

Test Site:
FCC Test Site No.:
IC OATS No.:

96997
IC3475A-1



ECL-EMC Test Report No.: 15-219

Equipment under test:

ION-U L EU 23/23

FCC ID:

XS5-UEUL2323

IC ID:

Type of test:

FCC 47 CFR Part 27 Subpart H, F: 2015

Miscellaneous Wireless Communication Services

Measurement Procedures:

47 CFR Parts 2: 2015 (*Frequency Allocations and Radio Treaty Matters; General Rules and Regulations*),
Part 27: 2015 (Miscellaneous Wireless Communication Services),
ANSI/TIA-603-C:2004, *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*

Test result:

Passed

| | | | |
|-------------------|----------------------|------------|--|
| Date of issue: | 21.10.15 | Signature: | |
| Issue-No.: | 01 | Author: | |
| Date of delivery: | 10.08.15 | Checked: | |
| Test dates: | 10.08. – 08.09.15 | | |
| Pages: | 54 | | |



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General:

The purpose of this report is to show compliance to the FCC regulations for devices operating under Part 27 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.



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1 Test Results Summary

| Name of Test | FCC Para. No. | FCC Method | FCC Spec. | Result |
|---|-----------------------|-----------------------|----------------------------|----------|
| RF Power Output | 27.50(a) | 2.1046 | 2000 Watts / 5 MHz E.I.R.P | Complies |
| Occupied Bandwidth | 2.1049 | 2.1049 | Input/Output | Complies |
| Spurious Emissions at Antenna Terminals | 27.53(a) | 2.1051 | -13dBm | Complies |
| Radiated Spurious emission | 27.53(m) | 2.1053 TIA/EA-603 | -13dBm E.I.R.P | Complies |
| Intermodulation | KDB 935210 D02 v03 | KDB 935210 D02 v03 | KDB 935210 D02 v03 | Complies |
| Frequency Stability | 27.54 | 2.1055 | Must stay in band | NA |
| Out of Band Rejection | KDB 935210 D02 v03 | KDB 935210 D03 v03 | KDB 935210 D03 v03 | 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 (Extension Unit 2) | ION-U L EU 23/23 | |
| Andrew Ident. Number | 7699392-0001 | |
| Serial no.(SN) | 12 | |
| Revision | 00 | |
| Software version and ID | n. a. | |
| Type of modulation and Designator | LTE (G7D) | <input checked="" type="checkbox"/> |
| Frequency Translation | F1-F1 | <input checked="" type="checkbox"/> |
| | F1-F2 | <input type="checkbox"/> |
| | N/A | <input type="checkbox"/> |
| Band Selection | Software | <input type="checkbox"/> |
| | Duplexer | <input checked="" type="checkbox"/> |
| | Full band | <input type="checkbox"/> |

| | |
|--------------------------------|-------------------------|
| Additional equipment for test* | |
| Remote Unit 1 | FCC ID: XS5-U7885L1719P |
| Romote Unit 2 | FCC ID: XS5-U7885L1719P |

*see 2.1.4

2.1.1 Downlink

| | |
|--|---------------------------|
| Pass band | 2350 MHz – 2360 MHz |
| Max. composite output power based on one carrier per path (rated) | 33 dBm = 2.0 W |
| MIMO max. composite output power based on one carrier per path (rated) | 36 dBm = 4.0 W |
| System Gain** | 0 dB @ Pout BTS of 33 dBm |

**see 2.1.5

2.1.2 Uplink

| | |
|---------------|---------------------|
| Pass band | 2305 MHz – 2315 MHz |
| 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 L EU 23/23 is a LTE MIMO multi-operator Extension Unit. It is used in conjunction with a Remote Unit in the ION optical distribution system.

This system transports multiple LTE channels simultaneously, providing a cost-effective solution for distributing capacity from one or more base stations.

This Test Report describes only the approval of the 2300 MHz Main Path.

The ION-U L EU 23/23 Repeater system consists of two 2300 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

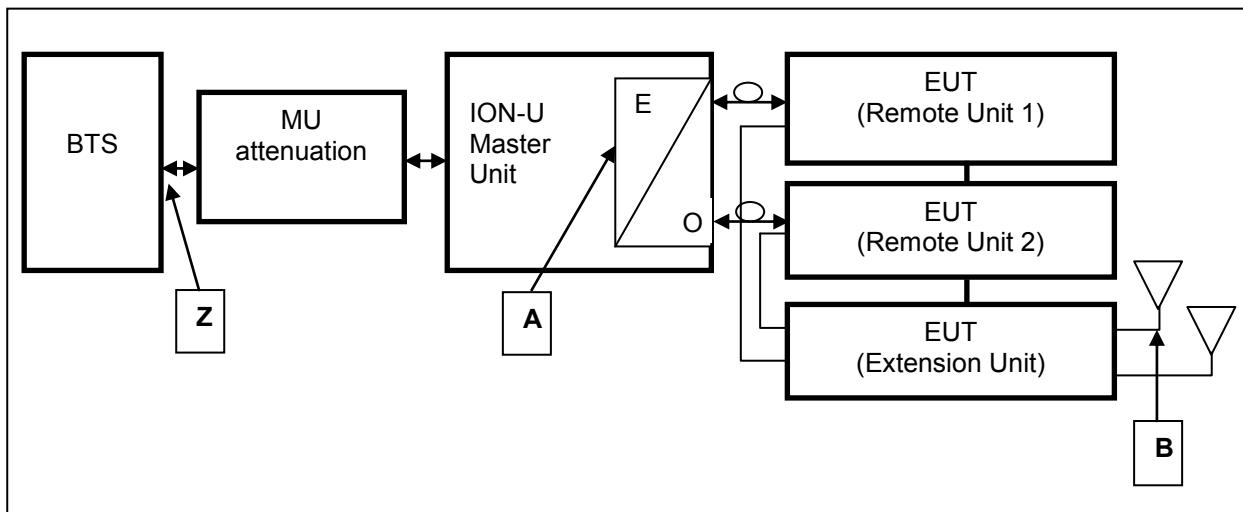


figure 2.1.4-#1 Block diagram of measurement reference points

Extension Unit (EU) 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 RU.

The EUT was tested with the worst case configuration (MIMO), where the highest interferers to be expected.



2.1.5 Downlink System Gain and Output Power

| System optimized for BTS power <i>(fixed value)</i> | MU Attenuation <i>(manual leveling)</i> | Maximum rated input power at the MU OTRX <i>(fixed value)</i> | RU Gain <i>(fixed value)</i> | Maximum rated output power at RU Antenna port <i>(fixed value)</i> |
|--|--|--|---------------------------------|---|
| Z | | A | A to B | B |
| +33 dBm | 57 dB | -24 dBm | +57 dB | +33.0 dBm @ 1 carrier |
| System Gain Z to B | | 0 dB | | |
| +43 dBm | 67 dB | -24 dBm | +57 dB | +33.0 dBm @ 1 carrier |
| System Gain Z to B | | -10 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 | $\pm 5\%$ 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 | 12/2014 |
| 9126 | Spectrum Analyzer | FSV 30 | R&S | 101237 | 11/2014 |
| 9069 | Generator | SMBV100A | R&S | 256275 | 08/2014 |
| 9046 | Generator | SMBV100A | R&S | 255090 | 05/2015 |
| 8542 | Power Meter | E4418A | Agilent | GB38273230 | 01/2015 |
| 8544 | Power Sensor | E8481H | Agilent | 3318A19208 | 01/2015 |
| 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 |
| 7406 | Matrix | | Andrew | | CIU |

CIU = Calibrate in use



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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
IC OATS: IC3475A-1

See relevant dates under section 9 of this test report.



5 RF Power Out: §27.50, §2.1046

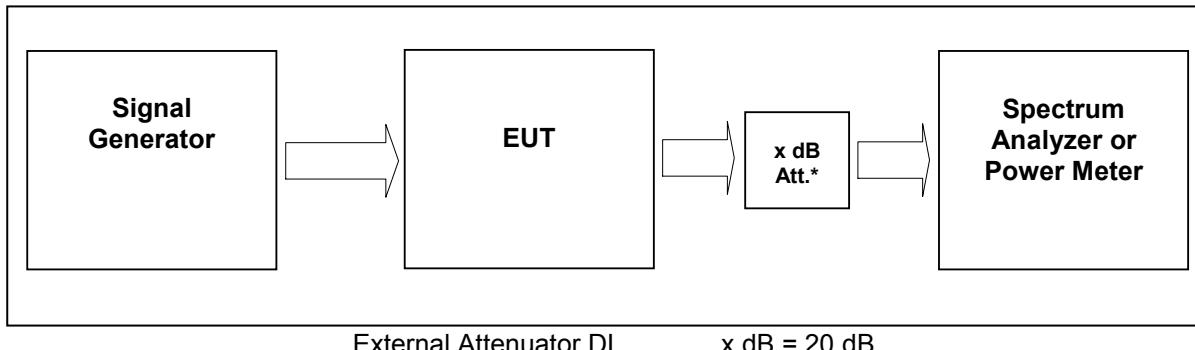


figure 5-#1 Test setup: RF Power Out: §27.50, §2.1046

| | |
|-------------------------|------------------------|
| Measurement uncertainty | $\pm 0,38 \text{ dB}$ |
| Test equipment used | 9069, 9046, 9126, 7406 |

5.1 Limit

Minimum standard:
Para. No.27.50(a)

(a) The following power limits and related requirements apply to stations transmitting in the 2305-2320 MHz band or the 2345-2360 MHz band.

(1) *Base and fixed stations.* (i) For base and fixed stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band:

(A) The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts within any 5 megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth.

(B) The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

(ii) For base and fixed stations transmitting in the 2315-2320 MHz band or the 2345-2350 MHz band, the peak EIRP must not exceed 2,000 watts.

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 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.



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(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 test conditions 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 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 | F / MHz | RBW VBW Span | Crest (dB) | RF Power (dBm) | RF Power (W) | MIMO RF Power (W) | Plot - |
|---|-------------|----------|---------------------------|------------|----------------|--------------|-------------------|------------|
| LTE 5 MHz | Middle | 2355 MHz | 100kHz 300kHz 20MHz | 8.18 | 33.0 | 2.0 | 4.0 | 5.3.1.1 #1 |
| LTE 10 MHz | Middle | 2355 MHz | 100kHz 300kHz 20MHz | 8.67 | 33.0 | 2.0 | 4.0 | 5.3.1.2 #1 |
| Maximum output power = 33 dBm = 2.0 W | | | | | | | | |
| Limit Maximum output power (eirp) = 2000 W / 5MHz (400 W / 1MHz) | | | | | | | | |

table 5.3.1.#1 RF Power Out: §27.50, §2.1046 Test Results Downlink

The max RF Power out is 33 dBm, so the maximum antenna gain (x) can be calculated as follow:

$$\text{Limit} = 2000\text{W (eirp)} = 63 \text{ dBm}$$

$$\text{Info: eirp} = \text{erp} * 1.64$$

$$63 \text{ dBm} > 33 \text{ dBm} + x \quad \rightarrow \quad x = 63 \text{ dBm} - 33 \text{ dBm} = 30 \text{ dBd}$$

=> The antenna that will be used for the complete system have to have a gain lower than 30 dBi, relative to a dipol.

**MIMO:**

The MIMO max RF Power out is 36 dBm, so the maximum antenna gain (x) can be calculated as follow:

$$\text{Limit} = 2000\text{W (eirp)} = \mathbf{63 \text{ dBm}}$$

Info: $\text{eirp} = \text{erp} * 1.64$

$$63 \text{ dBm} > 36 \text{ dBm} + x \quad \rightarrow \quad x = 63 \text{ dBm} - 36 \text{ dBm} = \underline{\underline{27 \text{ dBd}}}$$

=> The antenna that will be used for the complete system have to have a gain lower than 18 dBi, relative to a dipol.

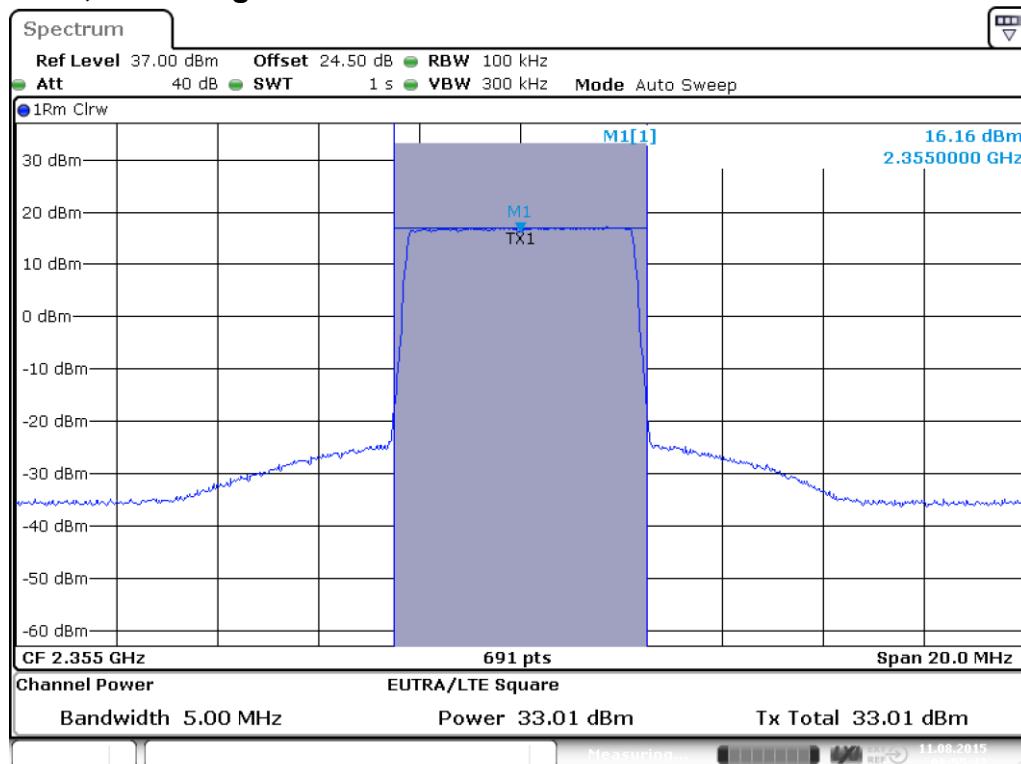
| Modulation | Pin / dBm (Ref. point A) |
|-------------------|-----------------------------|
| LTE 5 MHz signal | -24.0 |
| LTE 10 MHz signal | -23.9 |

table 5.3.1-#2 RF Power Out: §27.50, §2.1046 Test Results Downlink Input power

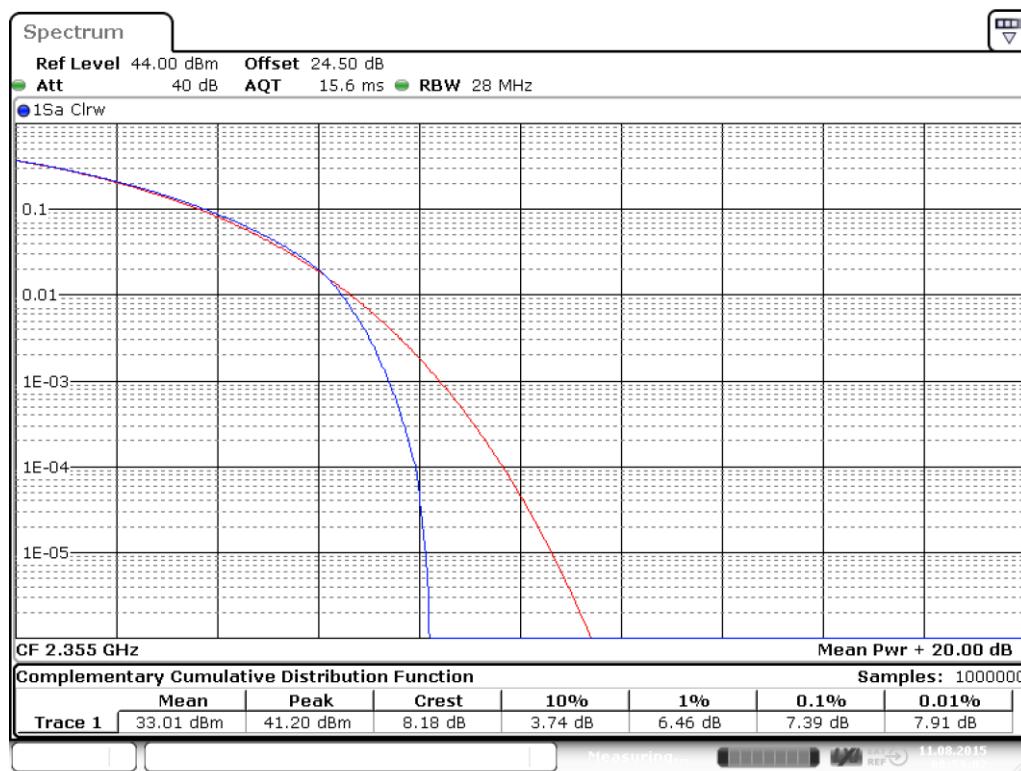
FCC ID: XS5-UEUL2323

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5.3.1.1 LTE; 5 MHz signal



plot 5.3.1.1-#1 RF Power Out: §27.50, §2.1046; Downlink; LTE; 5 MHz signal Middle



