

Test Site:  
FCC Test Site No.: 96997  
IC OATS No.: IC3475A-1



## ECL-EMC Test Report No.:

**Equipment under test:** AF 4037  
**FCC ID:** XS5-AF4037W4  
**IC ID:** 2237E-AF4037W4  
**Type of test:** **FCC 47 CFR Part 90 Subpart K: 2011**  
Private Land Mobile Radio Service  
**IC RSS-131: 2003**  
Zone Enhancers for the land Mobil Service

**Measurement Procedures:** 47 CFR Parts 2 (*Frequency Allocations and Radio Treaty Matters; General Rules and Regulations*),  
90 (Private Land Mobile),  
ANSI/TIA-603-C (2004), *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*  
IC-GEN General Requirements and Information for the Certification of Radiocommunication Equipment

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

|                   |                      |          |                                      |            |
|-------------------|----------------------|----------|--------------------------------------|------------|
| Date of issue:    | 04.08.10             |          |                                      | Signature: |
| Issue-No.:        | 01                   | Author:  | <b>T. Zahlmann</b><br>Test engineer  |            |
| Date of delivery: | 01.03.11             | Checked: | <b>M. Lehmann</b><br>Head of the ECL |            |
| Test dates:       | 04.08. –<br>01.03.11 |          |                                      |            |
| Pages:            | 42                   |          |                                      |            |

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IC ID: 2237E-AF4037W4

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**General:**

The purpose of this report is to show compliance to the FCC regulations for licensed devices operating under section 90 of the Code of Federal Regulations title 47.

This report informs about the results of the RF 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                         | 90.205        | 2.1046     | 500 Watts    | Complies |
| Occupied Bandwidth                      | 90.210        | 2.1049     | Input/Output | Complies |
| Spurious Emissions at Antenna Terminals | 90.210        | 2.1051     | -25dBm       | Complies |
| Radiated Spurious emission              | 90.210        | 2.1053     | -25dBm       | Complies |
| Frequency Stability                     | 90.213        | 2.1055     | 1 ppm        | NA       |

Frequency stability is not applicable because the device uses a common oscillator to up convert and down convert the RF signal. The EUT does not contain modulation circuitry, or frequency generation, therefore the test was not performed.



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

### 2.1 Description

|                                   |                                    |                                     |
|-----------------------------------|------------------------------------|-------------------------------------|
| Kind of equipment                 | AF4037W4                           |                                     |
| Andrew Ident. Number              | Id.No. 7602541-00                  |                                     |
| Serial no.(SN)                    | 15                                 |                                     |
| Revision                          | 04                                 |                                     |
| Software version and ID           | Node A Software V1.1.1; 7580898-01 |                                     |
| Type of modulation and Designator | F3E (Voice)                        | <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 checked="" type="checkbox"/> |
|                                   | and Duplexer                       | <input checked="" type="checkbox"/> |
|                                   | Full band                          | <input type="checkbox"/>            |

#### 2.1.1 Downlink

|  |                   |
|--|-------------------|
| Pass band  | 450 MHz – 465 MHz |
| Max. composite output power based on one carrier (rated) | 38,5 dBm = 7,1 W  |
| Gain   | 91 dB             |

#### 2.1.2 Uplink

|  |                   |
|--|-------------------|
| Pass band  | 455 MHz – 470 MHz |
| Max. composite output power based on one carrier (rated) | 28,0 dBm = 0,63 W |
| Gain   | 91 dB             |

#### 2.1.3 Description of EUT

The Node A is an RF enhancer which is capable of filtering and amplifying a multitude of distinct sub-bands up to 120 MHz in total anywhere within multiple frequency bands. It is designed to be part of the primary infrastructure.

### 2.1.4 System diagram of EUT

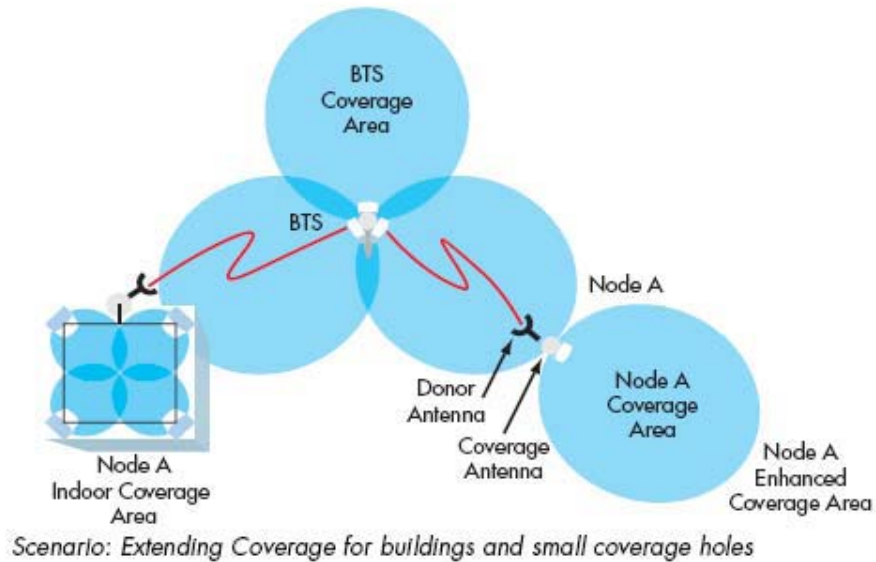


figure 2.1.4-#1 System diagram of EUT: Node A (AF4037)

### 2.1.5 Block diagram of measurement reference points

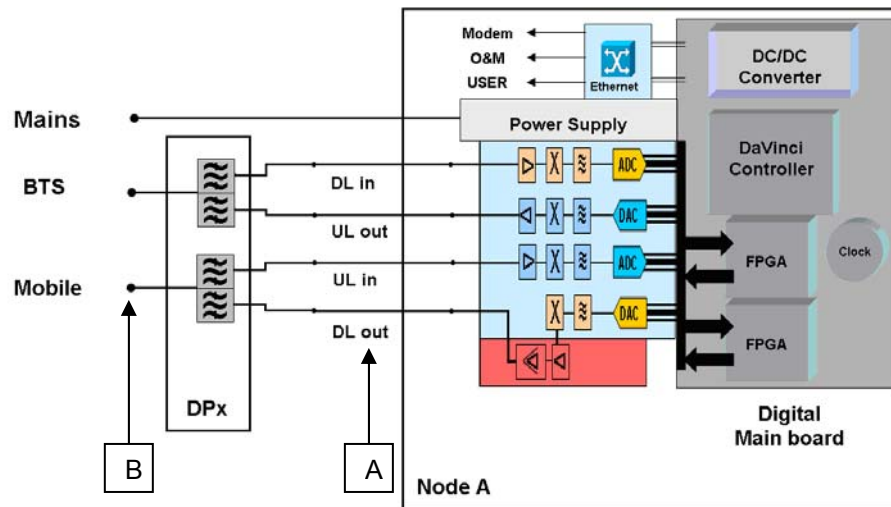


figure 2.1.5-#1 Block diagram of measurement reference points

Reference point A, for RF measurements, the RF measurements are without duplexer (DPx)  
 Reference point B, BTS and Mobile antennas connection

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### 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 |
|-----------------|-------------------|-------------------|----------------|------------|-------------|
| 8917            | Network Analyzer  | ZVCE8             | R&S            | 827712/009 | 12/10       |
| 9054            | Spectrum Analyzer | FSV13             | R&S            | 100859     | 01/11       |
| 8848            | Signal Generator  | E4438C            | Agilent        | MY45092504 | 07/11       |
| 8743            | Signal Generator  | SMIQ03B           | R&S            | 101248     | 02/11       |
| 8671            | Power Meter       | E4418B            | Agilent        | GB39513094 | 06/11       |
| 8672            | Power Sensor      | E9300H            | Agilent        | US41090179 | 06/11       |
| 7280            | Power Attenuator  | 768-30            | Narda          | ---        | CIU         |
| 7119            | Divider           | 2way              | Mikom          | 3512       | CIU         |
| 7363            | RF-Cable          | 2,0m; N-N         | Huber & Suhner | 28439/4PEA | CIU         |
| 7295            | RF-Cable          | 2,5m; N-N         | Huber & Suhner | 28964/4PEA | CIU         |
| 7299            | RF-Cable          | 2,5m; N-N         | Huber & Suhner | 28964/4PEA | CIU         |
| 7364            | RF-Cable          | 1,0m; SMA         | Huber & Suhner | 36309/4P   | CIU         |
| 7365            | RF-Cable          | 1,0m; SMA         | Huber & Suhner | 36292/4P   | CIU         |
| 7366            | RF-Cable          | 2,0m; SMA         | Huber & Suhner | 36183/4P   | CIU         |
| 7367            | RF-Cable          | 2,0m; SMA         | Huber & Suhner | 36158/4P   | CIU         |
| 7373            | RF-Cable          | Multiflex141 0,6m | Andrew         | ---        | CIU         |
| 7374            | RF-Cable          | Multiflex141 0,6m | 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 %.



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## 4 Test site (TEMPTON)

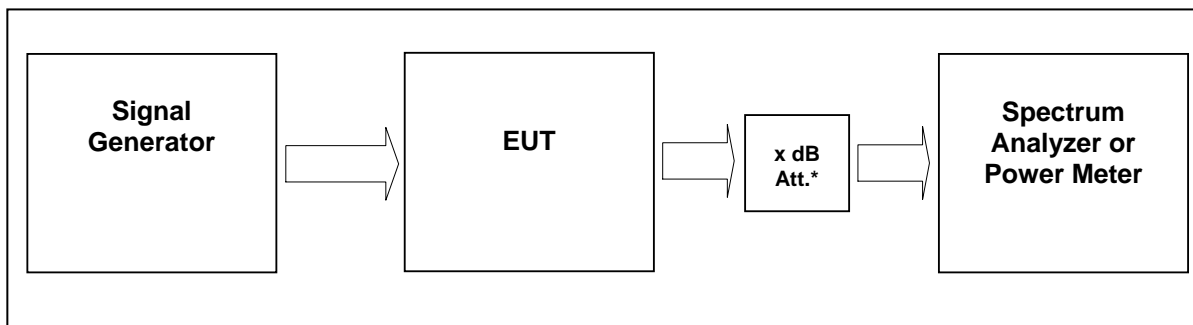
FCC Test site: 96997

IC OATS: IC3475A-1

See relevant dates under section 8 of this test report.



## 5 RF Power Out: §90.205, §2.1046



External Attenuator                      x dB = 30 dB  
 figure 5-#1 Test setup: RF Power Out: §90.205, §2.1046

|                         |  |
|-------------------------|--|
| Measurement uncertainty | ± 0,38 dB                                |
| Test equipment used     | 9054, 8848, 7366, 7367, 7299, 7280, 7363 |

### 5.1 Limit

Minimum standard:

90.205 Power and antenna height limits.

(h) 450–470 MHz.

(1) The maximum allowable station effective radiated power (ERP) is dependent upon the station’s antenna HAAT and required service area and will be authorized in accordance with table 2. Applicants requesting an ERP in excess of that listed in table 2 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires

TABLE 2—450–470 MHz—MAXIMUM ERP/REFERENCE HAAT FOR A SPECIFIC SERVICE AREA RADIUS

|                                       | Service area radius (km) |     |       |       |       |       |                 |                 |                 |                 |
|---------------------------------------|--------------------------|-----|-------|-------|-------|-------|-----------------|-----------------|-----------------|-----------------|
|                                       | 3                        | 8   | 13    | 16    | 24    | 32    | 40 <sup>4</sup> | 48 <sup>4</sup> | 64 <sup>4</sup> | 80 <sup>4</sup> |
| Maximum ERP (w) <sup>1</sup> .....    | 2                        | 100 | 2 500 | 2 500 | 2 500 | 2 500 | 2 500           | 2 500           | 2 500           | 2 500           |
| Up to reference HAAT (m) <sup>3</sup> | 15                       | 15  | 15    | 27    | 63    | 125   | 250             | 410             | 950             | 2700            |

<sup>1</sup> Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See § 73.699, Fig. 10 b).

<sup>2</sup> Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.

<sup>3</sup> When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation:  $ERP_{allow} = ERP_{max} \times (HAAT_{ref} / HAAT_{actual})^2$ .

<sup>4</sup> Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 39 dBu.

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## 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.

(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 Analog:

FM signal with 3.0 kHz deviation and 2.5 kHz rate and sine waveform.

