# REPORT

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The test site complies with RSS Gen, file no: IC 3482A

| Date | Reference | Page |
|---|---|---|
| 2010-08-25 | FX009340-22 | 1 (2) |

1002
ISO/IEC 17025

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P. R. China

## Permissible change measurements on GSM Remote Radio Unit with FCC ID: B5KAKRC161028-4 and IC: 287Y-AGS61284

(8 appendices)

### Test object

RRU-H19 Edge, product KRC 161 028/4, revision R1G, SN AE51446884

See appendix 1 for general information. Appendix 7 lists hardware and software. Appendix 8 shows photos of the test object.

### Summary

| Standard | Compliant | Appendix | Remarks |
|---|---|---|---|
| **FCC CFR 47 / IC RSS-133 Issue 5** | | | |
| 2.1046 / RSS-133 6.4 RF Power output | Yes | 2 | - |
| 2.1049 / RSS-133 6.5 Occupied bandwidth | Yes | 3 | - |
| 2.1051 / RSS-133 6.5 Band Edge | Yes | 4 | Note 1 |
| 2.1051 / RSS-133 6.5 Spurious emission at antenna port | Yes | 5 | - |
| 2.1053 / RSS-133 6.5 Field strength of spurious radiation | Yes | 6 | - |

Note 1: The first channel adjacent to the lower and higher band-edge may not be used. The lowest usable channel is 513 (1930.4 MHz), the highest usable channel is 809 (1989.6 MHz), in order to be in line with the frequency range of the original grant.

Note 2: Above RSS-133 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**

Christer Karlsson
Technical Manager

Reinhold Reul
Technical Officer

FCC ID: B5KAKRC161028-4
IC: 287Y-AGS61284

## Table of contents

**Description - Equipment Under Test (EUT)**

| | |
|---|---|
| Equipment: | GSM Base station Remote Radio Unit |
| TX frequency range: | 1930.4 - 1989.6 MHz |
| Modulations: | GMSK, 8PSK, 16QAM and 32QAM |

| | Modulation | | | |
|---|---|---|---|---|
| | GMSK | 8PSK | 16QAM | 32QAM |
| Nominal maximum output power, RMS value in [dBm] | 41.5 | 38.2 | 36.8 | 36.4 |

Supply voltage -48 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 16QAM and 32QAM modulation. This report verifies maintained performance characteristics of affected items according FCC CFR47 by re-testing the updated equipment with GMSK, 16QAM and 32QAM modulation.

## Summary of results

Measurement results are near identical for all modulations, apart from RMS output power, where GMSK modulation results in the highest RMS output power. GMSK modulation can be considered a worst case set-up.

## Tested configuration

The test object was assembled into a RBS 2109 during the measurements. The hardware list is shown in appendix 7. The test object was activated at maximum power, unless noted otherwise. Pseudorandom data was transmitted in all time slots with the various modulations being tested, one at a time. This set-up was considered a worst-case configuration.

### Conducted measurements

Conducted measurements were done at antenna connector “TX(/RX) 1”.

### Radiated measurements

During radiated emission measurements the antenna connector “TX(/RX) 1” was via a 50 ohm attenuator connected to a spectrum analyser to monitor the transmitted signal. For the scope of this test it was deemed sufficient to measure and compare radiated spurious emission at the TX band center frequency for GMSK, 16QAM and 32QAM modulation. GMSK modulation with the highest RMS output power was chosen as worst case reference modulation to compare the new 16QAM and 32QAM modulations with.

### Frequencies used

| ARFCN | Frequency | | Comment |
|---|---|---|---|
| 513 | 1930.4 | MHz | Bottom TX frequency |
| 661 | 1960.0 | MHz | Mid TX frequency |
| 809 | 1989.6 | MHz | Top TX frequency |

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Appendix 1

## Manufacturer's representative

Hua Yang, Ericsson (China) Communications Company Ltd

## References

Measurements were done according to relevant parts of the following standards:
ANSI ANSI/TIA/EIA-603-C-2004
ANSI/TIA/EIA 136-280-D-2002
RSS-133, Issue 5 (February 2009)
RSS-Gen, Issue 2 (June 2007)

## 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: 2010-05-07

## Test equipment

| Measurement equipment | Calibration Due | SP number |
|---|---|---|
| Anechoic chamber, Hertz | 2010-10 | 15:116 |
| Boonton RF Peak power meter/analyzer | 2010-09 | 503 144 |
| Boonton Power sensor 56518-S/4 | 2012-02 | 503 146 |
| Rohde & Schwarz FSQ40 | 2010-07 | 504 143 |
| Rohde & Schwarz FSIQ40 | 2010-10 | 503 738 |
| Rohde & Schwarz ESI40 | 2010-07 | 503 125 |
| Rohde & Schwarz Vector Network Analyser | 2010-07 | 503 687 |
| Chase bilog antenna CBL 6121A | 2011-10 | 502 460 |
| Schaffner Reference Dipole BSRD6500 | 2012-03 | 502 181 |
| EMCO Horn Antenna 3115 | 2011-01 | 502 175 |
| EMCO Horn Antenna 3115 | 2011-02 | 501 548 |
| Flann Std gain horn 20240-20 | - | 503 674 |
| MITEQ Low Noise Amplifier | 2010-06 | 503 277 |
| Attenuator 40 dB | 2010-06 | 504 159 |
| Attenuator 30 dB | 2010-08 | 900 229 |
| Wainright high pass filter | 2011-03 | 504 200 |
| RLC Electronics HP-filter F-16149 | 2010-06 | 503 739 |
| Multimeter Fluke 87 | 2011-01 | 502 190 |
| Testo 615 temperature and humidity meter | 2012-03 | 503 498 |

## 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

Fredrik Isaksson and Reinhold Reul

## Test witnesses

Bo Zhao and Kevin Sun, Ericsson (China) Communications Company Ltd.

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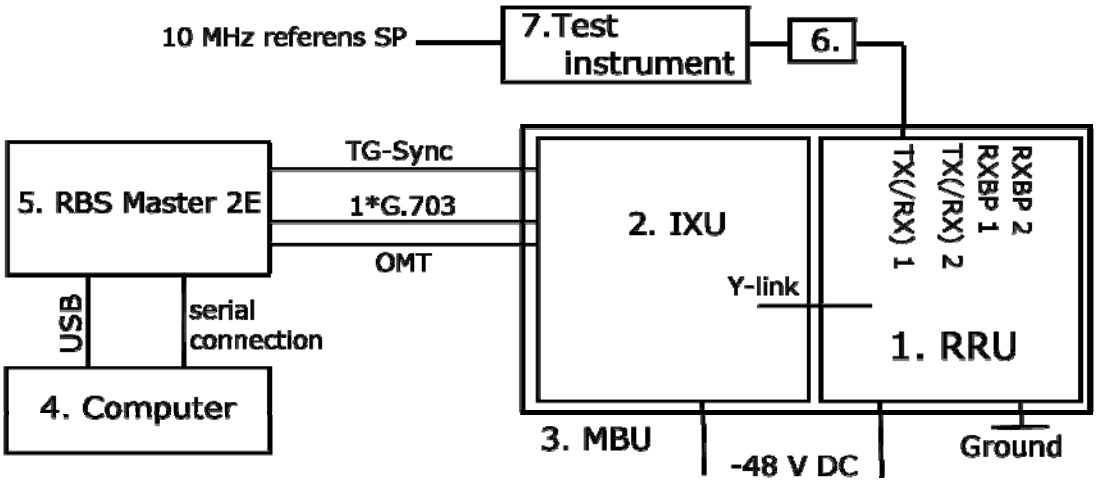
Appendix 1

