# ECL-EMC Test Report No.: 15-032

**Equipment under test:** **ION-U EU H 7P/80-85P/17P/19P 1900MHz Path**

**FCC ID:** **XS5–UEUH781719P**

**Type of test:** **FCC 47 CFR Part 24 Subpart E: 2015**
Broadband PCS

**Measurement Procedures:** 47 CFR Parts 2: 2015(*Frequency Allocations and Radio Treaty Matters; General Rules and Regulations*),
24 (Broadband PCS),
ANSI/TIA-603-C (2004), *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*

**Test result:** **Passed**

| | | | |
|---|---|---|---|
| Date of issue: | 29.06.15 | Signature: | |
| Issue-No.: | 01 | Author: | **Tom Zahlmann** Test engineer — Digitally signed by Tom Zahlmann DN: cn=Tom Zahlmann, o=Bureau Veritas CPS, ou=ECL, email=tom.zahlmann@de.bureauveritas.com, c=DE Date: 2015.06.29 15:09:11 +02'00' |
| Date of delivery: | 27.01.15 | Checked: | **Frank Tomandl** Project manager EMC — Digital unterschrieben von Frank Tomandl DN: cn=Frank Tomandl, o=Bureau Veritas CPS, ou=ECL, email=frank.tomandl@de.bureauveritas.com, c=DE Datum: 2015.06.29 15:58:54 +02'00' |
| Test dates: | 15.12.14 – 27.01.15 | | |
| Pages: | 57 | | |

The test report shall not be reproduced except in full without the written approval of the testing laboratory.

**Manufacturer:** ANDREW Wireless Systems GmbH
Industriering 10

D-86675 Buchdorf

Tel.: +49 (0)9099 69 0
Fax: +49 (0)9099 69 140

**Test Location:** Bureau Veritas Consumer Products Services
Germany GmbH
European Compliance Laboratory (ECL)
Thurn-und-Taxis-Straße 18
D-90411 Nürnberg
Tel.: +49 40 74041 0
Fax: +49 40 74041-2755

**General:**
The purpose of this report is to show compliance to the FCC regulations for unlicensed devices operating under section 15.249 of the Code of Federal Regulations title 47.
This report informs about the results of the EMC tests, it only refers to the equipment under test. No part of this report may be reproduced in any form, without written permission.

# Table of contents

1 TEST RESULTS SUMMARY ..... 6

2 EQUIPMENT UNDER TEST (E.U.T.) ..... 7

2.1 DESCRIPTION ..... 7
2.1.1 DOWNLINK ..... 7
2.1.2 UPLINK ..... 7
2.1.3 DESCRIPTION OF EUT ..... 8
2.1.4 BLOCK DIAGRAM OF MEASUREMENT REFERENCE POINTS ..... 9
2.1.5 DOWNLINK SYSTEM GAIN AND OUTPUT POWER ..... 9

3 TEST SITE (ANDREW BUCHDORF) ..... 10

3.1 TEST ENVIRONMENT ..... 10

3.2 TEST EQUIPMENT ..... 10

3.3 INPUT AND OUTPUT LOSSES ..... 11

3.4 MEASUREMENT UNCERTAINTY ..... 11

4 TEST SITE (BUREAU VERITAS CONSUMER PRODUCTS SERVICES) ..... 11

5 RF POWER OUT: §24.232, §2.1046 ..... 12

5.1 LIMIT ..... 12

5.2 TEST METHOD ..... 12

5.3 TEST RESULTS ..... 13
5.3.1 DOWNLINK ..... 14
5.3.1.1 GSM ..... 16
5.3.1.2 EDGE ..... 16
5.3.1.3 CDMA ..... 17
5.3.1.4 WCDMA ..... 17
5.3.1.5 LTE ..... 18
5.3.2 UPLINK ..... 18

5.4 SUMMARY TEST RESULT ..... 18

6 OCCUPIED BANDWIDTH: §2.1049; ..... 19

6.1 LIMIT ..... 19

6.2 TEST METHOD ..... 19
6.2.1 DOWNLINK ..... 20
6.2.1.1 GSM ..... 21
6.2.1.2 EDGE ..... 22
6.2.1.3 CDMA ..... 23
6.2.1.4 WCDMA ..... 24
6.2.1.5 LTE ..... 25
6.2.2 26DB BANDWIDTH ..... 26
6.2.2.1 GSM ..... 26
6.2.2.2 EDGE ..... 27
6.2.2.3 CDMA ..... 28
6.2.2.4 WCDMA ..... 29
6.2.2.5 LTE ..... 30

6.2.3 UPLINK ..... 31

6.3 SUMMARY TEST RESULT ..... 31

7 SPURIOUS EMISSIONS AT ANTENNA TERMINALS: §24.238, §2.1051 ..... 32

7.1 LIMIT ..... 32

7.2 TEST METHOD ..... 32

7.3 TEST RESULTS ..... 33
7.3.1 DOWNLINK ..... 33
7.3.1.1 GSM ..... 34
7.3.1.2 EDGE ..... 34
7.3.1.3 CDMA ..... 35
7.3.1.4 WCDMA ..... 35
7.3.1.5 LTE ..... 36
7.3.2 UPLINK ..... 36

7.4 SUMMARY TEST RESULT ..... 36

8 INTERMODULATION: §24.238, §2.1051 ..... 37

8.1 LIMIT ..... 37

8.2 TEST METHOD ..... 37

8.3 TEST RESULTS ..... 38
8.3.1 DOWNLINK ..... 38
8.3.1.1 GSM ..... 39
8.3.1.2 EDGE ..... 40
8.3.1.3 CDMA ..... 41
8.3.1.4 WCDMA ..... 42
8.3.1.5 LTE ..... 43
8.3.2 UPLINK ..... 44

8.4 SUMMARY TEST RESULT ..... 44

9 OUT OF BAND REJECTION ..... 45

9.1 LIMIT ..... 45

9.2 TEST METHOD ..... 45

9.3 TEST RESULTS ..... 45
9.3.1 DOWNLINK ..... 46
9.3.2 UPLINK ..... 46

9.4 SUMMARY TEST RESULT ..... 46

10 FIELD STRENGTH OF SPURIOUS EMISSIONS: §24.238, §2.1053 ..... 47

10.1 LIMIT §22.917 ..... 51

10.2 TEST METHOD ANSI/TIA/EA-603-C ..... 52

10.3 CLIMATIC VALUES IN THE LAB ..... 52

10.4 TEST RESULTS ..... 53
10.4.1 30 MHZ TO 1 GHZ DOWNLINK (BOTTOM – MIDDLE – TOP) SUBPART H ..... 53
10.4.2 30 MHZ TO 1 GHZ DOWNLINK (MIDDLE OF ALL PATHS) ..... 54
10.4.3 1 GHZ TO 20 GHZ DOWNLINK (BOTTOM – MIDDLE – TOP) SUBPART H ..... 55
10.4.4 1 GHZ TO 20 GHZ DOWNLINK (MIDDLE OF ALL PATHS) ..... 56

11 HISTORY ..... 57

The test report shall not be reproduced except in full without the written approval of the testing laboratory.

# 1 Test Results Summary

| Name of Test | FCC Para. No. | FCC Method | FCC Spec. | Result |
|---|---|---|---|---|
| RF Power Output | 24.232(a) | 2.1046(a) | 1640 Watts E.I.R.P | Complies |
| Occupied Bandwidth | KDB 935210 D02 v02r01 D.3(j) | 2.1049(h) | Input/Output | Complies |
| Spurious Emissions at Antenna Terminals | 24.238(a) | 2.1051 | -13dBm | Complies |
| Field Strength of Spurious Emissions | 24.238(a) | 2.1053 | -13dBm E.I.R.P | Complies |
| Intermodulation | KDB 935210 D02 v02r01 D.3(i) | KDB 935210 D02 v02r01 D.3(i) | KDB 935210 D02 v02r01 D.3(i) | Complies |
| Frequency Stability | NA | 2.1055(a)(d) | Must stay in band | NA |
| Out of Band Rejection | KDB 935210 D02 v02 | KDB 935210 D03 v02 | KDB 935210 D03 v02 | Complies |

Frequency stability is given by: The system gets an electrical analog signal from the BSS which is converted into an analog optical signal, transmitted by the optical links and then reconverted in the Remote Unit into an analog electrical signal. During this process happens no frequency change/modification, so input and output have same frequency what can be seen under clause “Occupied Bandwidth”.

# 2 Equipment under test (E.U.T.)

## 2.1 Description

| | |
|---|---|
| Kind of equipment | ION-U EU H 7P/80-85P/17P/19P-Vac-M2 |
| Andrew Ident. Number | 7698401-0001 |
| Serial no.(SN) | 11 |
| Revision | 00 |
| Software version and ID | 1.69.0 |
| Type of modulation and Designator | GSM (GXW) ☒<br>GSM EDGE (G7W) ☒<br>CDMA (F9W) ☒<br>W-CDMA (F9W) ☒<br>LTE (G7D) ☒ |
| Frequency Translation | F1-F1 ☒<br>F1-F2 ☐<br>N/A ☐ |
| Band Selection | Software ☐<br>Duplexer ☒<br>Full band ☐ |

### 2.1.1 Downlink

| | |
|---|---|
| Pass band | Path 1930 MHz – 1995 MHz |
| Max. composite output power based on one carrier per path (rated) | 43.0 dBm = 20 W |
| MIMO max. composite output power based on one carrier per path (rated) | 46.0 dBm = 40 W |
| System Gain* | 10 dB @ Pout BTS of 33 dBm |

*see 2.1.5

### 2.1.2 Uplink

| | |
|---|---|
| Pass band | Path 1850 MHz – 1915 MHz |
| Maximum rated output power | n. a. |
| System Gain* | n.a. |

*see 2.1.5

Note: The EUT does not transmit over the air in the uplink direction.

### 2.1.3 Description of EUT

CommScope's ION-U EU H 7P/80-85P/17P/19P-Vac-M2 is a multi-band, multi-operator extension unit for MIMO application in all RF paths. It is used in conjunction with the main unit ION-U H 7P/80-85P/17P/19P-Vac-M2. This extension transports up to four frequency bands simultaneously, providing a cost-effective solution for distributing capacity from one or more base stations.

This Test Report describes only the approval of the 1900 MHz Path.
The ION-U EU H 7P/80-85P/17P/19P-Vac-M2 Repeater system consists of one 700 MHz path, one 800-850 MHz path, one 1700/2100 MHz path and one 1900 MHz path with the intended use of simultaneous transmission.
The antenna(s) used with device must be fixed-mounted on permanent structures.

### 2.1.4 Block diagram of measurement reference points

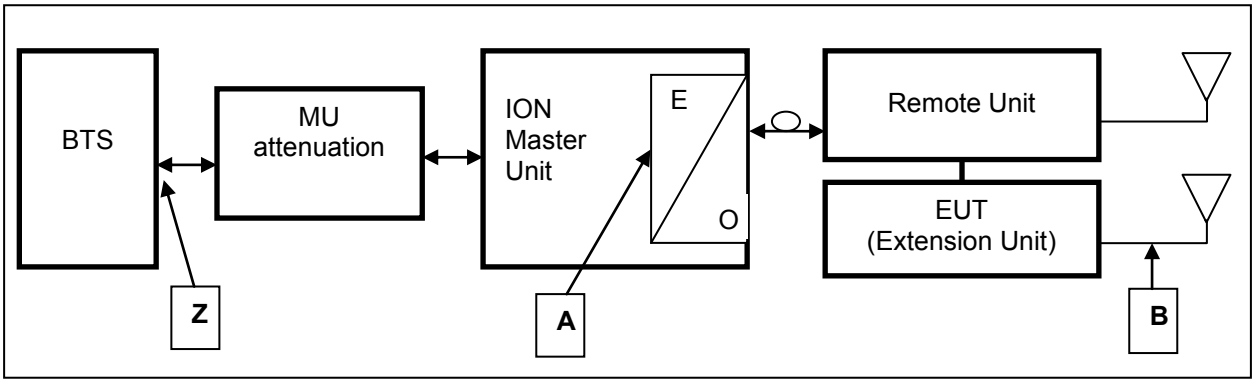



figure 2.1.4-#1 Block diagram of measurement reference points

Extension Unit 1 (EU1) is the EUT

| | |
|---|---|
| O/E | Optical / Electrical converter |
| MU | Master Unit |

| | | | |
|---|---|---|---|
| Reference point A | MU | UL output, | DL input |
| Reference point B | Extension Unit | DL output, | UL input |
| Reference point Z | BTS | DL output, | UL input |

Since a signal generator does not supply a good output signal with +33 or +43dBm, for the downlink measurement the MU Attenuation is not used.
That means for downlink measurements the signal generator is connected to measurement point A at the master optical / electrical converter and the analyzer to the measurement point B at the EU.

### 2.1.5 Downlink System Gain and Output Power

| System optimized for BTS power *(fixed value)* **Z** | MU Attenuation *(manual leveling)* | Maximum rated input power at the MU OTRX *(fixed value)* **A** | EU Gain *(fixed value)* **A to B** | Maximum rated output power at EU Antenna port *(fixed value)* **B** |
|---|---|---|---|---|
| **+33 dBm** | **55 dB** | **-22 dBm** | **+65 dB** | **+43.0 dBm** *@ 1 carrier* |
| **System Gain Z to B** | **+10 dB** | | | |
| **+43 dBm** | **65 dB** | **-22 dBm** | **+65 dB** | **+43.0 dBm** *@ 1 carrier* |
| **System Gain Z to B** | **+0 dB** | | | |

table 2.1.5-#1 Equipment under test (E.U.T.) Description Downlink System Gain and Output Power

# 3 Test site (Andrew Buchdorf)

## 3.1 Test environment

All tests were performed under the following environmental conditions:

| Condition | Minimum value | Maximum value |
|---|---|---|
| Barometric pressure | 86 kPa | 106 kPa |
| Temperature | 15°C | 30°C |
| Relative Humidity | 20 % | 75 % |
| Power supply range | ±5% of rated voltages | |

## 3.2 Test equipment

| ANDREW Inv. No. | Test equipment | Type | Manufacturer | Serial No. | Calibration |
|---|---|---|---|---|---|
| 9266 | Network Analyzer | ZNB 20 | R&S | 101490 | 12/2015 |
| 9236 | Spectrum Analyzer | FSV 30 | R&S | 101345 | 9/2015 |
| 9069 | Generator | SMBV100A | R&S | 256275 | 08/2015 |
| 9046 | Generator | SMBV100A | R&S | 255090 | 06/2015 |
| 8542 | Power Meter | E4418A | Agilent | GB38273230 | 02/2015 |
| 8544 | Power Sensor | E8481H | Agilent | 3318A19208 | 07/2015 |
| 7157 | RF-Cable | Succoflex | Suhner | 36180/4P | CIU |
| 7158 | RF-Cable | Succoflex | Suhner | 36182/4P | CIU |
| 7289 | RF-Cable | Succoflex | Suhner | 28443/4PE | CIU |
| 7290 | RF-Cable | Succoflex | Suhner | 28444/4PE | CIU |
| 7385 | RF-Cable | Succoflex | Suhner | 36267/4P | CIU |
| 7387 | RF-Cable | Succoflex | Suhner | 36267/4P | CIU |
| 7390 | RF-Cable | Succoflex | Suhner | 40193/4P | CIU |
| 7381 | RF-Cable | Succoflex | Suhner | 40200/4P | CIU |
| 7459 | Notch filter | WRCTF 1930 | Wainwright Instruments | 1 | CIU |
| 7406 | Switch-Matrix | | Andrew | | CIU |

CIU = Calibrate in use

## 3.3 Input and output losses

All recorded power levels should be referenced to the input and output connectors of the repeater, unless explicitly stated otherwise.
The test equipment used in this test has to be calibrated, so that the functionality is also checked.
All cables, attenuators, splitter, isolator, circulator and combiner etc. must be measured before testing and used for compensation during testing.

## 3.4 Measurement uncertainty

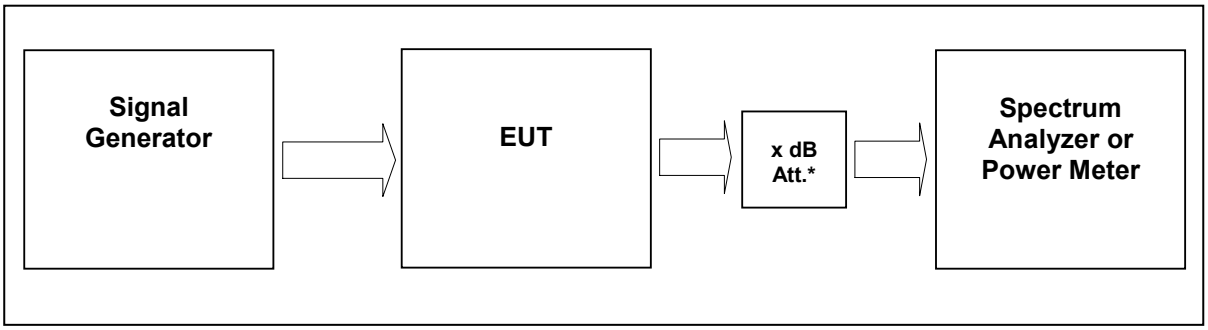
The extended measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k=2. The true value is located in the corresponding interval with a probability of 95 %.

# 4 Test site (Bureau Veritas Consumer Products Services)

FCC Test site: 96997

**See relevant dates under section 8.**

# 5 RF Power Out: §24.232, §2.1046




External Attenuator DL x dB = 20 dB

figure 5-#1 Test setup: RF Power Out: §24.232, §2.1046

| | |
|---|---|
| Measurement uncertainty | ± 0,38 dB |
| Test equipment used | 9069, 9046, 9236, 7406, 7157, 7158, 7289, 7290, 7385 |

## 5.1 Limit

Minimum standard:

Para. No.24.232

(a)(1) Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(2) Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

Table 1—Reduced Power for Base Station Antenna Heights Over 300 Meters

| HAAT in meters | Maximum EIRP watts |
|---|---|
| ≤ 300 | 1640 |
| ≤ 500 | 1070 |
| ≤ 1000 | 490 |
| ≤ 1500 | 270 |
| ≤ 2000 | 160 |

## 5.2 Test method

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the testconditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations

## 5.3 Test Results

Detector RMS.

**Test signal GSM:**
Signal waveform with GMSK modulation in all time slots according to 3GPP TS45.004

**Test signal GSM EDGE:**
Signal waveform with 8-PSK modulation in all time slots according to 3GPP TS45.004

**Test signal CDMA:**
Signal waveform according to table 6.2-1 of standard specification 3GPP2 C.p0051-0 v1.0 16.February 2006 pilot, sync, paging, 37 traffics, which is equal to the table 6.5.2.1 of 3GPP2 C.S0010-C v2.0 24.February 2006.

**Test signal WCDMA:**
Signal waveform according to Test Model 1 of standard specification 3GPP TS25.141. Signal modulated with a combination of PCCPCH, SCCPCH and Dedicated Physical Channels specified as test model 1 64 DPCH.

**Test signal LTE:**
Signal waveform according to Test Model 1.1, E-TM1.1, clause 6.1.1.1-1, table 6.1.1.1-1 of standard specification 3GPP TS 36.141 V9.3.0 (2010-03).

### 5.3.1 Downlink

| Modulation | Measured at | Carrier /MHz | RBW VBW Span | RF Power (dBm) | RF Power (W) | MIMO* RF Power (W) | Plot - |
|---|---|---|---|---|---|---|---|
| GSM | Middle | 1962.5 MHz | 1MHz 3MHz 10MHz | 43.0 | 20 | 40 | 5.3.1.1 #1 |
| EDGE | Middle | 1962.5 MHz | 1MHz 3MHz 10MHz | 43.0 | 20 | 40 | 5.3.1.2 #1 |
| CDMA | Middle | 1962.5 MHz | 3MHz 10MHz 15MHz | 43.0 | 20 | 40 | 5.3.1.3 #1 |
| WCDMA | Middle | 1962.5 MHz | 10MHz 10MHz 50MHz | 43.0 | 20 | 40 | 5.3.1.4 #1 |
| LTE | Middle | 1962.5 MHz | 3MHz 10MHz 15MHz | 43.0 | 20 | 40 | 5.3.1.5 #1 |
| Maximum output power = 43.0 dBm = 20 W | | | | | | | |
| Limit Maximum output power (erp) = 1000 W | | | | | | | |

table 5.3.1-#1 RF Power Out: §24.232, §2.1046 Test Results Downlink

**SISO:**
The max RF Power out is 43 dBm, so the maximum antenna gain (x) can be calculated as follow:

**Limit** = 1000W (erp) = **60 dBm** Info: 1000W (erp) = 1640W (eirp)

60 dBm **>** 43 dBm + x ------> x = 60 dBm – 43 dBm = 17 dBd
x dBi = 17 dBd + 2.15 = 19.15 dBi

=> The antenna that will be used for the complete system have to have a gain lower than 19.15 dBi, relative to a dipol.

