

Ericsson AB  
Camilla Karlsson  
PDU HW  
164 80 Stockholm

## Radio measurements on RRUS 12 B4 1700/2100 MHz radio equipment with FCC ID: TA8AKRC161349-2 and IC: 287AB-AS1613492 (8 appendices)

### Test object

Product name: RRUS 12 B4  
Product number: KRC 161 349/2

### Summary

| Standard                                                    | Compliant | Appendix |
|-------------------------------------------------------------|-----------|----------|
| FCC CFR 47 / IC RSS-139 ISSUE 2                             |           |          |
| 2.1046 / RSS-139 6.4 RF power output                        | Yes       | 2        |
| 2.1049 / RSS-Gen 4.6.1 Occupied bandwidth                   | Yes       | 3        |
| 2.1051 / RSS-139 6.5 Band edge                              | Yes       | 4        |
| 2.1051 / RSS-139 6.5 Spurious emission at antenna terminals | Yes       | 5        |
| 2.1053 / RSS-139 6.5 Field strength of spurious radiation   | Yes       | 6        |
| 2.1055 / RSS-139 6.3 Frequency stability                    | Yes       | 7        |

Note: Above RSS-139 items are given as cross-reference only. Measurements were performed according to ANSI procedures referenced by FCC and covered by SP's accreditation.

### SP Technical Research Institute of Sweden

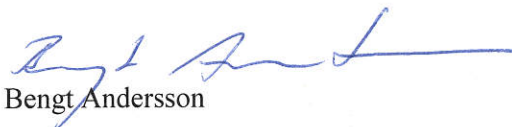
#### Electronics - EMC

Performed by

Examined by



Martin Theorin



Bengt Andersson

### SP Technical Research Institute of Sweden

Postal address

SP  
Box 857  
SE-501 15 BORÅS  
Sweden

Office location

Västeråsen  
Brinellgatan 4  
SE-504 62 BORÅS

Phone / Fax / E-mail

+46 10 516 50 00  
+46 33 13 55 02  
info@sp.se

This document may not be reproduced other than in full, except with the prior written approval of SP.

## Table of contents

|                                        |            |
|----------------------------------------|------------|
| Description of the test object         | Appendix 1 |
| Operation mode during measurements     | Appendix 1 |
| Test setups                            | Appendix 1 |
| Purpose of test                        | Appendix 1 |
| RF power output                        | Appendix 2 |
| Occupied bandwidth                     | Appendix 3 |
| Band edge                              | Appendix 4 |
| Spurious emission at antenna terminals | Appendix 5 |
| Field strength of spurious radiation   | Appendix 6 |
| Frequency stability                    | Appendix 7 |
| External photos                        | Appendix 8 |

## Appendix 1

**Description of the test object**

|                                        |                                                                                                                                                                                                                                               |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment:                             | Radio equipment RRUS 12 B4 supporting WCDMA                                                                                                                                                                                                   |
| Antenna ports:                         | 2 TX/RX ports                                                                                                                                                                                                                                 |
| RF configurations:                     | Single carrier, multi carrier and MIMO 2x2                                                                                                                                                                                                    |
| Frequency bands:                       | TX: 2110 – 2155 MHz<br>RX: 1710 – 1755 MHz                                                                                                                                                                                                    |
| Nominal output power per antenna port: | Single carrier: 1x 47.8 dBm (1 x 60W)<br>Multi carrier: 2 x 44.8 dBm (2 x 30W)<br>3 x 43.0 dBm (3 x 20W)<br>4 x 41.8 dBm (4 x 15W)<br>In MIMO configuration the maximum nominal output power is limited to 47 dBm (50W) per carrier and port. |
| Modulations:                           | QPSK, 16QAM and 64QAM                                                                                                                                                                                                                         |
| Channel bandwidth:                     | 4.2 to 5 MHz (configurable in steps of 100/200 kHz)                                                                                                                                                                                           |
| Channel spacing:                       | 4.4 to 5 MHz (configurable in steps of 100/200 kHz)                                                                                                                                                                                           |
| Nominal power voltage:                 | -48VDC                                                                                                                                                                                                                                        |

## Appendix 1

### Operation mode during measurements

Measurements were performed with the test object transmitting test models as defined in 3GPP TS 25.141. Test model 1 (TM1) was used to represent QPSK. Test model 5 (TM5) to represent 16QAM modulation and Test model 6 (TM6) to represent 64QAM modulation.

The settings below were deemed representative for all traffic scenarios when settings with different modulations, channel bandwidths, number of carriers and RF configurations has been tested to find the worst case setting. The settings below were used for all measurements if not otherwise noted.

Single carrier

TM1: 64 DPCH:s at 30 ksps (SF=128)

MIMO mode Single carrier

TM5: 8 HS-PDSCH at 240 ksps + 30 DPCH:s at 30 ksps (SF=128)

MIMO mode Multi carrier, 2 carriers

TM5: 8 HS-PDSCH at 240 ksps + 30 DPCH:s at 30 ksps (SF=128)

Channel bandwidth 5 MHz

All measurements were performed with the test object configured for the maximum transmit power applicable for the tested configuration.

### Conducted measurements

The test object was supplied with -48 VDC by an external power supply. Additional connections are documented in the set-up drawings below.

All measurements were made RF A and additional measurements on RF B to verify that the ports were electrical identical, as declared by the client.

### Radiated measurements

The test object was powered with -48 VDC. All measurements were performed with the test object configured for maximum transmit power

### Purpose of test

The purpose of the tests is to verify compliance to the performance characteristics specified in applicable items of FCC CFR 47 and Industry Canada RSS-139 and RSS-Gen.

### References

Measurements were done according to relevant parts of the following standards:

ANSI 63.4-2009

ANSI/TIA/EIA-603-C-2004

CFR 47 part 2, October 1<sup>st</sup>, 2012

CFR 47 part 27, October 1<sup>st</sup>, 2012

3GPP TS 25.141, version 8.9.0

RSS-Gen Issue 3

RSS-139 Issue 2

## Appendix 1

### Measurement equipment

|                                                            | Calibration Due | SP number |
|------------------------------------------------------------|-----------------|-----------|
| Test site Tesla                                            | 2014-01         | 503 881   |
| R&S FSIQ 40                                                | 2013-07         | 503 738   |
| R&S ESI 26                                                 | 2013-07         | 503 292   |
| R&S FSQ 40                                                 | 2014-03         | 504 143   |
| Control computer with<br>R&S software EMC32 version 8.52.0 | -               | 503 479   |
| High pass filter                                           | 2013-07         | 901 501   |
| High pass filter                                           | 2013-07         | 901 502   |
| High pass filter                                           | 2013-07         | 504 199   |
| High pass filter                                           | 2013-08         | 901 373   |
| High pass filter                                           | 2014-08         | 503 739   |
| High pass filter                                           | 2013-07         | 503 740   |
| RF attenuator                                              | 2013-07         | 504 159   |
| RF attenuator                                              | 2013-09         | 900 233   |
| RF attenuator                                              | 2013-08         | 900 691   |
| RF attenuator                                              | 2013-01         | 901 384   |
| RF attenuator                                              | 2013-12         | 901 508   |
| Chase Bilog Antenna CBL 6111A                              | 2014-10         | 503 182   |
| EMCO Horn Antenna 3115                                     | 2014-01         | 502 175   |
| Std.gain horn FLANN model 20240-20                         | 2014-03         | 503 674   |
| µComp Nordic, Low Noise Amplifier                          | 2014-04         | 901 545   |
| Schwarzbeck preamplifier BBV 9742                          | 2014-03         | 504 085   |
| MITEQ Low Noise Amplifier                                  | 2013-08         | 503 285   |
| Temperature and humidity meter, Testo 635                  | 2013-06         | 504 203   |
| Temperature and humidity meter, Testo 625                  | 2013-06         | 504 188   |
| Temperature Chamber                                        | 2013-11         | 501 031   |
| Datascan 7321                                              | 2013-11         | 502 698   |
| Multimeter Fluke 87                                        | 2013-08         | 502 190   |

## Appendix 1

### **Uncertainties**

Measurement and test instrument uncertainties are described in the quality assurance documentation "SP-QD 10885". The uncertainties are calculated with a coverage factor  $k=2$  (95% level of confidence).

Compliance evaluation is based on a shared risk principle with respect to the measurement uncertainty.

### **Reservation**

The test results in this report apply only to the particular test object as declared in the report.

### **Delivery of test object**

The test object was delivered 2013-05-06.

### **Manufacturer's representative**

Mihai Simon, Ericsson AB.

### **Test engineers**

Andreas Johnson, Tomas Lennhager, Tomas Isbring, Kexin Chen, Jörgen Wassholm and Martin Theorin, SP

### **Test participant**

None

## Appendix 1

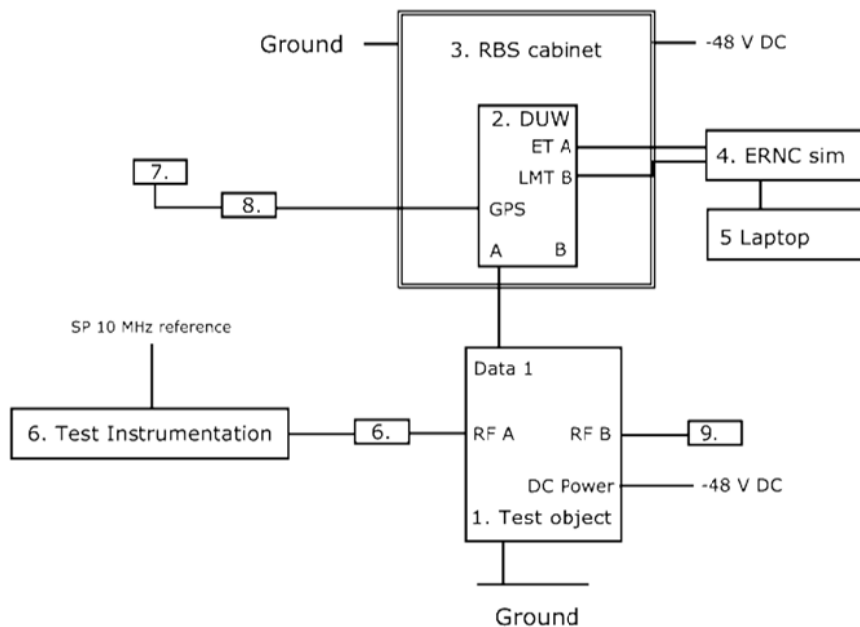
### Test frequencies during measurements

| UARFCN<br>Downlink | Frequency<br>[MHz] | Symbolic<br>name | Comment                                |
|--------------------|--------------------|------------------|----------------------------------------|
| 1537               | 2112.4             | B                | Single carrier TX bottom frequency     |
| 1537               | 2112.4             | B2               | 2 carrier TX band bottom constellation |
| 1562               | 2117.4             |                  |                                        |
| 1638               | 2132.6             | M                | Single carrier TX band mid frequency   |
| 1638               | 2132.6             | M2               | 2 carrier TX band mid constellation    |
| 1663               | 2137.6             |                  |                                        |
| 1738               | 2152.6             | T                | Single carrier TX top frequency        |
| 1713               | 2147.6             | T2               | 2 carrier TX band top constellation    |
| 1738               | 2152.6             |                  |                                        |

All RX frequencies were configured 400 MHz below the corresponding TX frequency according the applicable duplex offset for the operating band.

## Appendix 1

### Test set-up conducted measurements



### Test object:

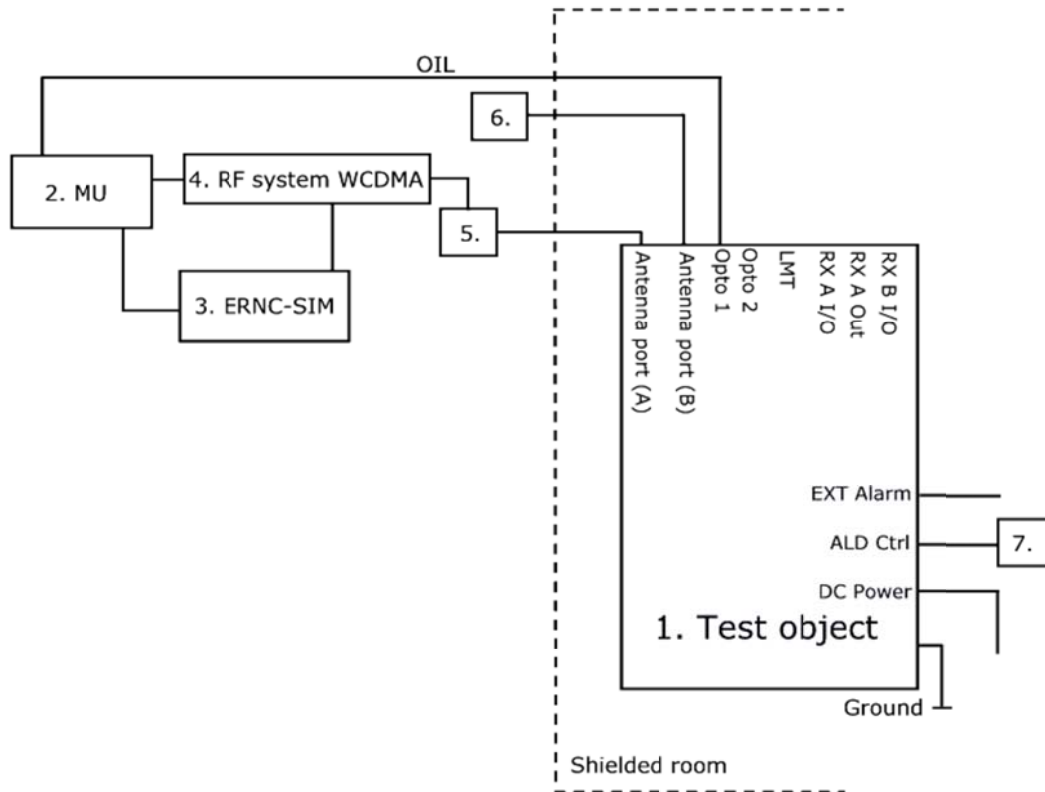
|    |                                                                                                         |
|----|---------------------------------------------------------------------------------------------------------|
| 1. | RRUS 12 B4, KRC 161 349/2, revision R1B, S/N: C827003190<br>working software CXP 901 7316/2, Rev. R49EG |
|----|---------------------------------------------------------------------------------------------------------|

### Functional test equipment

|    |                                                                                                                                                                                                                                                                               |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2. | DUW 30 01, KDU 127 161/3, rev:R4E, s/n: TU8X621366                                                                                                                                                                                                                            |
| 3. | SUP 6601 1/BFL 901 009/1, rev. R3B, s/n. BR881078499                                                                                                                                                                                                                          |
| 4. | ERNC Sim 072, BAMS – 1000579045<br>Fast Ethernet switch, Netgear GSM7224, BAMS – 1001252309<br>Fast Ethernet switch, Netgear GSM7212, BAMS – 1000517295<br>NTP Symmetricom sync server S250, BAMS – 1000690719<br>10 MHz reference, Symmetricom model 8040, BAMS – 1000645316 |
| 5. | Controlling computer SUN ULTRA 27, BAMS 1000758346                                                                                                                                                                                                                            |
| 6. | SP Test Instrumentation according to measurement equipment list                                                                                                                                                                                                               |
| 7. | GPS Active Antenna, KRE 101 2082/1                                                                                                                                                                                                                                            |
| 8. | GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K474887                                                                                                                                                                                                                            |
| 9. | Terminator, 50 ohm                                                                                                                                                                                                                                                            |

## Appendix 1

### Test set-up radiated measurements



#### Test object:

|    |                                                                                                      |
|----|------------------------------------------------------------------------------------------------------|
| 1. | RRUS 12 B4, KRC 161 349/2, rev. R1B, s/n: C827003180<br>working software: CXP 901 7316/2, rev: R49EG |
|----|------------------------------------------------------------------------------------------------------|

#### Functional test equipment:

|    |                                                                                                                                                                                                                                         |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2. | Main Unit<br>SUP 6601, 1/BFL 901 009/1, rev. R3B, s/n: BR80901309<br>SUP 6601, 1/BFL 901 009/1, rev. R3B, s/n: BR81066805<br>DUW 30 01, KDU 127 161/3, rev. R4E, s/n: TU8X621350<br>DUW 30 01, KDU 127 161/3, rev. R4E, s/n: C825945806 |
| 3. | ERNC-SIM 065, BAMS – 1000579038<br>Symmetricom SyncServer S250, BAMS – 1000491896<br>Switch Netgear GSM 7224, BAMS – 1000850751<br>10 MHz reference Symmetricom 8040, BAMS – 1000645315                                                 |
| 4. | RF system WCDMA<br>Computer, w-ultra27-14 standalone, BAMS – 1000758439<br>Anritsu MS2691A, BAMS – 1000698364<br>Switch Netgear GSM 7212, BAMS – 1000517298                                                                             |
| 5. | Directional Coupler, BAMS – 1000739626                                                                                                                                                                                                  |
| 6. | Terminator                                                                                                                                                                                                                              |
| 7. | RET – Remote Electrical Tilt unit, KRY 121 67/2, rev. R1N                                                                                                                                                                               |

## Appendix 1

### Interfaces:

|                                                                    |          |
|--------------------------------------------------------------------|----------|
| Power: -48 VDC                                                     | DC Power |
| Antenna port (A), 7/16 connector                                   | Antenna  |
| Antenna port (B), 7/16 connector                                   | Antenna  |
| Opto 1, Optical Interface Link, single mode opto fibre             | Telecom  |
| Opto 2, Optical Interface Link, single mode opto fibre, not in use | Telecom  |
| LMT, for maintenance use only                                      | Telecom  |
| RX A Out, no cable attached                                        | Antenna  |
| RX A I/O, no cable attached                                        | Antenna  |
| RX B I/O, no cable attached                                        | Antenna  |
| EXT Alarm, shielded multi-wire                                     | Signal   |
| ALD Ctrl, shielded multi-wire                                      | Signal   |
| Ground wire                                                        | Ground   |

### RBS software:

| Software      | Revision |
|---------------|----------|
| CXP 902 171/9 | R1CA15   |

## Appendix 2

### RF power output measurements according to CFR 47 §27.50 / IC RSS-139 6.4

| Date       | Temperature  | Humidity   |
|------------|--------------|------------|
| 2013-05-15 | 23 °C ± 3 °C | 29 % ± 5 % |
| 2013-05-16 | 23 °C ± 3 °C | 37 % ± 5 % |

#### Test set-up and procedure

The test object was connected to a signal analyzer measuring peak and RMS output power in CDF mode. A resolution bandwidth of 50 MHz was used.

| Measurement equipment                     | SP number |
|-------------------------------------------|-----------|
| R&S FSQ                                   | 504 143   |
| RF attenuator                             | 901 508   |
| Testo 635, temperature and humidity meter | 504 203   |

**Measurement uncertainty:** 1.1 dB

#### Results

Single carrier

Rated output power level at RF connector 1x 47.8 dBm Total nominal RF power 50.8 dBm.

| Tested configuration | Transmitter power<br>RMS (dBm) |                      |
|----------------------|--------------------------------|----------------------|
| BW and frequency     | Port RF A                      | Port RF B            |
| 5 MHz, B             | 47.37<br>(Diagram 1)           | 47.37<br>(Diagram 2) |
| 5 MHz, M             | 47.69<br>(Diagram 3)           | 47.50<br>(Diagram 4) |
| 5 MHz, T             | 47.26<br>(Diagram 5)           | 47.21<br>(Diagram 6) |

Note: The diagrams are shown on the following pages and provide Peak to Average Ratio (PAPR). The highest single carrier PAPR measured was 7.43 dB (0.1%). For multi-carrier constellations the measured “PAPR” is informative only as to the definition of Peak to Average Ratio per carrier.

## Appendix 2

### MIMO mode Single carrier

Rated output power 1x 47.0dBm per RF port.Total nominal RF power 50.0 dBm

| Tested configuration<br>Bandwidth and frequency | Transmitter power<br>RMS (dBm) |                          |                           |
|-------------------------------------------------|--------------------------------|--------------------------|---------------------------|
|                                                 | Port RF A                      | Port RF B                | Total power <sup>1)</sup> |
| 5 MHz, B                                        | 47.00<br>(Diagram 7)           | Not tested <sup>2)</sup> | 50.00                     |
| 5 MHz, M                                        | 46.79<br>(Diagram 8)           | Not tested <sup>2)</sup> | 49.79                     |
| 5 MHz, T                                        | 46.79<br>(Diagram 9)           | Not tested <sup>2)</sup> | 49.79                     |

<sup>1)</sup>: Since port B isn't measured 3dB has been added to the result on port RFA.

<sup>2)</sup>: Measurements were only made on port RF A due to the measurement result in single carrier mode that shows that the ports are identical, as declared by the client.

### MIMO mode, Multi carrier

Rated output power 2x 44.8dBm per RF port.Total nominal RF power 50.8 dBm

| Tested configuration<br>Bandwidth and frequency | Transmitter power<br>RMS (dBm) |                       |                           |
|-------------------------------------------------|--------------------------------|-----------------------|---------------------------|
|                                                 | Port RF A                      | Port RF B             | Total power <sup>1)</sup> |
| 5 MHz, B2                                       | 47.49<br>(Diagram 10)          | 47.43<br>(Diagram 11) | 50.47                     |
| 5 MHz, M2                                       | 47.48<br>(Diagram 12)          | 47.53<br>(Diagram 13) | 50.52                     |
| 5 MHz, T2                                       | 47.38<br>(Diagram 14)          | 47.37<br>(Diagram 15) | 50.39                     |

<sup>1)</sup>: Summed output power according to FCC KDB662911 Multiple transmitter output v01r02

### Limits

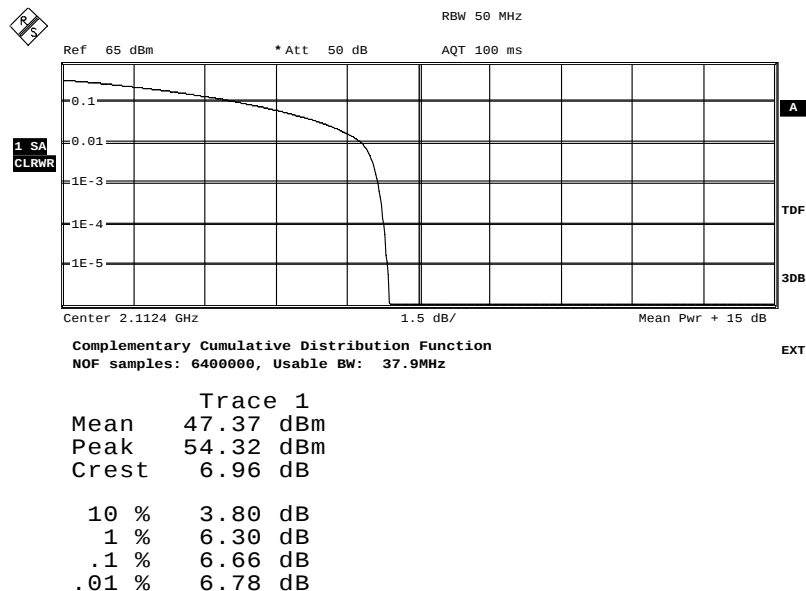
§27.50: The maximum output power may not exceed 1640 W (EIRP)/ MHz.  
The Peak to Average Ratio (PAR) may not exceed 13 dB.