## Test set-up conducted measurements



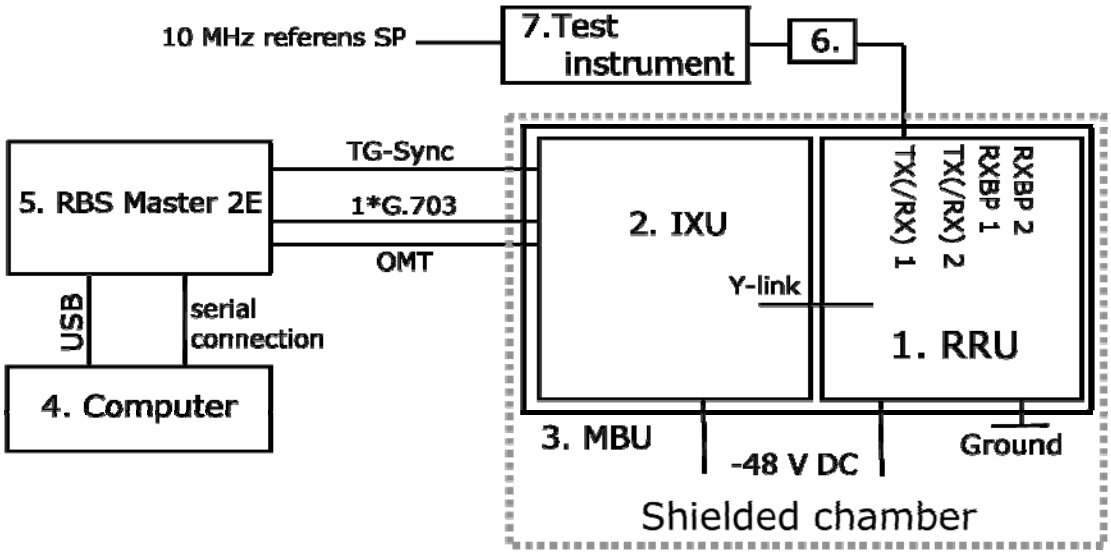

## Test object

1. RRU-H19 Edge, product KRC 161 028/4, revision R1G, SN AE51446884
   with FCC ID: B5KAKRC161028-4 and IC: 287Y-AGS61284

## Functional test equipment

2. IXU according hardware list in appendix 7
3. MBU frame according hardware list in appendix 7
4. HP laptop computer model Compaq NC6400,SN CND70310FD
   With software RBS Master2 control software, revision R7D02
5. Ericsson RBS Master 2E hardware, product number LBY 107 1007/3, revision R1C
   BAMS 1000735209
6. Attenuator / filter listed under test equipment in respective appendix
7. Measurement equipment specified in respective appendix
   The modulation type was verified using client-supplied Agilent MXA Signal Analyser model N9020A 20 Hz – 26.5 GHz, BAMS 1000737857

## Test set-up radiated measurements




### Test object

1. RRU-H19 Edge, product KRC 161 028/4, revision R1G, SN AE51446884
   with FCC ID: B5KAKRC161028-4 and IC: 287Y-AGS61284

### Functional test equipment

2. IXU according hardware list in appendix 7
3. MBU frame according hardware list in appendix 7
4. HP laptop computer model Compaq NC6400 SN CND72717JP
   With software RBS Master2 control software, revision R7D02
5. Ericsson RBS Master 2E hardware, product number LBY 107 1007/3, revision R1C, BAMS 1000735211
6. Attenuator 30 dB, SP 900229
7. Rohde & Schwarz FSIQ40 for signal monitoring, SP 503738

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Appendix 1

## Test object connections

| Interface | Type of port |
|---|---|
| -48 V DC | DC power |
| GND | Ground |
| Y-link to IXU | Optical interface |
| TX(/RX) 1, connected to test equipment | RF/Antenna |
| TX(/RX) 2, RXBP 1, RXBP 2 unconnected | RF/Antenna |

## Other connections

| Interface | Type of port: |
|---|---|
| PC – RBS Master 2E USB connection | Signal |
| PC – RBS Master 2E serial communication | Signal |
| TG-sync connection between RBS Master 2E & MU | Signal |
| IXU supply -48 V DC | DC power |
| G.703, shielded multi-wire with RJ-45connector, mode E1 | Telecom |
| OMT interface (only configuration, not connected in normal use) | O/M |

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Appendix 2

## RF Power output measurements according to CFR 47 2.1046 / IC RSS-133 6.4

| Date | Temperature | Humidity |
|---|---|---|
| 2010-05-27 | 22 °C ± 3 °C | 29 % ± 5 % |

### Test set-up and procedure

Measurements were made at antenna connector "TX(/RX) 1". The output was connected to a peak power analyser via a 50 ohm attenuator.

Configuration: TX ARFCN 661, 1960.0 MHz, and RBS master 2E software setting "41" for maximum output power were used. The transmitter was modulated with pseudorandom data during the measurements.

| Measurement equipment | SP number |
|---|---|
| Boonton RF Peak power meter/analyzer | 503 144 |
| Boonton Power sensor 56518-S/4 | 503 146 |
| Attenuator | 504 159 |
| Multimeter Fluke 87 | 502 190 |
| Testo 615 temperature and humidity meter | 503 498 |

**Measurement uncertainty**: 0.7 dB

### Results

| Test conditions Modulation | | Transmitter power (dBm) Peak / RMS | | |
|---|---|---|---|---|
| | | GMSK | 16QAM | 32QAM |
| $T_{nom}$ 22 °C | $V_{nom}$ -48.0 V DC | 41.9 / 41.1 | 41.8 / 37.3 | 41.8 / 36.5 |

### Limit

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).

RSS-133: Base station transmitters operating within the frequency range 1930 – 1995 MHz shall not exceed 100 W output power. The peak-to-average (PAR) ratio shall not exceed 13 dB. 1640 W EIRP shall not be exceeded (according SRSP-510).

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

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Appendix 3

## Occupied bandwidth measurements according to 47CFR 2.1049 / IC RSS-133 6.5

| Date | Temperature | Humidity |
|---|---|---|
| 2010-05-27 | 22 °C ± 3 °C | 29 % ± 5 % |

### Test set-up and procedure

The measurements were made per definition in §24.238. Measurements were made at antenna connector “TX(/RX) 1”. The test object output was connected to a spectrum analyser. The spectrum analyser was connected to an external 10 MHz reference standard during the measurements.

