



REPORT

issued by an FCC listed Laboratory Reg. no. 93866.
The test site complies with RSS Gen, file no: IC 3482A



Date
2010-08-25

Reference
FX009340-21

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Permissible change measurements on Remote Radio Unit with FCC ID: B5KAKRC161028-1 and IC: 287Y-AGS61281 (8 appendices)

Test object

RRU-H8, product KRC 161 028/1, revision R1B, SN AE51637450

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

Summary


Standard	Compliant	Appendix	Remarks
FCC CFR 47 / IC RSS-132 Issue 2			
2.1046 / RSS-132 4.4 RF Power output	Yes	2	-
2.1049 / RSS-132 4.5 Occupied bandwidth	Yes	3	-
2.1051 / RSS-132 4.5 Band Edge	Yes	4	Note 1
2.1051 / RSS-132 4.5 Spurious emission at antenna port	Yes	5	
2.1053 / RSS-132 4.5 Field strength of spurious radiation	Yes	6	-

Note 1: The maximum nominal output power that can be used on the channels adjacent to the frequency band edges (channel 128 and 251) is with the RBS master 2E control software configured for "39", resulting in a maximum measured RMS output power of 38.5 dBm for 16QAM and 37.6 dBm for 32QAM modulation on the tested sample. Channels 129 through 250 comply with 16QAM and 32QAM modulation in maximum nominal output power configuration.

Note 2: Above RSS-132 items are given as cross-reference only. Measurements were performed according to ANSI procedures referenced by FCC and covered by SP's accreditation.

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Appendix 1

Description - Equipment Under Test (EUT)

Equipment:	GSM Base station Remote Radio Unit			
TX frequency range:	869.2 – 893.8 MHz			
Modulations:	GMSK, 8PSK, 16QAM and 32QAM			
Nominal maximum output power, RMS value in [dBm]:	Modulation			
	GMSK	8PSK	16QAM	32QAM
	43.0	39.7	38.3	37.9
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.

An additional band edge measurement was done on the channels 128 and 251 adjacent to the band edge with the test object output power reduced as far as necessary to meet band edge requirements. In this configuration the RBS master 2E software setting was 39. Random data was transmitted in all time slots with various modulations being tested, one at a time.

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 was chosen as worst case reference modulation to compare the new 16QAM and 32QAM modulations with.

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Appendix 1

Frequencies used

ARFCN	Frequency	Comment
128	869.2 MHz	Bottom TX frequency, reduced output power
129	869.4 MHz	Bottom TX frequency, maximum output power
190	881.6 MHz	Mid TX band frequency, maximum output power
250	893.6 MHz	Top TX frequency, maximum output power
251	893.8 MHz	Top TX frequency, reduced output power

Manufacturer's representative

Hua Yang, Ericsson (China) Communications Company Ltd

References

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

ANSI/TIA/EIA-603-C-2004

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

RSS-132, Issue 2 (September 2005)

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.

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Appendix 1

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
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	504 199
RLC Electronics high pass filter F-16149	2010-06	503 739
Multimeter Fluke 87	2011-01	502 190
Testo 615 temperature and humidity meter	2012-03	503 498
Testo 635 temperature and humidity meter	2012-03	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

Reinhold Reul and Fredrik Isaksson

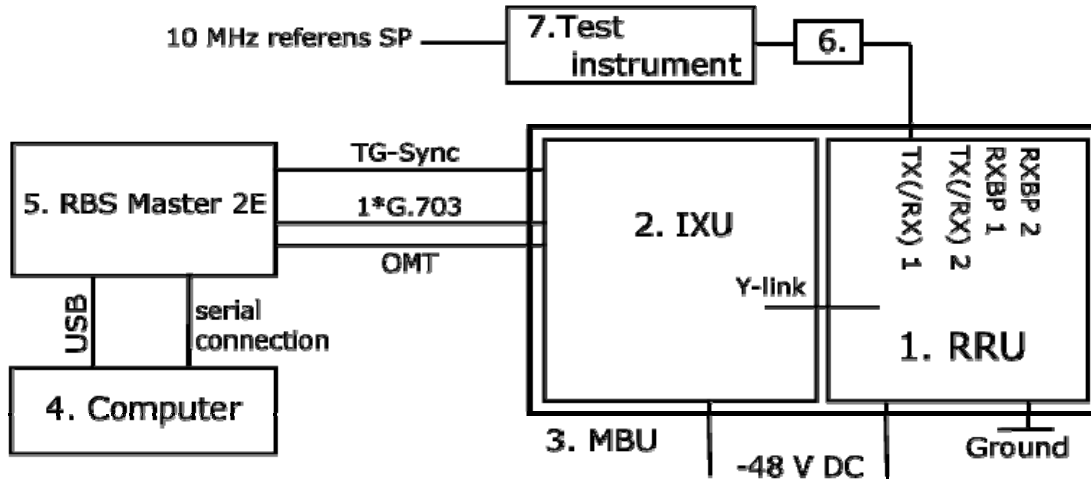
Test witnesses

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-H8, product KRC 161 028/1, revision R1B, SN AE51637450 with FCC ID: B5KAKRC161028-1 and IC: 287Y-AGS61281

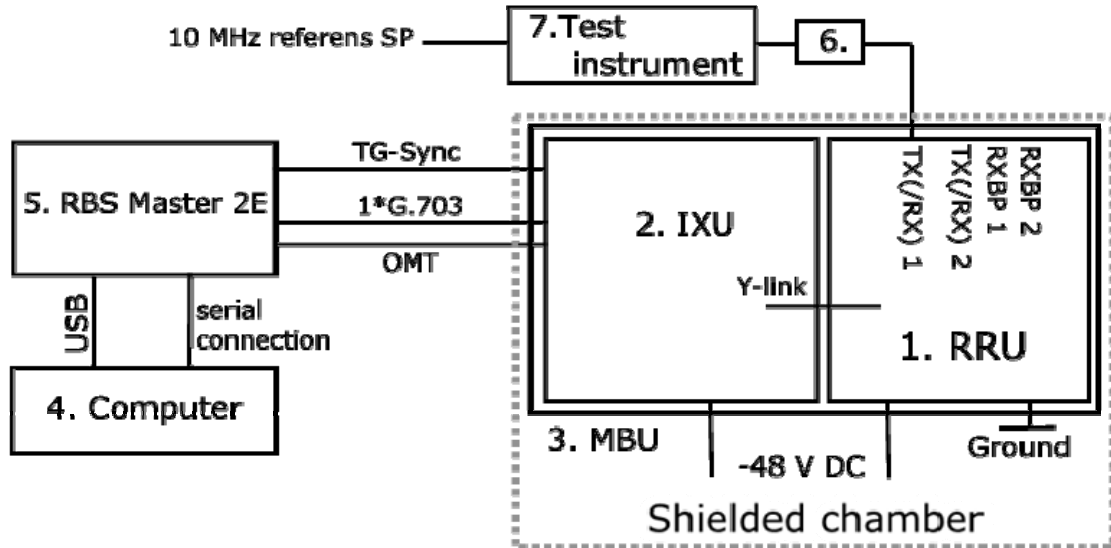
Functional test equipment

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

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Appendix 1

Test set-up radiated measurements



Test object

1. RRU-H8, product KRC 161 028/1, revision R1B, SN AE51637450 with FCC ID: B5KAKRC161028-1 and IC: 287Y-AGS61281

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

-48 V DC
GND
Y-link to IXU, IEEE-1394 interface
TX(/RX) 1, connected to test equipment
TX(/RX) 2, RXBP 1, RXBP 2 unconnected

Type of port

DC power
Ground
Signal
RF/Antenna
RF/Antenna

Other connections

Interface

PC – RBS Master 2E USB connection
PC – RBS Master 2E serial communication
TG-sync connection between RBS Master 2E & MU
IXU supply -48 V DC
G.703, shielded multi-wire with RJ-45connector, mode E1
OMT interface (only configuration, not connected in normal use)

Type of port:

Signal
Signal
Signal
DC power
Telecom
O/M



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Appendix 2

RF Power output measurements according to CFR 47 2.1046 / IC RSS-132 4.4

Date 2010-05-31	Temperature 22 °C ± 3 °C	Humidity 30 % ± 5 %
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Test set-up and procedure

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

Configuration: TX ARFCN 190, 881.6 MHz, and RBS master 2E software setting “43” 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	43.7 / 42.9	43.6 / 39.0	43.6 / 38.3

Limit

CFR 47 § 22.913: 500 W ERP shall not be exceeded.