### 5.3.1 Downlink

| Modulation                              | Measured at |           | RBW<br>VBW<br>Span         | RF Power<br>(dBm) | RF Power<br>(W) | Plot -        |
|---|-------------|-----------|----------------------------|-------------------|-----------------|---------------|
| Analog                                  | Middle      | 457.5 MHz | 100kHz<br>300kHz<br>1,5MHz | 38.5              | 7,1             | 5.3.1.1<br>#1 |
| Maximum output power = 38.5 dBm = 7.1 W |             |           |                            |                   |                 |               |
| Limit Maximum output power = 500 W      |             |           |                            |                   |                 |               |

table 5.3.1-#1 RF Power Out: §90.205, §2.1046 Test Results Downlink

| Modulation | Pin / dBm |
|------------|-----------|
| Analog     | -52,3     |

table 5.3.1-#2 RF Power Out: §90.205, §2.1046 Test Results Downlink Input power

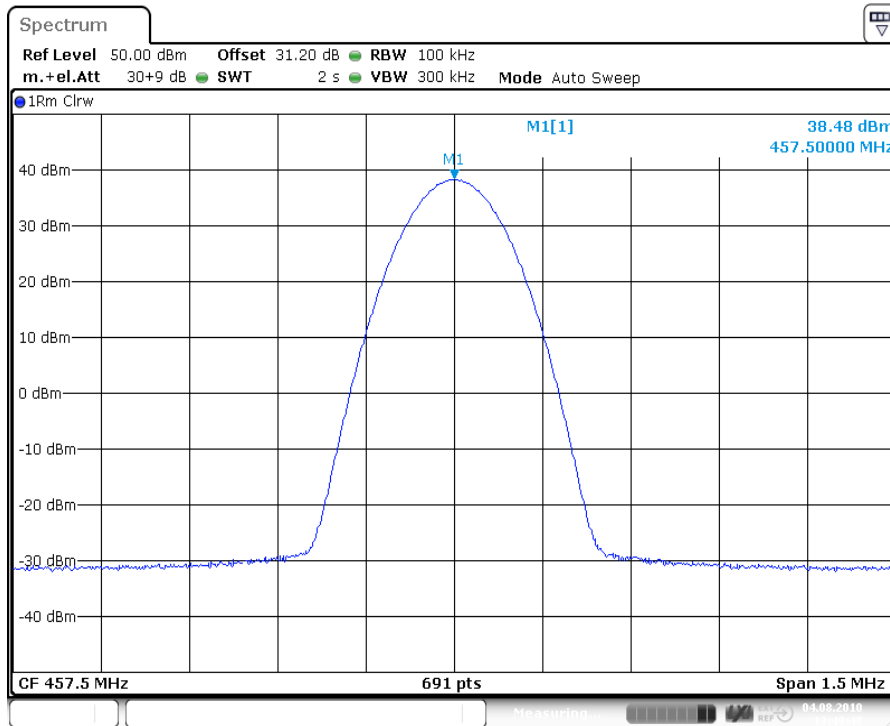
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### 5.3.1.1 Analog



plot 5.3.1.1-#1 RF Power Out: §90.205, §2.1046; Test Results; Downlink; Analog Middle

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### 5.3.2 Uplink

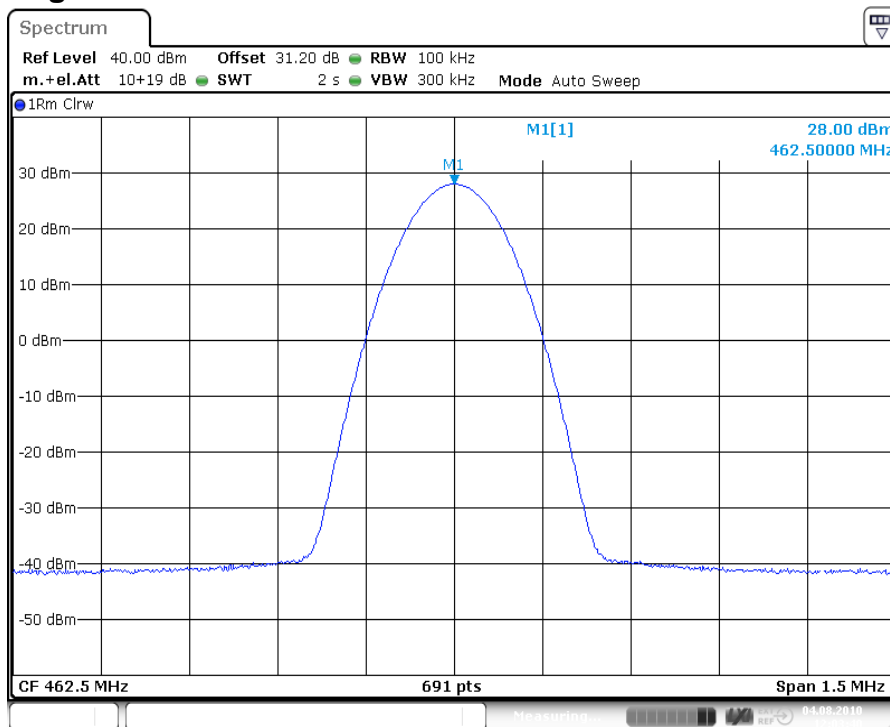
| Modulation                               | Measured at |           | RBW<br>VBW<br>Span         | RF Power (dBm) | RF Power (W) | Plot -     |
|--|-------------|-----------|----------------------------|----------------|--------------|------------|
| Analog                                   | Middle      | 462.5 MHz | 100kHz<br>300kHz<br>1,5MHz | 28.0           | 0,63         | 5.3.2.1 #1 |
| Maximum output power = 28,0 dBm = 0,63 W |             |           |                            |                |              |            |
| Limit Maximum output power = 500 W       |             |           |                            |                |              |            |

table 5.3.2-#3 RF Power Out: §90.205, §2.1046 Test Results Uplink

| Modulation | Pin / dBm |
|------------|-----------|
| Analog     | -62,5     |

table 5.3.2-#4 RF Power Out: §90.205, §2.1046 Test Results Uplink Input power

#### 5.3.2.1 Analog



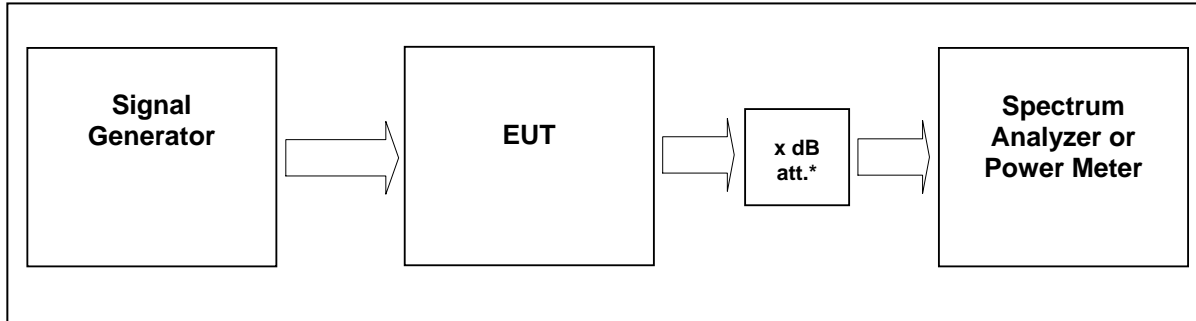
plot 5.3.2.1-#1 RF Power Out: §90.205, §2.1046; Test Results; Uplink; Analog Middle

### 5.4 Summary test result

|             |                                     |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by:  | M. Leinfelder                       |
| Date:       | 04.08.2010                          |



## 6 Occupied Bandwidth: §2.1049



External Attenuator x dB = 30 dB  
figure 6-#1 Test setup: Occupied Bandwidth: §2.1049

|                         |  |
|-------------------------|--|
| Measurement uncertainty | ± 0,38 dB                                |
| Test equipment used     | 9054, 8848, 7366, 7367, 7299, 7280, 7363 |

### 6.1 Limit

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

### 6.2 Test method

#### 6.2.1 FCC CFR47

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

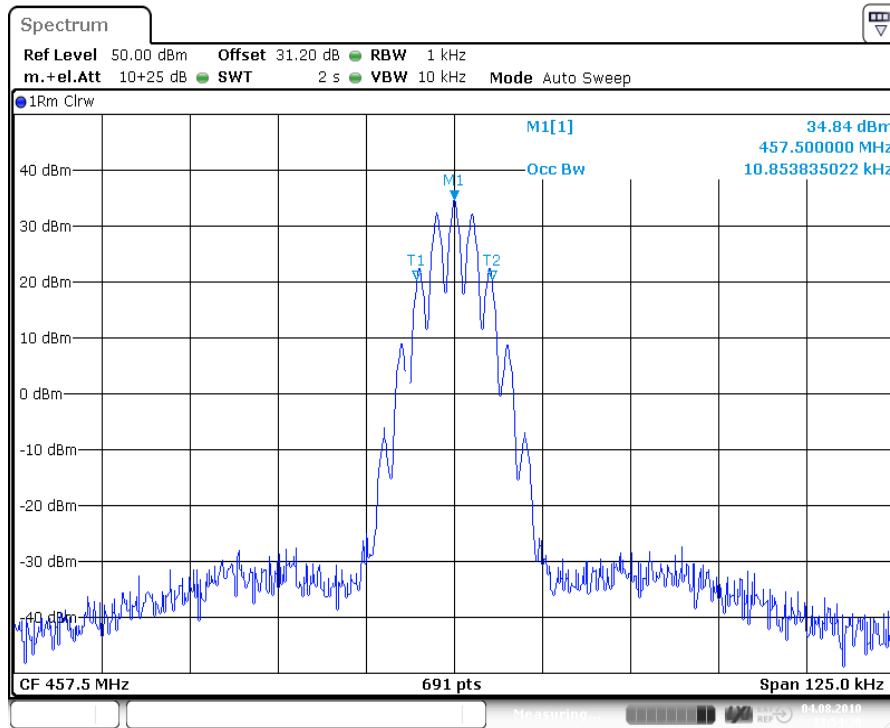
Detector RMS.

| Modulation | Measured at |           | RBW<br>VBW<br>Span         | Occupied Bandwidth / kHz | Plot #            |
|------------|-------------|-----------|----------------------------|--------------------------|-------------------|
| Analog     | Middle      | 457.5 MHz | 1 kHz<br>10 kHz<br>125 kHz | 10,85                    | 6.3.1.1<br>#1, #2 |

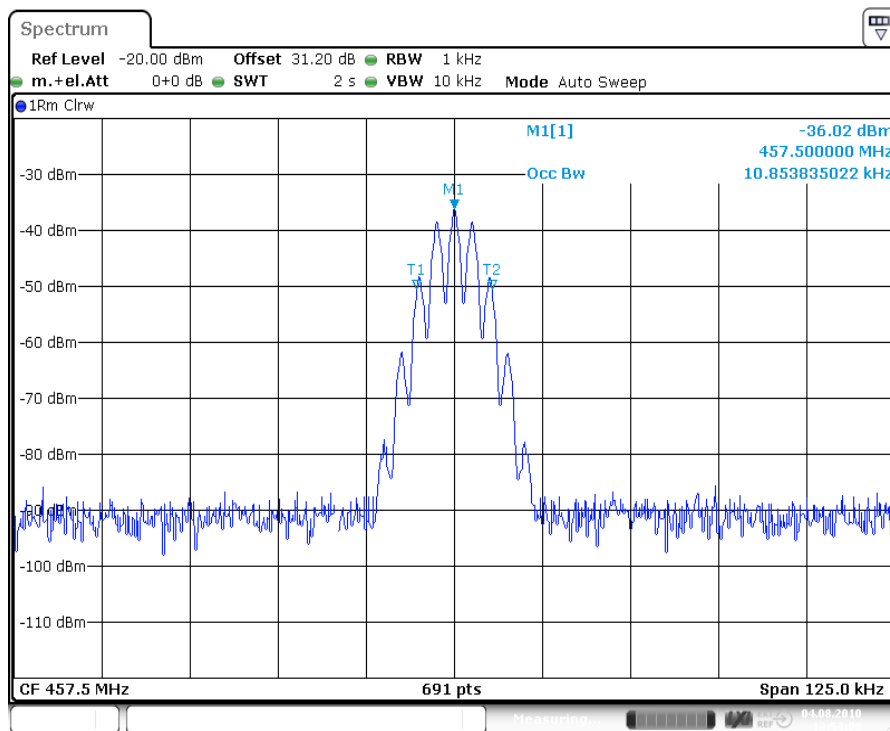
table 6.3-#1 Occupied Bandwidth: §2.1049 Test results



