REPORT

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Date	Reference	Page
2010-08-25	FX009340-12	1 (2)

1002
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Permissible change measurements on Remote Radio Unit with FCC ID: WODFKRC161170-4 and IC: 287AH-FG1611704

(8 appendices)

Test object

RRUN8-22, product KRC 161 170/4, revision R1A, SN (S)CB47233131

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 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 with a value of 41, resulting in a maximum measured RMS output power of 38.4 dBm for 16QAM and 37.5 dBm for 32QAM modulation. Remaining channels comply with RBS master 2E setting for maximum nominal output power.

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.

SP Technical Research Institute of Sweden
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Technical Manager

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Technical Officer

FCC ID: WODFKRC161170-4
IC: 287AH-FG1611704

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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 VDC

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 hardware lists for radiated and conducted measurements are shown in appendix 7. The test object was activated at maximum power, unless noted otherwise. Random 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 41. 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 “ANT 1”.

Radiated measurements

During radiated emission measurements the antenna connector “ANT 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
128	869.2 MHz	Low TX frequency, reduced output power
129	869.4 MHz	Low TX frequency, maximum output power
190	881.6 MHz	TX band center frequency, maximum output power
250	893.6 MHz	High TX frequency, maximum output power
251	893.8 MHz	High 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: 2010-06-10.

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).

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation ”EL-QD 8.2”. The measurement uncertainties can be found in the table below. The uncertainties are calculated with a coverage factor k=2 (95% level of confidence).