RSS-139 6.4: The average equivalent isotropically radiated power (e.i.r.p.) limits in SRSP-513 apply, resulting in a maximum EIRP of 1640 W/ MHz for the scope of this report. The peak-to-average ratio of the power shall not exceed 13 dB.

|           |     |
|-----------|-----|
| Complies? | Yes |
|-----------|-----|

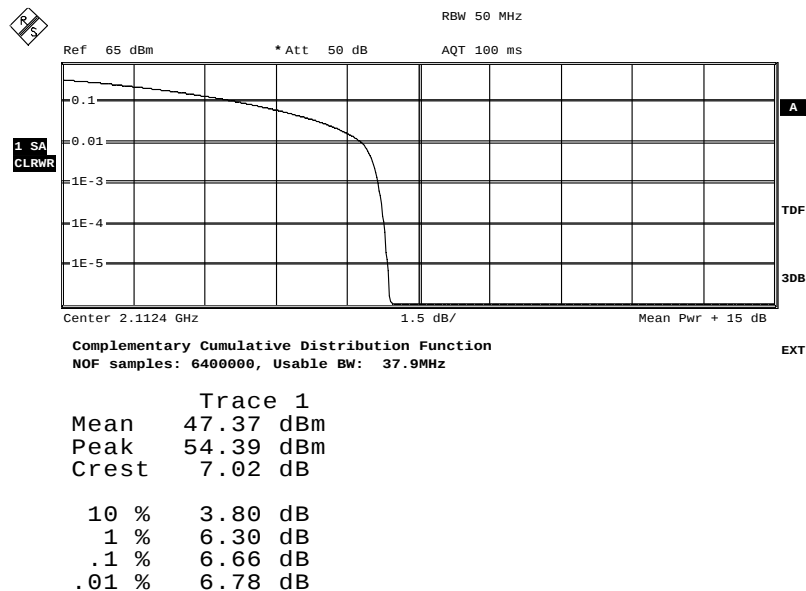
## Appendix 2

Diagram 1:



Date: 15.MAY.2013 11:55:59

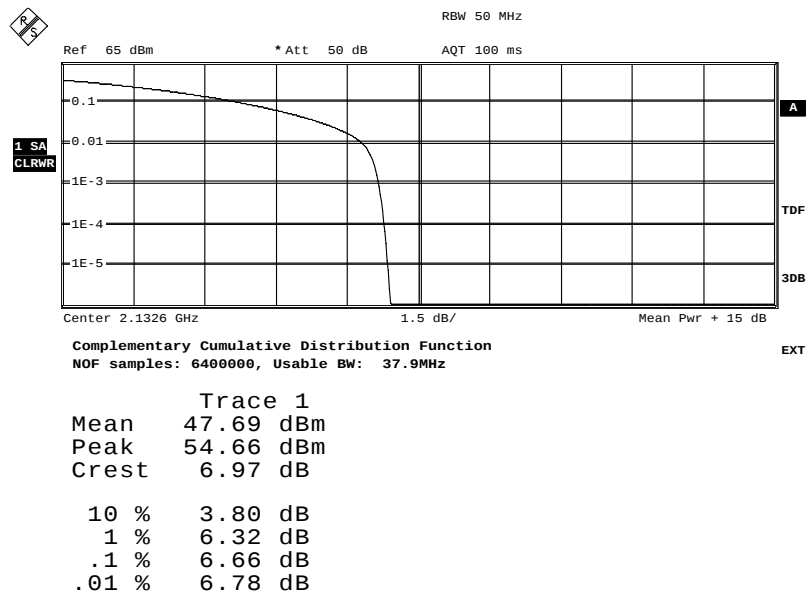
Diagram 2:



Date: 15.MAY.2013 12:33:55

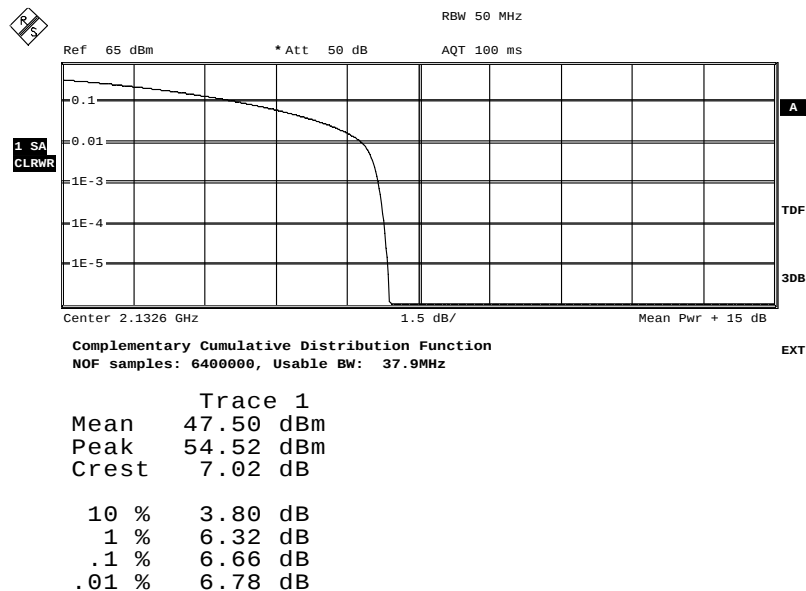
## Appendix 2

Diagram 3:



Date: 15.MAY.2013 11:43:25

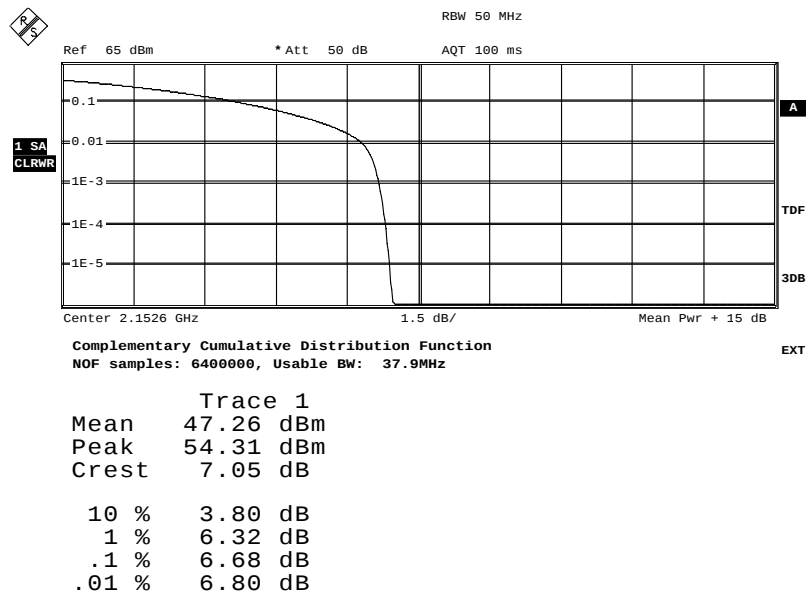
Diagram 4:



Date: 15.MAY.2013 12:43:36

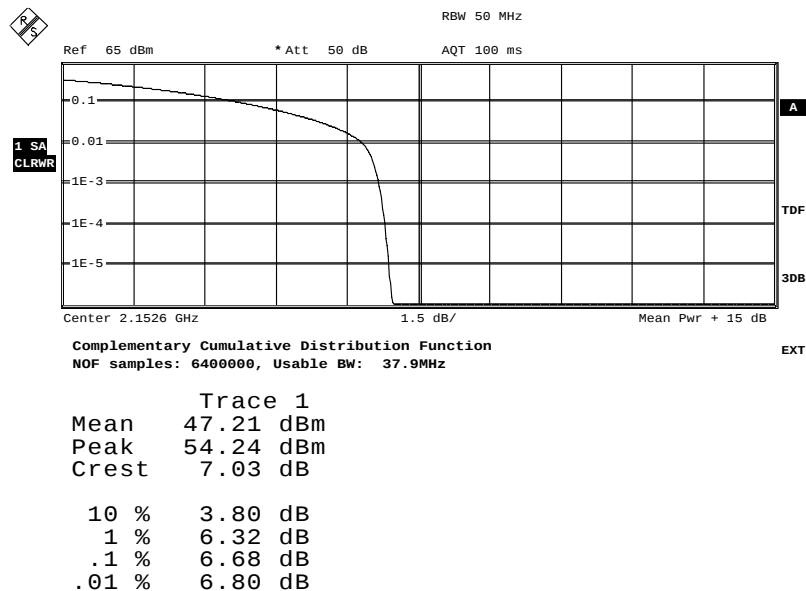
## Appendix 2

Diagram 5:



Date: 15.MAY.2013 12:07:43

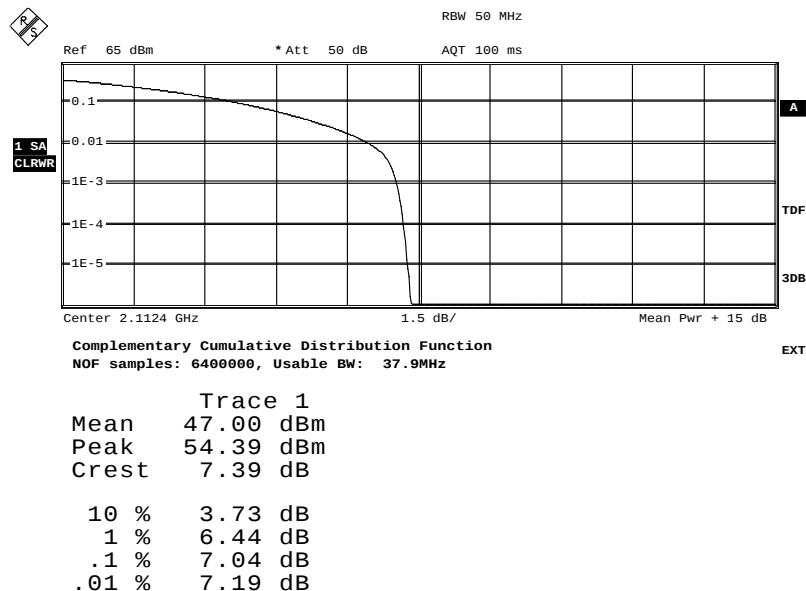
Diagram 6:



Date: 15.MAY.2013 12:28:21

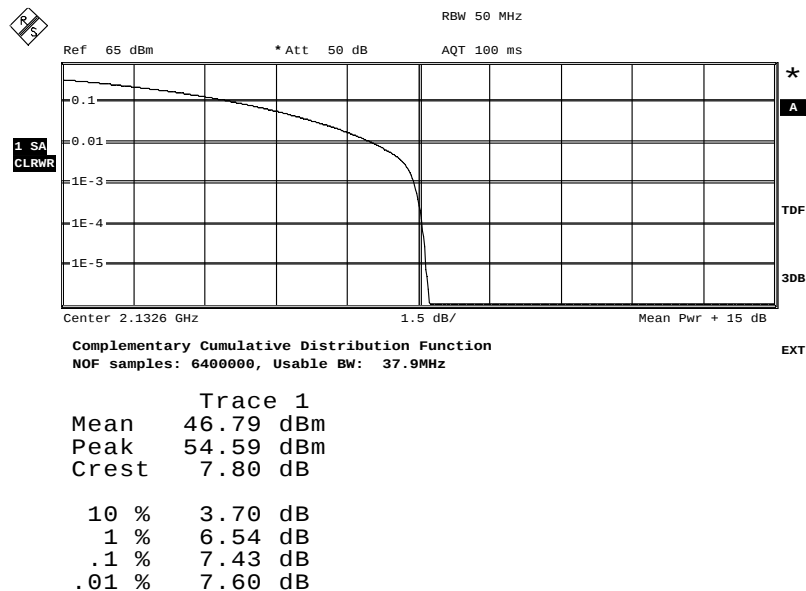
## Appendix 2

Diagram 7:



Date: 15.MAY.2013 10:22:50

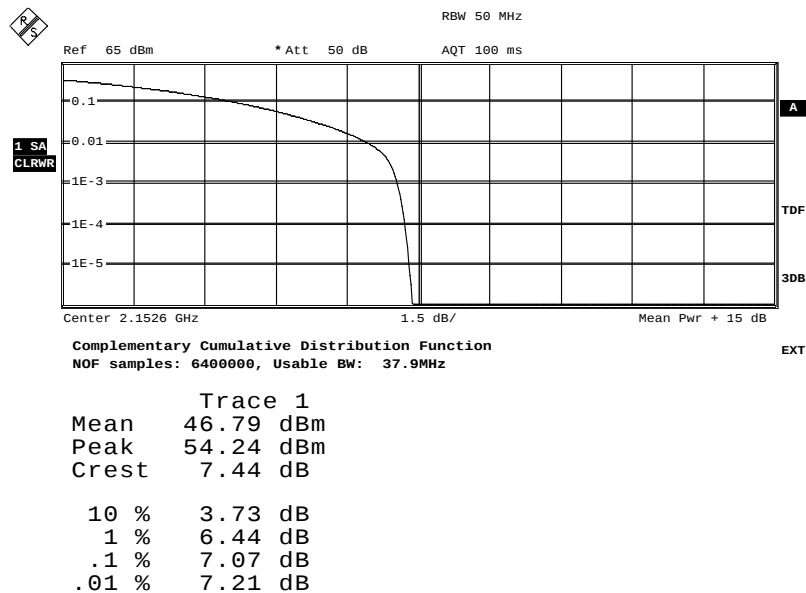
Diagram 8:



Date: 15.MAY.2013 09:22:56

## Appendix 2

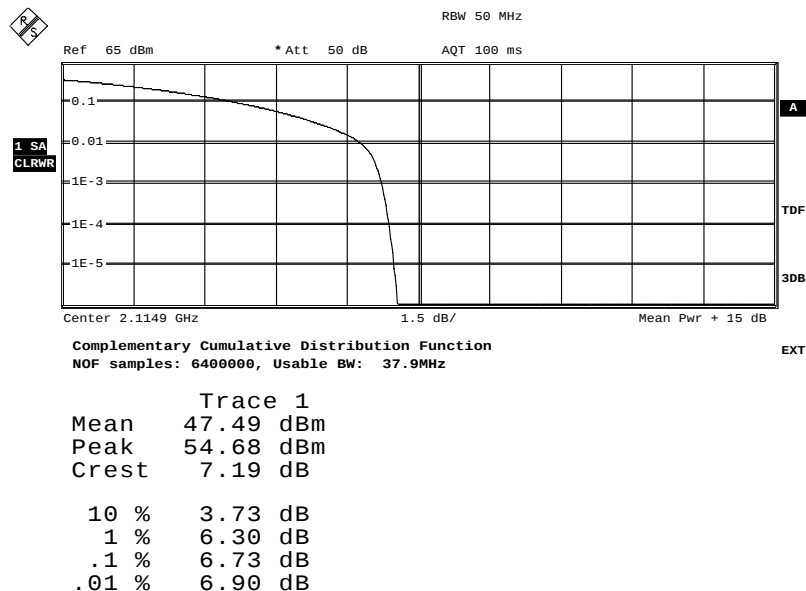
Diagram 9:



Date: 15.MAY.2013 11:17:00

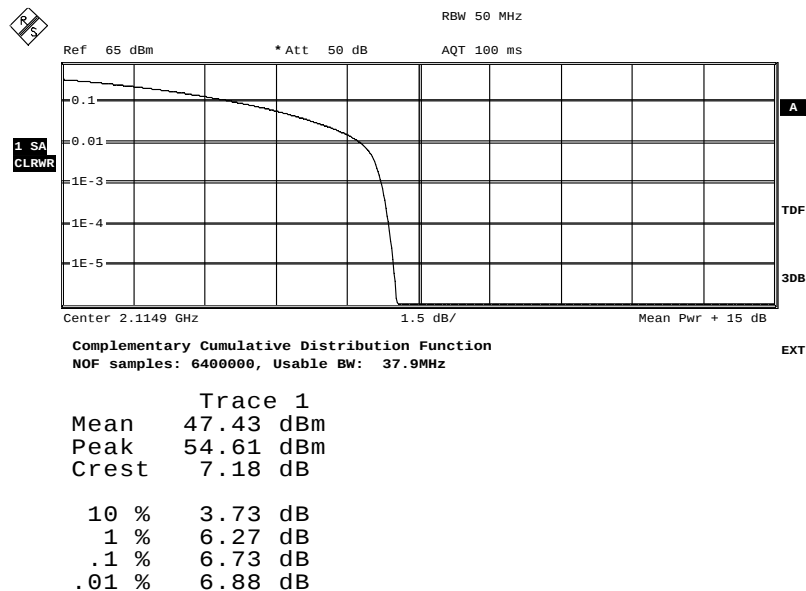
## Appendix 2

Diagram 10:



Date: 16.MAY.2013 10:04:44

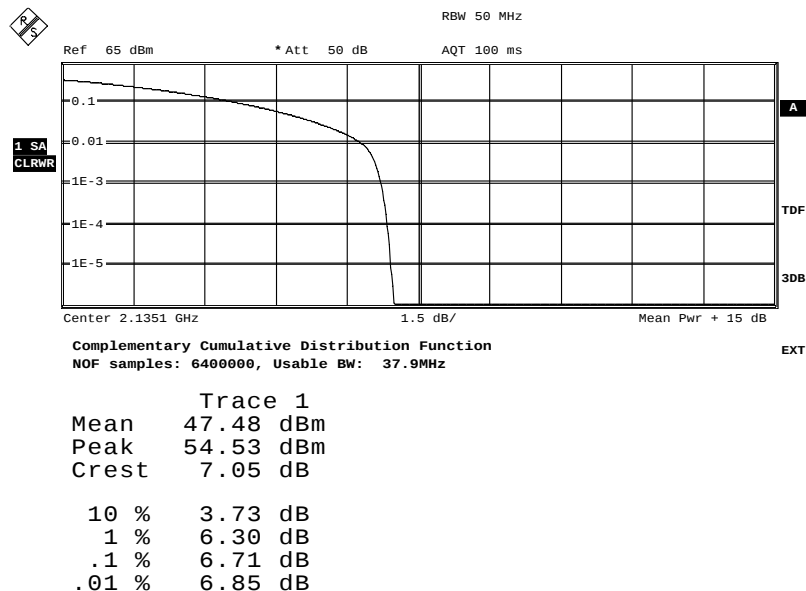
Diagram 11:



Date: 16.MAY.2013 10:29:31

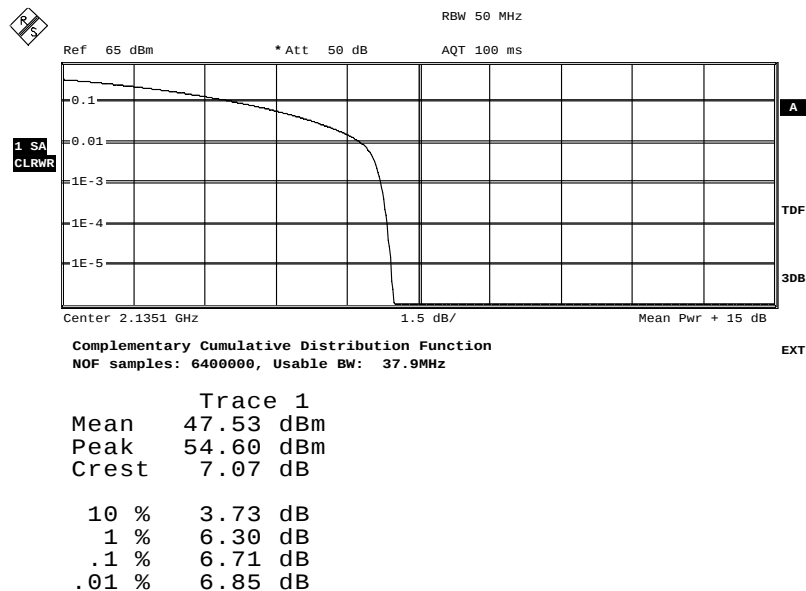
## Appendix 2

Diagram 12:



Date: 16.MAY.2013 12:21:55

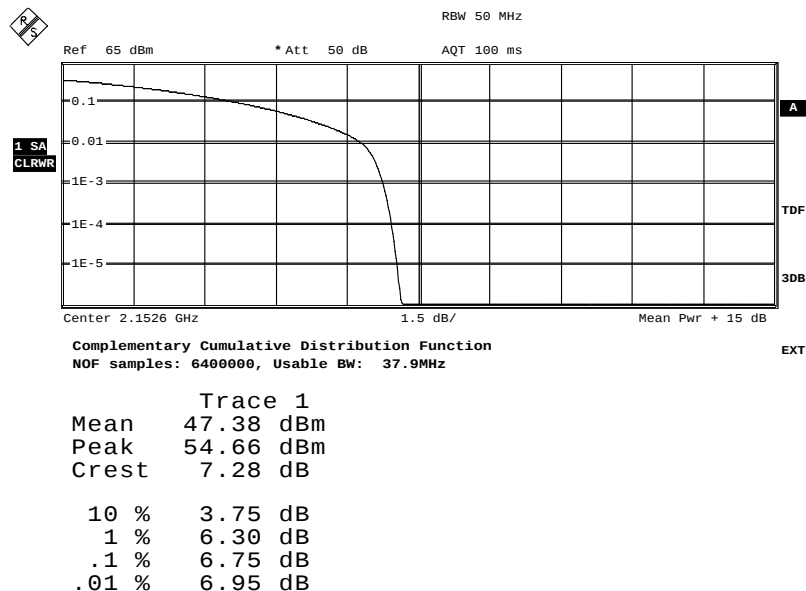
Diagram 13:



Date: 16.MAY.2013 12:16:51

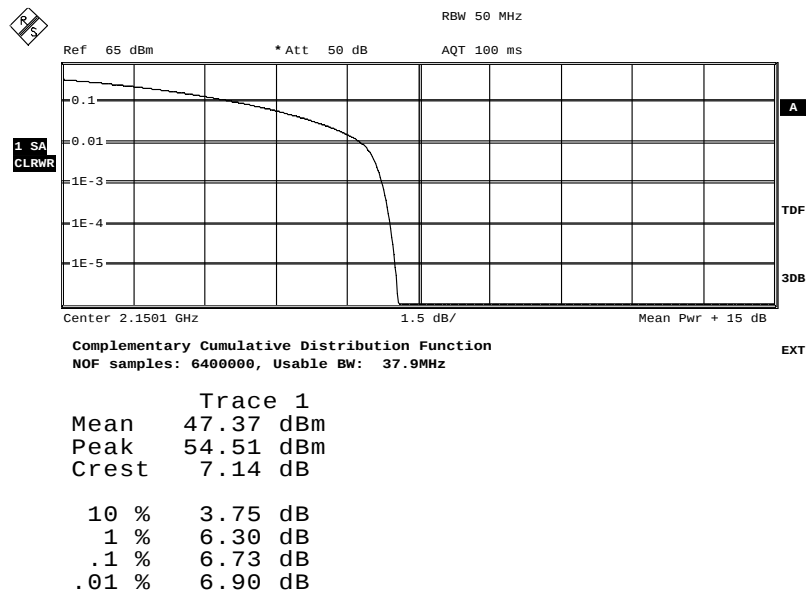
## Appendix 2

Diagram 14:



Date: 16.MAY.2013 10:54:09

Diagram 15:



Date: 16.MAY.2013 12:05:35

### Appendix 3

#### Occupied bandwidth measurements according to 47 CFR 2.1049 / RSS-Gen 4.6.1

|            |              |            |
|------------|--------------|------------|
| Date       | Temperature  | Humidity   |
| 2013-05-15 | 23 °C ± 3 °C | 29 % ± 5 % |

#### Test set-up and procedure

The measurements were made per definition in §2.1049. The output was connected to a signal analyzer with the RMS detector activated. The signal analyzer was connected to an external 10 MHz reference standard during the measurements.

| Measurement equipment                     | SP number |
|-------------------------------------------|-----------|
| R&S FSQ                                   | 504 143   |
| RF attenuator                             | 901 508   |
| Testo 635, temperature and humidity meter | 504 203   |

Measurement uncertainty: 3.7 dB

#### Results

##### Single carrier

| Diagram | BW configuration | Tested frequency | Tested Port | Occupied BW (99%) [MHz] |
|---------|------------------|------------------|-------------|-------------------------|
| 1       | 5 MHz            | B                | RF A        | 4.17                    |
| 2       | 5 MHz            | M                | RF A        | 4.18                    |
| 3       | 5 MHz            | M                | RF B        | 4.18                    |
| 4       | 5 MHz            | T                | RF A        | 4.18                    |

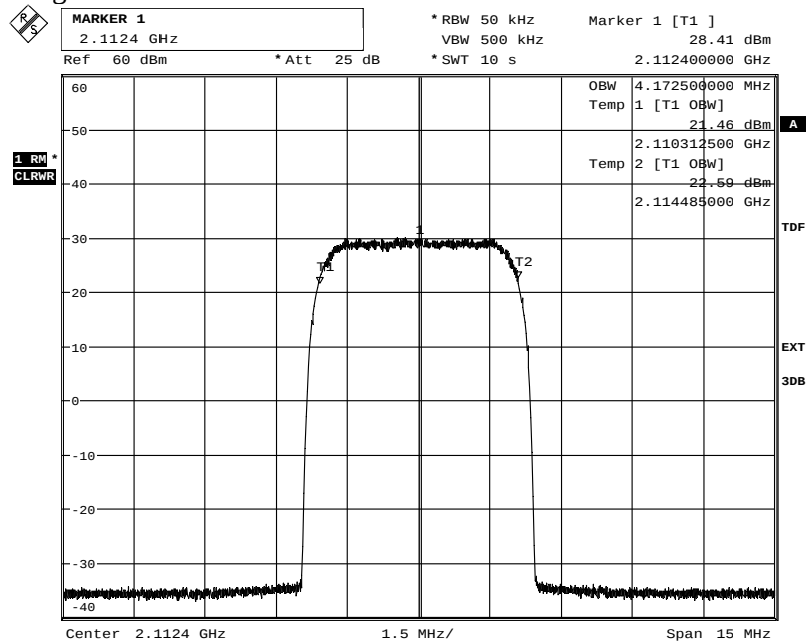
##### MIMO mode, Single carrier

| Diagram | BW configuration | Tested frequency | Tested Port | Occupied BW (99%) [MHz] |
|---------|------------------|------------------|-------------|-------------------------|
| 5       | 5 MHz            | M                | RF A        | 4.17                    |

Note: Measurements were limited to port RF A due to the measurement result in single carrier mode that shows that the ports are electrical identical as declared by the client.