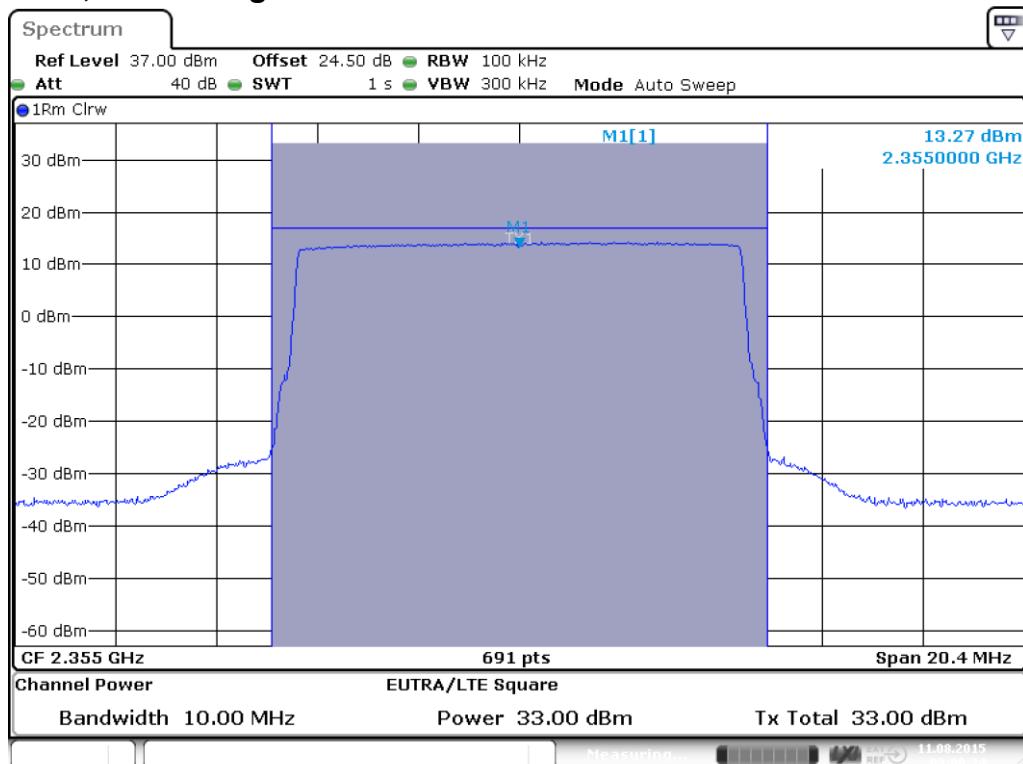
plot 5.3.1.1-#2 RF Power Out: §27.50, §2.1046; Downlink; LTE; 5 MHz signal Middle; CCDF



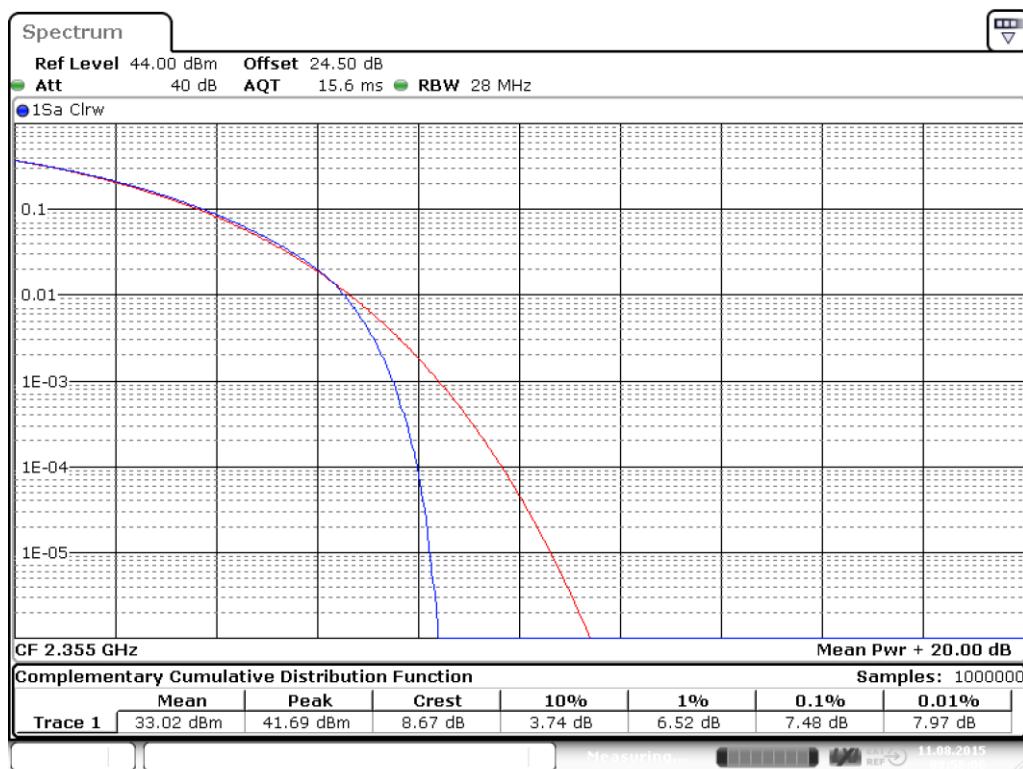
FCC ID: XS5-UEUL2323

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5.3.1.2 LTE; 10 MHz signal



plot 5.3.1.2-#1 RF Power Out: §27.50, §2.1046; Downlink; LTE; 10 MHz signal Middle



plot 5.3.1.2-#2 RF Power Out: §27.50, §2.1046; Downlink; LTE; 10 MHz signal Middle; CCDF



5.3.2 Uplink

n.a.

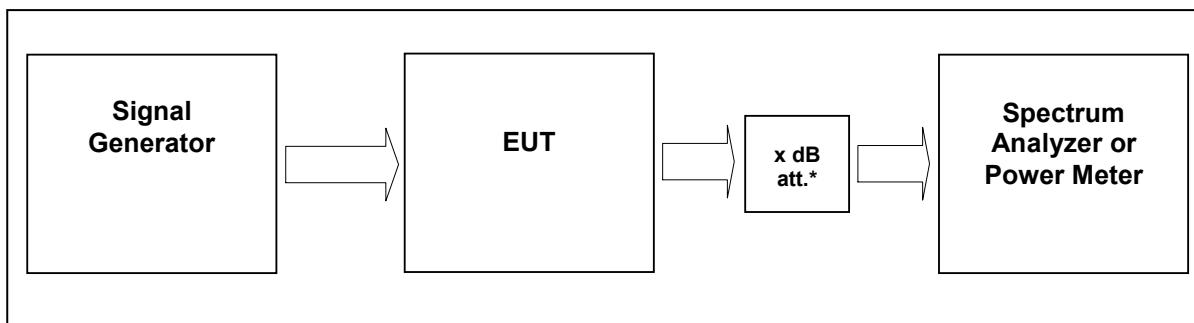
Note: The EUT does not transmit over the air in the uplink direction.

5.4 Summary test result

| | |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by: | F. Bengesser |
| Date: | 11.08.2015 |



6 Occupied Bandwidth: §2.1049



External Attenuator DL $x \text{ dB} = 20 \text{ dB}$
 figure 6-#1 Test setup: Occupied Bandwidth: §2.1049

| | |
|-------------------------|------------------------|
| Measurement uncertainty | $\pm 0,38 \text{ dB}$ |
| Test equipment used | 9069, 9046, 9126, 7406 |

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:

6.3 Test results

6.3.1 Downlink

Detector PK.

| Modulation | Measured at | F / MHz | RBW VBW Span | Occupied Bandwidth / MHz | Plot # |
|------------|-------------|---------|------------------------------|--------------------------------|-------------------|
| LTE 5 MHz | Middle | 2355 | 100 kHz 200 kHz 15 MHz | 4.515 | 6.3.1.1 #1, #2 |
| LTE 10 MHz | Middle | 2355 | 200 kHz 300 kHz 30 MHz | 9.03 | 6.3.1.3 #1, #2 |



| Modulation | Measured at | | F / MHz | RBW VBW Span | 26dB Bandwidth / MHz | Plot # |
|------------|-------------|--|---------|------------------------------|-------------------------|-------------------|
| LTE 5 MHz | Middle | | 2355 | 100 kHz 200 kHz 15 MHz | 5.036 | 6.3.1.2 #1, #2 |
| LTE 10 MHz | Middle | | 2355 | 200 kHz 300 kHz 30 MHz | 9.986 | 6.3.1.4 #1, #2 |

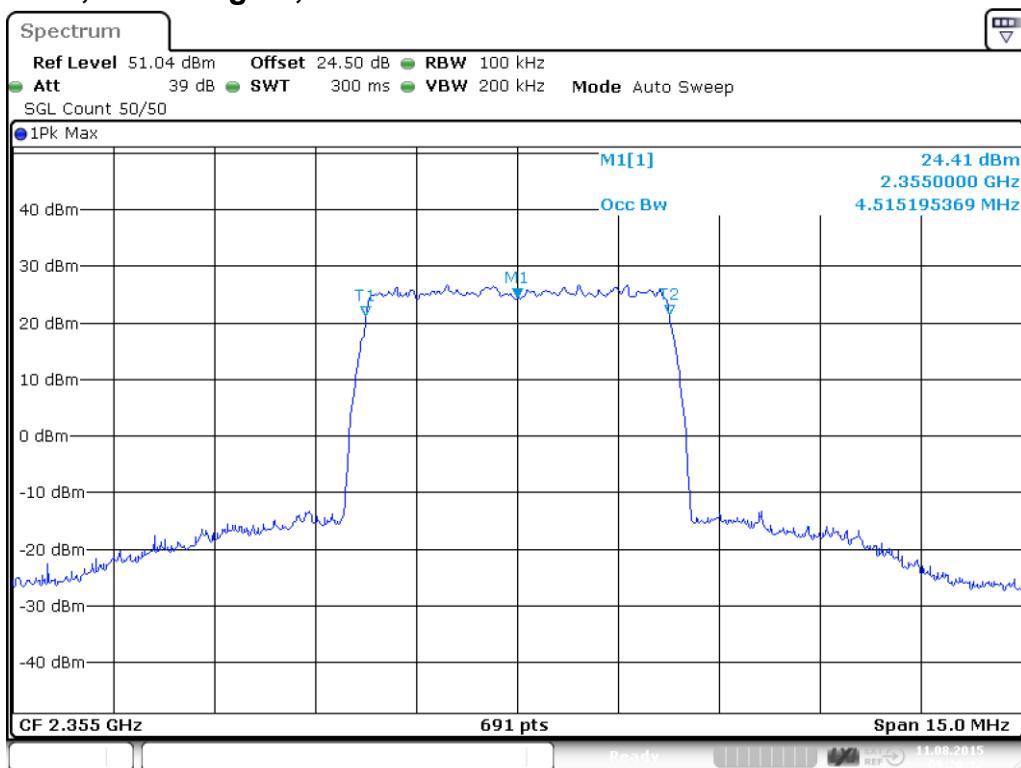
table 6.3-#1 Occupied Bandwidth: §2.1049 Test results



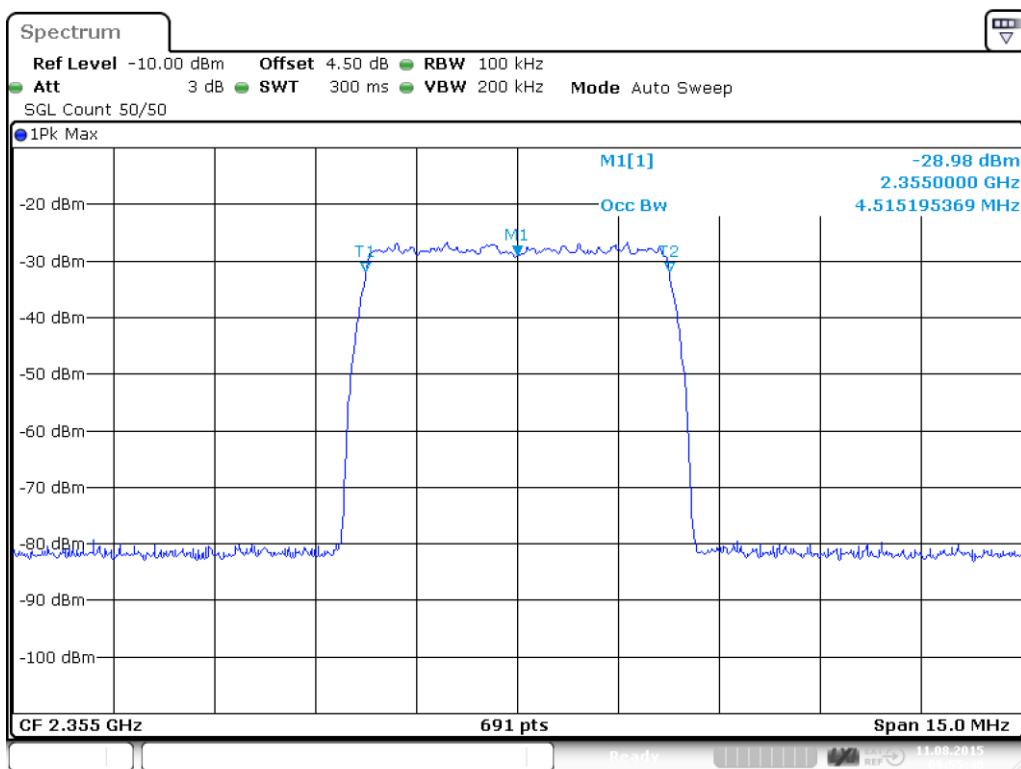
FCC ID: XS5-UEUL2323

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6.3.1.1 LTE; 5 MHz signal; OBW 99%



plot 6.3.1.1-#1 Occupied Bandwidth: §2.1049; Test results; Downlink; LTE; 5 MHz signal; OBW 99% Output



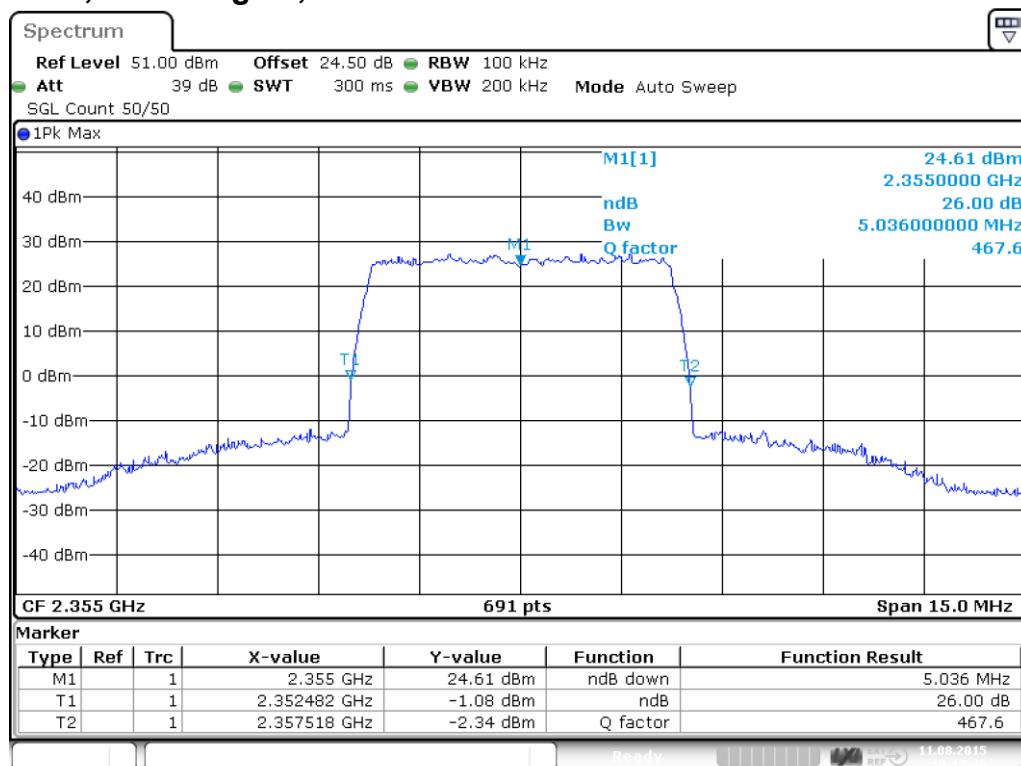
plot 6.3.1.1-#2 Occupied Bandwidth: §2.1049; Test results; Downlink; LTE; 5 MHz signal; OBW 99% Input



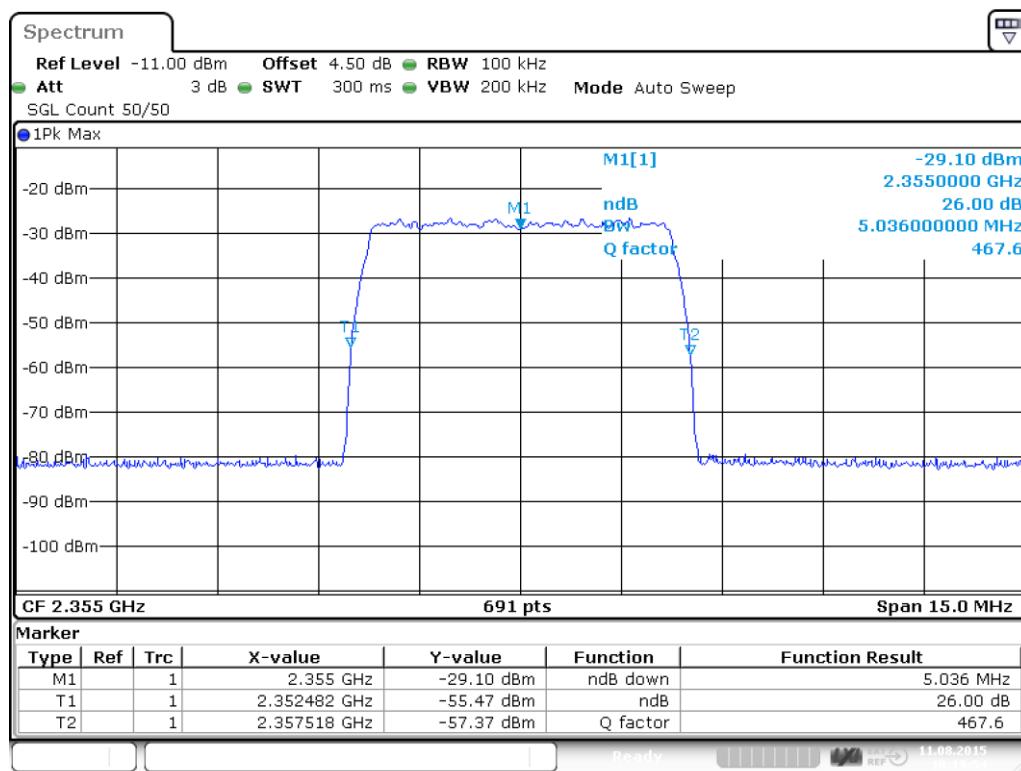
FCC ID: XS5-UEUL2323

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6.3.1.2 LTE; 5 MHz signal; OBW 26dB



plot 6.3.1.2-#1 Occupied Bandwidth: §2.1049; Test results; Downlink; LTE; 5 MHz signal; OBW 26dB Output