RSS-132 / SRSP-503:

1640 W EIRP shall not be exceeded with an antenna height above average terrain (HAAT) up to 150 m, except in urban areas where they are limited to a maximum EIRP of 820 watts.

Complies?	Yes
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Appendix 3

Occupied bandwidth measurements according to 47CFR 2.1049 / IC RSS-132 4.5

Date 2010-05-31	Temperature 22 °C ± 3 °C	Humidity 30 % ± 5 %
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Test set-up and procedure

The test object was via an 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.

Configuration: TX ARFCN 190, 881.6 MHz, and RBS master 2E software setting “43” 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	240.0	kHz
Diagram 3:	32QAM	240.7	kHz

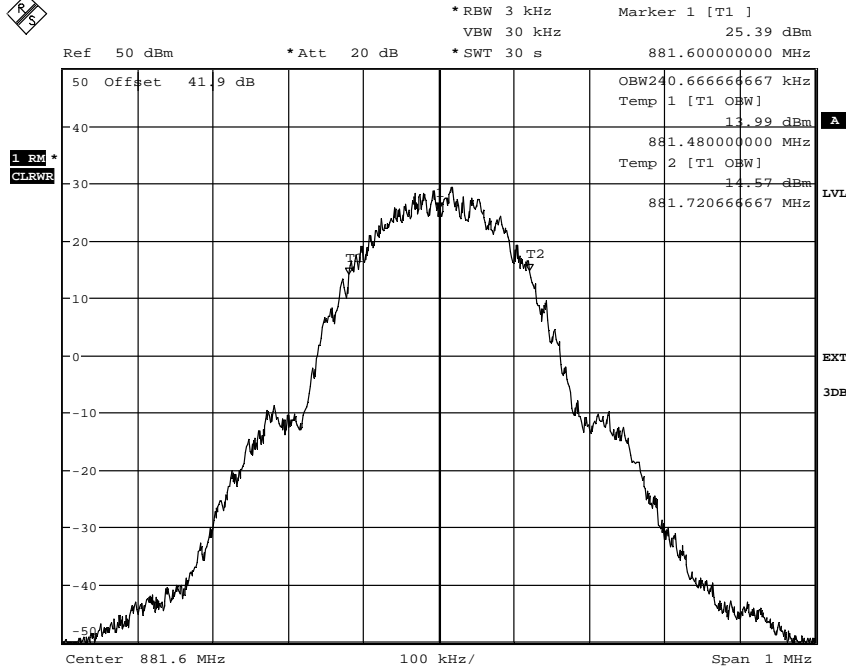
Complies?	Yes
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FCC ID: B5KAKRC161028-1
IC: 287Y-AGS61281

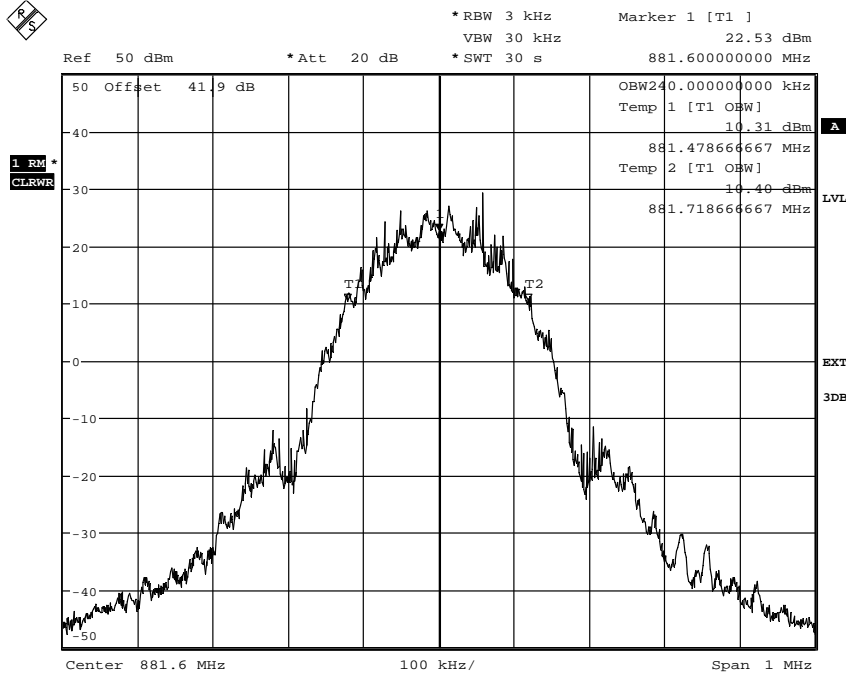
Appendix 3.1

Diagram 1



Date: 31.MAY.2010 15:11:20

Diagram 2



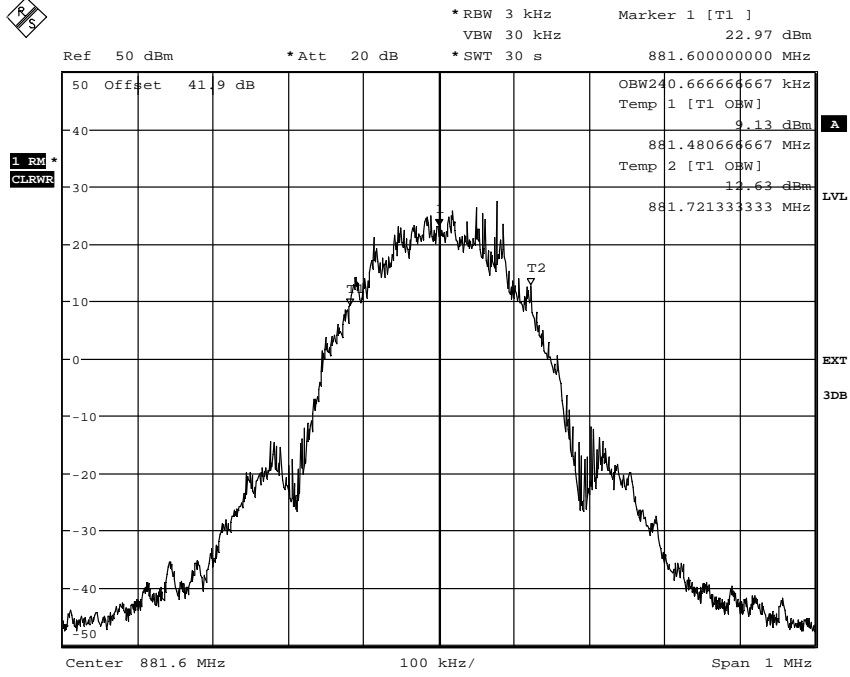
Date: 31.MAY.2010 15:19:17



FCC ID: B5KAKRC161028-1
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Appendix 3.1

Diagram 3



Date: 31.MAY.2010 15:28:20



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Appendix 4

Band edge measurements according to 47CFR 2.1049 / IC RSS-132 4.5

Date 2010-05-31	Temperature 22 °C ± 3 °C	Humidity 29 % ± 5 %
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Test set-up and procedure

The measurements were made per definition in §22.917, with the test object 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 100 KHz 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 -15.2 dB ($10 \cdot \log(3/100)$) to -28.2 dBm for frequencies >1 MHz away from the band edges.

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

Reduced output power to nominal 39 dBm (setting “39” in RBS master 2E control software) on the channels adjacent to the band edge for 16QAM and 32QAM modulation.