***MIMO:**

MIMO path test results see RF Test Report FCC ID XS5-UH781719P.

If the DUT used in MIMO configuration according to KDB 662911, the MIMO Max RF Power is the sum of the RF power from the SISO path and MIMO path.

**MIMO Max RF Power = SISO path RF Power + MIMO path RF Power**

**MIMO Max RF Power = 20 W + 20 W = 40 W = 46 dBm**

The MIMO max RF Power out is 46 dBm, so the maximum antenna gain (x) can be calculated as follow:

**Limit** = 1000W (erp) = **60 dBm** Info: 1000W (erp) = 1640W (eirp)

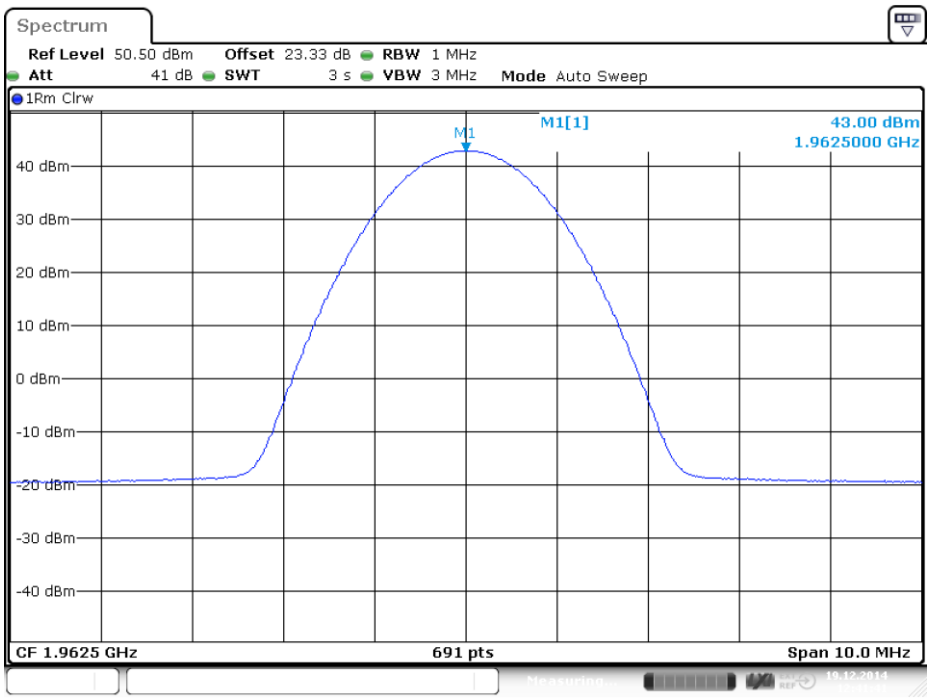
60 dBm **>** 46 dBm + x ------> x = 60 dBm – 46 dBm = 14 dBd
x dBi = 14 dBd + 2.15 = 16.15 dBi

=> The antenna that will be used for the complete system have to have a gain lower than 16.15 dBi, relative to a dipol.

| Modulation | Pin / dBm (Ref. point B) |
|---|---|
| GSM | -22.2 |
| EDGE | -22.2 |
| CDMA | -21.9 |
| WCDMA | -22.0 |
| LTE | -22.1 |

table 5.3.1-#2 RF Power Out: §24.232, §2.1046 Test Results Downlink Input power

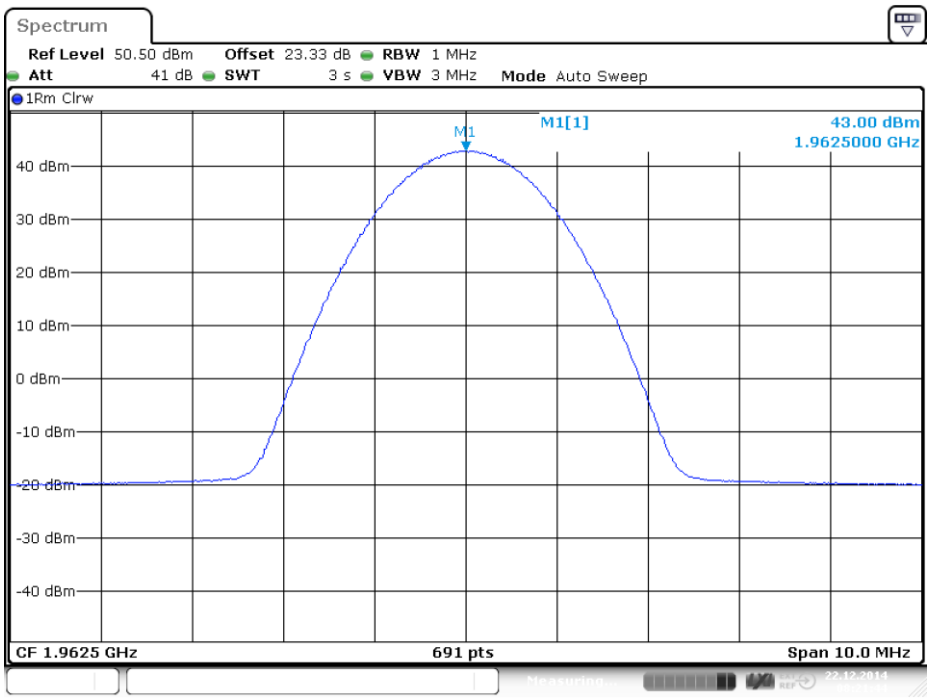
### 5.3.1.1 GSM




Date: 19.DEC.2014 12:41:41

plot 5.3.1.1-#1 RF Power Out: §24.232, §2.1046; Test Results; Downlink; GSM Middle

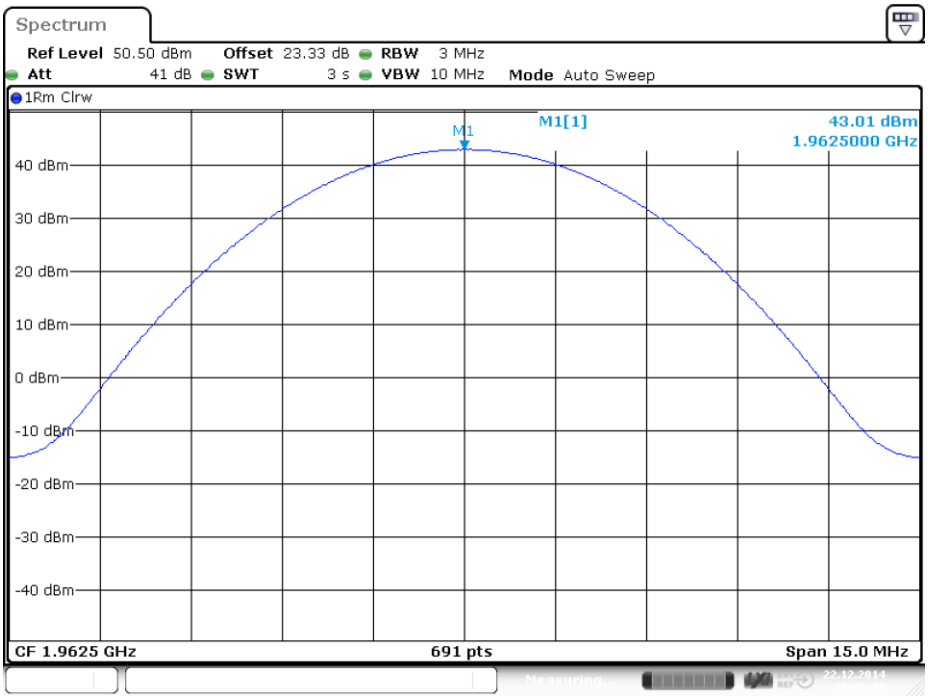
### 5.3.1.2 EDGE




Date: 22.DEC.2014 08:21:44

plot 5.3.1.2-#1 RF Power Out: §24.232, §2.1046; Test Results; Downlink; EDGE Middle

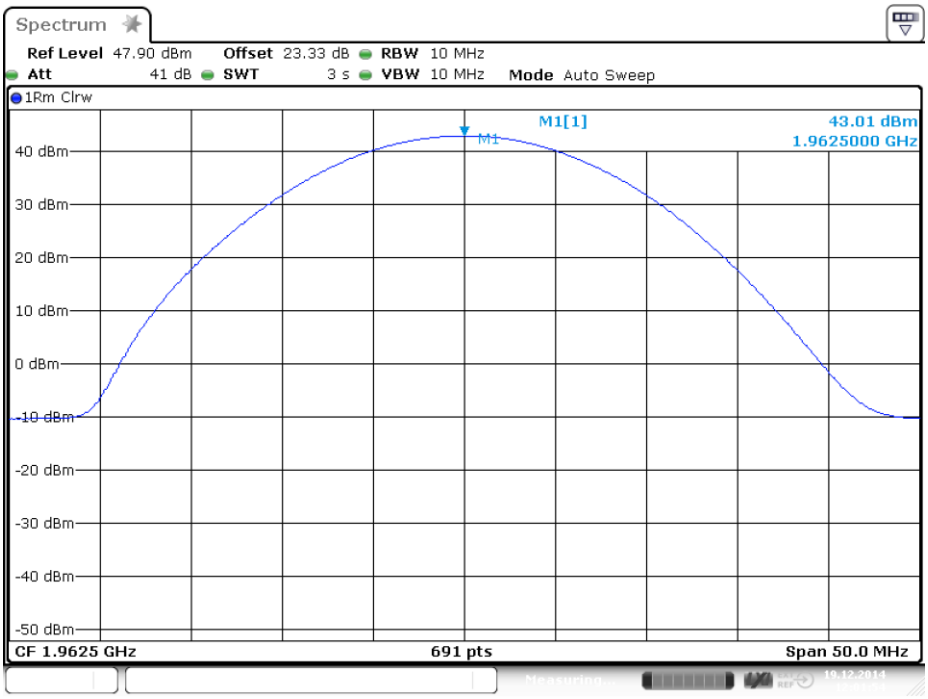
### 5.3.1.3 CDMA




Date: 22.DEC.2014 10:43:32

plot 5.3.1.3-#1 RF Power Out: §24.232, §2.1046; Test Results; Downlink; CDMA Middle

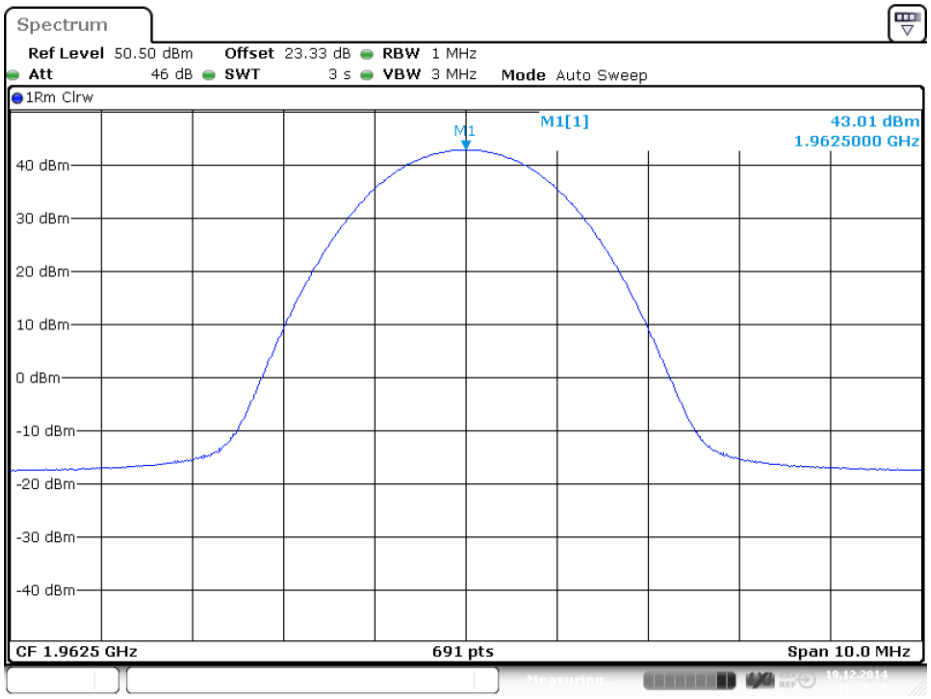
### 5.3.1.4 WCDMA




Date: 19.DEC.2014 12:01:55

plot 5.3.1.4-#1 RF Power Out: §24.232, §2.1046; Test Results; Downlink; WCDMA Middle

#### 5.3.1.5 LTE




plot 5.3.1.5-#1 RF Power Out: §24.232, §2.1046; Test Results; Downlink; LTE Middle

### 5.3.2 Uplink

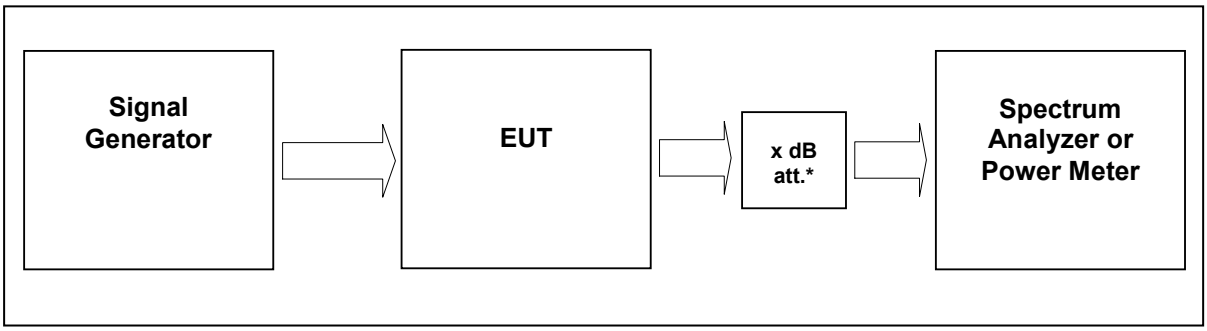
n.a.

Note: The EUT does not transmit over the air in the uplink direction.

## 5.4 Summary test result

| | |
|---|---|
| Test result | complies, according the plots above |
| Tested by: | F. Bengesser |
| Date: | 22.12.2014 |

# 6 Occupied Bandwidth: §2.1049;




External Attenuator DL x dB = 20 dB

figure 6-#1 Test setup: Occupied Bandwidth: §2.1049;

| Measurement uncertainty | ± 0,38 dB |
|---|---|
| Test equipment used | 9069, 9046, 9236, 7406, 7157, 7158, 7289, 7290, 7385 |

## 6.1 Limit

The spectral shape of the output should look similar to input for all modulations.

## 6.2 Test method

Para. No.2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

Test results

### 6.2.1 Downlink

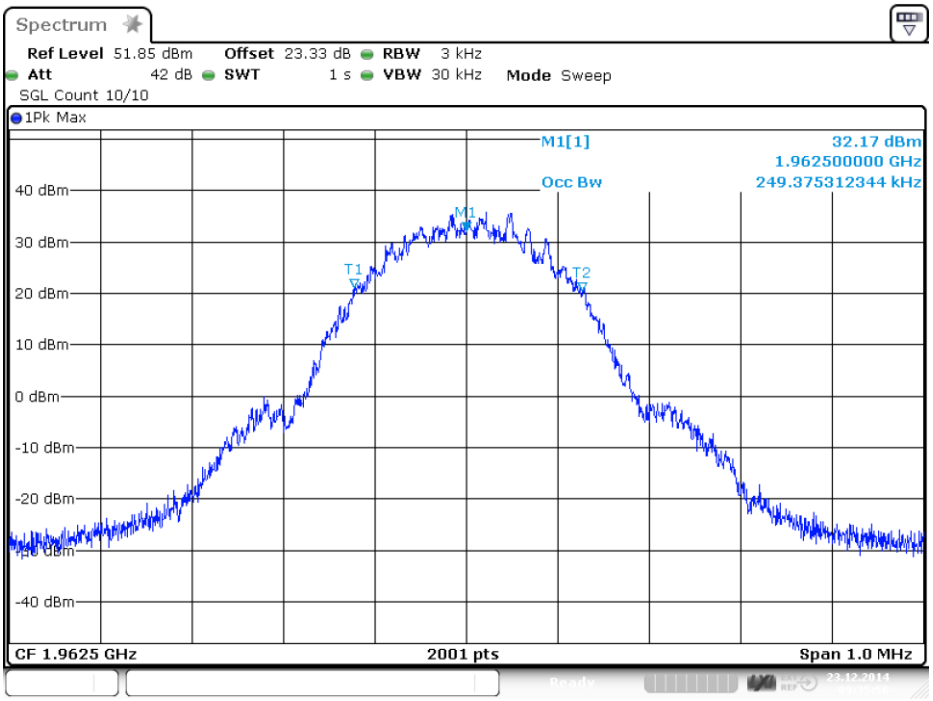
Detector PK.

| Modulation | Measured at | Carrier /MHz | RBW<br>VBW<br>Span | Occupied Bandwidth | Plot # |
|---|---|---|---|---|---|
| GSM | Middle | 1962,5 MHz | 3 kHz<br>30 kHz<br>1 MHz | 249.4 kHz | 6.2.1.1<br>#1, #2 |
| EDGE | Middle | 1962,5 MHz | 3 kHz<br>30 kHz<br>1 MHz | 241.4 kHz | 6.2.1.2<br>#1, #2 |
| CDMA | Middle | 1962,5 MHz | 30 kHz<br>300 kHz<br>5 MHz | 1.2 MHz | 6.2.1.3<br>#1, #2 |
| WCDMA | Middle | 1962,5 MHz | 100 kHz<br>1 MHz<br>10 MHz | 4.2 MHz | 6.2.1.4<br>#1, #2 |
| LTE | Middle | 1962,5 MHz | 30 kHz<br>300 kHz<br>5 MHz | 1.1 MHz | 6.2.1.5<br>#1, #2 |

| Modulation | Measured at | Carrier /MHz | RBW<br>VBW<br>Span | 26dB Bandwidth | Plot # |
|---|---|---|---|---|---|
| GSM | Middle | 1962,5 MHz | 3 kHz<br>30 kHz<br>1 MHz | 321.3 kHz | 6.2.2.1<br>#1, #2 |
| EDGE | Middle | 1962,5 MHz | 3 kHz<br>30 kHz<br>1 MHz | 297.4 kHz | 6.2.2.2<br>#1, #2 |
| CDMA | Middle | 1962,5 MHz | 30 kHz<br>300 kHz<br>5 MHz | 1.4 MHz | 6.2.2.3<br>#1, #2 |
| WCDMA | Middle | 1962,5 MHz | 100 kHz<br>1 MHz<br>10 MHz | 4.7 MHz | 6.2.2.4<br>#1, #2 |
| LTE | Middle | 1962,5 MHz | 30 kHz<br>300 kHz<br>5 MHz | 1.3 MHz | 6.2.2.5#<br>1, #2 |

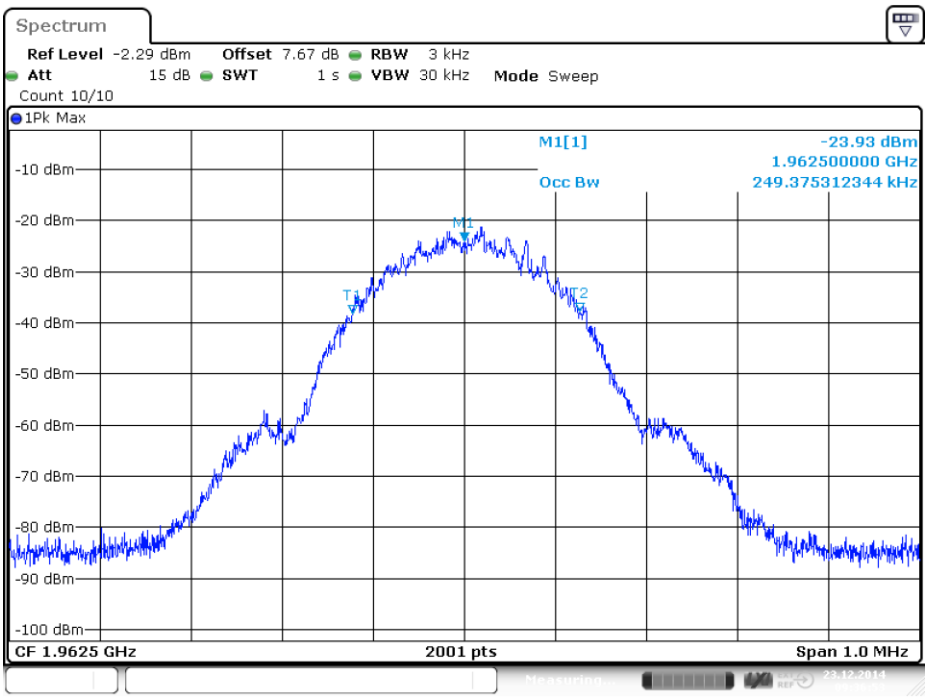
table 6.2-#1 Occupied Bandwidth: §2.1049; Test method