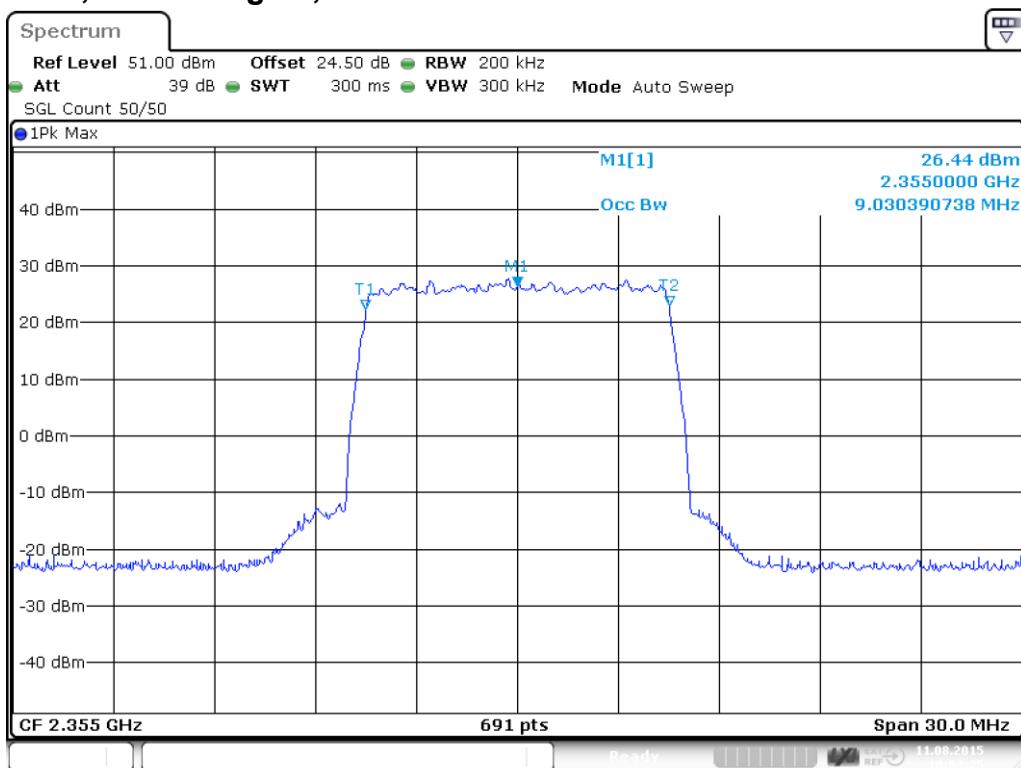
plot 6.3.1.2-#2 Occupied Bandwidth: §2.1049; Test results; Downlink; LTE; 5 MHz signal; OBW 26dB Input



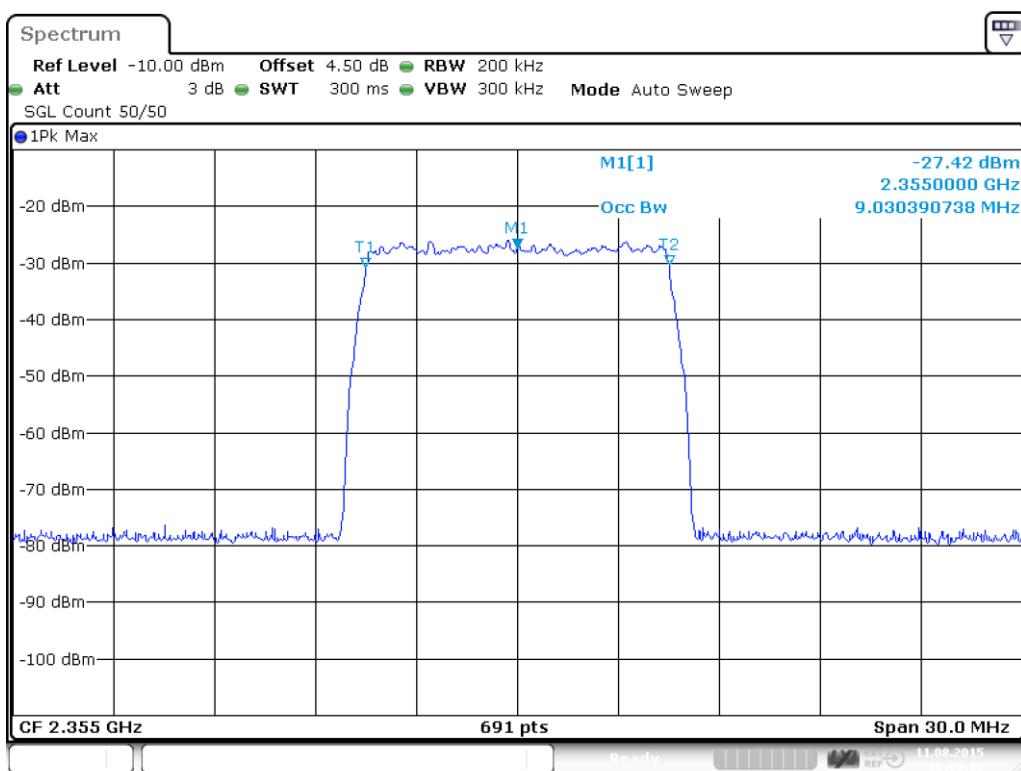
FCC ID: XS5-UEUL2323

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6.3.1.3 LTE; 10 MHz signal; OBW 99%



plot 6.3.1.3-#1 Occupied Bandwidth: §2.1049; Test results; Downlink; LTE; 10 MHz signal; OBW 99% Output



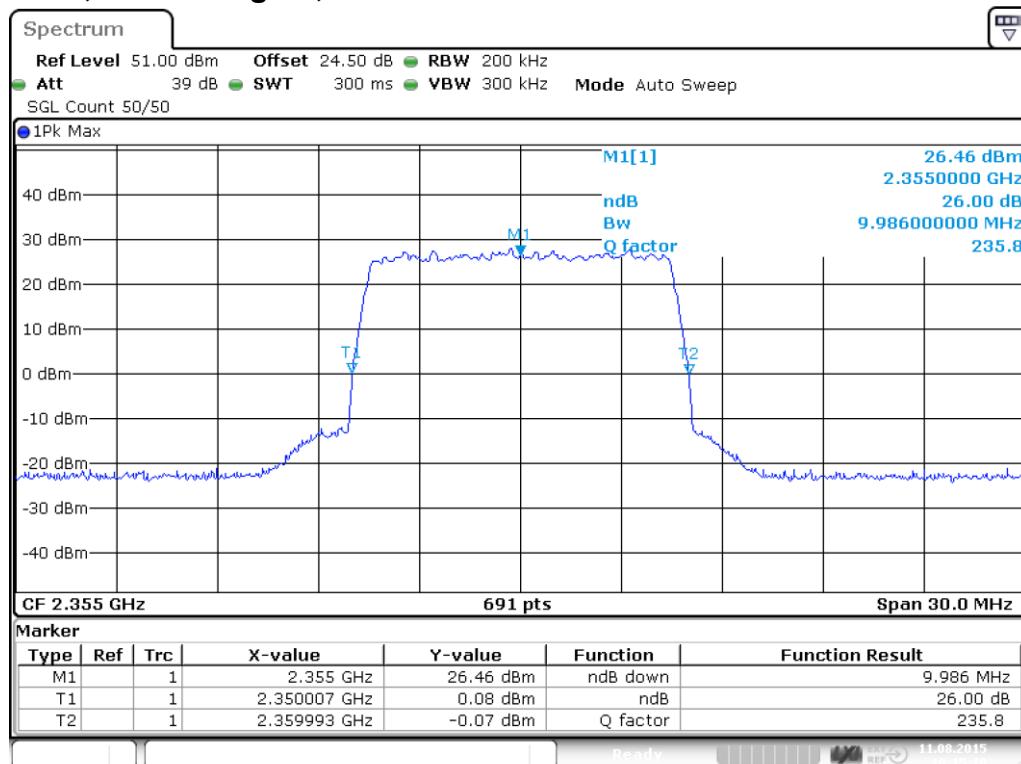
plot 6.3.1.3-#2 Occupied Bandwidth: §2.1049; Test results; Downlink; LTE; 10 MHz signal; OBW 99% Input



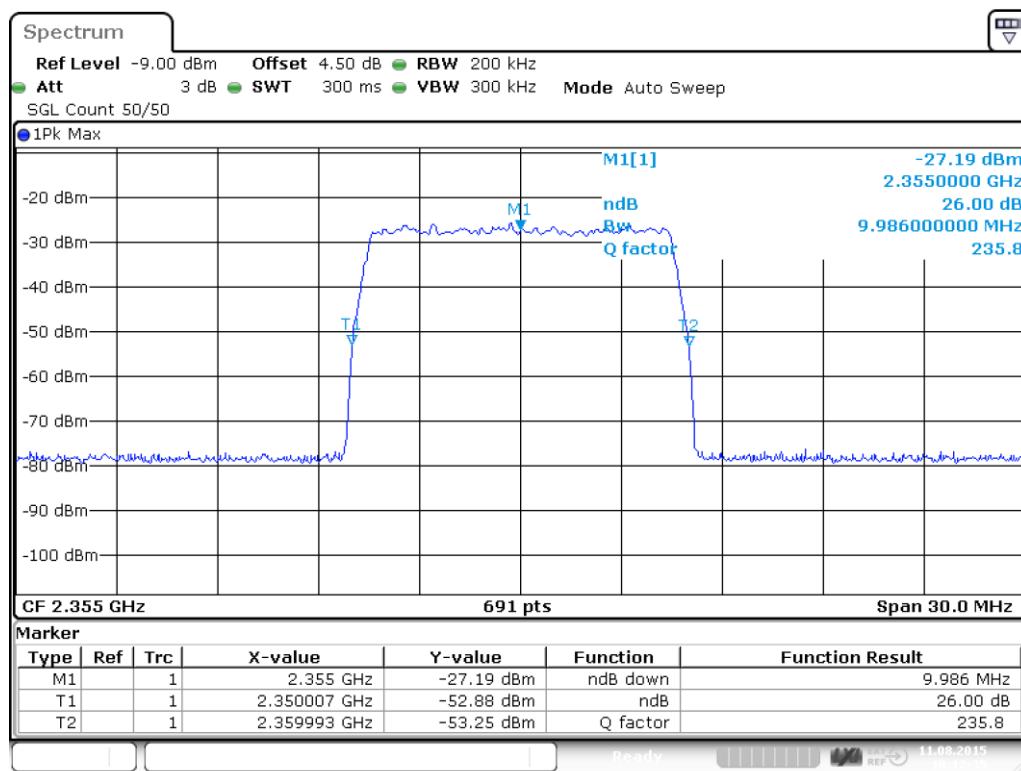
FCC ID: XS5-UEUL2323

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6.3.1.4 LTE; 10 MHz signal; OBW 26dB



plot 6.3.1.4-#1 Occupied Bandwidth: §2.1049; Test results; Downlink; LTE; 10 MHz signal; OBW 26dB Output



plot 6.3.1.4-#2 Occupied Bandwidth: §2.1049; Test results; Downlink; LTE; 10 MHz signal; OBW 26dB Input



6.3.2 Uplink

n.a.

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

6.4 Summary test result

| | |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by: | F. Bengesser |
| Date: | 11.08.2015 |

7 Spurious Emissions at Antenna Terminals: §27.53, §2.1051

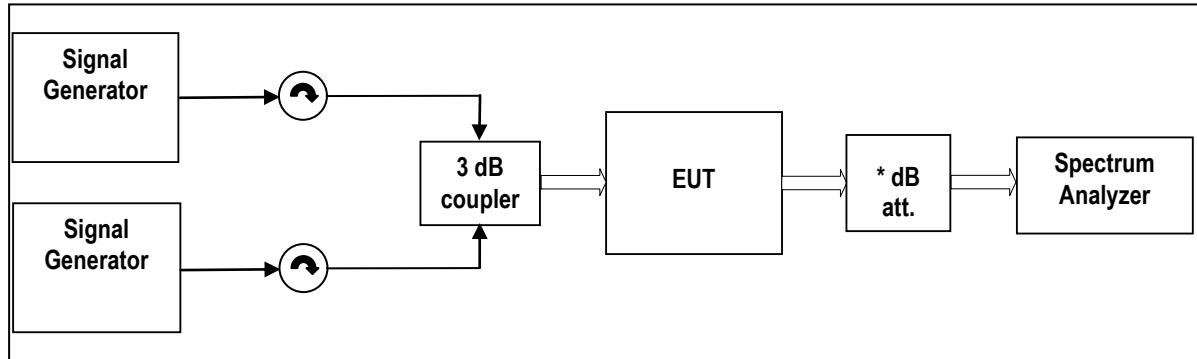
External Attenuator DL $x \text{ dB} = 20 \text{ dB}$

figure 7-#1 Test setup: Spurious Emissions at Antenna Terminals: §27.53, §2.1051

| | | |
|-------------------------|---|---|
| Measurement uncertainty | $\pm 0,54 \text{ dB}$ $\pm 1,2 \text{ dB}$ $\pm 1,5 \text{ dB}$ | 9 kHz to 3 GHz 3 GHz to 7 GHz 7 GHz to 26 GHz |
| Test equipment used | 9069, 9046, 9126, 7406 | |

7.1 Limit

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than $75 + 10 \log (P)$ dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2300 and 2305 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2287.5 and 2300 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2285 and 2287.5 MHz, and $75 + 10 \log (P)$ dB below 2285 MHz;

(iii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2360 and 2362.5 MHz, $55 + 10 \log (P)$ dB on all frequencies between 2362.5 and 2365 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2365 and 2367.5 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2367.5 and 2370 MHz, and $75 + 10 \log (P)$ dB above 2370 MHz.

(2) For fixed customer premises equipment (CPE) stations operating in the 2305-2320 MHz band and the 2345-2360 MHz band transmitting with more than 2 watts per 5 megahertz average EIRP:

(i) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than $75 + 10 \log (P)$ dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2300 and 2305 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2287.5 and 2300 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2285 and 2287.5 MHz, and $75 + 10 \log (P)$ dB below 2285 MHz;



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(iii) By a factor of not less than $43 + 10 \log(P)$ dB on all frequencies between 2360 and 2362.5 MHz, $55 + 10 \log(P)$ dB on all frequencies between 2362.5 and 2365 MHz, $70 + 10 \log(P)$ dB on all frequencies between 2365 and 2367.5 MHz, $72 + 10 \log(P)$ dB on all frequencies between 2367.5 and 2370 MHz, and $75 + 10 \log(P)$ dB above 2370 MHz.

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.

7.2 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 and amended at 63 FR 36599, July 7, 1998]

7.3 Test results

7.3.1 Downlink

Detector: RMS.

| Modulation | Carrier(s) F / MHz | Limit pass/fail | Limit with MIMO pass/fail | Plot - |
|------------------|-----------------------|--------------------|---------------------------------|------------------|
| 2 x LTE 5 MHz | 2352.5 2357.5 | pass | pass | 7.3.1.1 1 - 6 |
| LTE 10 MHz | 2355 | pass | pass | 7.3.1.2 1 - 6 |

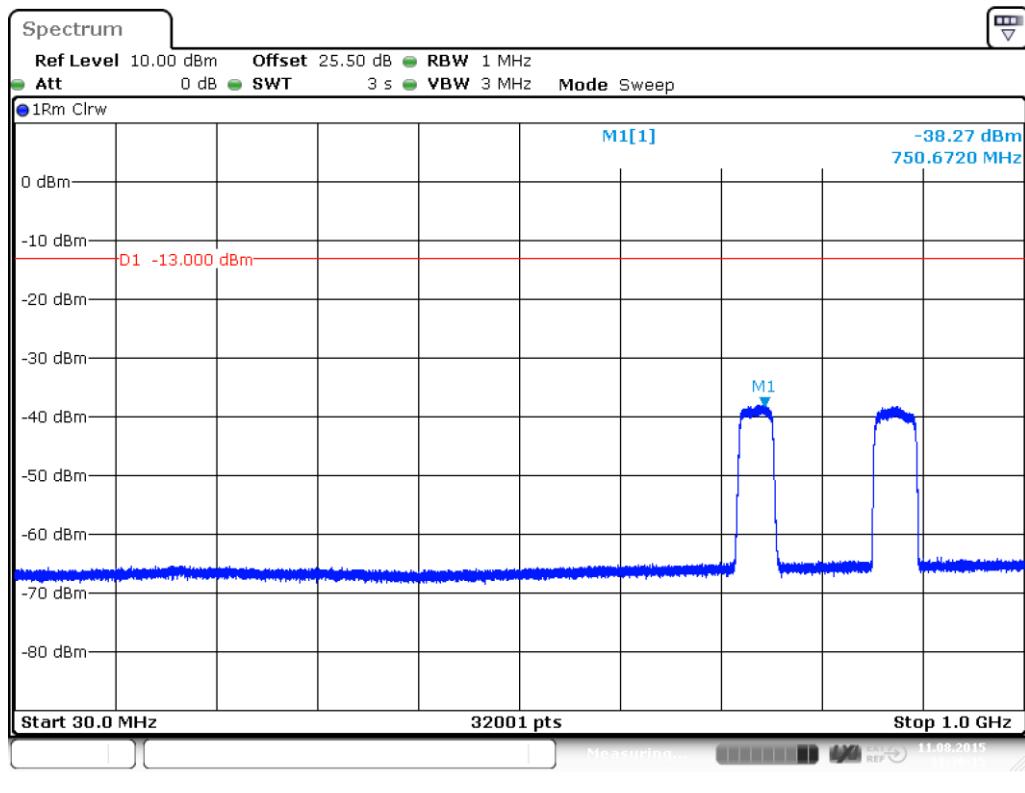
table 7.3-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051 Test results



