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## Class II Permissive Change measurements on GSM Base station Transceiver Unit with FCC ID: B5KBR1311004-2 (8 appendices)

Revision 1 corrects client information in appendix 1 regarding the declared nominal output power.

### Test object

Transceiver Unit dTRU-19, product KRC 131 1004/2, revision R1G

### Summary

| Standard                                    | Compliant | Appendix | Remarks |
|---|-----------|----------|---------|
| <b>FCC CFR 47</b>                           |           |          |         |
| 2.1046 RF Power output                      | Yes       | 2        | -       |
| 2.1049 Occupied bandwidth                   | Yes       | 3        | -       |
| 2.1051 Band Edge                            | Yes       | 4        | -       |
| 2.1051 Spurious emission at antenna port    | Yes       | 5        | -       |
| 2.1053 Field strength of spurious radiation | Yes       | 6        | -       |

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## Appendix 1

### Description - Equipment Under Test (EUT)

Equipment: GSM Base station transceiver unit (dTRU) 1900 MHz

TX frequency band: 1930 – 1990 MHz

Modulations: GMSK, 8PSK, 16QAM, 32QAM, AQPSK

| Declared maximum output power, RMS value in [dBm] | Modulations |      |       |       |       |
|---|-------------|------|-------|-------|-------|
|   | GMSK        | 8PSK | 16QAM | 32QAM | AQPSK |
| Hybrid combined (HC) mode                         | 41,7        | 38,4 | 37,0  | 36,6  | 38,3  |
| Uncombined (UC) mode                              | 45,0        | 41,7 | 40,3  | 39,9  | 41,6  |
| TCC mode  | 47,0        | 43,7 | 42,3  | 41,9  | 43,6  |

Supply voltage 24 V DC

### Purpose of test

The purpose of this test is to justify a Class II Permissive Change of the test object to include the use of AQPSK modulation with SCPIR 0 dB. This report verifies maintained performance characteristics of affected items according FCC CFR47 by re-testing the updated equipment and comparing results for AQPSK modulation in SCPIR 0 dB with results for GMSK reference modulation. For band-edge performance the acceptable settings for the new implemented AQPSK modulation were determined.

### Summary of results

Measurement results are similar for all tested modulations, apart from output power, where GMSK modulation results in the highest RMS output power, and for band-edge performance, where only AQPSK was tested as described in appendix 4. Where several modulations were compared, GMSK modulation shall be considered a worst case set-up.

### Tested configuration

All measurements were performed with the test object installed in a RBS 2206 V2 cabinet. The hardware list for radiated and conducted measurements is shown in appendix 7. Unless noted otherwise the test object was activated at maximum power, configured for TCC mode with RBS master 2E setting 49, resulting in the highest achievable output power. Random data was transmitted in all time slots with the various tested modulations being activated one at a time.

## Appendix 1

### Conducted measurements

Conducted measurements were done at the TX/RX 1 output of the CDU-G19.

### Radiated measurements

During radiated emission measurements the TX/RX 1 output of CDU-G19 was via a 50 ohm attenuator connected to a spectrum analyser to monitor the transmitted signal level. For the scope of this test it was deemed sufficient to measure radiated spurious emission at the TX band centre frequency for GMSK modulation as worst case reference modulation with the highest RMS power and compare it with results for the AQPSK modulation with SCPIR 0 dB.

### Frequencies used

| Channel | ARFCN | Frequency  | Comment  |
|---------|-------|------------|--|
| B       | 512   | 1930.2 MHz | Lowest usable TX frequency                         |
| B+1     | 513   | 1930.4 MHz | Low alternate TX frequency, 1 channel inside band  |
| M       | 661   | 1960.0 MHz | TX band centre frequency                           |
| T-1     | 809   | 1989.6 MHz | High alternate TX frequency, 1 channel inside band |
| T       | 810   | 1989.8 MHz | Highest usable TX frequency                        |

### Manufacturer's representative

Hua Yang, Ericsson (China) Communications Company Ltd

### References

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

ANSI C63.4-2009

ANSI/TIA/EIA-603-C-2004

ANSI/TIA/EIA 136-280-D-2002

CFR 47 part 2, October 1<sup>st</sup>, 2010

CFR 47 part 24, October 1<sup>st</sup>, 2010

### Reservation

The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in the report.

### Delivery of test object

The test object was delivered on 23<sup>rd</sup> May 2011.

## Appendix 1

### Test equipment

| Measurement equipment                      | Calibration Due | SP number |
|--|-----------------|-----------|
| Anechoic chamber, Hertz                    | 2013-10         | 15:116    |
| Boonton 4500A RF Peak power meter/analyser | 2012-11         | 503 144   |
| Boonton Power sensor 56518-S/4             | 2012-11         | 503 146   |
| Rohde & Schwarz FSIQ40                     | 2012-07         | 503 738   |
| Rohde & Schwarz ESI40                      | 2012-07         | 503 125   |
| Rohde & Schwarz Vector Network Analyser    | 2012-07         | 503 687   |
| Chase bilog antenna CBL 6121A              | 2014-10         | 502 460   |
| Schaffner Reference Dipole BSRD6500        | 2012-03         | 502 181   |
| EMCO Horn Antenna 3115                     | 2014-01         | 502 175   |
| EMCO Horn Antenna 3115                     | 2014-01         | 501 548   |
| MITEQ Low Noise Amplifier                  | 2012-08         | 503 277   |
| Flann Std gain horn 20240-20               | 2014-03         | 503 674   |
| Attenuator 40 dB                           | 2012-08         | 504 159   |
| High pass filter                           | 2012-08         | 504 200   |
| High pass filter                           | 2012-08         | 503 739   |
| Multimeter Fluke 87                        | 2012-05         | 502 190   |
| Testo 615 temperature and humidity meter   | 2012-03         | 503 498   |
| Testo 635 temperature and humidity meter   | 2013-05         | 504 203   |

### 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).

### Test engineers

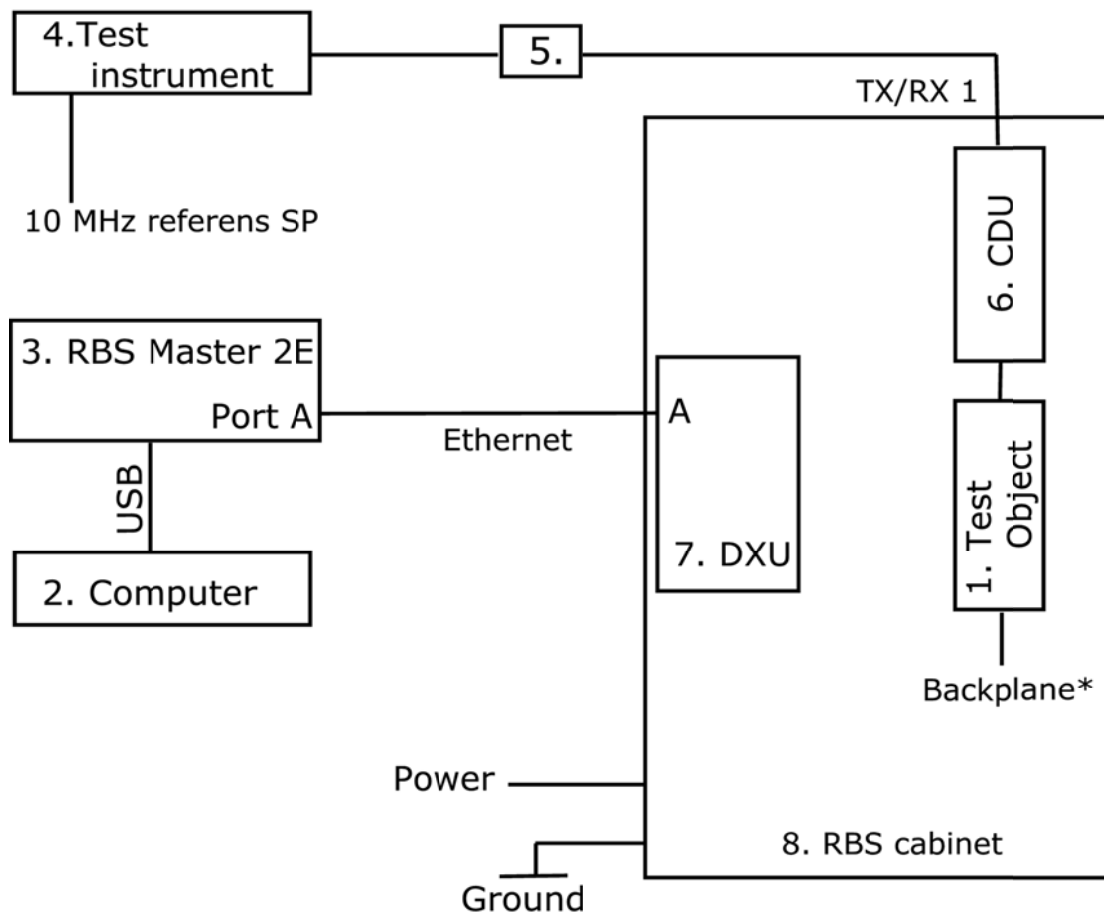
Jörgen Wassholm, Fredrik Isaksson, Martin Nilsson, Martin Forsberg and Reinhold Reul, SP