Configuration: TX ARFCN 661, 1960.0 MHz, and RBS master 2E software setting “41” for maximum output power were used. The transmitter was modulated with pseudorandom data during the measurements.

| Measurement equipment | SP number |
|---|---|
| Rohde & Schwarz FSQ40 | 504 143 |
| Attenuator | 504 159 |
| Testo 615 temperature and humidity meter | 503 498 |

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

### Results

The results are shown in appendix 3.1

| | | **Modulation** | **OBW** | |
|---|---|---|---|---|
| Diagram | 1: | GMSK | 240.7 | kHz |
| Diagram | 2: | 16QAM | 240.7 | kHz |
| Diagram | 3: | 32QAM | 241.3 | kHz |

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

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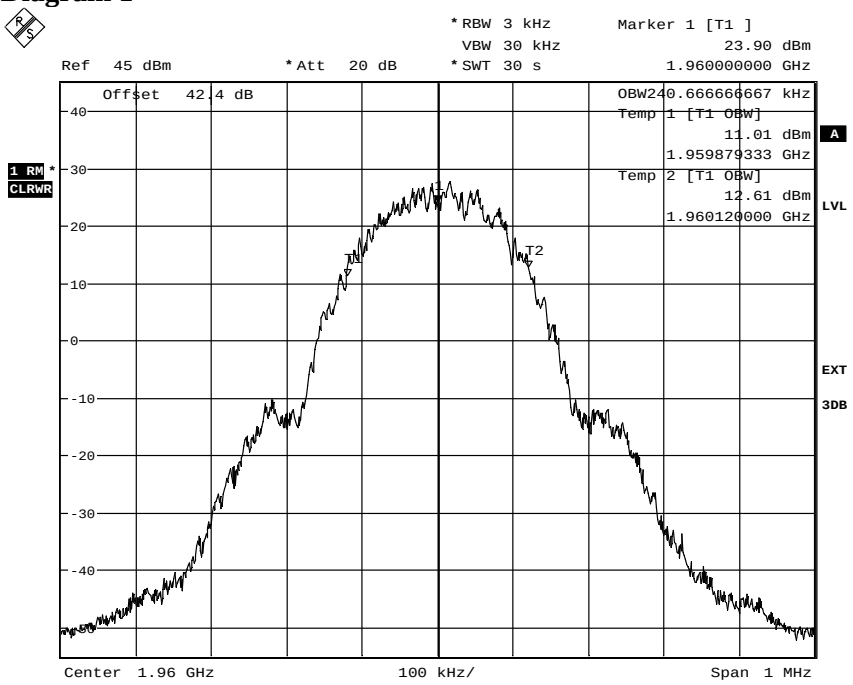
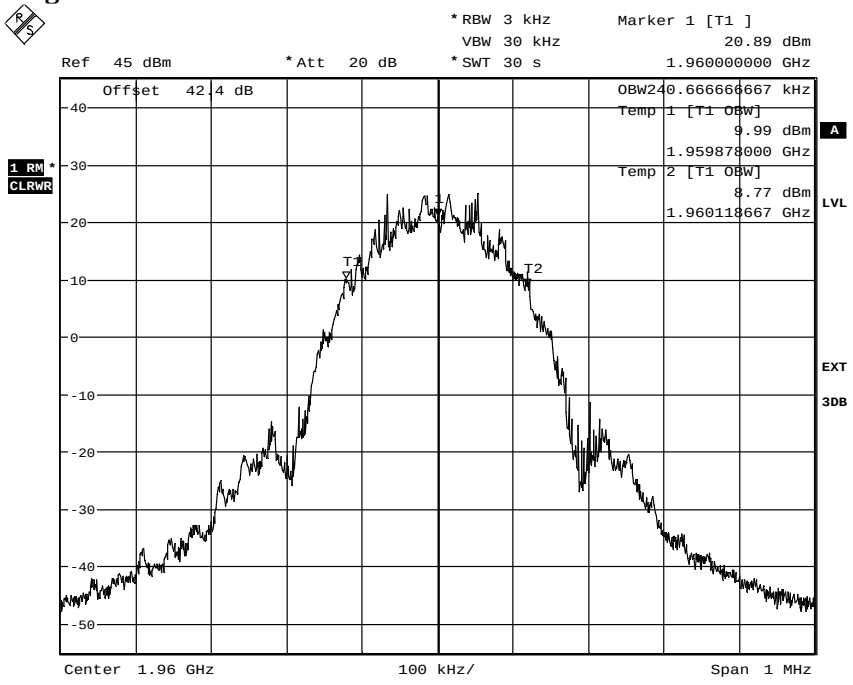
## Diagram 1




Date: 27.MAY.2010 14:37:20

## Diagram 2




Date: 27.MAY.2010 14:45:49

FCC ID: B5KAKRC161028-4 Appendix 3.1
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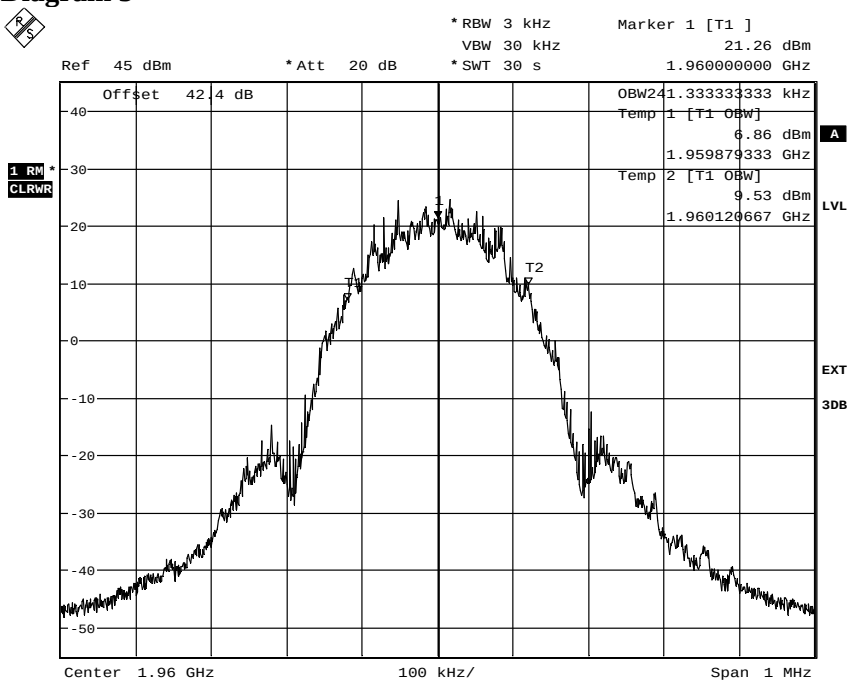
## Diagram 3




Date: 27.MAY.2010 14:54:24

FCC ID: B5KAKRC161028-4
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Appendix 4

## Band edge measurements according to 47CFR 2.1049 / IC RSS-133 6.5

| Date | Temperature | Humidity |
|---|---|---|
| 2010-05-27 | 22 °C ± 3 °C | 29 % ± 5 % |

### Test set-up and procedure

The measurements were made per definition in §24.238. The measurements were made at antenna connector “TX(/RX) 1”. The output 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 1 MHz for measurements of emissions >1 MHz away from the band edges. For the measurement close to the band edges a resolution bandwidth of 3 kHz was used. The limit line was adapted to the reduced RBW by -25.2 dB (10*log(3/1000) to -38.2 dBm for frequencies >1 MHz away from the band edges. For the 10 MHz wide measurement beyond the first MHz off the band edges a RBW of 50 kHz was used and the limit was adapted by -13 dB (10*log(50/1000)) to -26 dBm.

