REPORT

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Date	Reference	Page
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1002
ISO/IEC 17025

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Class II permissive change measurements on RRU-H19 1900 MHz cellular radio equipment with FCC ID: B5KAKRC161028-4

(7 appendices)

Test object

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

Summary

Standard	Compliant	Appendix
FCC CFR 47		
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 terminals	Yes	5
2.1053 Field strength of spurious radiation	Yes	6

SP Technical Research Institute of Sweden
Electronics - EMC

Performed by

Reinhold Reul

Examined by

Christer Karlsson

Table of contents

Description - Equipment Under Test (EUT)

Equipment:	GSM Base station transceiver unit
TX frequency band:	1930 – 1990 MHz
Modulations:	GMSK, 8PSK, 16QAM, 32QAM and AQPSK

Nominal maximum output power, RMS value in [dBm]:	Per modulation:				
	GMSK	8PSK	16QAM	32QAM	AQPSK
	41.5	38.2	36.8	36.4	38.1

Nominal 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 modulation AQSPK in SCPIR 0 dB. This report verifies maintained performance characteristics of affected items by re-testing the updated equipment and comparing results for prior worst case modulation GMSK with results for the new modulation.

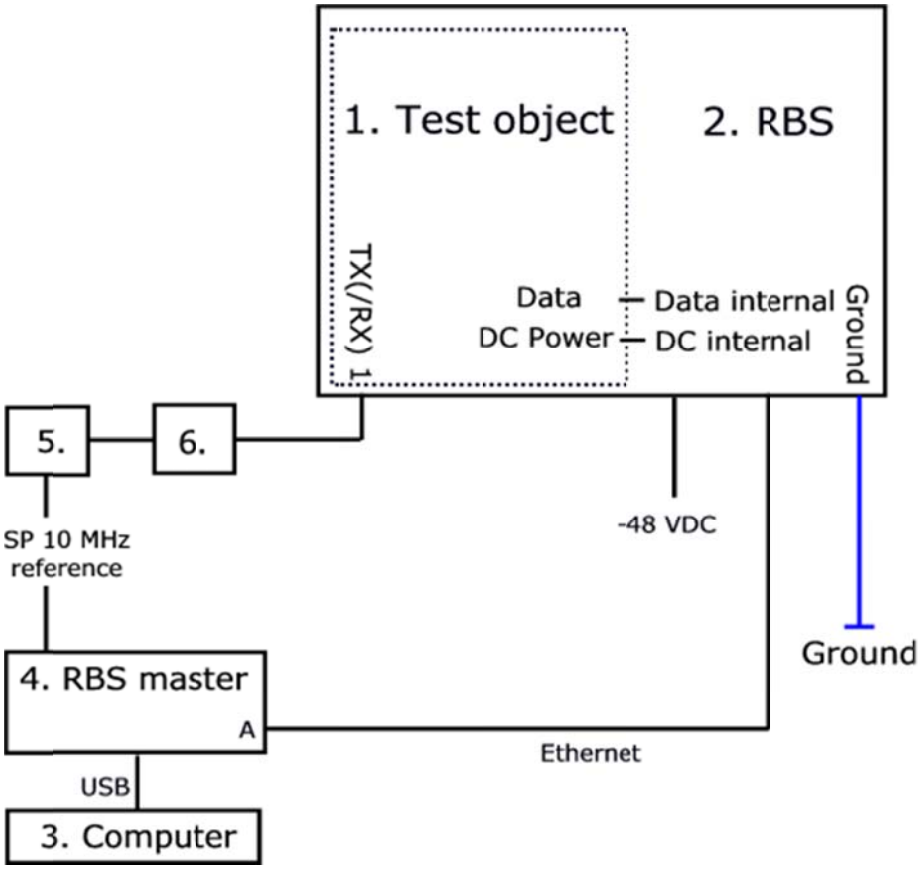
Tested configurations and set-ups

During tests the EUT was integrated into a RBS 2109 base station. The tested TX was activated at maximum nominal RF output power, with RBS Master 2 setting 41, and random data was transmitted in all time slots, with the various modulations being tested one at a time. Connections and reference points for measurements are shown in the set-ups below.

Test frequencies used

Channel	ARFCN	Frequency	Comment
B+1	513	1930.4 MHz	TX lowest frequency
M	661	1960.0 MHz	TX band center frequency
T+1	809	1989.6 MHz	TX highest frequency

Test set-up, conducted measurements



Note: Unconnected ports are omitted for simplicity.