### Test witness

-

## Appendix 1

### Test set-up, conducted measurements



\*) Power and data communication via backplane

### Test object

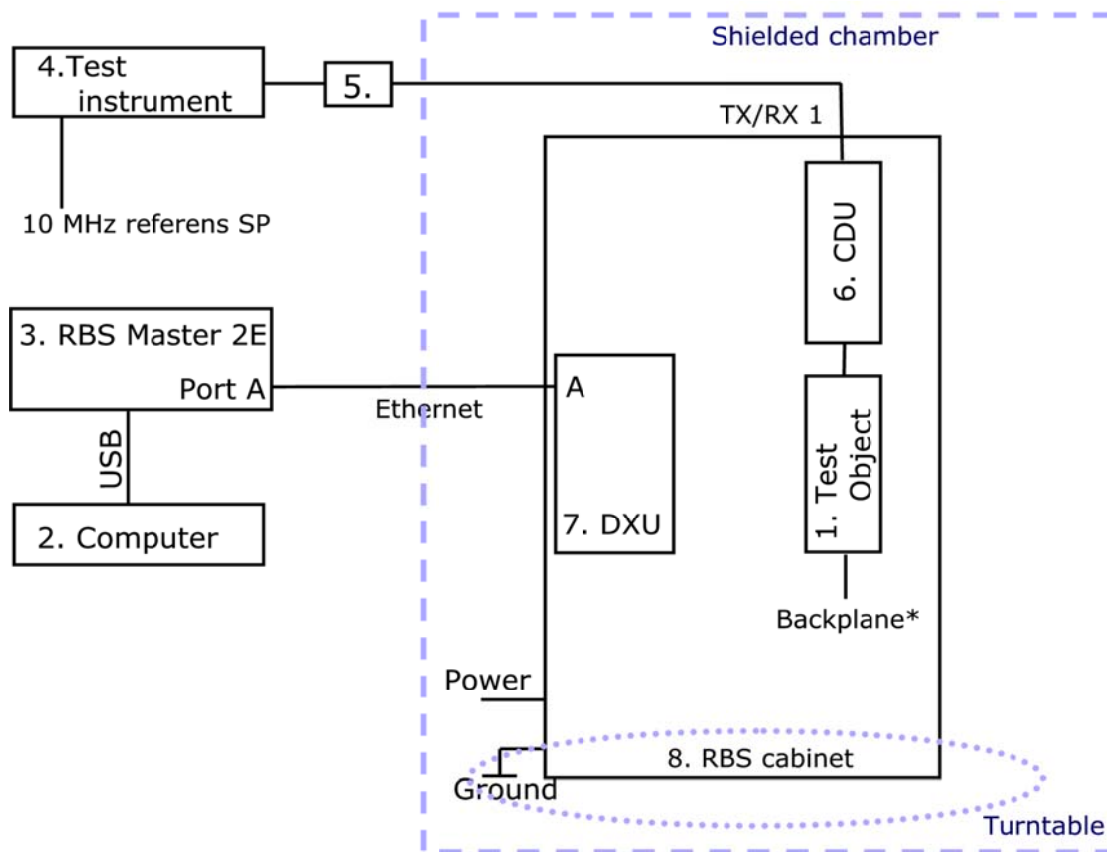
1. Transceiver Unit dTRU-19, product KRC 131 1004/2, revision R1G, SN AE50094077 with FCC ID: B5KBRKRC1311004-2

### Functional test equipment

2. HP laptop computer Compaq nc6000, product PM307ES#AB2, SN CNU51206GT With software RBS Master2 control software
3. Ericsson RBS Master 2E hardware, product LBY 107 1007/3, revision R1C BAMS 1000878365
4. Agilent MXA Signal Analyser model N9020A 20 Hz – 3.6 GHz, BAMS 1000785533, used to verify the modulation schemes or SP measurement instrument used according respective appendix
5. Attenuator / filter listed as test equipment in respective appendix
6. CDU-G8, product BFL 119 155/1, revision R3A, serial number A40004WCLV
- 7./8. DXU and remaining RBS cabinet according hardware list in appendix 7

## Appendix 1

### Test set-up, radiated emission



\*) Power and data communication via backplane

### Test object

1. Transceiver Unit dTRU-19, product KRC 131 1004/2, revision R1G, SN AE50094077 with FCC ID: B5KBKRC1311004-2

### Functional test equipment

2. HP laptop computer model Compaq NC6400 SN CND72717JP with RBS Master2 control software
3. Ericsson RBS Master 2E hardware, product LBY 107 1007/3, revision R1C, BAMS 1000735211
4. Rohde & Schwarz ESI40 for signal verification or 50 ohm termination
5. Attenuator 40 dB, SP 504 159
6. CDU-G19, product BFL 119 153/1, revision R5F, serial number A40003X4CF
- 7./8. DXU and remaining RBS cabinet according hardware list in appendix 7

## Appendix 1

**Test object connections****Interface**

Power via RBS backplane

TX 1 + TX 2 interconnection to CDU in TCC/HC mode

Interconnection TX 1 to CDU in UC mode

Interconnection TX 2 to CDU in UC mode

RX 1 to CXU10

RX 2 to CXU10

RX 3 not connected

RX 4 not connected

**Type of port**

DC power

RF interconnect

RF interconnect

RF interconnect

RF interconnect

RF interconnect

RF interconnect

**RBS cabinet external connections****Interface**

External supply 24 V DC

Active CDU TX/RX 1, used for measurement and monitoring

Active CDU TX/RX 2 and inactive CDU's outputs unconnected

Ethernet shielded multi-wire with RJ-45 connector to RBS master

2E, port A, mode E1

External alarm not connected

ESB not connected

GPS not connected

OMT interface for configuration not connected

**Type of port:**

DC power

RF/Antenna

RF/Antenna

Telecom

Signal

Signal

Signal

O/M



## Appendix 2

### RF Power output measurements according to CFR 47 2.1046

|            |              |            |
|------------|--------------|------------|
| Date       | Temperature  | Humidity   |
| 2011-11-30 | 24 °C ± 3 °C | 25 % ± 5 % |

#### Test set-up and procedure

Measurements were made at the CDU output connector. The output was connected to a Peak power analyser via a 50 ohm attenuator.

| Measurement equipment                      | SP number |
|--|-----------|
| Boonton 4500A RF Peak power meter/analyzer | 503 144   |
| Boonton Power sensor 56518-S/4             | 503 146   |
| Attenuator                                 | 504 159   |
| Multimeter Fluke 87                        | 502 190   |
| Testo 635 temperature and humidity meter   | 504 203   |

**Measurement uncertainty:** 0.7 dB

#### Results

The test object was configured for maximum nominal output power, using TCC mode configuration with RBS master 2E setting 49.

| Transmitter power (dBm) |            |      |      |
|-------------------------|------------|------|------|
| Channel                 | Modulation | Peak | RMS  |
| M                       | GMSK       | 47.4 | 46.6 |
| M                       | AQPSK      | 47.3 | 43.4 |

The maximum measured PAR was 3.9 dB.

#### Limits

According to CFR § 24 there are no conducted limits at the antenna connector.

§ 24.232: The peak-to-average (PAR) ratio shall not exceed 13 dB. Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP).

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

### Appendix 3

#### Occupied bandwidth measurements according to 47CFR 2.1049

| Date       | Temperature  | Humidity   |
|------------|--------------|------------|
| 2011-11-29 | 23 °C ± 3 °C | 27 % ± 5 % |
| 2011-12-01 | 24 °C ± 3 °C | 25 % ± 5 % |

#### Test set-up and procedure

The measurements were made per definition in §24.238. Measurements were made at the CDU output connector, which was connected to a spectrum analyser with the RMS detector activated. The spectrum analyser was connected to an external 10 MHz reference standard during the measurements.

| Measurement equipment                    | SP number |
|--|-----------|
| R&S FSIQ                                 | 503 738   |
| Attenuator                               | 504 159   |
| Multimeter Fluke 87                      | 502 190   |
| Testo 635 temperature and humidity meter | 504 203   |

**Measurement uncertainty:** 3.7 dB, 1.33 kHz

#### Results

The results are shown in the diagrams below.