### 6.2.1.1 GSM




Date: 23.DEC.2014 09:35:56

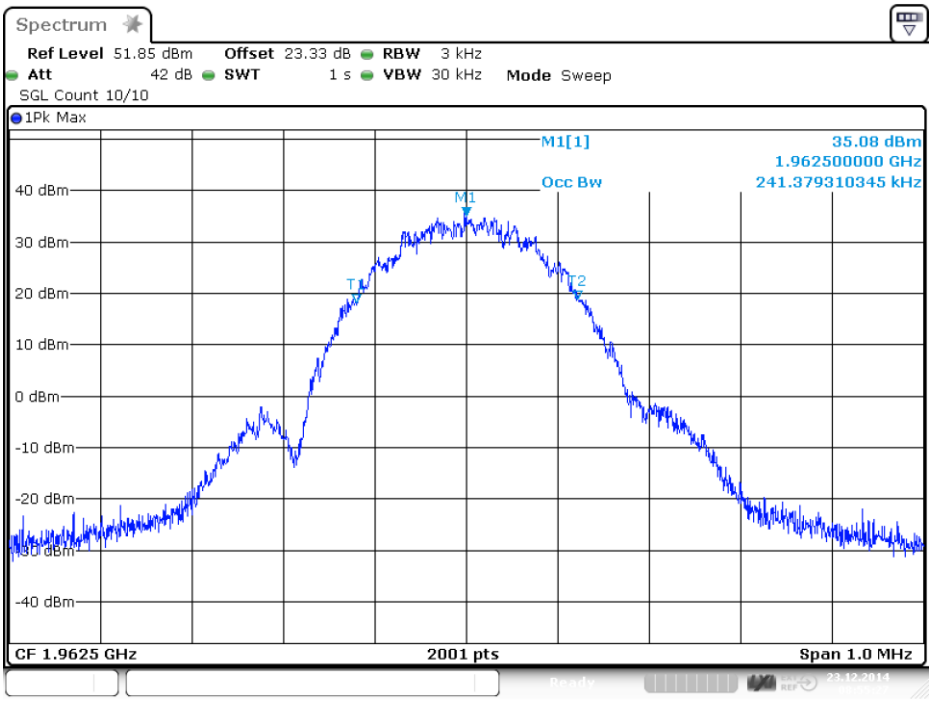
plot 6.2.1.1-#1 Occupied Bandwidth: §2.1049;; Test method; Downlink; GSM Output




Date: 23.DEC.2014 09:36:52

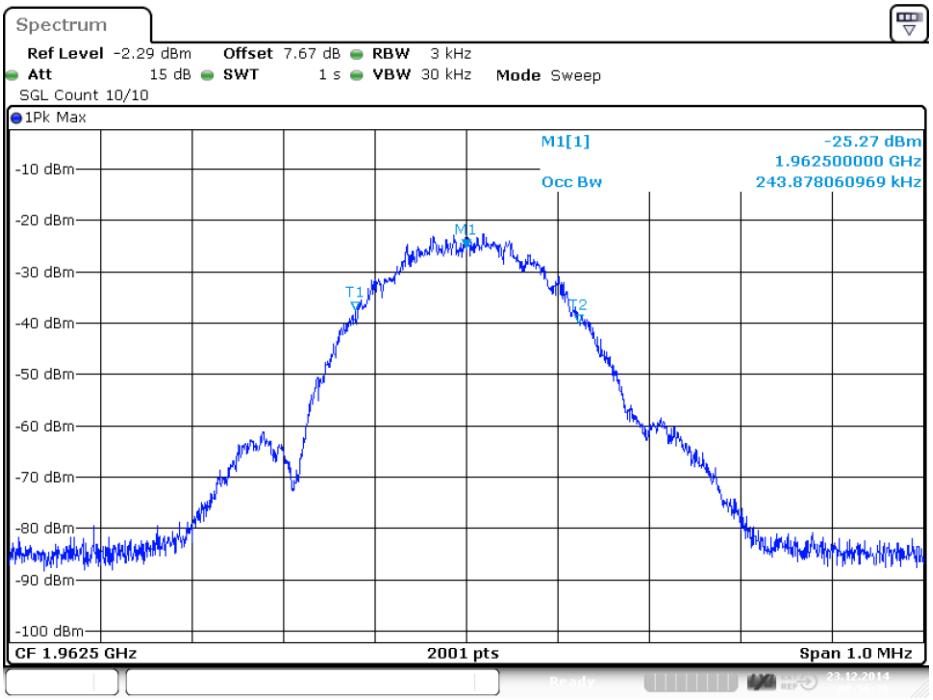
plot 6.2.1.1-#2 Occupied Bandwidth: §2.1049;; Test method; Downlink; GSM Input

### 6.2.1.2 EDGE




Date: 23.DEC.2014 08:55:27

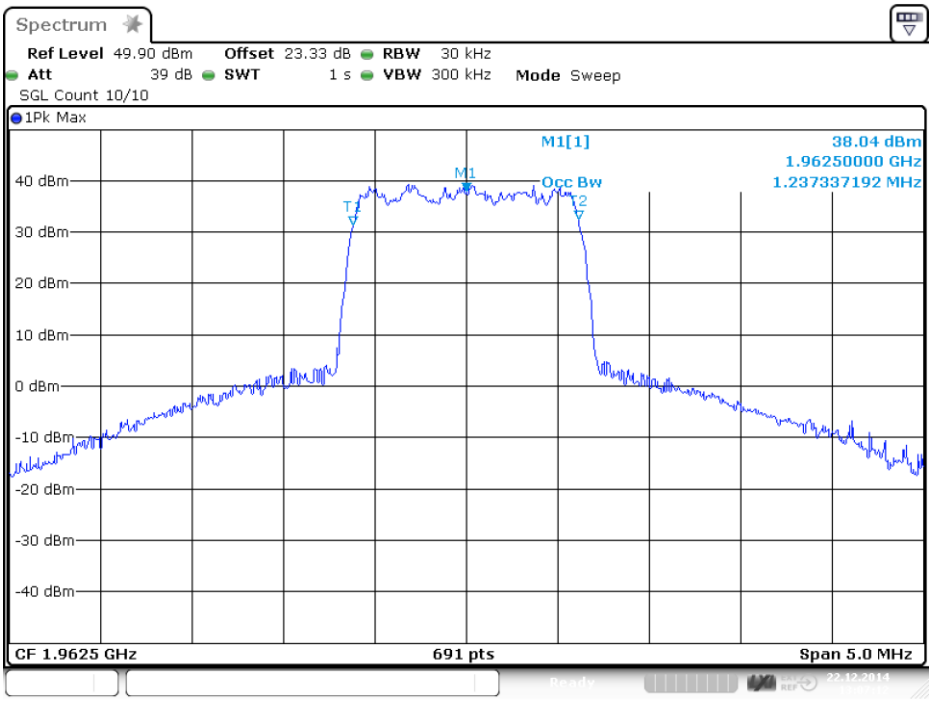
plot 6.2.1.2-#1 Occupied Bandwidth: §2.1049;; Test method; Downlink; EDGE Output




Date: 23.DEC.2014 08:56:35

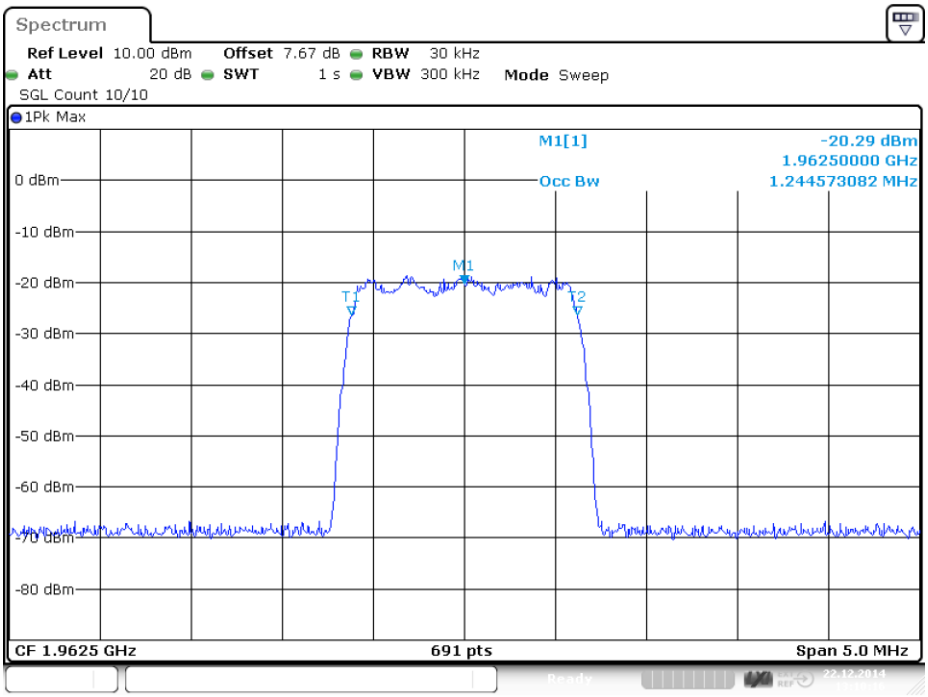
plot 6.2.1.2-#2 Occupied Bandwidth: §2.1049;; Test method; Downlink; EDGE Input

### 6.2.1.3 CDMA




Date: 22.DEC.2014 13:07:13

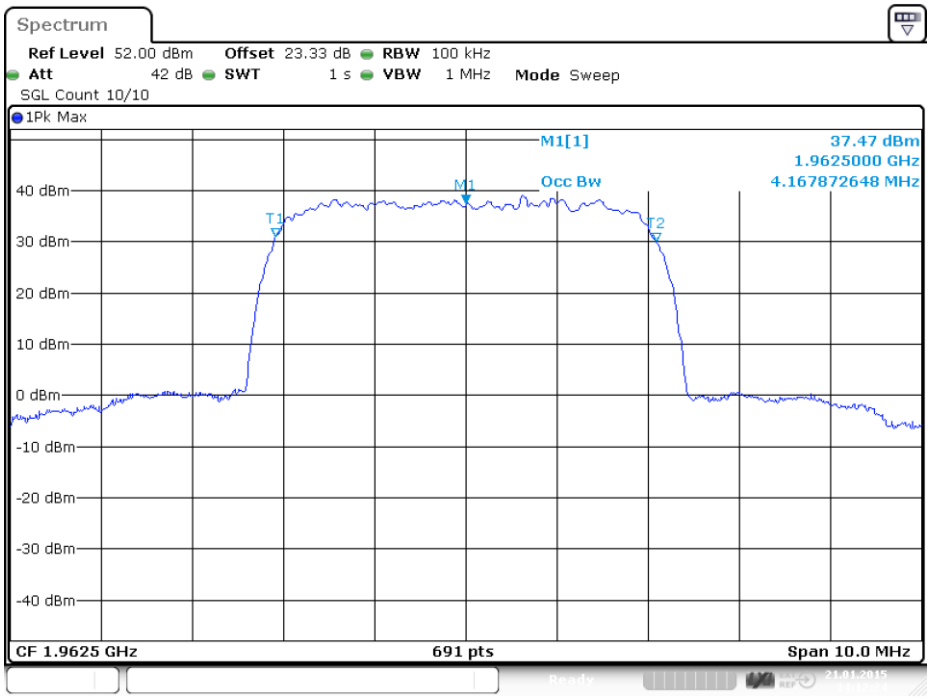
plot 6.2.1.3-#1 Occupied Bandwidth: §2.1049;; Test method; Downlink; CDMA Output




Date: 22.DEC.2014 13:10:16

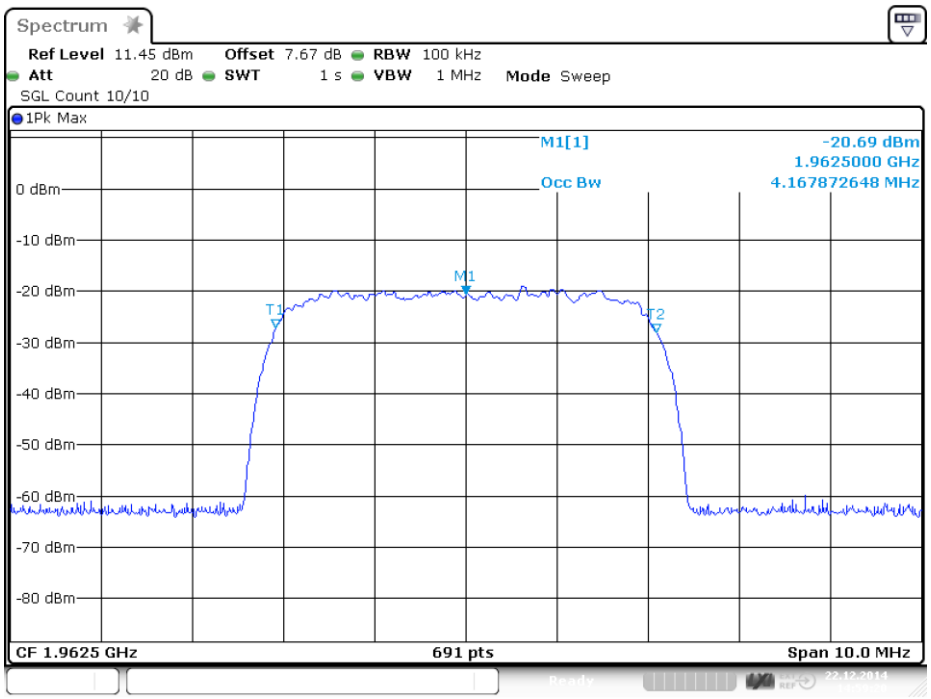
plot 6.2.1.3-#2 Occupied Bandwidth: §2.1049;; Test method; Downlink; CDMA Input

### 6.2.1.4 WCDMA




Date: 21.JAN.2015 14:12:24

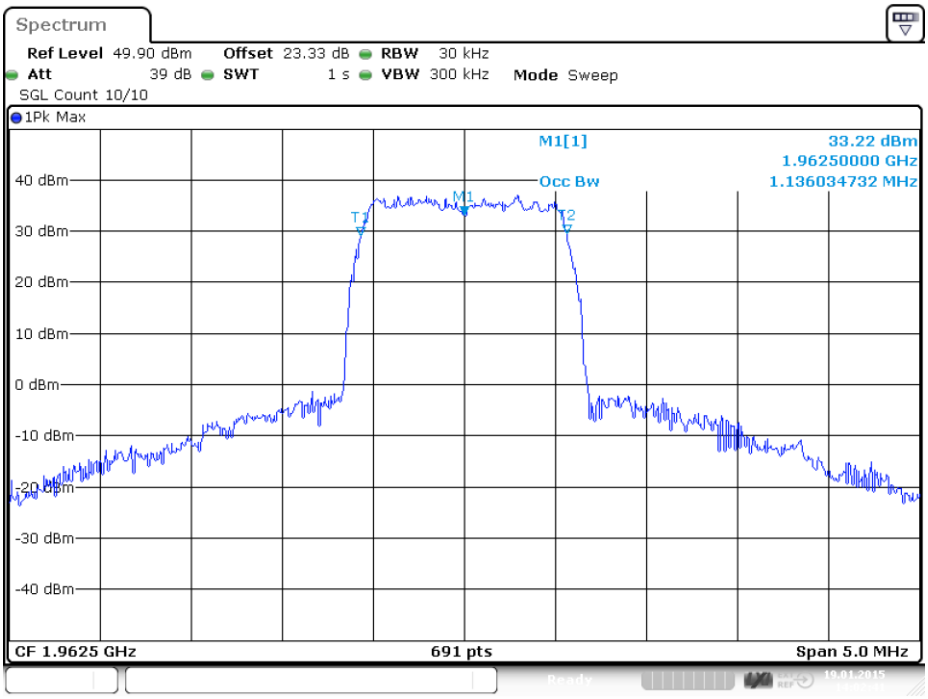
plot 6.2.1.4-#1 Occupied Bandwidth: §2.1049;; Test method; Downlink; WCDMA Output




Date: 22.DEC.2014 14:59:20

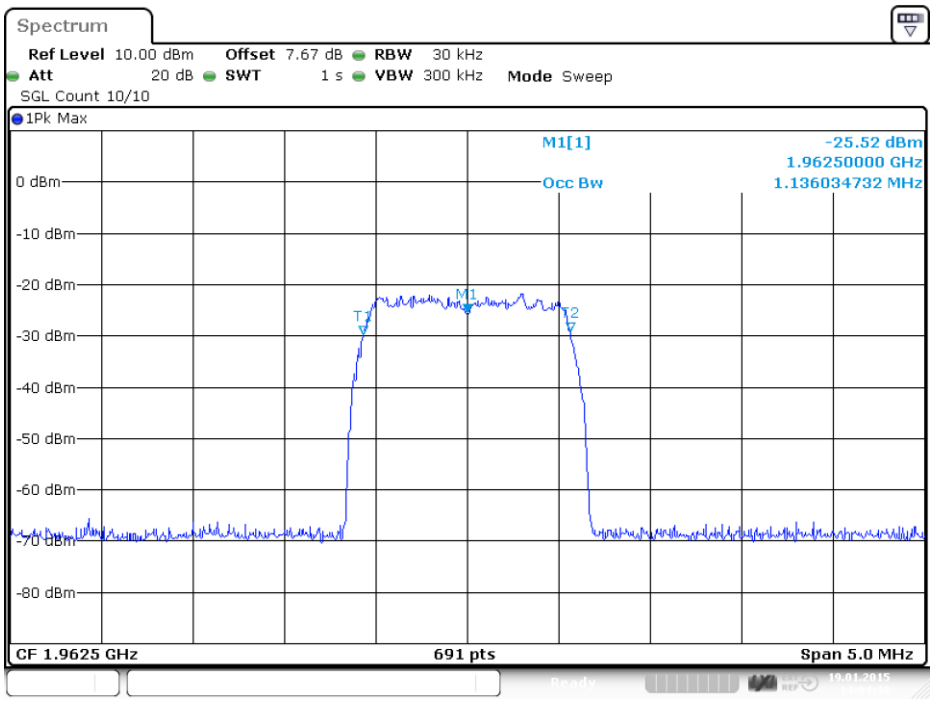
plot 6.2.1.4-#2 Occupied Bandwidth: §2.1049;; Test method; Downlink; WCDMA Input

