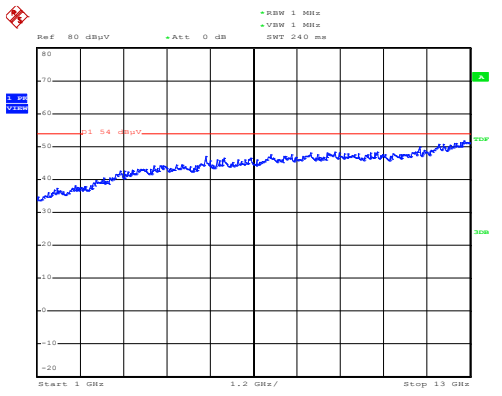
## 2.9 RX unwanted emissions (radiated, 1 - 13 GHz)

| | | |
|---|---|---|
| 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 | : | 36 % |

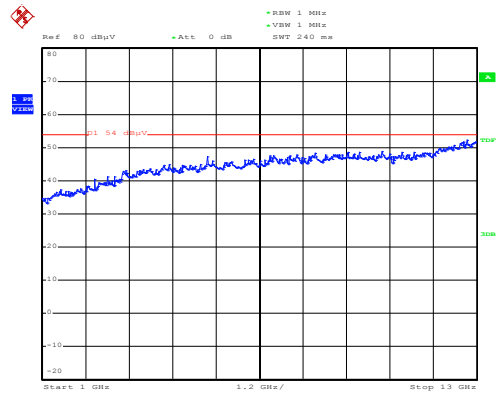
Test results :



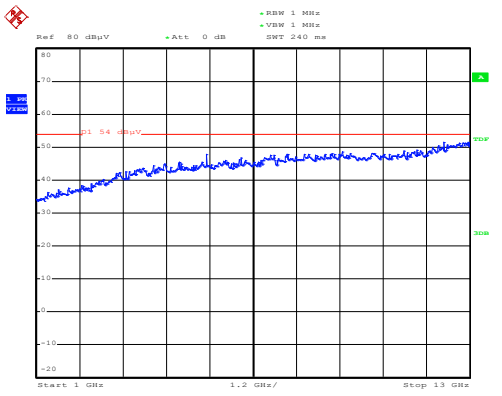
CH 1 (hor. pol.)



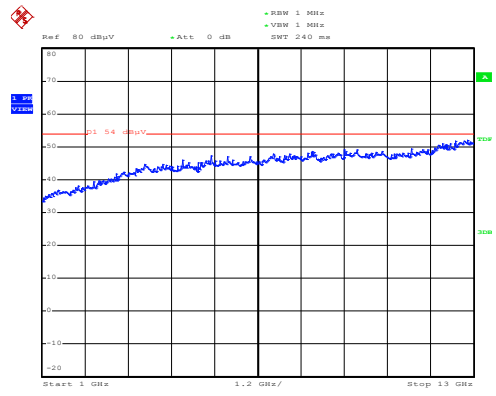
CH 1 (vert. pol)



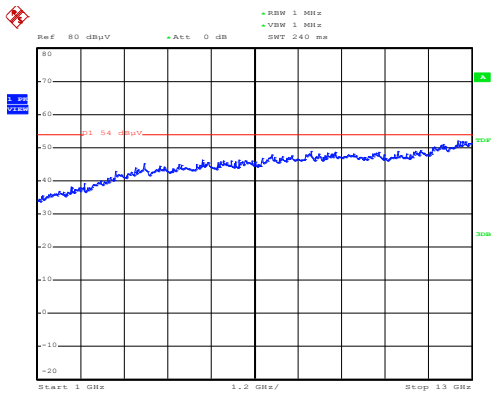
CH 2 (hor. pol.)



CH 2 (vert. pol.)



CH 3 (hor. pol.)



CH 3 (vert. pol.)

Measurement uncertainty: +4.5 / -6.1 dB

**Limit:**

| | |
|---|---|
| Field strength @ 3 meter | Above 1 GHz: ≤ 54 dBµV/m |

# Used test equipment module

| Description | ID | Manufacturer | Model | Used at par. |
|---|---|---|---|---|
| Spectrum Analyzer | TE 11125 | Rohde & Schwarz | FSP 40 | 2.2, 2.3, 2.4, 2.5, 2.7, 2.8, 2.9 |
| Power meter | TE 00489 | Hewlett Packard | 437B | 2.1 |
| Power sensor | TE 00485 | Hewlett Packard | 8481A | 2.1 |
| Pre amplifier | TE 11132 | Miteq | AFS42-041001800-28-OP-42 | 2.9 |
| Horn antenna | TE 00531 | EMCO | 3115 | 2.7, 2.9 |
| Semi Anechoic Room | TE 00861 | Comtest | -- | 2.7, 2.8, 2.9 |
| EMI test receiver | TE 00481 | Rohde & Schwarz | ESCI | 2.8 |
| Biconilog antenna | 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 (10-1-14 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 4** | **FCC 47 CFR Ch. 1 part 15, subpart C (10-1-14 Edition)** |
| § 4.6.1 | -- |
| **Receiver** | |
| **IC RSS-Gen Issue 4** | **FCC 47 CFR Ch. 1 part 15, subpart B (10-1-14 Edition)** |
| § 7.2.3 | § 15.109 |