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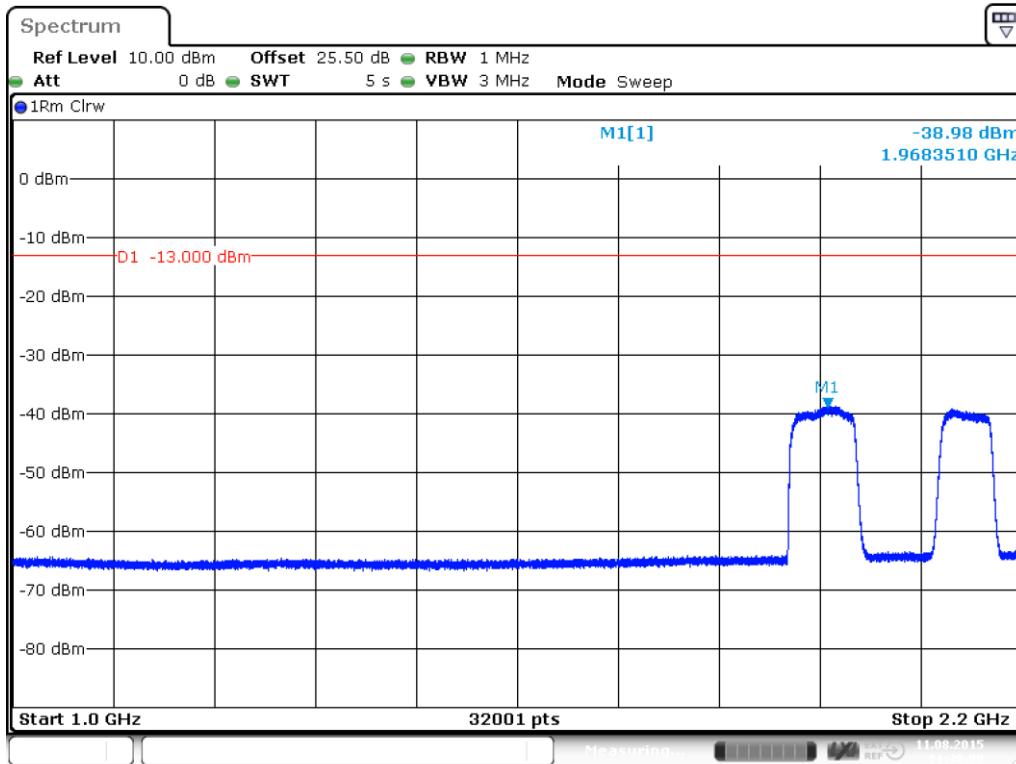
7.3.1.1 LTE; 2 x 5 MHz signal



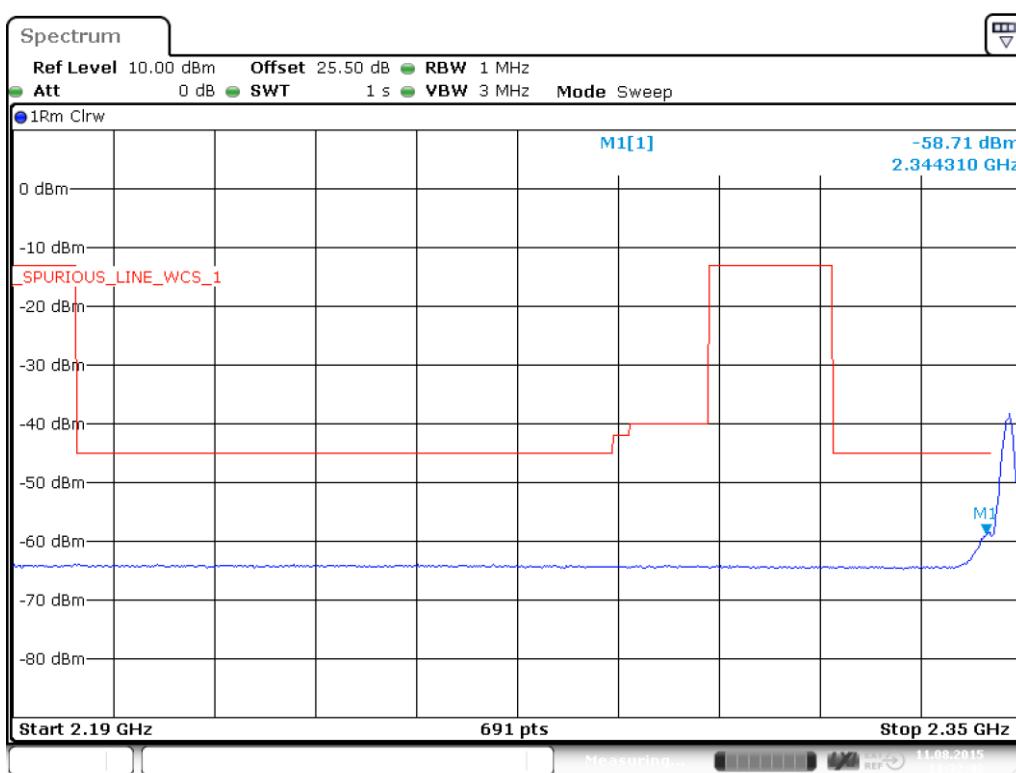
plot 7.3.1.1-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 2 x 5 MHz signal; 30 MHz – 1 GHz; carrier notched



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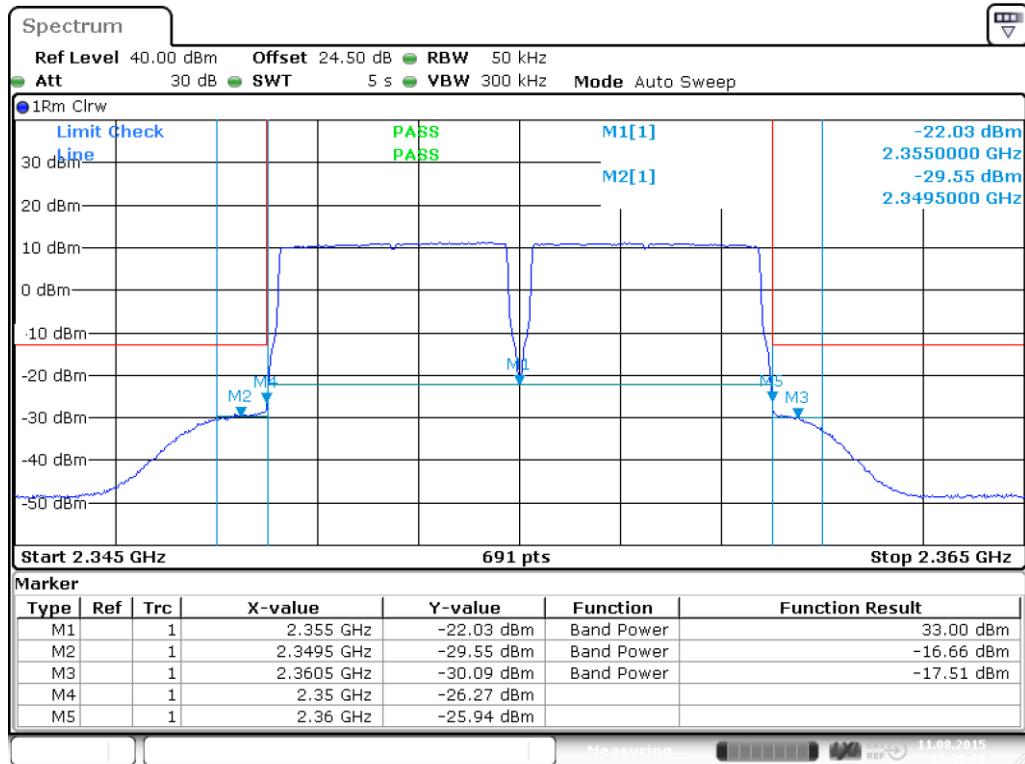
plot 7.3.1.1-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 2 x 5 MHz signal; 1 GHz – 2.2 GHz; carrier notched



plot 7.3.1.1-#3 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 2 x 5 MHz signal; 2.19 GHz – 2.35 GHz; carrier notched

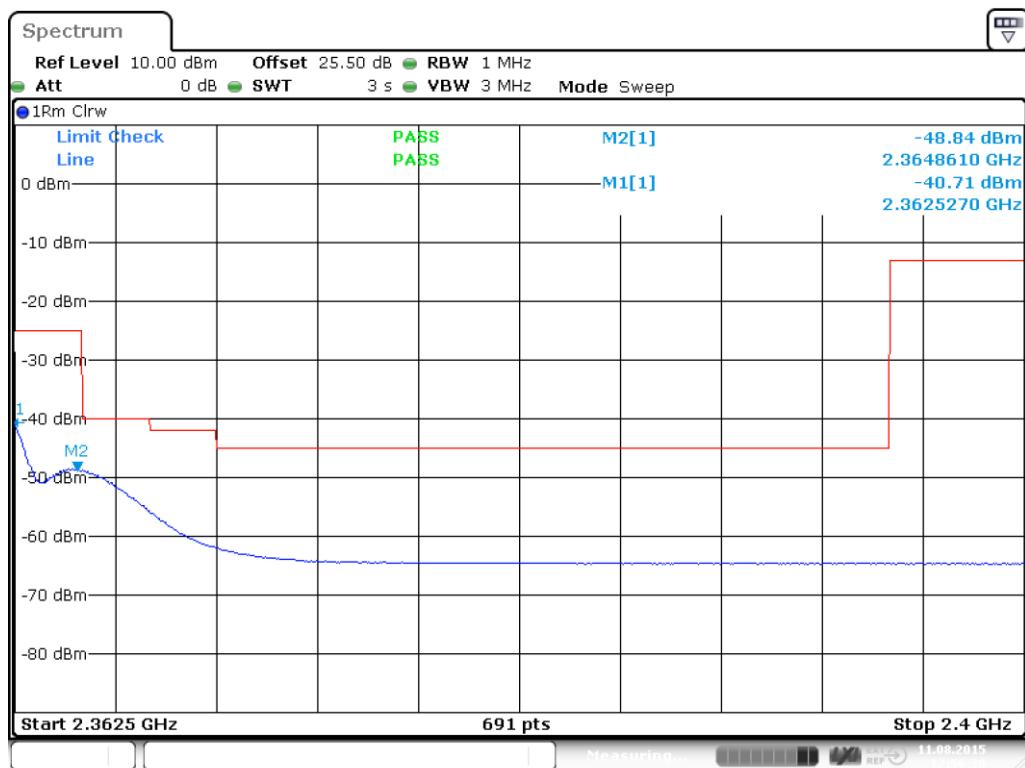


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Date: 11.AUG.2015 12:39:28

plot 7.3.1.1-#4 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 2 x 5 MHz signal; 2.345 GHz – 2.365 GHz

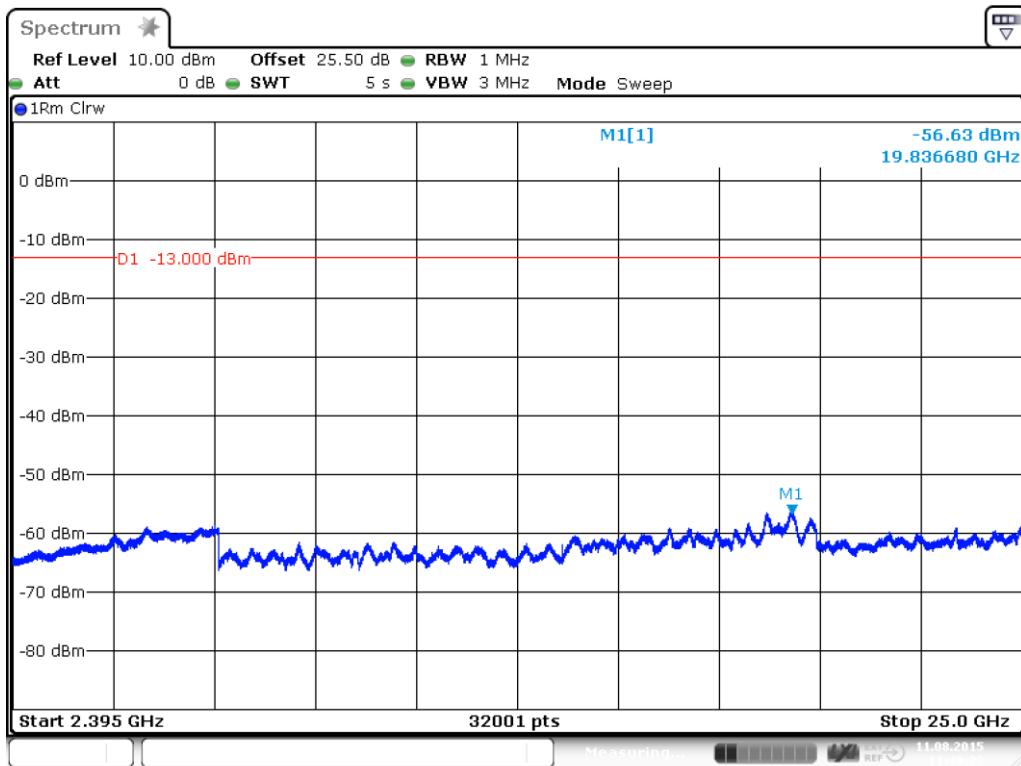


Date: 11.AUG.2015 12:56:30

plot 7.3.1.1-#5 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 2 x 5 MHz signal; 2.3625 GHz – 2.4 GHz; carrier notched



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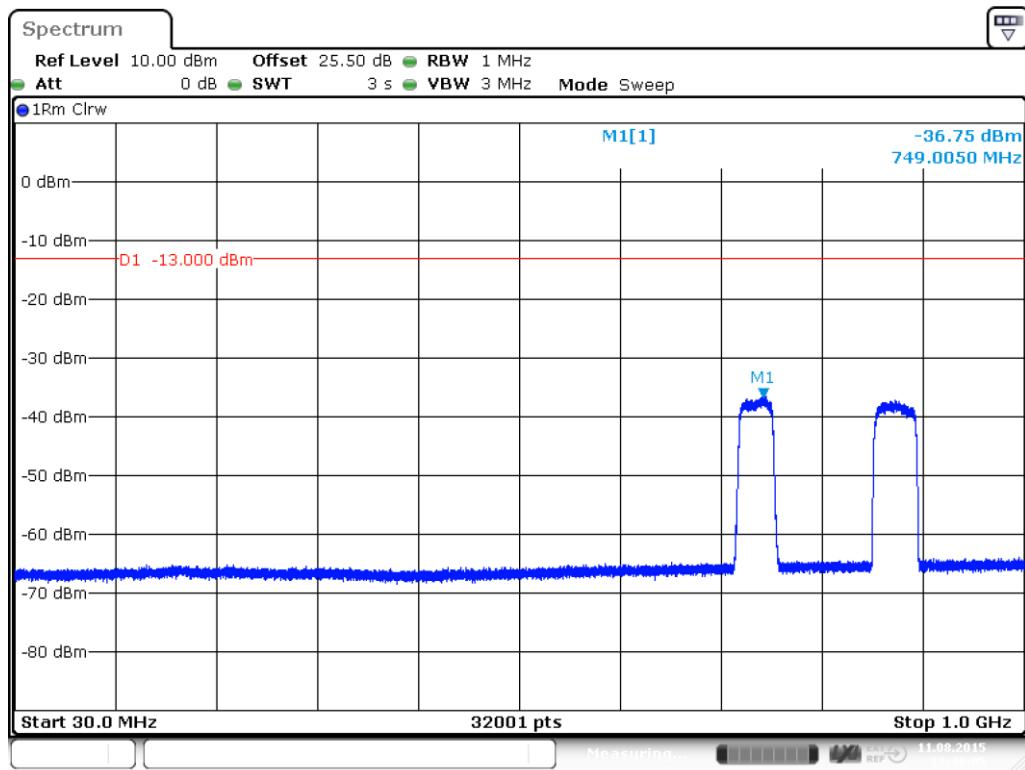
plot 7.3.1.1-#6 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 2 x 5 MHz signal; 2.395 GHz – 25 GHz; carrier notched



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7.3.1.2 LTE; 10 MHz signal

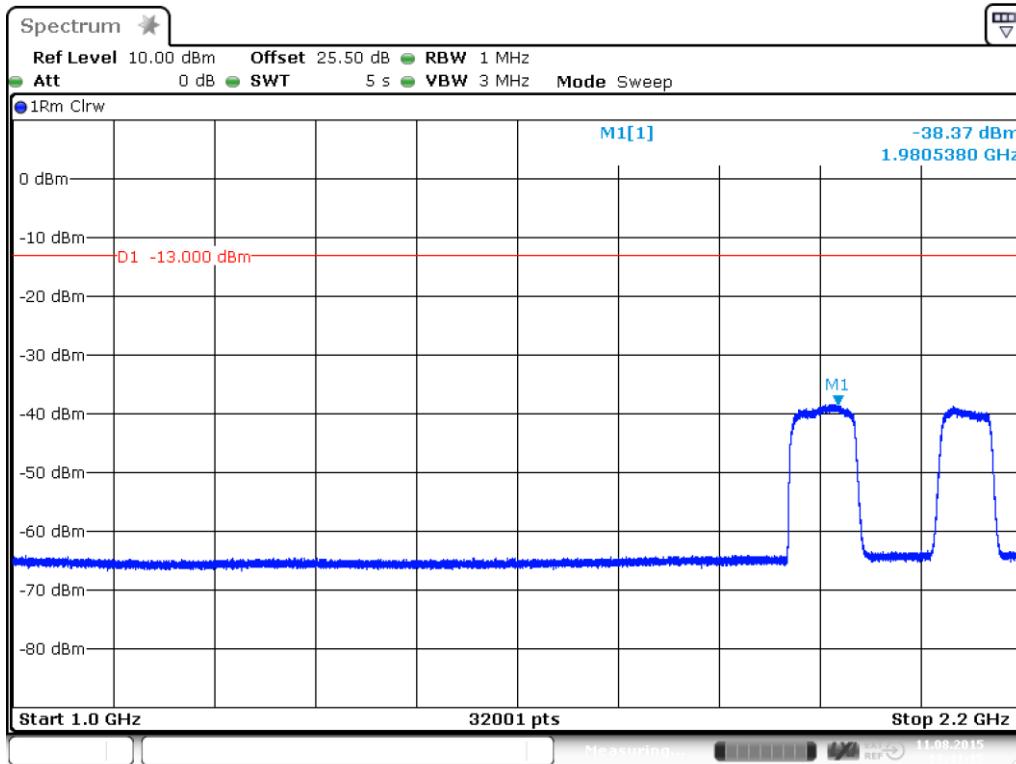


Date: 11.AUG.2015 13:40:05

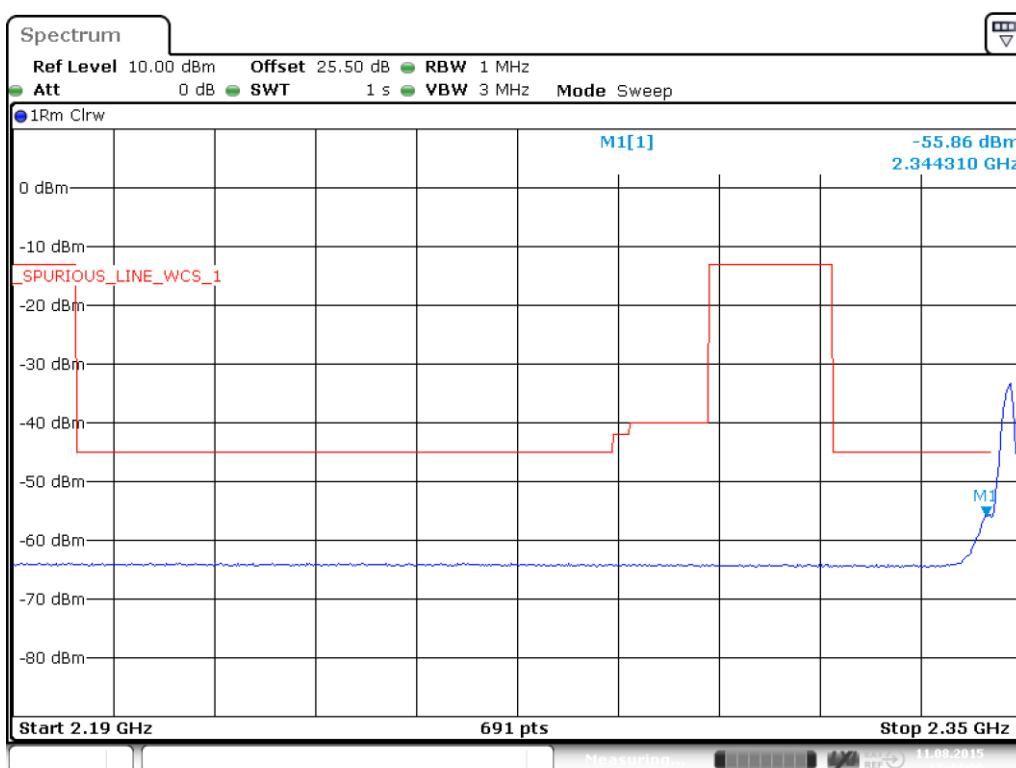
plot 7.3.1.2-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 10 MHz signal; 30 MHz – 1 GHz; carrier notched