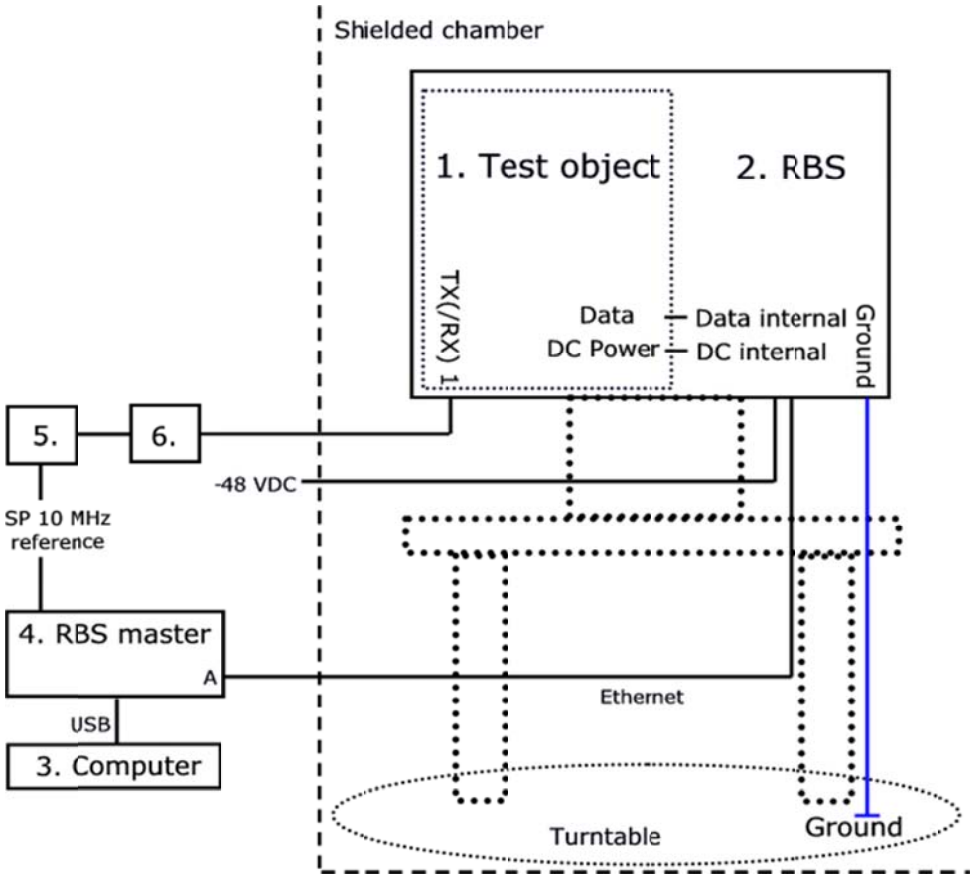
Test object

1. RRU-H19, product KRC 161 028/4, revision R1G, SN AE51446884 with FCC ID: B5KAKRC161028-4

Functional test equipment

2. RBS 2109, consisting of the test object and
   MBU-01, product SEB 112 1133/3, revision R3C, SN B340754654 and
   IXU-21, product BOE 602 15/2, revision R5C, SN AE53495267
3. Laptop Compaq nc6220, S/N: CNU54722NZ, BAMS 1000208319,
   with RBS Master 2E control software
4. RBS Master 2E hardware,
   product LPY 107 1007/3, revision R1C/A, SN T01E6555543, BAMS 1000878432,
   with shielded Ethernet multi-wire connected to RBS internal data port,
   using transmission mode E1
5. Measurement equipment specified in respective appendix or
   client supplied Agilent MXA Signal Analyser model N9020A 20 Hz – 3.6 GHz,
   BAMS 1000785533 used to verify the modulation schemes
6. Attenuator / filter listed under test equipment in respective appendix

Test set-up, radiated emission



Note: Unconnected ports are omitted for simplicity.

Test object

1. RRU-H19, product KRC 161 028/4, revision R1G, SN AE51446884 with FCC ID: B5KAKRC161028-4

Functional test equipment

2. RBS 2109, consisting of the test object and
   MBU-01, product SEB 112 1133/3, revision R3C, SN B340754654 and
   IXU-21, product BOE 602 15/2, revision R5C, SN AE53495267
3. Laptop Compaq nc6220, S/N: CNU54722NZ, BAMS 1000208319, with RBS Master 2E control software
4. RBS Master 2E hardware, product LPY 107 1007/3, revision R1C/A, SN T01E6555543, BAMS 1000878432, with shielded Ethernet multi-wire connected to RBS internal data port, using transmission mode E1
5. Rohde & Schwarz ESI40 (SP 503 125) for signal monitoring or 50 ohm termination
6. Attenuator 30 dB, SP 900229

Test object connections

Interface	Type of port
DC provided RBS internal, nominal -48 VDC	DC power
Ground connected to grounded RBS shell on top side	Ground
TX(/RX) 1, N female connector	Antenna
TX(/RX) 2, N female, unconnected	Antenna
RXBP 1 and RXBP 2, TNC female, unconnected, The RXBP ports may be used for connecting an optional RX band pass filter not used on the tested sample	Antenna
RBS internal Y-link for data, with IEEE-1394 connector	Signal

Note: Unconnected ports are omitted in the drawings above for simplicity. The photos in appendix 7 show EUT top & bottom views with all ports.

Test object software

Software	Revision
CXP 104 0007/05	R31E

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 1st, 2010
CFR 47 part 24, October 1st, 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: 2011-05-31

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 FSQ40	2012-07	504 143
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
Attenuator 30 dB	2012-08	900 229
High pass filter	2012-08	504 200
Multimeter Fluke 87	2012-05	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).

Reservation

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

Test engineers

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

Manufacturer’s representative

Hua Yang, Ericsson (China) Communications Company Ltd

Test witness

-

RF Power output measurements according to CFR 47 2.1046

Date	Temperature	Humidity
2011-12-07	23 °C ± 3 °C	23 % ± 5 %

Test set-up and procedure

Measurements were made with EUT port TX(/RX) 1via a 50 ohm attenuator connected to a peak power analyser.

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 615 temperature and humidity meter	503 498

Measurement uncertainty: 0.7 dB

Results

The test object was configured for maximum nominal output power using RBS Master2E power setting 41.

Transmitter power (dBm), Peak / RMS	
Modulation:	Channel: M
GMSK	41.8 / 41.0
AQPSK	41.3 / 37.5

The highest PAR measured above was 3.8 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

Occupied bandwidth measurements according to CFR 47 2.1049

Date	Temperature	Humidity
2011-12-07	23 °C ± 3 °C	23 % ± 5 %

Test set-up and procedure

Measurements were made with EUT port TX(/RX 1) via a 50 ohm attenuator 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
Rohde & Schwarz FSIQ40	503 738
Attenuator	504 159
Multimeter Fluke 87	502 190
Testo 615 temperature and humidity meter	503 498

Measurement uncertainty: 3.7 dB, 1.33 kHz

Results

The test object was configured for maximum nominal output power using RBS Master2E control setting 41. The measurement was performed at channel M.

		Channel	Modulation	OBW
Diagram	1:	M	GMSK	241 kHz
Diagram	2:	M	AQPSK	238 kHz

The diagrams are shown on the following page.