- Diagram 1 16QAM, Ch 128 (869.2 MHz)
- Diagram 2 16QAM, Ch 251 (893.8 MHz)
- Diagram 3 32QAM, Ch 128 (869.2 MHz)
- Diagram 4 32QAM, Ch 251 (893.8 MHz)

Maximum nominal output power configured (setting “43” in RBS master 2E control software) on channels alternate adjacent to the band edges for 16QAM and 32QAM modulation.

- Diagram 5 16QAM, Ch 129 (869.4 MHz)
- Diagram 6 16QAM, Ch 250 (893.6 MHz)
- Diagram 7 32QAM, Ch 129 (869.4 MHz)
- Diagram 8 32QAM, Ch 250 (893.6 MHz)



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Appendix 4

Remark

The maximum nominal output power that can be used on the channels adjacent to the frequency band edges (channel 128 and 251) is with the RBS master 2E control software configured for “39”, resulting in a maximum measured RMS output power of 38.5 dBm for 16QAM and 37.6 dBm for 32QAM modulation on the tested sample. Channels 129 through 250 comply with 16QAM and 32QAM modulation in maximum nominal output power configuration.

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.

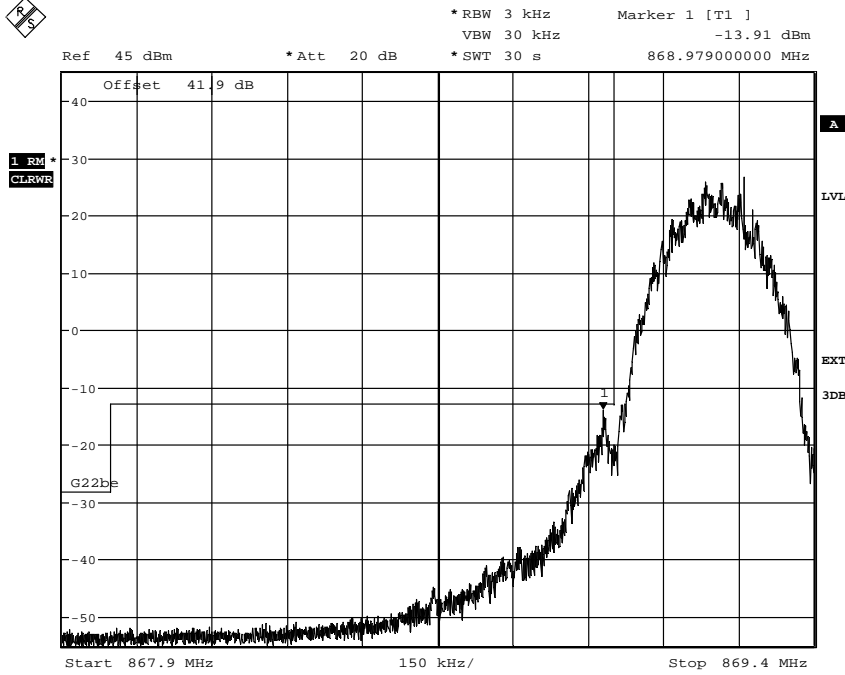
Tested configurations comply?	Yes
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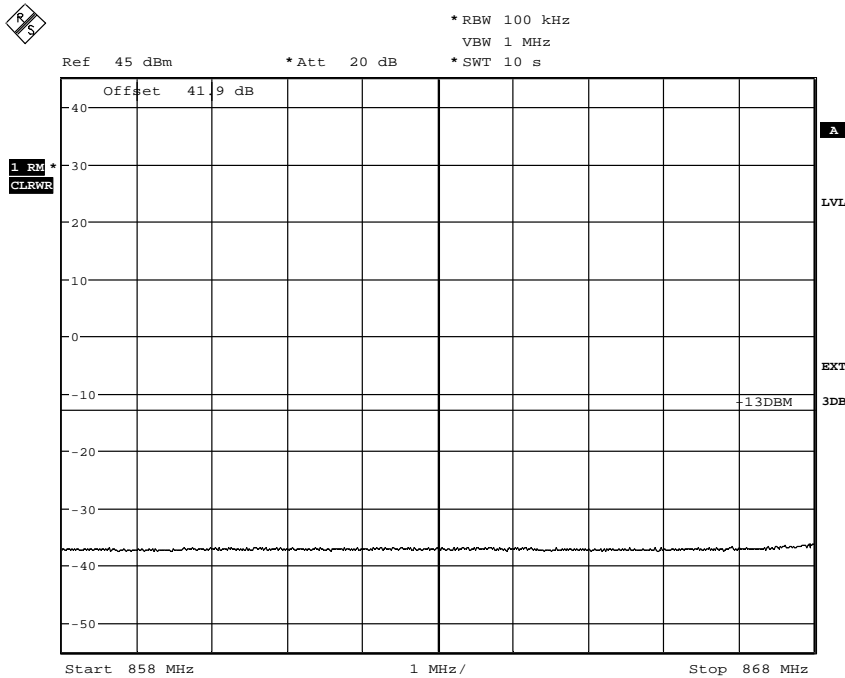
FCC ID: B5KAKRC161028-1
IC: 287Y-AGS61281

Appendix 4.1

Diagram 1



Date: 31.MAY.2010 13:11:23



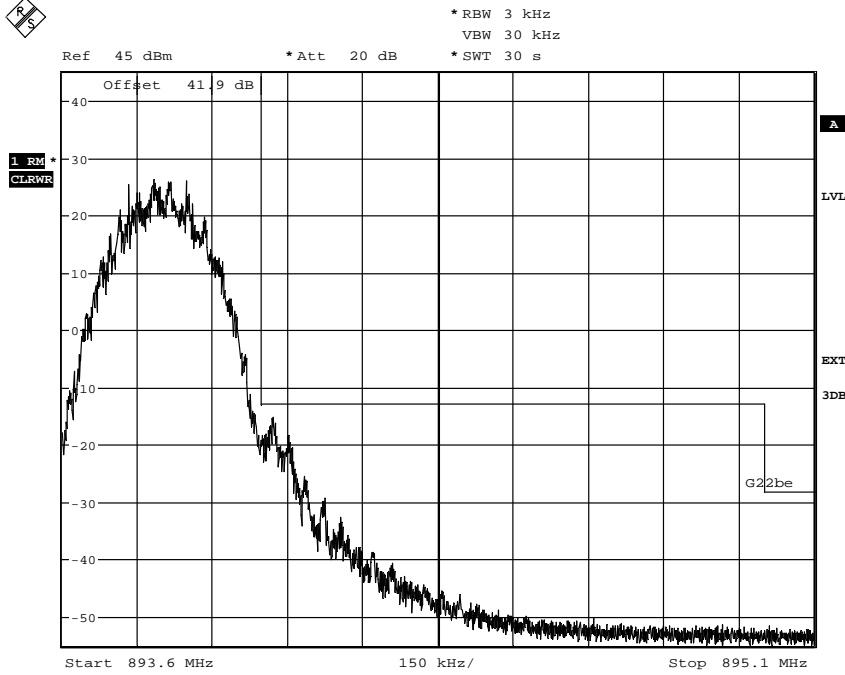
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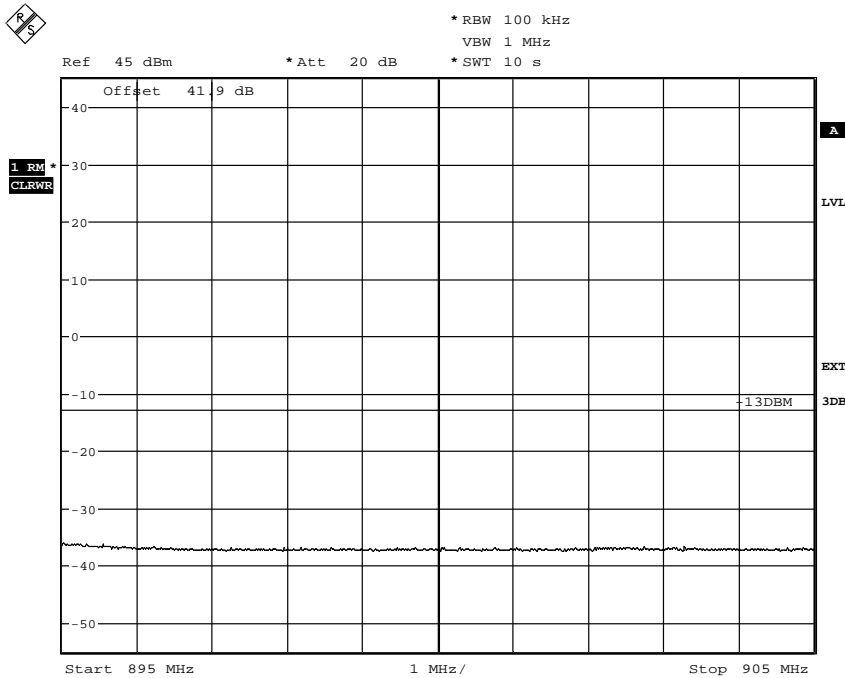
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IC: 287Y-AGS61281