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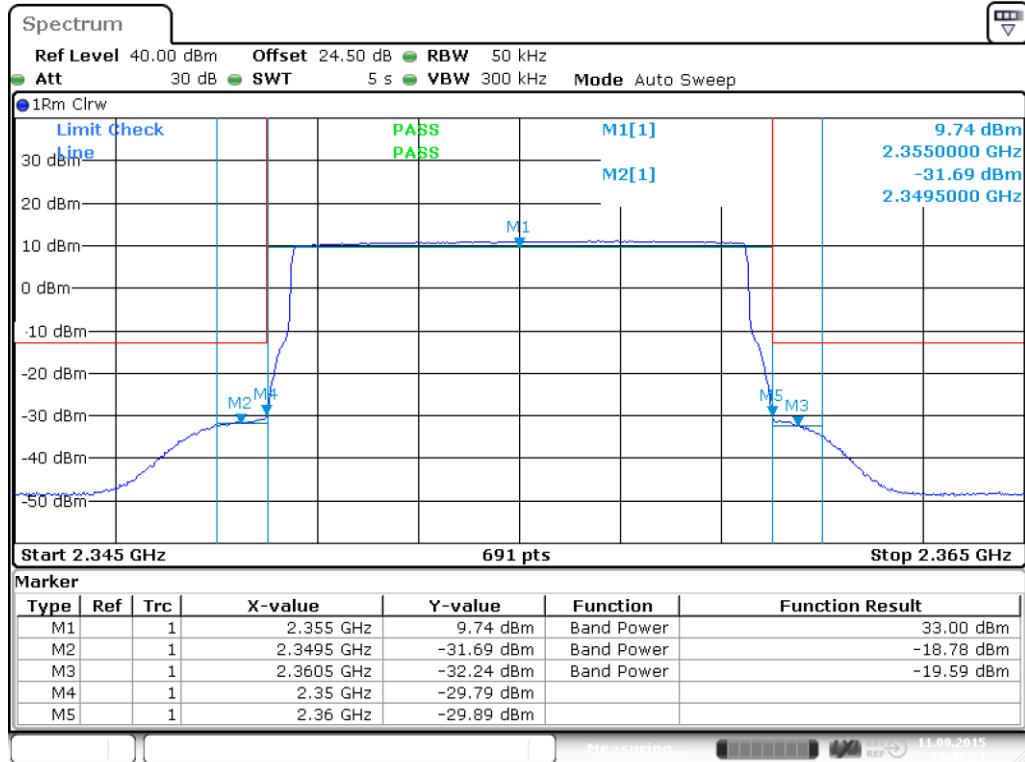
plot 7.3.1.2-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 10 MHz signal; 1 GHz – 2.2 GHz; carrier notched



plot 7.3.1.2-#3 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 10 MHz signal; 2.19 GHz – 2.35 GHz; carrier notched

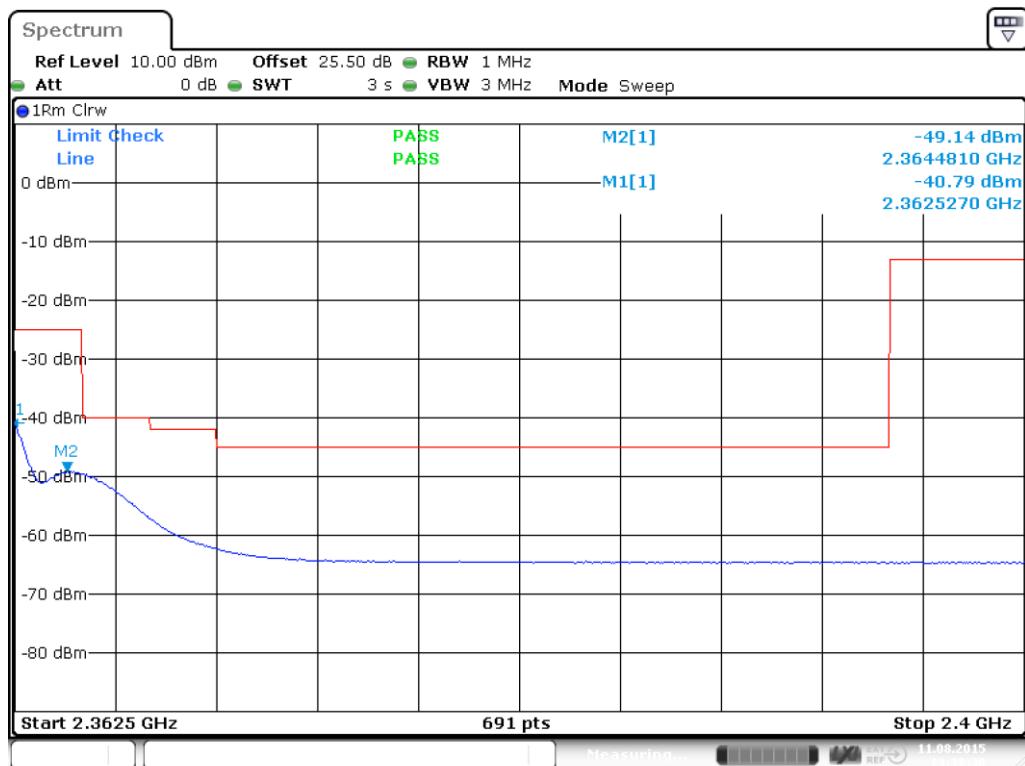


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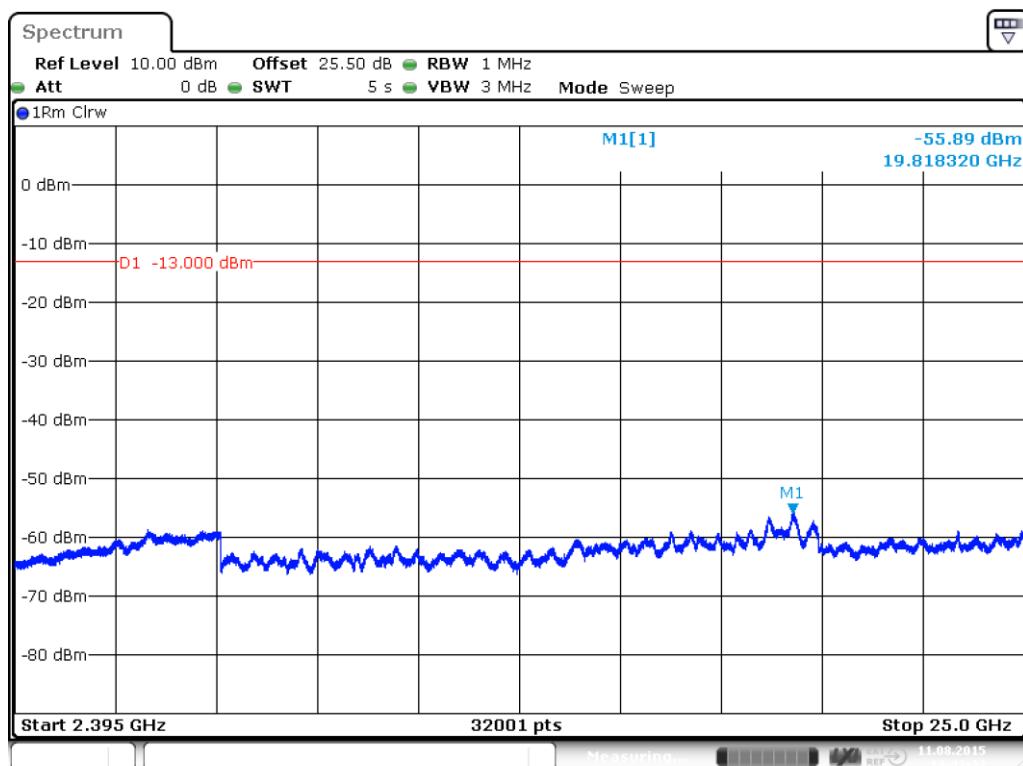
Date: 11.AUG.2015 13:49:21

plot 7.3.1.2-#4 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 10 MHz signal; 2.345 GHz – 2.365 GHz;



Date: 11.AUG.2015 13:38:36

plot 7.3.1.2-#5 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 10 MHz signal; 2.3625 GHz – 2.4 GHz; carrier notched



Date: 11.AUG.2015 13:42:33

plot 7.3.1.2-#6 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE; 10 MHz signal; 2.395 GHz – 25 GHz; carrier notched

7.3.2 Uplink

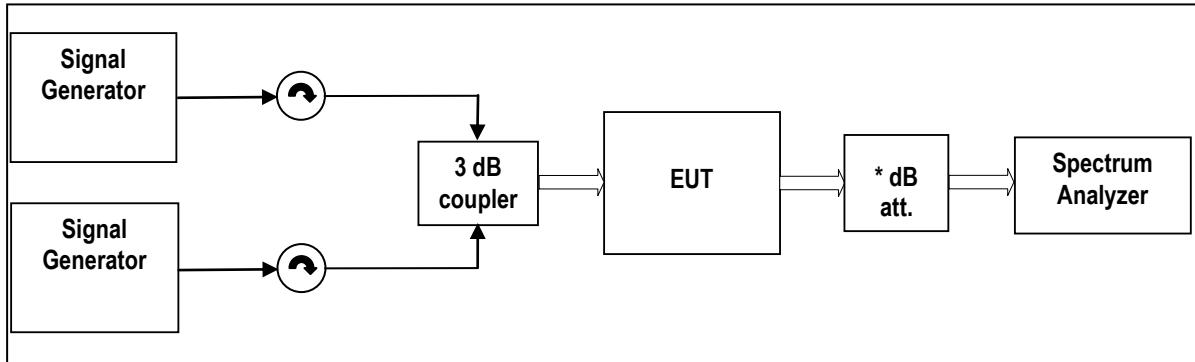
n.a.

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: | 11.05.2015 |

8 Intermodulation: §27.53, §2.1051



External Attenuator DL $x \text{ dB} = 20 \text{ dB}$

figure 8-#1 Test setup: Intermodulation: §27.53, §2.1051

| | | |
|-------------------------|---|---|
| Measurement uncertainty | $\pm 0,54 \text{ dB}$ $\pm 1,2 \text{ dB}$ $\pm 1,5 \text{ dB}$ | 9 kHz to 3 GHz 3 GHz to 7 GHz 7 GHz to 26 GHz |
| Test equipment used | 9069, 9046, 9126, 7406 | |

8.1 Limit

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than $75 + 10 \log (P)$ dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2300 and 2305 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2287.5 and 2300 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2285 and 2287.5 MHz, and $75 + 10 \log (P)$ dB below 2285 MHz;

(iii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2360 and 2362.5 MHz, $55 + 10 \log (P)$ dB on all frequencies between 2362.5 and 2365 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2365 and 2367.5 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2367.5 and 2370 MHz, and $75 + 10 \log (P)$ dB above 2370 MHz.

(2) For fixed customer premises equipment (CPE) stations operating in the 2305-2320 MHz band and the 2345-2360 MHz band transmitting with more than 2 watts per 5 megahertz average EIRP:

(i) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than $75 + 10 \log (P)$ dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2300 and 2305 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2287.5 and 2300 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2285 and 2287.5 MHz, and $75 + 10 \log (P)$ dB below 2285 MHz;



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(iii) By a factor of not less than $43 + 10 \log(P)$ dB on all frequencies between 2360 and 2362.5 MHz, $55 + 10 \log(P)$ dB on all frequencies between 2362.5 and 2365 MHz, $70 + 10 \log(P)$ dB on all frequencies between 2365 and 2367.5 MHz, $72 + 10 \log(P)$ dB on all frequencies between 2367.5 and 2370 MHz, and $75 + 10 \log(P)$ dB above 2370 MHz.

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.

8.2 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 and amended at 63 FR 36599, July 7, 1998]

8.3 Test results

8.3.1 Downlink

Detector: RMS.

| Modulation | Carrier(s) F / MHz | Limit pass/fail | Limit with MIMO pass/fail | Plot - |
|------------------|-----------------------|--------------------|---------------------------------|--------------|
| 2 x LTE 5 MHz | 2352.5 2357.5 | pass | pass | 8.3.1.1 1 |
| LTE 10 MHz | 2355 | pass | pass | 8.3.1.2 1 |

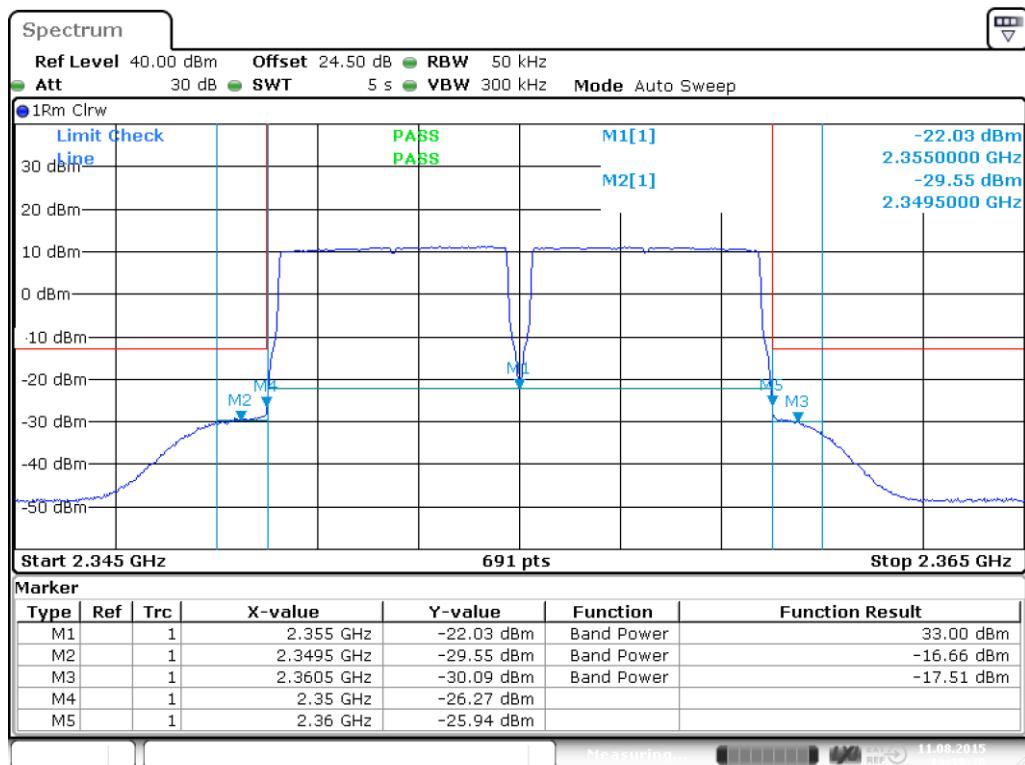
table 8.3-#1 Intermodulation: §27.53, §2.1051 Test results



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8.3.1.1 LTE; 2 x 5 MHz signal