Configuration:

TCC mode with RBS master 2E setting 49, maximum nominal output power.

| Diagram | Channel | Modulation | OBW     |
|---------|---------|------------|---------|
| 1       | M       | GMSK       | 241 kHz |
| 2       | M       | AQPSK      | 237 kHz |

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

## Appendix 3

Diagram 1:

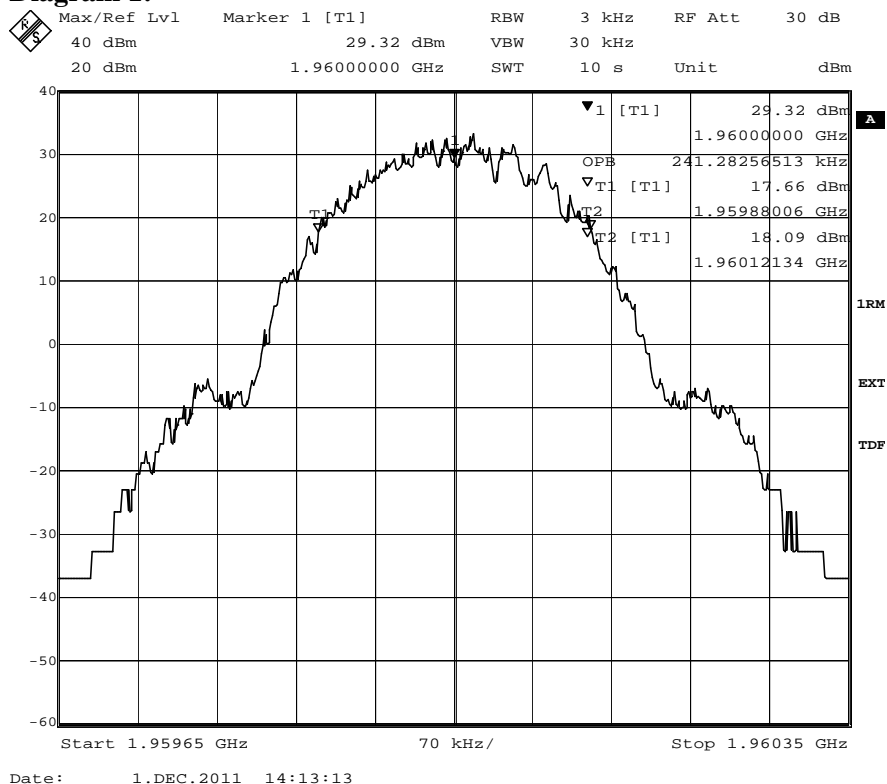
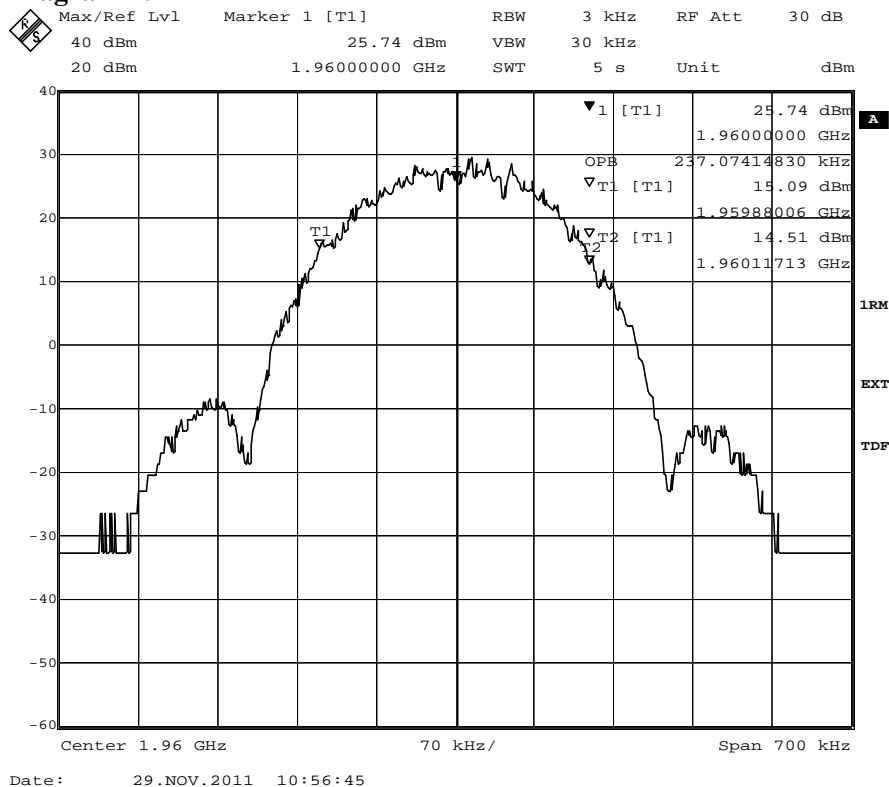


Diagram 2:



## Appendix 4

### Band edge measurements according to 47CFR 2.1051

|            |              |            |
|------------|--------------|------------|
| Date       | Temperature  | Humidity   |
| 2011-11-30 | 22 °C ± 3 °C | 59 % ± 5 % |

#### Test set-up and procedure

The measurements were made per definition in §24.238, with the CDU output connected to a spectrum analyser with the RMS detector activated. The spectrum analyser was connected to an external 10 MHz reference standard during the measurements.

FCC rules allow a resolution bandwidth of one per cent of the emission bandwidth of the fundamental emission within the first 1 MHz off the band edge. FCC rules require a resolution bandwidth of 1 MHz for measurements of emissions with band edge offsets exceeding 1 MHz. Measurement bandwidths of 3 kHz, 30 kHz and 1MHz were used and the respective limit was adapted by  $[10 * \log(RBW_{used}/RBW_{required})]$  dB.

| Measurement equipment                    | SP number |
|--|-----------|
| R&S FSIQ                                 | 503 738   |
| Attenuator                               | 504 159   |
| Multimeter Fluke 87                      | 502 190   |
| Testo 635 temperature and humidity meter | 504 203   |

**Measurement uncertainty:** 3.7 dB

#### Results

Configuration: AQPSK modulation with SCPIR 0 dB.

| Diagram   | Channel | Configuration | RBS master 2E setting | Measured RMS power / [dBm] |
|-----------|---------|---------------|-----------------------|----------------------------|
| 1 a, b, c | B       | HC mode       | 43                    | 36.9                       |
| 2 a, b, c | T       | UC mode       | 45                    | 40.3                       |
| 3 a, b, c | B+1     | TCC mode      | 49                    | 42.8                       |
| 4 a, b, c | T-1     | TCC mode      | 49                    | 42.7                       |

The diagrams are shown on the following pages.

#### Remark

For channels B and T the above documented RMS output powers were found to represent maximum usable settings for AQPSK modulation using SCPIR 0 dB.

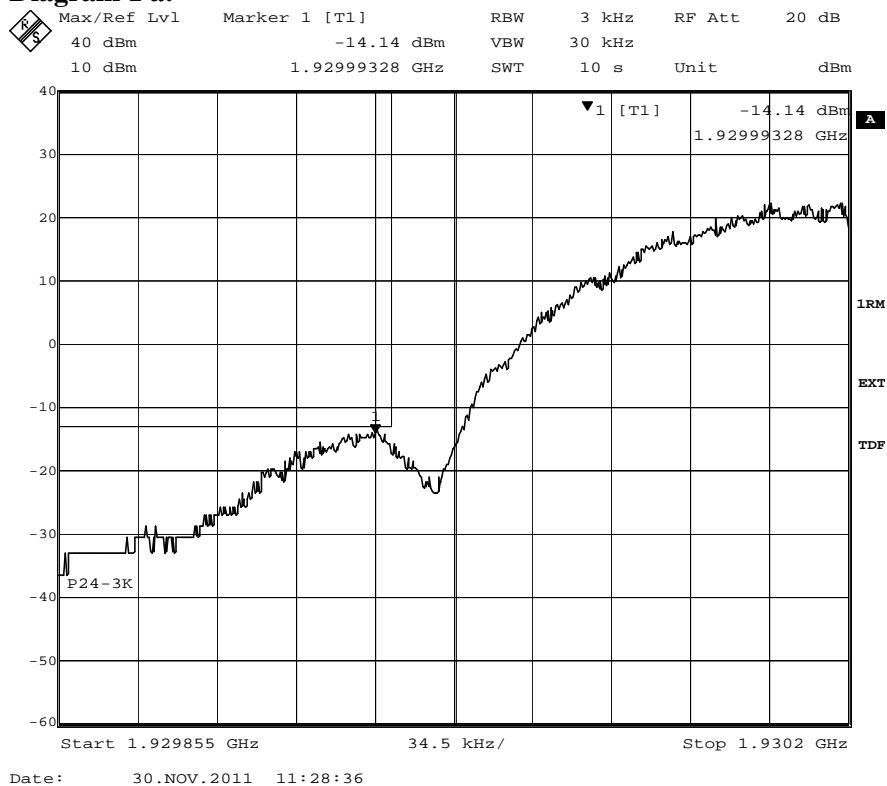
#### Limit

The power of any emission outside the frequency band shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log P$  dB.