6.3.1.1 Analog



plot 6.3.1.1-#1 Occupied Bandwidth: §2.1049; Test results; Downlink; Analog Output



plot 6.3.1.1-#2 Occupied Bandwidth: §2.1049; Test results; Downlink; Analog Input; Input power + 20 dB



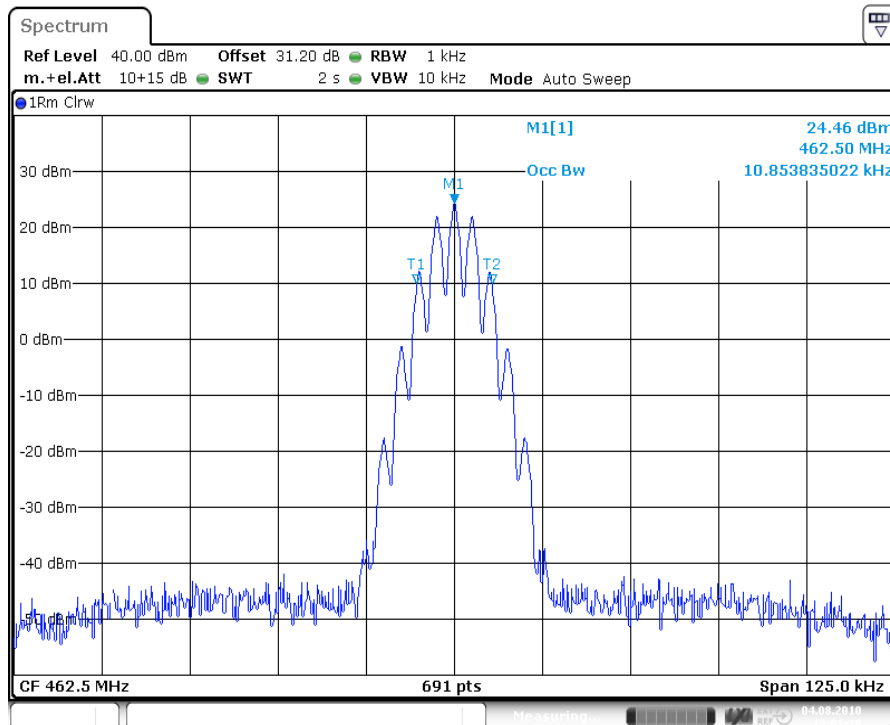
### 6.3.2 Uplink

Detector RMS.

| Modulation | Measured at |           | RBW<br>VBW<br>Span         | Occupied<br>Bandwidth /<br>kHz | Plot #            |
|------------|-------------|-----------|----------------------------|--------------------------------|-------------------|
| Analog     | Middle      | 462.5 MHz | 1 kHz<br>10 kHz<br>125 kHz | 10,85                          | 6.3.2.1<br>#1, #2 |

table 6.3-#2 Occupied Bandwidth: §2.1049 Test results

#### 6.3.2.1 Analog



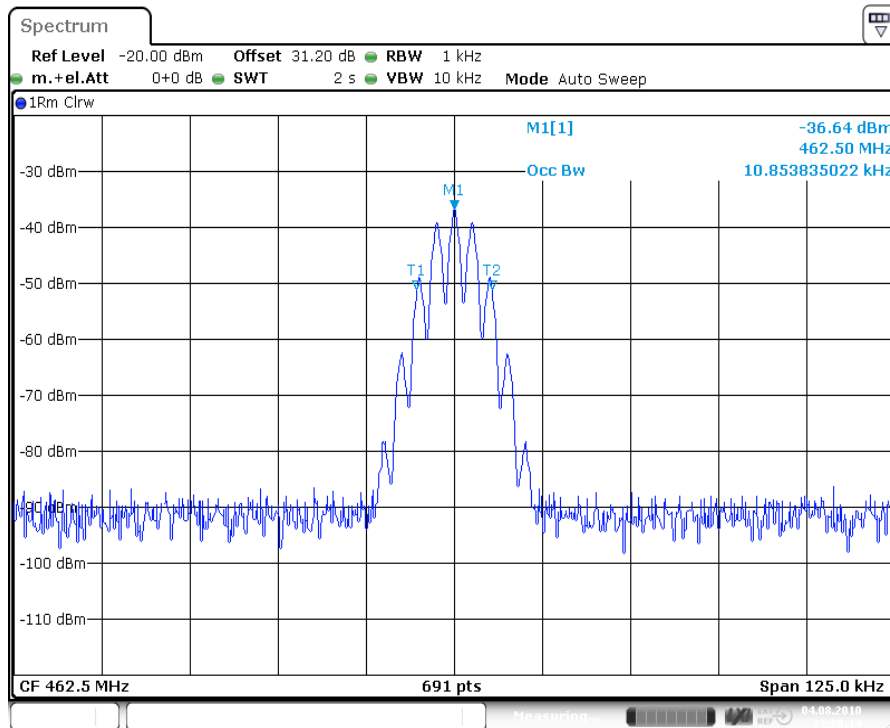
plot 6.3.2.1-#1 Occupied Bandwidth: §2.1049; Test results; Uplink; Analog Output



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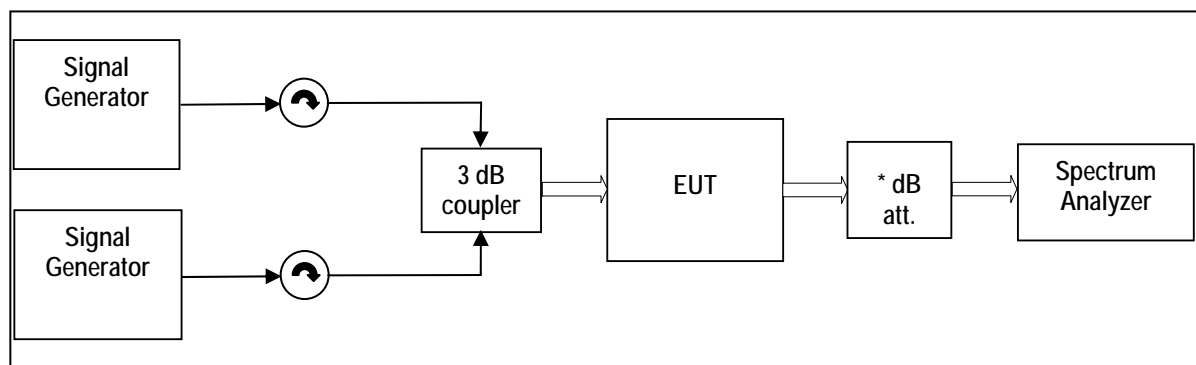
plot 6.3.2.1-#2 Occupied Bandwidth: §2.1049; Test results; Uplink; Analog Input; Input power + 30 dB

#### 6.4 Summary test result

|             |                                     |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by:  | M. Leinfelder                       |
| Date:       | 04.08.2010                          |



## 7 Spurious Emissions at Antenna Terminals: §90.210, §2.1051



External Attenuator x dB = 30 dB  
figure 7-#1 Test setup: Spurious Emissions at Antenna Terminals: §90.210, §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     | 9054, 8848, 7365, 7366, 7367, 7299, 7280, 7363 |   |

### 7.1 Limit

#### 7.1.1 FCC CFR47

##### § 90.210 Emission masks.

| APPLICABLE EMISSION MASKS |   |  |
|---------------------------|---|--|
| Frequency band(MHz)       | Mask for equipment with Audio low pass filter | Mask for equipment without audio low pass filter |
| 421–512*                  | B, D, or E                                    | C, D, or E                                       |

\* Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

Limit Mask E = -25 dBm

### 7.2 Test method

#### 7.2.1 FCC CFR47

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]

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### 7.3 Test results

#### 7.3.1 Downlink

##### <1MHz from Band Edge

Detector: RMS.

| Modulation | Measured at Band Edge    | Carriers   | RBW<br>VBW<br>Span    | Max. level (dBm) | Plot -                  |
|------------|--------------------------|--|-----------------------|------------------|-------------------------|
| Analog     | Lower Edge<br>Upper Edge | 450.0125 MHz<br>450.0375 MHz<br>464.9625 MHz<br>464.9875 MHz | 300Hz<br>3kHz<br>2MHz | < -28,9          | 7.3.1.1<br>#1<br><br>#2 |

table 7.3-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051 Test results <1MHz from Band

##### >1MHz from Band Edge

Detector: RMS.

| Modulation | Carrier   | RBW<br>VBW<br>Span           | Max. level (dBm) | Plot -           |
|------------|-----------|------------------------------|------------------|------------------|
| Analog     | 457.5 MHz | 1MHz<br>3MHz<br>30MHz – 6GHz | -58,7*           | 7.3.1.2<br>#1,#2 |

table 7.3-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051 Test results <1MHz from Band Edge

\* the measurement value is out of range because the measurement is done at Reference point A without duplexer see 2.1.5 Block diagram of measurement reference points.

The EUT is always used with one of the four duplexers see clause 7.3.3.

Each of Duplexer has a **rejection > 50 dB** at frequencies 10MHz outside the repeater operating band (see under 7.3.3).

All measured spurs are min. 90MHz outside of the repeater operating band see plots in clause 7.3.3.

The duplexer suppresses at these frequency offsets any spur by min.50dB.

So the real spurious value with duplexer at Reference point B with duplexer see 2.1.5 are minimum 50 dB below the measured value.

Calculate the real spurious including the duplexer.

Max. measured value from plot 7.3.1.2-#1 Marker 2 at 367,41MHz is -8,7 dBm.

Max. measured value - Duplexer rejection = calculate value

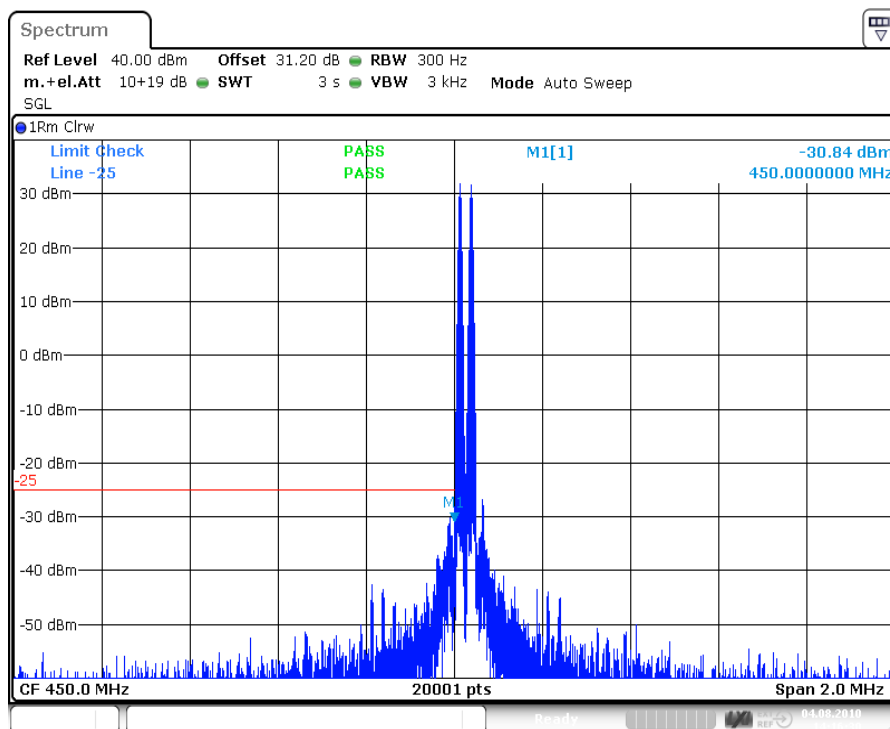
$$-8,7 \text{ dBm} - 50 \text{ dB} = -58,7 \text{ dBm}$$

Limit = -25 dBm

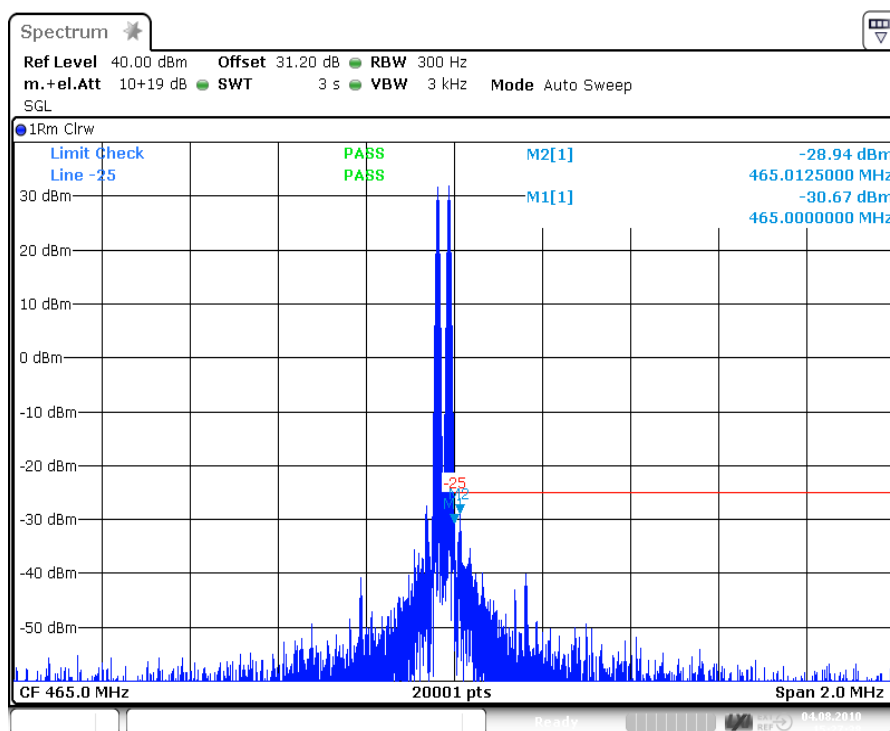
The calculation proves that real spur at Reference Point B (Antenna port) is, with any of the four Duplexer, lower than the limit.