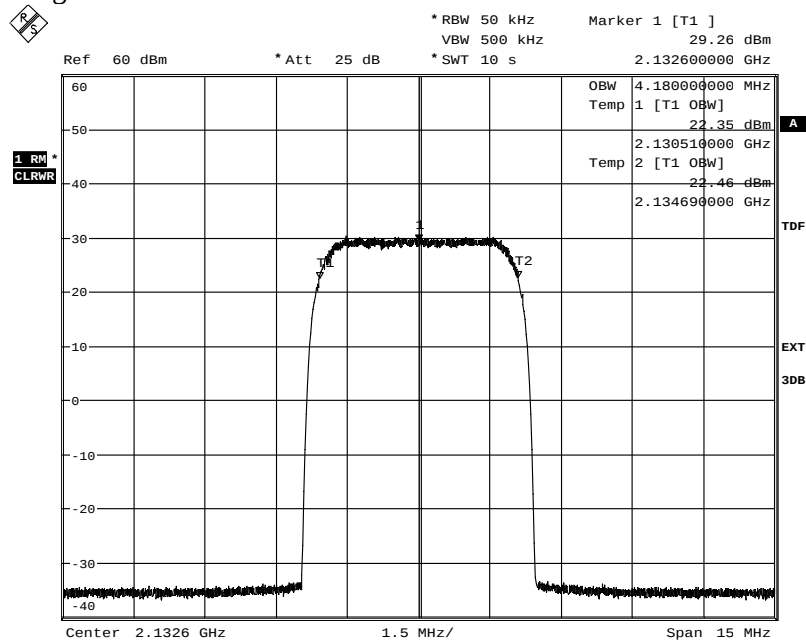
## Appendix 3

Diagram 1:



Date: 15.MAY.2013 11:57:02

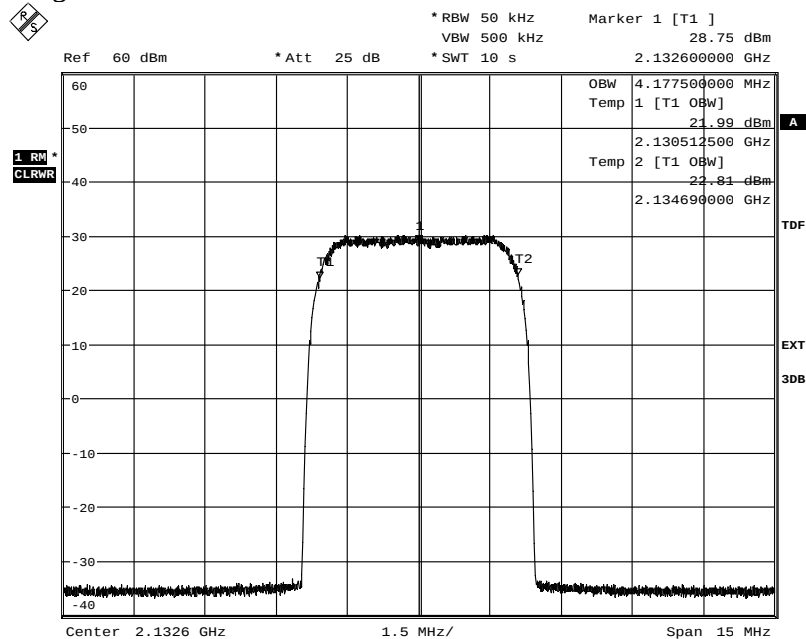
Diagram 2:



Date: 15.MAY.2013 11:40:04

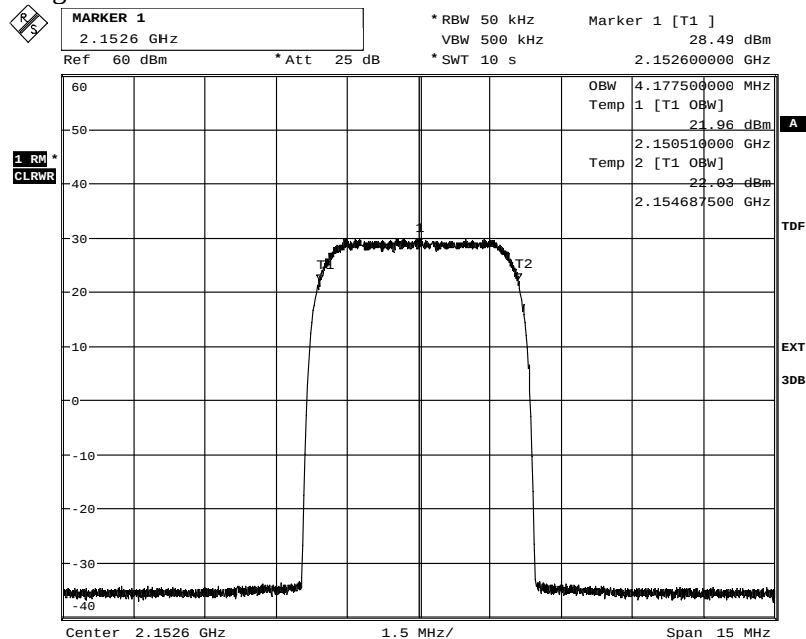
### Appendix 3

Diagram 3:



Date: 15.MAY.2013 12:42:27

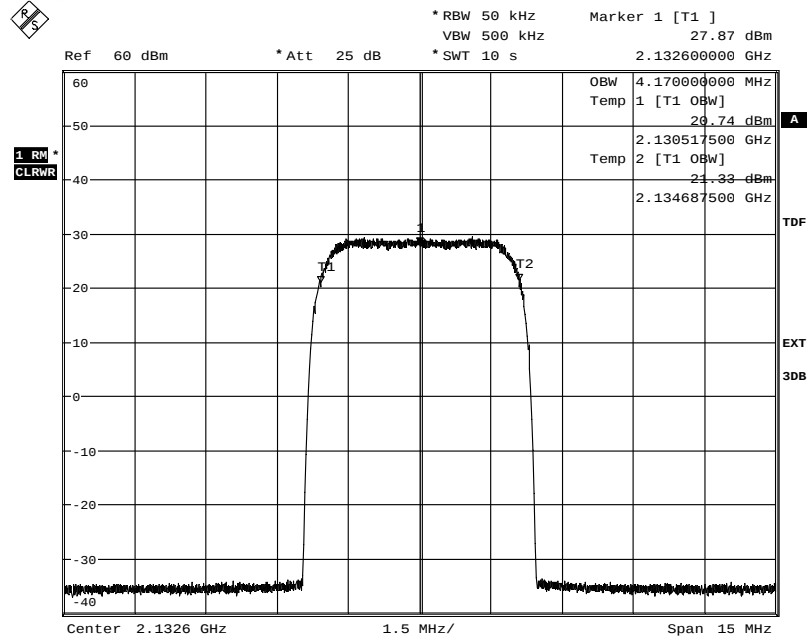
Diagram 4:



Date: 15.MAY.2013 12:09:51

## Appendix 3

Diagram 5:



Date: 15.MAY.2013 09:24:46

## Appendix 4

### Band edge measurements according to CFR 47 §27.53(h) / IC RSS-139 6.5

|            |              |            |
|------------|--------------|------------|
| Date       | Temperature  | Humidity   |
| 2013-05-15 | 23 °C ± 3 °C | 29 % ± 5 % |

#### Test set-up and procedure

The measurements were made per definition in §27.53(h). The test object was connected to a spectrum analyzer with the RMS detector activated. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

FCC rules specify a RBW of at least 1% of the fundamental emission bandwidth (EBW) for offsets up to 1 MHz from the band edge and a RBW of 1 MHz for measurements of emissions more than 1 MHz away from the band edges.

Where a smaller RBW was used as compared to the rules the limit in the plot is adjusted by  $10 \cdot \log(\text{RBW}_{\text{used}}/\text{RBW}_{1\% \text{EBW}})$  [dB].

| BW configuration | Emission BW [MHz] | RBW used | Adjusted limit [dBm] |
|------------------|-------------------|----------|----------------------|
| 5 MHz            | 4.37              | 20 kHz   | -16.40               |

A resolution bandwidth of 100 kHz was used 1 MHz to 6 MHz away from the band edges, to compensate for the reduced resolution bandwidth the limit was adjusted by 10 dB to -23 dBm.

Before comparing the results to the limit, 3 dB [ $10 \log(2)$ ] should be added according to method 2 “measure and add  $10 \log(N_{\text{ANT}})$ ” of FCC KDB662911 D01 Multiple Transmitter Output v01r02

| Measurement equipment                     | SP number |
|-------------------------------------------|-----------|
| R&S FSQ                                   | 504 143   |
| RF attenuator                             | 901 508   |
| Testo 635, temperature and humidity meter | 504 203   |

Measurement uncertainty: 3.7 dB

## Appendix 4

### Results

#### Single carrier

| Diagram | Tested frequency | Tested port |
|---------|------------------|-------------|
| 1 a-c   | B                | RF A        |
| 2 a-c   | B                | RF B        |
| 3 a-c   | T                | RF A        |
| 4 a-c   | T                | RF B        |

#### MIMO mode, Single carrier

| Diagram | Tested frequency | Tested port |
|---------|------------------|-------------|
| 5 a-c   | B                | RF A        |
| 6 a-c   | T                | RF A        |

Note: Measurements were limited to port RF A due to the measurement result in single carrier mode that shows that the ports are electrical identical as declared by the client.

#### MIMO mode, Multi carrier

| Diagram | Tested frequency | Tested port |
|---------|------------------|-------------|
| 7 a-c   | B2               | RF A        |
| 8 a-c   | B2               | RF B        |
| 9 a-c   | T2               | RF A        |
| 10 a-c  | T2               | RF B        |

### Limits

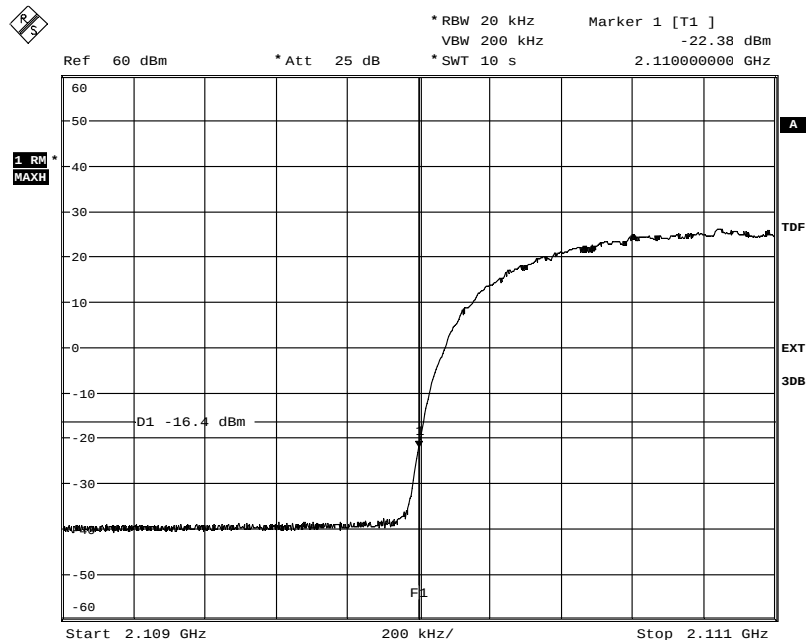
CFR 47 §22.917(h) and RSS-132 5.5.1.2 issue 3.

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB, resulting in a limit of -13 dBm.

|           |     |
|-----------|-----|
| Complies? | Yes |
|-----------|-----|

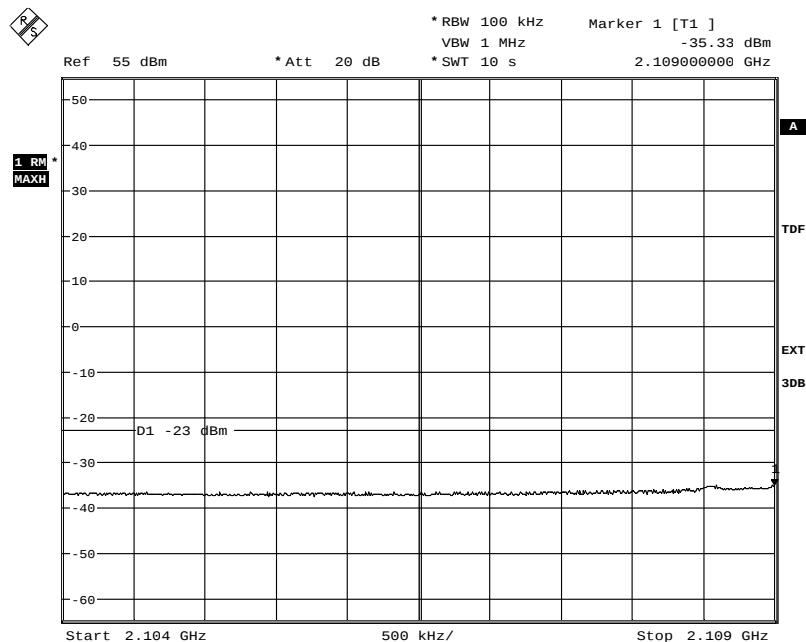
## Appendix 4

Diagram 1a:



Date: 15.MAY.2013 11:59:35

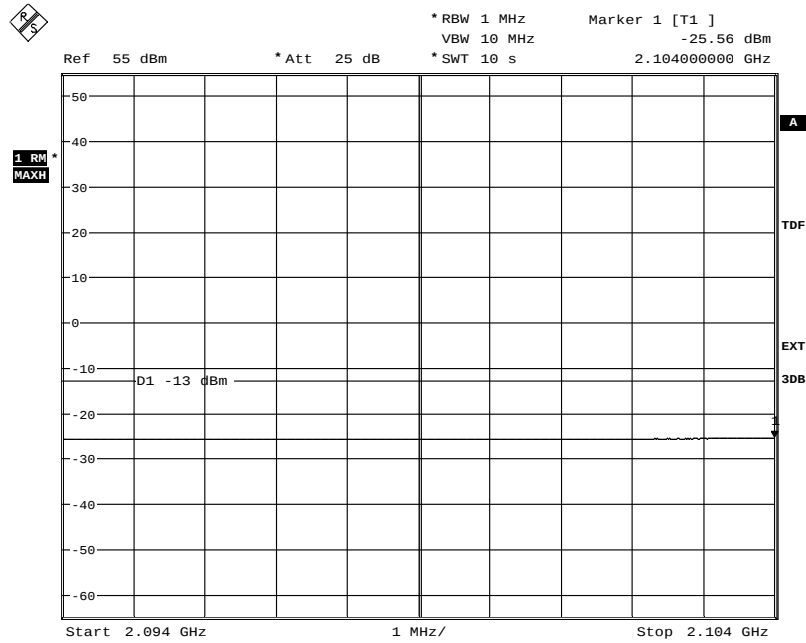
Diagram 1b:



Date: 15.MAY.2013 12:00:18

## Appendix 4

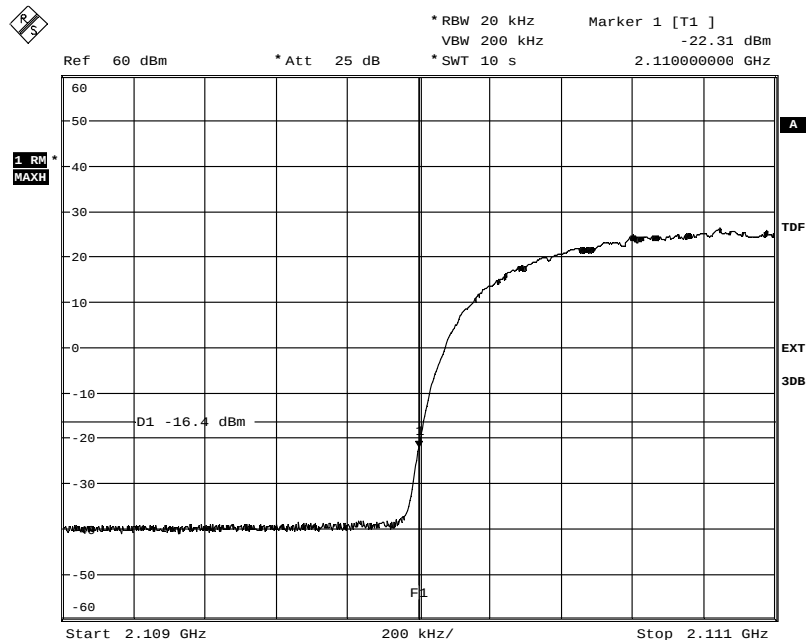
Diagram 1c



Date: 15.MAY.2013 12:01:31

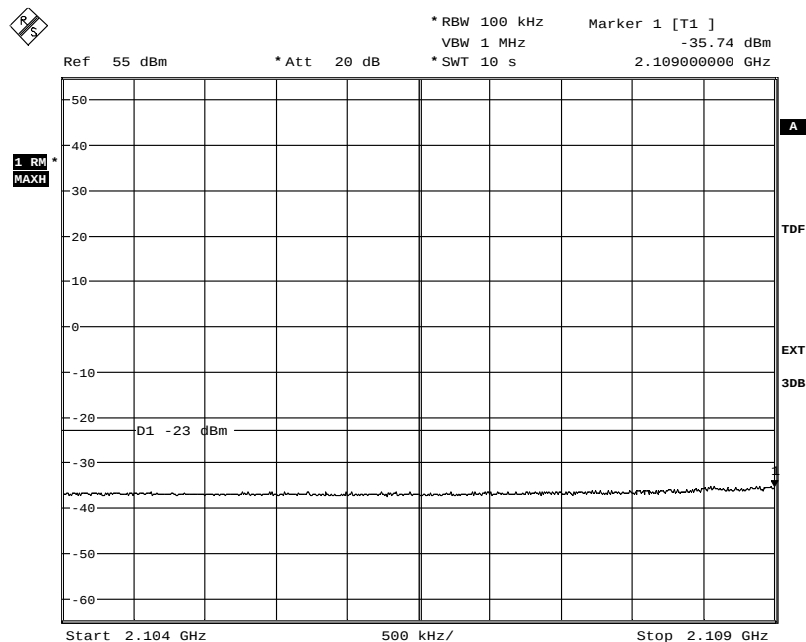
## Appendix 4

Diagram 2a:



Date: 15.MAY.2013 12:35:03

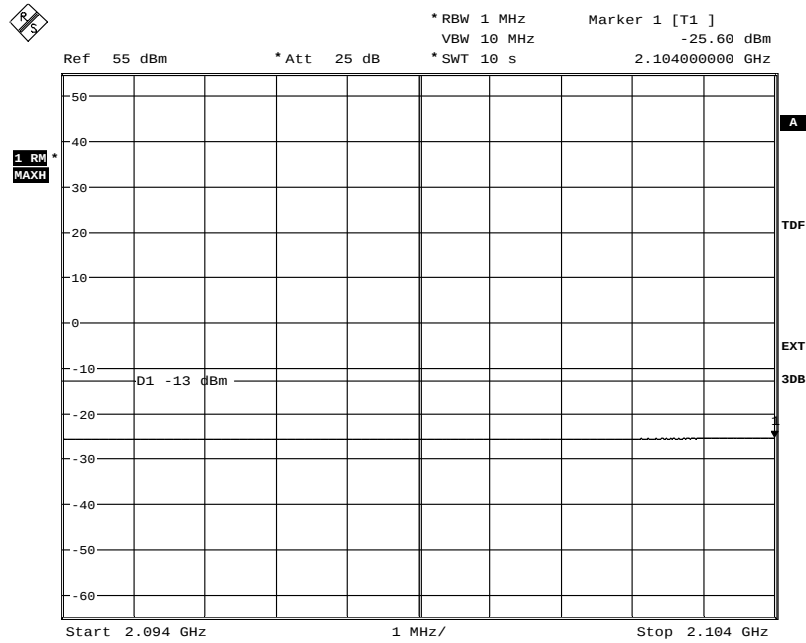
Diagram 2b:



Date: 15.MAY.2013 12:35:55

## Appendix 4

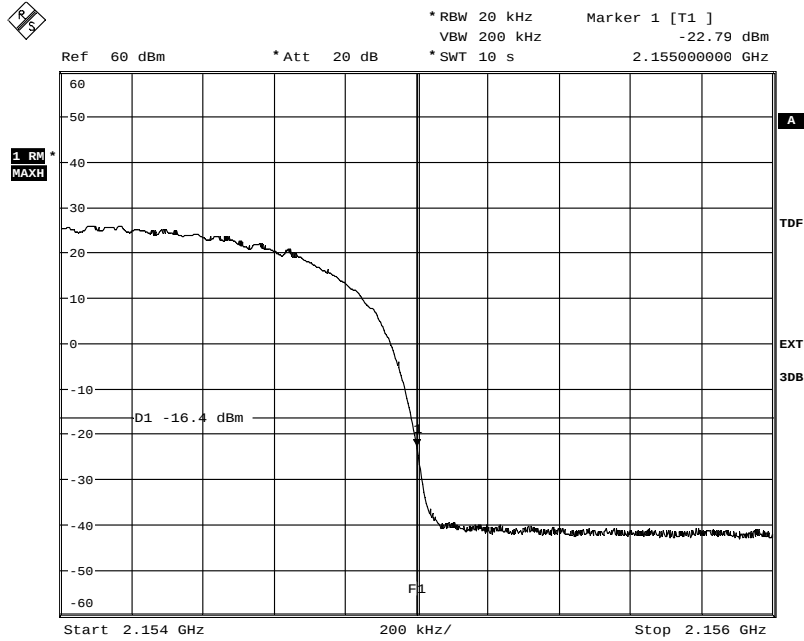
Diagram 2c:



Date: 15.MAY.2013 12:36:43

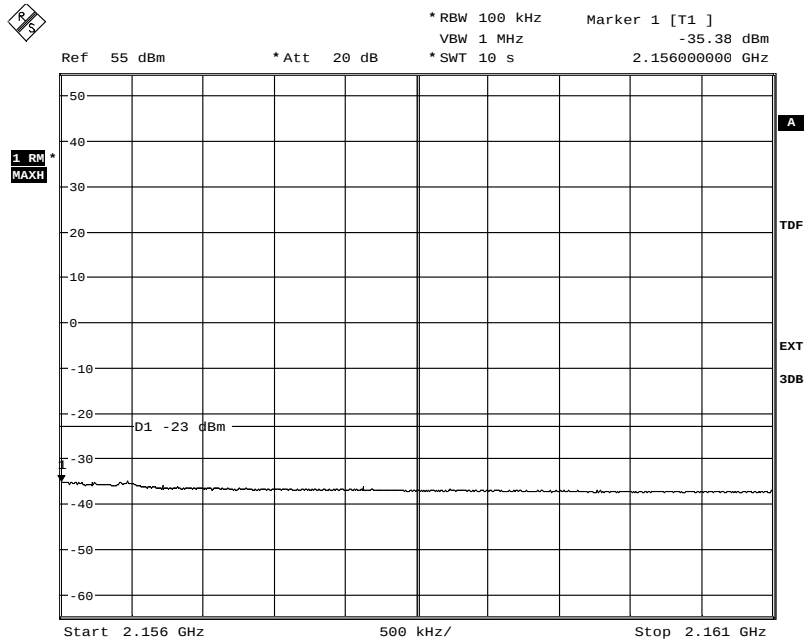
## Appendix 4

Diagram 3a:



Date: 15.MAY.2013 12:11:23

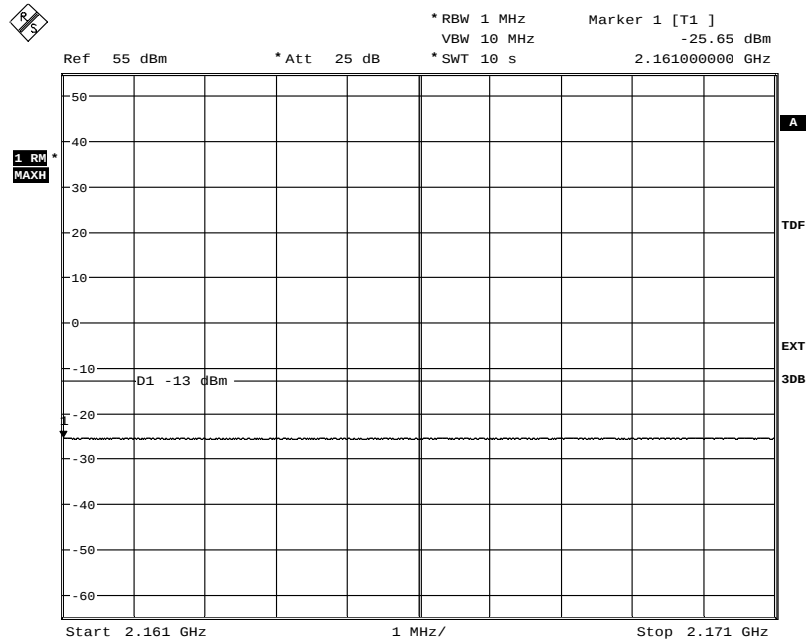
Diagram 3b:



Date: 15.MAY.2013 12:12:20

## Appendix 4

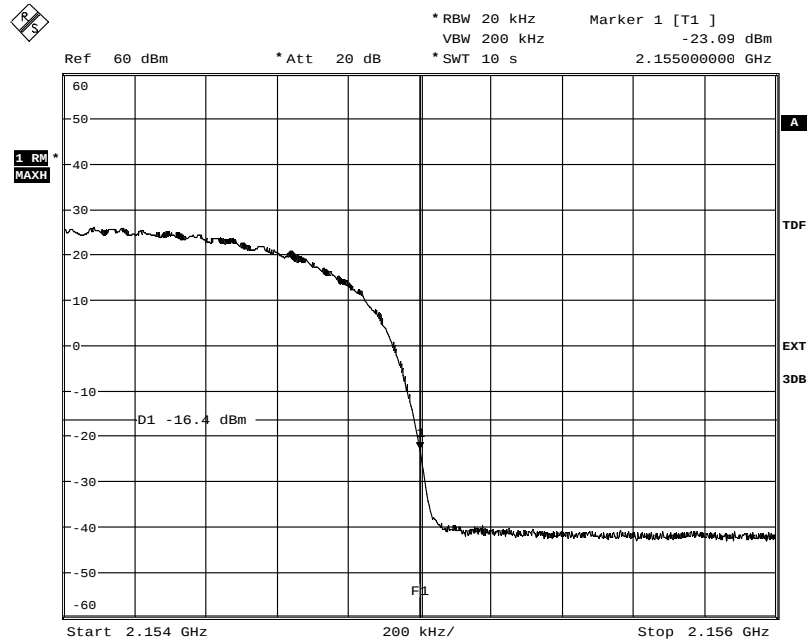
Diagram 3c:



Date: 15.MAY.2013 12:13:02

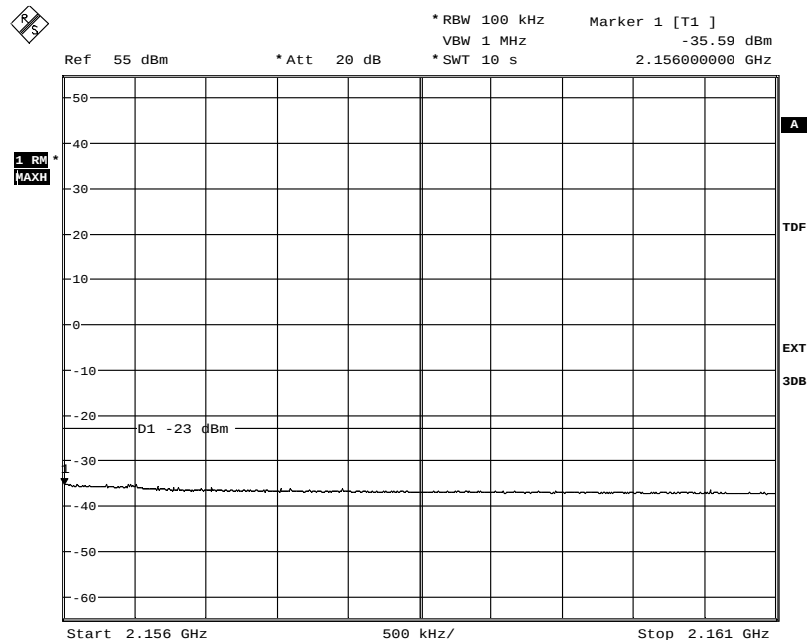
## Appendix 4

Diagram 4a:



Date: 15.MAY.2013 12:25:38

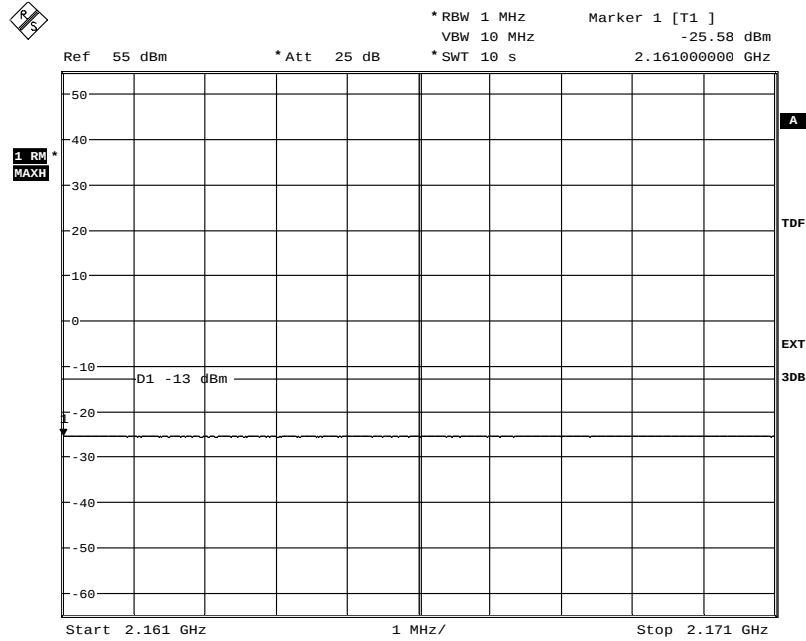
Diagram 4b:



Date: 15.MAY.2013 12:26:30

## Appendix 4

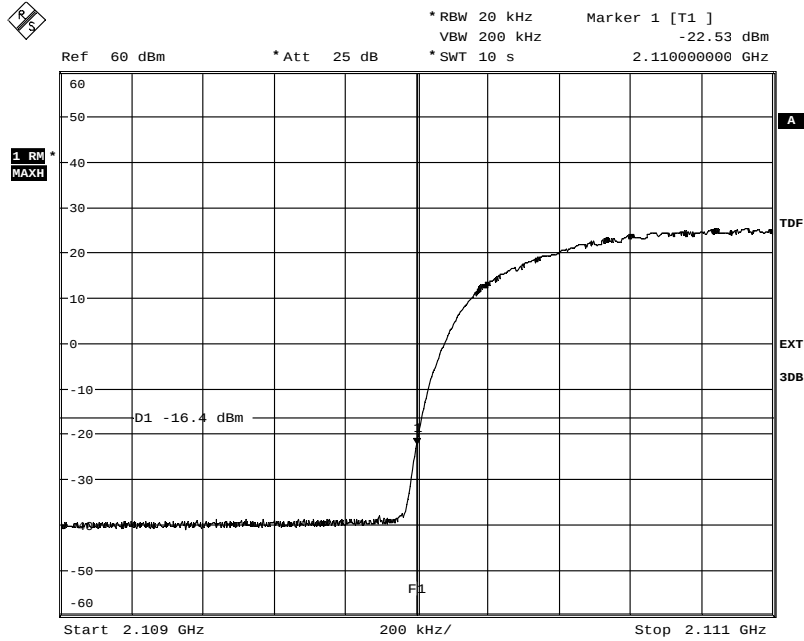
Diagram 4c:



Date: 15.MAY.2013 12:27:15

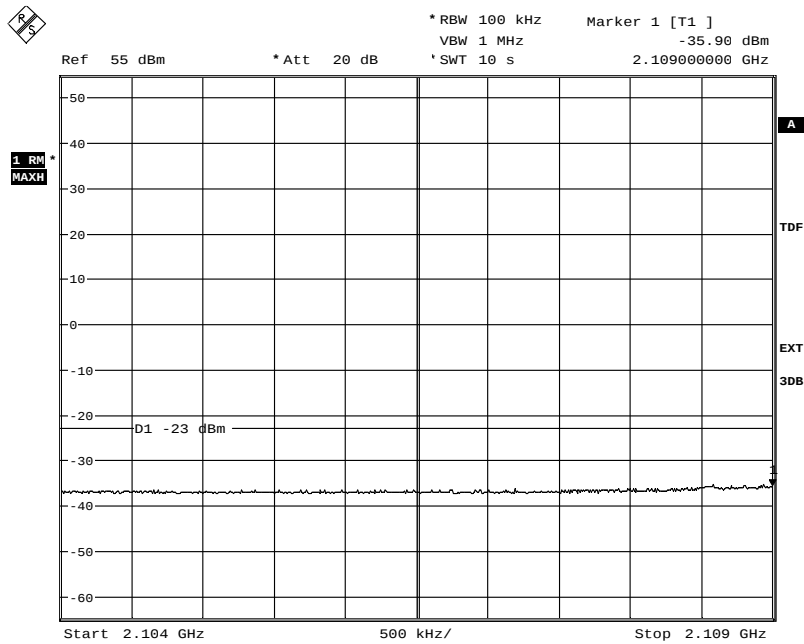
## Appendix 4

Diagram 5a:



Date: 15.MAY.2013 10:37:51

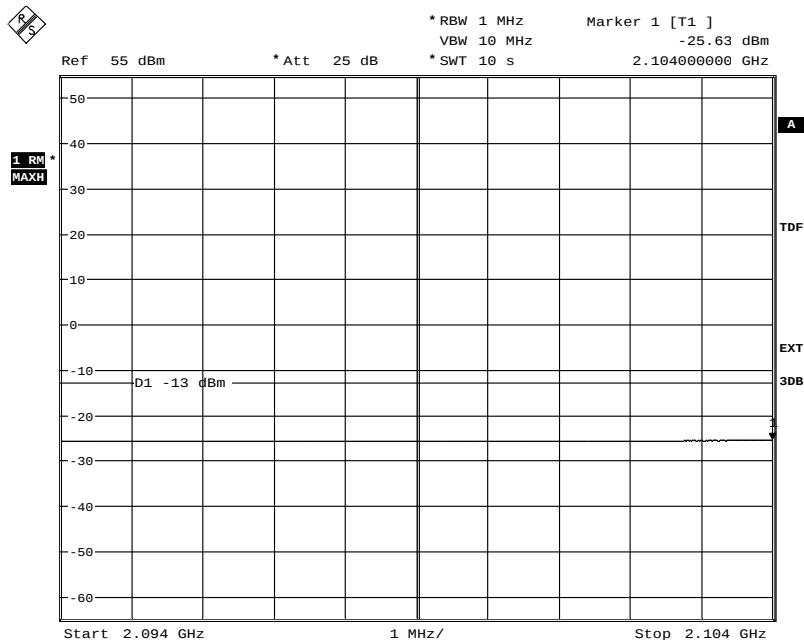
Diagram 5b:



Date: 15.MAY.2013 10:40:37

## Appendix 4

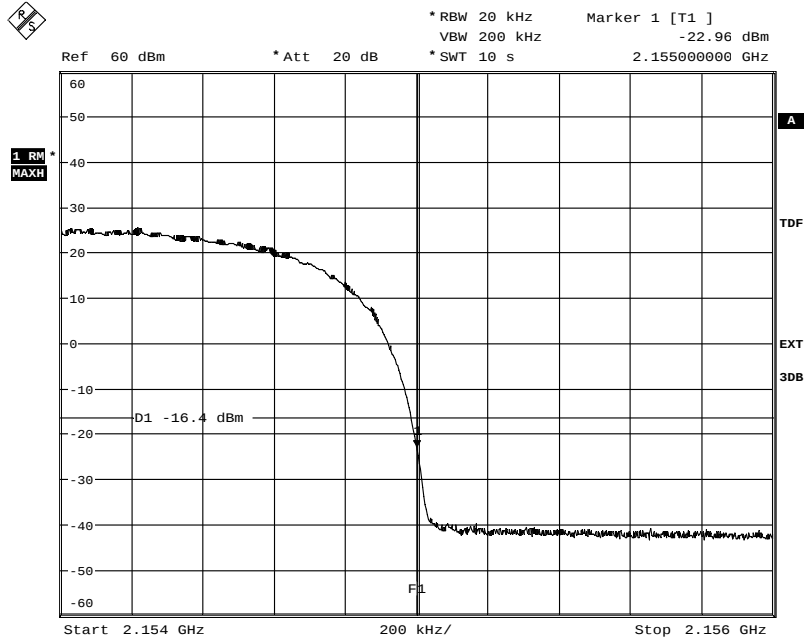
Diagram 5c:



Date: 15.MAY.2013 10:41:36

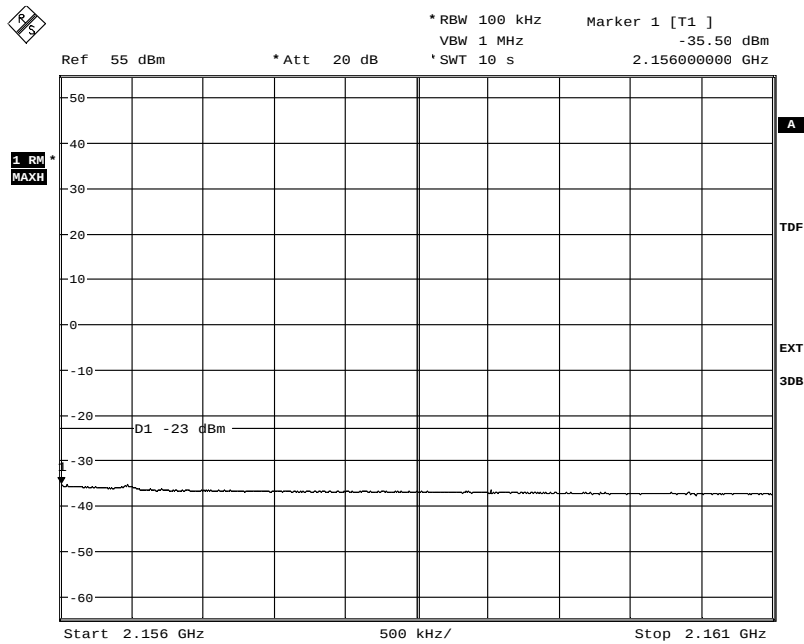
## Appendix 4

Diagram 6a:



Date: 15.MAY.2013 11:12:57

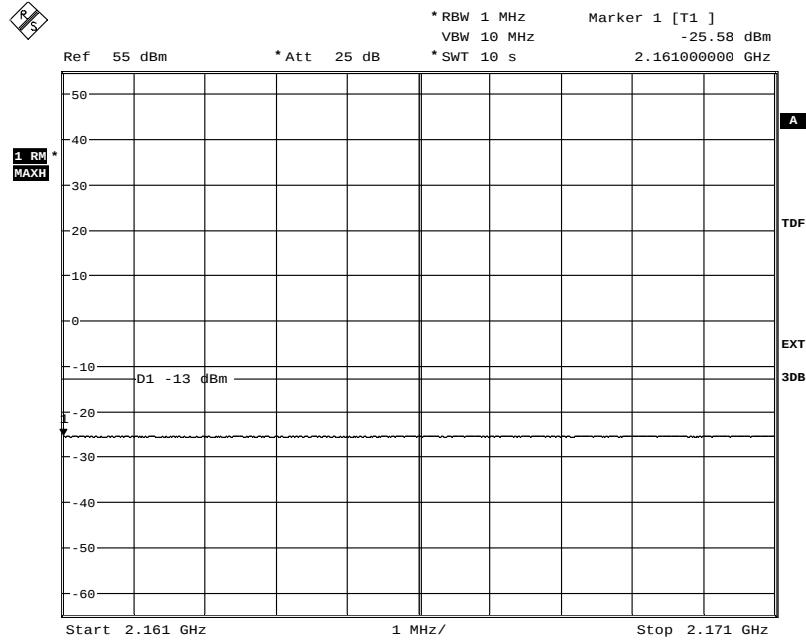
Diagram 6b:



Date: 15.MAY.2013 11:14:24

## Appendix 4

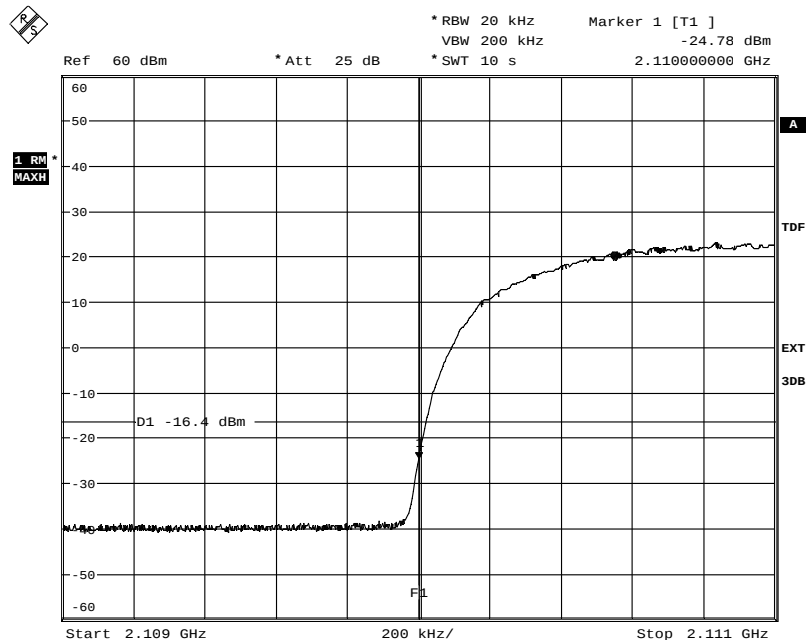
Diagram 6c:



Date: 15.MAY.2013 11:16:00

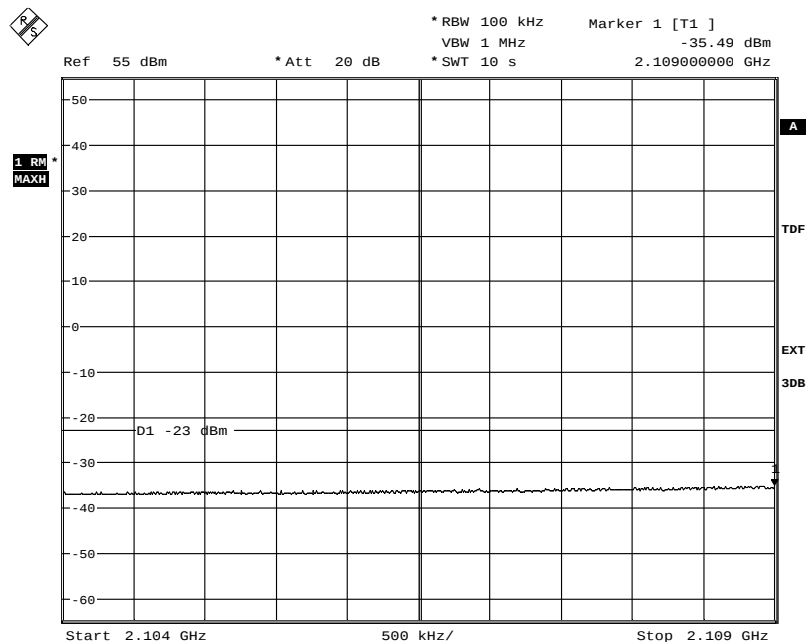
## Appendix 4

Diagram 7a:



Date: 16.MAY.2013 10:07:44

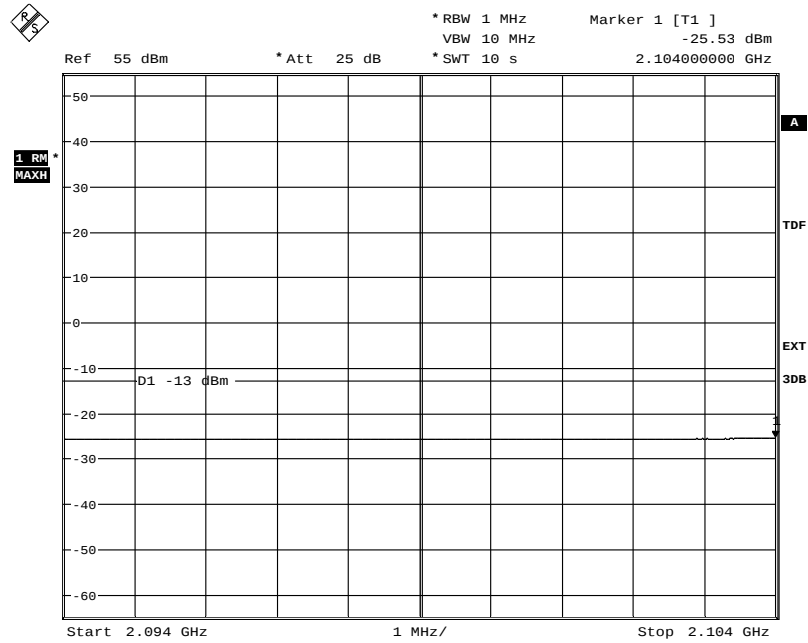
Diagram 7b:



Date: 16.MAY.2013 10:08:35

## Appendix 4

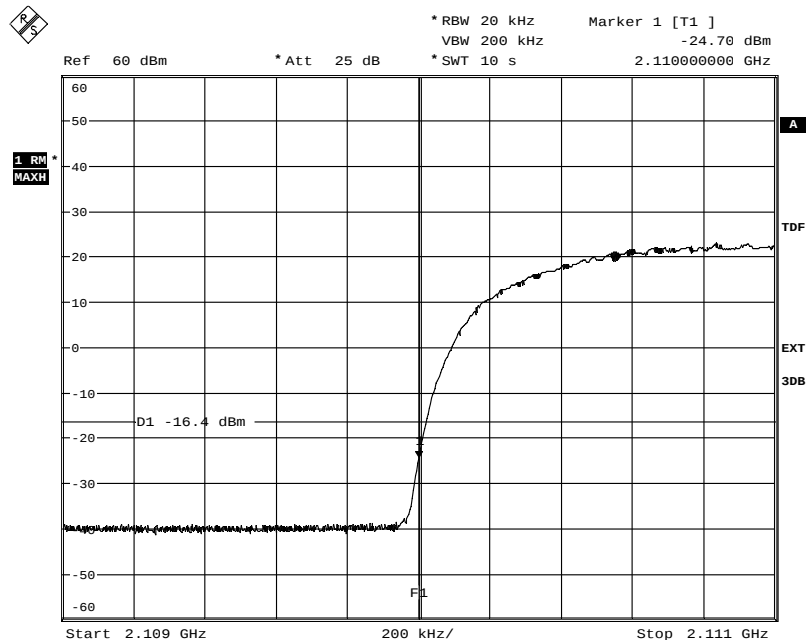
Diagram 7c:



Date: 16.MAY.2013 10:09:55

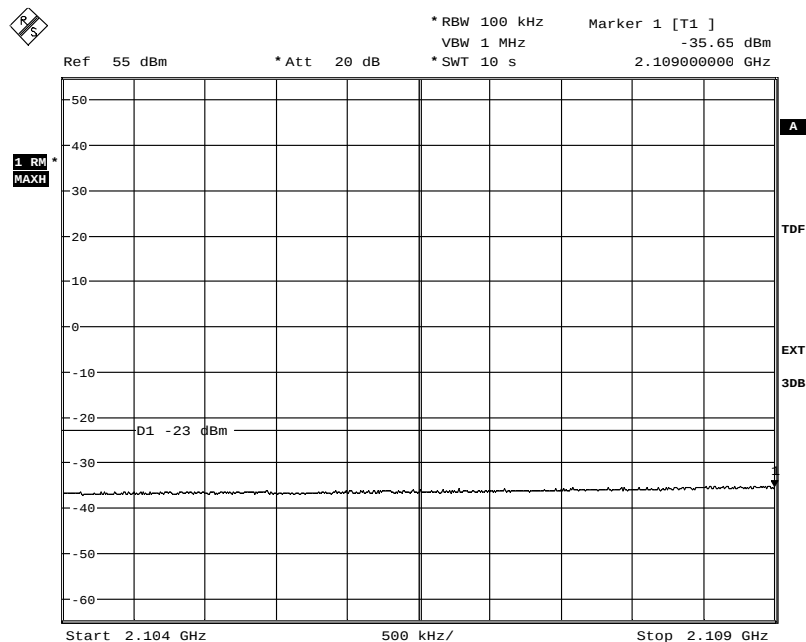
## Appendix 4

Diagram 8a:



Date: 16.MAY.2013 10:30:25

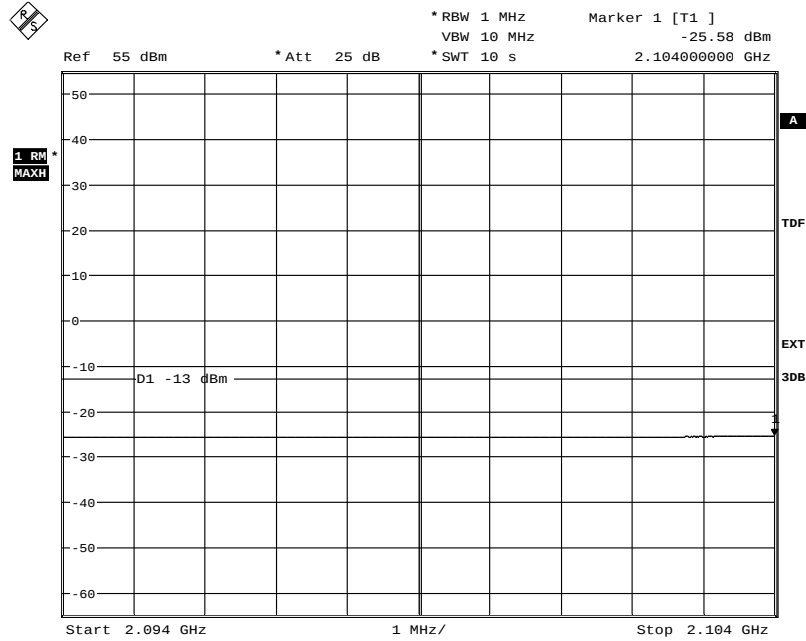
Diagram 8b:



Date: 16.MAY.2013 10:31:21

## Appendix 4

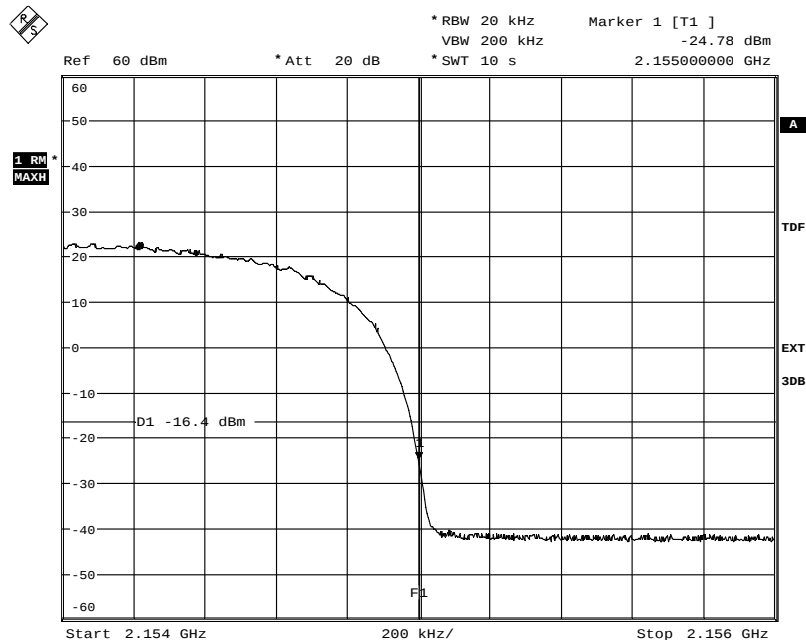
Diagram 8c:



Date: 16.MAY.2013 10:32:31

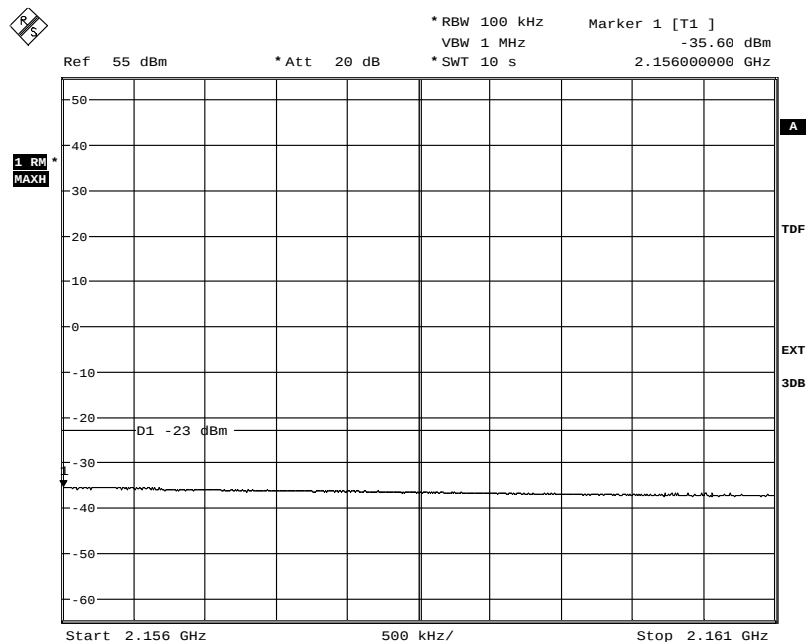
## Appendix 4

Diagram 9a:



Date: 16.MAY.2013 10:58:09

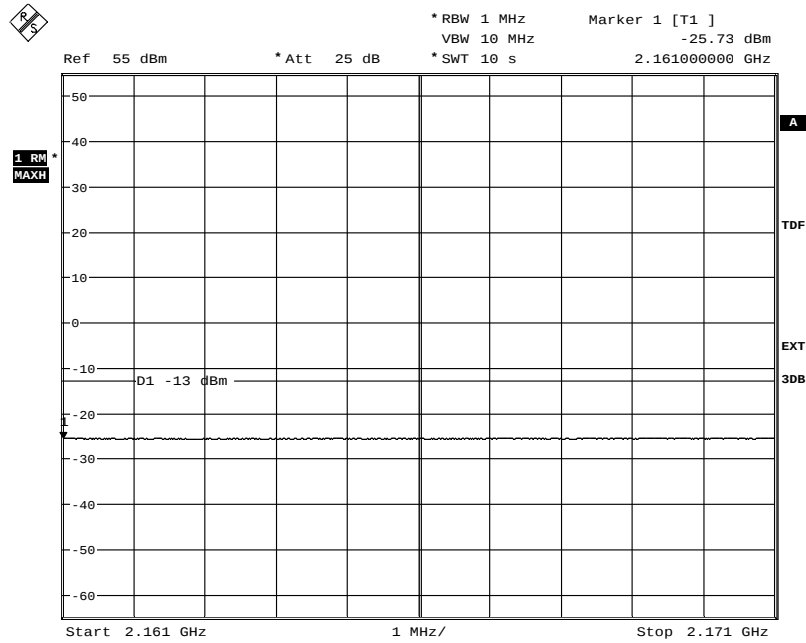
Diagram 9b:



Date: 16.MAY.2013 10:56:26

## Appendix 4

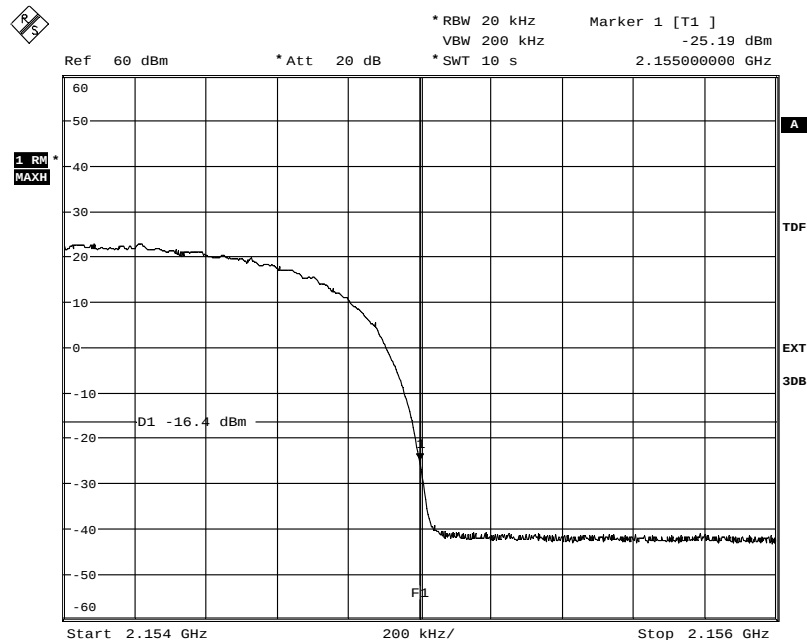
Diagram 9c:



Date: 16.MAY.2013 10:55:13

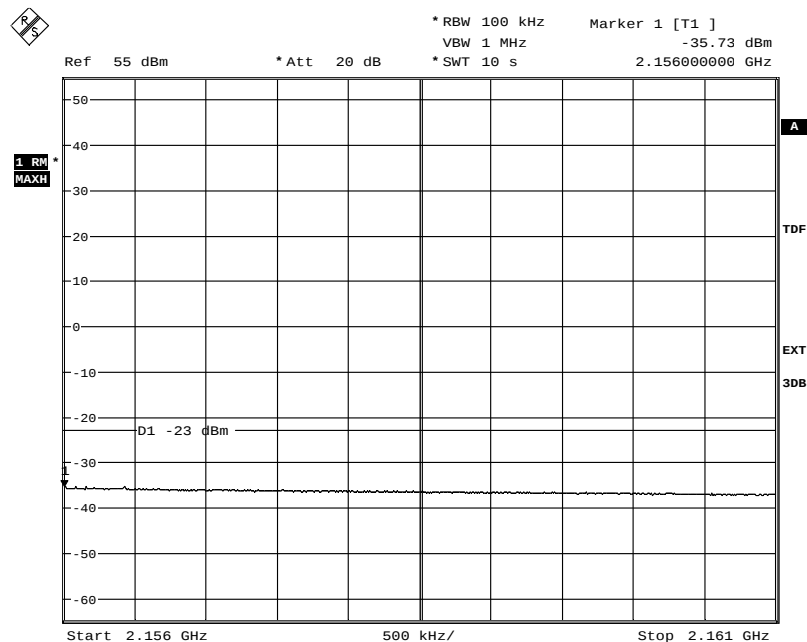
## Appendix 4

Diagram 10a:



Date: 16.MAY.2013 12:07:05

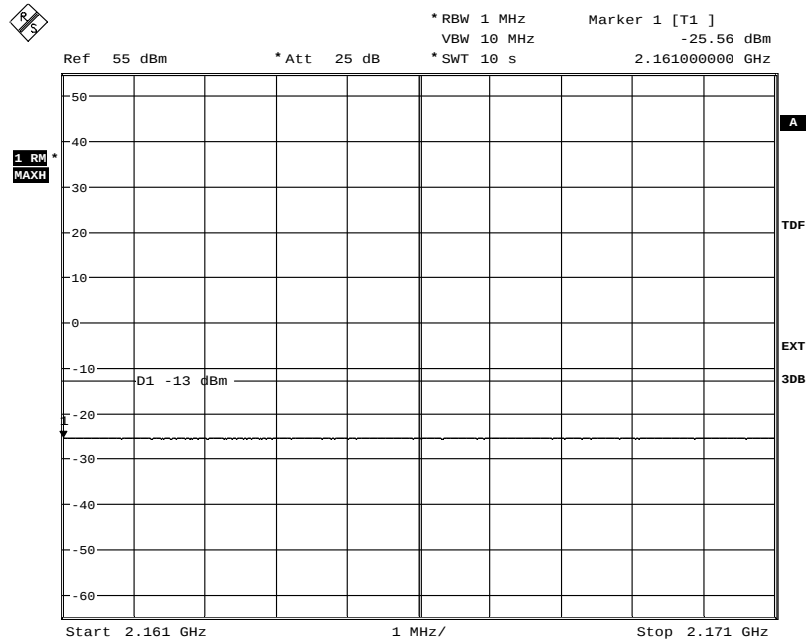
Diagram 10b:



Date: 16.MAY.2013 12:08:19

## Appendix 4

Diagram 10c:



Date: 16.MAY.2013 12:09:22

## Appendix 5

### Conducted spurious emission measurements according to CFR 47 §27.53(h)/ IC RSS-139 6.5

| Date       | Temperature  | Humidity   |
|------------|--------------|------------|
| 2013-05-15 | 23 °C ± 3 °C | 29 % ± 5 % |
| 2013-05-16 | 23 °C ± 3 °C | 37 % ± 5 % |

#### Test set-up and procedure

The measurements were made per definition in §27.53(h). The output was connected to a spectrum analyzer with a RBW setting of 1 MHz and RMS detector activated. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

Before comparing the results to the limit, 3 dB [10 log (2)] should be added according to method 2 “measure and add 10 log( $N_{ANT}$ )” of FCC KDB662911 D01 Multiple Transmitter Output v01r02

| Measurement equipment                     | SP number |
|-------------------------------------------|-----------|
| R&S FSQ                                   | 504 143   |
| RF attenuator                             | 901 508   |
| High pass filter                          | 901 502   |
| Testo 635, temperature and humidity meter | 504 203   |

Measurement uncertainty: 3.7 dB

## Appendix 5

### Results

#### Single carrier

| Diagram   | BW configuration / [MHz] | Tested frequency | Tested Port |
|-----------|--------------------------|------------------|-------------|
| 1 a+b+c+d | 5 MHz                    | B                | RF A        |
| 2 a+b+c+d | 5 MHz                    | M                | RF A        |
| 3 a+b+c+d | 5 MHz                    | M                | RF B        |
| 4 a+b+c+d | 5 MHz                    | T                | RF A        |

#### MIMO mode, Single carrier

| Diagram   | BW configuration / [MHz] | Tested frequency | Tested Port |
|-----------|--------------------------|------------------|-------------|
| 5 a+b+c+d | 5 MHz                    | B                | RF A        |
| 6 a+b+c+d | 5 MHz                    | M                | RF A        |
| 7 a+b+c+d | 5 MHz                    | T                | RF A        |

Note: Measurements were limited to port RF A due to the measurement result in single carrier mode that shows that the ports are electrical identical as declared by the client.

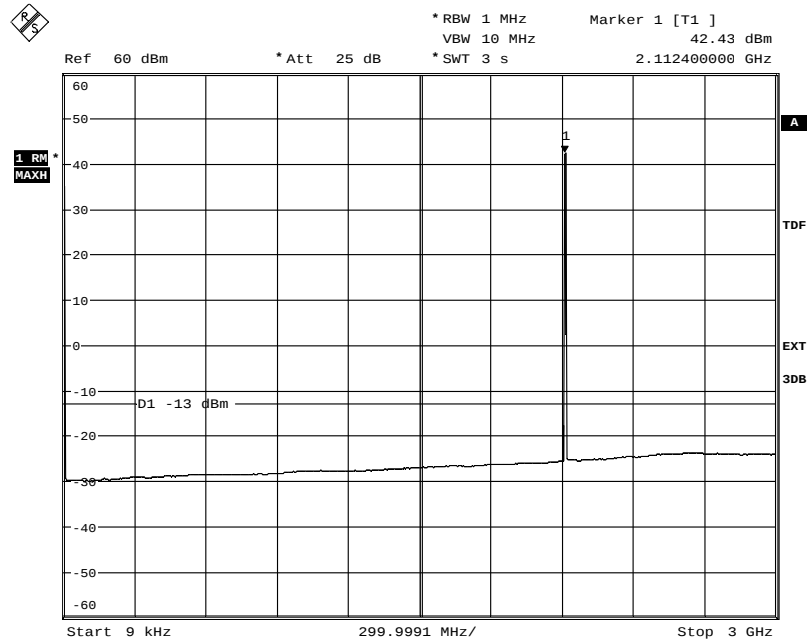
#### MIMO mode, Multi carrier

| Diagram    | BW configuration / [MHz] | Tested frequency | Tested Port |
|------------|--------------------------|------------------|-------------|
| 8 a+b+c+d  | 5 MHz                    | B2               | RF A        |
| 9 a+b+c+d  | 5 MHz                    | M2               | RF A        |
| 10 a+b+c+d | 5 MHz                    | T2               | RF A        |

Note: Measurements were limited to port RF A due to the measurement result in single carrier mode that shows that the ports are electrical identical as declared by the client.

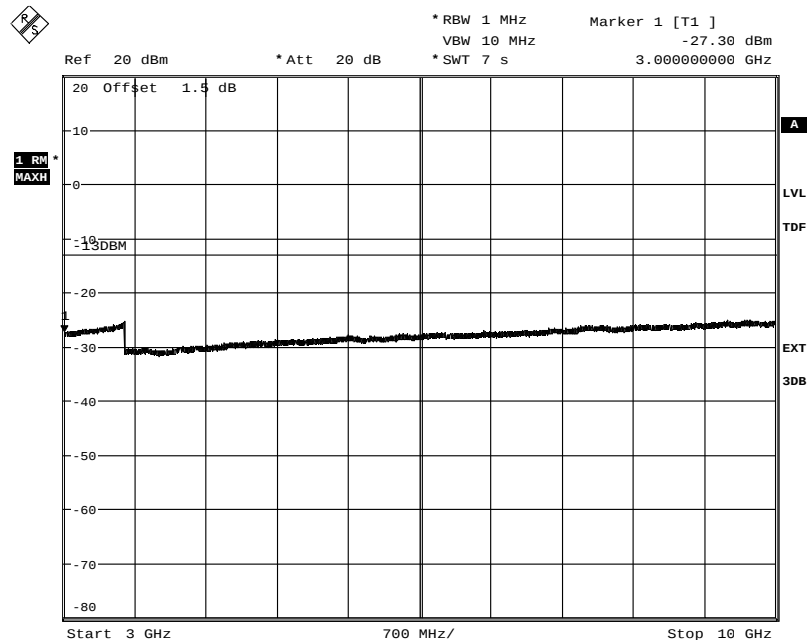
## Appendix 5

Diagram 1a:



Date: 15.MAY.2013 11:55:04

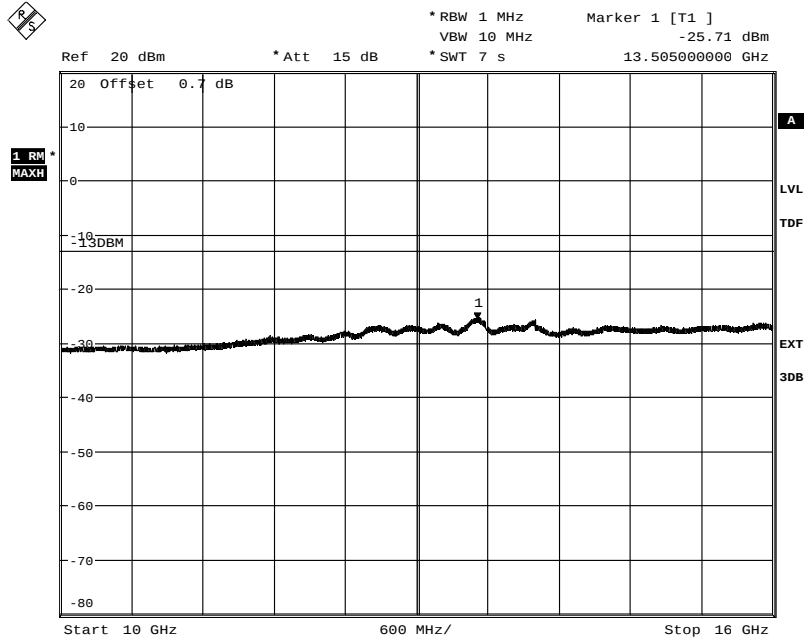
Diagram 1b:



Date: 15.MAY.2013 11:53:46

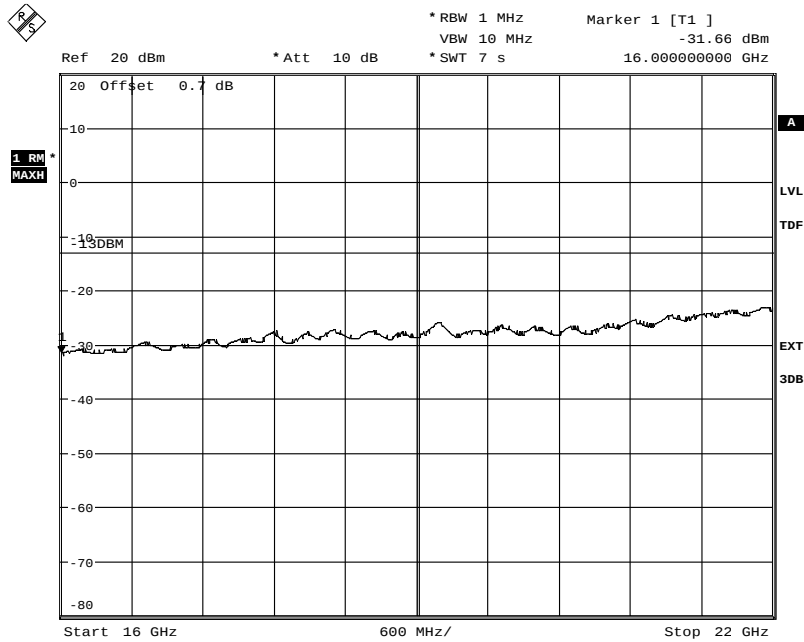
## Appendix 5

Diagram 1c:



Date: 15.MAY.2013 11:53:00

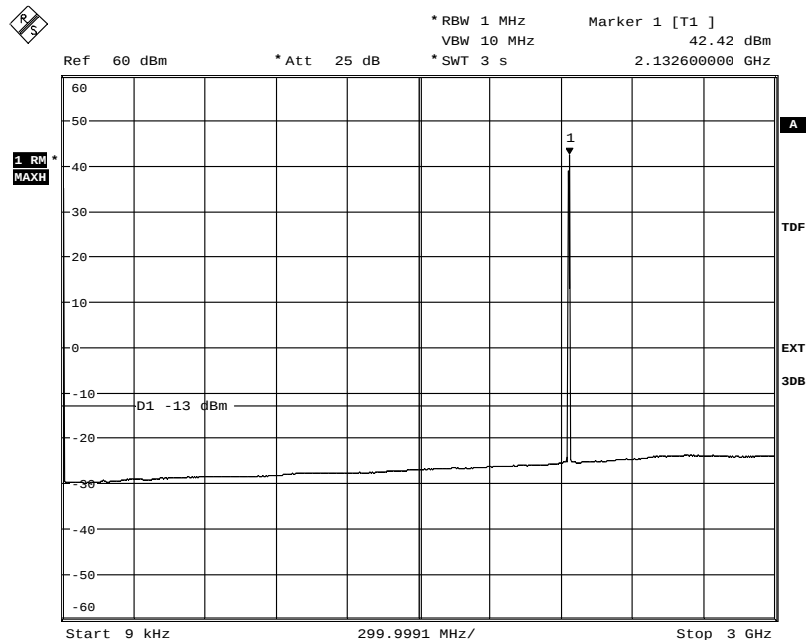
Diagram 1d:



Date: 15.MAY.2013 11:52:13

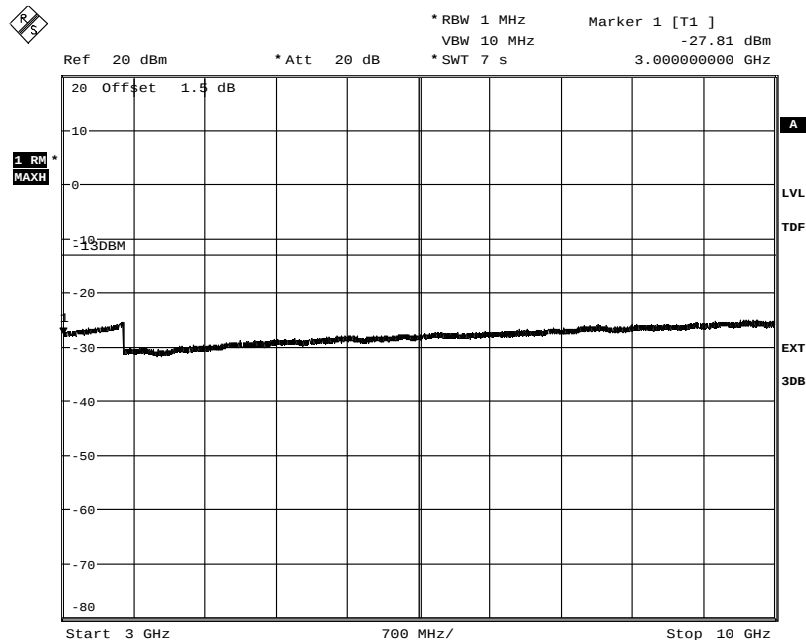
## Appendix 5

Diagram 2a:



Date: 15.MAY.2013 11:38:56

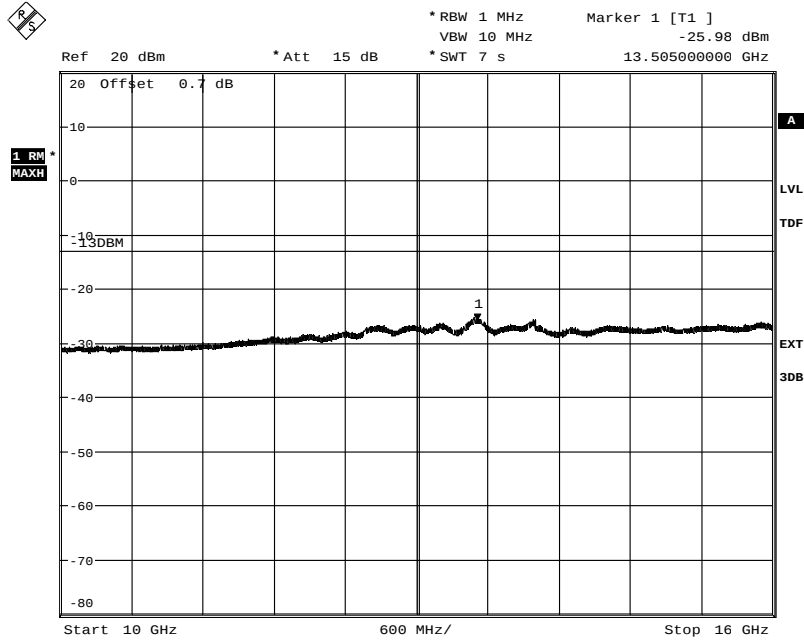
Diagram 2b:



Date: 15.MAY.2013 11:37:30

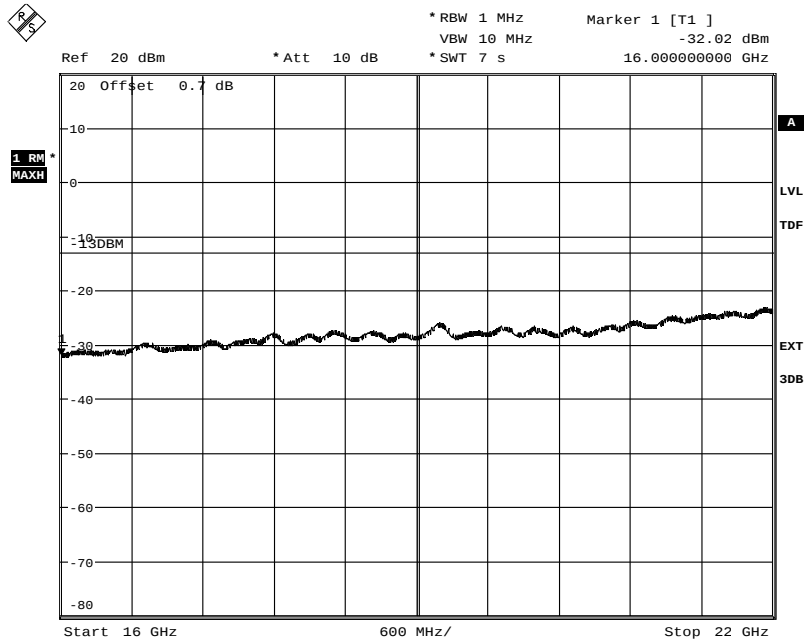
## Appendix 5

Diagram 2c:



Date: 15.MAY.2013 11:36:40

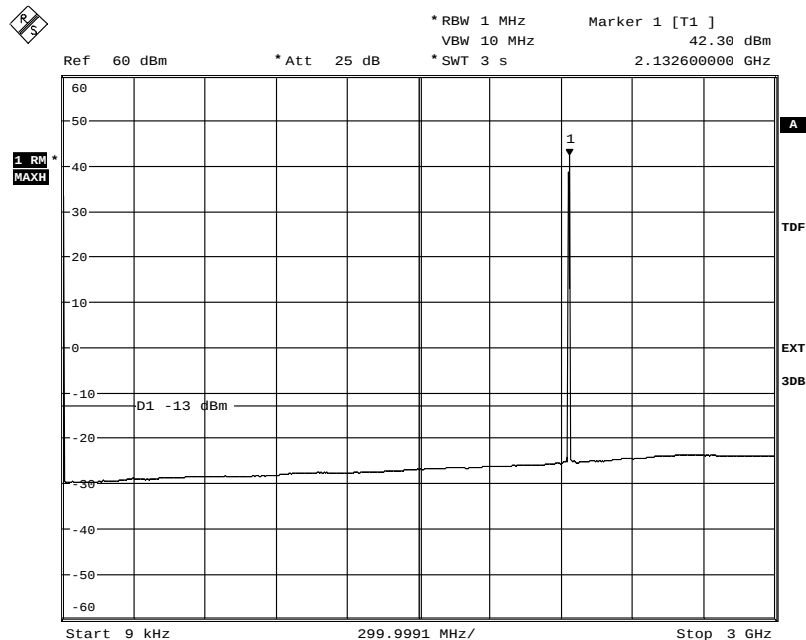
Diagram 2d:



Date: 15.MAY.2013 11:45:00

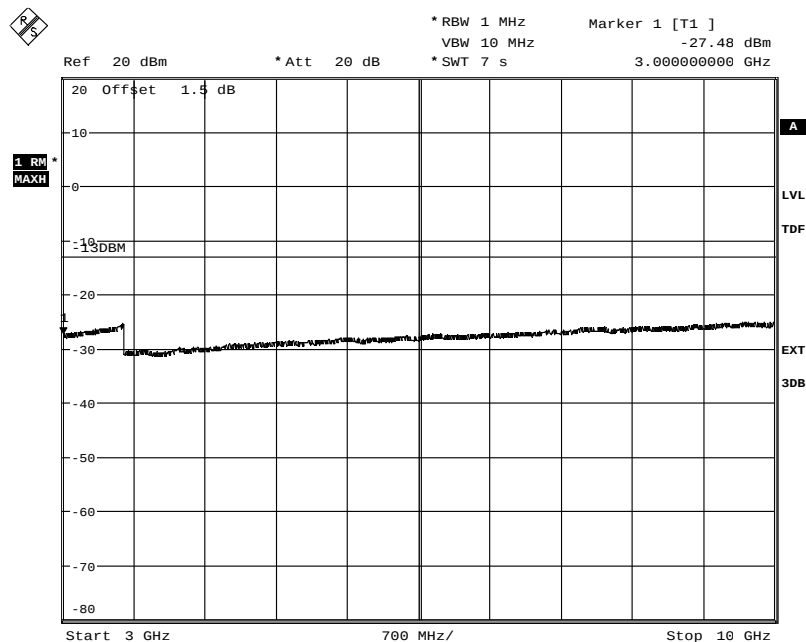
## Appendix 5

Diagram 3a:



Date: 15.MAY.2013 12:45:07

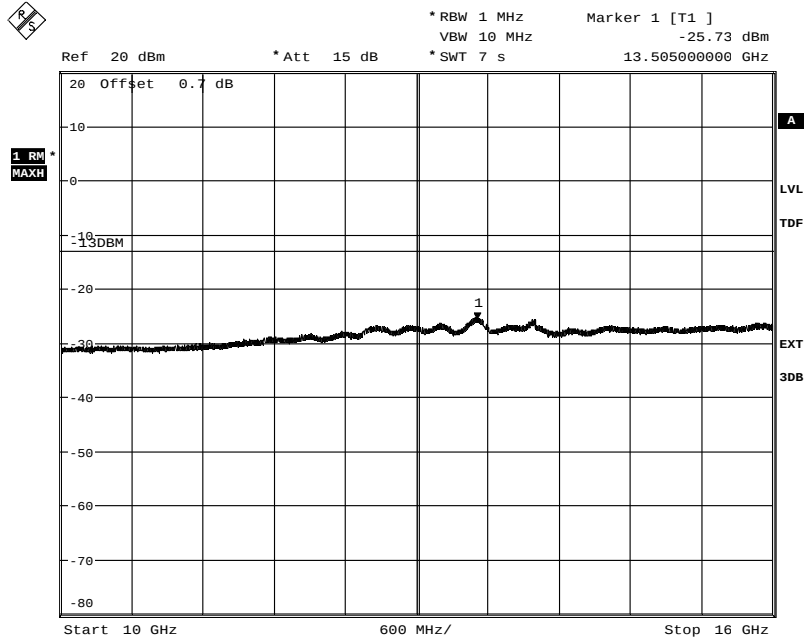
Diagram 3b:



Date: 15.MAY.2013 12:46:55

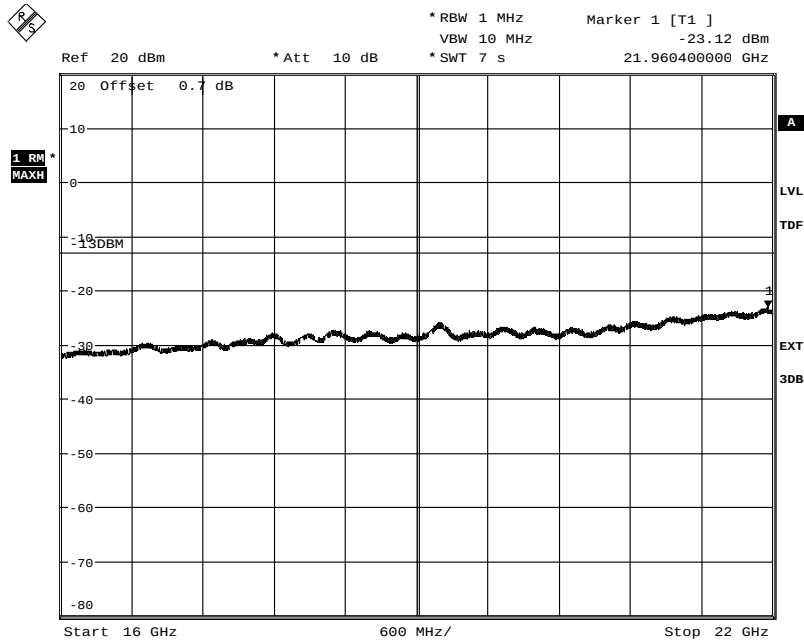
## Appendix 5

Diagram 3c:



Date: 15.MAY.2013 12:47:42

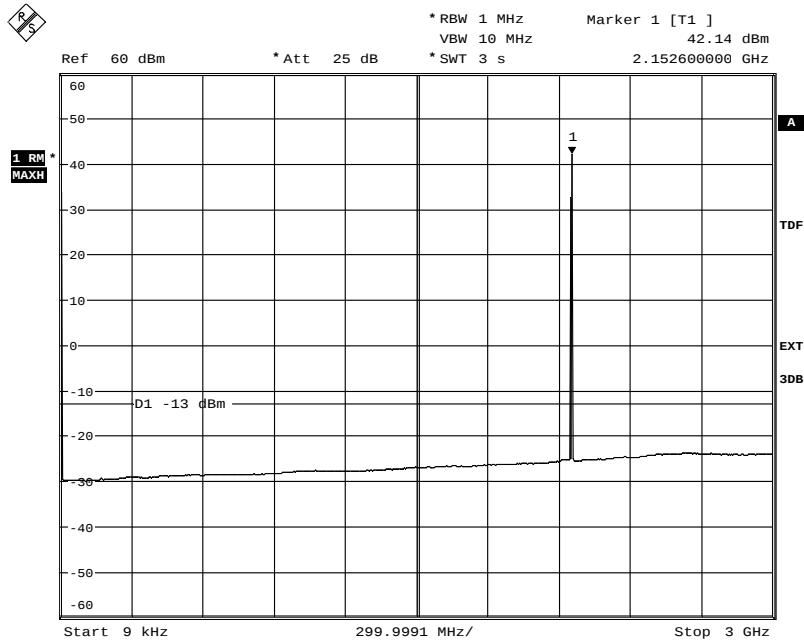
Diagram 3d:



Date: 15.MAY.2013 12:48:46

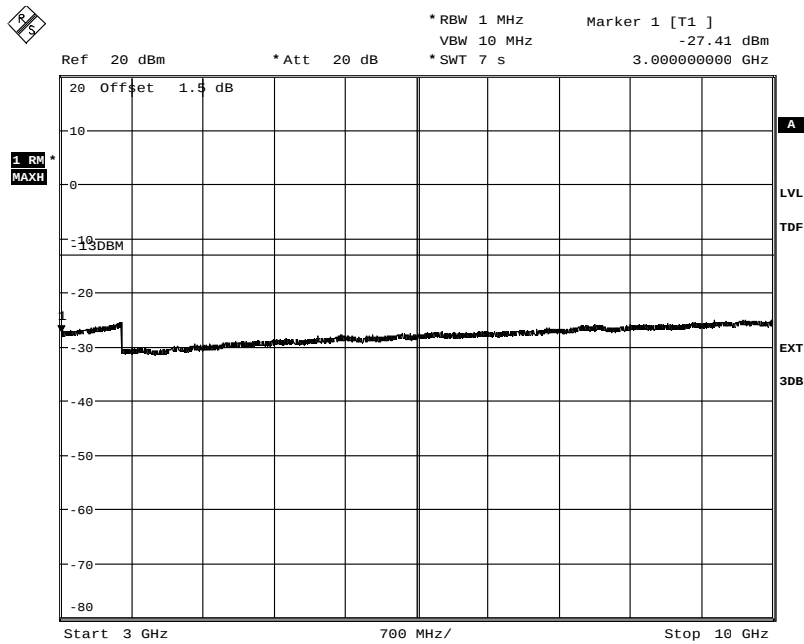
## Appendix 5

Diagram 4a:



Date: 15.MAY.2013 12:13:56

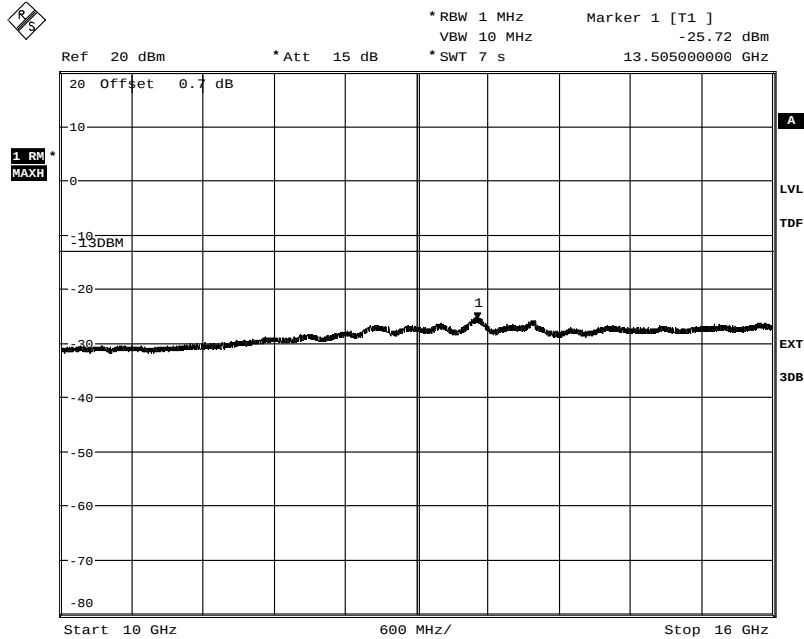
Diagram 4b:



Date: 15.MAY.2013 12:15:01

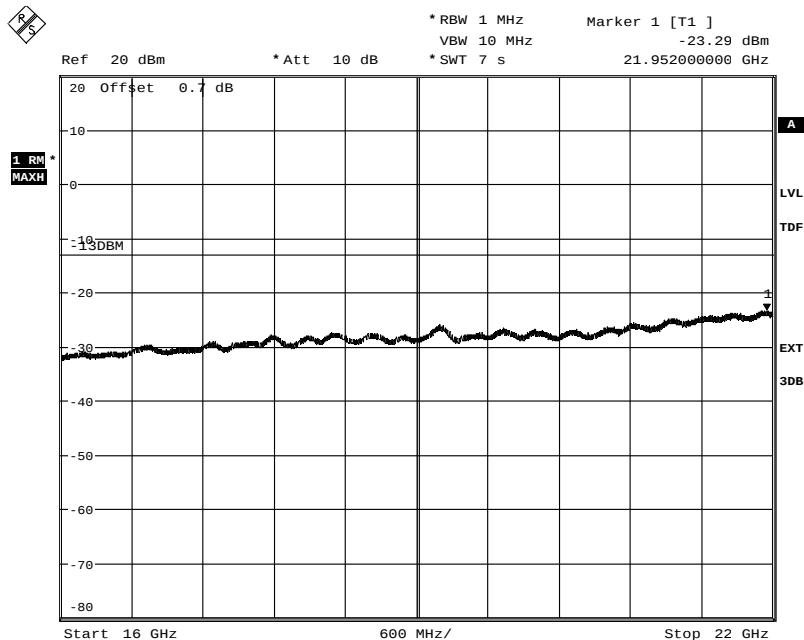
## Appendix 5

Diagram 4c:



Date: 15.MAY.2013 12:15:55

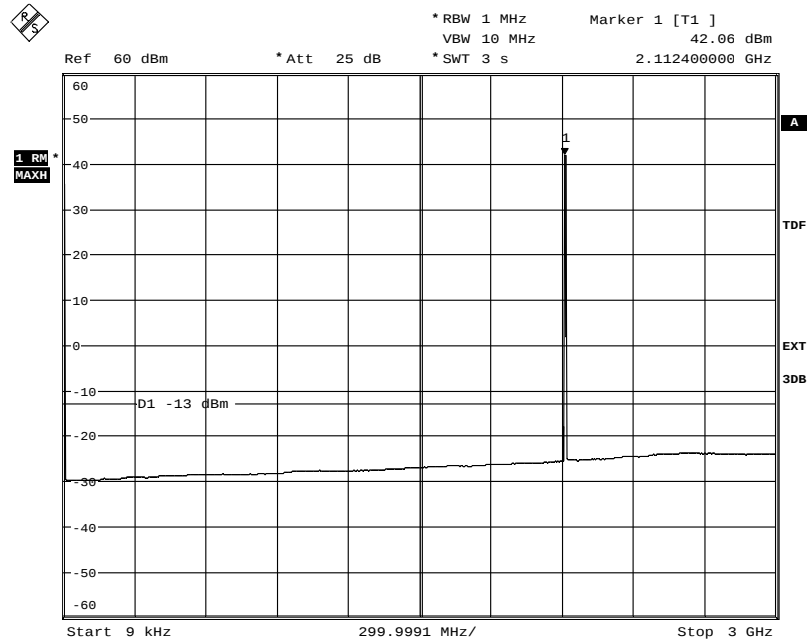
Diagram 4d:



Date: 15.MAY.2013 12:17:18

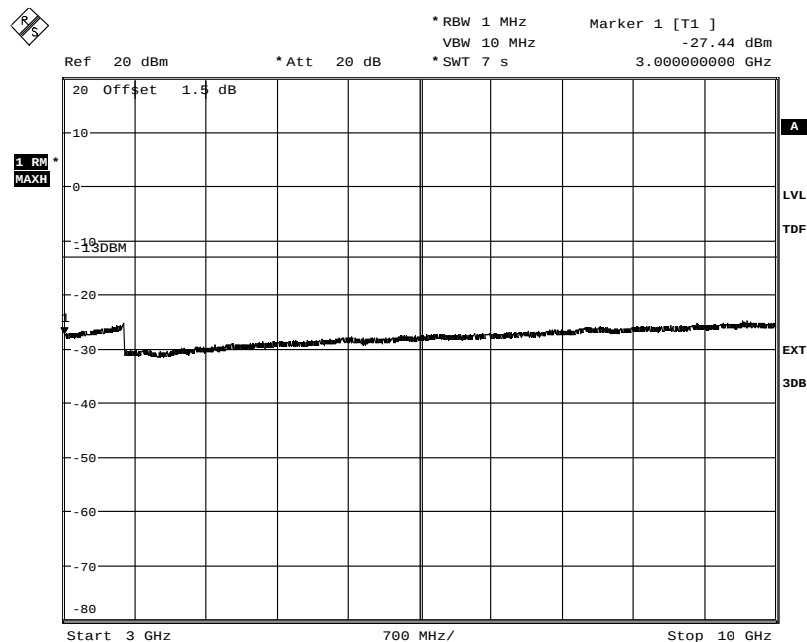
## Appendix 5

Diagram 5a:



Date: 15.MAY.2013 10:21:37

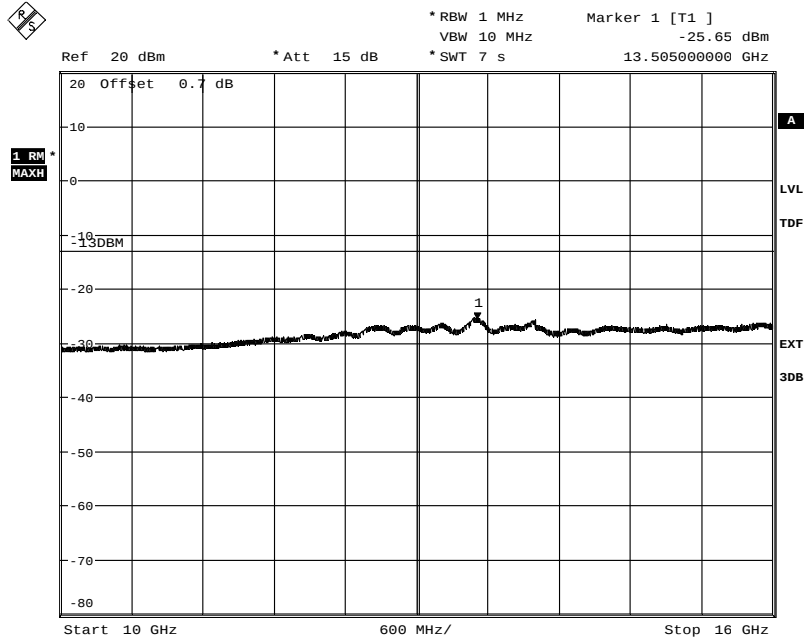
Diagram 5b:



Date: 15.MAY.2013 10:18:23

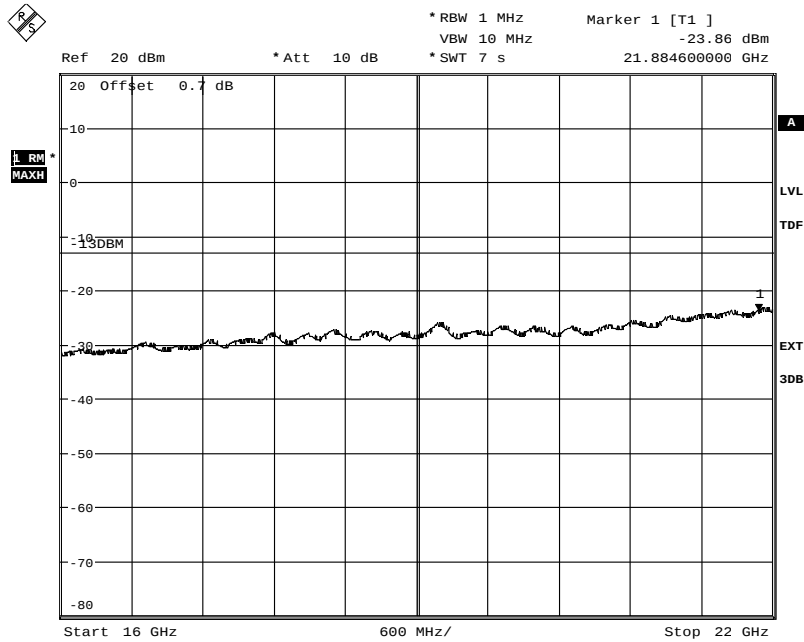
## Appendix 5

Diagram 5c:



Date: 15.MAY.2013 10:19:34

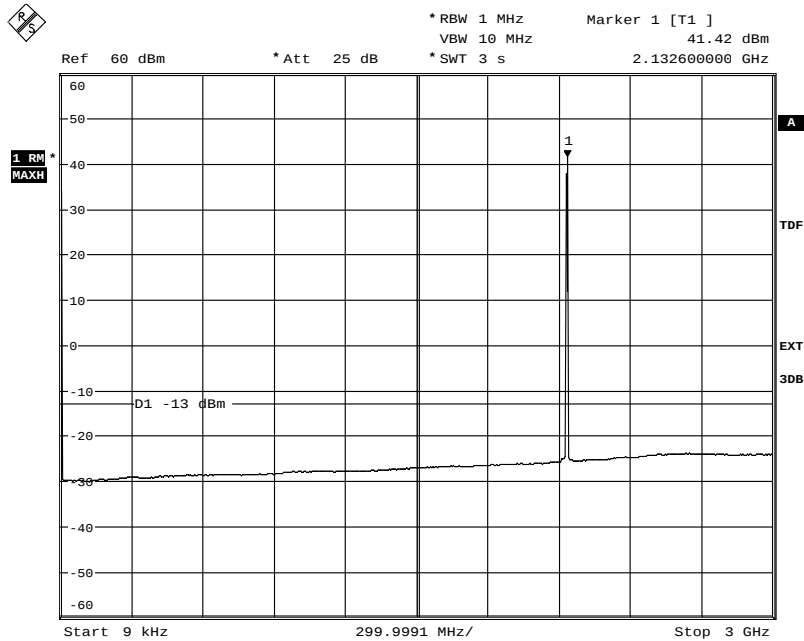
Diagram 5d:



Date: 15.MAY.2013 10:17:21

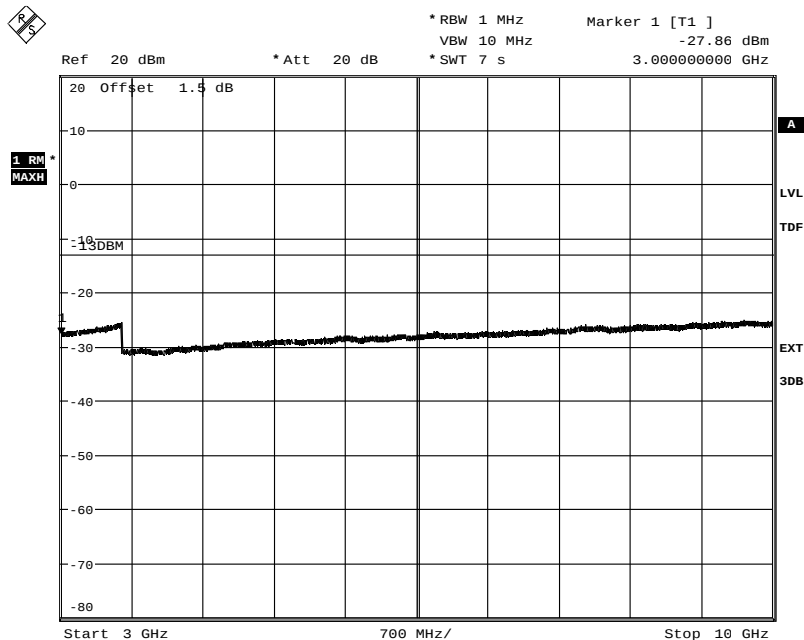
## Appendix 5

Diagram 6a:



Date: 15.MAY.2013 09:28:32

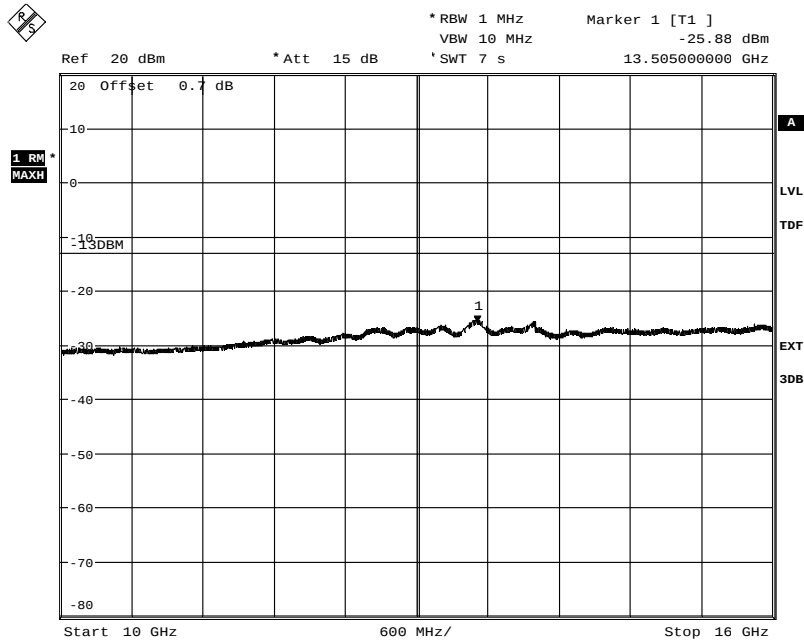
Diagram 6b:



Date: 15.MAY.2013 09:29:58

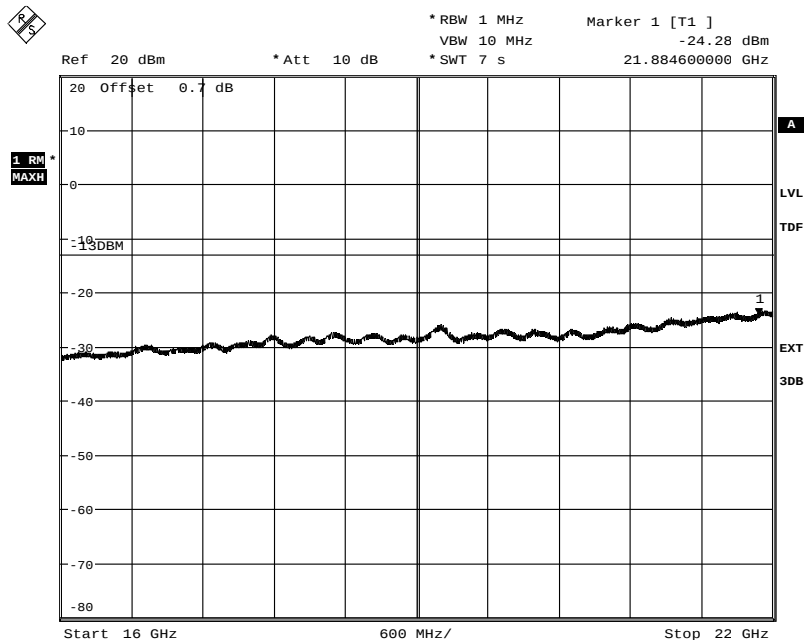
## Appendix 5

Diagram 6c:



Date: 15.MAY.2013 09:31:17

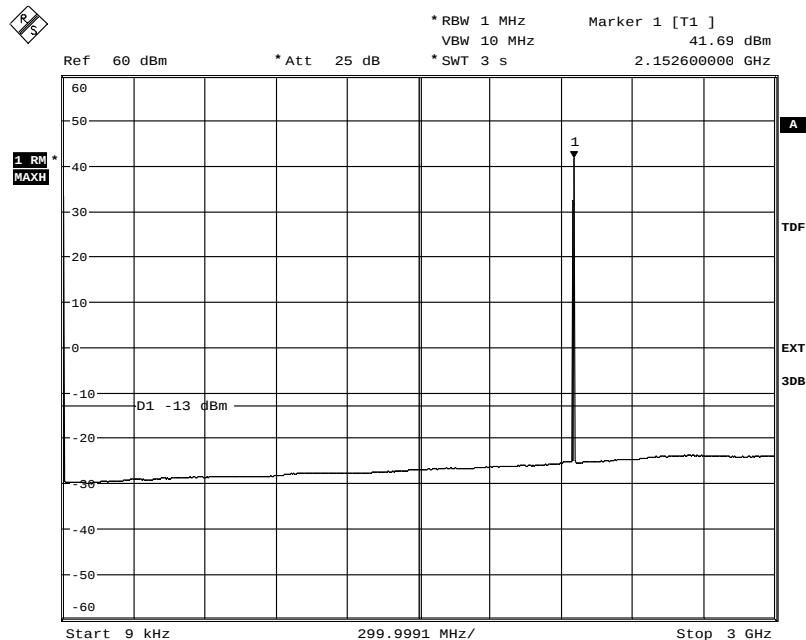
Diagram 6d:



Date: 15.MAY.2013 09:32:18

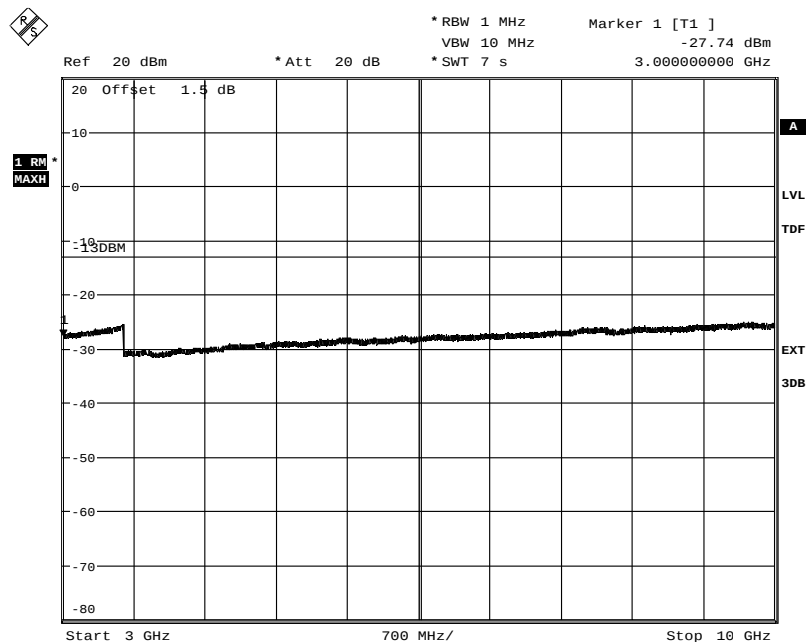
## Appendix 5

Diagram 7a:



Date: 15.MAY.2013 11:18:33

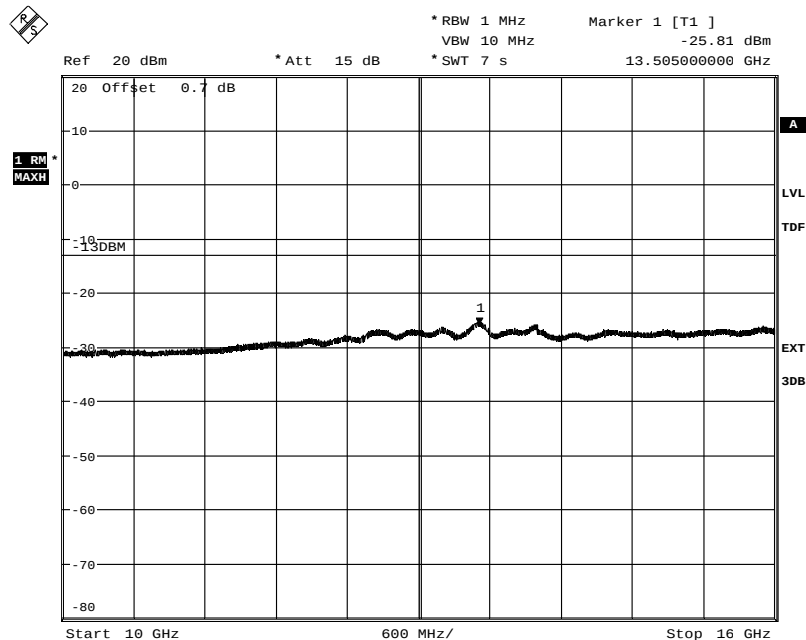
Diagram 7b:



Date: 15.MAY.2013 11:20:05

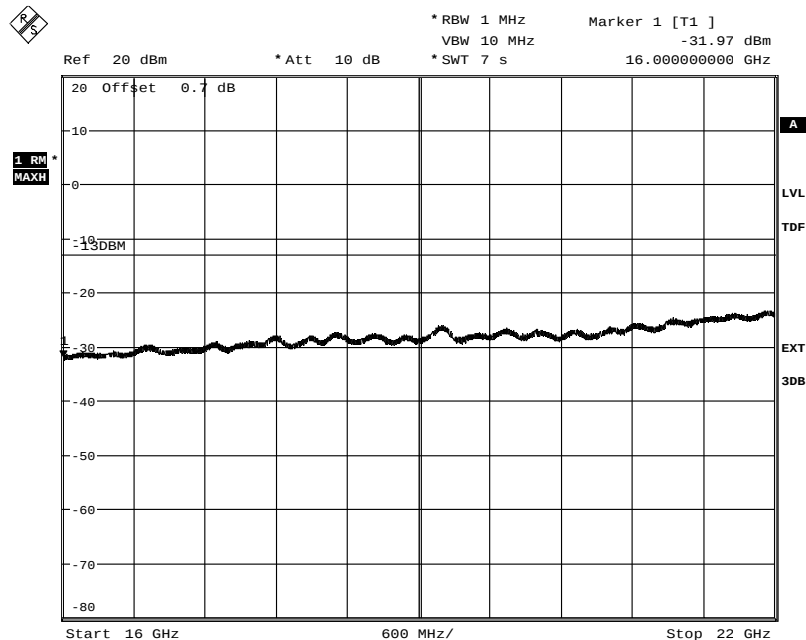
## Appendix 5

Diagram 7c:



Date: 15.MAY.2013 11:21:01

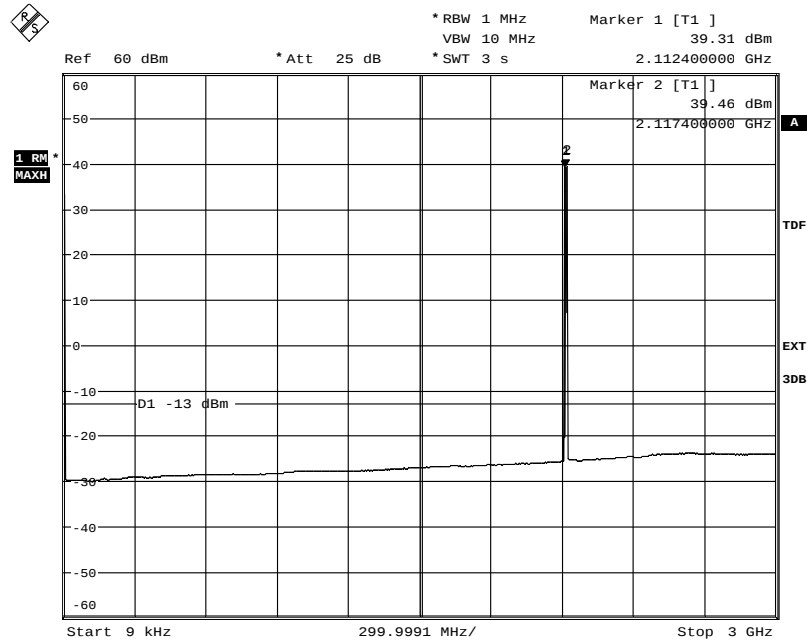
Diagram 7d:



Date: 15.MAY.2013 11:22:06

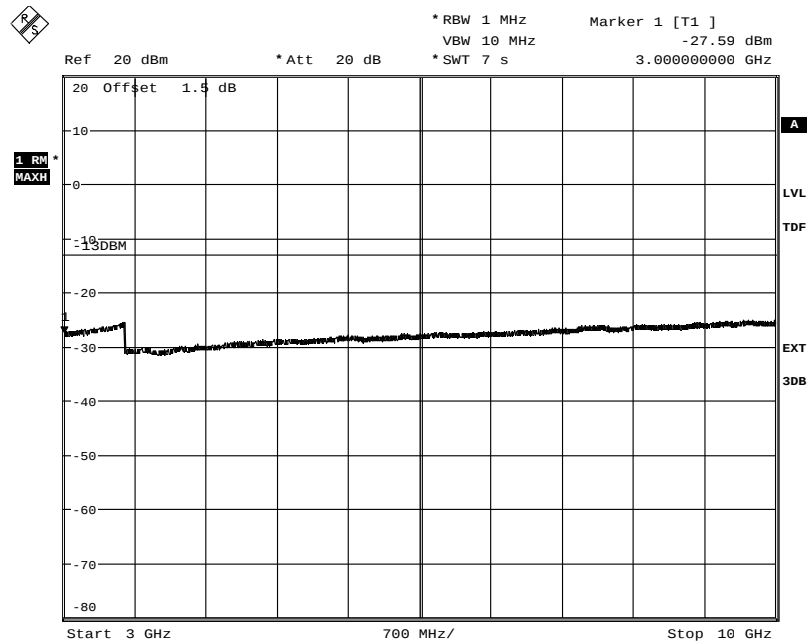
## Appendix 5

Diagram 8a:



Date: 16.MAY.2013 10:05:53

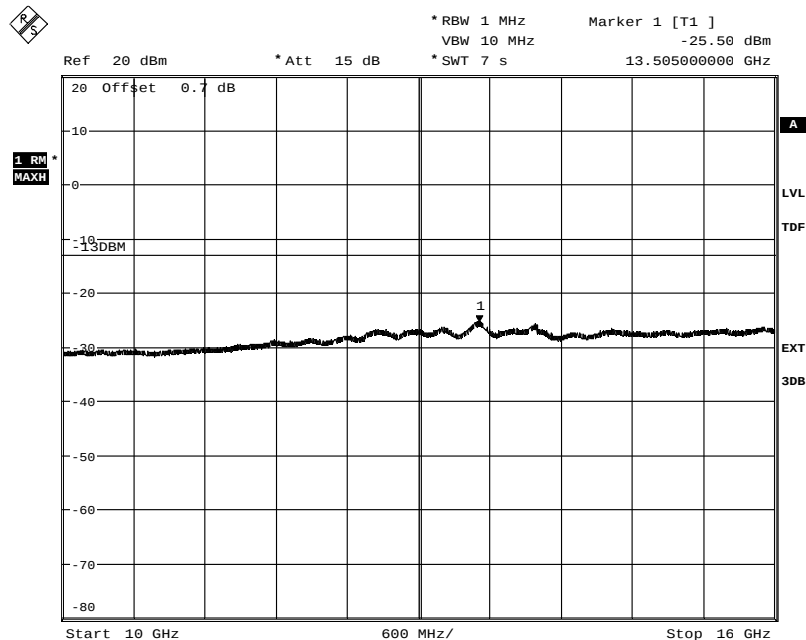
Diagram 8b:



Date: 16.MAY.2013 10:18:08

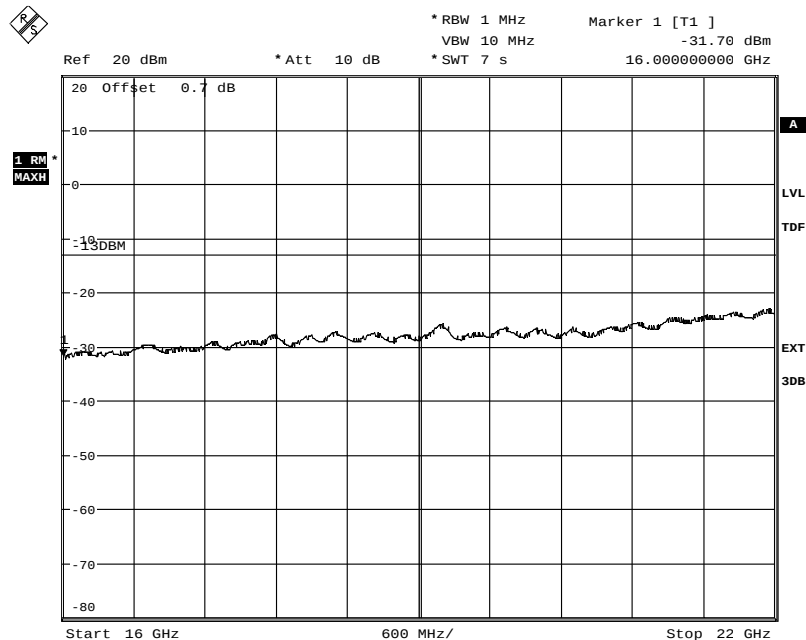
## Appendix 5

Diagram 8c:



Date: 16.MAY.2013 10:19:32

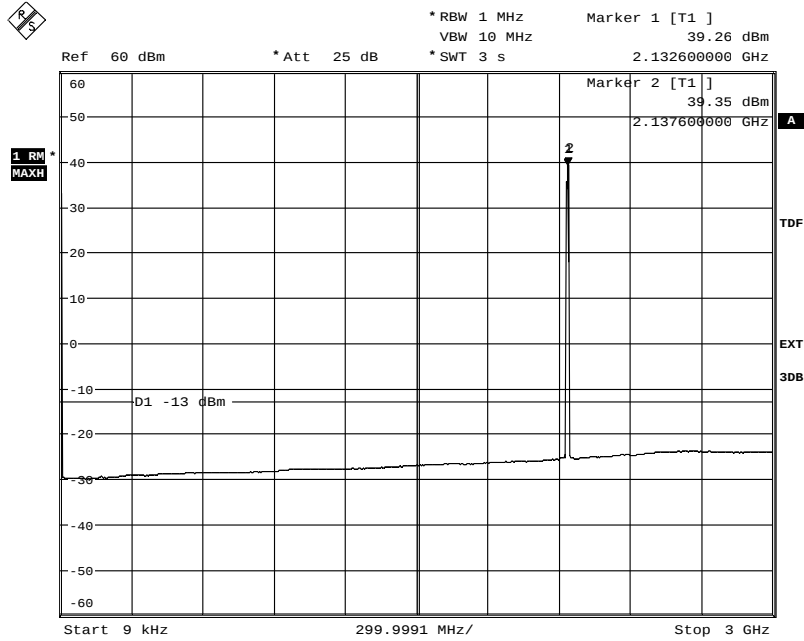
Diagram 8d:



Date: 16.MAY.2013 10:23:27

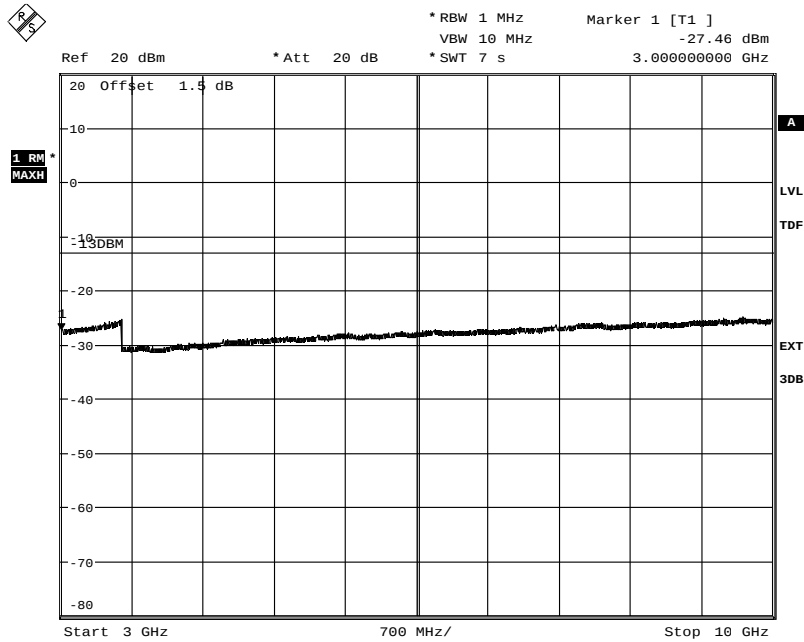
## Appendix 5

Diagram 9a:



Date: 16.MAY.2013 12:23:14

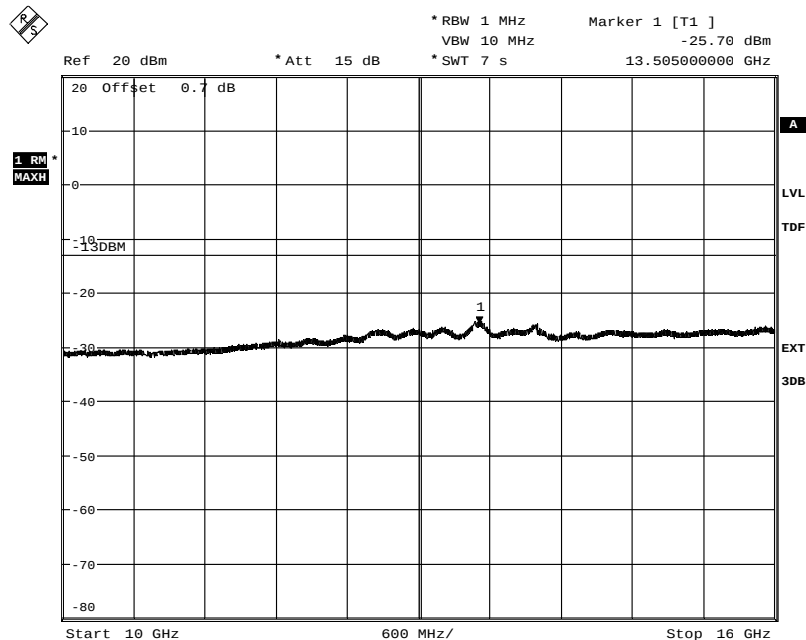
Diagram 9b:



Date: 16.MAY.2013 12:24:32

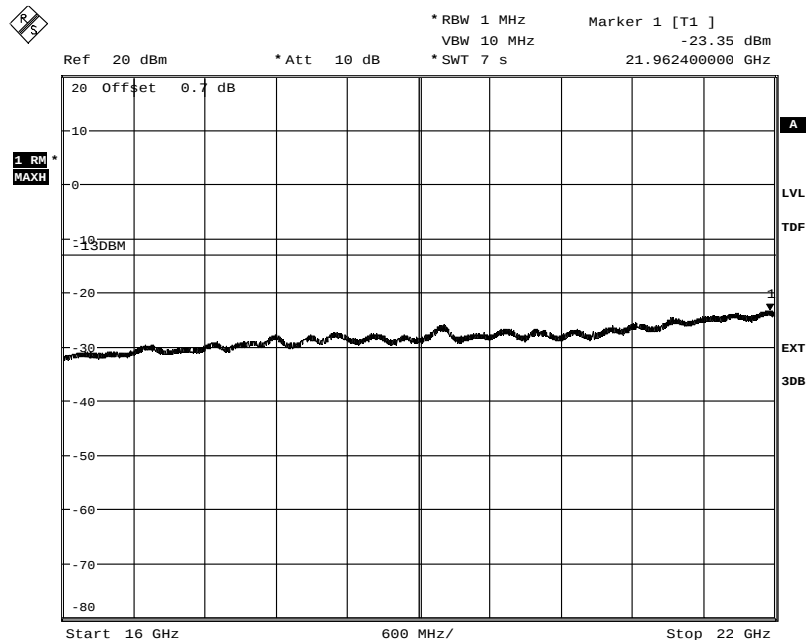
## Appendix 5

Diagram 9c:



Date: 16.MAY.2013 12:25:24

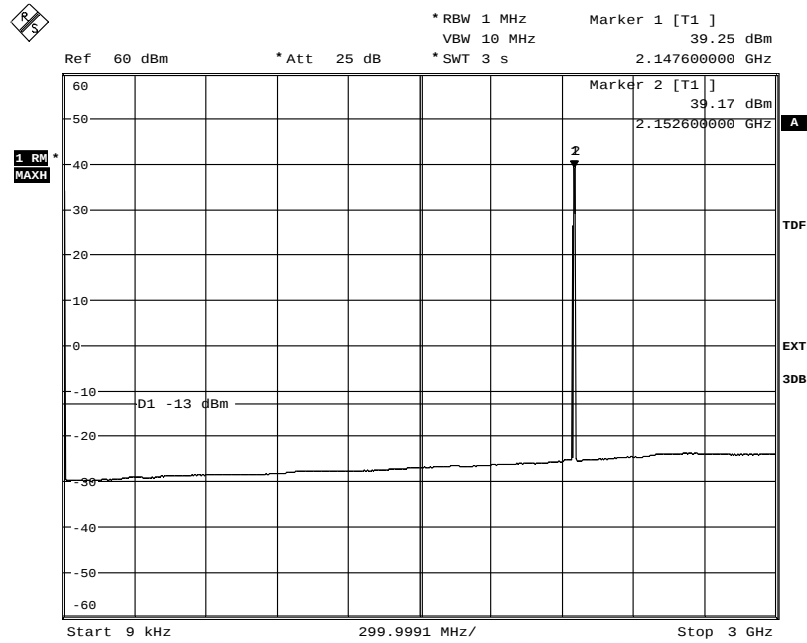
Diagram 9d:



Date: 16.MAY.2013 12:26:27

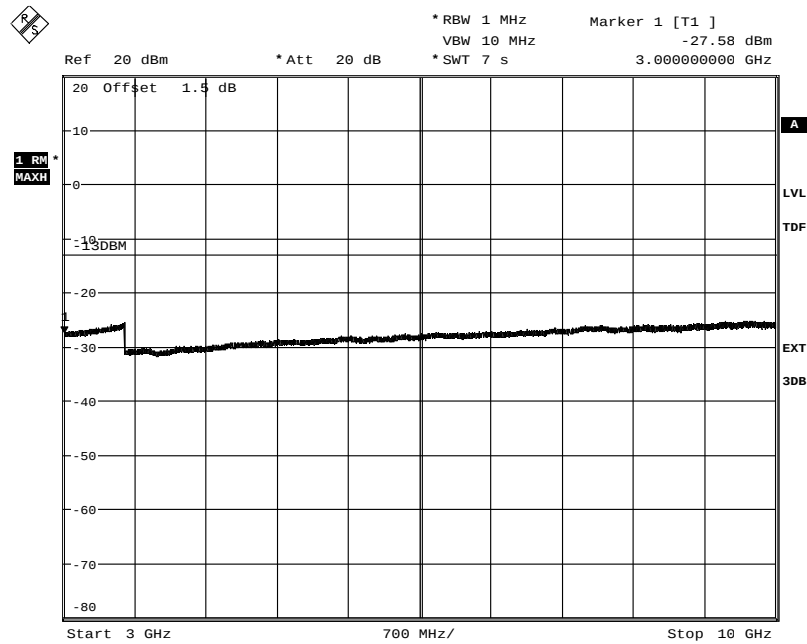
## Appendix 5

Diagram 10a:



Date: 16.MAY.2013 11:48:03

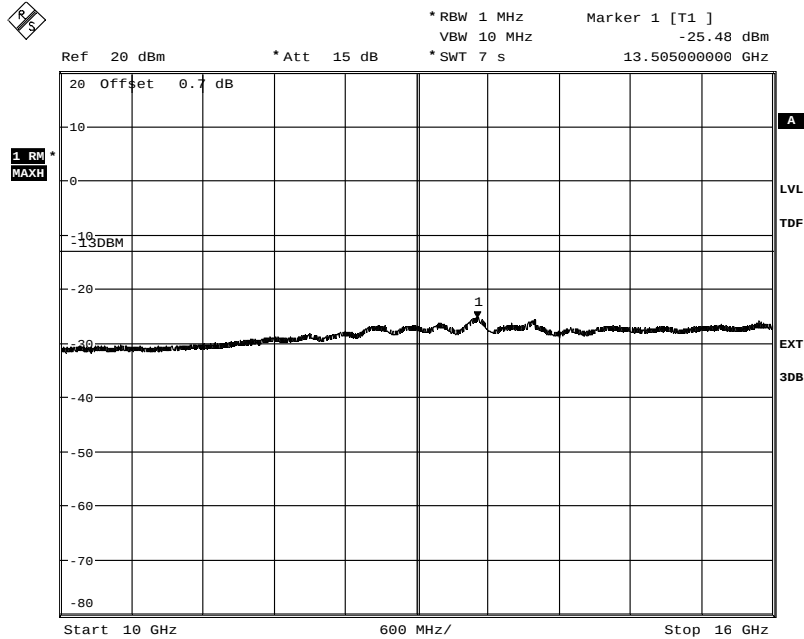
Diagram 10b:



Date: 16.MAY.2013 11:51:03

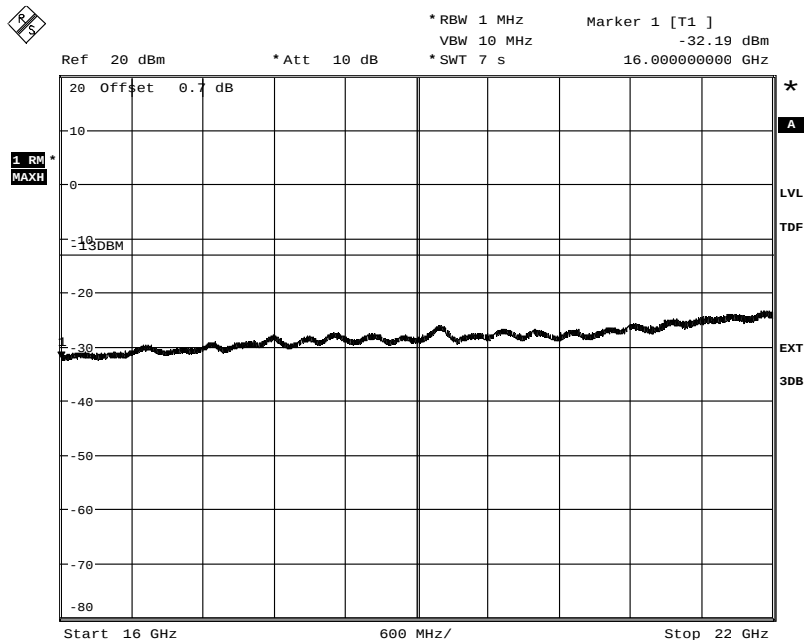
## Appendix 5

Diagram 10c:



Date: 16.MAY.2013 11:50:10

Diagram 10d:



Date: 16.MAY.2013 11:51:56

## Appendix 5

**Remark**

The emission at 9 kHz on the plots was not generated by the test object. A complementary measurement with a smaller RBW showed that it was related to the LO feed-through.