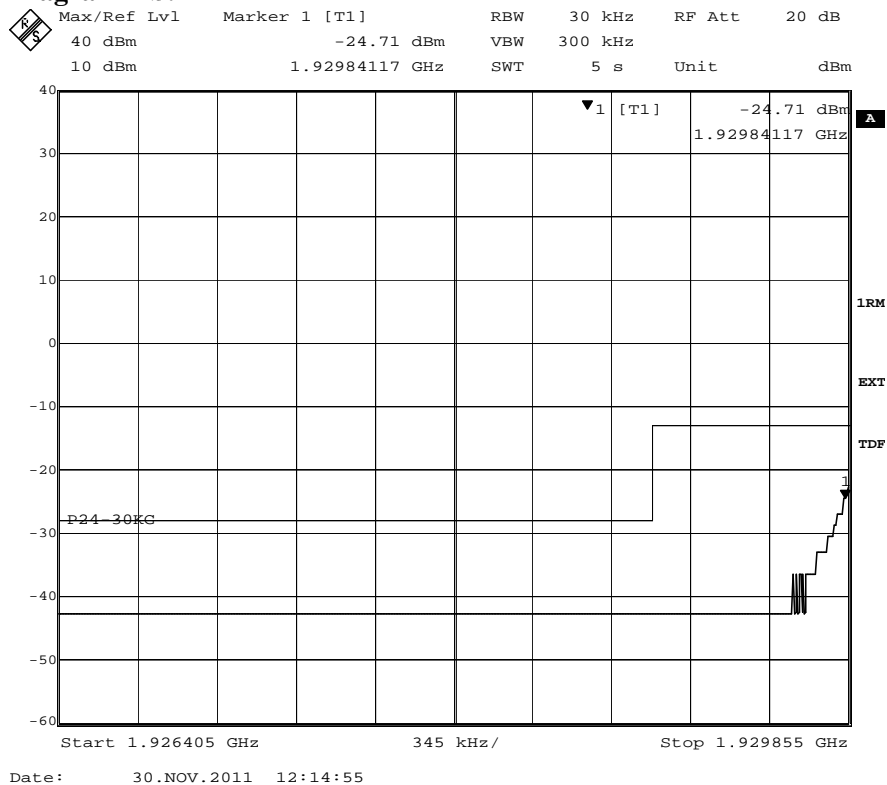
|           |     |
|-----------|-----|
| Complies? | Yes |
|-----------|-----|