Configuration: RBS master 2E software setting “41” for maximum output power was used.
The transmitter was modulated with pseudorandom data during the measurements.

| Measurement equipment | SP number |
|---|---|
| Rohde & Schwarz FSQ40 | 504 143 |
| Attenuator | 504 159 |
| Testo 615 temperature and humidity meter | 503 498 |

**Measurement uncertainty:** 3.7 dB

### Results

The results are shown in appendix 4.1

Diagram 1 16QAM, Ch 513 (1930.4 MHz)
Diagram 2 16QAM, Ch 809 (1989.6 MHz)
Diagram 3 32QAM, Ch 513 (1930.4 MHz)
Diagram 4 32QAM, Ch 809 (1989.6 MHz)

### Remark

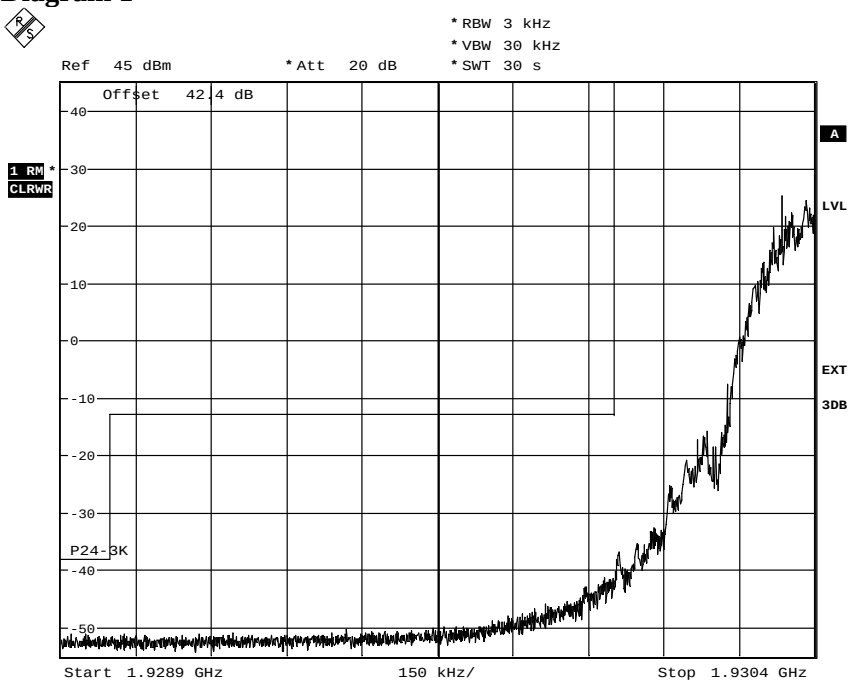
The first channel adjacent to the lower and higher band-edge may not be used. The lowest usable channel is 513 (1930.4 MHz), the highest usable channel is 809 (1989.6 MHz), in order to be in line with the frequency range of the original grant.

### 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 |

## Diagram 1

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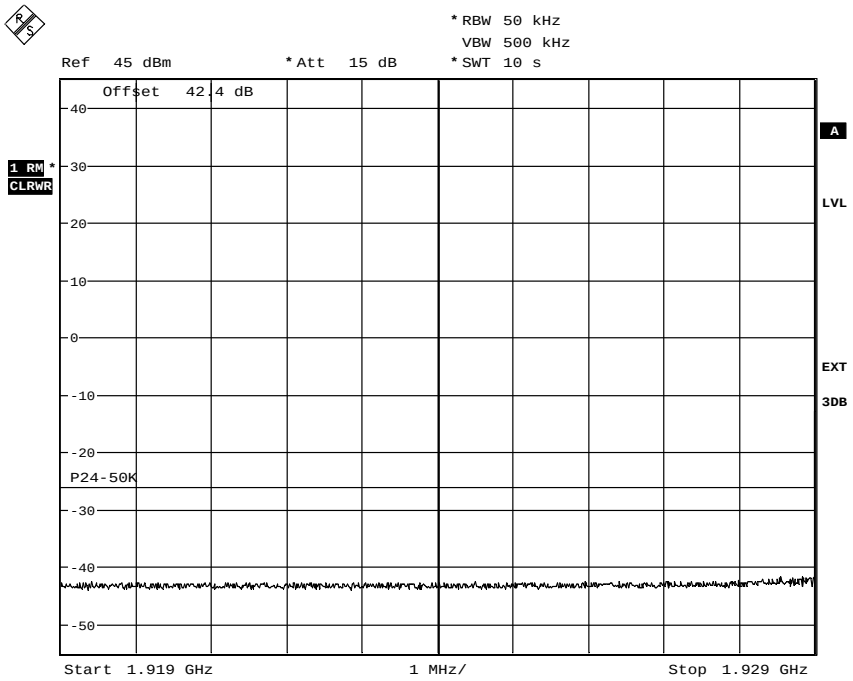
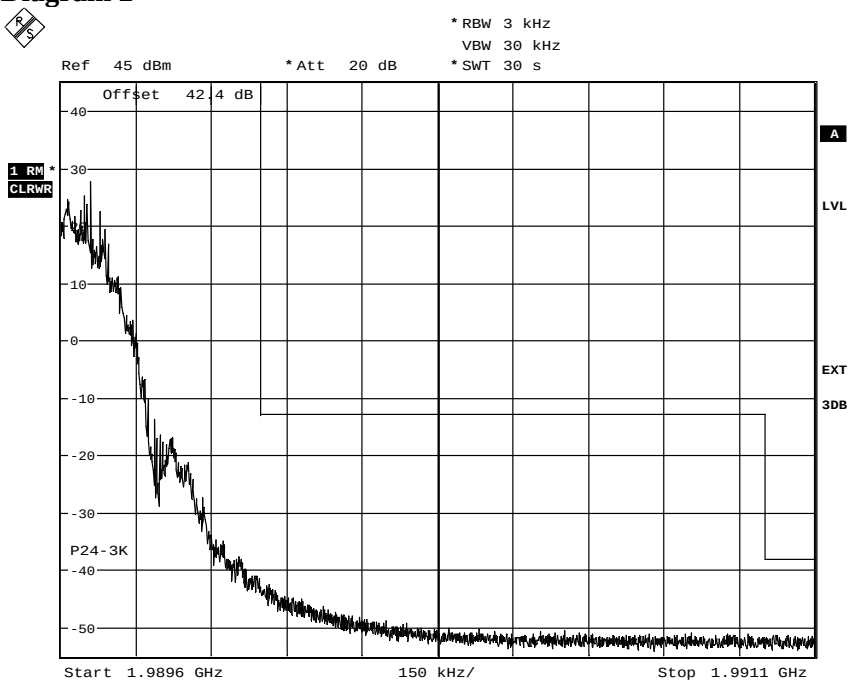