### 6.2.1.5 LTE




Date: 19.JAN.2015 14:02:42

plot 6.2.1.5-#1 Occupied Bandwidth: §2.1049;; Test method; Downlink; LTE Output

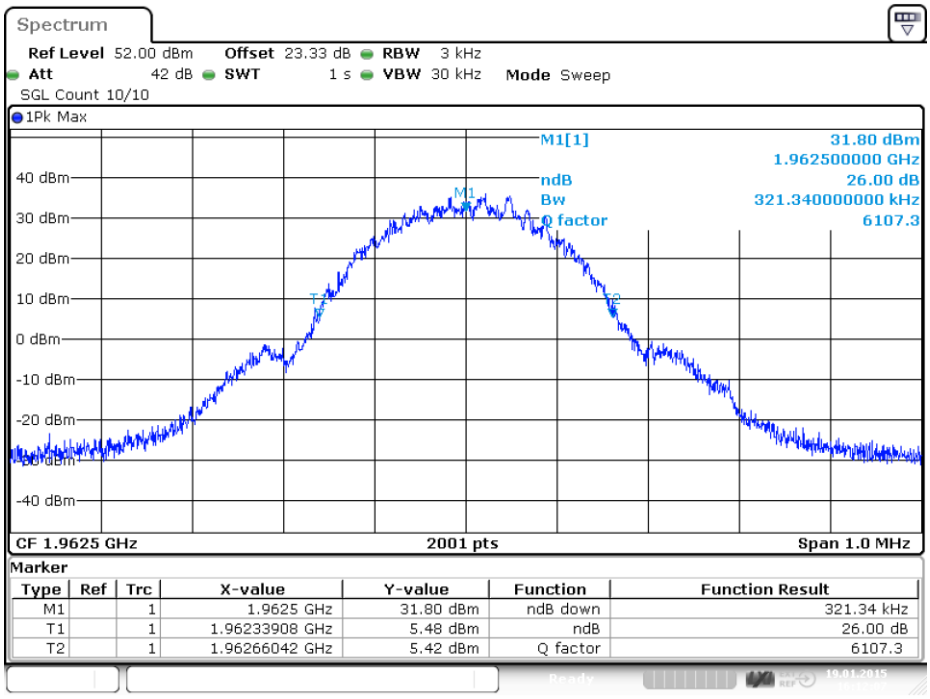



Date: 19.JAN.2015 14:04:49

plot 6.2.1.5-#2 Occupied Bandwidth: §2.1049;; Test method; Downlink; LTE Input

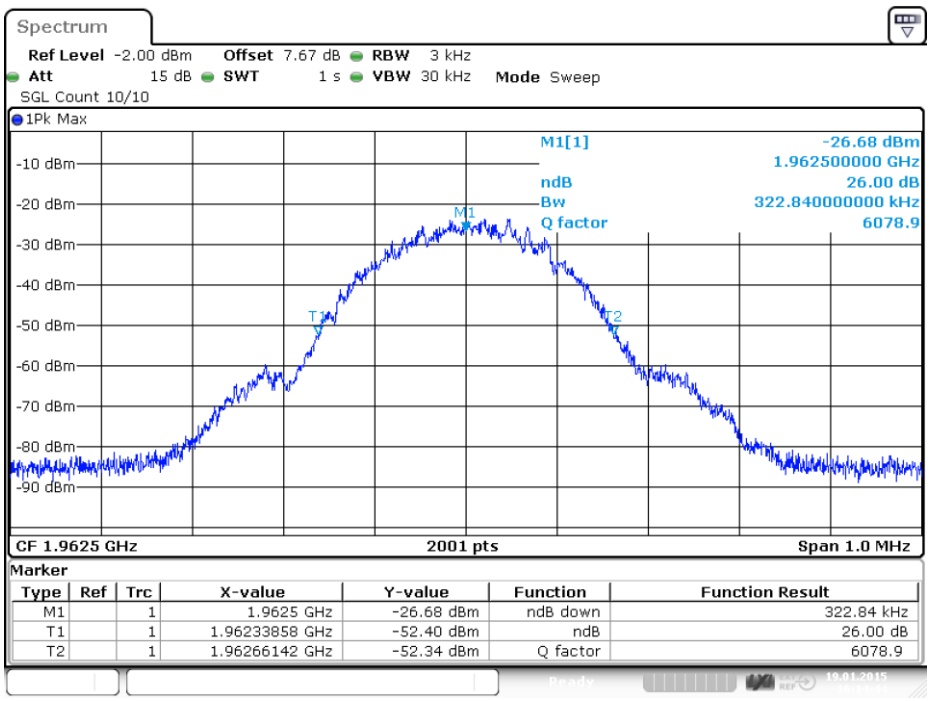
## 6.2.2 26dB Bandwidth

### 6.2.2.1 GSM




Date: 19.JAN.2015 16:12:08

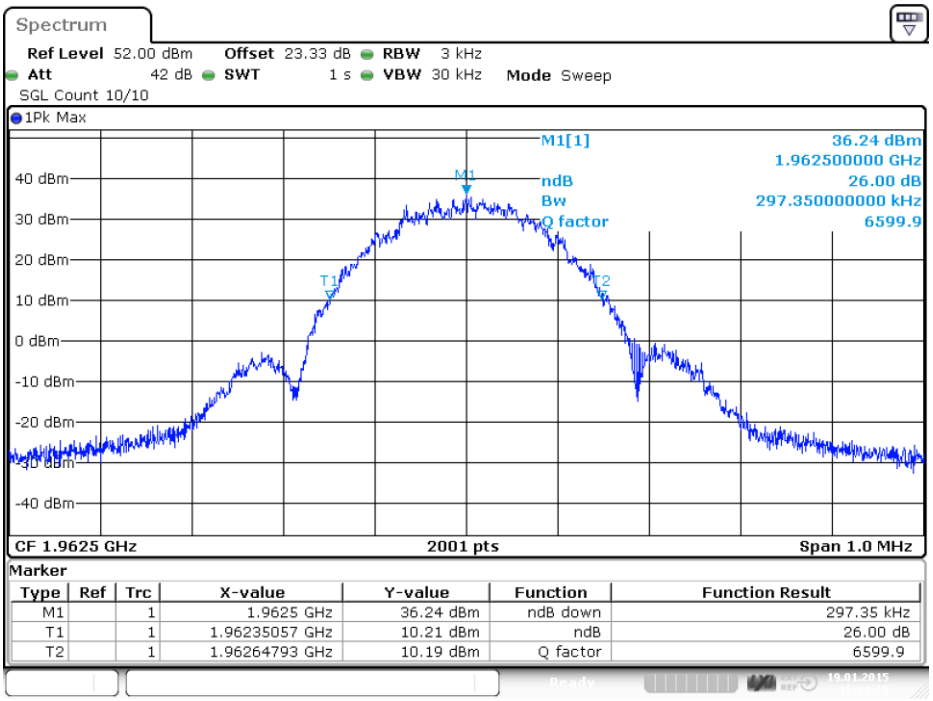
plot 6.2.2.1-#1 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; GSM Output



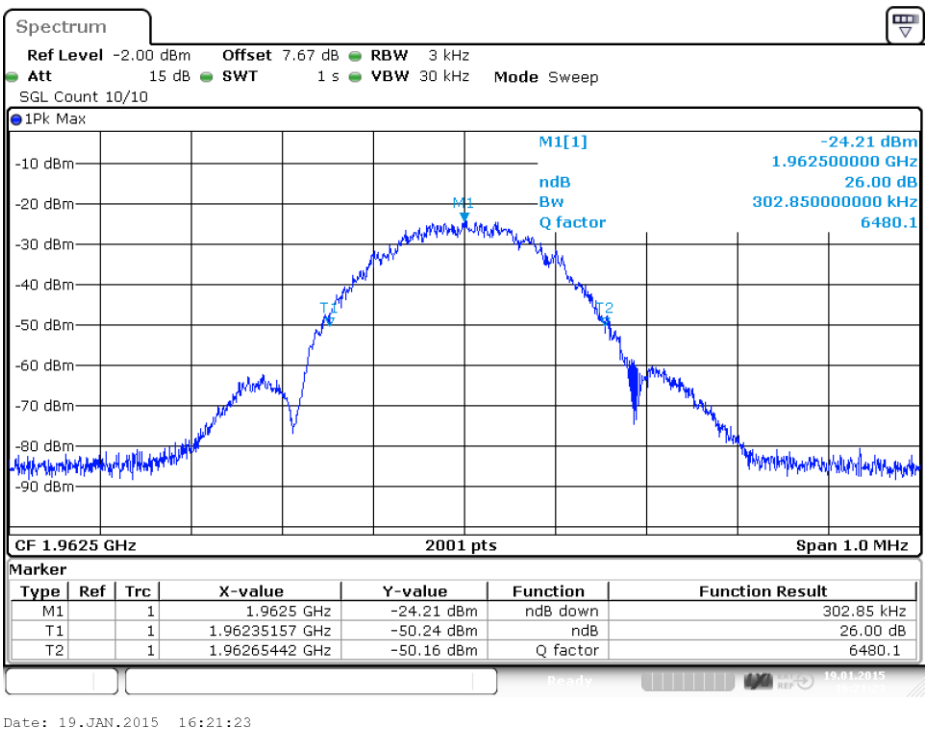

Date: 19.JAN.2015 16:14:44

plot 6.2.2.1-#2 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; GSM Input

### 6.2.2.2 EDGE

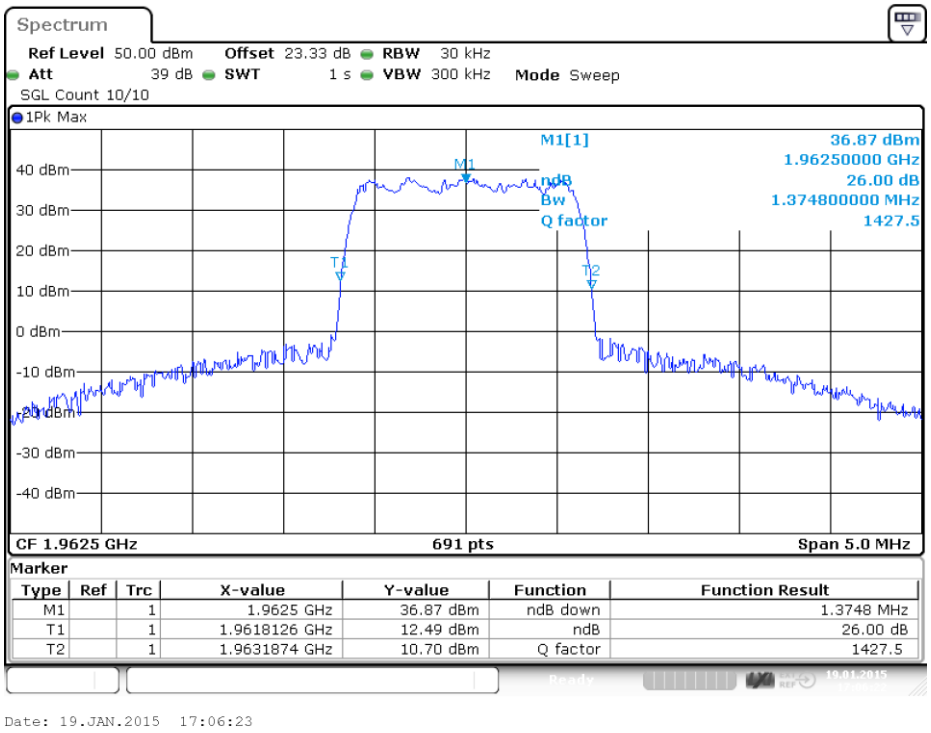



plot 6.2.2.2-#1 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; EDGE Output



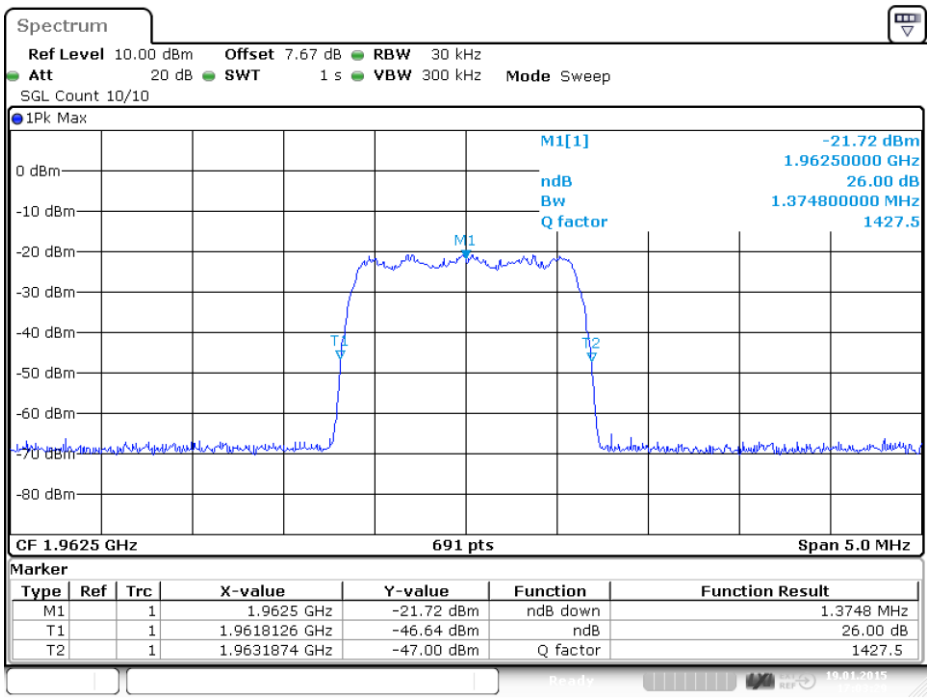

plot 6.2.2.2-#2 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; EDGE Input

### 6.2.2.3 CDMA




Date: 19.JAN.2015 17:06:23

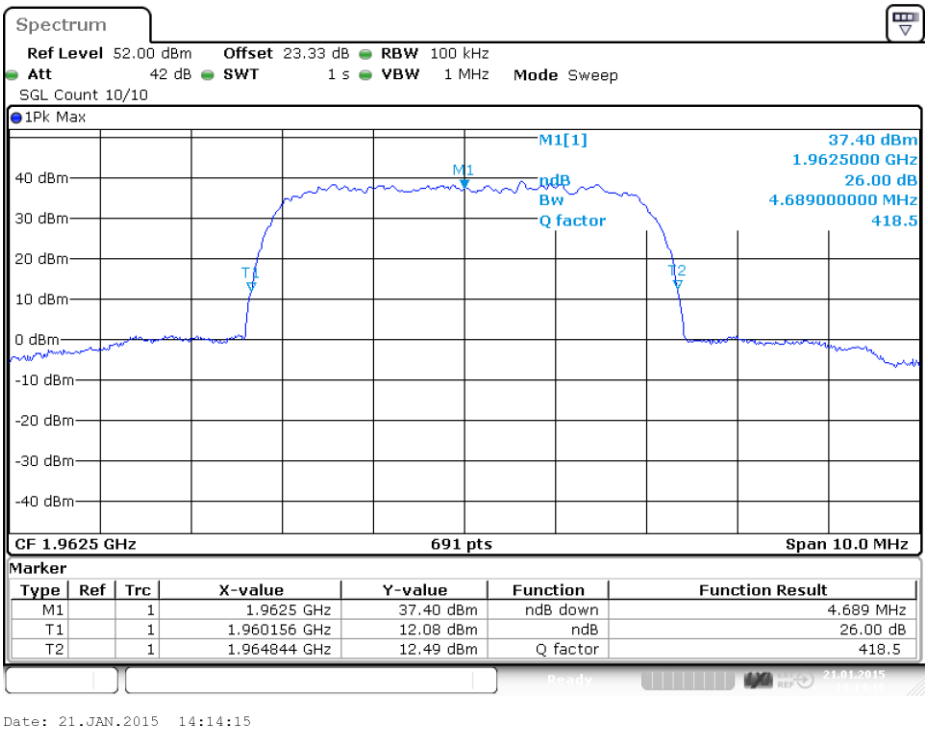
plot 6.2.2.3-#1 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; CDMA Output



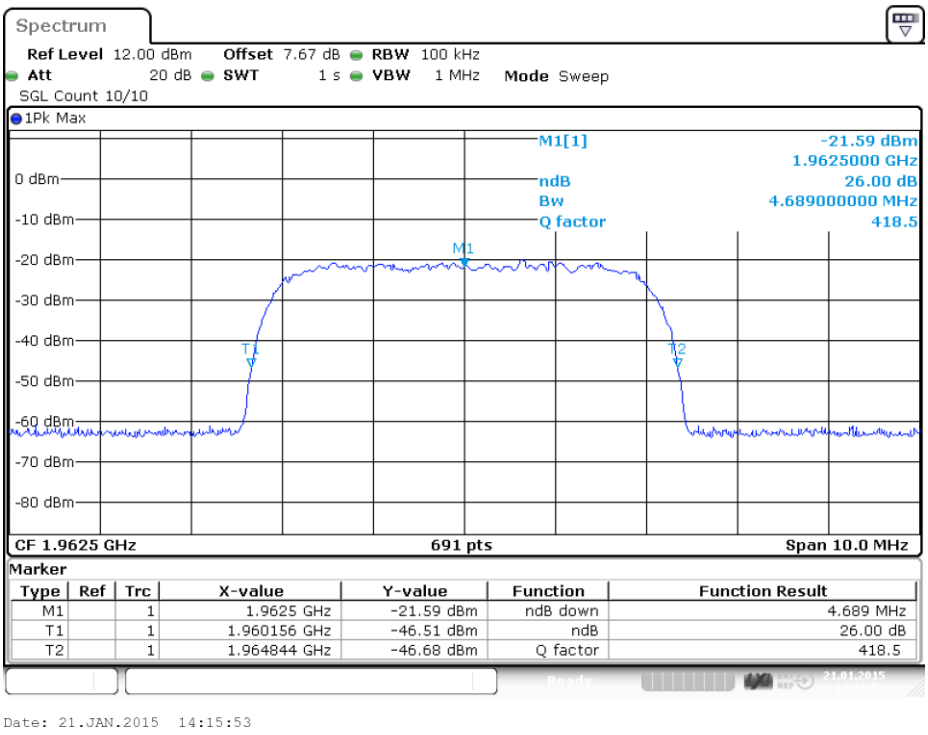

Date: 19.JAN.2015 17:03:30

plot 6.2.2.3-#2 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; CDMA Input

### 6.2.2.4 WCDMA

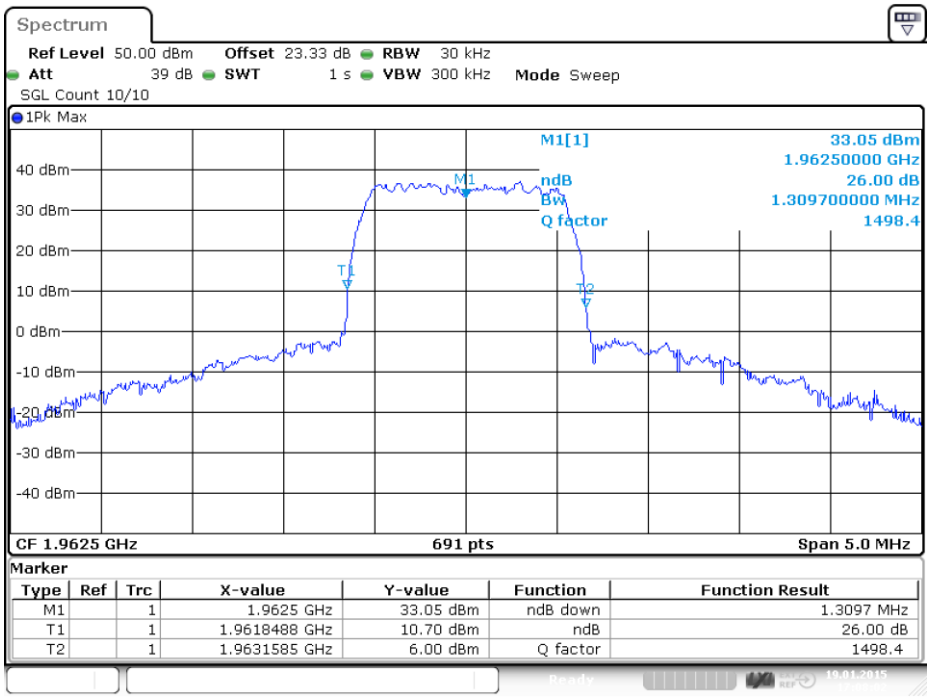



plot 6.2.2.4-#1 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; WCDMA Output



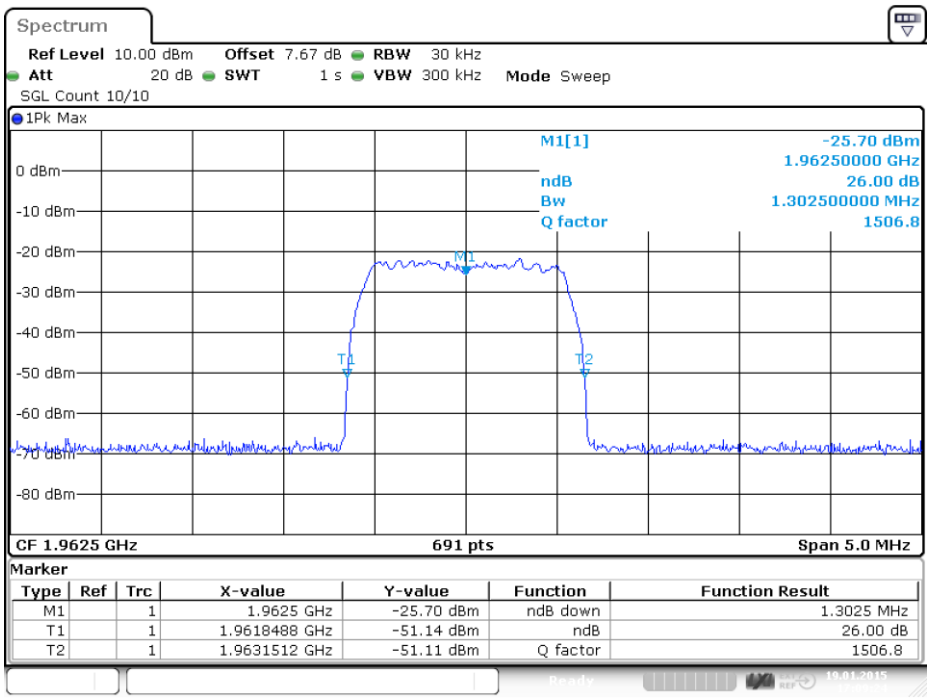

plot 6.2.2.4-#2 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; WCDMA Input

### 6.2.2.5 LTE




Date: 19.JAN.2015 17:08:03

plot 6.2.2.5-#1 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; LTE Output




Date: 19.JAN.2015 17:09:25

plot 6.2.2.5-#2 Occupied Bandwidth: §2.1049;; Test method; 26dB Bandwidth; LTE Input

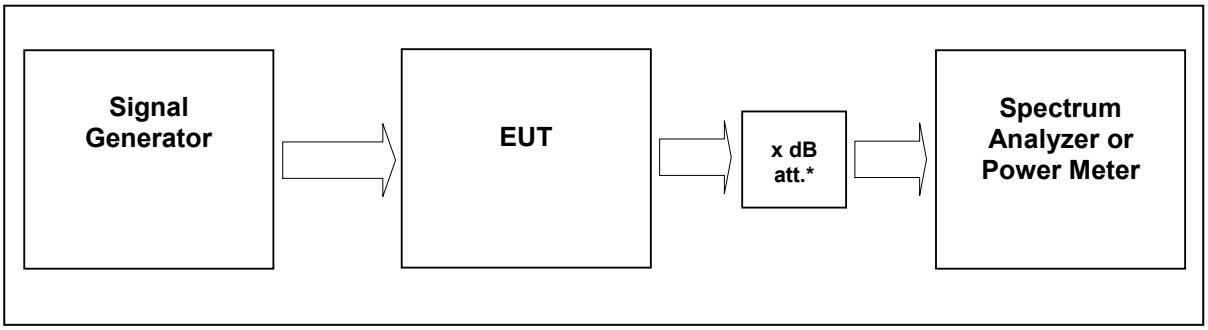
### 6.2.3 Uplink

n.a.
Note: The EUT does not transmit over the air in the uplink direction.