## Appendix 4

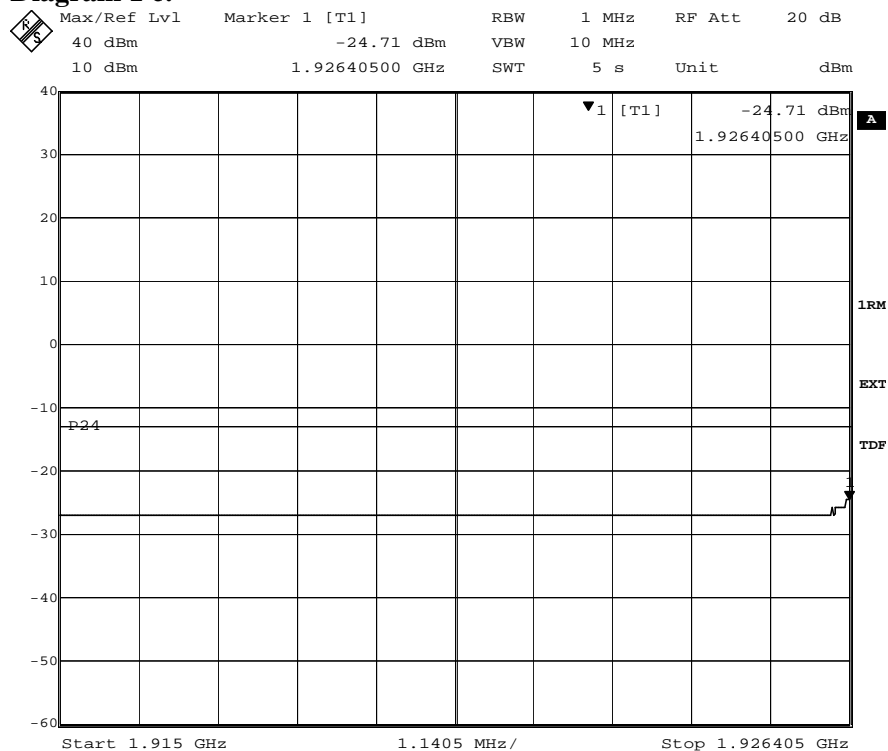
**Diagram 1 a:**



**Diagram 1 b:**



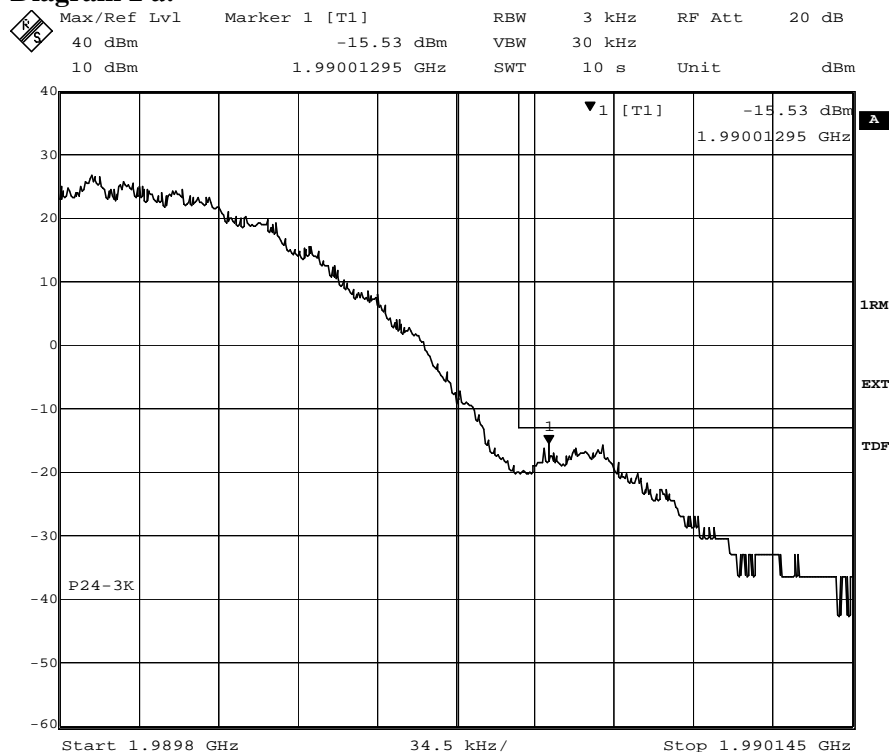
## Appendix 4

**Diagram 1 c:**


Date: 30.NOV.2011 12:16:15

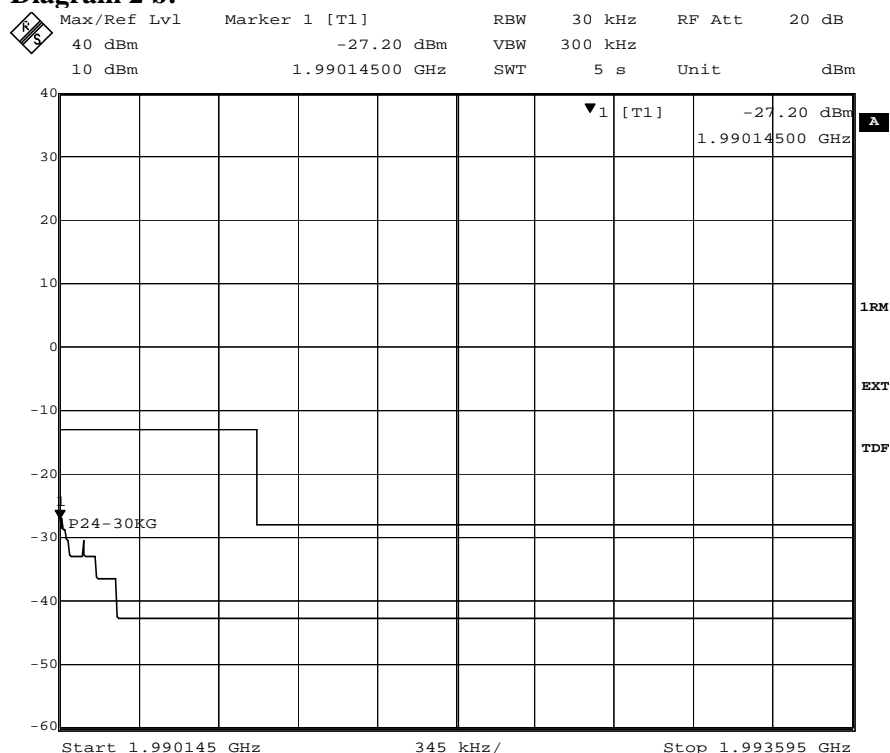
## Appendix 4

**Diagram 2 a:**



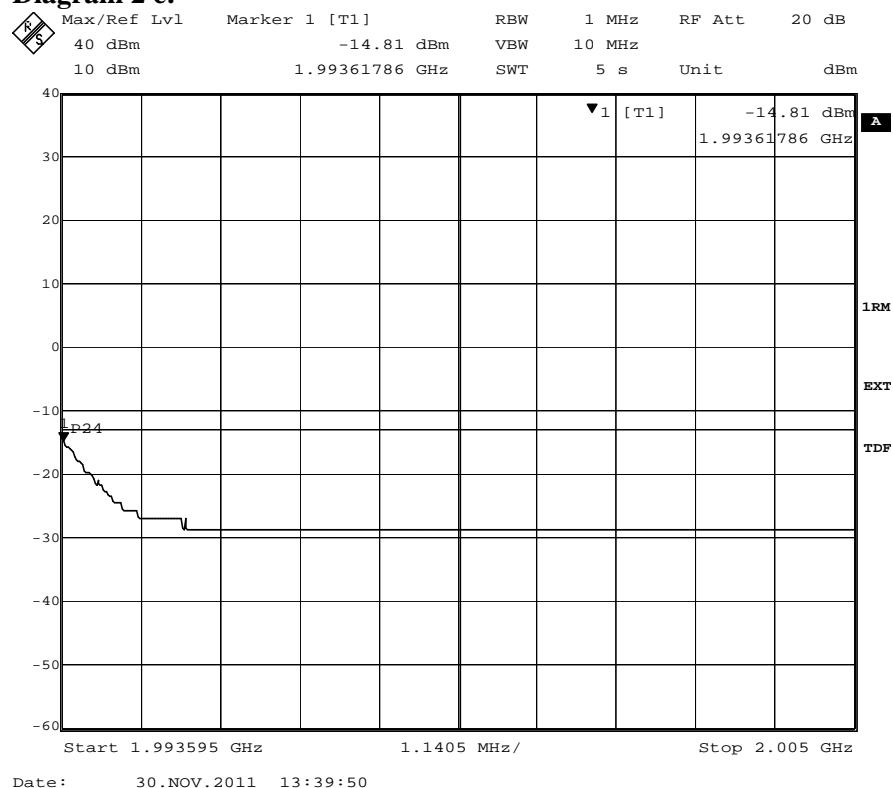
Date: 30.NOV.2011 13:37:20

**Diagram 2 b:**



Date: 30.NOV.2011 13:39:16

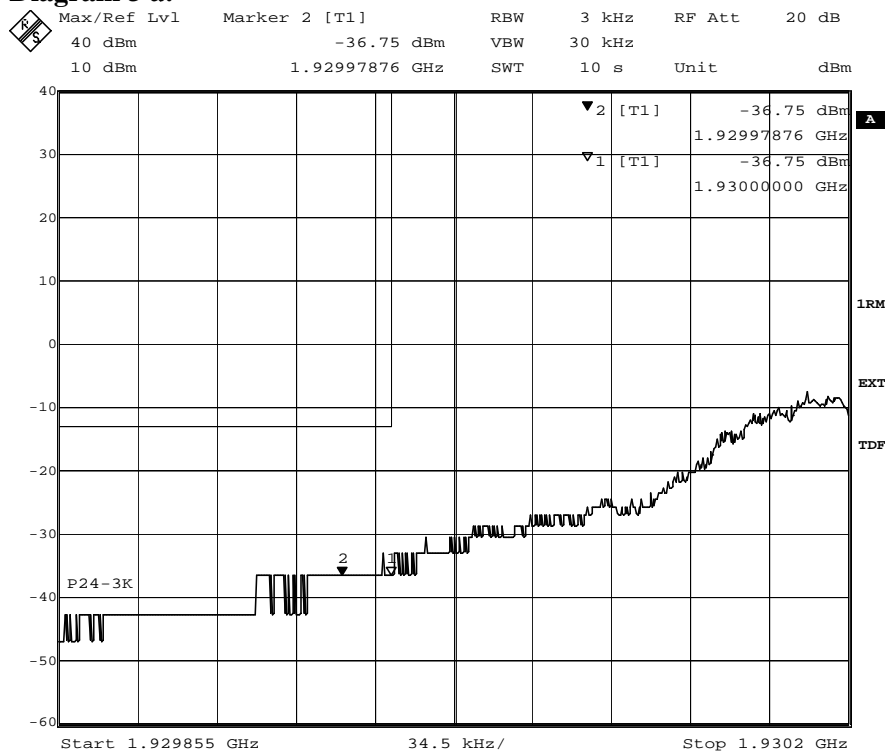
## Appendix 4

**Diagram 2 c:**




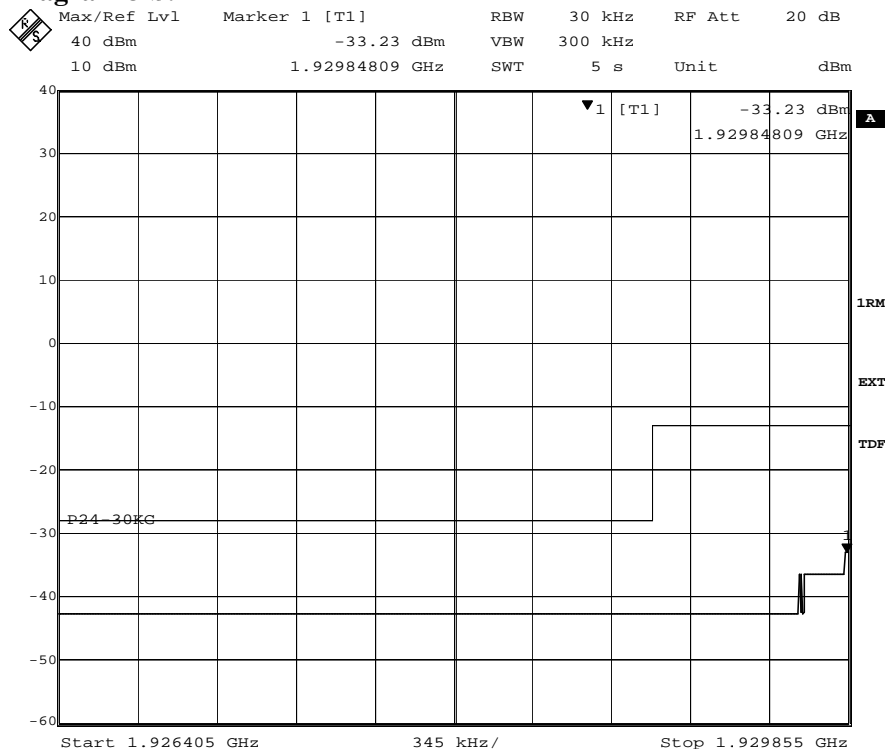
## Appendix 4

**Diagram 3 a:**



Date: 30.NOV.2011 09:15:54

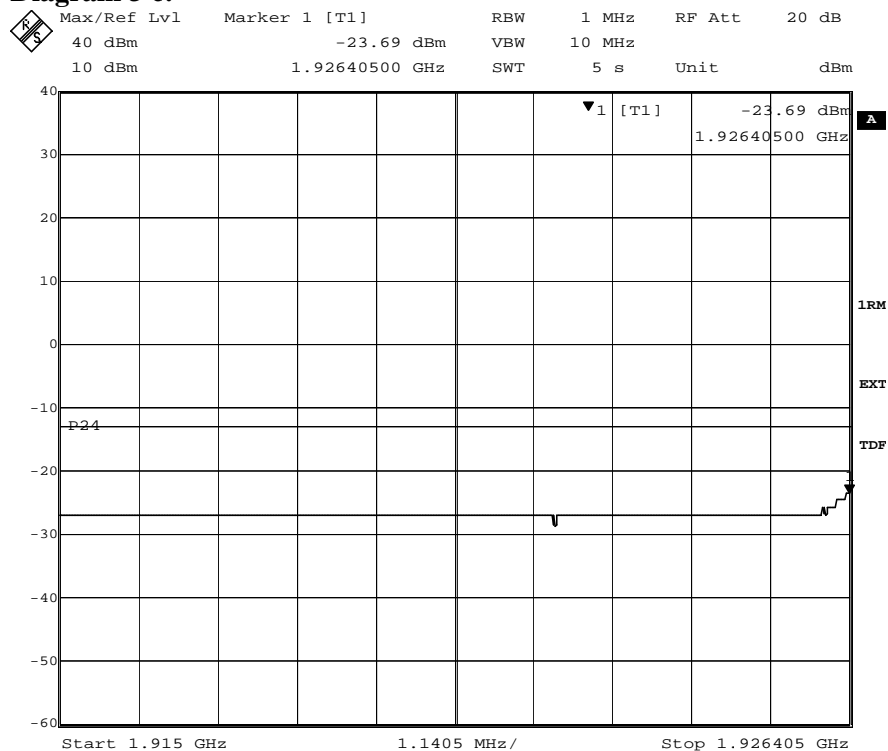
**Diagram 3 b:**



Date: 30.NOV.2011 09:14:54

## Appendix 4

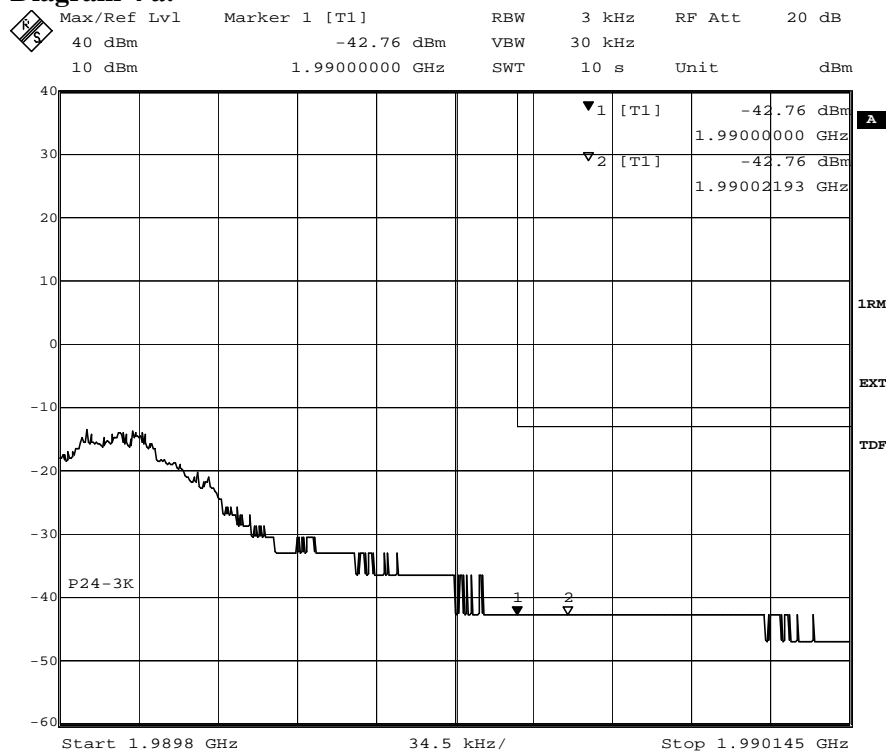
**Diagram 3 c:**



Date: 30.NOV.2011 09:17:14

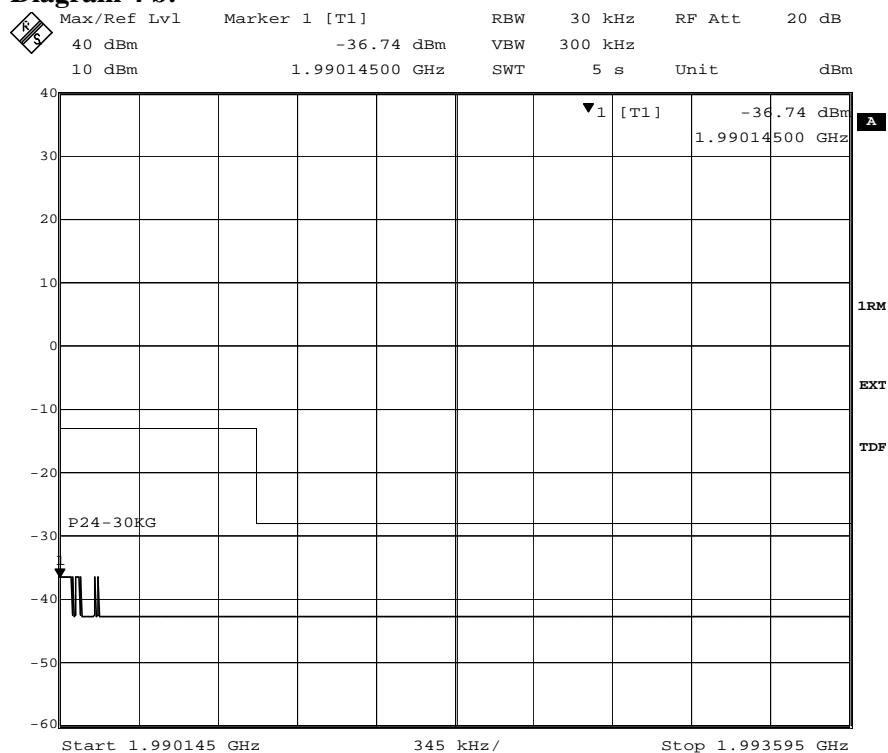
## Appendix 4

**Diagram 4 a:**



Date: 30.NOV.2011 10:17:37

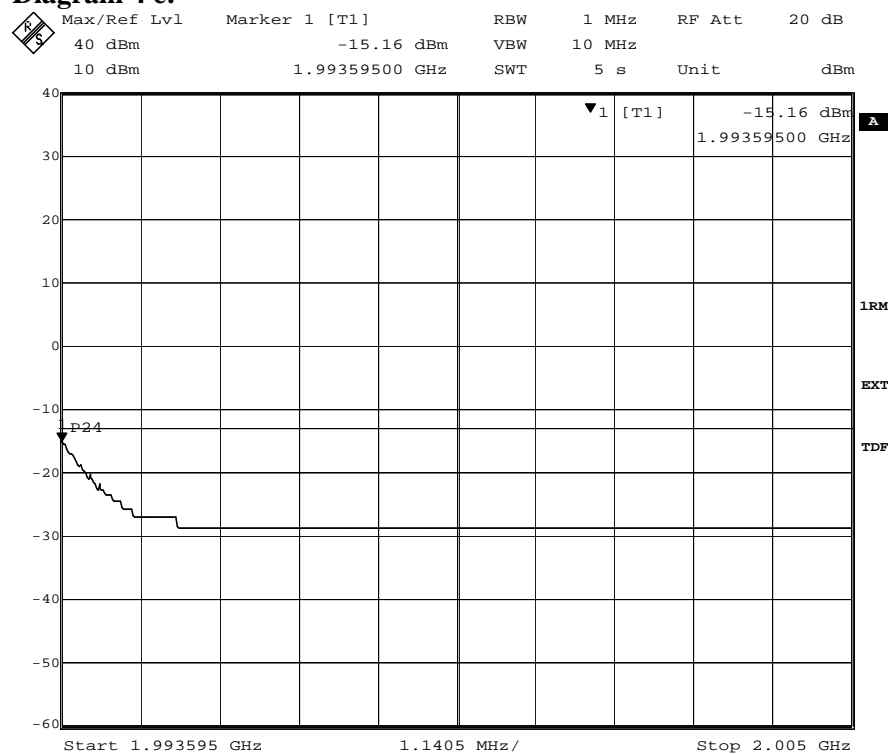
**Diagram 4 b:**



Date: 30.NOV.2011 10:20:40

## Appendix 4

**Diagram 4 c:**



Date: 30.NOV.2011 10:22:36

## Appendix 5

### Conducted spurious emission measurements according to 47CFR 2.1051

| Date       | Temperature  | Humidity   |
|------------|--------------|------------|
| 2011-11-29 | 23 °C ± 3 °C | 27 % ± 5 % |
| 2011-12-01 | 24 °C ± 3 °C | 25 % ± 5 % |