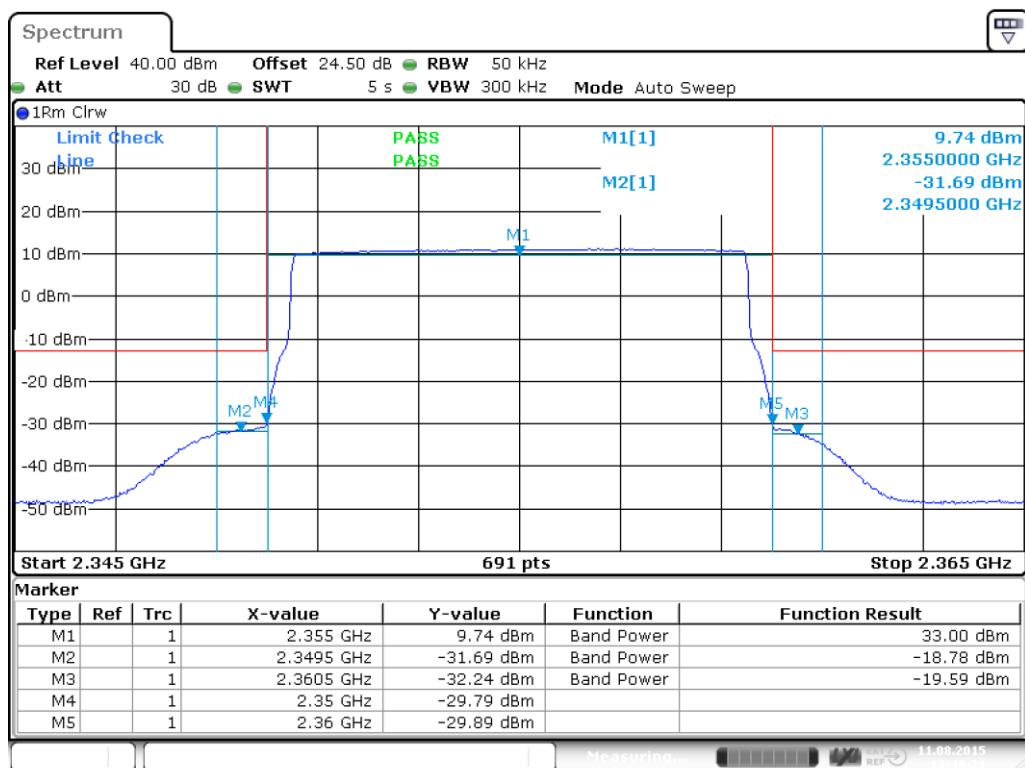
plot 8.3.1.1-#1 Intermodulation: §27.53, §2.1051; Test results; Downlink; LTE; 2 x 5 MHz signal; 2.345 GHz – 2.365 GHz



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8.3.1.2 LTE; 10 MHz signal



Date: 11.AUG.2015 13:49:21

plot 8.3.1.2-#1 Intermodulation: §27.53, §2.1051; Test results; Downlink; LTE; 10 MHz signal; 2.345 GHz – 2.365 GHz;

8.3.2 Uplink

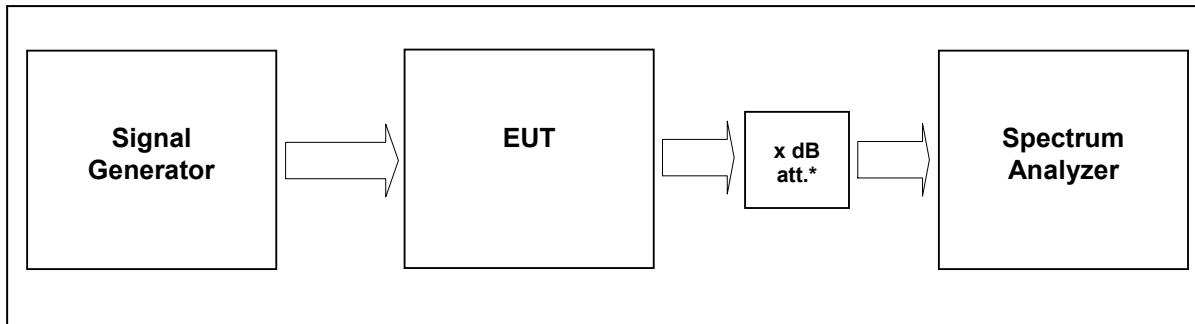
n.a.

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: | 11.08.2015 |

9 Out of Band Rejection



External Attenuator DL $x \text{ dB} = 20 \text{ dB}$
 figure 9-#1 Test setup: Out of Band Rejection

| | |
|-------------------------|------------------------|
| Measurement uncertainty | $\pm 0,38 \text{ dB}$ |
| Test equipment used | 9069, 9046, 9126, 7406 |

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

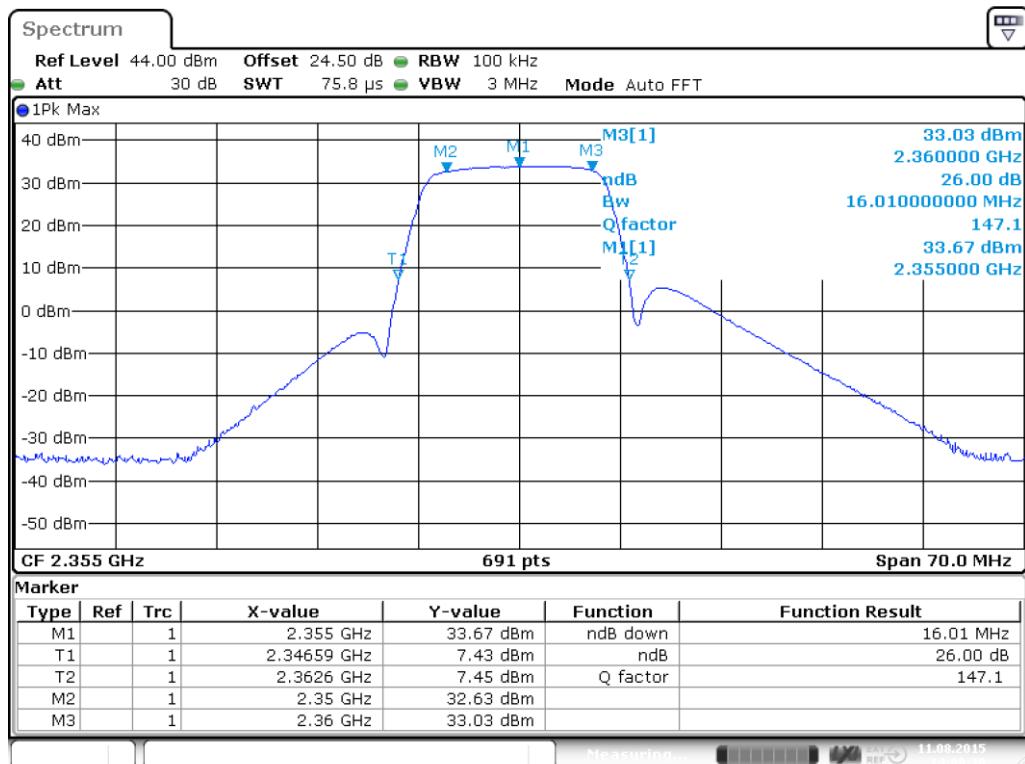
Detector Peak max hold



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9.3.1 Downlink



Date: 11.AUG.2015 14:09:30

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: | 11.08.2015 |



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10 Radiated Spurious Emissions at the ECL (BV): §27.53, §2.1053

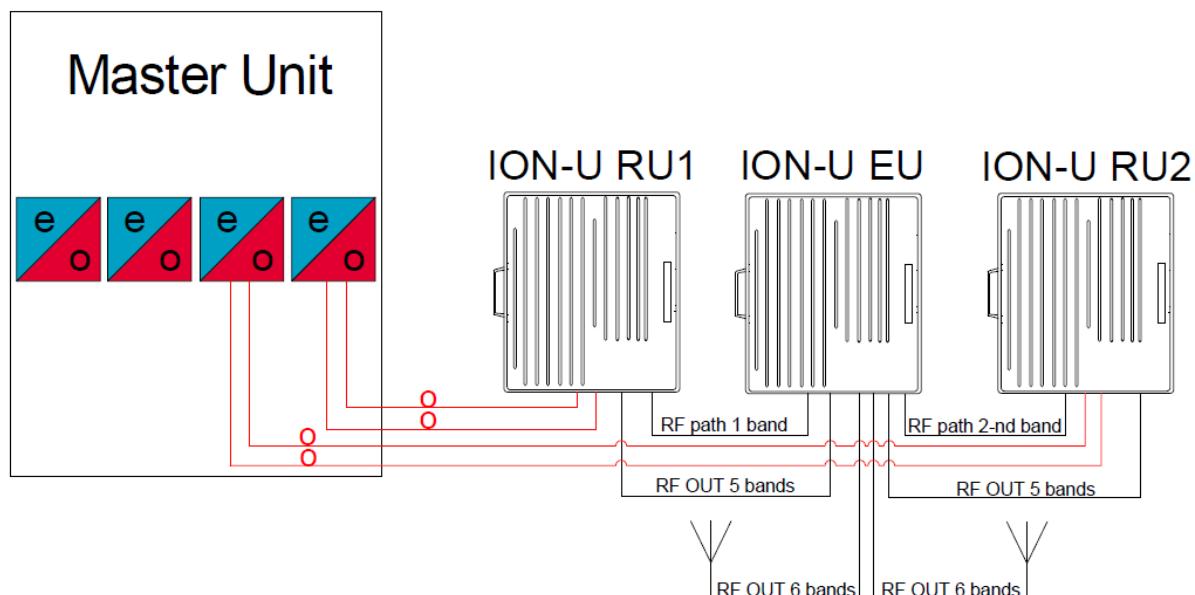
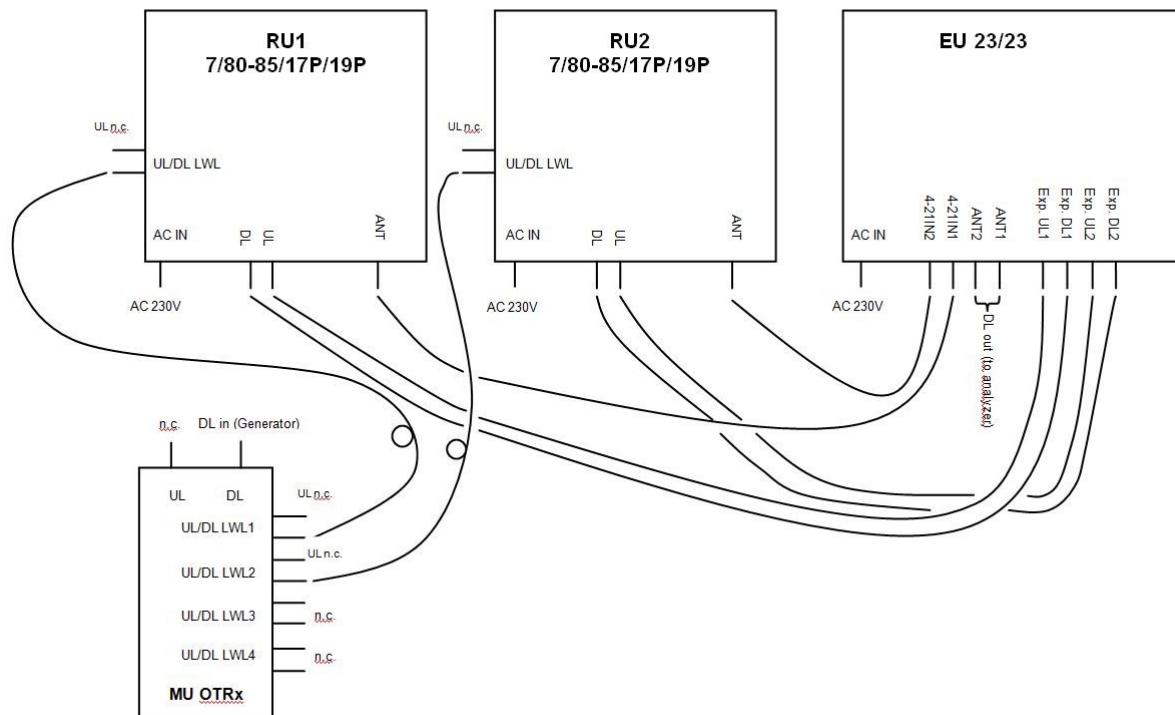


picture 8.1: label EUT

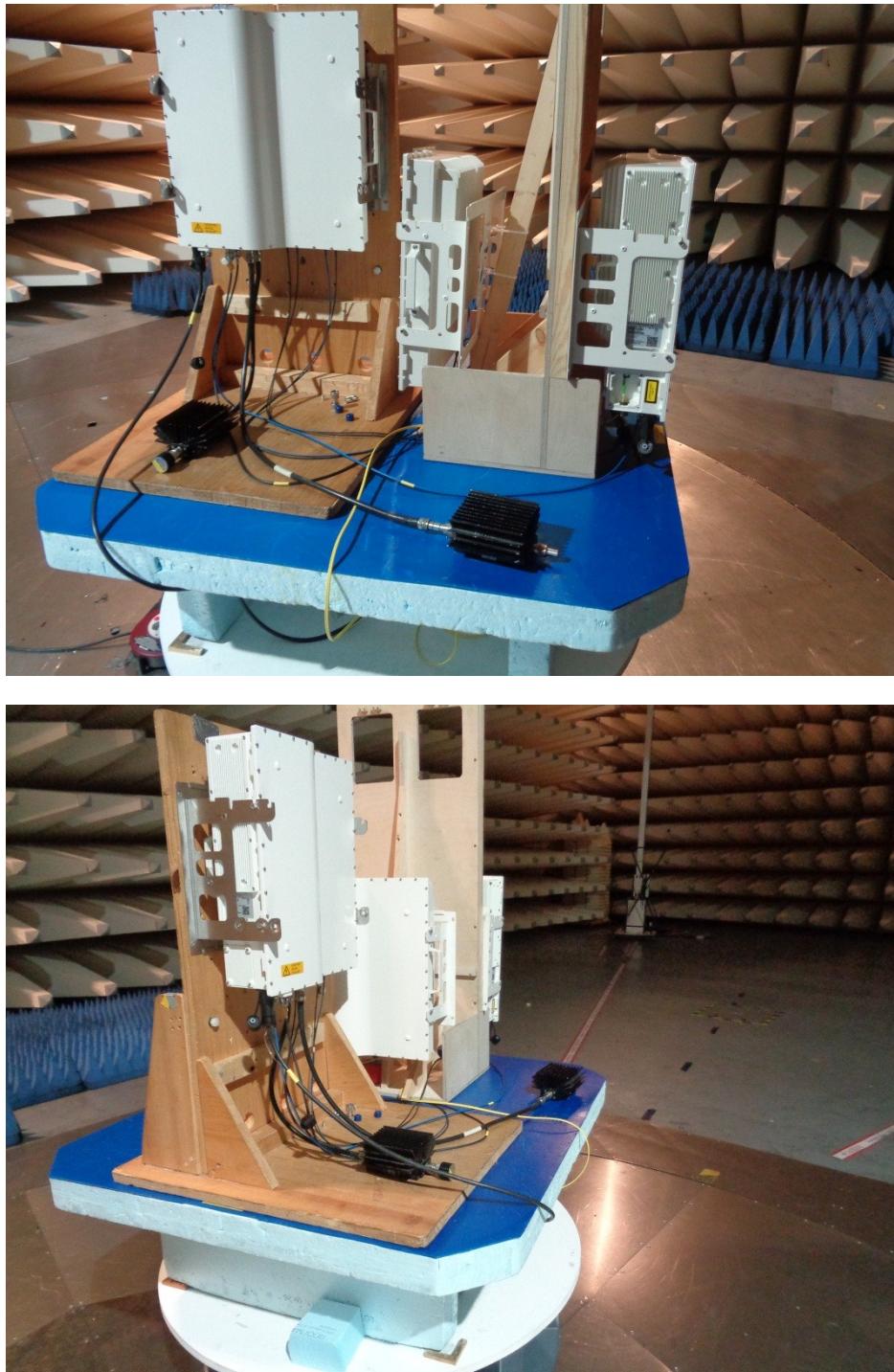


picture 8.2: label auxiliary equipment

The radiated emission was tested with the worst case configuration (MIMO), where the highest interferers to be expected.



picture 8.3: Test configuration



picture 8.3: Test setup



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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 27.53 | TIA/EIA-603-C:2004 |
| 1 – 26 GHz | 3 metres / SAC | | |

Test equipment used:

| Designation | Type | Manufacturer | Invent.-no. | Cal.-date | due Cal.-date | used |
|-------------------|---------------|-----------------|-------------|------------|---------------|------|
| EMI test receiver | ESU40 | Rohde & Schwarz | E2025 | 18.05.2015 | 18.05.2016 | X |
| Antenna | CBL 6111 | Chase | K1149 | 09.03.2015 | 09.03.2016 | X |
| RF Cable | RG214 | Frankonia | K1121 | 16.04.2015 | 16.04.2017 | X |
| Antenna | HL 025 | R&S | K1114 | 09.03.2015 | 09.03.2016 | X |
| Preamplifier | AFS4-00102000 | Miteq | K838 | 17.06.2015 | 17.06.2016 | X |
| RF Cable | Sucoflex 100 | Suhner | K1760 | 04.08.2015 | 04.08.2016 | 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 / FAC
 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: 110 V / 60 Hz
- Type of EUT: Wall mounted

Measurement uncertainty:

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

10.1 Method of Measurement

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 Bottom/Middle/Top frequencies for Part 27 F/H are as follows:

- 728/737/746 MHz (§27 Subpart H)
- 746/755/763 MHz (§27 Subpart F)

The maximum RFI field strength was determined during the measurement by rotating the turntable (± 180 degrees) 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 width during the 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.

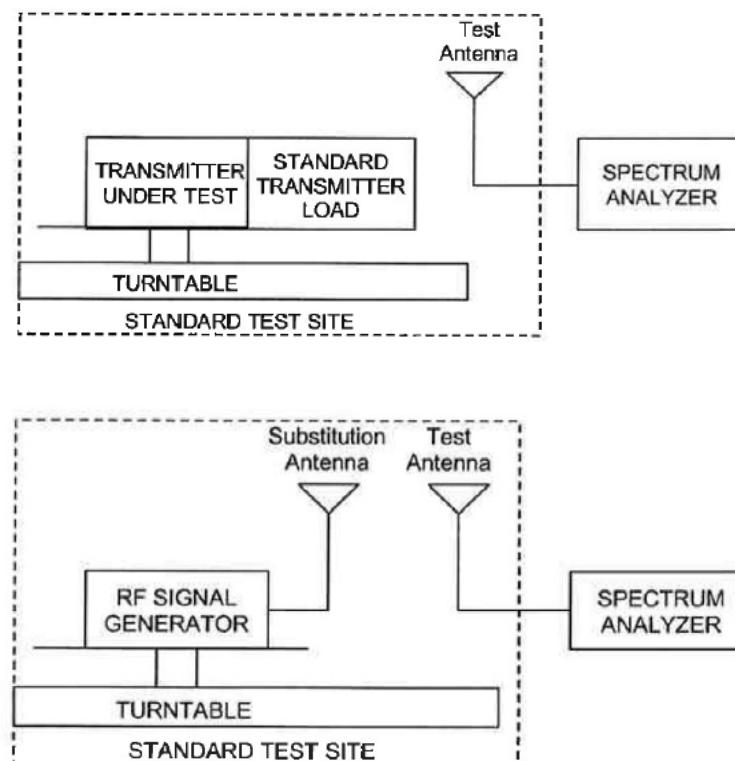


Figure #8.3 Substitution methods TIA/EIA-603-C



10.2 Limit

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than $75 + 10 \log (P)$ dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2300 and 2305 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2287.5 and 2300 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2285 and 2287.5 MHz, and $75 + 10 \log (P)$ dB below 2285 MHz;

(iii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2360 and 2362.5 MHz, $55 + 10 \log (P)$ dB on all frequencies between 2362.5 and 2365 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2365 and 2367.5 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2367.5 and 2370 MHz, and $75 + 10 \log (P)$ dB above 2370 MHz.