Diagram 1:

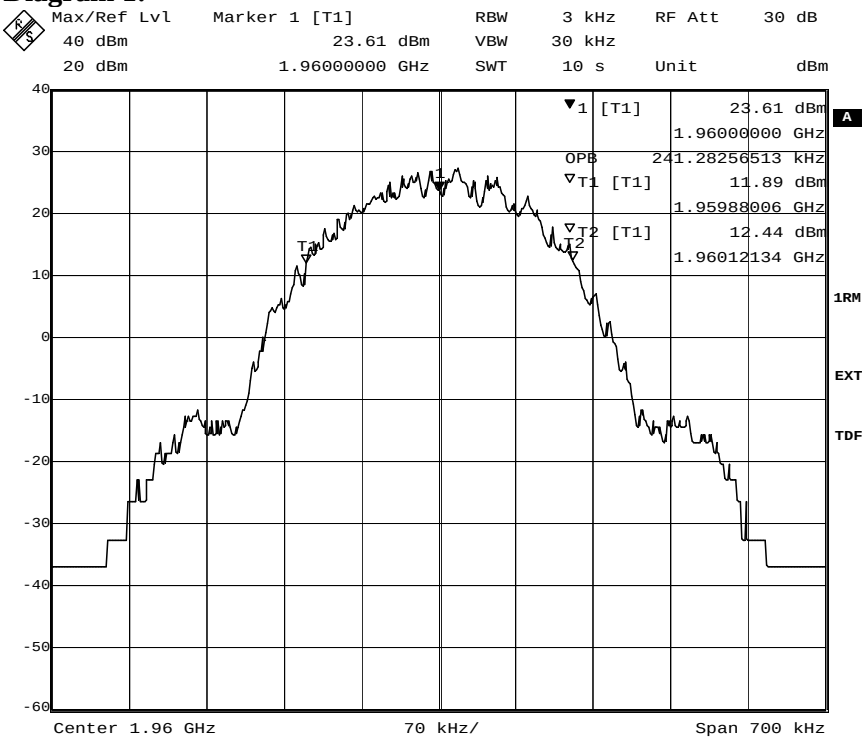
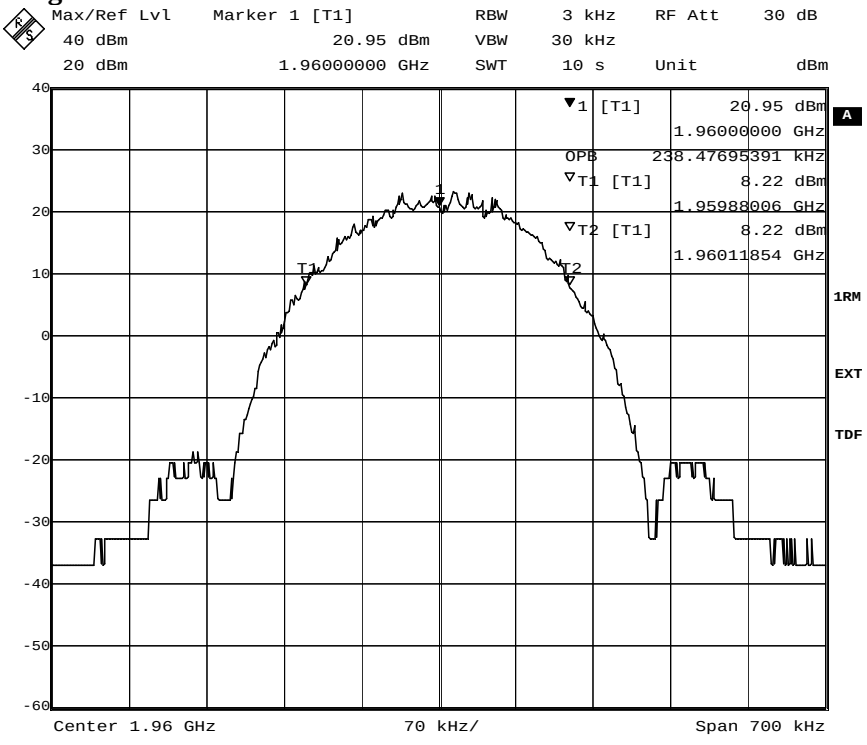


Diagram 2:



Band edge measurements according to CFR 47 2.1051

Date	Temperature	Humidity
2011-12-07	23 °C ± 3 °C	23 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §24.238. The measurements were made with EUT port TX(/RX) 1 via a 50 ohm attenuator 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.

The standard allows a RBW of 1% of the EBW within the 1st MHz off the band-edge and requires a RBW of 1 MHz for offsets beyond 1 MHz. Where a reduced RBW was used the limit line was adapted by 10*log(RBWused /1 MHz) dB.

Measurement equipment	SP number
Rohde & Schwarz FSIQ40	503 738
Attenuator	504 159
Multimeter Fluke 87	502 190
Testo 615 temperature and humidity meter	503 498

Measurement uncertainty: 3.7 dB

Results

The test object was configured for maximum nominal output power using RBS Master 2E power setting 41.

Diagram	Channel	Modulation
1 a, b, c	B+1	AQPSK
2 a, b, c	T+1	AQPSK

The diagrams are shown on the following pages.

Remark

The channels adjacent to the frequency band-edges, ARFCN 512 and 810, must not be used.