Date: 27.MAY.2010 15:39:32

**Diagram 2**

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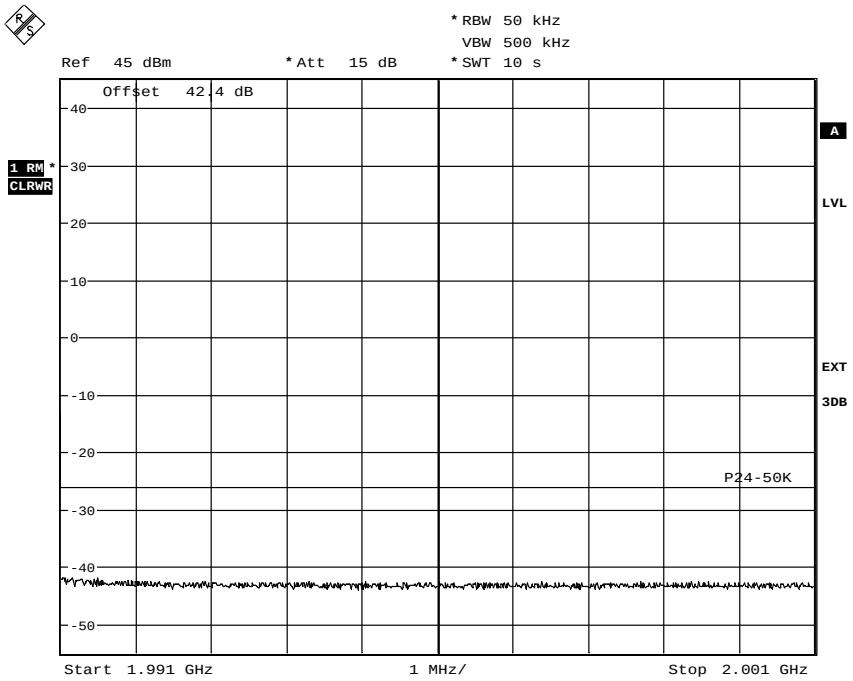
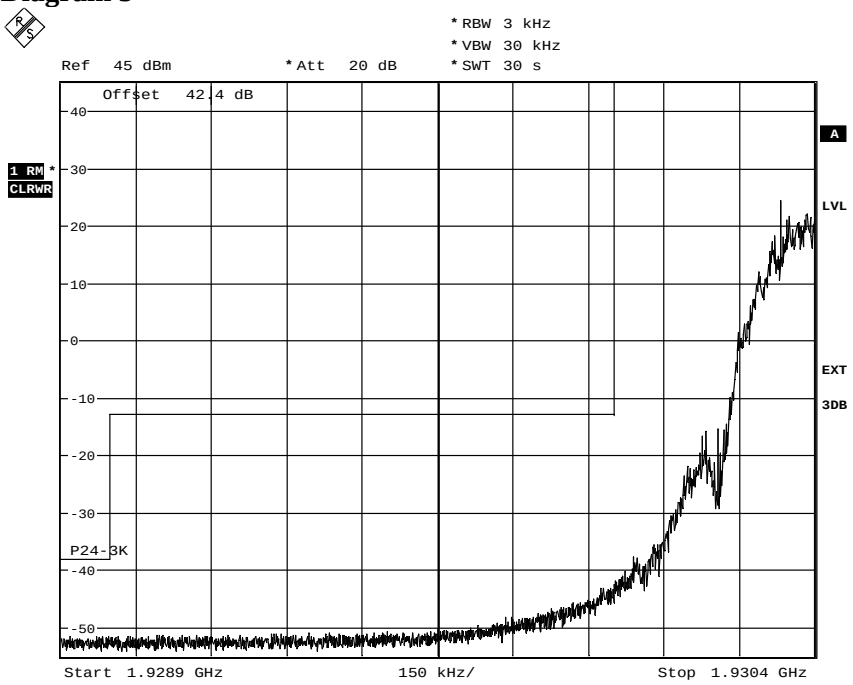



Date: 27.MAY.2010 16:08:07

## Diagram 3

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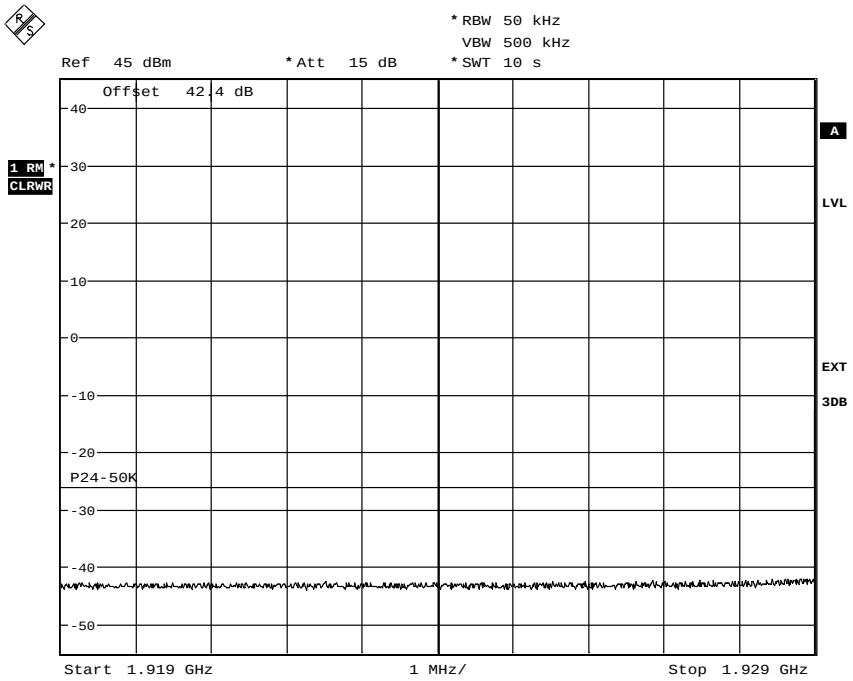
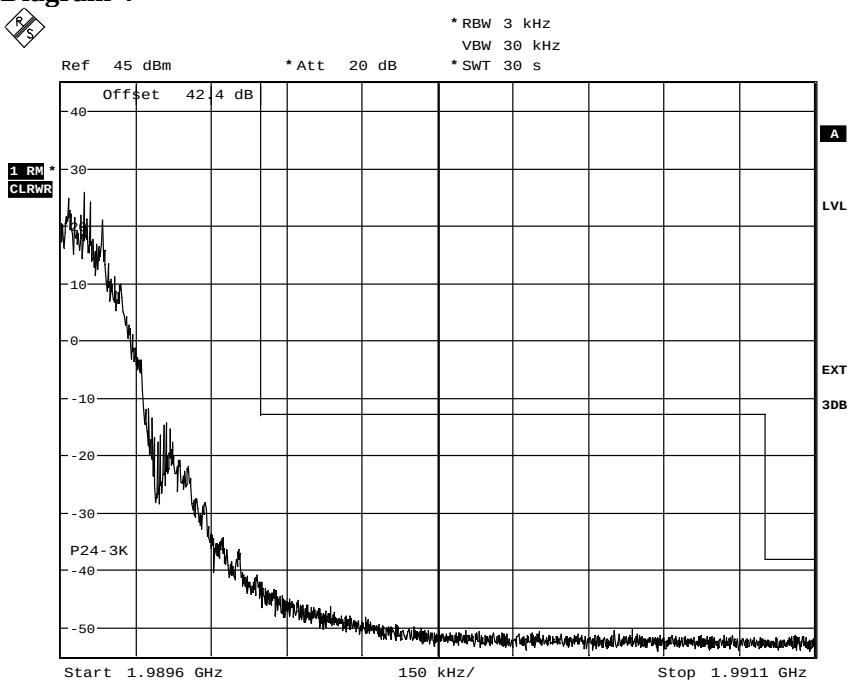
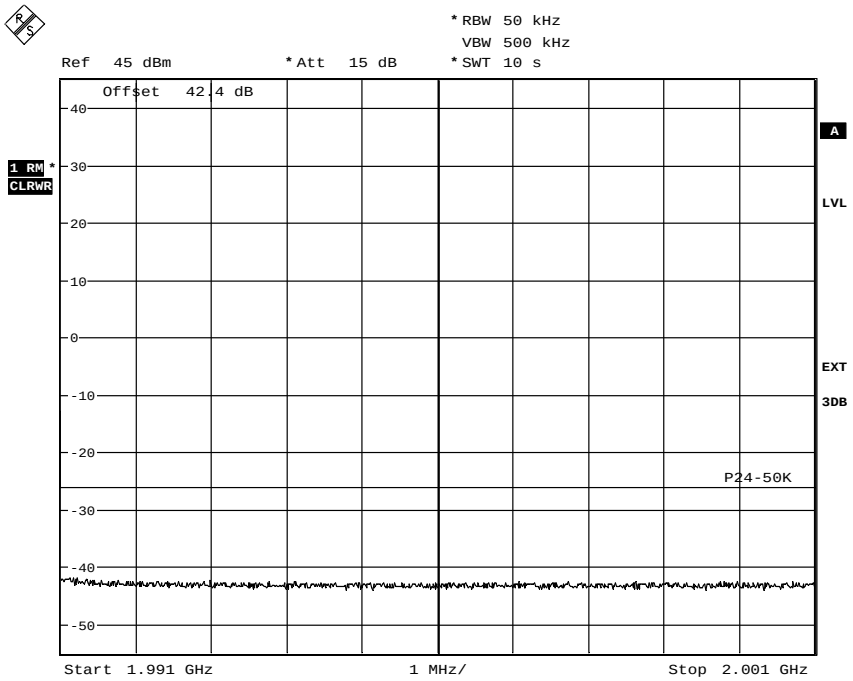