Appendix 4.1

Diagram 2



Date: 31.MAY.2010 13:50:56



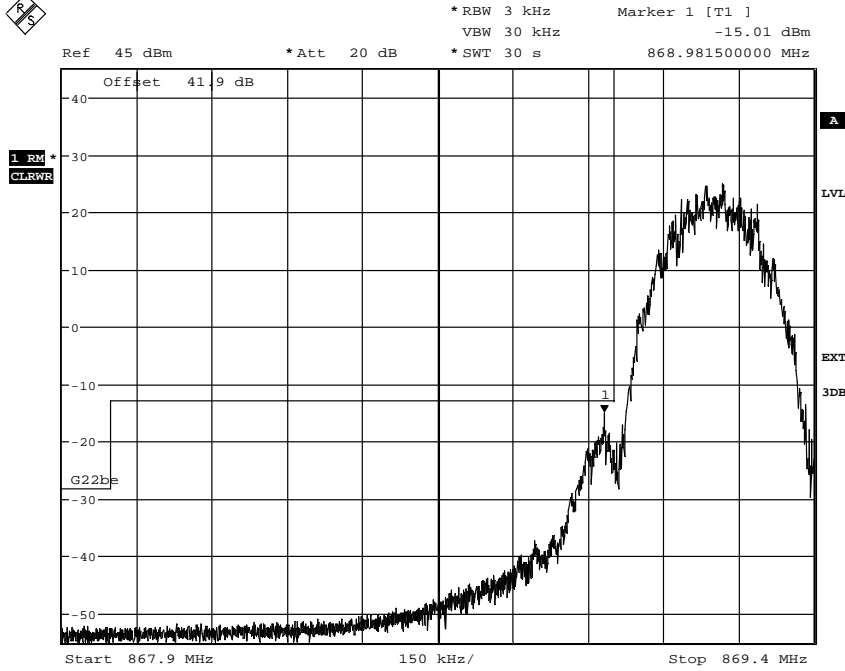
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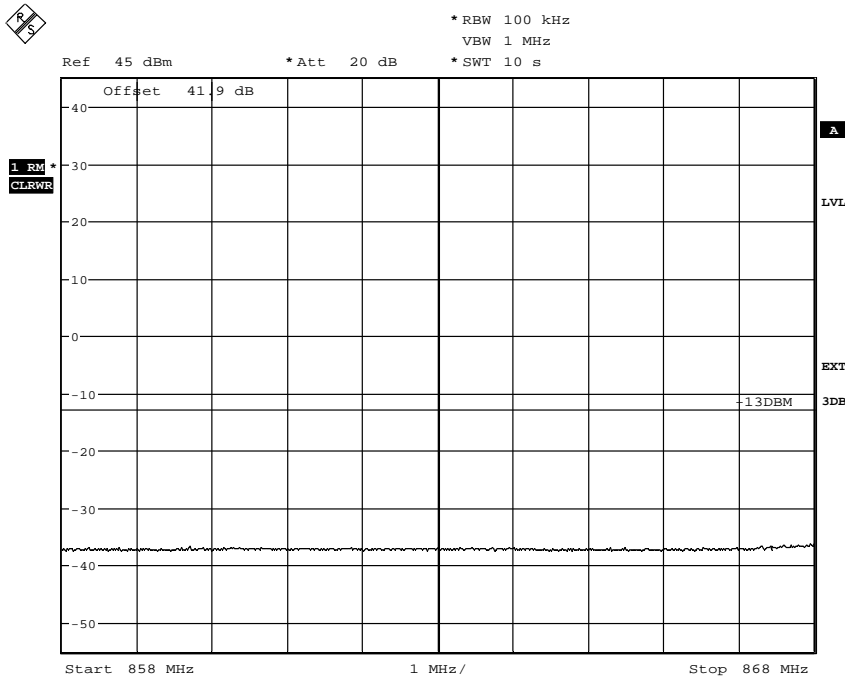
FCC ID: B5KAKRC161028-1
IC: 287Y-AGS61281

Appendix 4.1

Diagram 3



Date: 31.MAY.2010 13:20:23

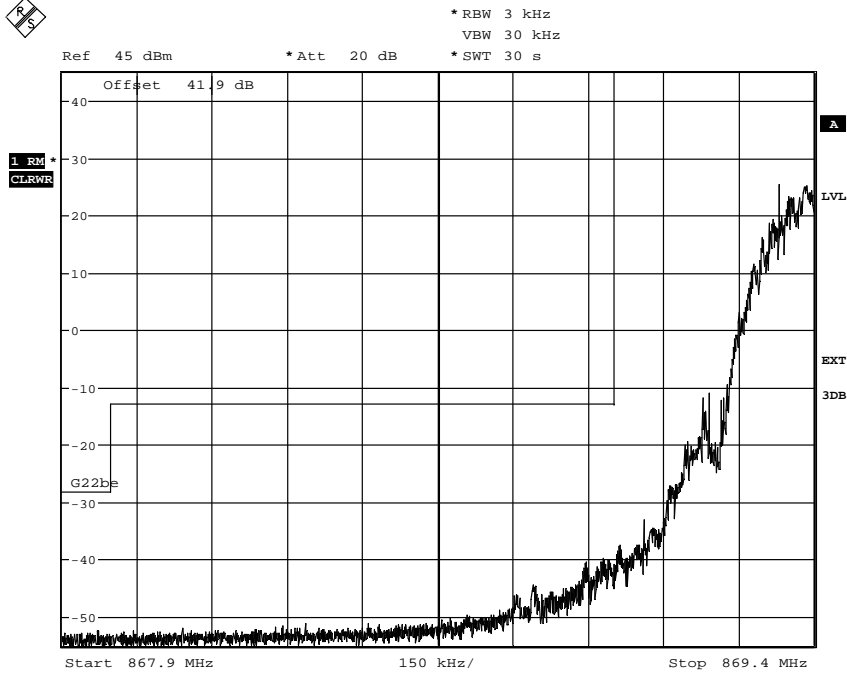


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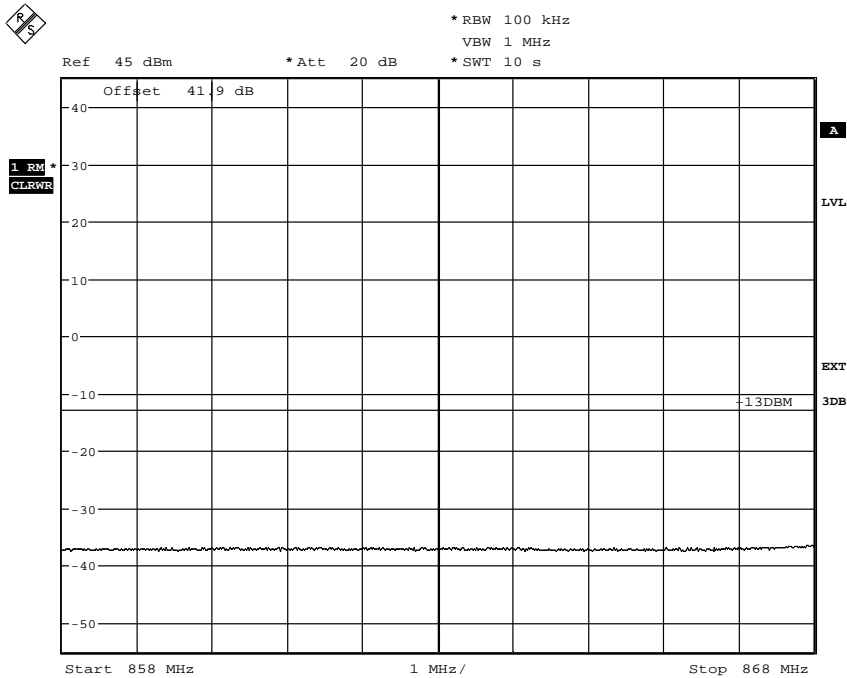
FCC ID: B5KAKRC161028-1
IC: 287Y-AGS61281