## 6.3 Summary test result

| | |
|---|---|
| Test result | complies, according the plots above |
| Tested by: | F. Bengesser |
| Date: | 21.01.2015 |

# 7 Spurious Emissions at Antenna Terminals: §24.238, §2.1051




External Attenuator DL x dB = 20 dB

figure 7-#1 Test setup: Spurious Emissions at Antenna Terminals: §24.238, §2.1051

| | | |
|---|---|---|
| Measurement uncertainty | ± 0,54 dB<br>± 1,2 dB<br>± 1,5 dB | 9 kHz to 3 GHz<br>3 GHz to 7 GHz<br>7 GHz to 26 GHz |
| Test equipment used | 9069, 9046, 9236, 7406, 7157, 7158, 7289, 7459, 7385 | |

## 7.1 Limit

Minimum standard:

Para. No.24.238(a)

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

## 7.2 Test method

Para. No 2.1051 Measurements required: Spurious emissions at antenna terminals.
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.
[39 FR 5919, Feb. 15, 1974. Redesignated andamended at 63 FR 36599, July 7, 1998]

## 7.3 Test results

### 7.3.1 Downlink

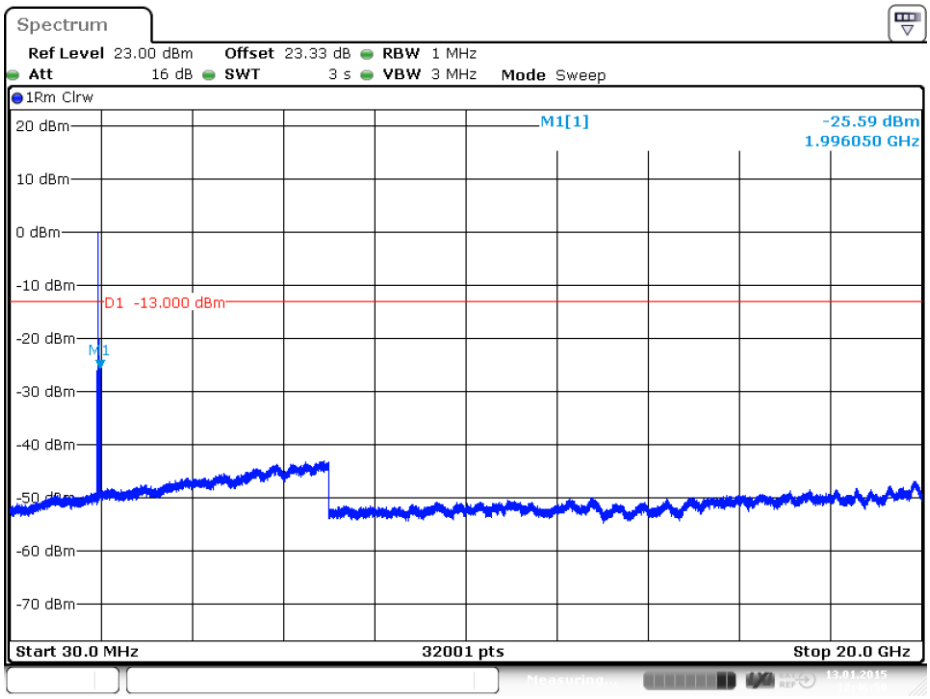
Detector: RMS.

| Modulation | Carrier | RBW<br>VBW<br>Span | Max. level (dBm) | MIMO Max. level (dBm) | Plot - |
|---|---|---|---|---|---|
| GSM | 1962.5 MHz | 1MHz<br>3MHz<br>30MHz – 20GHz | -25.6 | -22.6 | 7.3.1.1<br>#1 |
| EDGE | 1962.5 MHz | 1MHz<br>3MHz<br>30MHz – 20GHz | -25.5 | -22.5 | 7.3.1.2<br>#1 |
| CDMA | 1962.5 MHz | 1MHz<br>3MHz<br>30MHz – 20GHz | -25.8 | -22.8 | 7.3.1.3<br>#1 |
| WCDMA | 1962.5 MHz | 1MHz<br>3MHz<br>30MHz – 20GHz | -25.4 | -22.4 | 7.3.1.4<br>#1 |
| LTE | 1962.5 MHz | 1MHz<br>3MHz<br>30MHz – 20GHz | -25.9 | -22.9 | 7.3.1.5<br>#1 |

table 7.3-#1 Spurious Emissions at Antenna Terminals: §24.238, §2.1051 Test results

If the DUT used in MIMO configuration according to KDB 662911, the summed emission (MIMO Max. Level) is calculated (Max. Level) of the output port plus 10 log ($N_{ANT}$). With ($N_{ANT}$ =2) the MIMO Max. Level (dBm) equals Max. Level (dBm) plus 3dB.

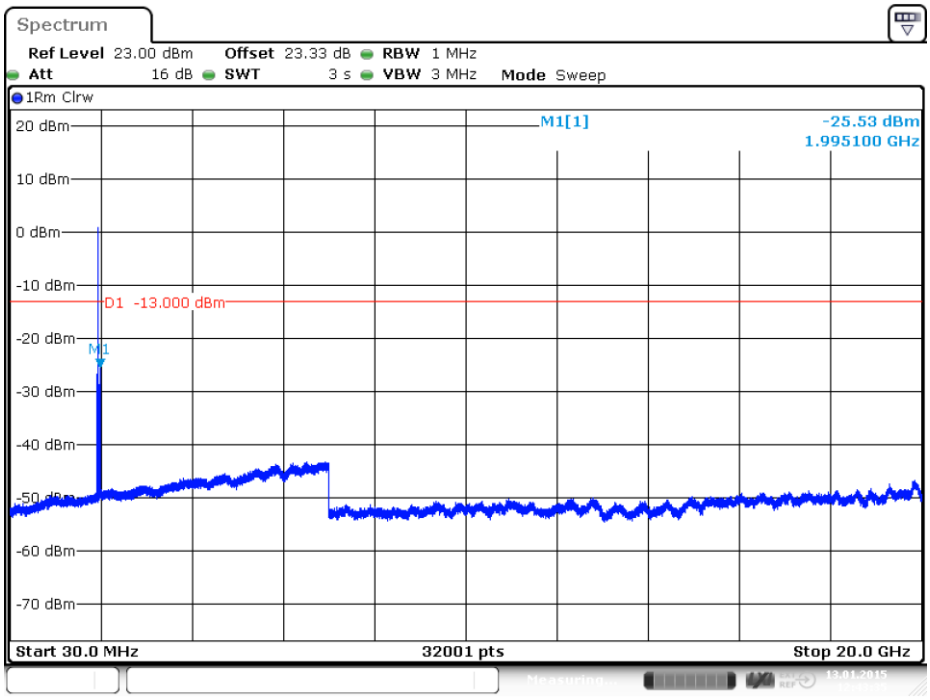
### 7.3.1.1 GSM




Date: 13.JAN.2015 12:46:51

plot 7.3.1.1-#1 Spurious Emissions at Antenna Terminals: §24.238, §2.1051; Test results; Downlink; GSM; carrier (881,5MHz) notched

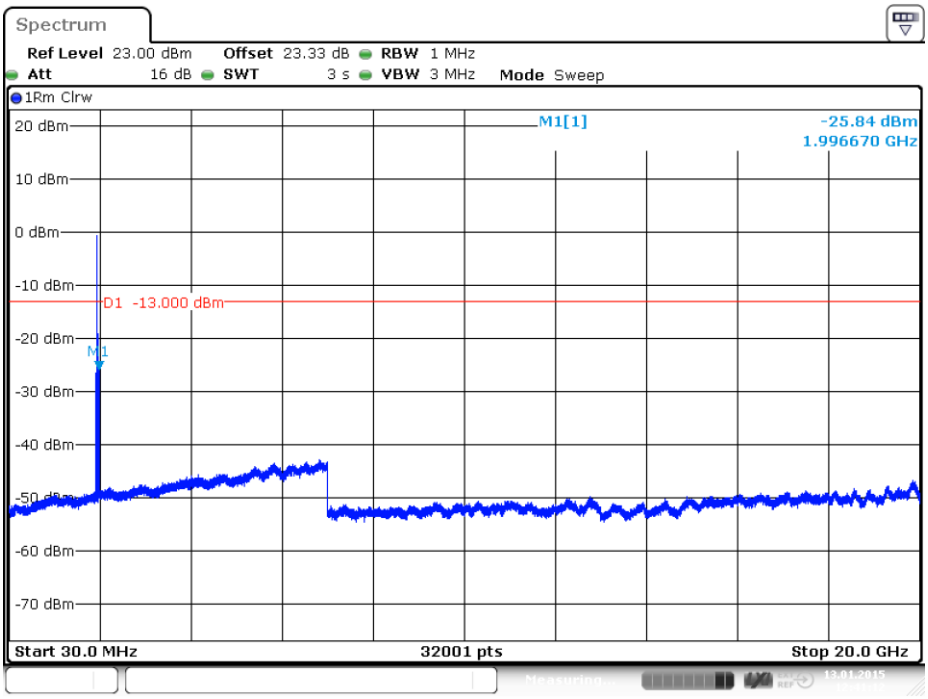
### 7.3.1.2 EDGE




Date: 13.JAN.2015 12:43:35

plot 7.3.1.2-#1 Spurious Emissions at Antenna Terminals: §24.238, §2.1051; Test results; Downlink; EDGE; carrier (881,5MHz) notched

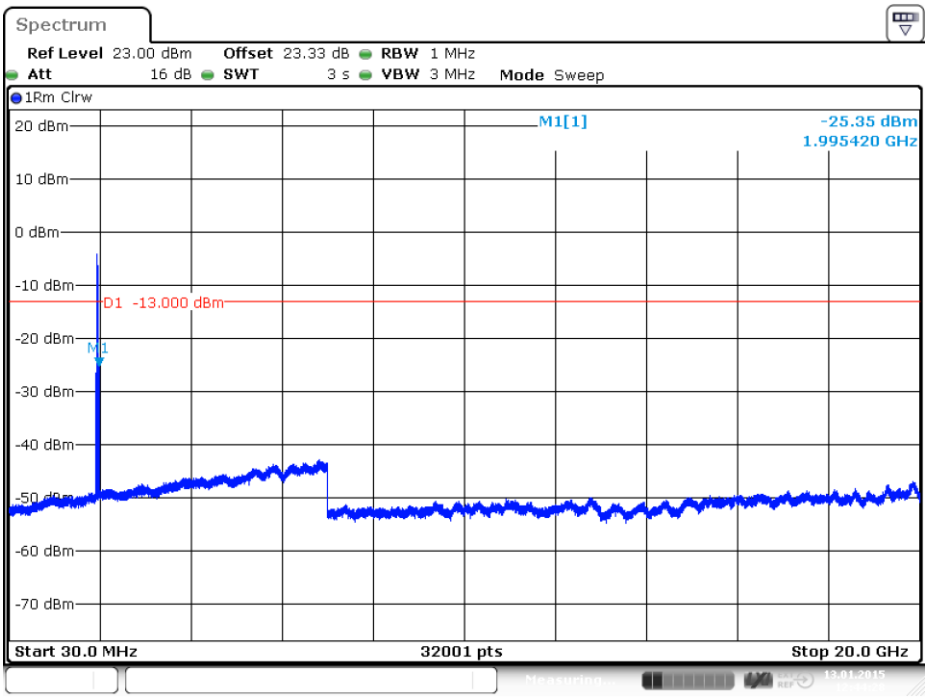
### 7.3.1.3 CDMA




Date: 13.JAN.2015 12:41:12

plot 7.3.1.3-#1 Spurious Emissions at Antenna Terminals: §24.238, §2.1051; Test results; Downlink; CDMA; carrier (881,5MHz) notched

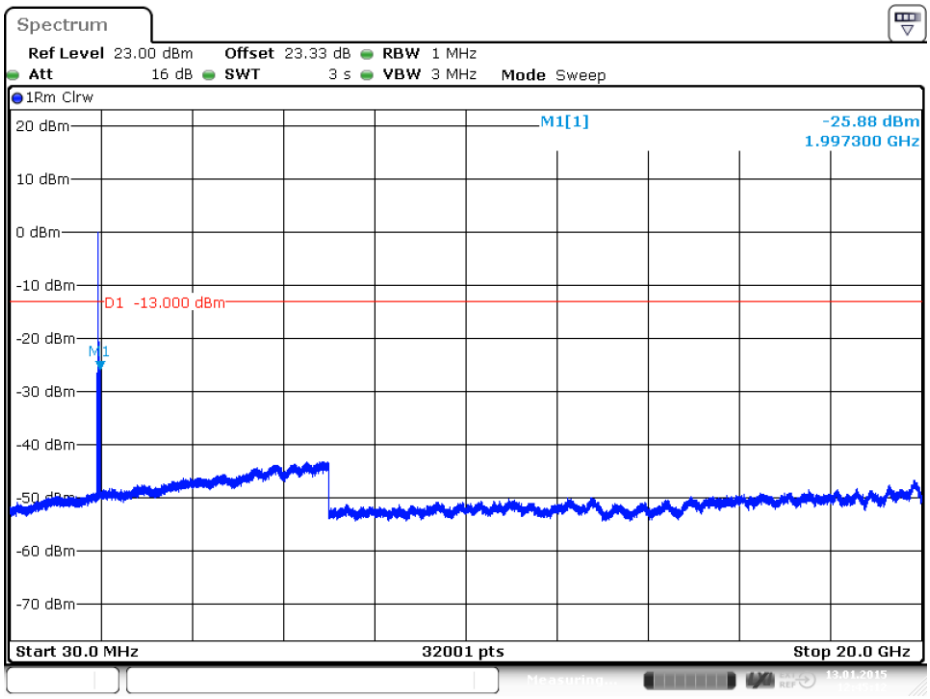
### 7.3.1.4 WCDMA




Date: 13.JAN.2015 12:44:28

plot 7.3.1.4-#1 Spurious Emissions at Antenna Terminals: §24.238, §2.1051; Test results; Downlink; WCDMA; carrier (881,5MHz) notched

### 7.3.1.5 LTE




plot 7.3.1.5-#1 Spurious Emissions at Antenna Terminals: §24.238, §2.1051; Test results; Downlink; LTE; carrier (881,5MHz) notched

### 7.3.2 Uplink

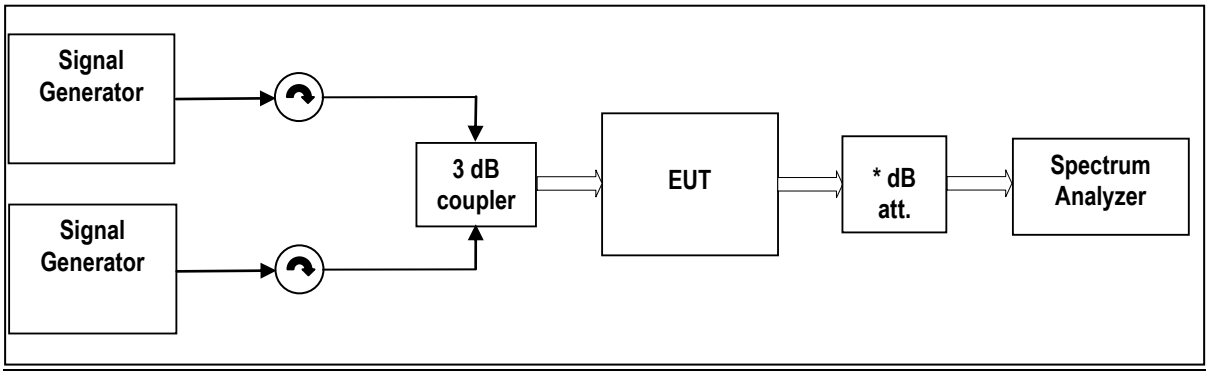
n.a.

Note: The EUT does not transmit over the air in the uplink direction.

## 7.4 Summary test result

| | |
|---|---|
| Test result | complies, according the plots above |
| Tested by: | F. Bengesser |
| Date: | 23.01.2015 |

# 8 Intermodulation: §24.238, §2.1051




External Attenuator DL x dB = 20 dB

figure 8-#1 Test setup: Intermodulation: §24.238, §2.1051

| | | |
|---|---|---|
| Measurement uncertainty | ± 0,54 dB<br>± 1,2 dB<br>± 1,5 dB | 9 kHz to 3 GHz<br>3 GHz to 7 GHz<br>7 GHz to 26 GHz |
| Test equipment used | 9069, 9046, 9236, 7406, 7157, 7158, 7289, 7459, 7385 | |

## 8.1 Limit

Minimum standard:

Para. No.24.238(a)

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

## 8.2 Test method

Para. No 2.1051 Measurements required: Spurious emissions at antenna terminals.
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.
[39 FR 5919, Feb. 15, 1974. Redesignated andamended at 63 FR 36599, July 7, 1998]

## 8.3 Test results

### 8.3.1 Downlink

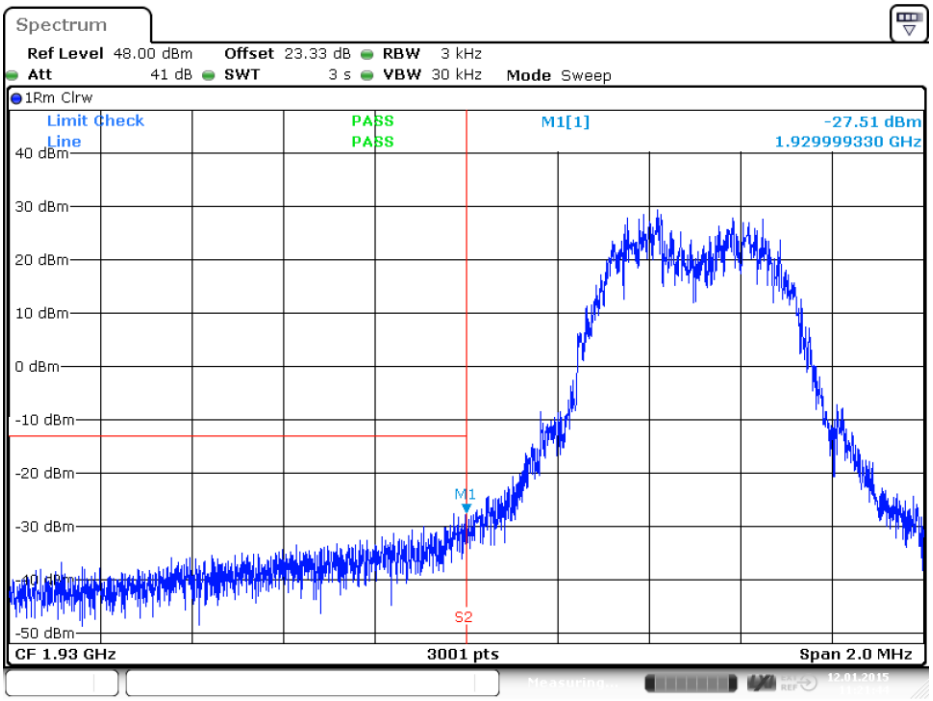
Detector: RMS.