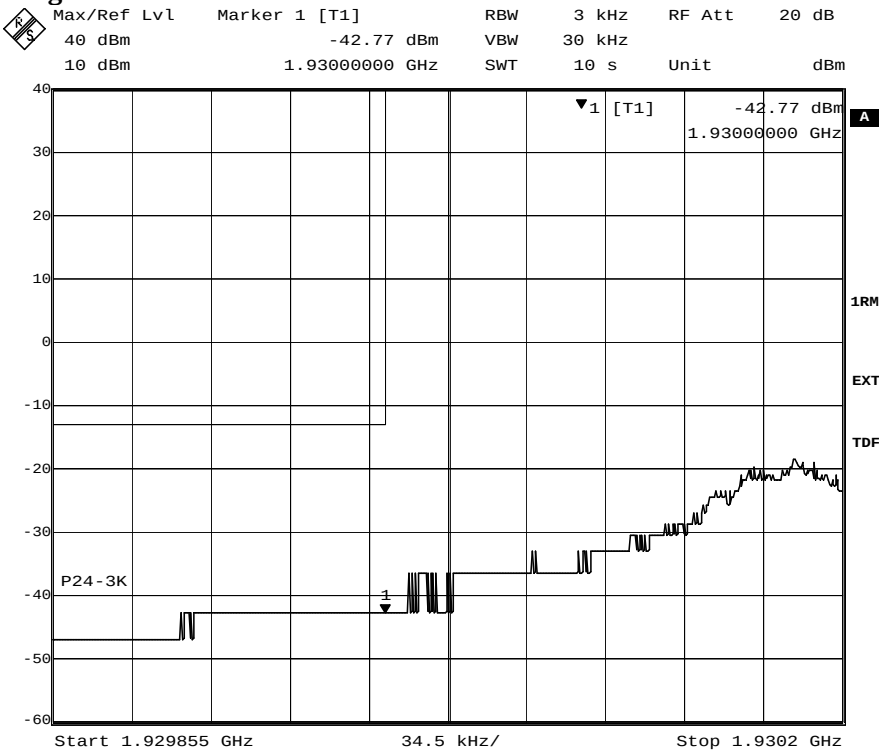
Limits

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

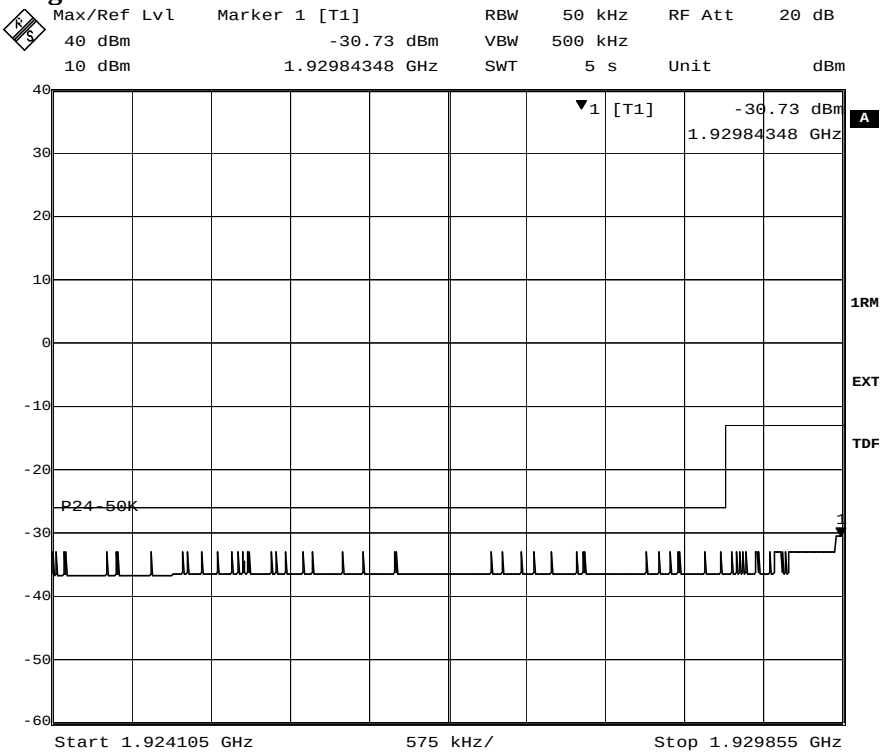
Appendix 4

Diagram 1 a:



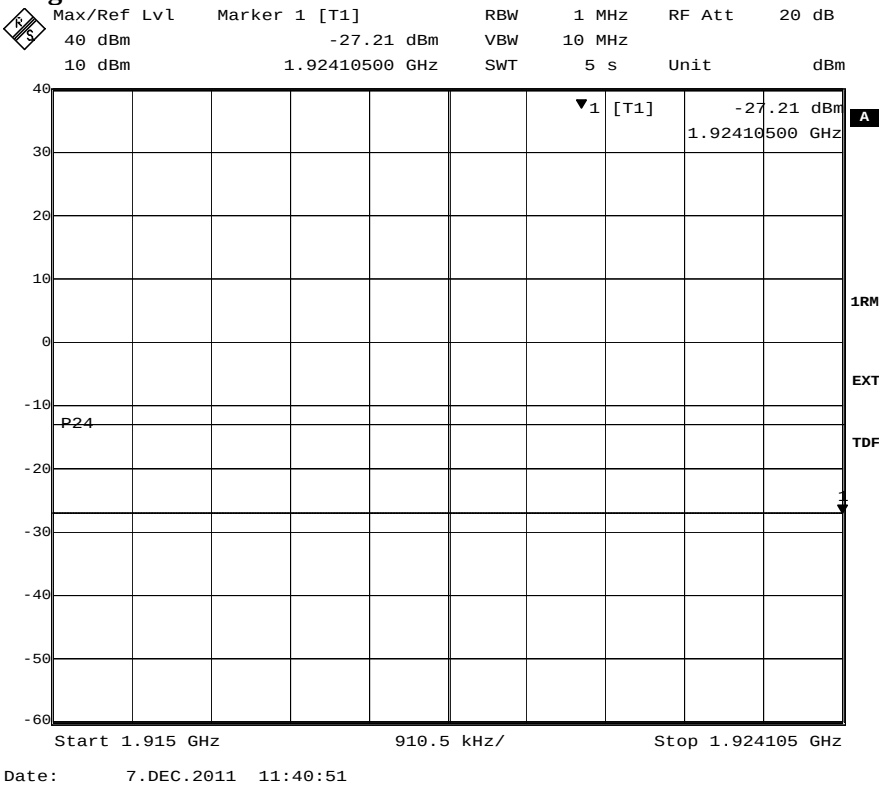
Date: 7.DEC.2011 11:37:45

Diagram 1 b:



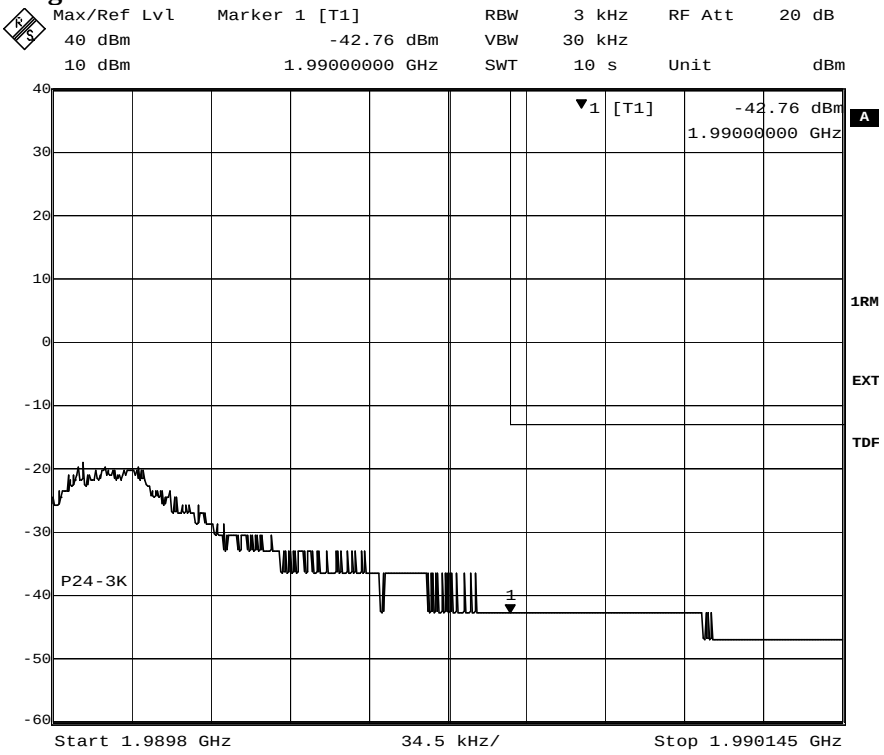
Date: 7.DEC.2011 11:38:52

Diagram 1 c:


Max/Ref Lvl
40 dBm
10 dBm
Marker 1 [T1]
-27.21 dBm
1.92410500 GHz
RBW 1 MHz
VBW 10 MHz
SWT 5 s
RF Att 20 dB
Unit dBm
1 [T1]
-27.21 dBm
1.92410500 GHz
A
1RM
EXT
TDF
P24
40
30
20
10
0
-10
-20
-30
-40
-50
-60
Start 1.915 GHz
910.5 kHz/
Stop 1.924105 GHz
Date: 7.DEC.2011 11:40:51

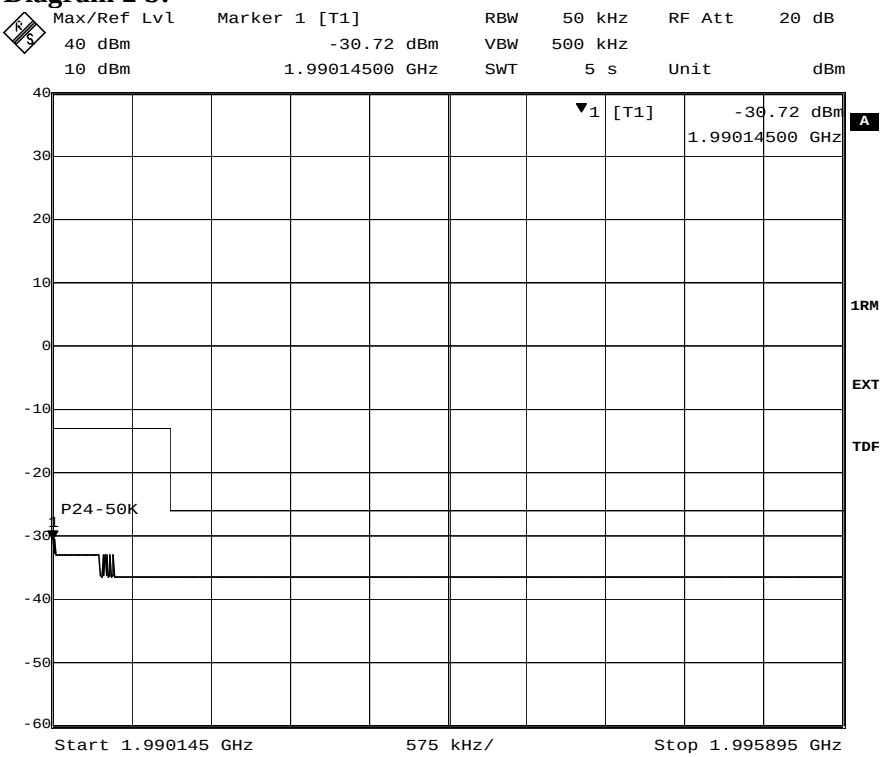
Appendix 4

Diagram 2 a:



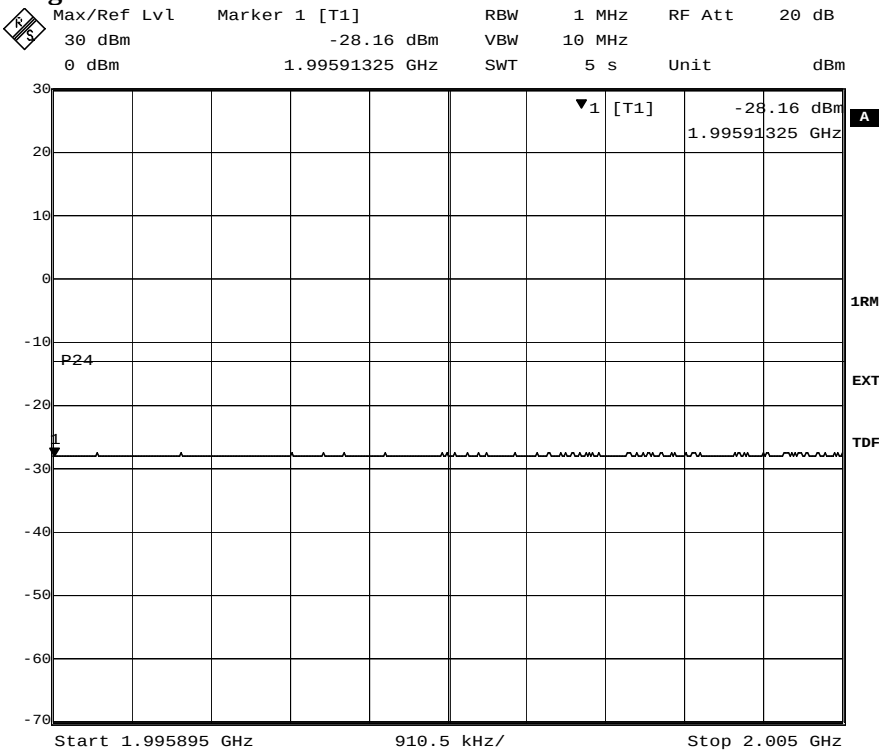
Date: 7.DEC.2011 11:30:29

Diagram 2 b:



Date: 7.DEC.2011 11:31:38

Diagram 2 c:


Max/Ref Lvl
30 dBm
0 dBm
Marker 1 [T1]
-28.16 dBm
1.99591325 GHz
RBW 1 MHz
VBW 10 MHz
SWT 5 s
RF Att 20 dB
Unit dBm
1 [T1]
-28.16 dBm
1.99591325 GHz
A
1RM
EXT
TDF
P24
Start 1.995895 GHz
910.5 kHz/
Stop 2.005 GHz
Date: 7.DEC.2011 11:32:14

Conducted spurious emission measurements according to CFR 47 2.1051

Date	Temperature	Humidity
2011-12-07	23 °C ± 3 °C	23 % ± 5 %

Test set-up and procedure

The measurements were made with EUT port TX(/RX) 1 via a 50 ohm attenuator 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
Rohde & Schwarz FSIQ40	503 738
Attenuator	504 159
Highpass filter	504 200
Testo 615 temperature and humidity meter	503 498

Measurement uncertainty: 3.7 dB

Results

The test object was configured for maximum nominal output power using RBS Master2E control setting 41. The tested TX was activated at channel M.

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

The diagrams are shown on the following pages.

Remark

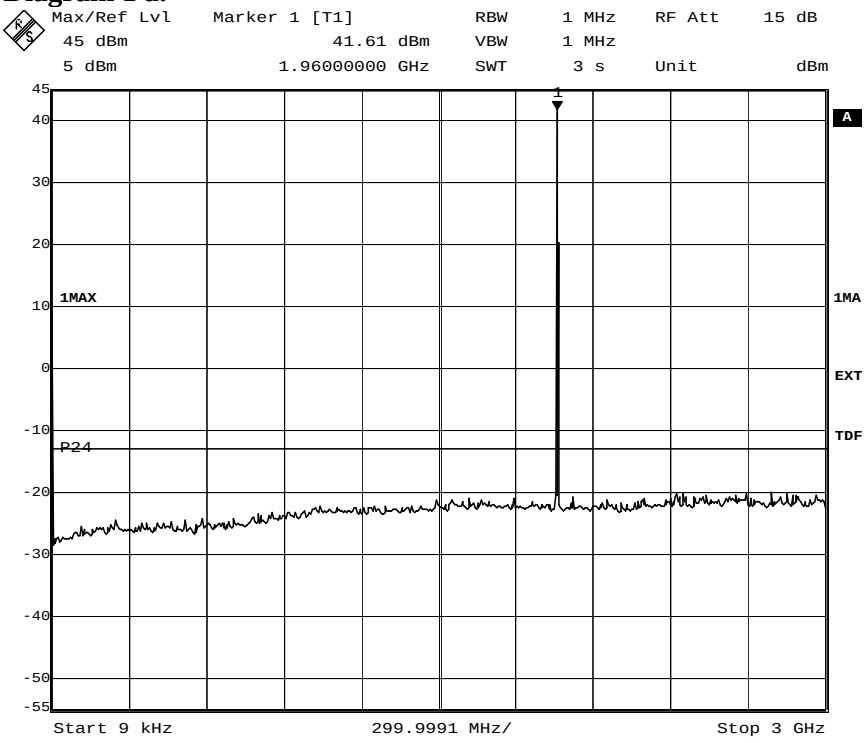
The emission at 9 kHz on some plots was not generated by the test object. A complementary measurement with a smaller RBW showed that it was related to the LO feed-through.

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.