Appendix 4.1

Diagram 5



Date: 31.MAY.2010 14:21:11



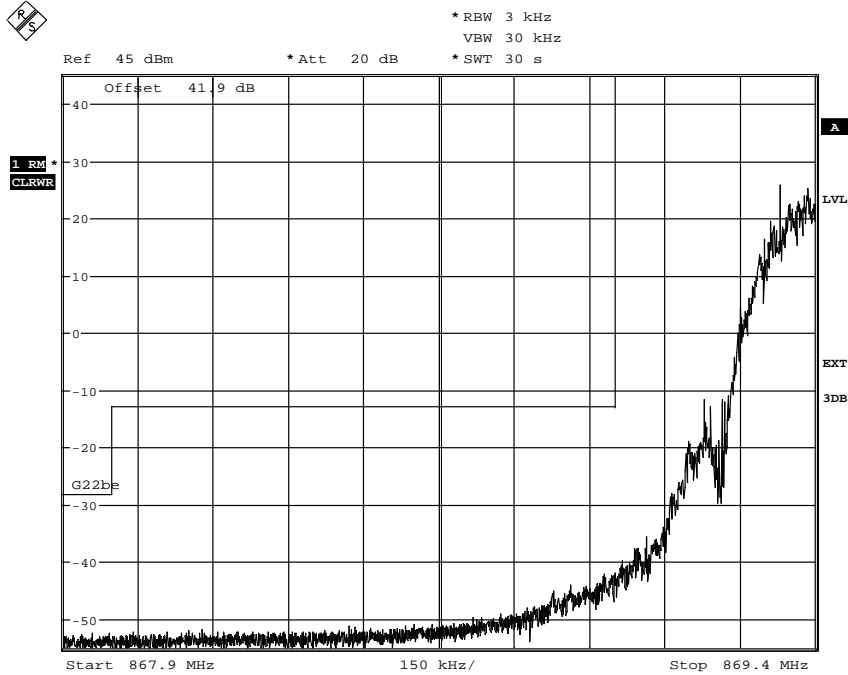
Date: 31.MAY.2010 14:25:45



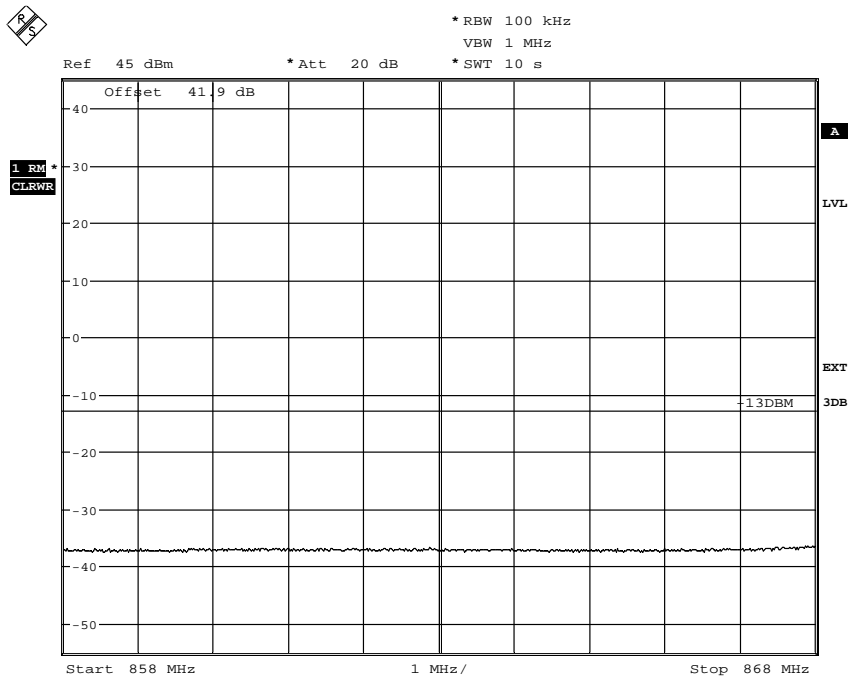
FCC ID: B5KAKRC161028-1
IC: 287Y-AGS61281

Appendix 4.1

Diagram 7



Date: 31.MAY.2010 14:28:16



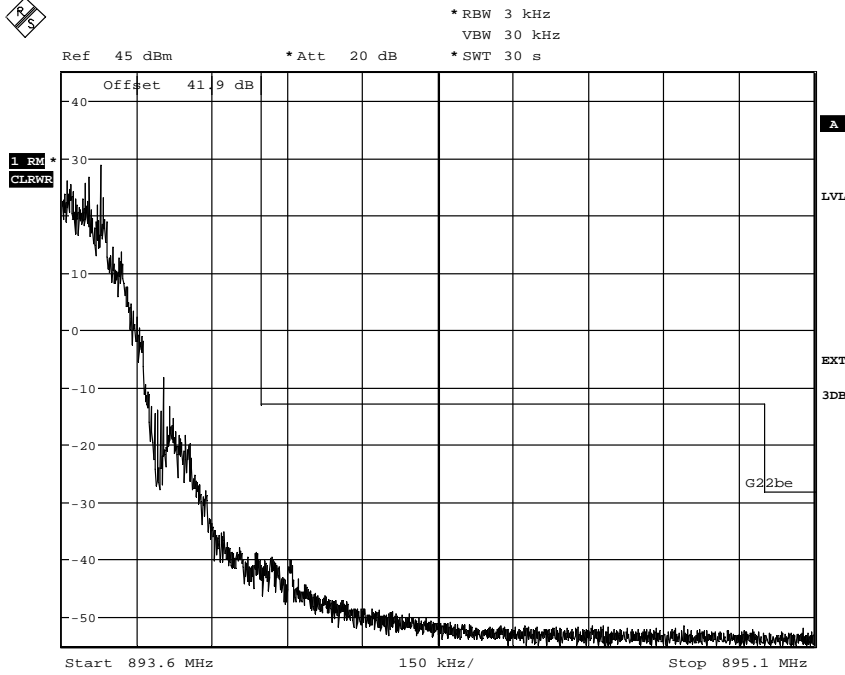
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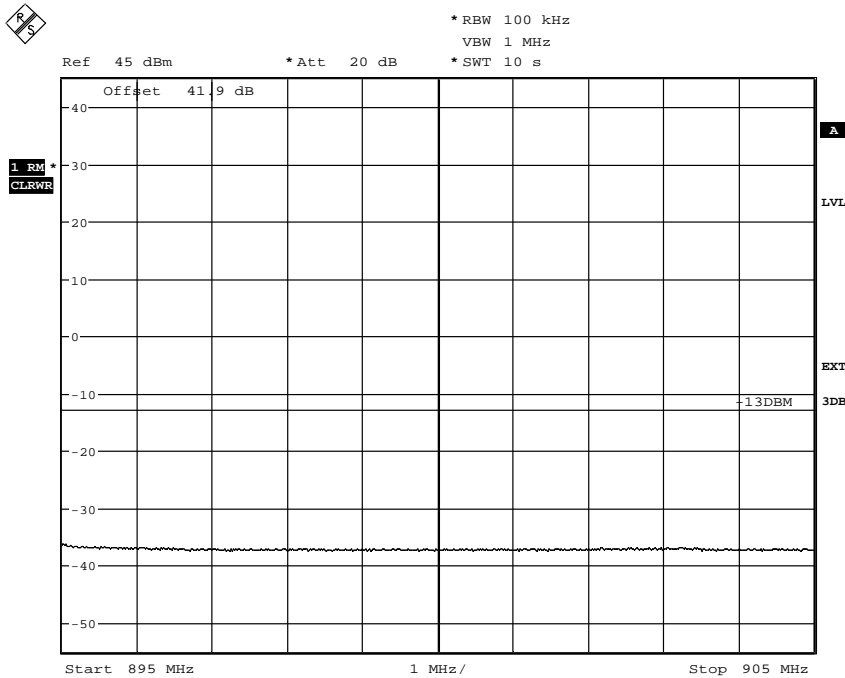
FCC ID: B5KAKRC161028-1
IC: 287Y-AGS61281