Date: 27.MAY.2010 15:32:08

## Diagram 4




Date: 27.MAY.2010 16:11:54




Date: 27.MAY.2010 16:13:23

## Conducted spurious emission measurements according to 47CFR 2.1051 / IC RSS-133 6.5

| Date | Temperature | Humidity |
|---|---|---|
| 2010-05-27 | 22 °C ± 3 °C | 29 % ± 5 % |

### Test set-up and procedure

The measurements were made per definition in §24.238. Measurements were made at antenna connector “TX (/RX) 1”. The output was connected to a spectrum analyser. A pre-measurement was performed with the PEAK detector activated. Emission 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.

Configuration: TX ARFCN 661, 1960.0 MHz, and RBS master 2E software setting “41” for maximum output power were used. The transmitter was modulated with pseudorandom data during the measurements.

| Measurement equipment | SP number |
|---|---|
| R&S FSQ | 504 143 |
| Attenuator | 504 159 |
| High pass filter | 504 200 |
| Testo 615 temperature and humidity meter | 503 498 |

**Measurement uncertainty:** 3.7 dB

### Results

The results are shown in appendix 5.1

Diagram 1: GMSK, 9 KHz – 3 GHz
Diagram 2: GMSK, 3 GHz – 20 GHz

Diagram 3: 16QAM, 9 KHz – 3 GHz
Diagram 4: 16QAM, 3 GHz – 20 GHz

Diagram 5: 32QAM, 9 KHz – 3 GHz
Diagram 6: 32QAM, 3 GHz – 20 GHz

### 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 feedthrough.

### Limits

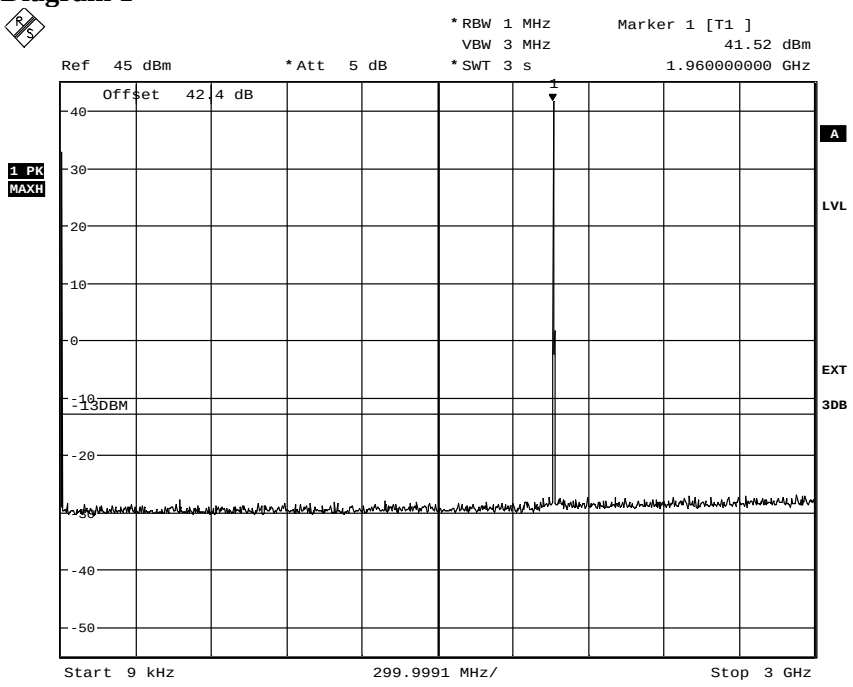
The power of any emission outside the frequency band shall be attenuated below the transmitter power (P) by at least 43 + 10 log P dB.

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

FCC ID: B5KAKRC161028-4
IC: 287Y-AGS61284

Appendix 5.1

## Diagram 1

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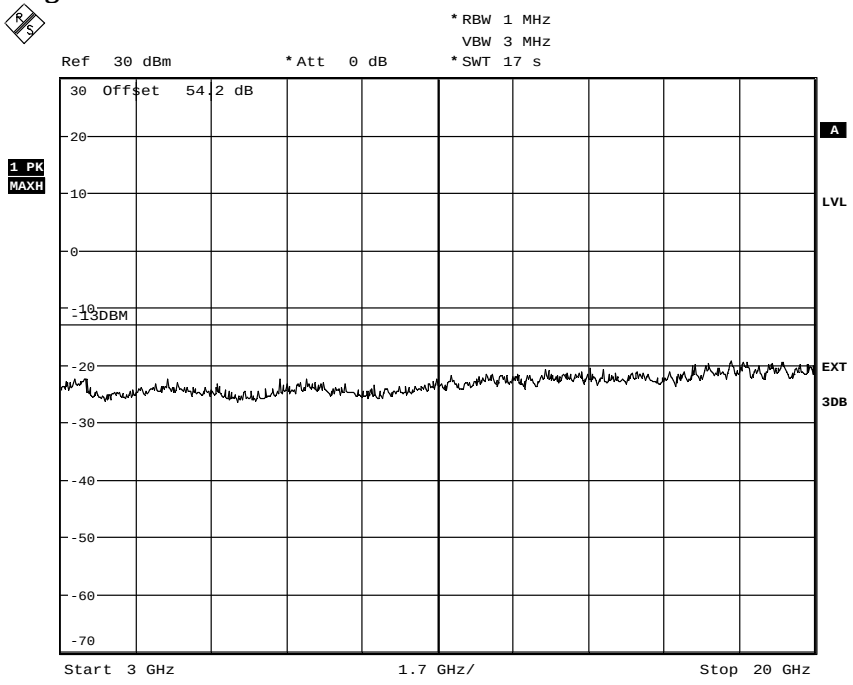
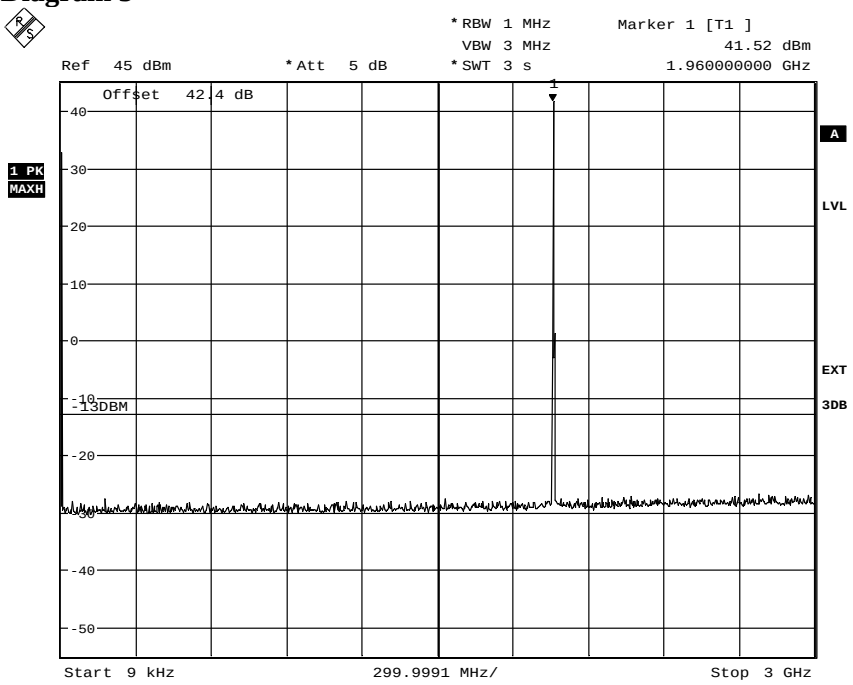
## Diagram 2