| Modulation | Measured at Band Edge | Carriers | RBW VBW Span | Max. level (dBm) | MIMO Max. level (dBm) | Plot - |
|---|---|---|---|---|---|---|
| GSM | Lower Edge | 1930,4 MHz 1930,6 MHz | 3kHz 30kHz 2MHz | -27.5 | -24.5 | 8.3.1.1 #1 |
| | Upper Edge | 1994,4 MHz 1994,6 MHz | | | | #2 |
| EDGE | Lower Edge | 1930,4 MHz 1930,6 MHz | 3kHz 30kHz 2MHz | -27.2 | -24.2 | 8.3.1.2 #1 |
| | Upper Edge | 1994,4 MHz 1994,6 MHz | | | | #2 |
| CDMA | Lower Edge | 1930,775 MHz 1932,025 MHz | 30kHz 300kHz 6MHz | -19.1 | -16.1 | 8.3.1.3 #1 |
| | Upper Edge | 1992,975 MHz 1994,225 MHz | | | | #2 |
| WCDMA | Lower Edge | 1932,6 MHz 1937,6 MHz | 100kHz 1MHz 15MHz | -18.2 | -15.2 | 8.3.1.4 #1 |
| | Upper Edge | 1987,4 MHz 1992,4 MHz | | | | #2 |
| LTE | Lower Edge | 1930.7 MHz 1932.1 MHz | 30kHz 300kHz 6MHz | -17.1 | -14.1 | 8.3.1.5 #1 |
| | Upper Edge | 1992.9 MHz 1994.3 MHz | | | | #2 |

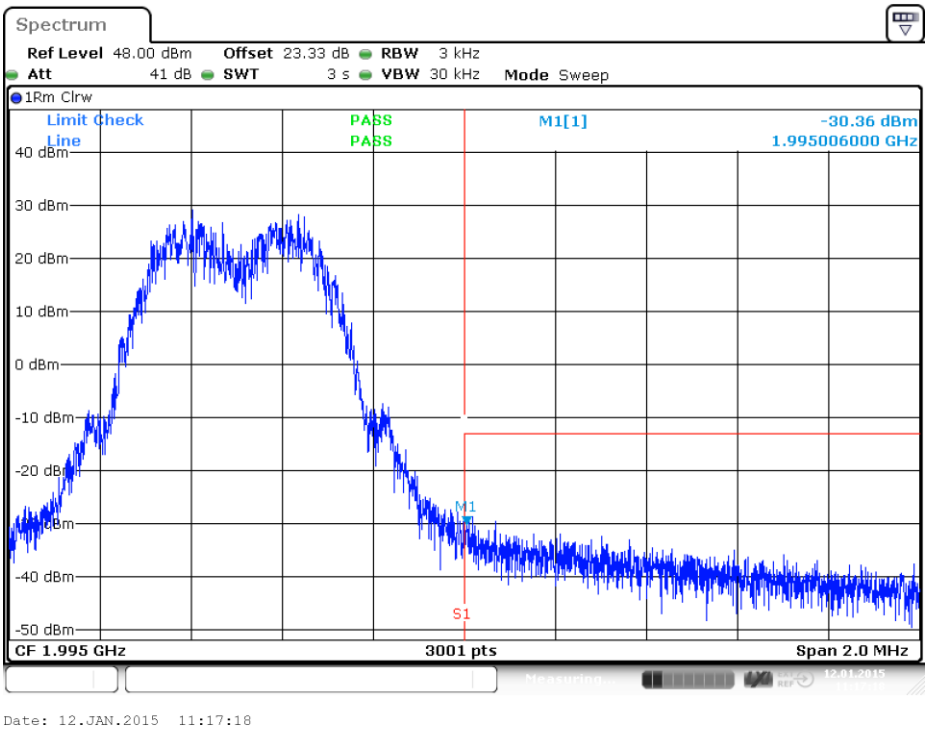
table 8.3-#1 Intermodulation: §24.238, §2.1051 Test results

If the DUT used in MIMO configuration according to KDB 662911, the summed emission (MIMO Max. Level) is calculated (Max. Level) of the output port plus 10 log ($N_{ANT}$). With ($N_{ANT}$ =2) the MIMO Max. Level (dBm) equals Max. Level (dBm) plus 3dB.

### 8.3.1.1 GSM

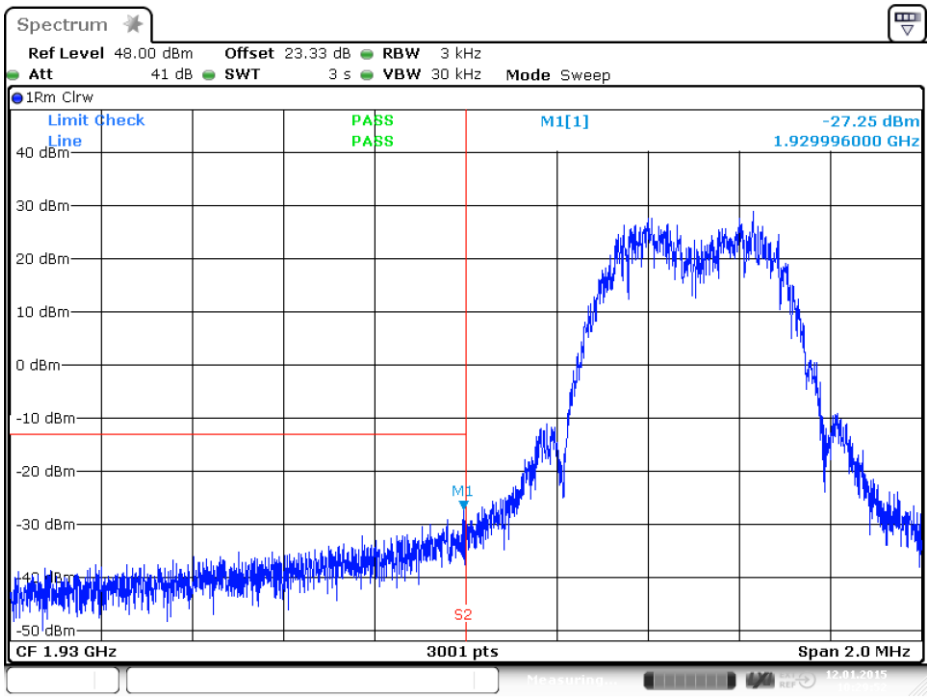



plot 8.3.1.1-#1 Intermodulation: §24.238, §2.1051; Test results; Downlink; GSM Lower Band Edge



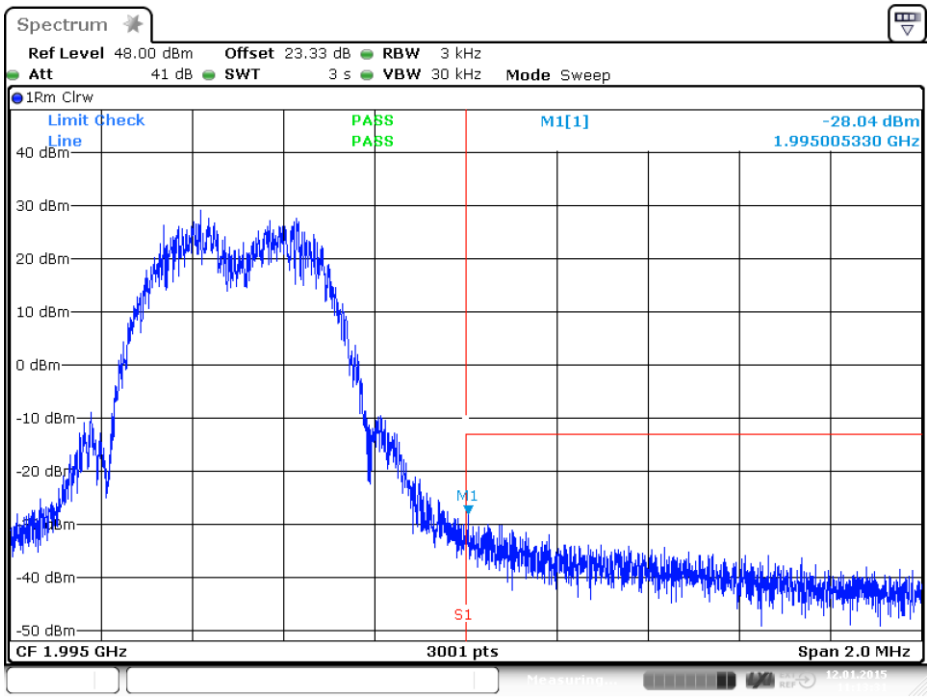

plot 8.3.1.1-#2 Intermodulation: §24.238, §2.1051; Test results; Downlink; GSM Upper Band Edge

### 8.3.1.2 EDGE




Date: 12.JAN.2015 10:29:52

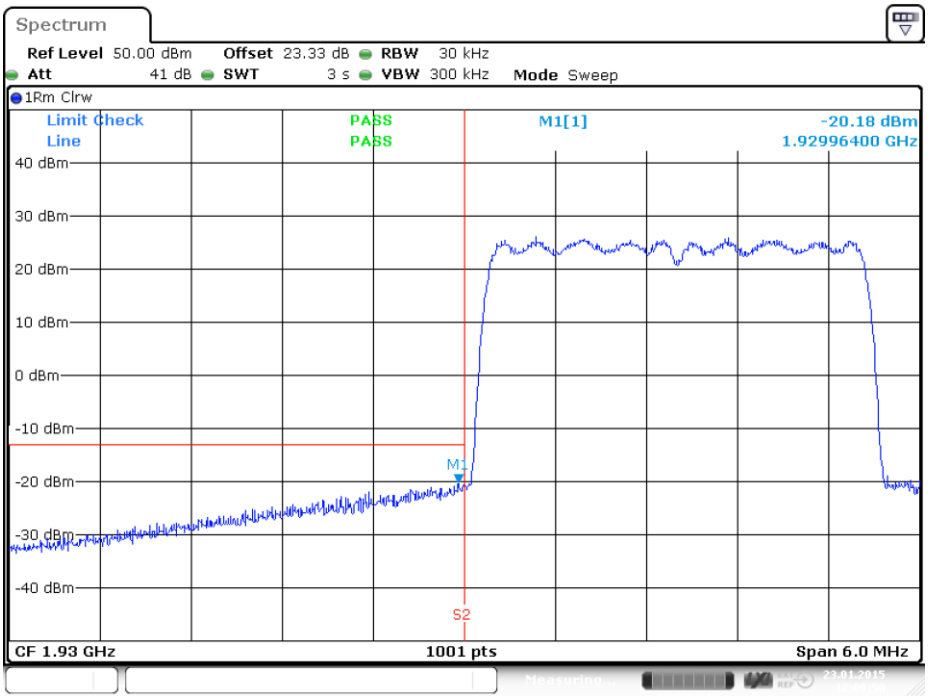
plot 8.3.1.2-#1 Intermodulation: §24.238, §2.1051; Test results; Downlink; EDGE Lower Band Edge




Date: 12.JAN.2015 11:13:31

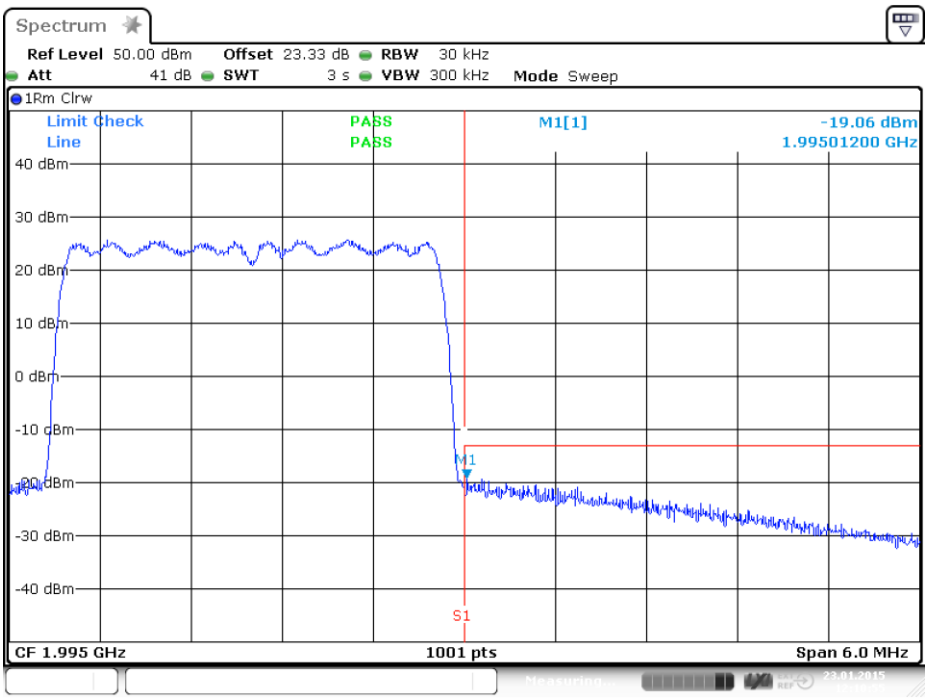
plot 8.3.1.2-#2 Intermodulation: §24.238, §2.1051; Test results; Downlink; EDGE Upper Band Edge

### 8.3.1.3 CDMA




Date: 23.JAN.2015 12:06:50

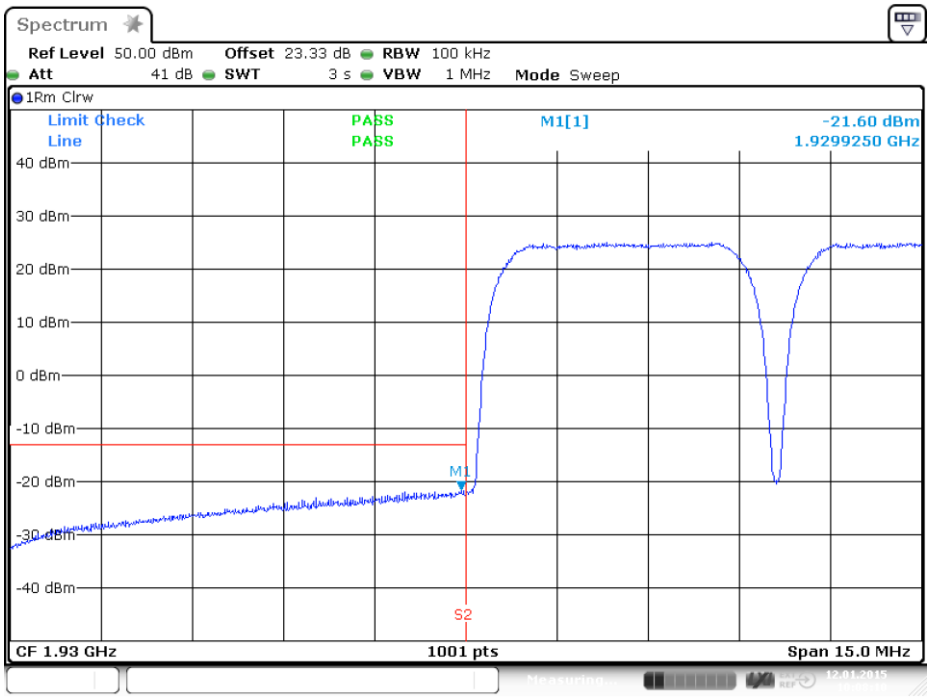
plot 8.3.1.3-#1 Intermodulation: §24.238, §2.1051; Test results; Downlink; CDMA Lower Band Edge




Date: 23.JAN.2015 12:10:55

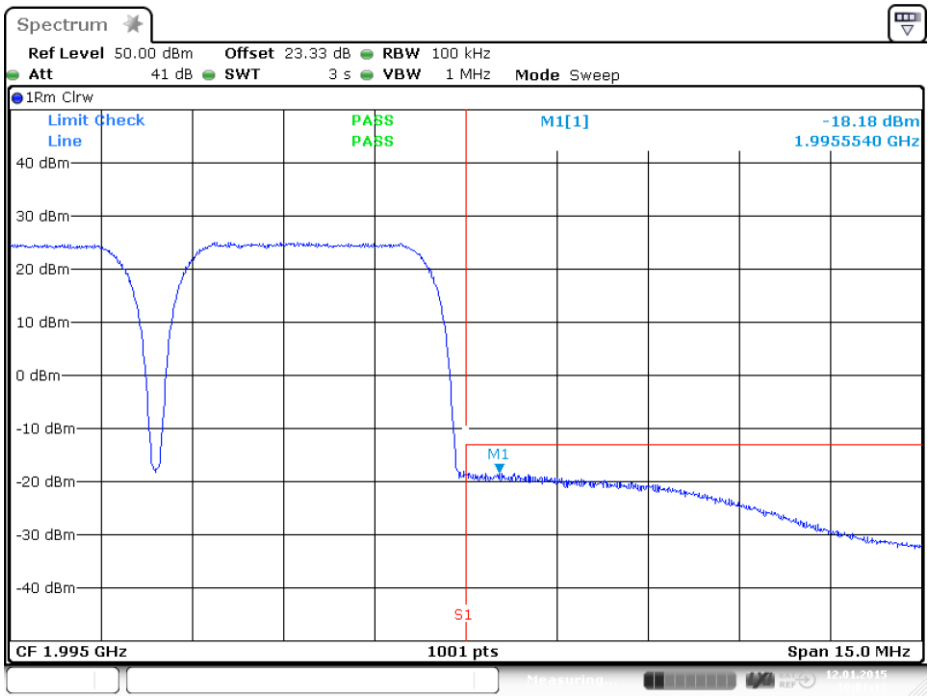
plot 8.3.1.3-#2 Intermodulation: §24.238, §2.1051; Test results; Downlink; CDMA Upper Band Edge

### 8.3.1.4 WCDMA




Date: 12.JAN.2015 10:08:10

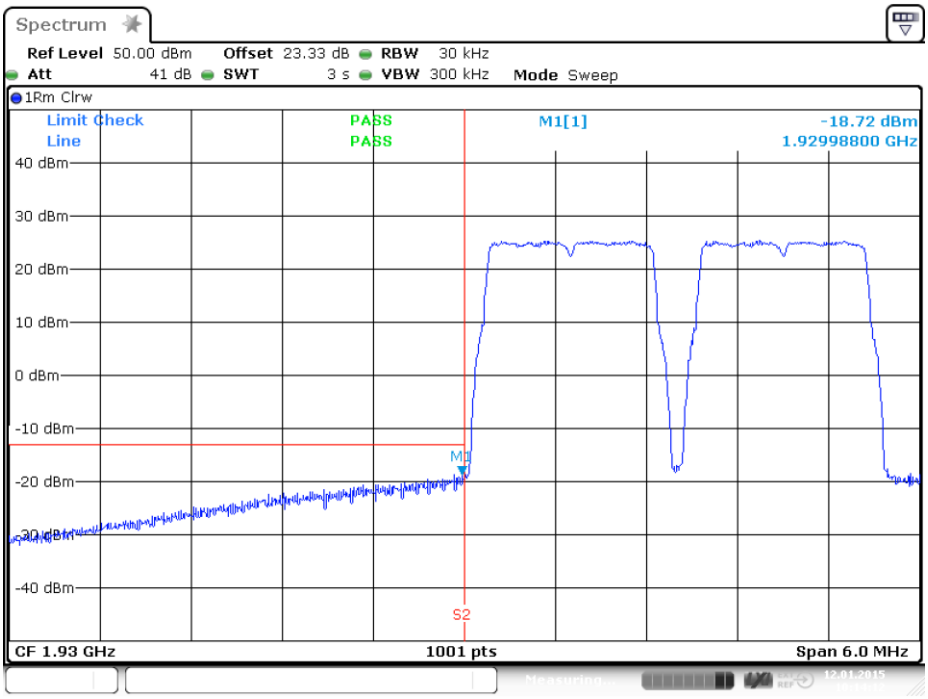
plot 8.3.1.4-#1 Intermodulation: §24.238, §2.1051; Test results; Downlink; WCDMA Lower Band Edge




Date: 12.JAN.2015 10:01:13

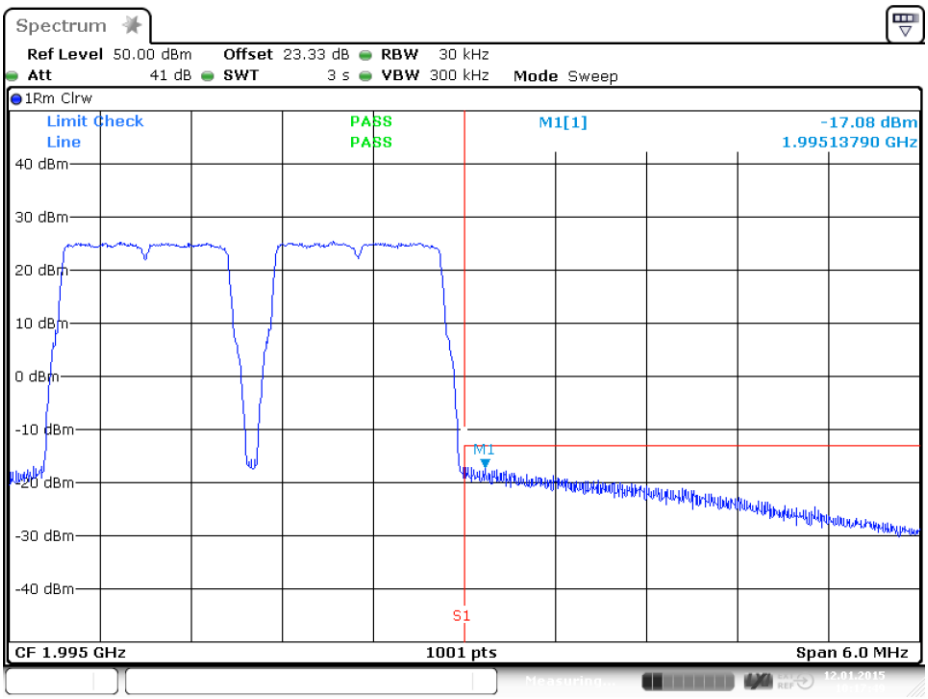
plot 8.3.1.4-#2 Intermodulation: §24.238, §2.1051; Test results; Downlink; WCDMA Upper Band Edge

### 8.3.1.5 LTE




Date: 12.JAN.2015 10:14:12

plot 8.3.1.5-#1 Intermodulation: §24.238, §2.1051; Test results; Downlink; LTE Lower Band Edge




Date: 12.JAN.2015 10:17:49

plot 8.3.1.5-#2 Intermodulation: §24.238, §2.1051; Test results; Downlink; LTE Upper Band Edge

### 8.3.2 Uplink

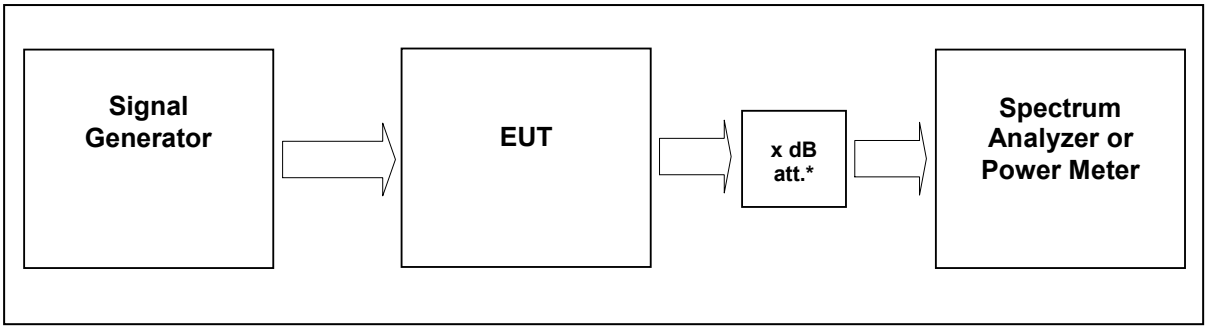
n.a.