Appendix 4.1

Diagram 8



Date: 31.MAY.2010 14:48:39



Date: 31.MAY.2010 14:49:26



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Appendix 5

Conducted spurious emission measurements according to 47CFR 2.1051 / IC RSS-132 4.5

Date 2010-05-31	Temperature 22 °C ± 3 °C	Humidity 30 % ± 5 %
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Test set-up and procedure

The test object 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 190, 881.6 MHz, and RBS master 2E software setting “43” 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 1 – 15 GHz	504 199
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 – 1 GHz
- Diagram 2: GMSK, 1 GHz – 10 GHz

- Diagram 3: 16QAM, 9 KHz – 1 GHz
- Diagram 4: 16QAM, 1 GHz – 10 GHz

- Diagram 5: 32QAM, 9 KHz – 1 GHz
- Diagram 6: 32QAM, 1 GHz – 10 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.

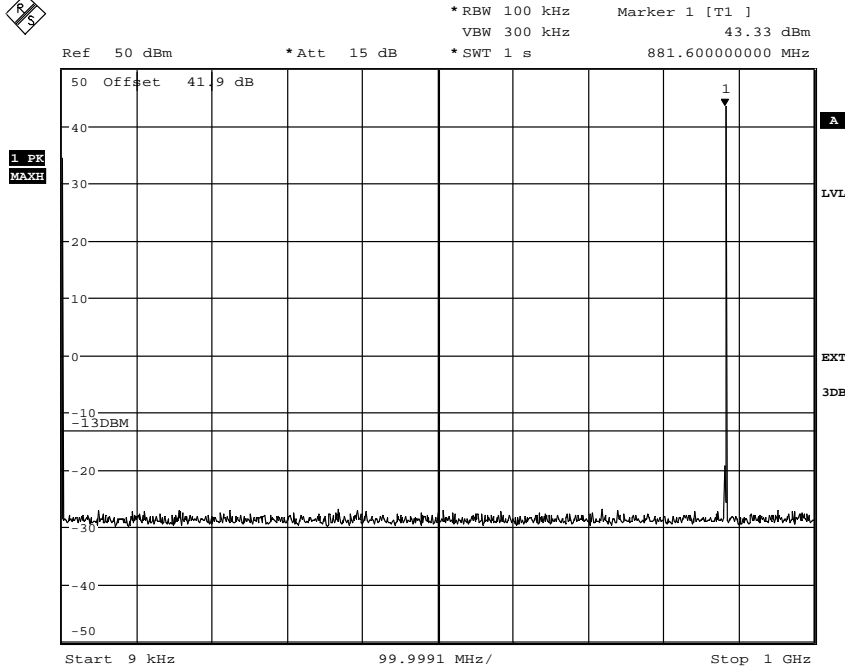
Complies?	Yes
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FCC ID: B5KAKRC161028-1
IC: 287Y-AGS61281

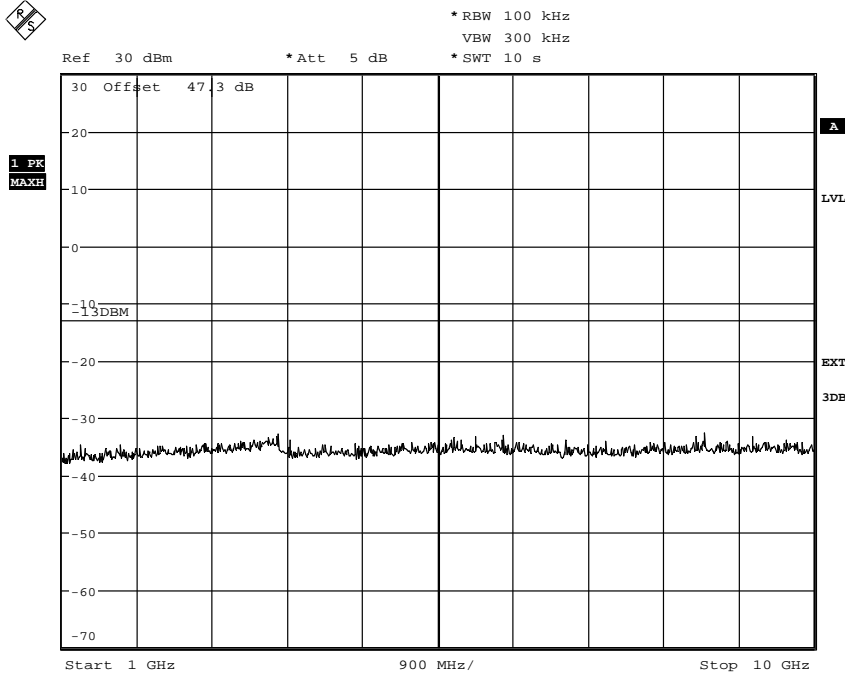
Appendix 5.1

Diagram 1



Date: 31.MAY.2010 15:12:15

Diagram 2



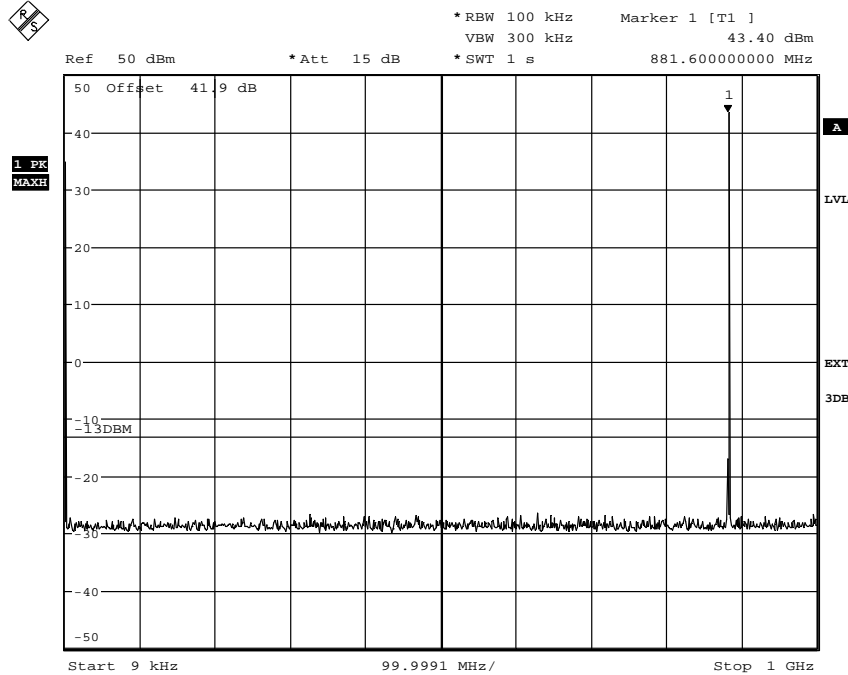
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IC: 287Y-AGS61281