### Test set-up and procedure

The measurements were made per definition in §24.238. Measurements were made with the CDU output connected to a spectrum analyser. A pre-measurement was performed with the PEAK detector activated. Emission close to or above the limit with the PEAK detector is measured with the RMS detector activated. The spectrum analyser was connected to an external 10 MHz reference standard during the measurements.

| Measurement equipment                    | SP number |
|--|-----------|
| R&S FSIQ                                 | 503 738   |
| Attenuator                               | 504 159   |
| High pass filter                         | 504 200   |
| Testo 635 temperature and humidity meter | 504 203   |

**Measurement uncertainty:** 3.7 dB

### Results

The results are shown in the diagrams below.

Configuration: TCC mode with RBS master 2E setting 49 for maximum nominal output power. The measurement was performed using ARFCN 661 (1960.0 MHz)

| Diagram | Modulation | Frequency range |
|---------|------------|-----------------|
| 1 a:    | GMSK       | 9 KHz – 3 GHz   |
| 1 b:    | GMSK       | 3 GHz – 20 GHz  |
| 2 a:    | AQPSK      | 9 KHz – 3 GHz   |
| 2 b:    | AQPSK      | 3 GHz – 20 GHz  |

The diagrams are shown on the following pages.

### Remark

The emission at 9 kHz on some 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.