Note: The EUT does not transmit over the air in the uplink direction.

## 8.4 Summary test result

| | |
|---|---|
| Test result | complies, according the plots above |
| Tested by: | F. Bengesser |
| Date: | 23.01.2015 |

# 9 Out of Band Rejection




External Attenuator DL x dB = 20 dB
figure 9-#1 Test setup: Out of Band Rejection

| | |
|---|---|
| Measurement uncertainty | ± 0,38 dB |
| Test equipment used | 9069, 9046, 9236, 7406, 7157, 7158, 7289, 7290, 7385 |

## 9.1 Limit

KDB 935210 D02 v02
Test for rejection of out of band signals. Filter frequency response plots are acceptable.

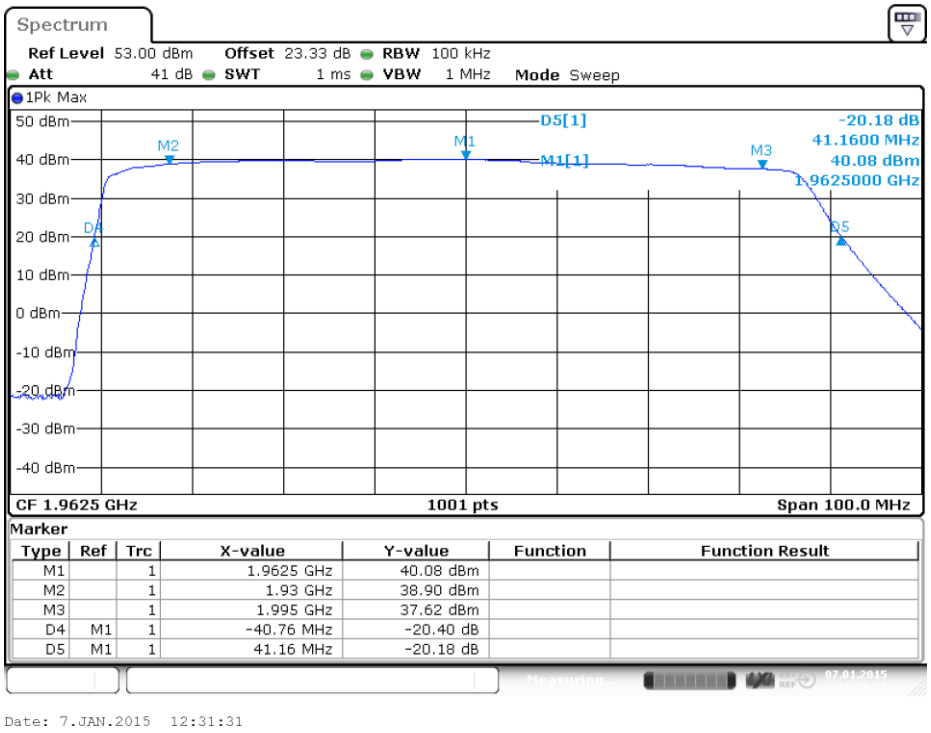
## 9.2 Test method

935210 D03 v02
7.1 Authorized frequency band verification test

## 9.3 Test results

Detector Peak max hold

### 9.3.1 Downlink




plot 9.3.1-#1 Out of Band Rejection; Test results; Downlink;

### 9.3.2 Uplink

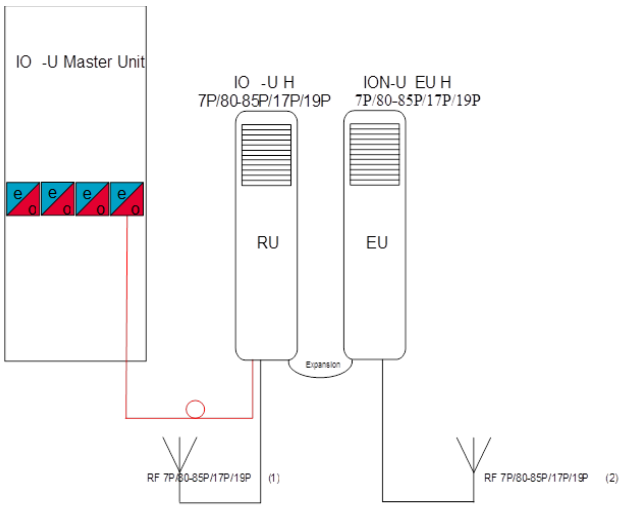
n.a.

Note: The EUT does not transmit over the air in the uplink direction.

## 9.4 Summary test result

| | |
|---|---|
| Test result | complies, according the plots above |
| Tested by: | F. Bengesser |
| Date: | 07.01.2015 |

# 10 Field Strength of Spurious Emissions: §24.238, §2.1053

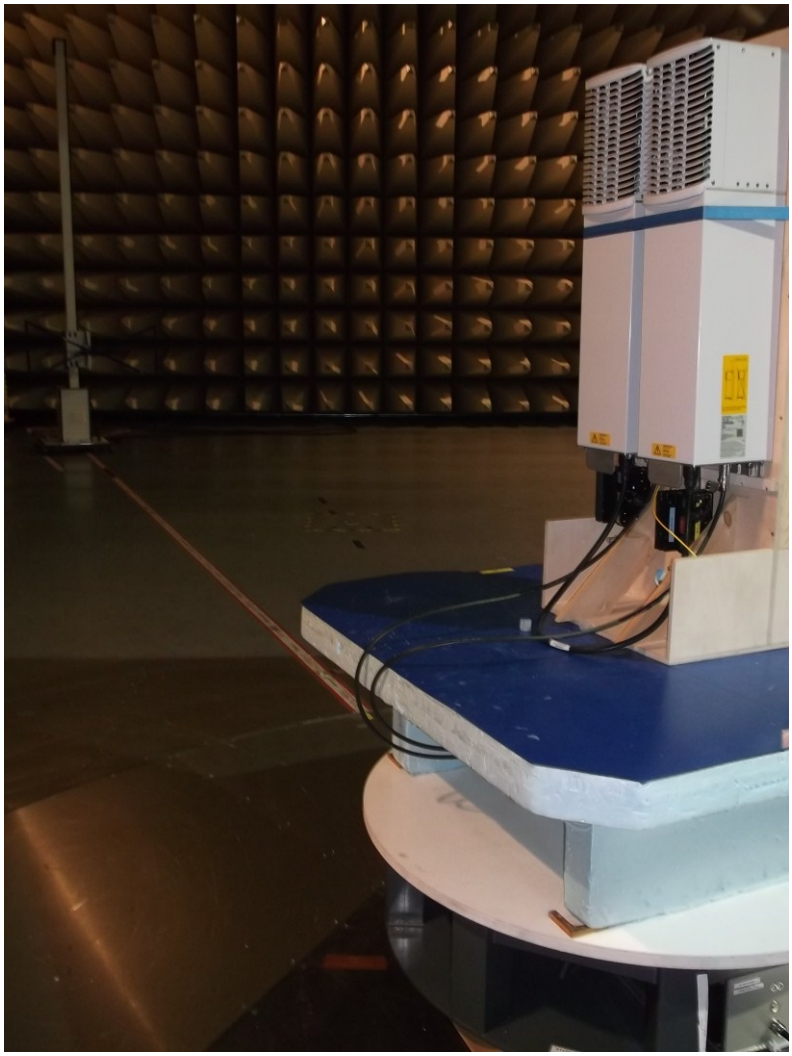



The frequencies bands of the extension unit will be implemented on the master unit with a compensation frequency bands.
About the optical fiber all frequencies will be forwarded to the RU.
At the RU the optical signals will be converted into RF signals.
The frequency bands, which were not changed will be filtered by the duplexer, then amplified and transmitted by the RU.
The replaced frequency bands filtered out and forwarded via the Cable Bridge to the EU. These frequencies converted back by the conversion module (FCM) to their original frequencies band and then they were amplified and sent out.

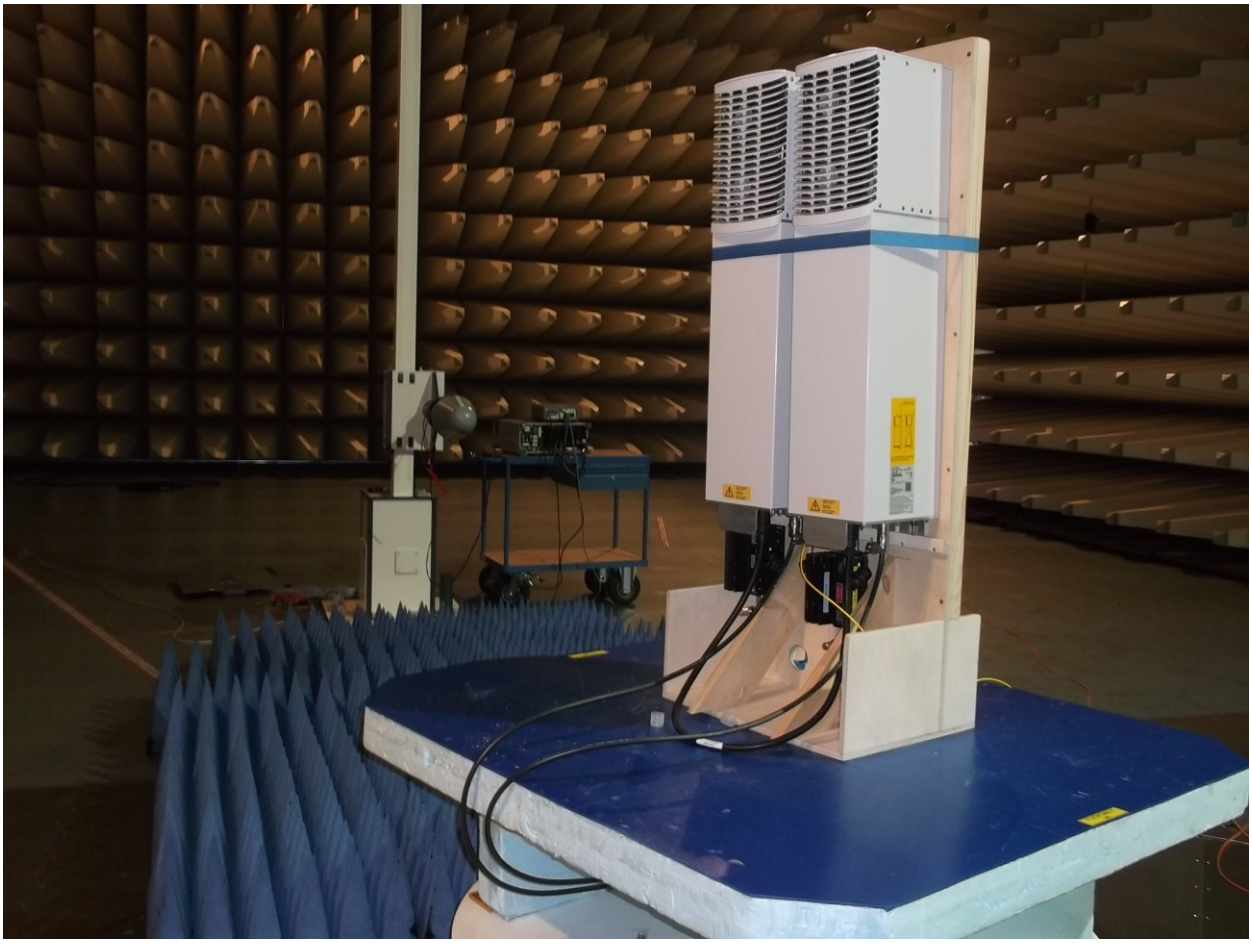
**The worst case mode for the radiated emission is the MIMO mode. Both devices are operated with the maximum power, at the same time.**

**picture 8.1:** label (EUT)

**picture 8.2:** label (auxiliary equipment)



**picture 8.3:** Test setup: Field Strength Emission <1 GHz @10m in the SAC



**picture 8.4:** Test setup: Field Strength Emission >1 GHz @3m in the SAC

**This clause specifies requirements for the measurement of radiated emission.**

| Frequency range | Distance: EUT <-> antenna / location | Limit | Test method |
|---|---|---|---|
| 30 MHz – 1 GHz | 10 metres / SAC | FCC 47 CFR Part §24.238 | TIA/EIA-603-C:2004 |
| 1 GHz – 20 GHz | 3 metres / SAC | IC RSS-131 sec. 4.4 | |

**Test equipment used:**

| Designation | Type | Manufacturer | Invent.-no. | Cal.-date | due Cal.-date | used |
|---|---|---|---|---|---|---|
| EMI test receiver | ESU40 | Rohde & Schwarz | E2025 | 12.09.2014 | 12.09.2015 | X |
| Antenna | CBL 6111 | Chase | K1026 | 27.06.2014 | 27.06.2015 | X |
| RF Cable | RG214 | Frankonia | K1121 | 20.02.2013 | 20.02.2015 | X |
| Antenna | HL 025 | R&S | K1114 | 03.03.2014 | 03.03.2015 | X |
| Preamplifier | AFS4-00102000 | Miteq | K838 | 03.04.2014 | 03.04.2015 | X |
| RF Cable | Sucoflex 100 | Suhner | K1760 | 03.07.2014 | 03.07.2015 | X |

The REMI version 2.135 has been used to maximize radiated emission from the EUT with regards to ANSI C63.4:2009.

**Test set-up:**

Test location: SAC
Both, the Fully Anechoic Chamber (FAC) and the Semi Anechoic Chamber (SAC) fulfil the requirements of ANSI C63.4 and CISPR 16-1-4 with regards to NSA and SVSWR.
Test Voltage: 110V / 60 Hz
Type of EUT: Wall mounted

**Measurement uncertainty:**

| | |
|---|---|
| Measurement uncertainty expanded (95% or K=2) | ± 4,7 dB for ANSI C63.4 measurement<br>± 0,5 dB for TIA-603 measurement |

## 10.1 Limit §22.917

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) *Measurement procedure.* Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth ( *i.e.* 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

The emission measurements have been made with transmission at **Bottom/Middle/Top** frequency **(869MHz/881.5MHz/894MHz)**

The limit is -13dBm (e.i.r.p).

## 10.2 Test method ANSI/TIA/EA-603-C

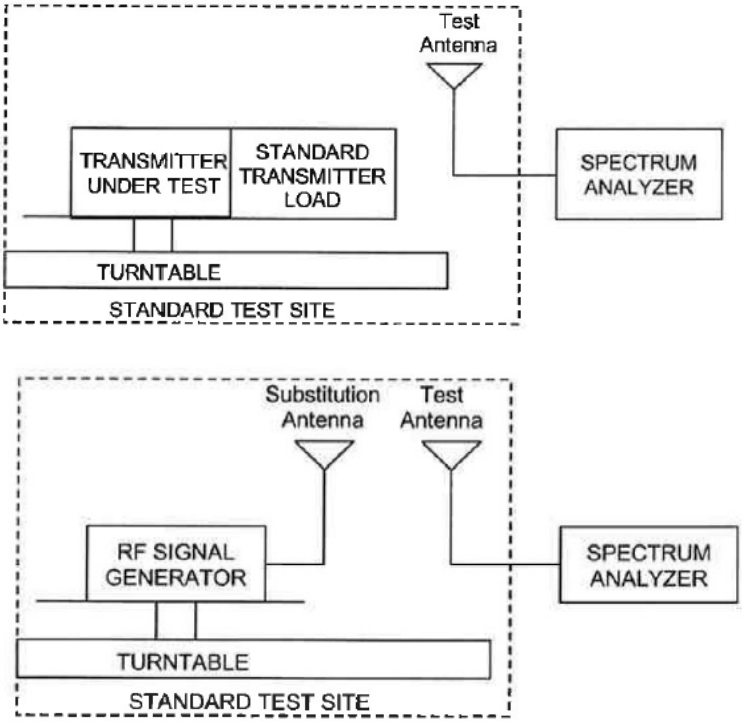
***Measurement procedure.*** **TIA-603-C**

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to a dipole. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic dipole (see Figure 7.2).

From KDB (AMPLIFIER, BOOSTER, AND REPEATER REMINDER SHEET):
Radiated spurs (enclosure) – Use of CW signal (low, mid. and high freq.) is acceptable rather than all modulations.

The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) and varying the height of the receive antenna (h = 1 ... 4 m) as like defined in ANSI C63.4. A measurement receiver has been used with a RBW 120 kHz up to 1 GHz and 1 MHz above 1 GHz. Steps with during pre measurement was half the RBW.

Both, the Fully Anechoic Chamber (FAC) and the Semi Anechoic Chamber (SAC) fulfil the requirements of ANSI C63.4 and CISPR 16-1-4 with regards to NSA and SVSWR.