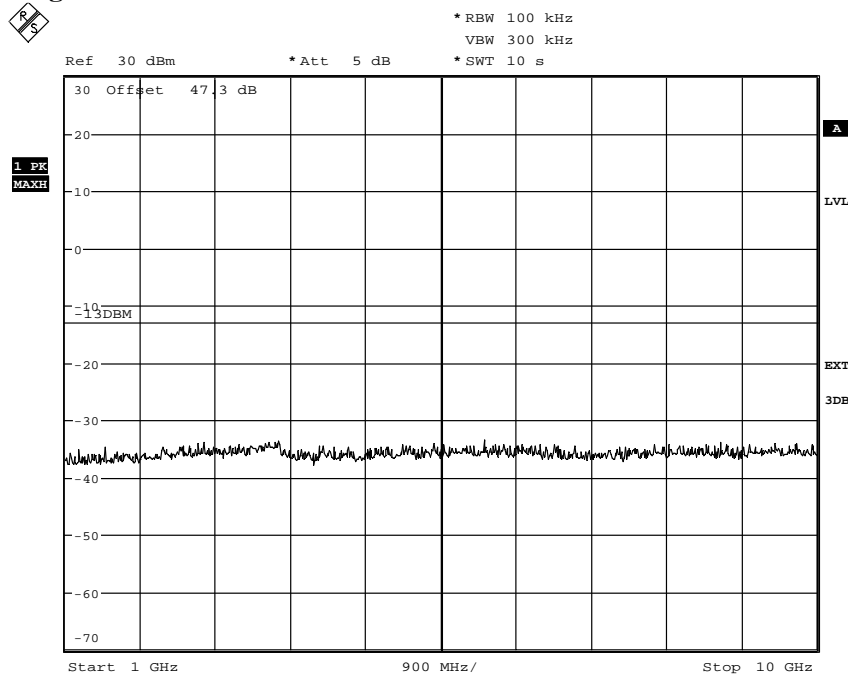
Appendix 5.1

Diagram 3



Date: 31.MAY.2010 15:17:22

Diagram 4



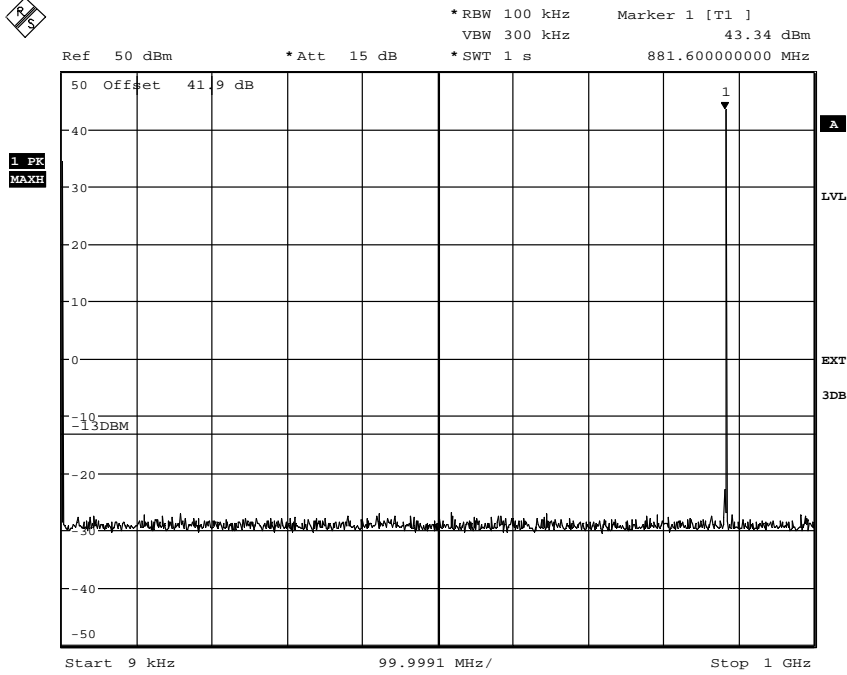
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IC: 287Y-AGS61281

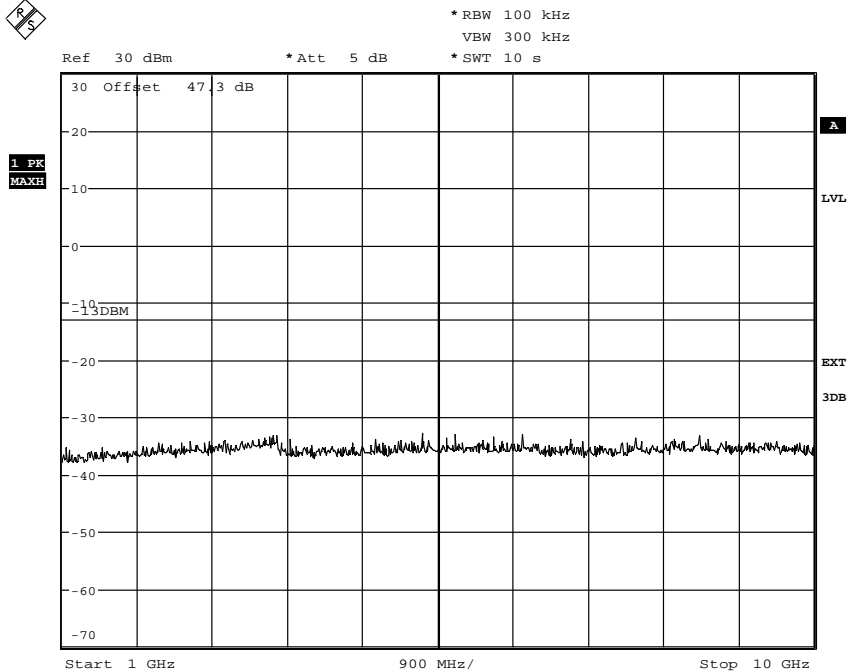
Appendix 5.1

Diagram 5



Date: 31.MAY.2010 15:31:11

Diagram 6



Date: 31.MAY.2010 15:34:24

FCC ID: B5KAKRC161028-1
IC: 287Y-AGS61281

Appendix 6

Field strength of spurious radiation measurements according to 47CFR 2.1053 / IC RSS-132 4.5

Date 2010-06-07	Temperature 22 °C ± 3 °C	Humidity 50 % ± 5 %
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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 – 10 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.