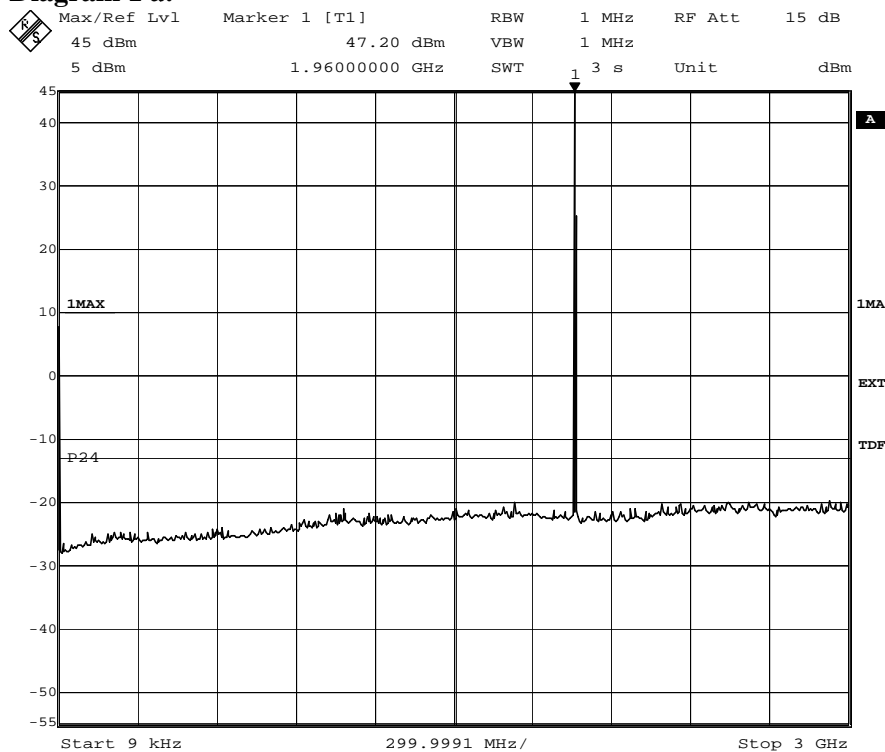
### Limits

The power of any emission outside the frequency band shall be attenuated below the transmitter power (P) by at least 43 + 10 log P dB.

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

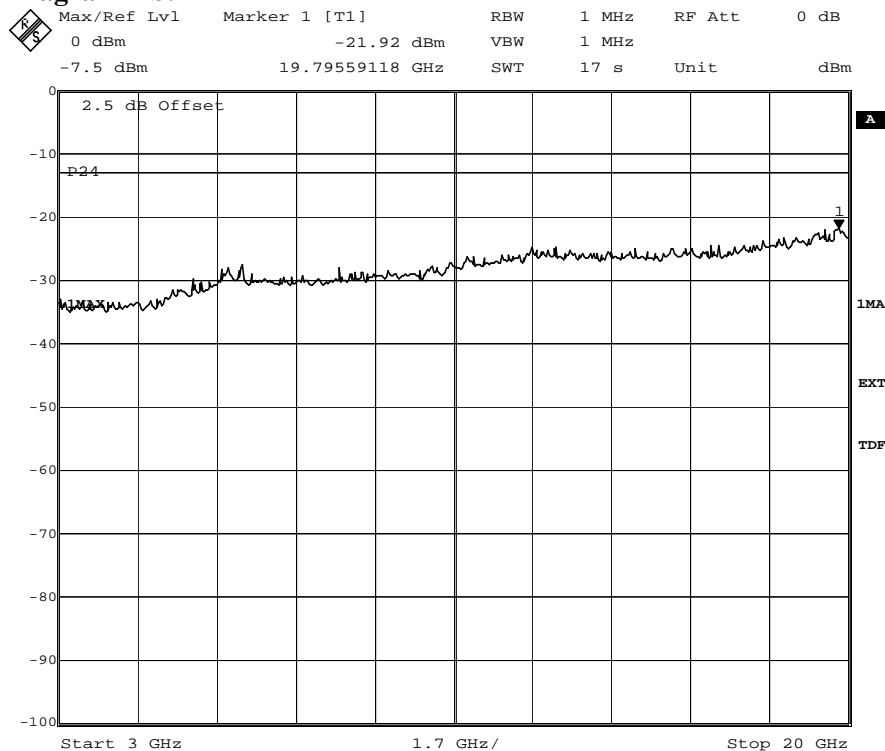
## Appendix 5

Diagram 1 a:



Date: 1.DEC.2011 14:17:02

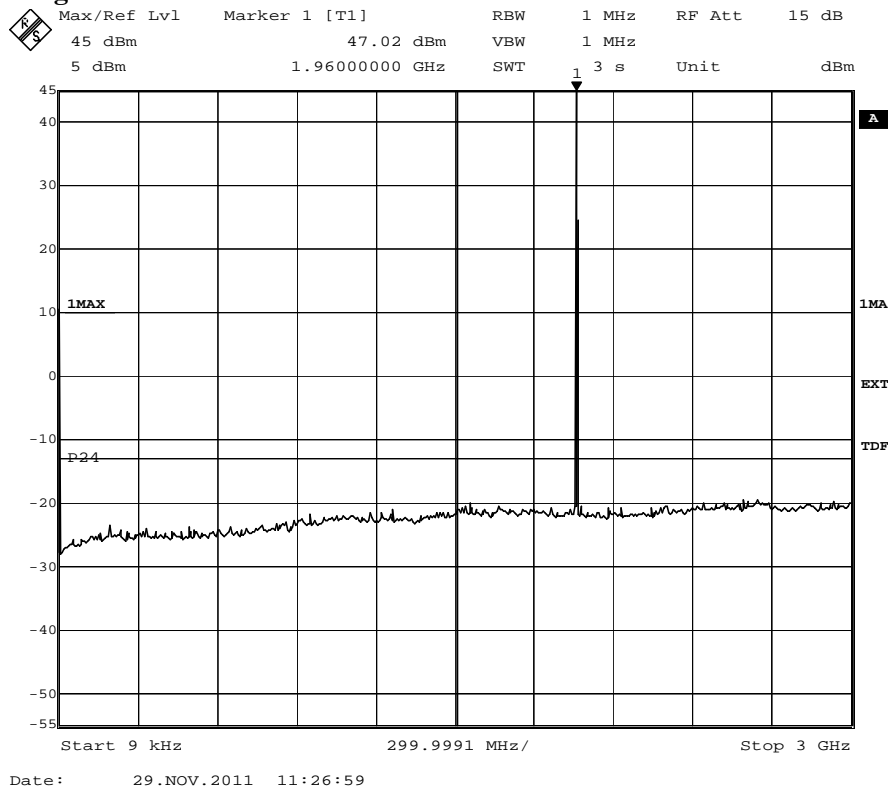
Diagram 1 b:



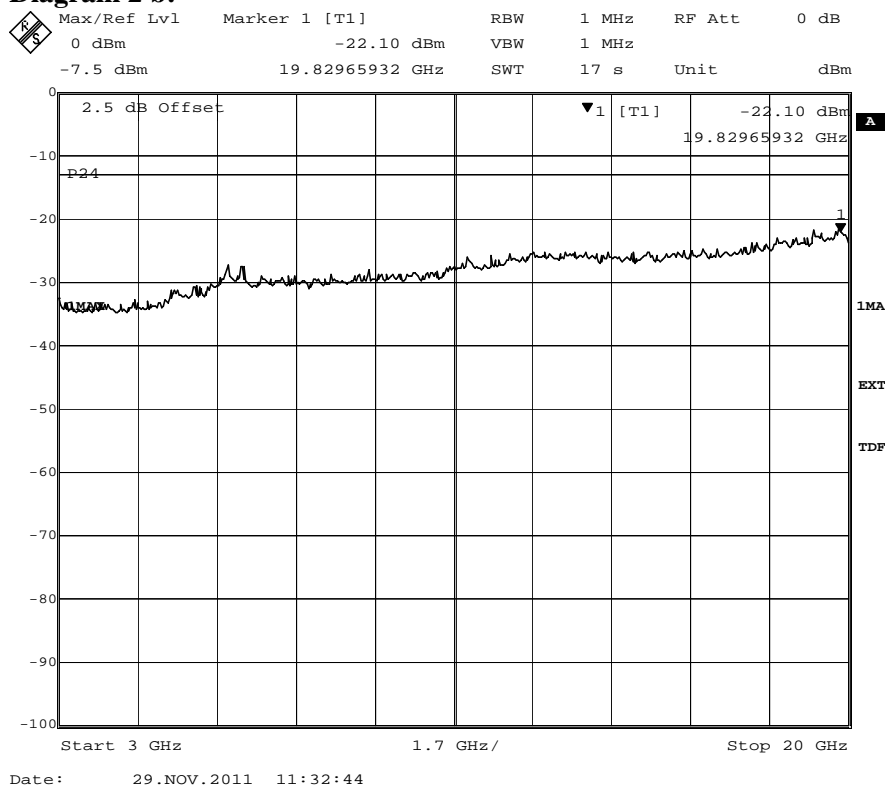
Date: 1.DEC.2011 14:18:22

## Appendix 5

**Diagram 2 a:**



**Diagram 2 b:**



## Appendix 6

### Field strength of spurious radiation measurements according to 47CFR 2.1053

|            |              |            |
|------------|--------------|------------|
| Date       | Temperature  | Humidity   |
| 2011-06-23 | 22 °C ± 3 °C | 52 % ± 5 % |

#### Test set-up and procedure

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 18-20 GHz.