### 7.3.1.1 Analog < 1MHz to band edge



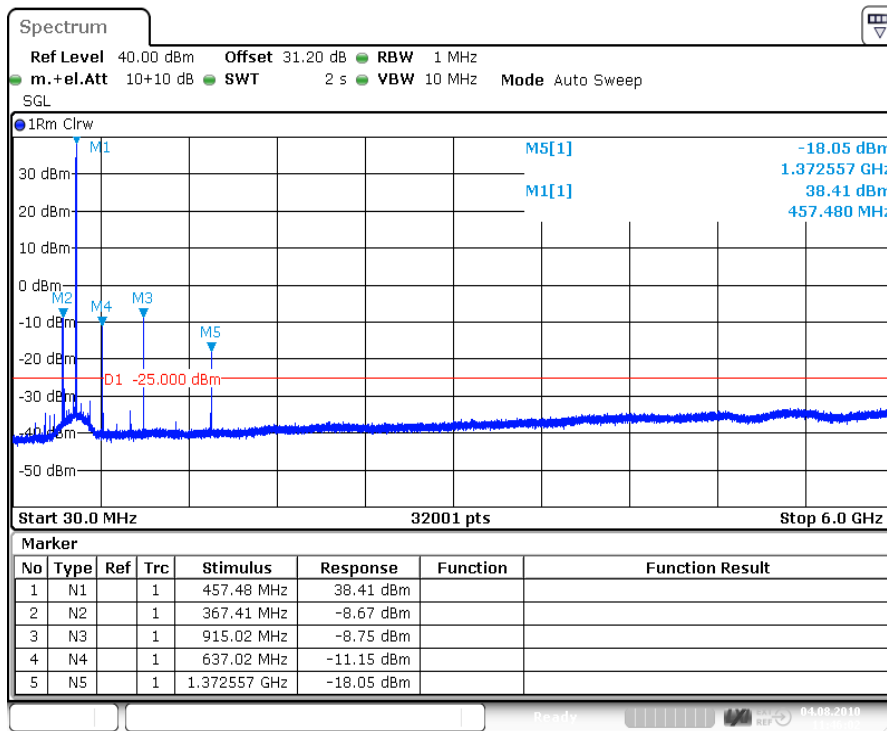
plot 7.3.1.1-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; Analog < 1MHz to band edge; Lower Band Edge



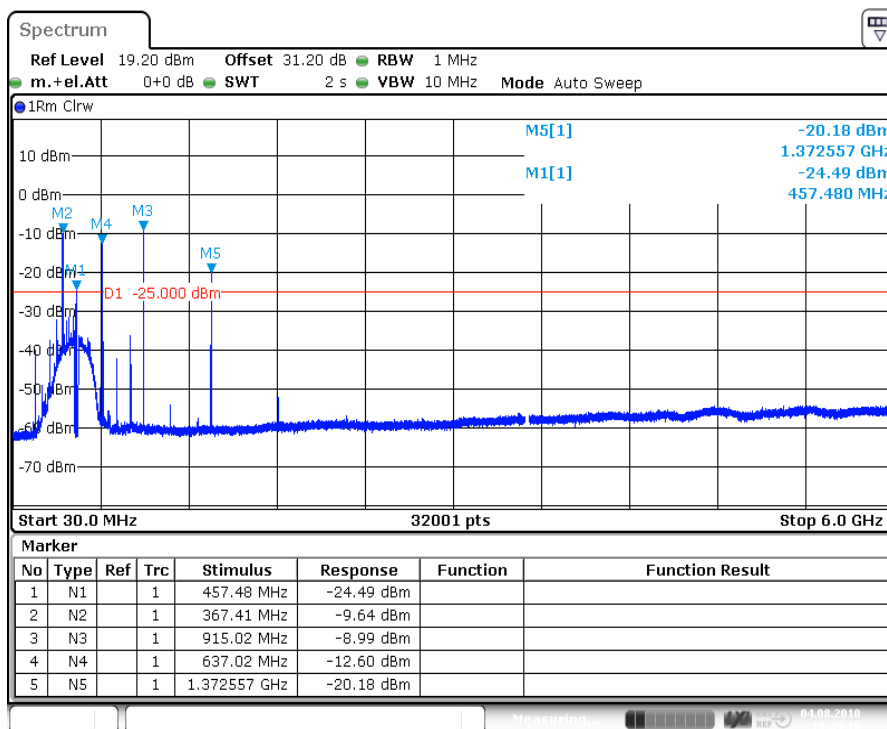
plot 7.3.1.1-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; Analog < 1MHz to band edge; Upper Band Edge



7.3.1.2 Analog > 1MHz to band edge



plot 7.3.1.2-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; Analog > 1MHz to band edge;



plot 7.3.1.2-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; Analog > 1MHz to band edge; carrier notched

Test Report No.:

FCC ID: XS5-AF4037W4

IC ID: 2237E-AF4037W4



### 7.3.2 Uplink

#### <1MHz from Band Edge

Detector: RMS.

| Modulation | Measured at Band Edge    | Carriers   | RBW<br>VBW<br>Span    | Max. level (dBm) | Plot -              |
|------------|--------------------------|--|-----------------------|------------------|---------------------|
| Analog     | Lower Edge<br>Upper Edge | 455.0125 MHz<br>455.0375 MHz<br>469.9625 MHz<br>469.9875 MHz | 300Hz<br>3kHz<br>2MHz | < -29,5          | 7.3.2.1<br>#1<br>#2 |

table 7.3-#3 Spurious Emissions at Antenna Terminals: §90.210, §2.1051 Test results <1MHz from Band

#### >1MHz from Band Edge

Detector: RMS.

| Modulation | Carrier   | RBW<br>VBW<br>Span           | Max. level (dBm) | Plot -           |
|------------|-----------|------------------------------|------------------|------------------|
| Analog     | 462.5 MHz | 1MHz<br>3MHz<br>30MHz – 6GHz | -77,3*           | 7.3.2.2<br>#1,#2 |

table 7.3-#4 Spurious Emissions at Antenna Terminals: §90.210, §2.1051 Test results <1MHz from Band Edge

\* is a calculated value see under 7.3.1

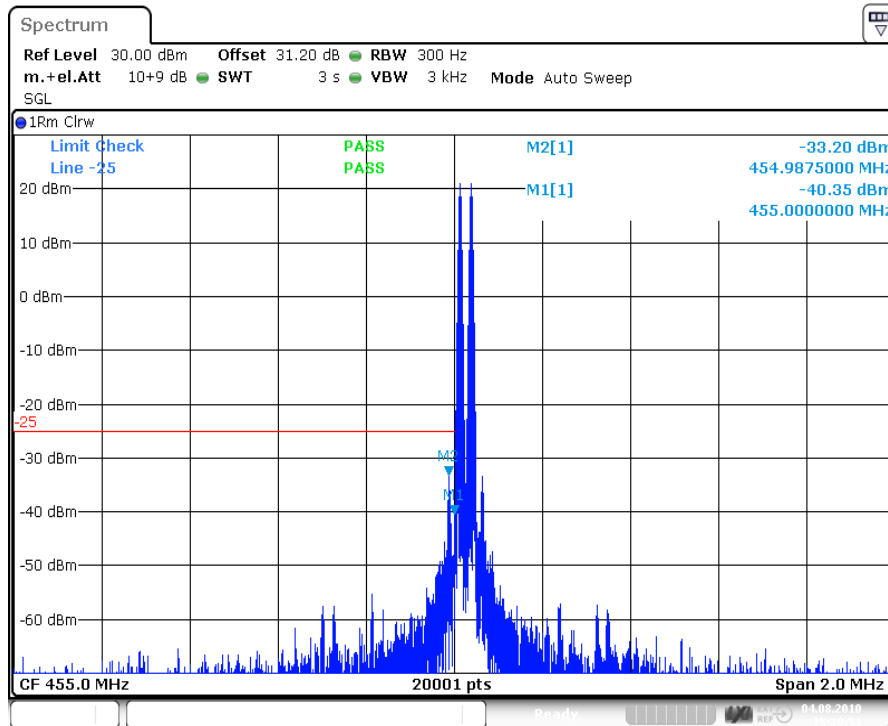
Test Report No.:

FCC ID: XS5-AF4037W4

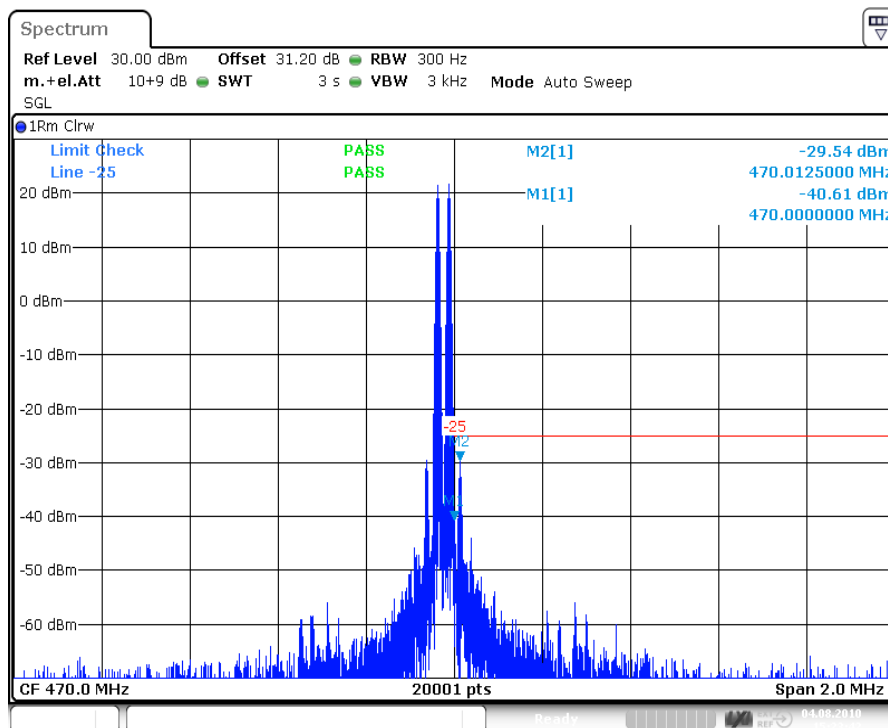
IC ID: 2237E-AF4037W4



### 7.3.2.1 Analog < 1MHz to band edge



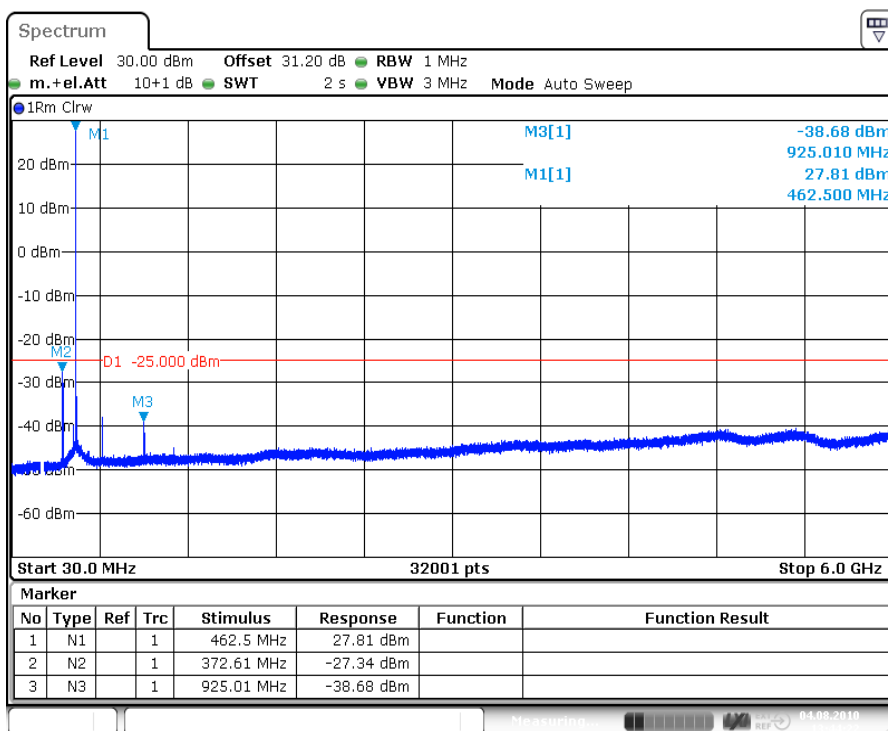
plot 7.3.2.1-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Uplink; Analog < 1MHz to band edge; Lower Band Edge