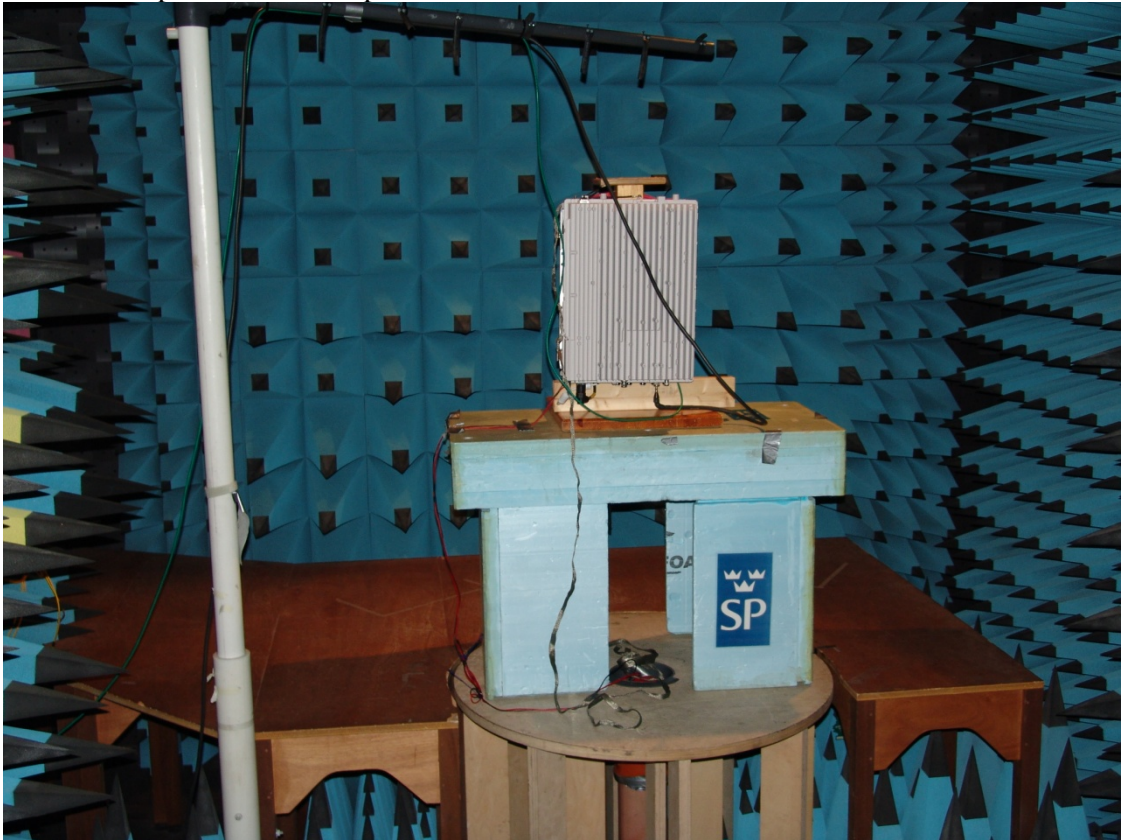
Configuration: TX ARFCN 190, 881.6 MHz, and RBS master 2E software setting “43” for maximum output power were used. The transmitter was modulated with pseudorandom data during the measurements.

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
MITEQ Low Noise Amplifier	503 277
R&S Vector Network Analyser	503 687
Wainwright HP-filter WHKY1.0/15G-12SS	503 739
Testo 615, Temperature and humidity meter	503 498

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Appendix 6

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





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Appendix 6

Results

Modulation GMSK

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-10 000	All emission > 20 dB below limit	All emission > 20 dB below limit

Modulation 16QAM

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-10 000	All emission > 20 dB below limit	All emission > 20 dB below limit

Modulation 32QAM

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-10 000	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty: 3.2 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
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REPORT

Date
2010-08-25

Reference
FX009340-21

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Appendix 7

Hardware & software list

Parts of tested sample RBS 2109:

Unit	Product Number	Revision	Serial Number
MBU-01	SEB 112 1133/3	R2A	B340172876
IXU-21	BOE 602 15/2	R5C	AE53804963
RRU-H8	KRC 161 028/1	R1B	AE51637450

Software	Revision
CXP 104 0007/05	G11B

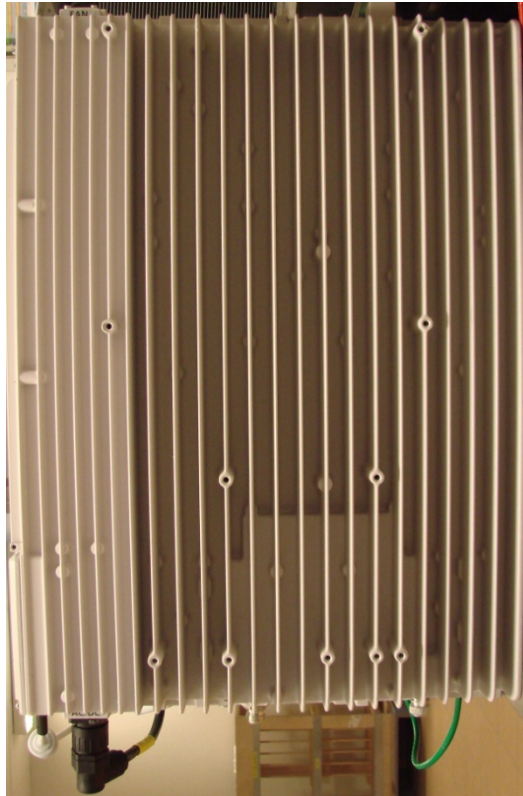
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Appendix 8

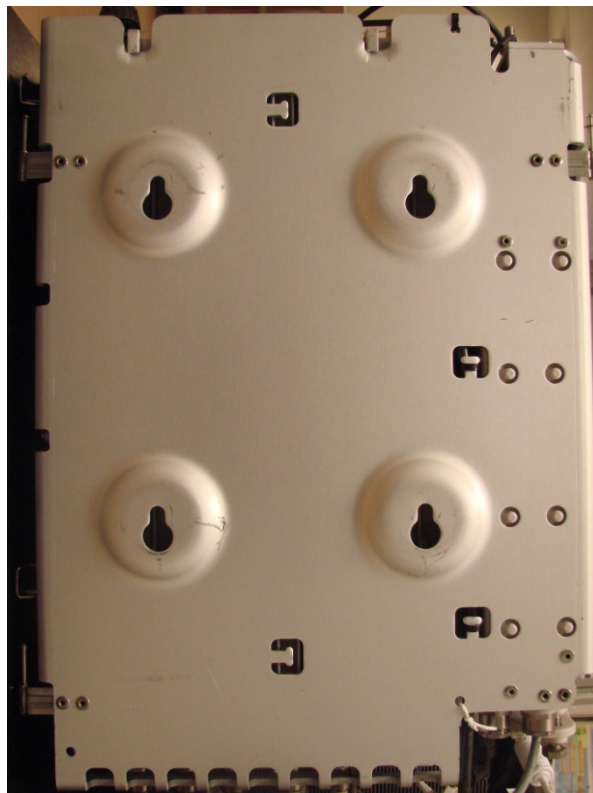
Photos of the test object

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

Front side



Back side



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Appendix 8

Left side



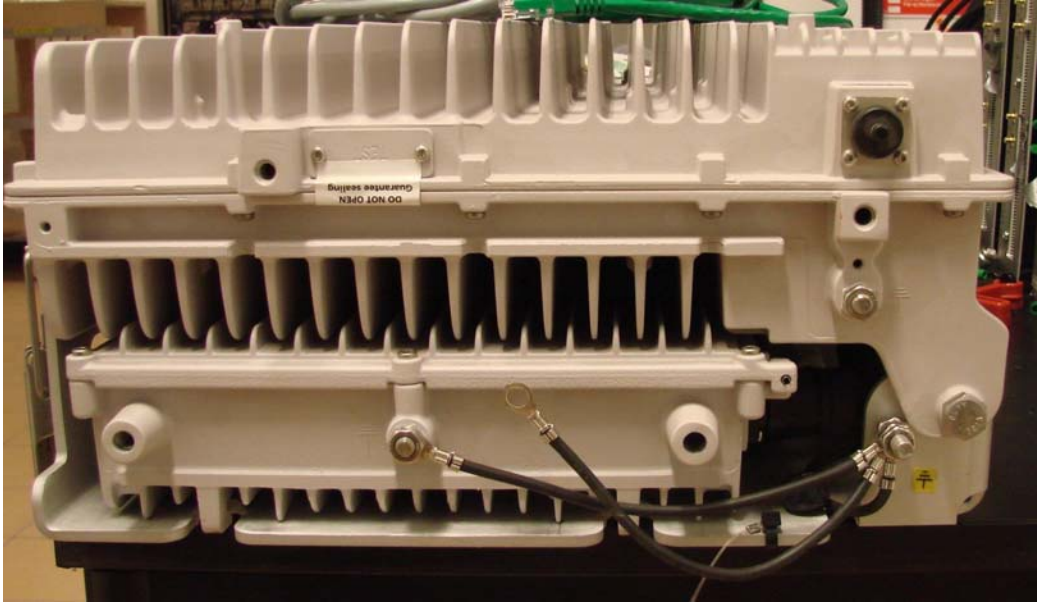
Right side



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Appendix 8

Top side



Bottom side