Date: 27.MAY.2010 14:42:39

## Diagram 3

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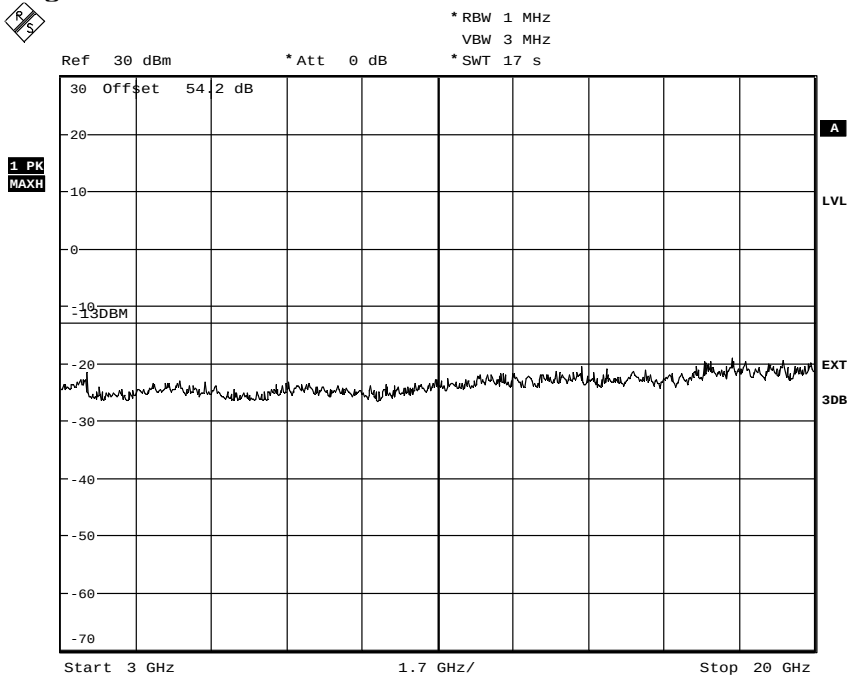
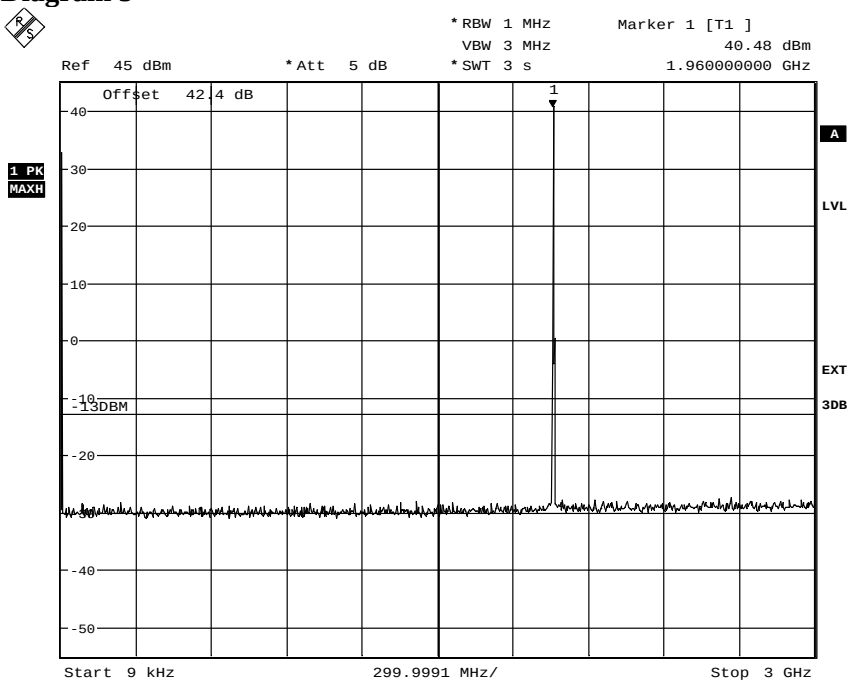
## Diagram 4



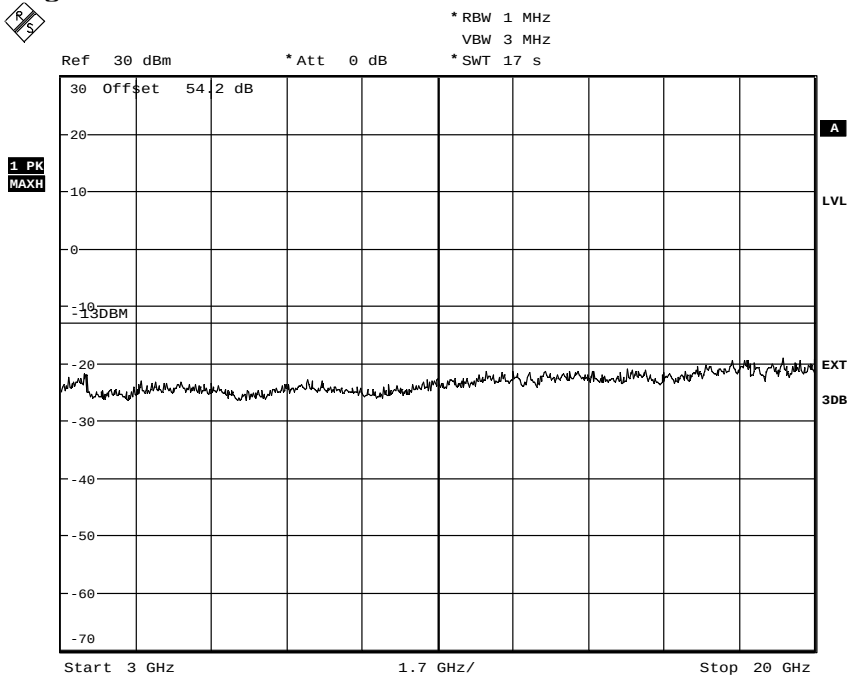

Date: 27.MAY.2010 14:50:01

## Diagram 5




Date: 27.MAY.2010 14:56:21

## Diagram 6




Date: 27.MAY.2010 14:58:24

FCC ID: B5KAKRC161028-4
IC: 287Y-AGS61284

Appendix 6

## Field strength of spurious radiation measurements according to 47CFR 2.1053 / IC RSS-133 6.5

| Date | Temperature | Humidity |
|---|---|---|
| 2010-05-28 | 22 °C ± 3 °C | 30 % ± 5 % |

### Test set-up and procedure

The measurements were performed with both horizontal and vertical polarisation 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.