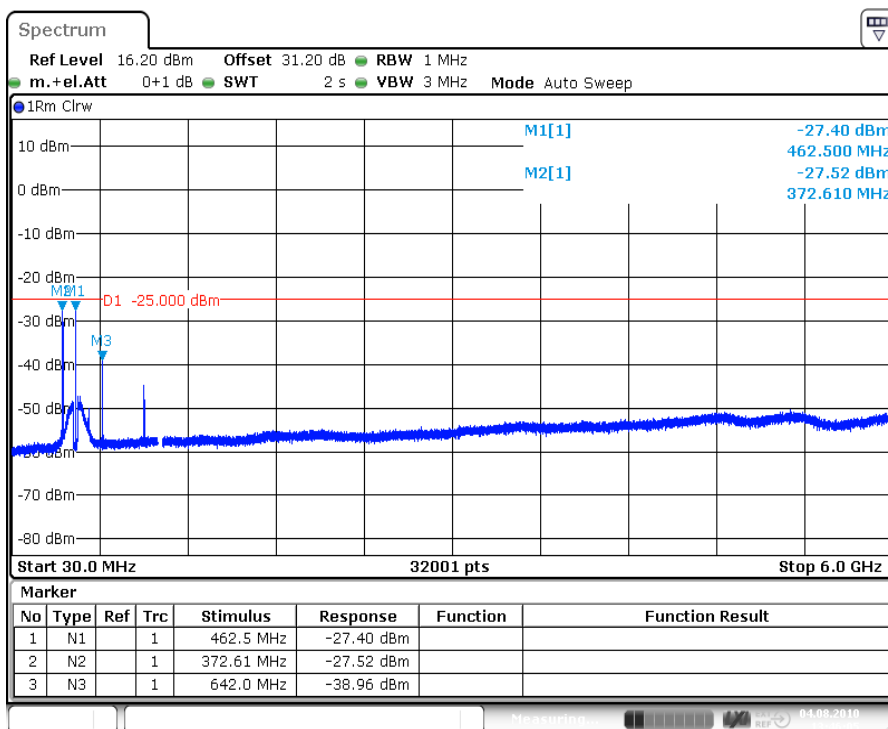
plot 7.3.2.1-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Uplink; Analog < 1MHz to band edge; Upper Band Edge



7.3.2.2 Analog > 1MHz to band edge



plot 7.3.2.2-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Uplink; Analog > 1MHz to band edge



plot 7.3.2.2-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Uplink; Analog > 1MHz to band edge; carrier notched





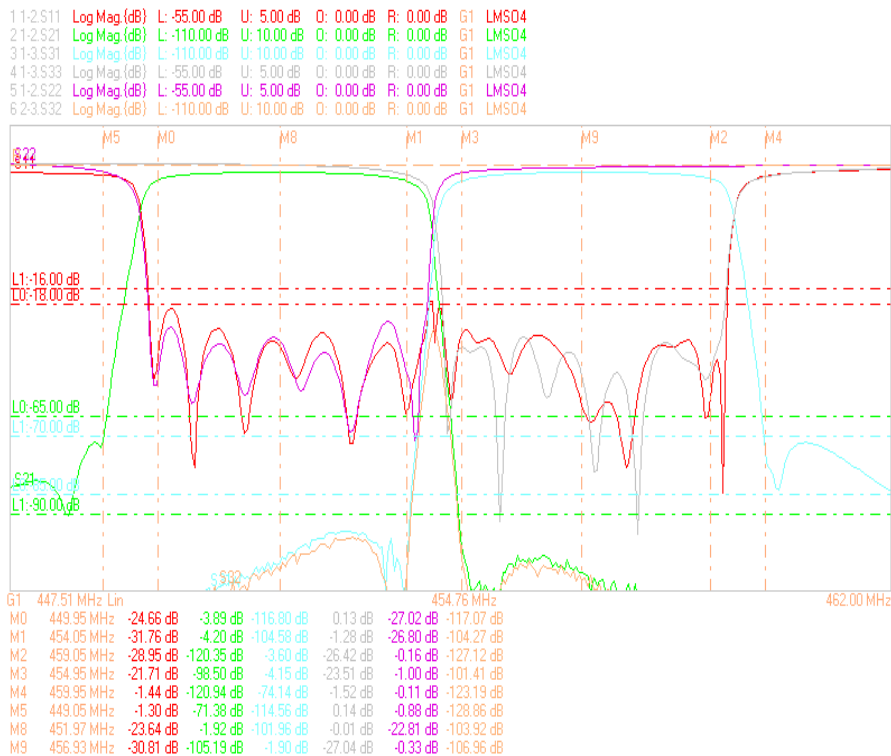
### 7.3.3 Duplexer rejection

The EUT is always operated with a duplexer from the duplex family 7605118-XXXX, they can be seen in the data sheet. The last four digits are numbered consecutively. As an example, four of them are used for subsequent measurements in the following paragraph. The actual duplexers are shown in the following table. If another duplexer is used within the approved frequency range, they must work under the same principle and have a minimal rejection of 50dB, too.

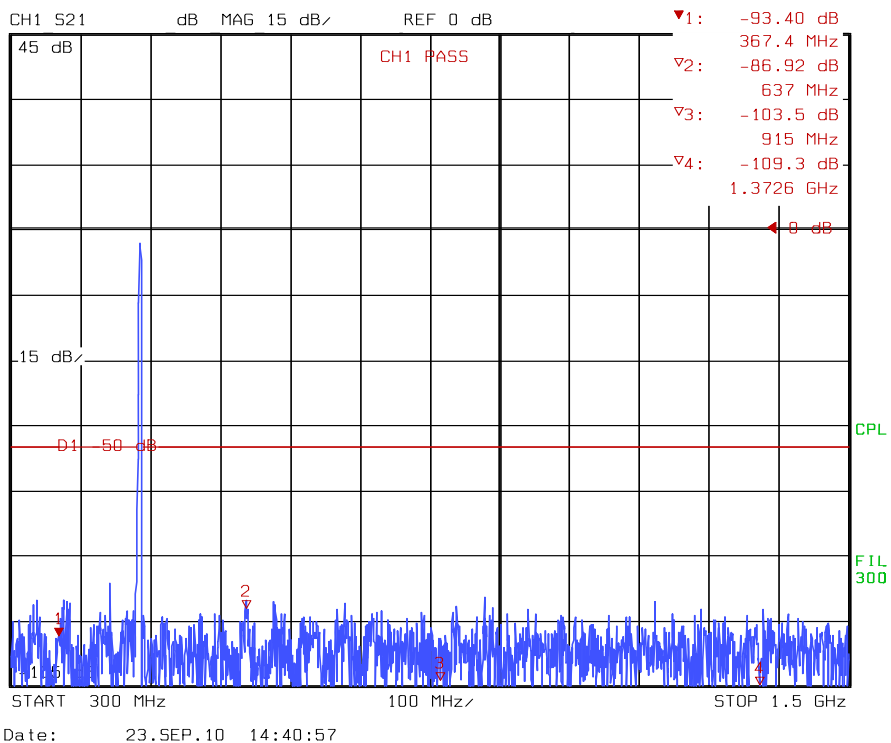
| Description                                  | Part-Number  | Used |
|--|--------------|------|
| Node A Duplexer Rack 455-459 and 450-454 MHz | 7605118-0001 | X    |
| Node A Duplexer Rack 456-460 and 451-455 MHz | 7605118-0002 | X    |
| Node A Duplexer Rack 465-469 and 460-464 MHz | 7605118-0003 | X    |
| Node A Duplexer Rack 466-470 and 461-465 MHz | 7605118-0004 | X    |
| Node A Duplexer Rack 473-475 and 470-472 MHz | 7605118-0005 |      |
| Node A Duplexer Rack 474-476 and 471-473 MHz | 7605118-0006 |      |
| Node A Duplexer Rack 479-481 and 476-478 MHz | 7605118-0007 |      |
| Node A Duplexer Rack 480-482 and 477-479 MHz | 7605118-0008 |      |
| Node A Duplexer Rack 485-487 and 482-484 MHz | 7605118-0009 |      |
| Node A Duplexer Rack 486-488 and 483-485 MHz | 7605118-0010 |      |
| Node A Duplexer Rack 491-493 and 488-490 MHz | 7605118-0011 |      |
| Node A Duplexer Rack 492-494 and 489-491 MHz | 7605118-0012 |      |
| Node A Duplexer Rack 497-499 and 494-496 MHz | 7605118-0013 |      |
| Node A Duplexer Rack 498-500 and 495-497 MHz | 7605118-0014 |      |
| Node A Duplexer Rack 503-505 and 500-502 MHz | 7605118-0015 |      |
| Node A Duplexer Rack 504-506 and 501-503 MHz | 7605118-0016 |      |
| Node A Duplexer Rack 509-511 and 506-508 MHz | 7605118-0017 |      |
| Node A Duplexer Rack 510-512 and 507-509 MHz | 7605118-0018 |      |



7.3.3.1 Duplexer DL band 450-454 MHz UL band 455-459 MHz



plot 7.3.3.1-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Duplexer rejection; Duplexer DL band 450-454 MHz UL band 455-459 MHz; pass band



plot 7.3.3.1-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Duplexer rejection; Duplexer DL band 450-454 MHz UL band 455-459 MHz; rejection > 50 dB

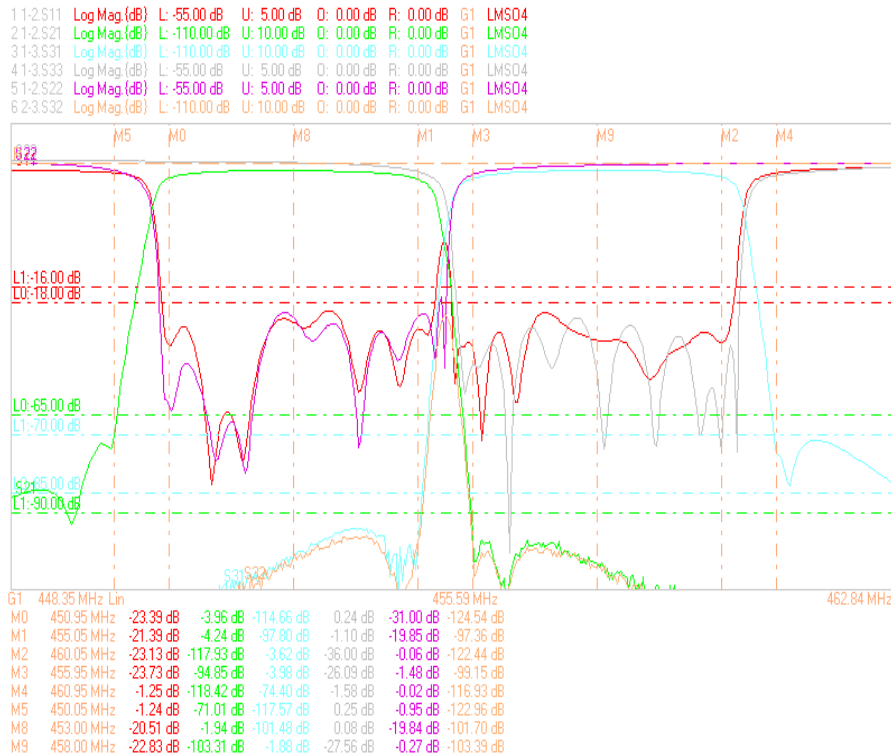
Test Report No.:

FCC ID: XS5-AF4037W4

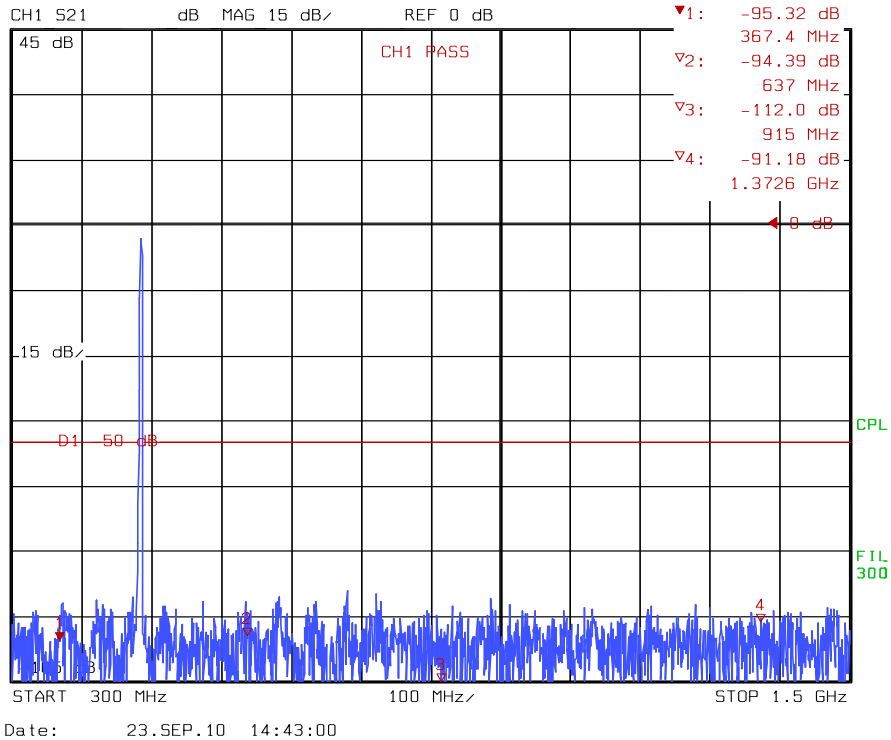
IC ID: 2237E-AF4037W4



### 7.3.3.2 Duplexer DL band 451-455 MHz UL band 456-460 MHz



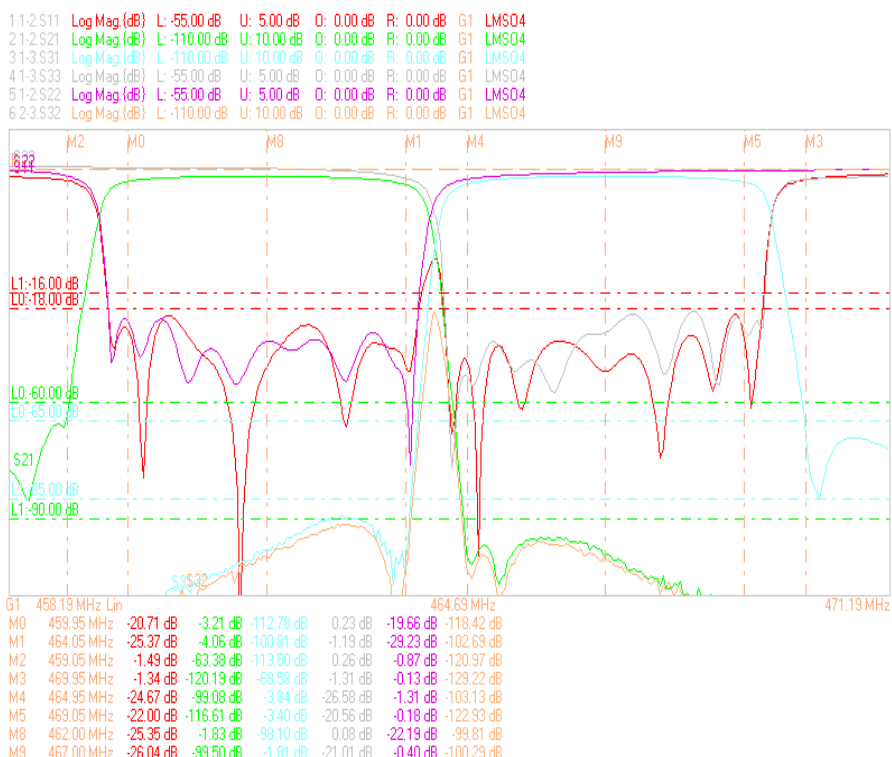
plot 7.3.3.2-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Duplexer rejection; Duplexer DL band 451-455 MHz UL band 456-460 MHz; pass band



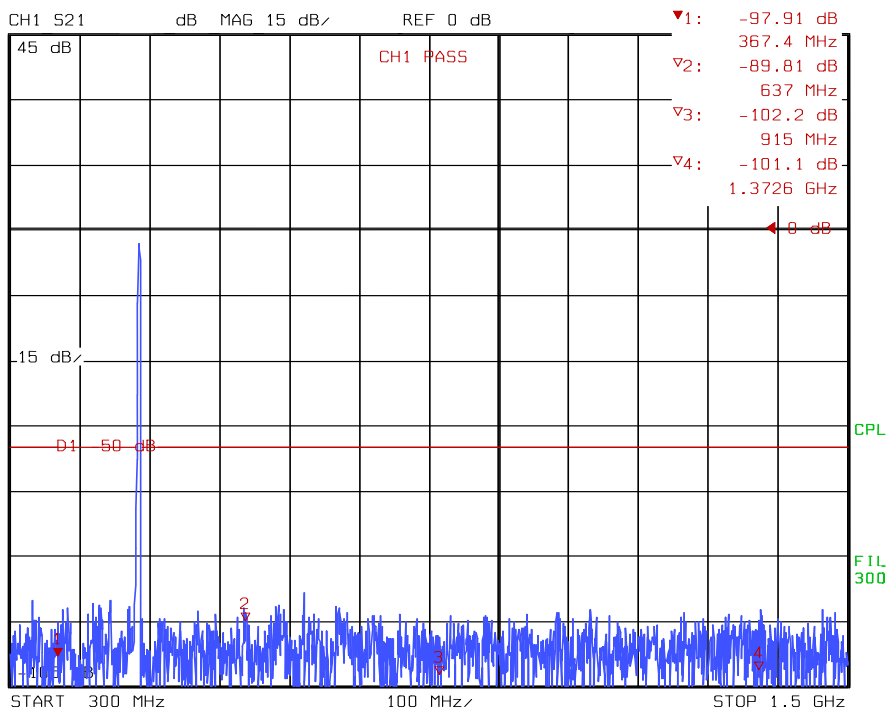
plot 7.3.3.2-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Duplexer rejection; Duplexer DL band 451-455 MHz UL band 456-460 MHz; rejection > 50 dB



7.3.3.3 Duplexer DL band 460-464 MHz UL band 465-469 MHz



plot 7.3.3.3-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Duplexer rejection; Duplexer DL band 460-464 MHz UL band 465-469 MHz; pass band



plot 7.3.3.3-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Duplexer rejection; Duplexer DL band 460-464 MHz UL band 465-469 MHz; rejection > 50 dB

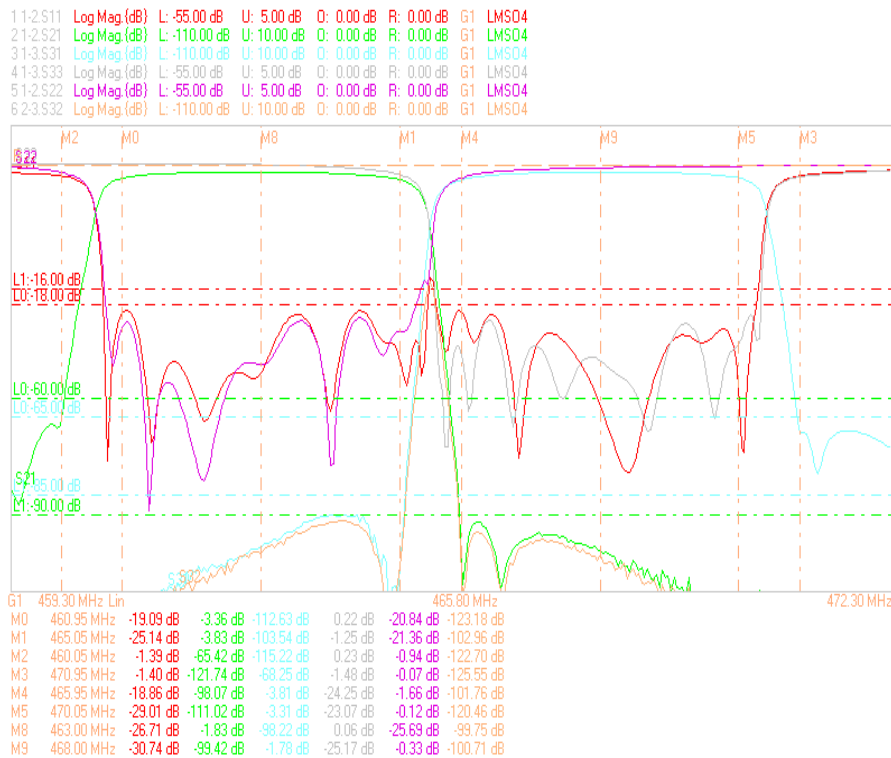
Test Report No.:

FCC ID: XS5-AF4037W4

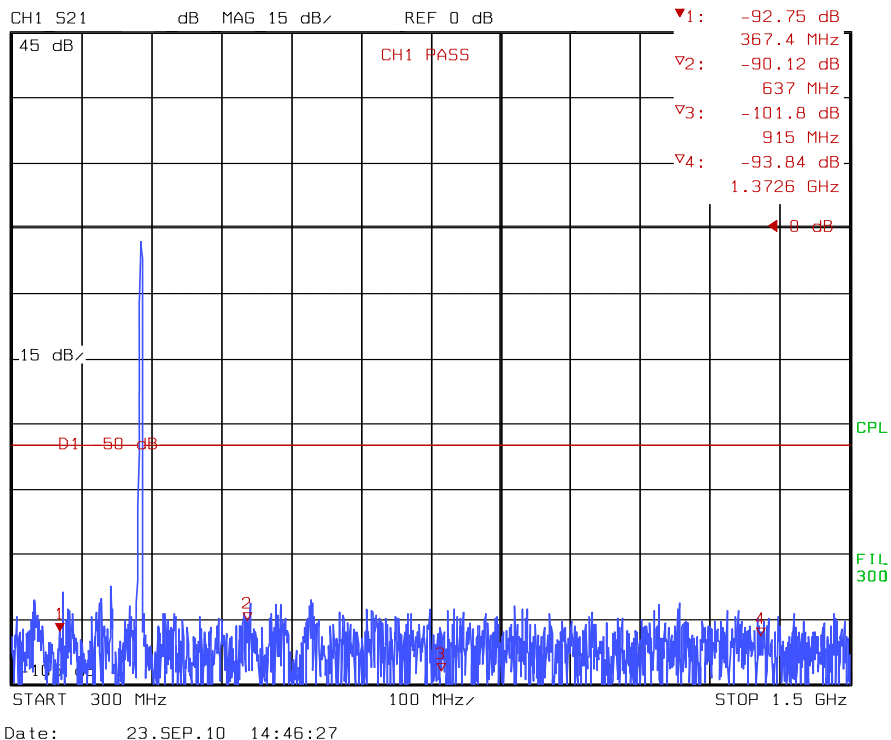
IC ID: 2237E-AF4037W4



### 7.3.3.4 Duplexer DL band 461-465 MHz UL band 466-470 MHz



plot 7.3.3.4-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Duplexer rejection; Duplexer DL band 461-465 MHz UL band 466-470 MHz; pass band



plot 7.3.3.4-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Duplexer rejection; Duplexer DL band 461-465 MHz UL band 466-470 MHz; rejection > 50 dB