(2) For fixed customer premises equipment (CPE) stations operating in the 2305-2320 MHz band and the 2345-2360 MHz band transmitting with more than 2 watts per 5 megahertz average EIRP:

(i) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than $75 + 10 \log (P)$ dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2300 and 2305 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2287.5 and 2300 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2285 and 2287.5 MHz, and $75 + 10 \log (P)$ dB below 2285 MHz;

(iii) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2360 and 2362.5 MHz, $55 + 10 \log (P)$ dB on all frequencies between 2362.5 and 2365 MHz, $70 + 10 \log (P)$ dB on all frequencies between 2365 and 2367.5 MHz, $72 + 10 \log (P)$ dB on all frequencies between 2367.5 and 2370 MHz, and $75 + 10 \log (P)$ dB above 2370 MHz.



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10.3 Receiver Settings

| | up to 1 GHz | above 1 GHz |
|-----------------------|--------------------|--------------------|
| Measurement bandwidth | 120 kHz | 1 MHz |
| Step width | 60 kHz | 500 kHz |
| Dwell time | 20ms | |
| Detector | Peak | Average |

10.4 Climatic values in the lab

| | |
|-------------------|----------|
| Temperature | 21C |
| Relative Humidity | 50% |
| Air-pressure | 1014 hPa |

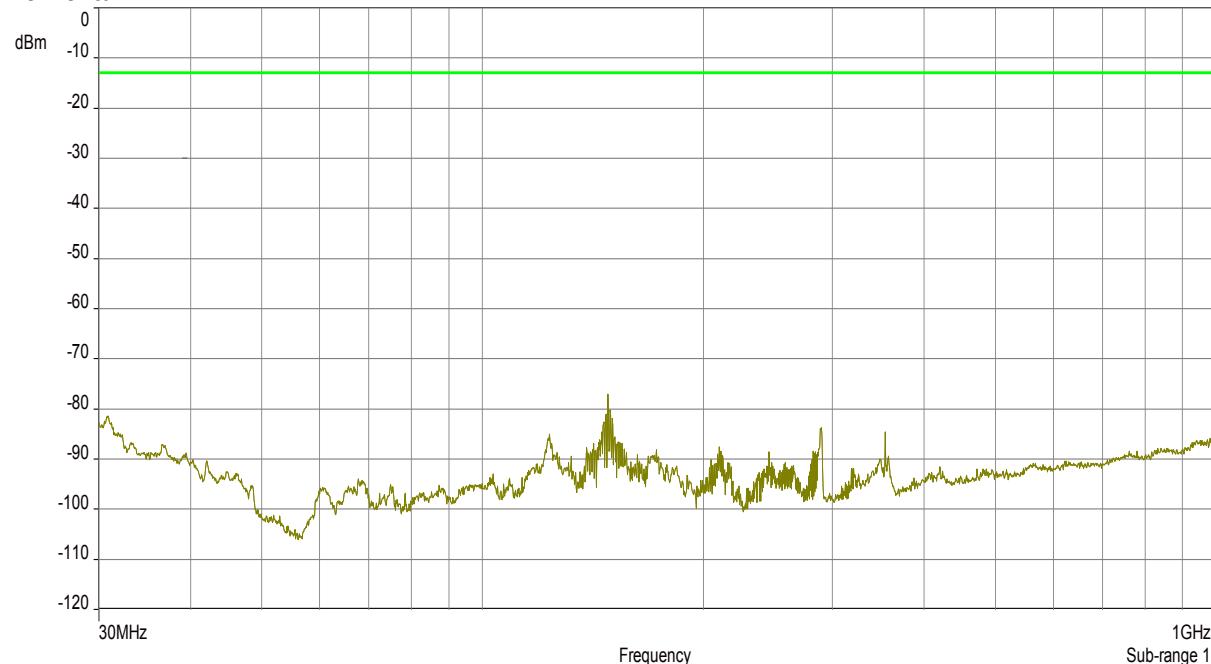


10.5 Test results

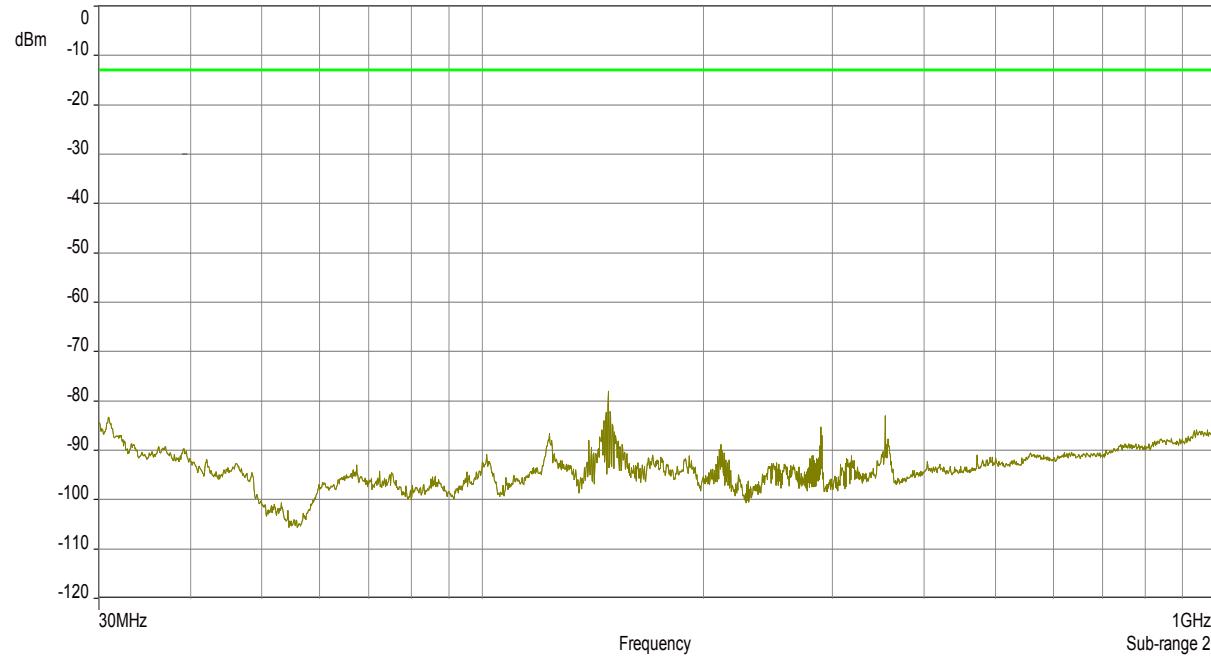
10.5.1 30 MHz to 1 GHz Downlink (Bottom – Middle – Top)

Bottom: 2350 MHz; Middle: 2355 MHz; Top: 2360 MHz

horizontal



Vertikal



The RF output power is terminated.

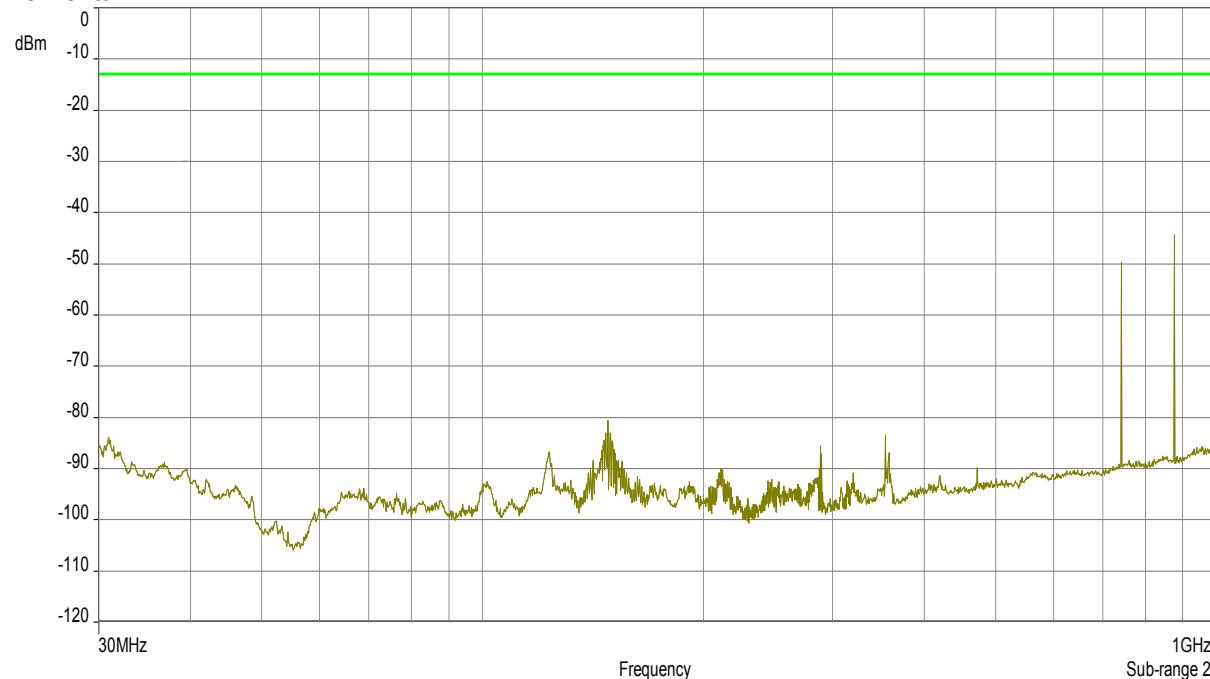


FCC ID: XS5-UEUL2323

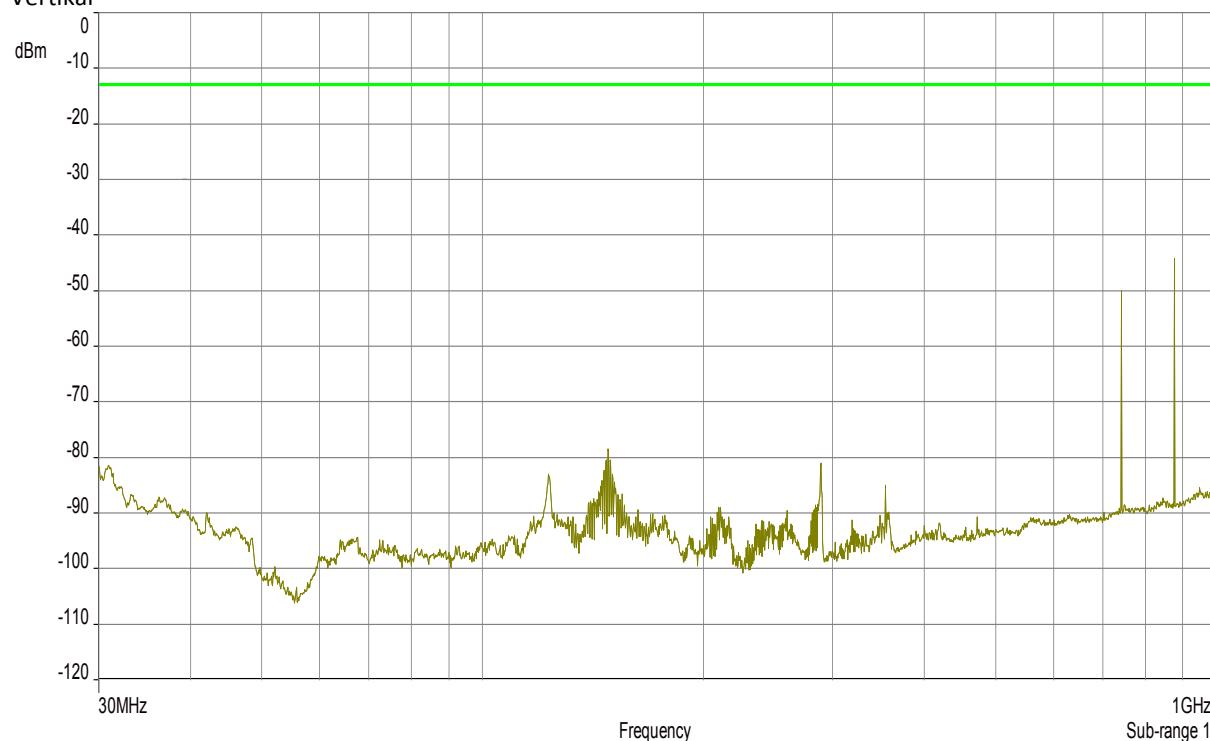
BUREAU
VERITAS**10.5.3 30 MHz to 1 GHz Downlink (Middle of all paths)**

F1: 742.5 MHz; F2: 876.25 MHz; F3: 1962.5 MHz; F3: 2132.5 MHz; F3: 2355 MHz

horizontal



Vertikal



The RF output power is terminated.

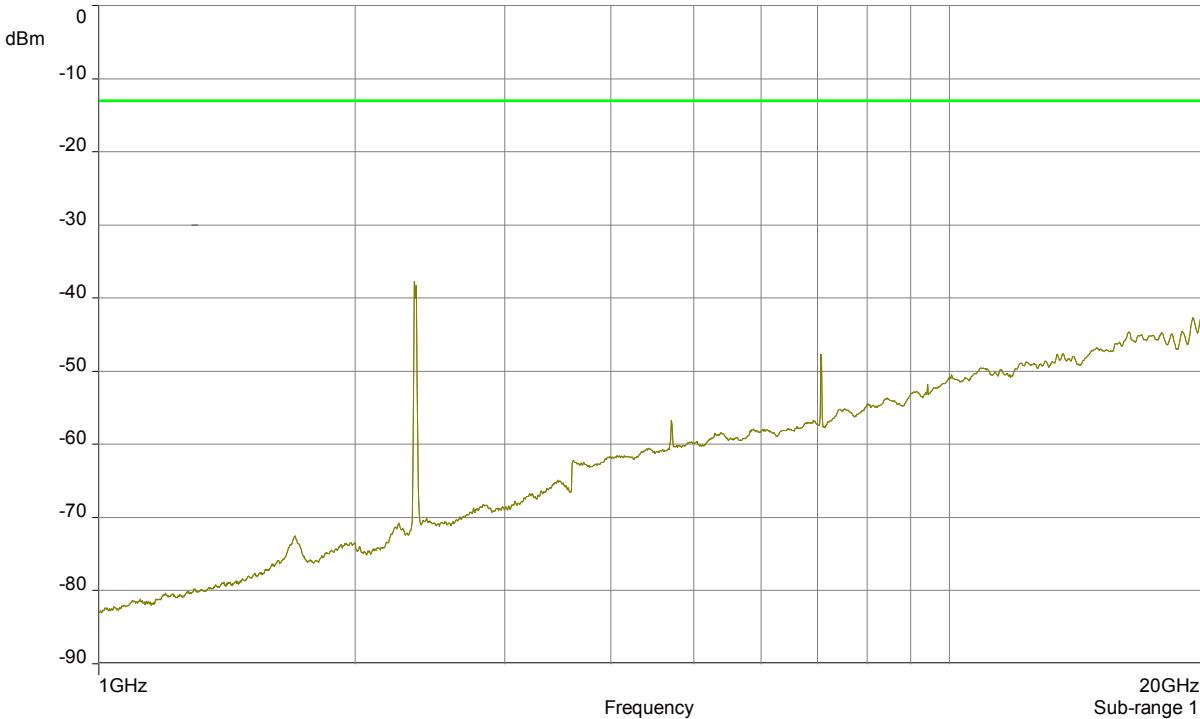


FCC ID: XS5-UEUL2323

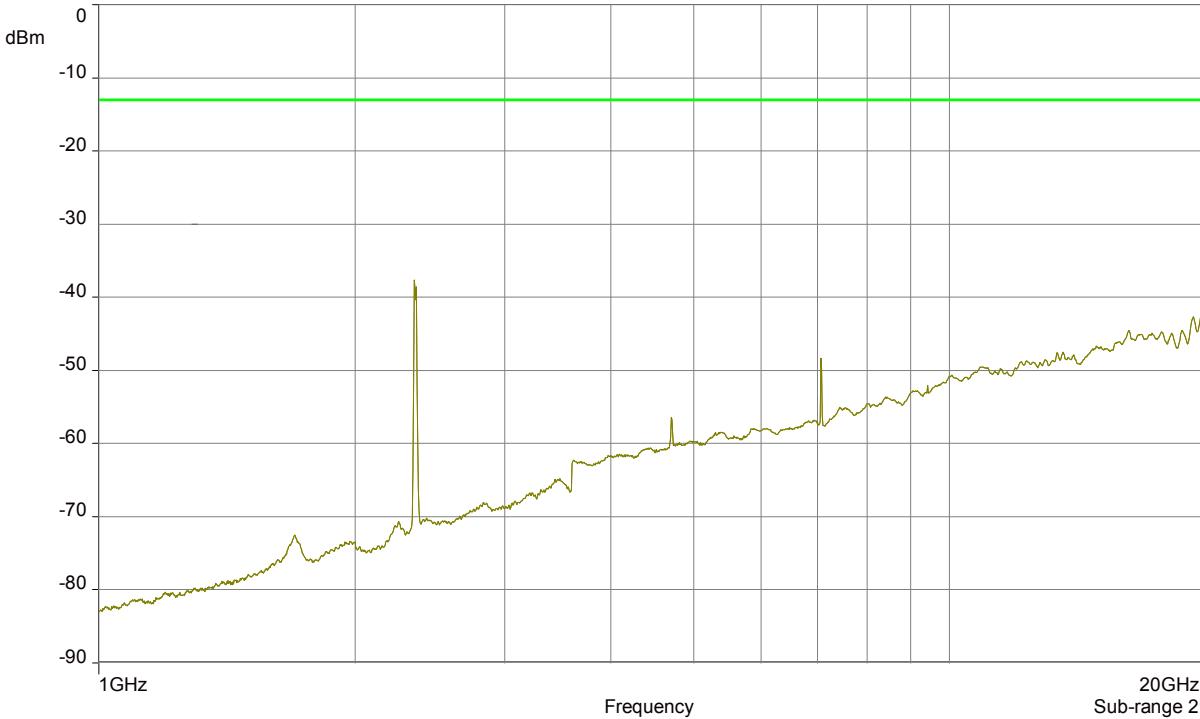
BUREAU
VERITAS**10.5.4 1 GHz to 20 GHz Downlink (Bottom – Middle – Top)**