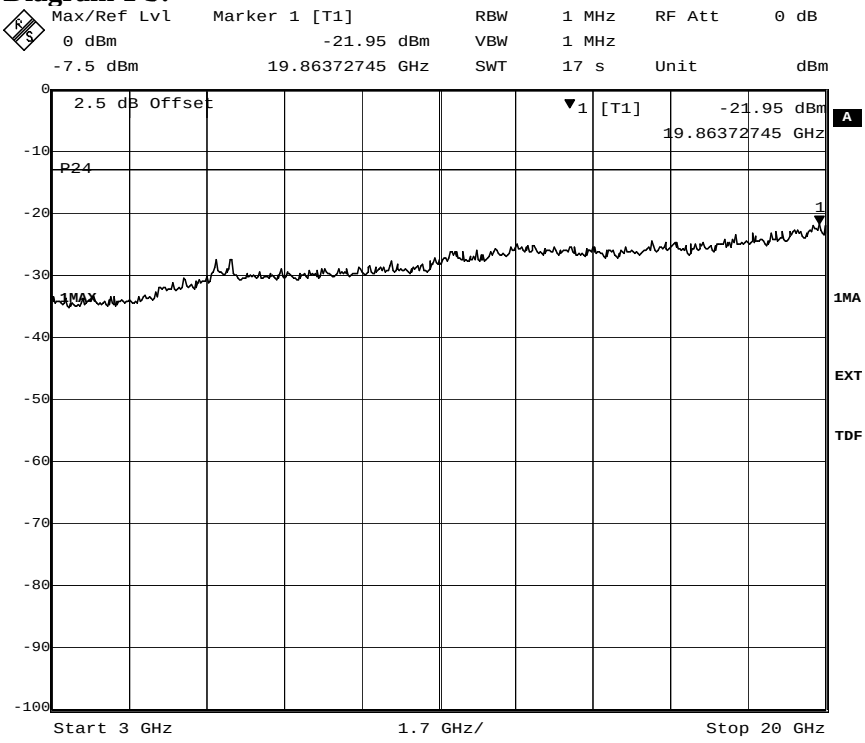
Complies?	Yes

Diagram 1 a:



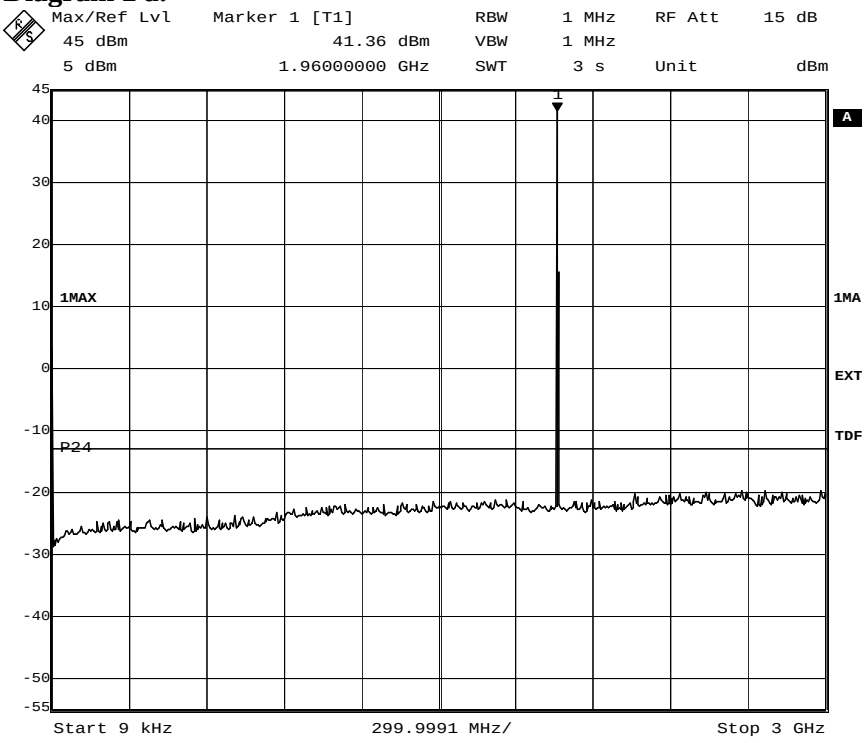
Date: 7.DEC.2011 10:11:34

Diagram 1 b:



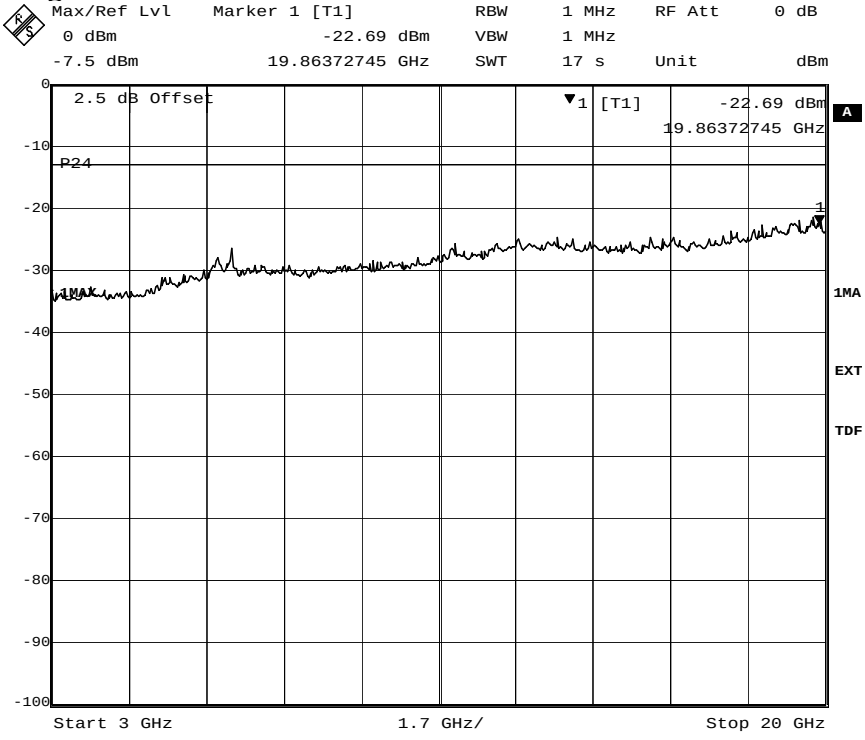
Date: 7.DEC.2011 10:12:53

Diagram 2 a:



Date: 7.DEC.2011 10:10:11

Diagram 2 b:



Date: 7.DEC.2011 10:14:39

Field strength of spurious radiation measurements according to CFR 47 2.1053

Date	Temperature	Humidity
2011-06-01	22 °C ± 3 °C	41 % ± 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 1 m in the frequency range 18 GHz – 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.