Test Report No.:

FCC ID: XS5-AF4037W4

IC ID: 2237E-AF4037W4



#### 7.4 Summary test result

|             |                                     |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by:  | M. Leinfelder                       |
| Date:       | 04.08.2010                          |

Test Report No.:

FCC ID: XS5-AF4037W4

IC ID: 2237E-AF4037W4



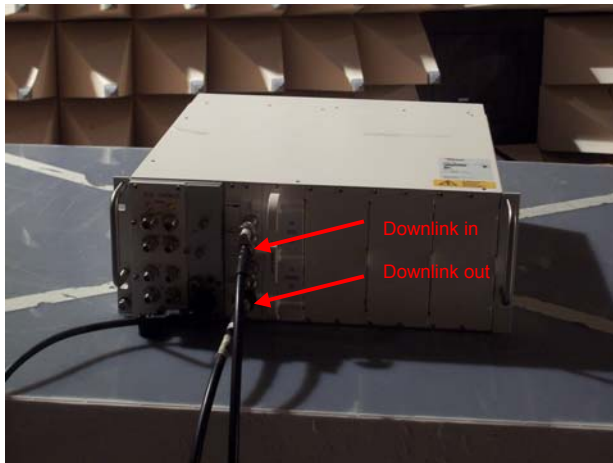
## 8 Radiated Spurious Emissions at the ECL (TEMPTON): §90.543, §2.1053



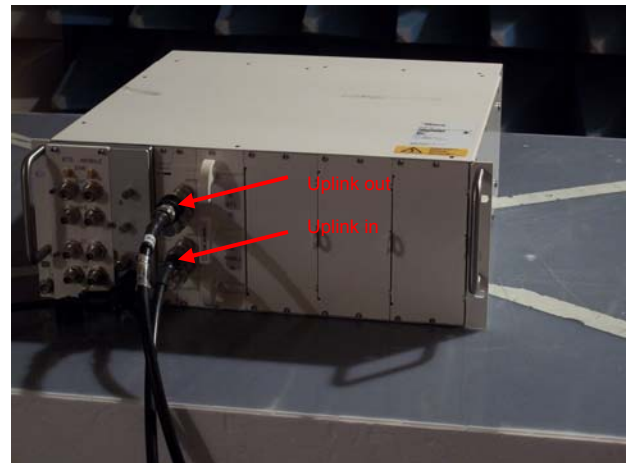
picture 8.1: label



picture 8.2: EUT



picture 8.3: Test setup for Downlink



picture 8.4: Test setup for Uplink



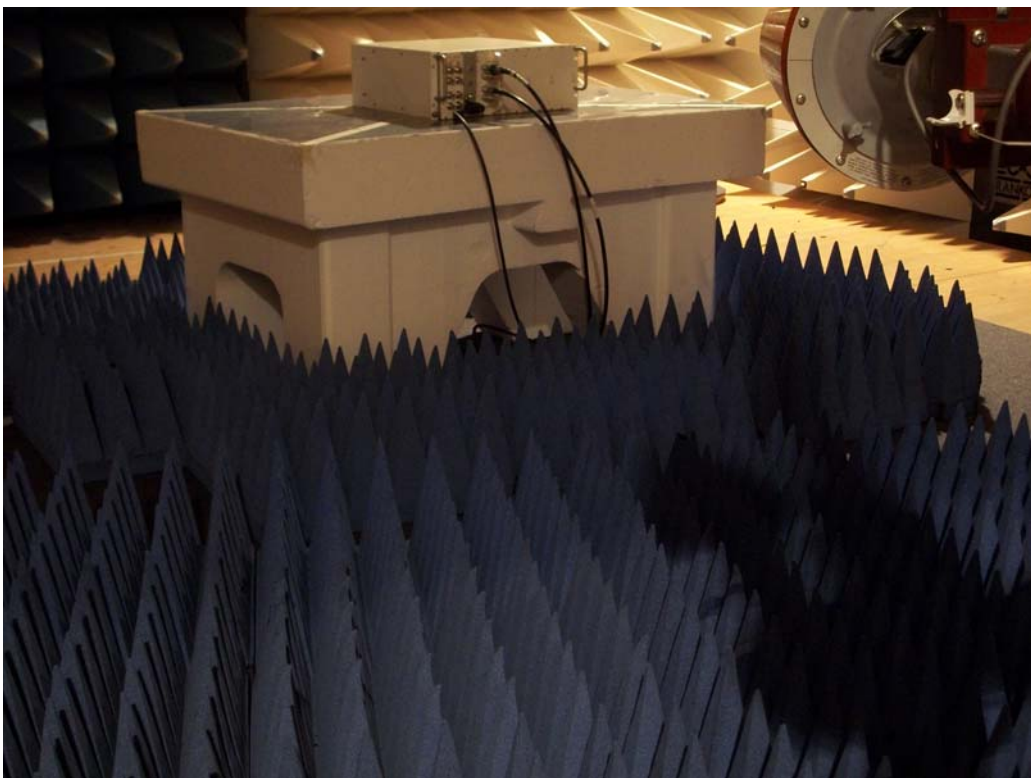
Test Report No.:

FCC ID: XS5-AF4037W4

IC ID: 2237E-AF4037W4



picture 8.5: Test setup: Field Strength Emission <1 GHz @3m in the FAC



picture 8.6: Test setup: Field Strength Emission >1 GHz @3m in the FAC



Test Report No.:

FCC ID: XS5-AF4037W4

IC ID: 2237E-AF4037W4



This clause specifies requirements for the measurement of radiated emission.

| Frequency range | Distance:<br>EUT <-> antenna /<br>location | Limit                  | Test method        |
|-----------------|--|------------------------|--------------------|
| 30 MHz - 1 GHz  | 3 metres / FAC                             | FCC 47 CFR Part 90.210 | TIA/EIA-603-C:2004 |
|                 |  | IC RSS-131 sec. 4.4    |                    |
| 1 GHz – 9 GHz   | 3 metres / FAC                             | FCC 47 CFR Part 90.210 |                    |
|                 |  | IC RSS-131 sec. 4.4    |                    |

**Test equipment used:**

| Designation       | Type          | Manufacturer    | Invent.-no. | Cal.-date  | due Cal.-<br>date | used |
|-------------------|---------------|-----------------|-------------|------------|-------------------|------|
| EMI test receiver | ESI40         | Rohde & Schwarz | E1687       | 21.12.2010 | 21.12.2011        | X    |
| Antenna           | CBL 6111      | Chase           | K1149       | 24.09.2010 | 24.09.2011        | X    |
| RF Cable          |               | Frankonia       | K1121 SET   | 01.07.2010 | 01.07.2011        | X    |
| Pre amplifier     | AM1431        | Miteq           | K1721       | 02.07.2010 | 02.07.2011        | X    |
| Antenna           | HL 025        | R&S             | K809        | 28.09.2010 | 28.09.2011        | X    |
| Preamplifier      | AFS4-00102000 | Miteq           | K838        | 09.02.2011 | 09.02.2012        | X    |
| RF Cable          | Sucoflex 100  | Suhner          | K1742       | 09.04.2010 | 09.04.2011        | X    |

The REMI version 2.135 has been used for max search.

**Test set-up:**

Test location: 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: 115V / 60 Hz  
Type of EUT: Wall mounted

**Measurement uncertainty:**

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

## 8.1 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 maximum RFI field strength was determined during the measurement by rotating the turntable ( $\pm 180$  degrees) and varying the height of the receive antenna ( $h = 1 \dots 4$  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.

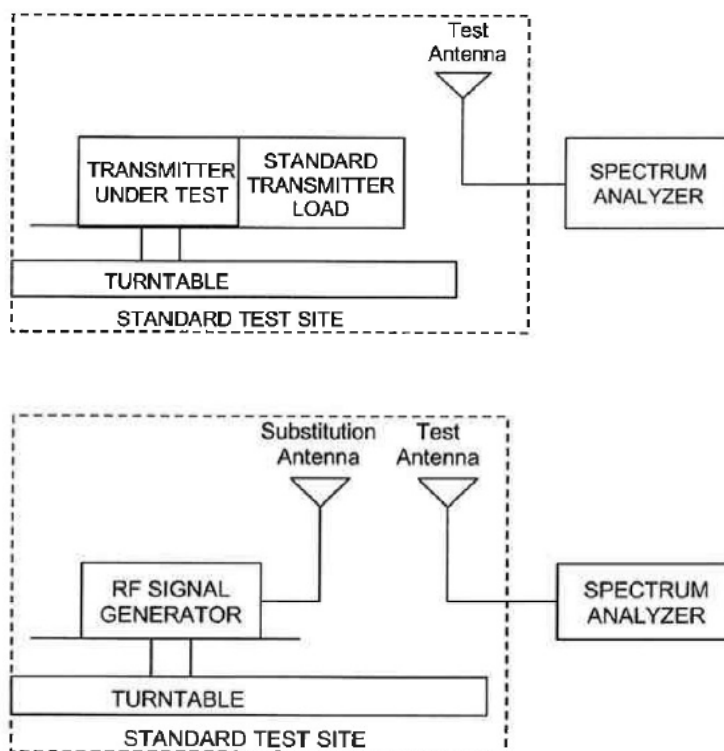


Figure #7.2 Substitution methods TIA/EIA-603-C

The  $P_{out}$  in the frequency range from 450 MHz to 470 MHz is independent from the frequency and constant by a constant  $P_{in}$ . For that reason the spurious emission are measured in the bandwidth as follow into the authorized bandwidth.

Downlink: 460 MHz / 462 MHz / 464 MHz

Uplink: 465 MHz / 467 MHz / 469 MHz

Test Report No.:

FCC ID: XS5-AF4037W4

IC ID: 2237E-AF4037W4

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## 8.2 Limit

### § 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

[39 FR 5919, Feb. 15, 1974. Redesignated and amended at 63 FR 36599, July 7, 1998]



**§ 90.210 Emission masks.**

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Applicable Emission Masks

| Frequency band (MHz)         | Mask for equipment with Audio low pass filter | Mask for equipment without audio low pass filter |
|------------------------------|---|--|
| Below 25 <sup>1</sup>        | A or B  | A or C   |
| 25–50                        | B   | C  |
| 72–76                        | B   | C  |
| 150–174 <sup>2</sup>         | B, D, or E                                    | C, D, or E                                       |
| 150 Paging-only              | B   | C  |
| 220–222                      | F   | F  |
| 421–512 <sup>2</sup>         | B, D, or E                                    | C, D, or E                                       |
| 450 Paging-only              | B   | G  |
| 806–809/851–854              | B   | H  |
| 809–824/854–869 <sup>3</sup> | B   | G  |
| 896–901/935–940              | I   | J  |
| 902–928                      | K   | K  |
| 929–930                      | B   | G  |
| 4940–4990 MHz                | L or M  | L or M.  |
| 5850–5925 <sup>4</sup>       |   |  |
| All other bands              | B   | C  |

<sup>1</sup>Equipment using single sideband J3E emission must the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.

<sup>2</sup>Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth Must meet the requirements of Emission Mask E.

<sup>3</sup>Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691.

<sup>4</sup>DSRCS Roadside Units equipment in the 5850–5925 MHz band is governed under subpart M of this part.