Configuration: TX ARFCN 661, 1960.0 MHz, and RBS master 2E software setting “41” for maximum output power were used. The transmitter was modulated with pseudorandom data during the measurements.

| Measurement equipment | SP number |
|---|---|
| Anechoic chamber, Hertz | 15:116 |
| R&S FSIQ40 Signal Analyser | 503 738 |
| R&S 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 |
| R&S Vector Network Analyser | 503 687 |
| RLC Electronics HP-filter F-16149 | 503 739 |
| Testo 615, Temperature and humidity meter | 503 498 |

FCC ID: B5KAKRC161028-4
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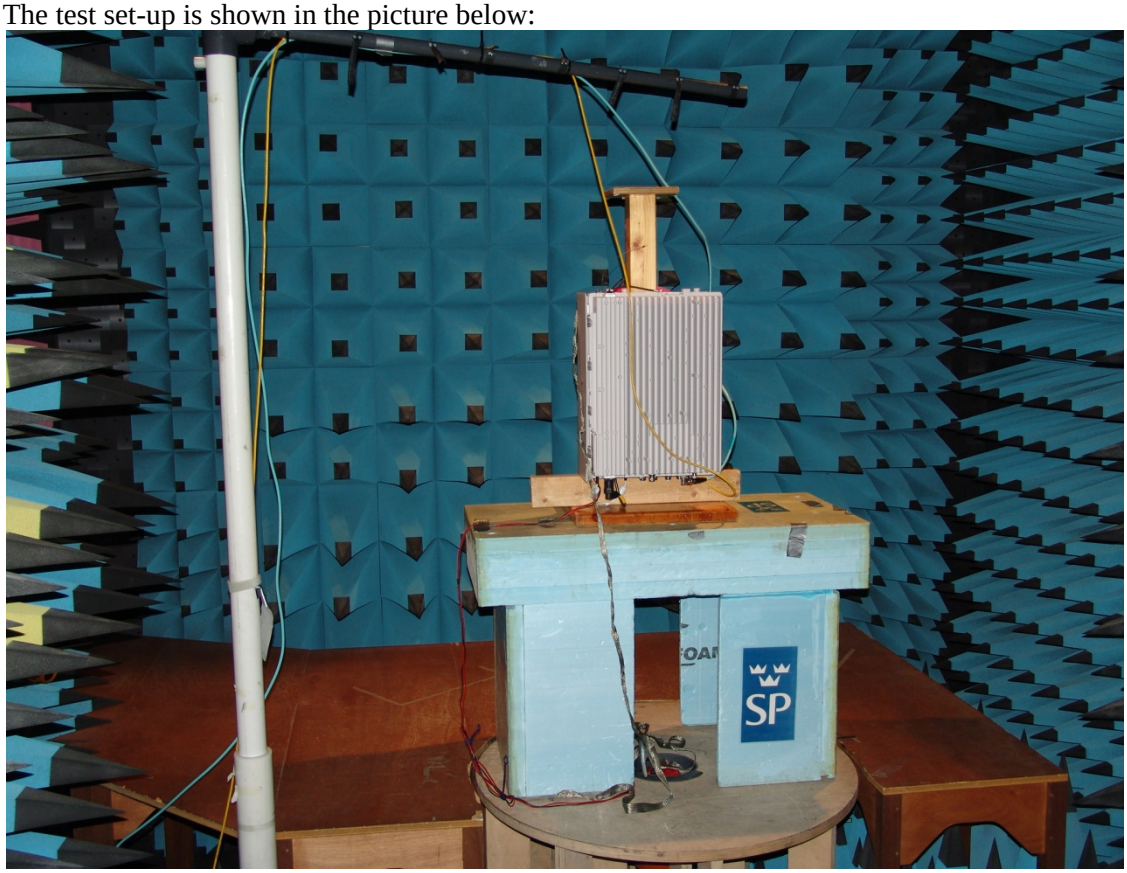
Appendix 6

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



**Results**

Modulation GMSK

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

Modulation 16QAM

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

Modulation 32QAM

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

**Measurement uncertainty: 3.2 dB up to 18 GHz, 3.6 dB above 18 GHz**

**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 |

FCC ID: B5KAKRC161028-4
IC: 287Y-AGS61284

Appendix 8

## Hardware & software list

Parts of tested sample RBS 2109:

| Unit | Product Number | Revision | Serial Number |
|---|---|---|---|
| MBU-01 | SEB 112 1133/3 | R3C | B340754654 |
| IXU-21 | BOE 602 15/2 | R5C | AE53495267 |
| RRU-H19 | KRC 161 028/4 | R1G | AE51446884 |

| Software | Revision |
|---|---|
| CXP 104 0007/05 | G11B |

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## Photos of the test object

Note: Below pictures show the test object assembled into a RBS 2109.

Front side

Back side

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Appendix 8

Left side


Right side

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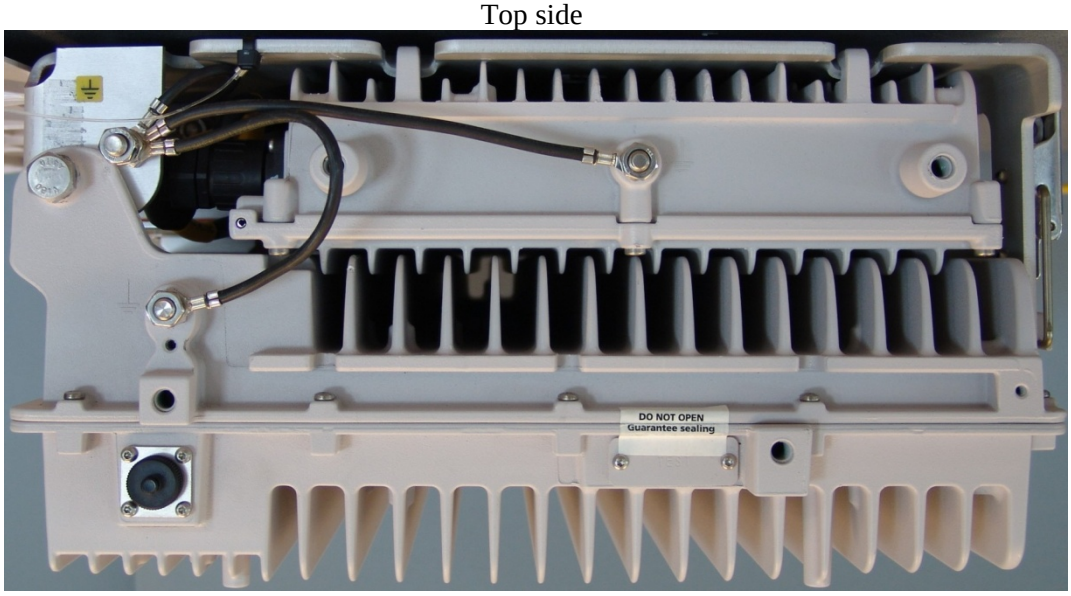
Appendix 8

Top side




Bottom side