The measurements were performed in Effective Radiated Power (ERP). A fully anechoic chamber was used during the measurements. The chamber is regularly calibrated with the substitution method and from that calibration an ERP correction factor is derived. The correction factor was used as a transducer to get the readings in ERP.

The measurement procedure was as the following:

1. A pre-measurement was first performed with peak detector. The EUT was continuously measured in 360 degrees.
2. Spurious radiation on frequencies closer than 6 dB to the limit was re-measured with RMS detector and with the substitution method according to the standard.

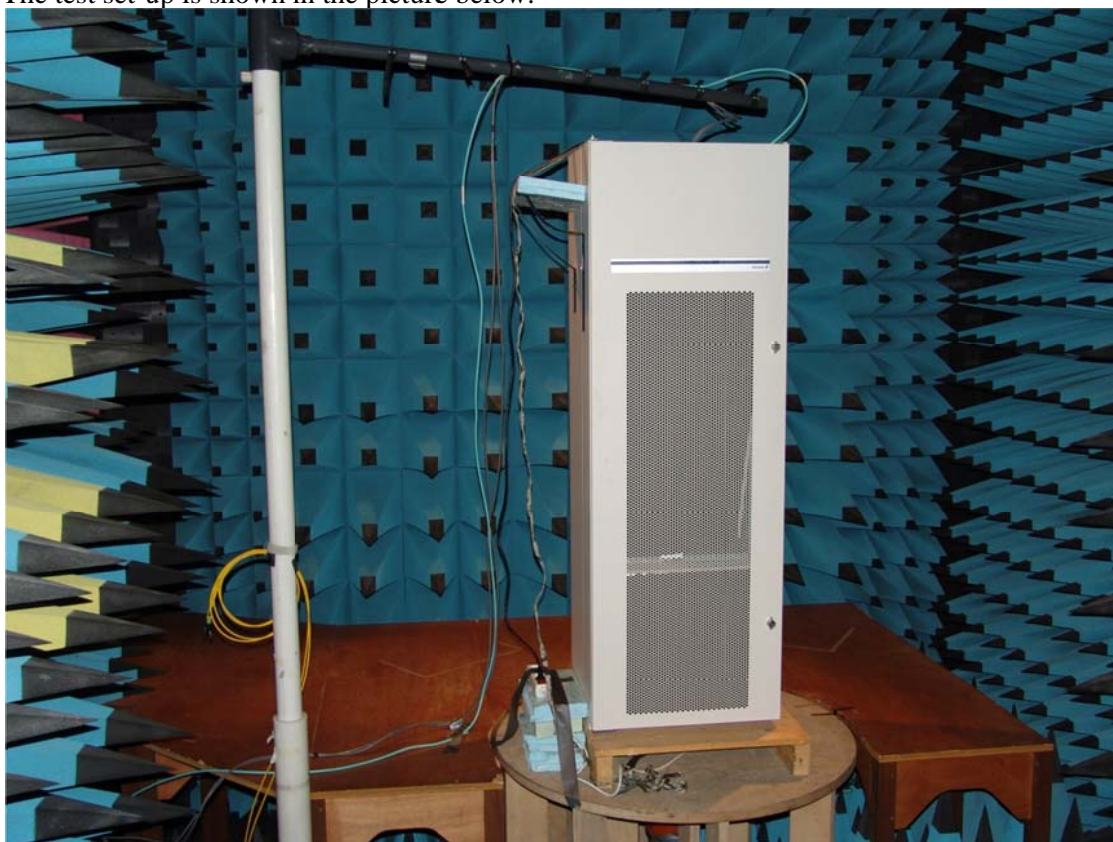
The test object was configured in TCC mode with RBS master 2E setting 49. TX ARFCN 661 (1960.0 MHz) was used.

| Measurement equipment                    | SP number |
|--|-----------|
| Anechoic chamber, Hertz                  | 15:116    |
| Rohde & Schwarz FSIQ40 Signal Analyser   | 503 738   |
| Rohde & Schwarz EMI Test Receiver ESI40  | 503 125   |
| Chase bilog antenna CBL 6121A            | 502 460   |
| Schaffner Reference Dipole BSRD6500      | 503 649   |
| EMCO Horn Antenna 3115                   | 502 175   |
| EMCO Horn Antenna 3115                   | 501 548   |
| Flann Std gain horn 20240-20             | 503 674   |
| MITEQ Low Noise Amplifier                | 503 277   |
| Rohde & Schwarz Vector Network Analyser  | 503 687   |
| Attenuator                               | 504 159   |
| Highpass filter                          | 503 739   |
| Testo 615 temperature and humidity meter | 503 498   |



## Appendix 6

The test set-up is shown in the picture below:



## Appendix 6

### Results

#### Modulation GMSK

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

#### Modulation AQPSK

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

**Measurement uncertainty:** 3.1 dB

### Limits

The power of any emission outside the frequency band shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log P$  dB.

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

## Appendix 7

### Hardware list RBS 2206 V2, conducted & radiated measurements

| Unit                | Product Number | Revision | Serial Number |
|---------------------|----------------|----------|---------------|
| Cabinet RBS 2206 V2 | SEB 112 1154/1 | R3A      | AB20131926    |
| Door                | SXK 109 7157/1 | R1B      | -             |
| ACCU-11             | BMG 980 07/09  | R1C      | (S)BH41071675 |
|                     |                |          |               |
| Subrack             | BFL 119 424/1  | R2C      | -             |
| CDU-G19             | BFL 119 153/1  | R5F      | A40003KLA1    |
| CDU-G19             | BFL 119 153/1  | R5F      | TR40177576    |
| CDU-G19             | BFL 119 153/1  | R5F      | A40003TYJ8    |
|                     |                |          |               |
| Dummy               | SXK 107 5031/2 | R1B      | -             |
| CXU-10              | KRY 101 1856/1 | R3D      | TR43605527    |
| Dummy               | SXK 107 5031/1 | R1B      | -             |
|                     |                |          |               |
| TRU shelf           | BFL 119 425/1  | R1C      | -             |
| Backplane           | BFX 101 107/3  | R1B      | -             |
| Empty               | -              | -        | -             |
| Empty               | -              | -        | -             |
| dTRU-19             | KRC 131 1004/2 | R1G      | AE50094077    |
| Empty               | -              | -        | -             |
| Empty               | -              | -        | -             |
| Empty               | -              | -        | -             |
| IDM-11              | BMG 980 327/2  | R1B      | X181175710    |
|                     |                |          |               |
| PSU-shelf           | BFL 119 453/1  | R1A      | (S)BK41073473 |
| Backplane           | BFX 101 107/3  | R1A      | -             |
| PSU-AC-32           | BML 353 206/2  | R1C      | (S)BR80299542 |
| PSU-AC-32           | BML 353 206/2  | R1C      | (S)BR80397732 |
| PSU-AC-32           | BML 353 206/2  | R1C      | (S)BR80348807 |
| Dummy               | SXK 107 9314/1 | R1C      | -             |
| Cover plate         | -              | -        | -             |
| (Empty gap)         | -              | -        | -             |
| DXU-23              | BOE 602 21/1   | R1C/A    | TU8D176697    |

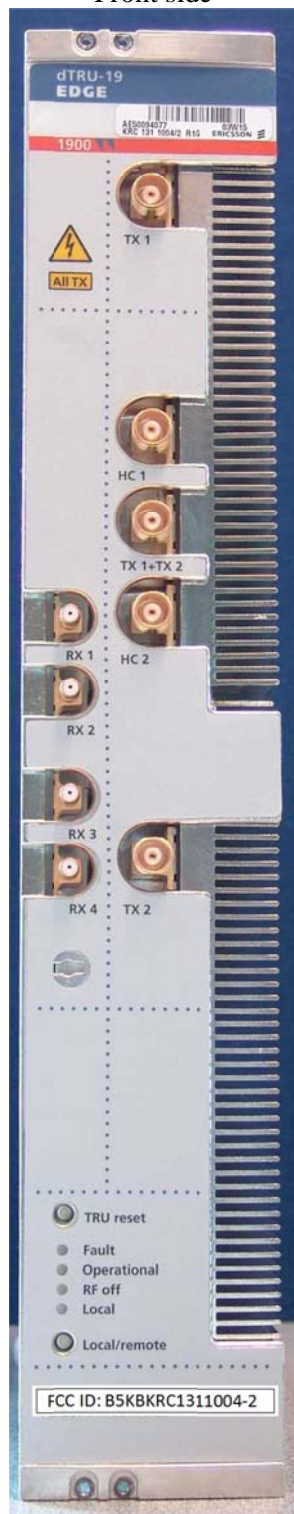
### Test object software during conducted and radiated measurements

| Software        | Revision |
|-----------------|----------|
| CXP 104 0007/05 | R31E     |

## Appendix 8

### Photos of the test object

Front side



Rear side