**(e) Emission Mask E—6.25 kHz or less channel bandwidth equipment.** For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 3.0 kHz removed from  $f_0$ : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least  $30 + 16.67(f_d - 3 \text{ kHz})$  or  $55 + 10 \log(P)$  or 65 dB, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least  **$55 + 10 \log(P)$  or 65 dB**, whichever is the **lesser attenuation**.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (m) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

Limits:

a = lesser attenuation /dB

$$a = 55 + 10 \cdot \log(P) = 55 + 10 \log(10^{P[\text{dBm}]/10} / 1000) = 55 + 10 \cdot [\log(10^{P[\text{dBm}]/10}) - \log(1000)] =$$

$$a = 55 + 10 \cdot P[\text{dBm}] / 10 - 10 \cdot 3 = 25 + P[\text{dBm}]$$

$$a_{\text{Downlink}} = 25 + 38,5 = 63,5 < 65$$

$$a_{\text{Uplink}} = 25 + 28 = 53 < 65$$

=> The less attenuation is the factor  $a_{\text{Downlink}}$  and  $a_{\text{Uplink}}$

=> **Limit** =  $P[\text{dBm}] - (a) = P[\text{dBm}] - (25 + P[\text{dBm}]) = \mathbf{-25\text{dBm}}$

|                      | Downlink                         | Uplink                       |
|----------------------|----------------------------------|------------------------------|
| $P_{\text{max,out}}$ | 38,5dBm (5.3.1)                  | 28dBm (5.3.2)                |
| $P_{\text{limit}}$   | 38,5dBm – 63,5dB = <b>-25dBm</b> | 28dBm - 53dB = <b>-25dBm</b> |

**8.3 Climatic values in the lab**

Temperature: 19,5°  
 Relative Humidity: 43%  
 Air-pressure: 998 hPa

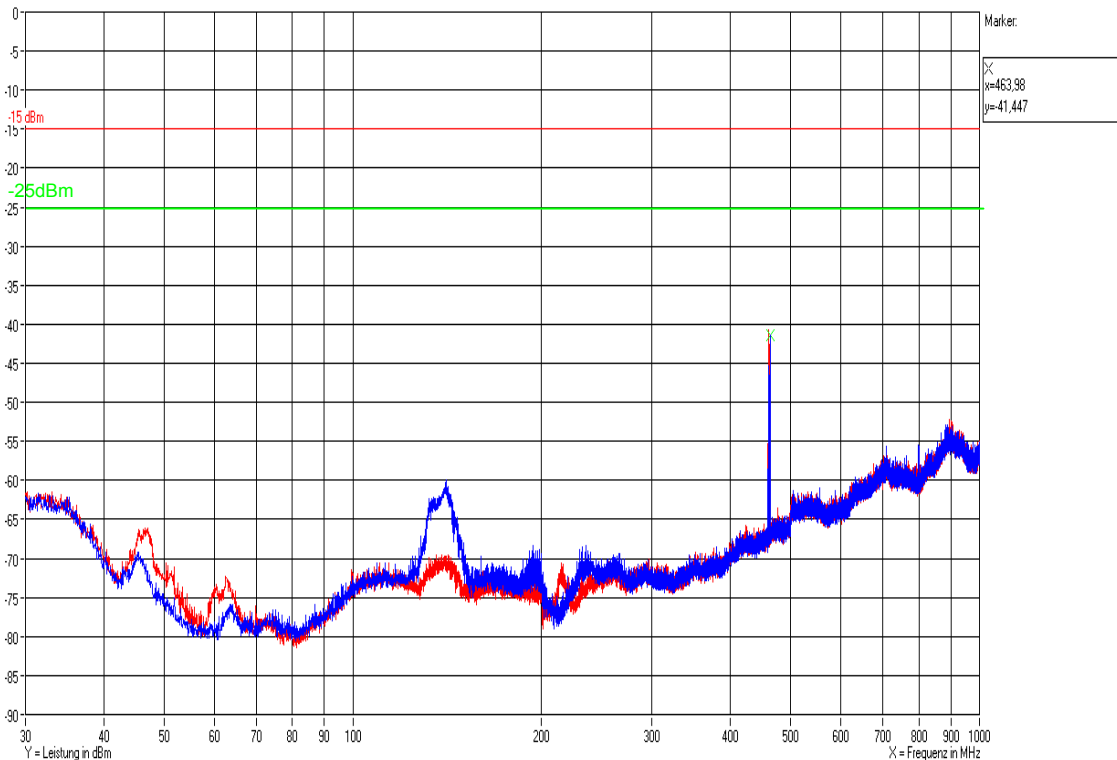


## 8.4 Test results

### 8.4.1 30 MHz to 1 GHz Downlink

#### Vertikal / Horizontal

The maximum unwanted radiated emission was searched by variation of the turn table from +180 to -180 degree and by moving the height of the antenna from 1m to 3m.



| Frequency (MHz) | Meter reading (dBμV) | AF + Cable + Amplifier (dB) | Field intensity (dBm) | Limit (dBm) | Margin (dB) | Polarization H / V |
|-----------------|----------------------|-----------------------------|-----------------------|-------------|-------------|--------------------|
| 45,480          | -90,0                | 20,8                        | -69,2                 | -25         | 44,2        | H                  |
| 46,980          | -86,6                | 20,6                        | -66,0                 | -25         | 41,0        | V                  |
| 140,820         | -80,3                | 20,3                        | -60,0                 | -25         | 35,0        | H                  |
| 235,440         | -91,0                | 22,7                        | -68,3                 | -25         | 43,3        | H                  |
| 463,980         | -71,3                | 29,9                        | -41,4                 | -25         | 16,4        | H                  |



### 8.4.2 30 MHz to 1 GHz Uplink

Vertikal / Horizontal

The maximum unwanted radiated emission was searched by variation of the turn table from +180 to -180 degree and by moving the height of the antenna from 1m to 3m.



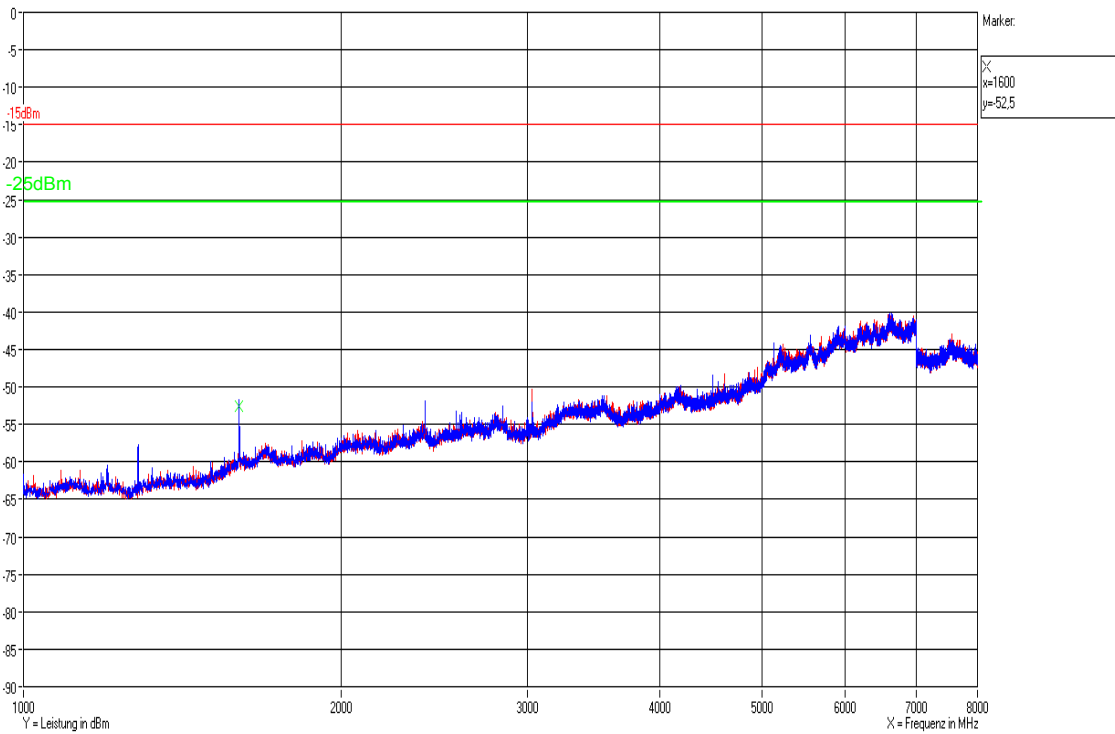
| Frequency (MHz) | Meter reading (dBμV) | AF + Cable + Amplifier (dB) | Field intensity (dBm) | Limit (dBm) | Margin (dB) | Polarization H / V |
|-----------------|----------------------|-----------------------------|-----------------------|-------------|-------------|--------------------|
| 45,300          | -88,6                | 20,9                        | -67,7                 | -25         | 42,7        | V                  |
| 62,820          | -87,1                | 15,6                        | -71,5                 | -25         | 46,5        | V                  |
| 466,980         | -83,3                | 30,3                        | -53,0                 | -25         | 28,0        | H                  |
| 799,980         | -84,8                | 33,3                        | -51,5                 | -25         | 26,5        | H                  |



### 8.4.3 1 GHz to 8 GHz Downlink

**Vertikal / Horizontal**

The maximum unwanted radiated emission was searched by variation of the turn table from +180 to -180 degree and by moving the height of the antenna from 1m to 3m.



| Frequency (MHz) | Meter reading (dBμV) | AF + Cable + Amplifier (dB) | Field intensity (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Polarization H / V |
|-----------------|----------------------|-----------------------------|--------------------------|----------------|-------------|--------------------|
| 959,600         | -69,7                | 14,7                        | -55,0                    | -25            | 30,0        | V                  |
| 1284,400        | -74,2                | 16,5                        | -57,7                    | -25            | 32,7        | H                  |
| 1600,400        | -71,9                | 20,3                        | -51,6                    | -25            | 26,6        | H                  |
| 3030,000        | -75,1                | 24,8                        | -50,3                    | -25            | 25,3        | V                  |



Test Report No.:

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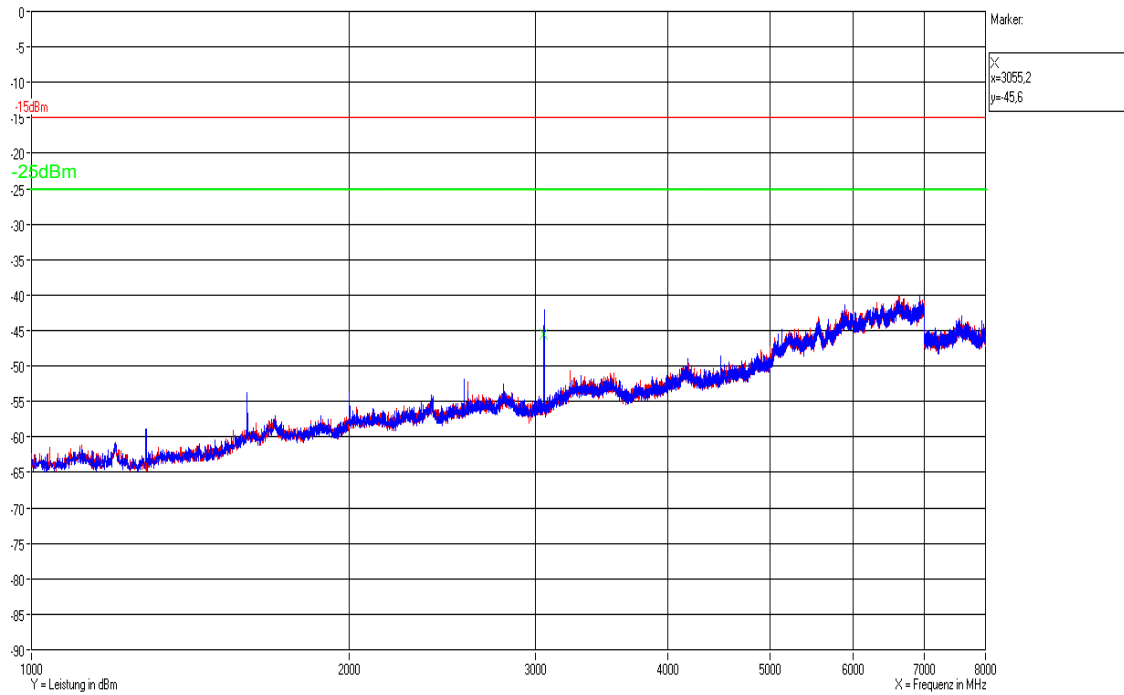
IC ID: 2237E-AF4037W4



### 8.4.4 1 GHz to 8 GHz Uplink

Vertikal / Horizontal

The maximum unwanted radiated emission was searched by variation of the turn table from +180 to -180 degree and by moving the height of the antenna from 1m to 3m.



| Frequency (MHz) | Meter reading (dBμV) | AF + Cable + Amplifier (dB) | Field intensity (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Polarization H / V |
|-----------------|----------------------|-----------------------------|--------------------------|----------------|-------------|--------------------|
| 1284,400        | -75,4                | 16,5                        | -58,9                    | -25            | 33,9        | H                  |
| 1600,400        | -74,1                | 20,3                        | -53,8                    | -25            | 28,8        | H                  |
| 2568,400        | -75,9                | 23,9                        | -52,0                    | -25            | 27,0        | H                  |
| 3057,200        | -66,9                | 24,9                        | -42,0                    | -25            | 17,0        | H                  |

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

Test Report No.:

FCC ID: XS5-AF4037W4

IC ID: 2237E-AF4037W4



## 9 History

| Revision | Modification   | Date       | Name     |
|----------|----------------|------------|----------|
| 01.00    | Initial report | 25.02.2011 | Zahlmann |
|          |                |            |          |
|          |                |            |          |
|          |                |            |          |

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