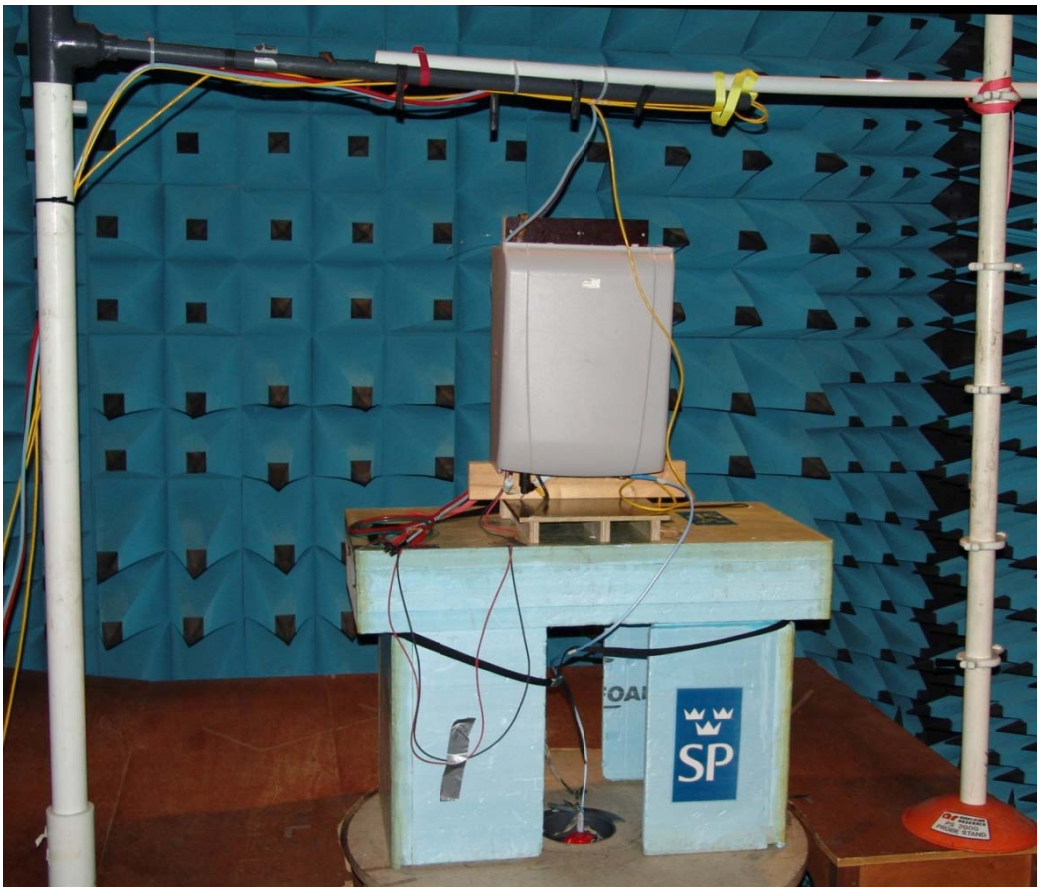
The measurement procedure was as the following:

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 for maximum nominal output power using RBS Master2E control setting 41. The TX was activated at channel M.

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
Highpass	504 200
Testo 615 temperature and humidity meter	503 498

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 AQPSK in SCPIR 0 dB

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: 3.1 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

Photos of the test object

Front side

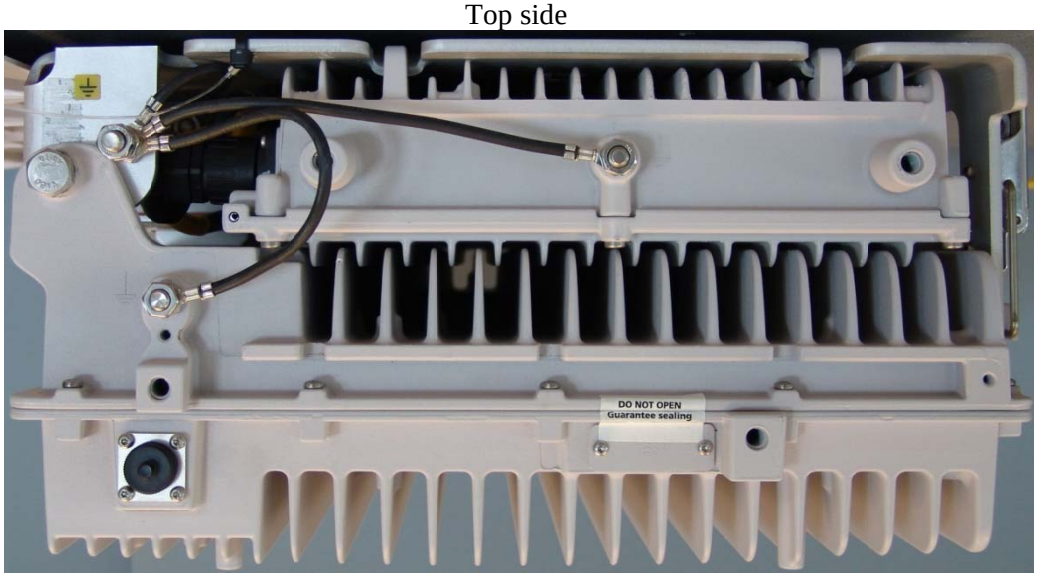
Rear side

Left side

Rear side

Note: The EUT is shown assembled into a RBS 2109, as used during the test.

Top side



Bottom side