The highest fundamental frequency is 2.155 GHz. The measurements were made up to 22 GHz (10x2.155 GHz = 21.55 GHz).

**Limits**

§27.53(h) and RSS-139 6.5

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB, resulting in a limit of -13 dBm per 1 MHz RBW.

|           |     |
|-----------|-----|
| Complies? | Yes |
|-----------|-----|

## Appendix 6

### Field strength of spurious radiation measurements according to 47 CFR 27.53 (h) / IC RSS-139 6.5

| Date       | Temperature  | Humidity   |
|------------|--------------|------------|
| 2013-05-15 | 23.0°C ± 3°C | 36 % ± 5 % |
| 2013-05-16 | 22.0°C ± 3°C | 37 % ± 5 % |
| 2013-05-17 | 22.5°C ± 3°C | 52 % ± 5 % |

#### Test set-up and procedure

The test sites are listed at FCC, Columbia with registration number: 93866. The test site complies with RSS-Gen, Industry Canada file no. 3482A-1.

The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz – 18 GHz and 1m in the frequency range 18 - 22 GHz.

In the frequency range 30 MHz – 22 GHz the measurement was performed in power with a RBW of 1 MHz. A propagation loss in free space was calculated. The used formula was

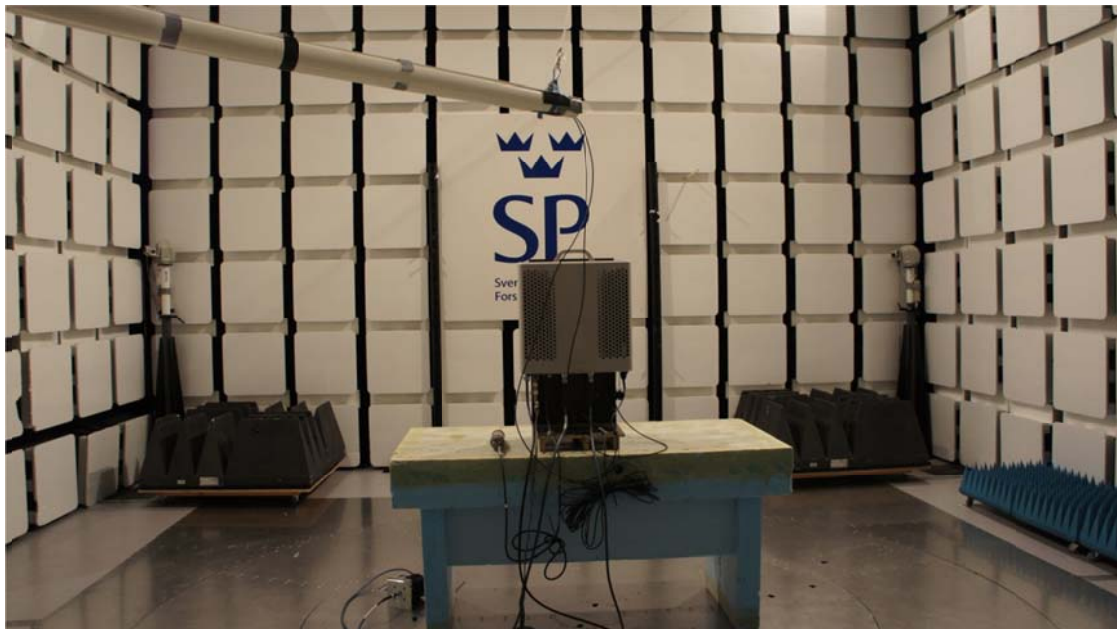
$$\gamma = 20 \log \left( \frac{4\pi D}{\lambda} \right), \gamma \text{ is the propagation loss and } D \text{ is the antenna distance.}$$

The measurement procedure was as the following:

1. The pre-measurement was first performed with peak detector. The EUT was measured in eight directions and with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m.
2. Spurious radiation on frequencies closer than 20 dB to the limit in the pre-measurement is scanned 0-360 degrees and the antenna is scanned 1- 4 m for maximum response. The emission is then measured with the RMS detector and the RMS value is reported. Frequencies closer than 10 dB to the limit when measured with the RMS detector were measured with the substitution method according to the standard.

## Appendix 6

The test set-up during the spurious radiation measurements is shown in the picture below:



### Measurement equipment

| Measurement equipment                     | SP number |
|-------------------------------------------|-----------|
| Semi anechoic chamber                     | 503 881   |
| R&S ESI 26                                | 503 292   |
| EMC 32 ver. 8.52.0                        | 503 745   |
| Chase Bilog Antenna CBL 6111A             | 502 181   |
| EMCO Horn Antenna 3115                    | 502 175   |
| Flann STD Gain Horn Antenna 20240-20      | 503 674   |
| High pass filter, RLC Electronics         | 503 739   |
| Miteq, Low Noise Amplifier                | 503 285   |
| µComp Nordic, Low Noise Amplifier         | 901 545   |
| Temperature and humidity meter, Testo 625 | 504 188   |

## Appendix 6

### Tested configurations

|    |
|----|
| B  |
| M  |
| T  |
| M2 |

**Results**, representing worst case

M: Diagram 1 a-d

| Frequency<br>(MHz) | Spurious emission level (dBm)    |                                  |
|--------------------|----------------------------------|----------------------------------|
|                    | Vertical                         | Horizontal                       |
| 30-22 000          | All emission > 20 dB below limit | All emission > 20 dB below limit |

### Measurement uncertainty:

3.2 dB up to 18 GHz, 3.6 dB above 18 GHz

### Limits

§27.53(h) and RSS-139 6.5

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB, resulting in a limit of -13 dBm per 1 MHz RBW.

|           |     |
|-----------|-----|
| Complies? | Yes |
|-----------|-----|

## Appendix 6

Diagram 1a:

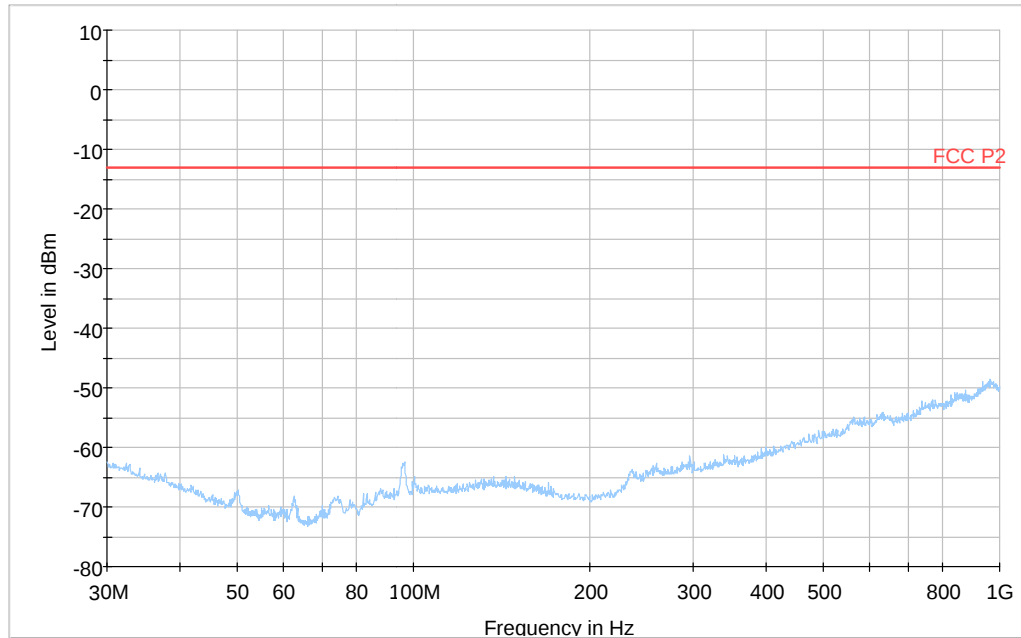
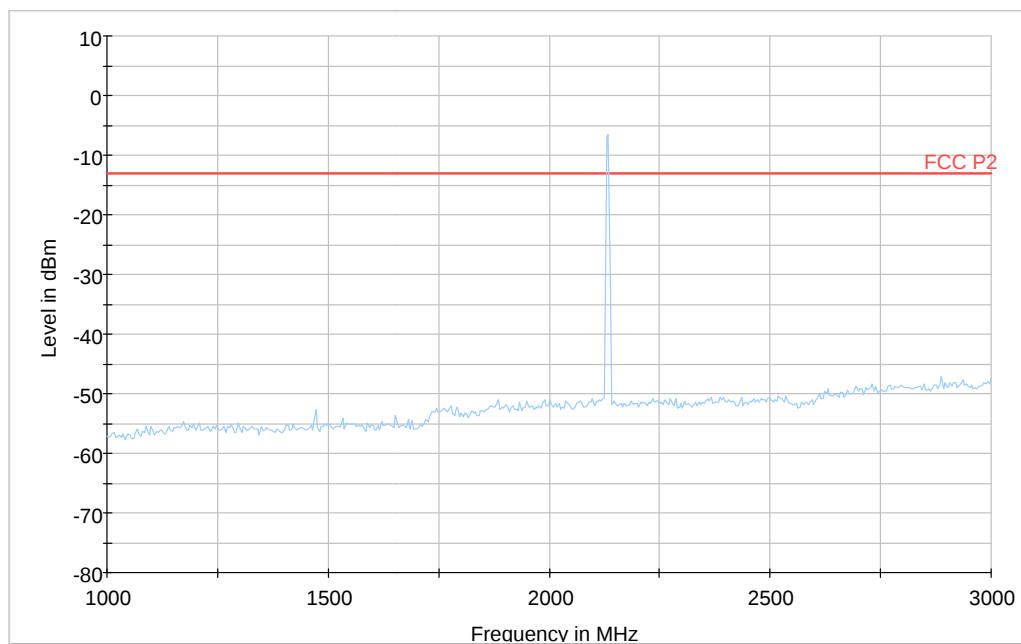


Diagram 1b:



Note: The emission at 2132.6 MHz is the carrier frequency and shall be ignored in the context.

## Appendix 6

Diagram 1c:

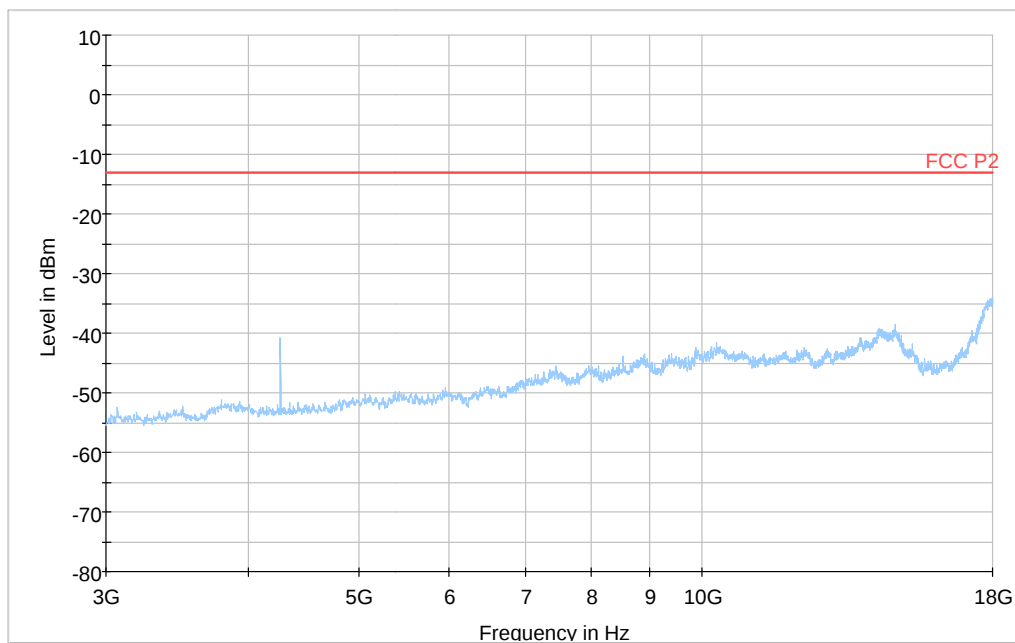
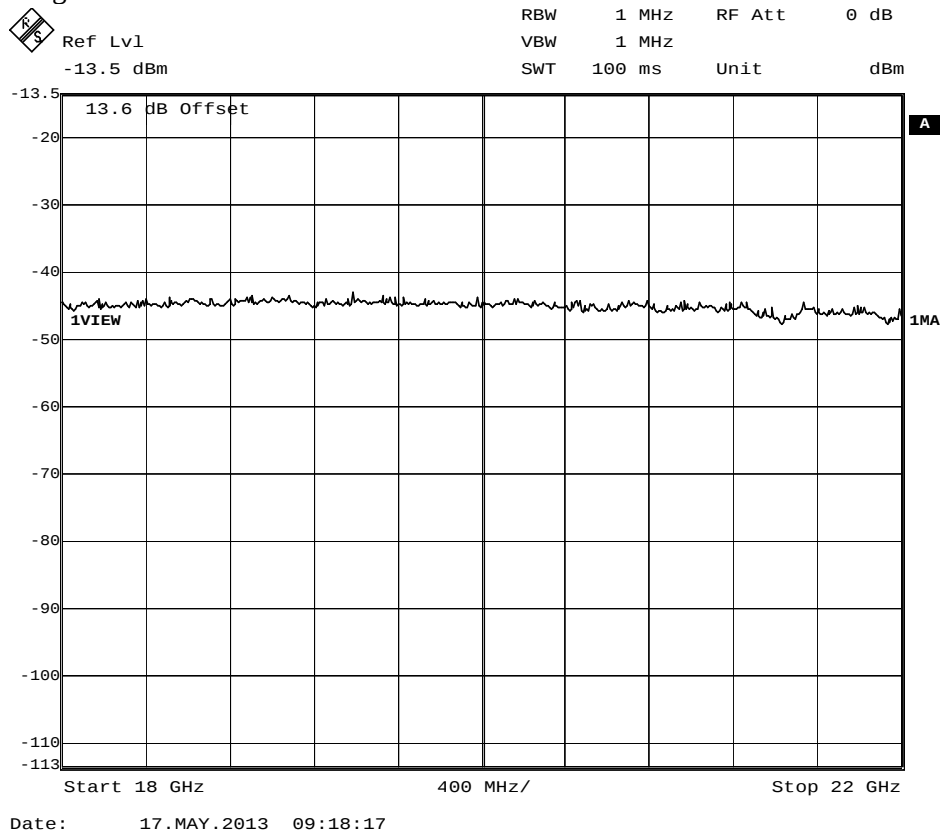


Diagram 1d:



Date: 17.MAY.2013 09:18:17

## Appendix 7

### Frequency stability measurements according to CFR 47 §27.54 / IC RSS 139 6.3

| Date       | Temperature (test equipment) | Humidity (test equipment) |
|------------|------------------------------|---------------------------|
| 2013-05-16 | 23 °C ± 3 °C                 | 37% ± 5 %                 |
| 2013-05-17 | 22 °C ± 3 °C                 | 45% ± 5 %                 |
| 2013-05-21 | 22 °C ± 3 °C                 | 43% ± 5 %                 |

#### Test set-up and procedure

The measurement was made per 3GPP TS 25.141. The output was connected to a spectrum analyzer. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

| Measurement equipment                     | SP number |
|-------------------------------------------|-----------|
| R&S FSQ                                   | 504 143   |
| RF attenuator                             | 900 233   |
| RF attenuator                             | 901 384   |
| Temperature Chamber                       | 501 031   |
| Datascan 7321                             | 502 698   |
| Testo 635, temperature and humidity meter | 504 203   |
| Multimeter Fluke 87                       | 502 190   |

## Appendix 7

### Results

Nominal Voltage -48 V DC

Maximum output power at mid channel (M)

Channel Bandwidth 5MHz

| Test conditions          |        | Frequency error (Hz)     |
|--------------------------|--------|--------------------------|
| Supply voltage DC (V)    | T (°C) |                          |
| -48.0                    | +20    | -6                       |
| -55.2                    | +20    | -12                      |
| -40.8                    | +20    | -8                       |
| -48.0                    | +30    | -9                       |
| -48.0                    | +40    | +9                       |
| -48.0                    | +50    | -10                      |
| -48.0                    | +10    | -11                      |
| -48.0                    | 0      | -17                      |
| -48.0                    | -10    | +15                      |
| -48.0                    | -20    | +18                      |
| -48.0                    | -30    | +16                      |
| Maximum freq. error (Hz) |        | 18                       |
| Measurement uncertainty  |        | $< \pm 1 \times 10^{-7}$ |

### Remark

It was deemed sufficient to test one combination of TX frequency, channel bandwidth configuration and test model (modulation), as all combinations share a common internal reference to derive the TX frequency from.

## Appendix 7

**Limits**

Limit according to 3GPP TS 25.141:

The frequency error shall be within  $\pm 0.05 \text{ PPM} \pm 12 \text{ Hz}$  ( $\pm 106.63 \text{ Hz}$ ).

§27.54

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-139 6.3 Frequency:

The frequency stability shall be sufficient to ensure that the emission bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

|           |     |
|-----------|-----|
| Complies? | Yes |
|-----------|-----|

## Appendix 8

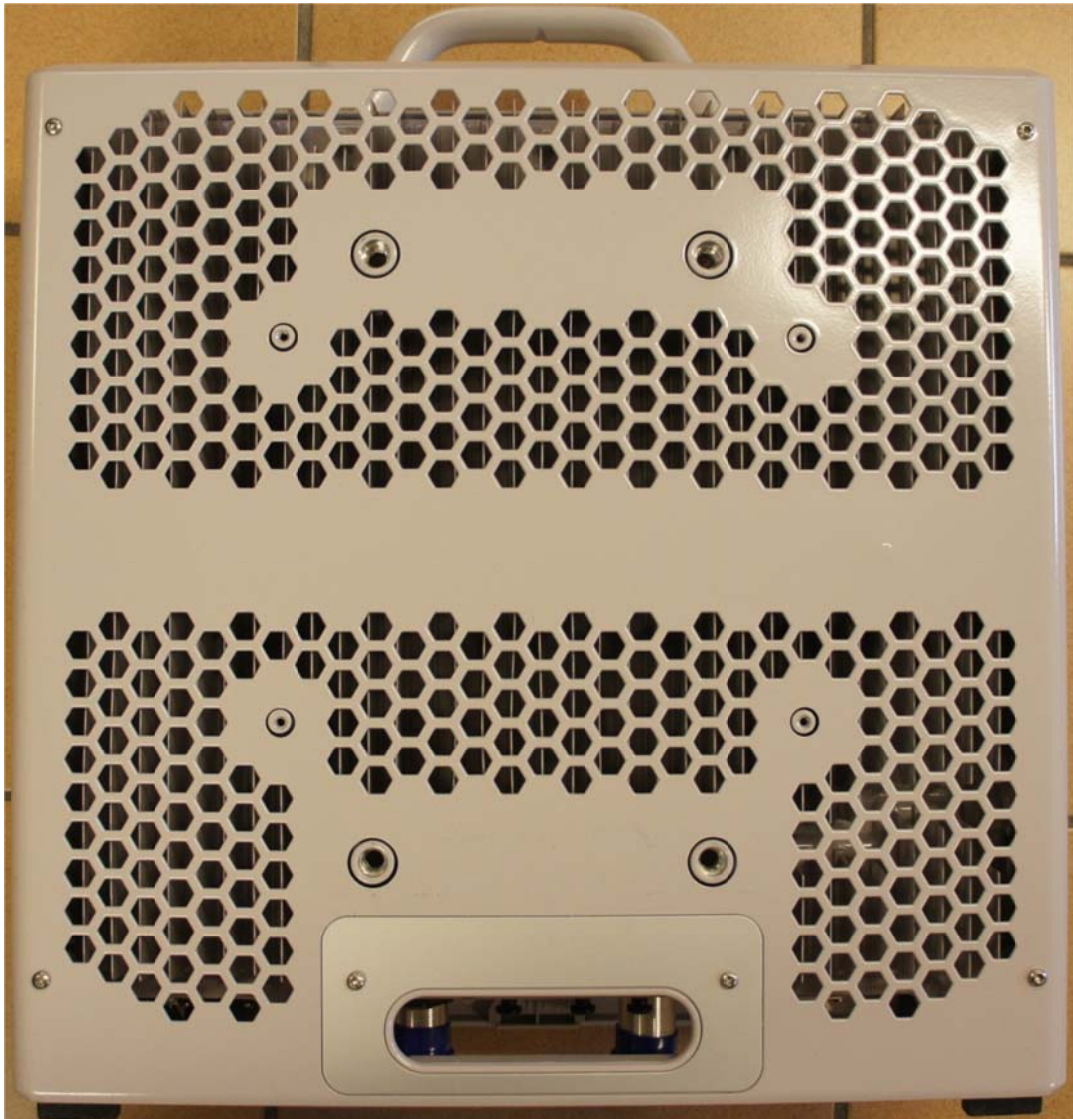
### External photos

Front side



## Appendix 8

Rear side



## Appendix 8

Left side

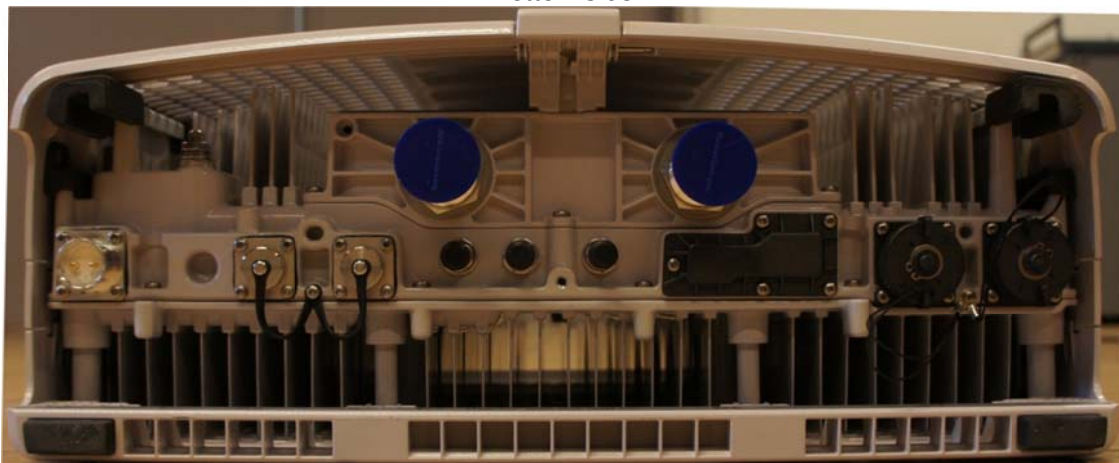


Right side



## Appendix 8

Bottom side



Top side



Product label