**picture 8.3:** Substitution method

## 10.3 Climatic values in the lab

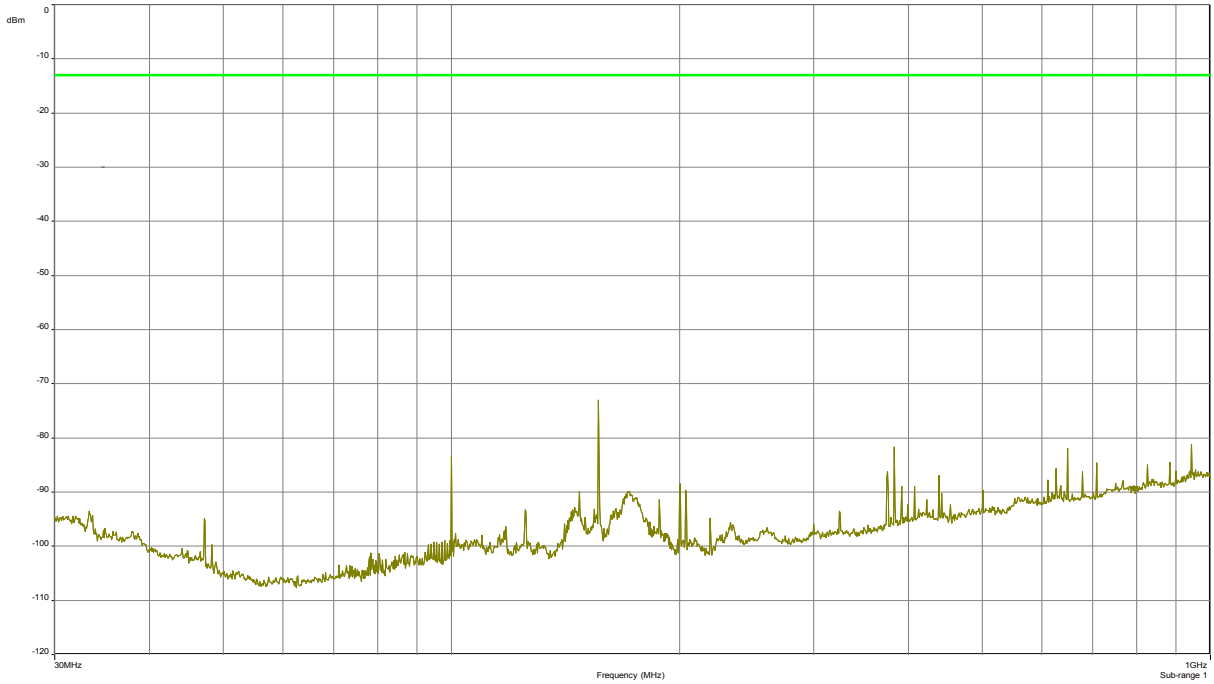
Temperature: 20°
Relative Humidity: 45%
Air-pressure: 1009hPa

## 10.4 Test results

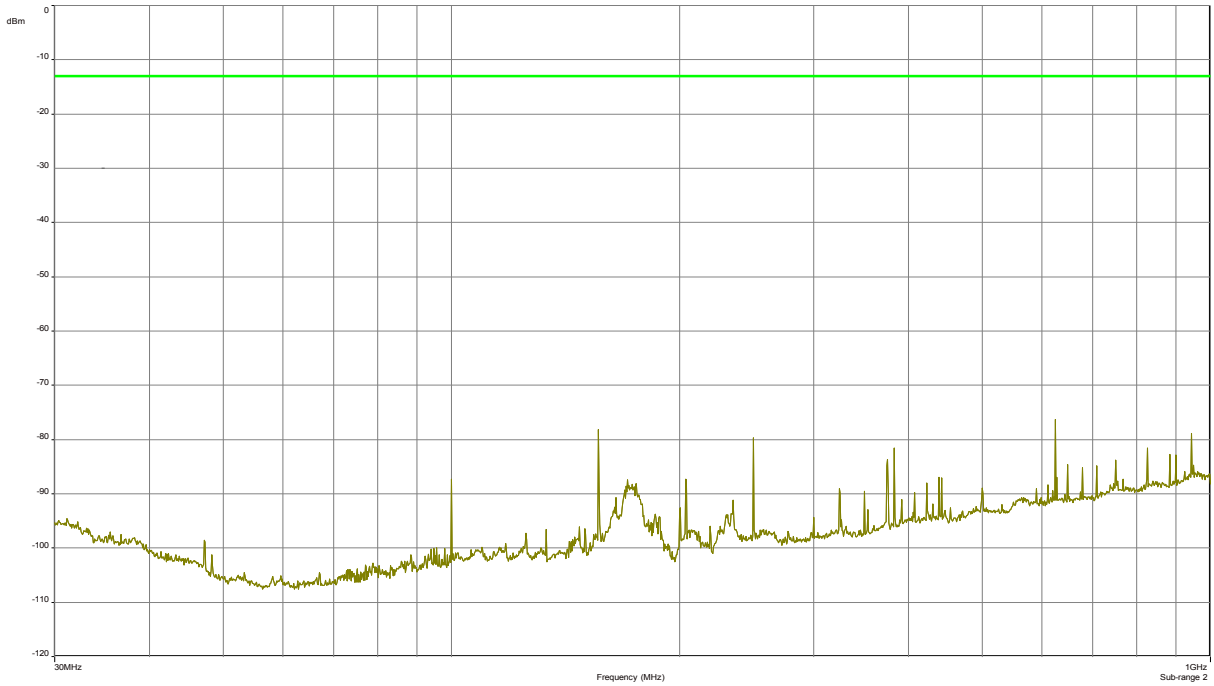
### 10.4.1 30 MHz to 1 GHz Downlink (Bottom – Middle – Top) Subpart H

B/M/T: 1930 MHz/ 1962.5 MHz/ 1995 MHz

Vertikal




Horizontal

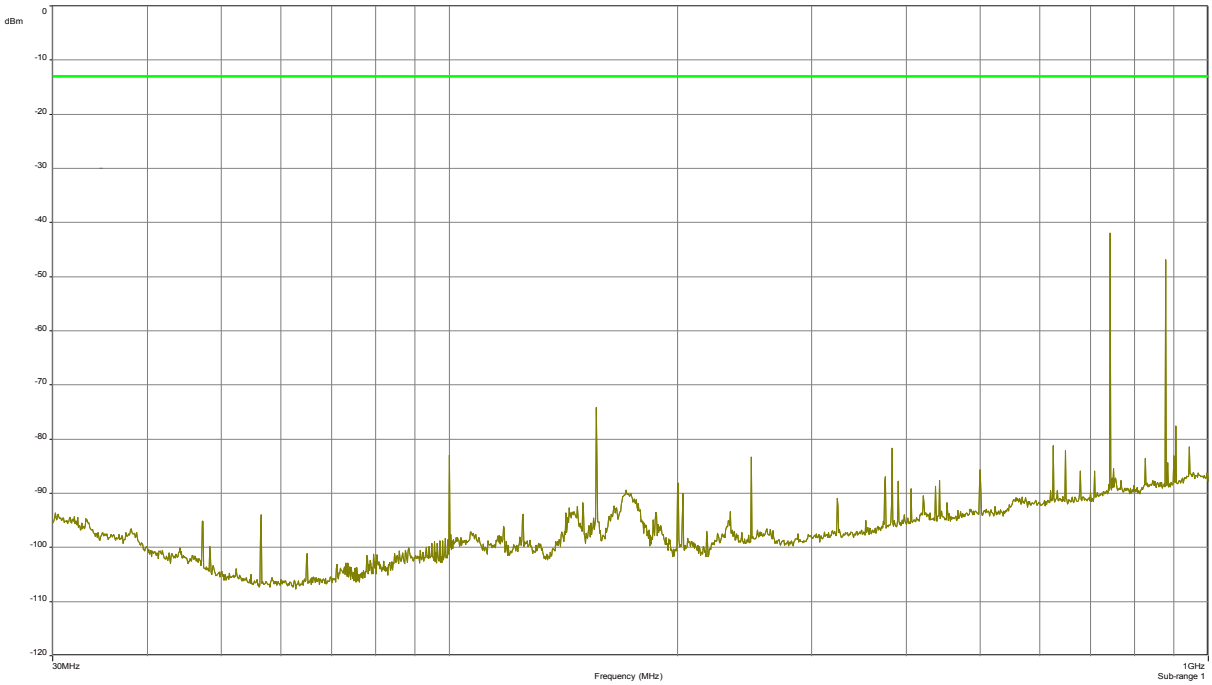



The RF output power is terminated.

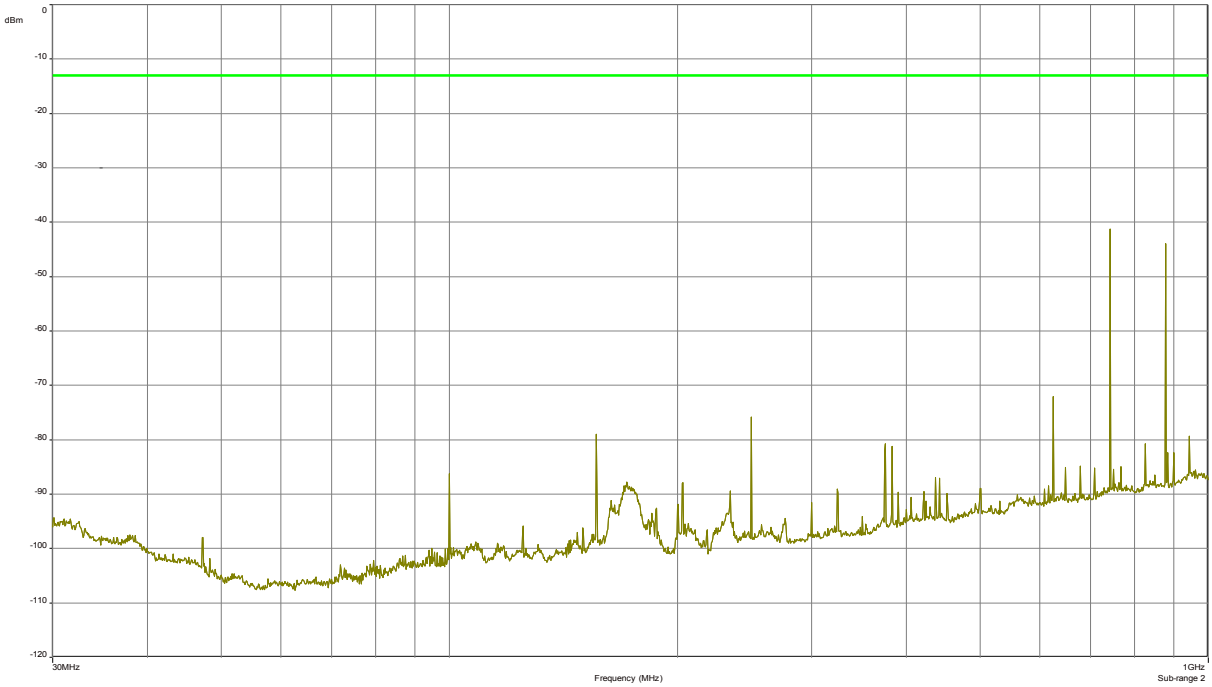
## 10.4.2 30 MHz to 1 GHz Downlink (Middle of all paths)

F1: 742.5 MHz; F2: 878 MHz; F3: 1962.5 MHz; F4: 2132.5 MHz

Vertikal




Horizontal

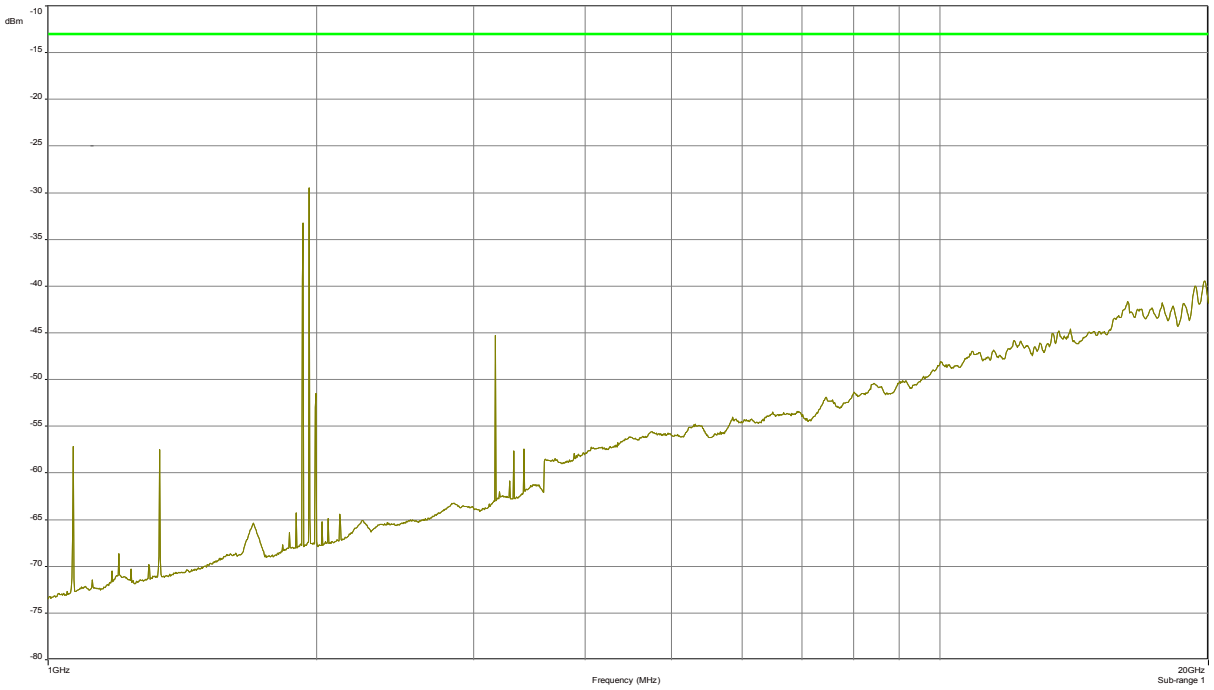



The RF output power is terminated.

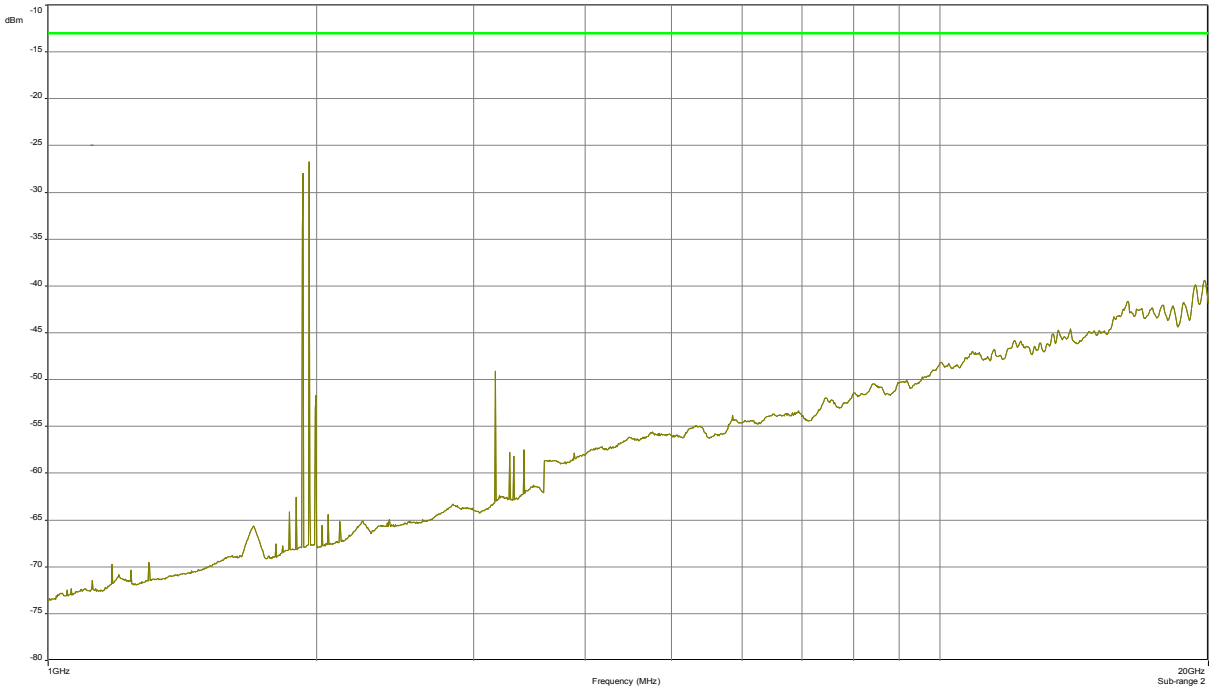
### 10.4.3 1 GHz to 20 GHz Downlink (Bottom – Middle – Top) Subpart H

B/M/T: 1930 MHz/ 1962.5 MHz/ 1995 MHz

Vertikal




Horizontal

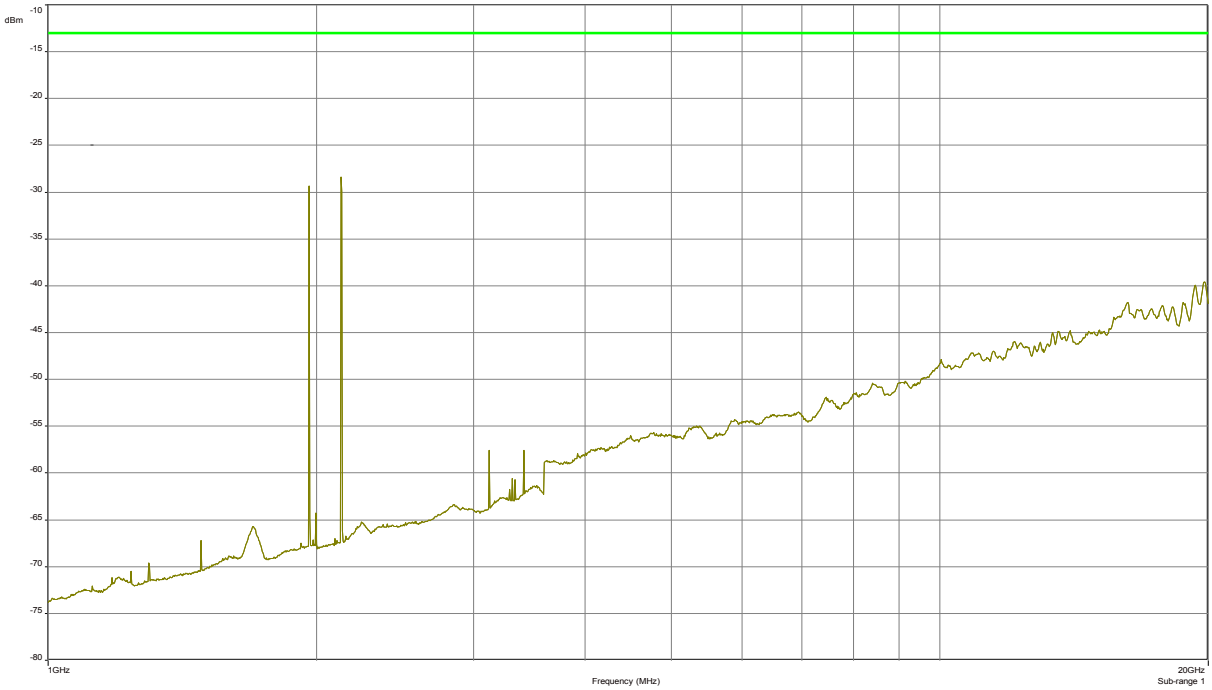



The RF output power is terminated.

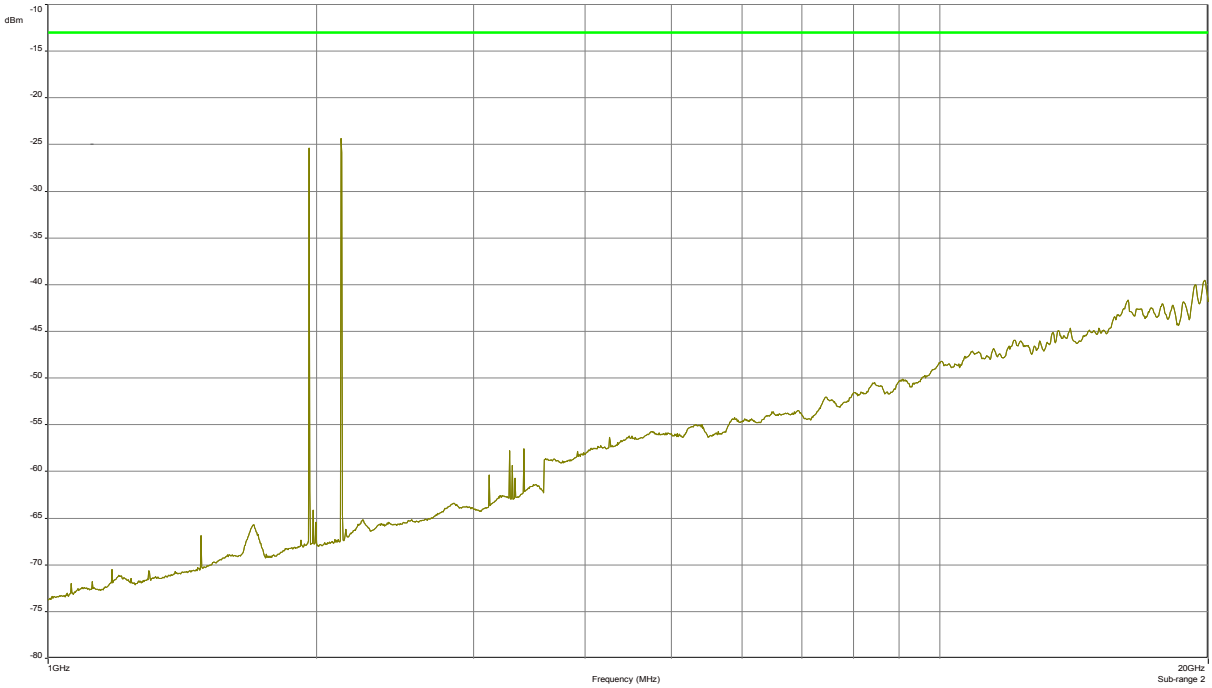
## 10.4.4 1 GHz to 20 GHz Downlink (Middle of all paths)

F1: 742.5 MHz; F2: 878 MHz; F3: 1962.5 MHz; F4: 2132.5 MHz

Vertikal




Horizontal




The RF output power is terminated.

Za / 14.12.2014

**The radiated spurious emission measurements have been passed!**

# 11 History

| Revision | Modification | Date | Name |
|---|---|---|---|
| V01.00 | Initial | 03.02.2015 | Tom Zahlmann |
| | | | |
| | | | |

******** End of test report *******