Bottom: 2350 MHz; Middle: 2355 MHz; Top: 2360 MHz

horizontal



vertikal



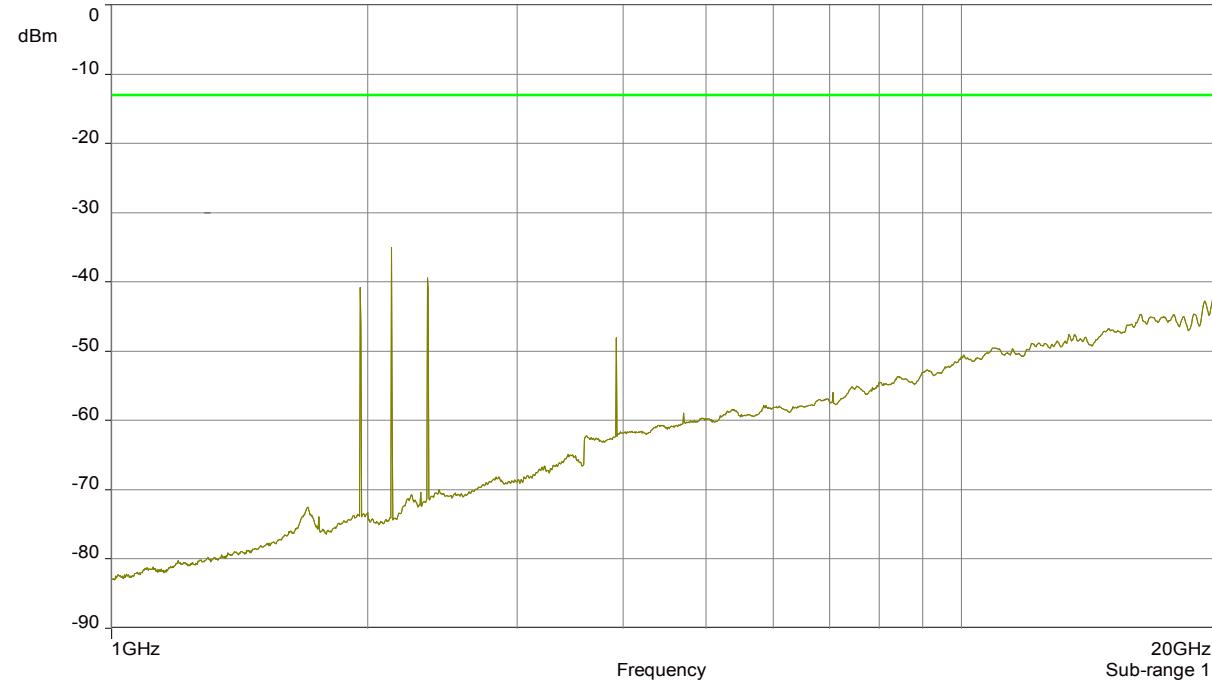
The RF output power is terminated.

FCC ID: XS5-UEUL2323

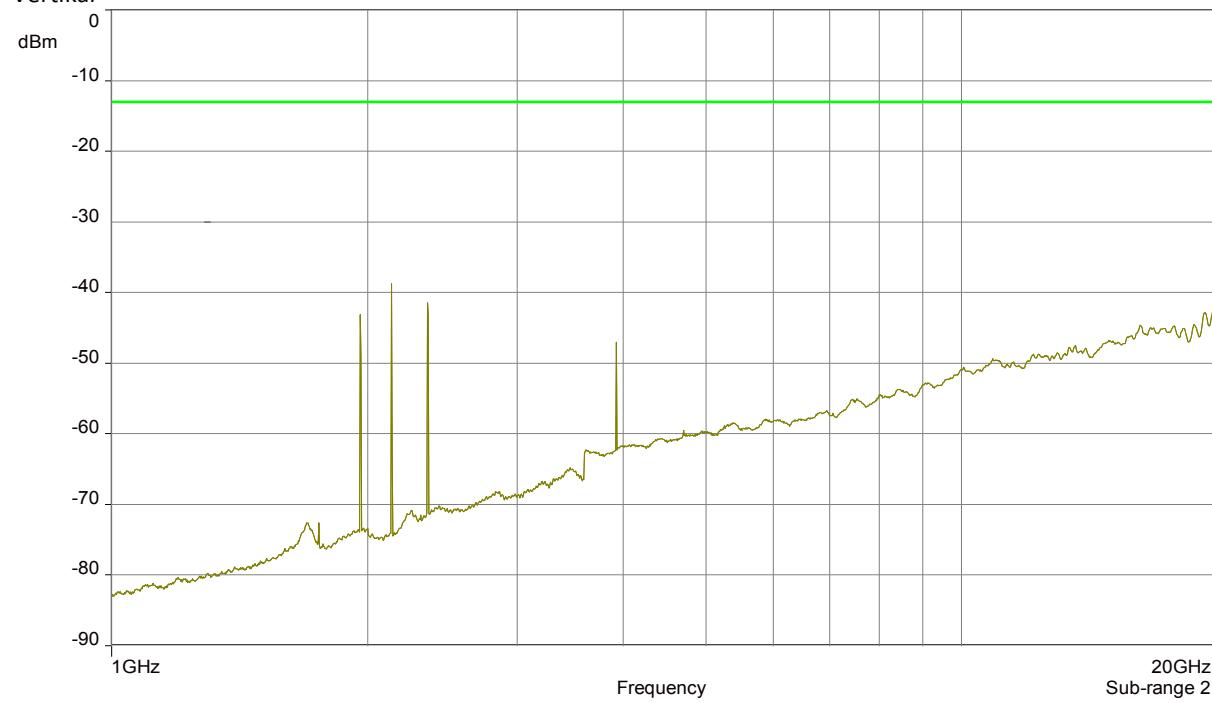
BUREAU
VERITAS**10.5.6 1 GHz to 20 GHz Downlink (Middle of all paths)**

F1: 742.5 MHz; F2: 876.25 MHz; F3: 1962.5 MHz; F3: 2132.5 MHz; F3: 2355 MHz

horizontal



Vertikal

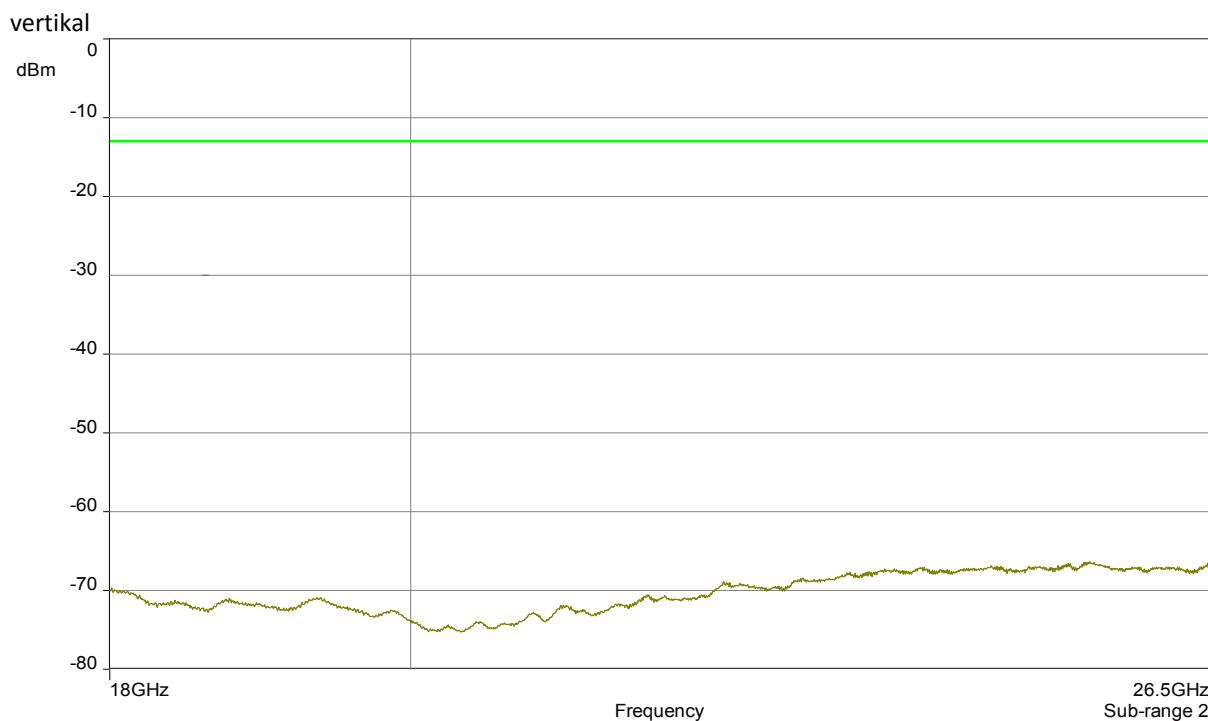
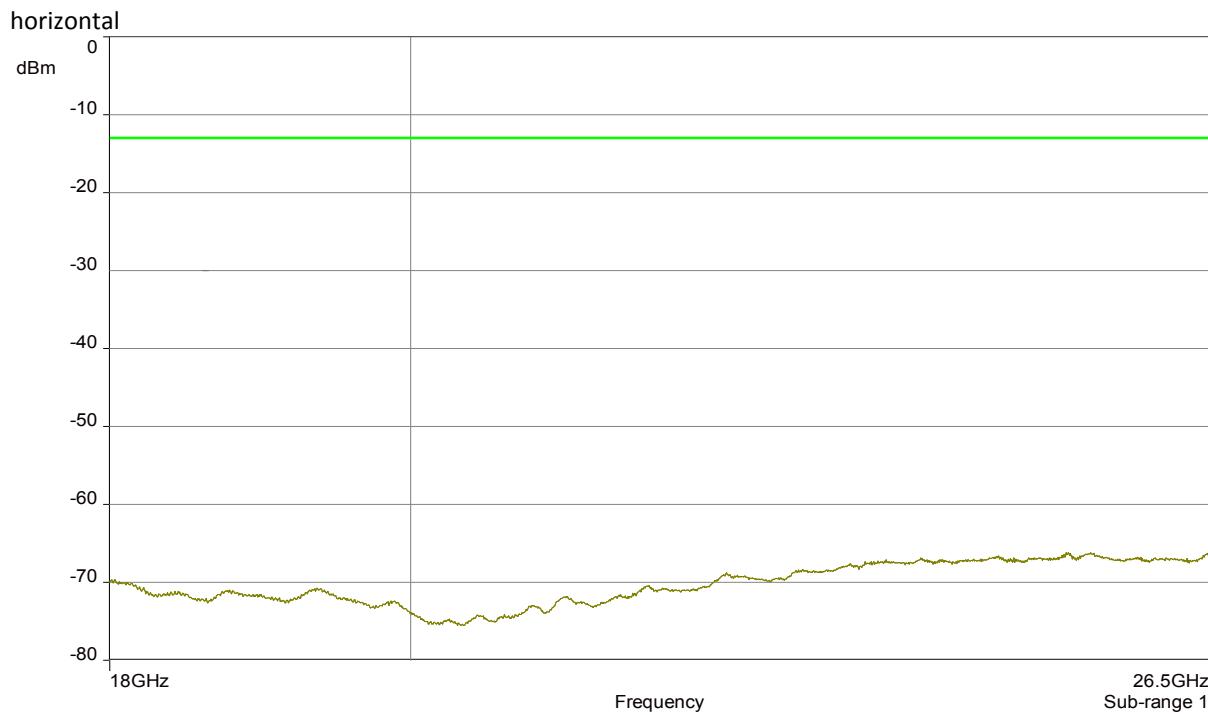




FCC ID: XS5-UEUL2323

BUREAU
VERITAS**10.5.7 18 GHz to 26 GHz Downlink (Bottom – Middle – Top)**

Bottom: 2350 MHz; Middle: 2355 MHz; Top: 2360 MHz



The RF output power is terminated.



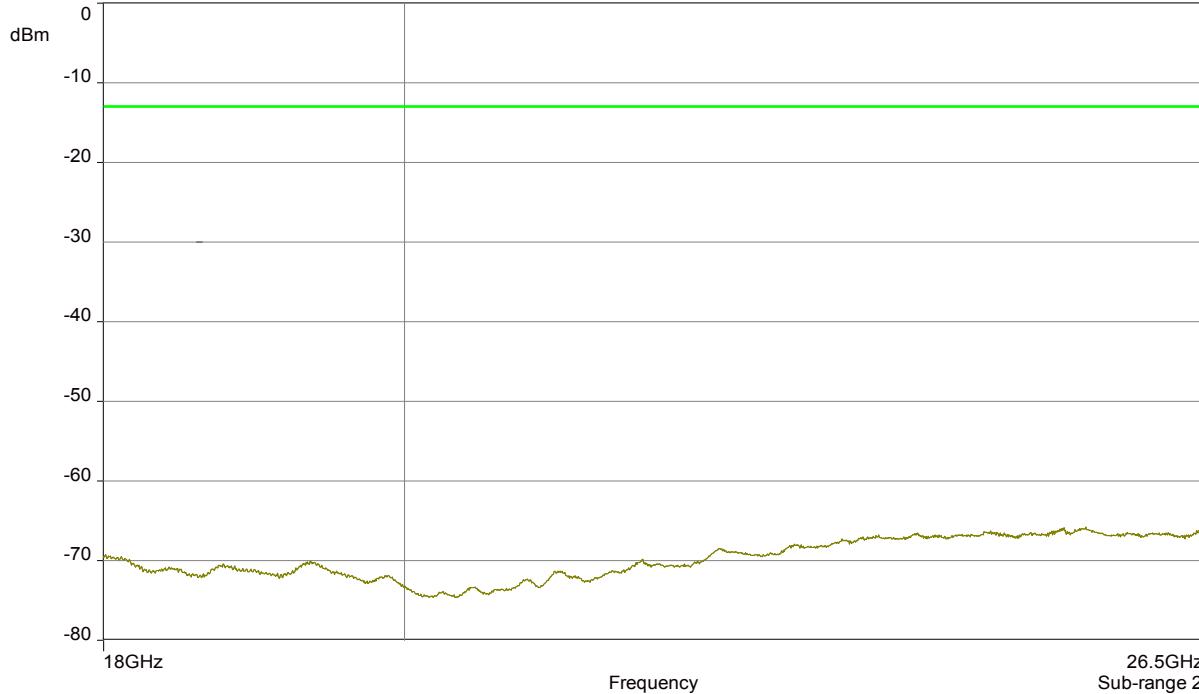
FCC ID: XS5-UEUL2323

BUREAU
VERITAS

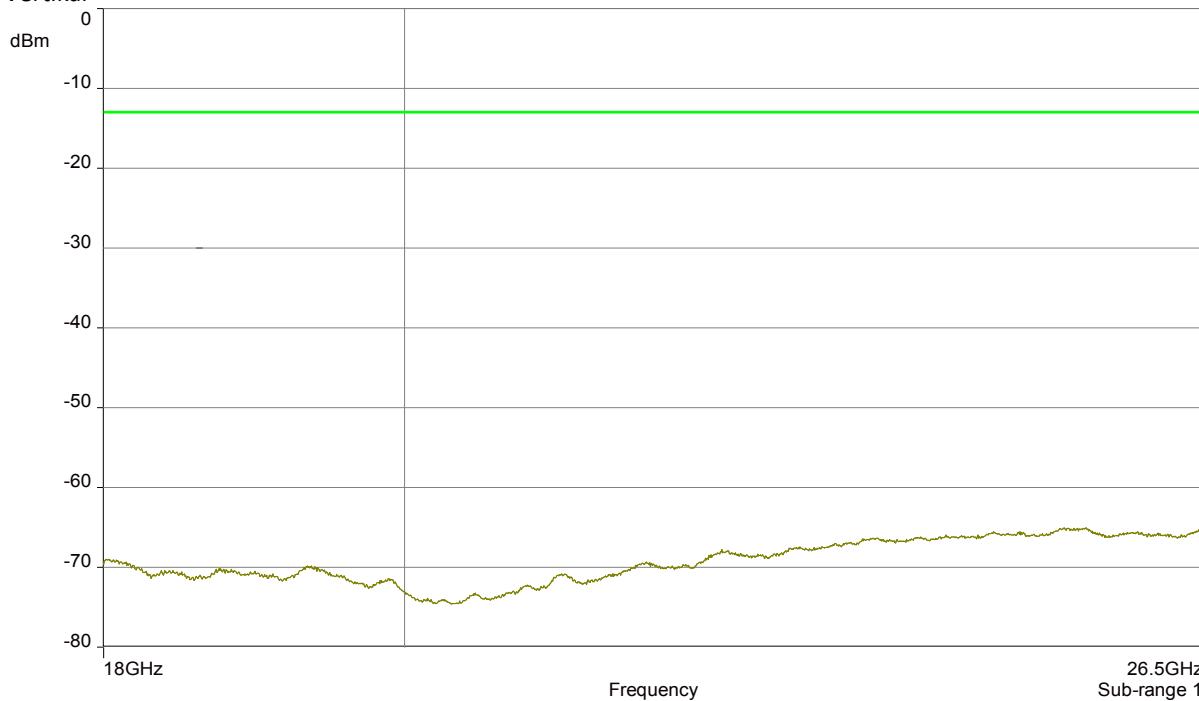
10.5.9 18 GHz to 26 GHz Downlink (Middle of all paths)

F1: 742.5 MHz; F2: 876.25 MHz; F3: 1962.5 MHz; F3: 2132.5 MHz; F3: 2355 MHz

horizontal



Vertikal



Za / 08.09.2015

The radiated spurious emission measurements have been passed!



11 History

| Revision | Modification | Date | Name |
|----------|----------------|------------|--------------|
| 01.00 | Initial report | 16.09.2015 | Tom Zahlmann |
| | | | |
| | | | |

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