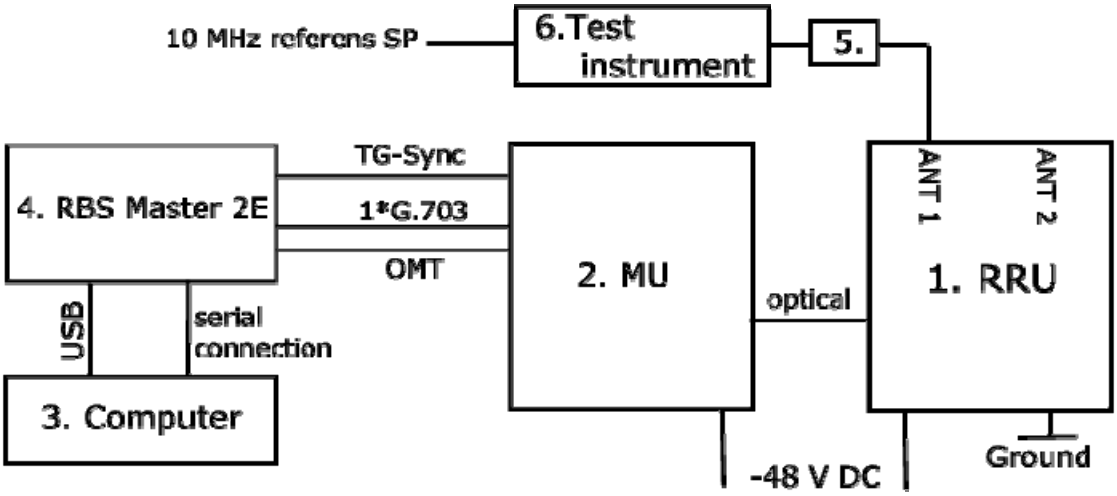
Test engineer

Jonas Bremholt and Fredrik Isaksson

Test witnesses

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

Test set-up conducted measurements



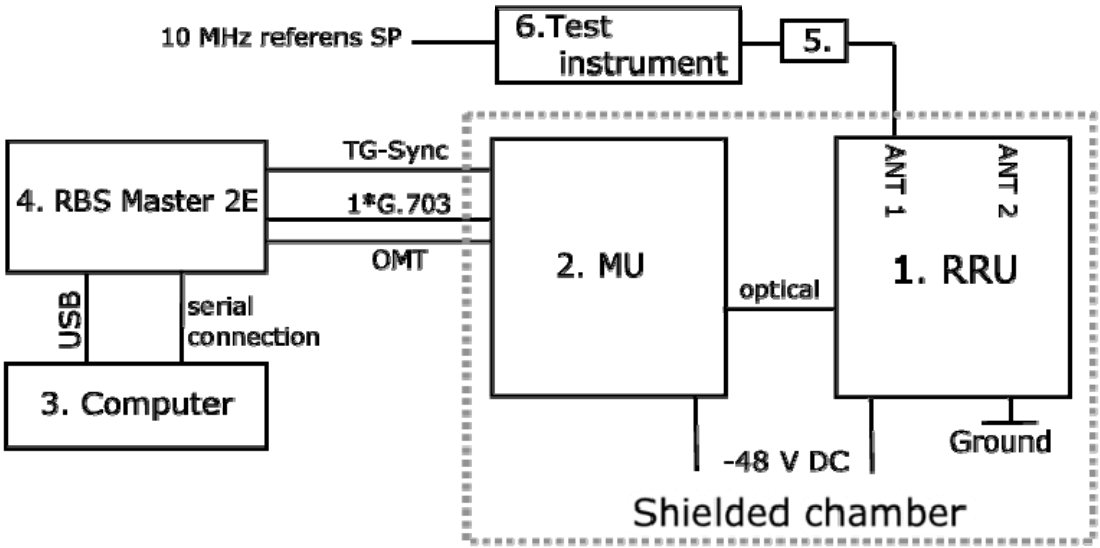
Test object

1. RRUN8-22, product KRC 161 170/4, revision R1A, SN (S)CB47233131 with FCC ID: WODFKRC161170-4 and IC: 287AH-FG1611704

Functional test equipment

2. MU according hardware list in appendix 7
3. HP laptop computer model Compaq NC6400,SN CND70310FD
   With software RBS Master2 control software, revision R7D02
4. Ericsson RBS Master 2E hardware, product number LBY 107 1007/3, revision R1C
   BAMS 1000735209
5. Attenuator / filter listed under test equipment in respective appendix
6. 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. RRUN8-22, product KRC 161 170/4, revision R1A, SN (S)CB47233131 with FCC ID: WODFKRC161170-4 and IC: 287AH-FG1611704

Functional test equipment

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

FCC ID: WODFKRC161170-4 Appendix 1
IC: 287AH-FG1611704

Test object connections

Interface	**Type of port**
-48 V DC	DC power
GND	Ground
Optical connection to MU	Optical interface
ANT 1, connected to test equipment	RF/Antenna
ANT 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
MU 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-132 4.4

Date	Temperature	Humidity
2010-06-14	23 °C ± 3 °C	37 % ± 5 %

Test set-up and procedure

The output was connected to a peak power analyser via a 50 ohm attenuator. The transmitter was modulated with pseudorandom data in all the time slots 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 635 temperature and humidity meter	504 203

Measurement uncertainty: 0.7 dB

Results

Configuration: RBS master 2E setting 43, maximum nominal output power.

The measurement was performed at ARFCN 190 (881.6 MHz).

Test conditions Modulation		Transmitter power (dBm) Peak / RMS		
		GMSK	16QAM	32QAM
T_{nom} 23 °C	V_{nom} -48.0 V DC	43.3 / 42.6	43.3 / 38.5	43.2 / 37.7

Limits

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	Temperature	Humidity
2010-06-14	23 °C ± 3 °C	37 % ± 5 %

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. The transmitter was activated at maximum output power and modulated with pseudorandom data in all time slots during the measurements.

Measurement equipment	SP number
Rohde & Schwarz FSQ40	504 143
Attenuator	504 159
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB, 1.33 kHz

Results

The results are shown in appendix 3.1

The measurement was performed at ARFCN 190 (881.6 MHz).

		Modulation	**OBW**	
Diagram	1:	GMSK	240.7	kHz
Diagram	2:	16QAM	240.0	kHz
Diagram	3:	32QAM	240.7	kHz

Complies?	Yes

FCC ID: WODFKRC161170-4 Appendix 3.1
IC: 287AH-FG1611704

Diagram 1

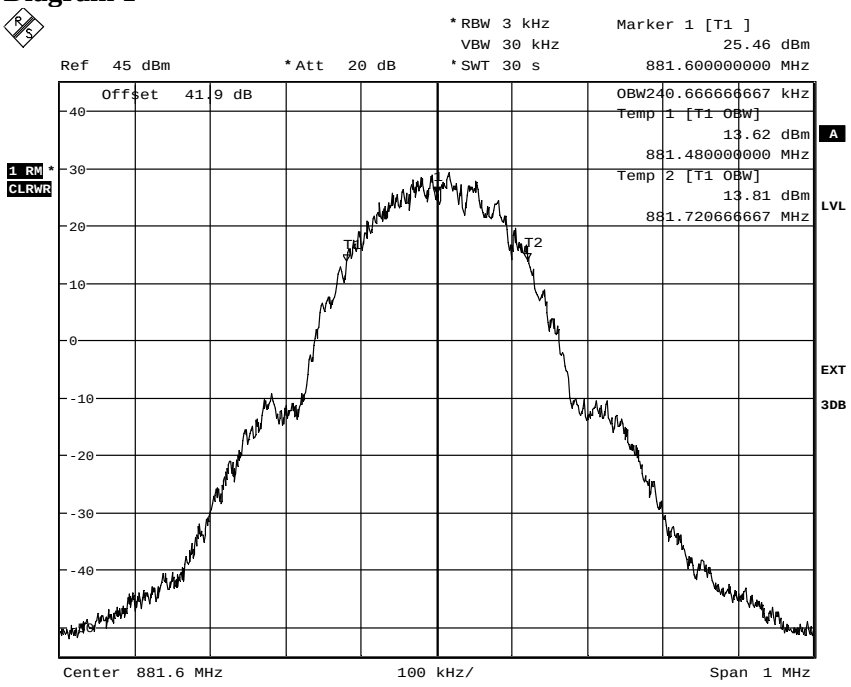

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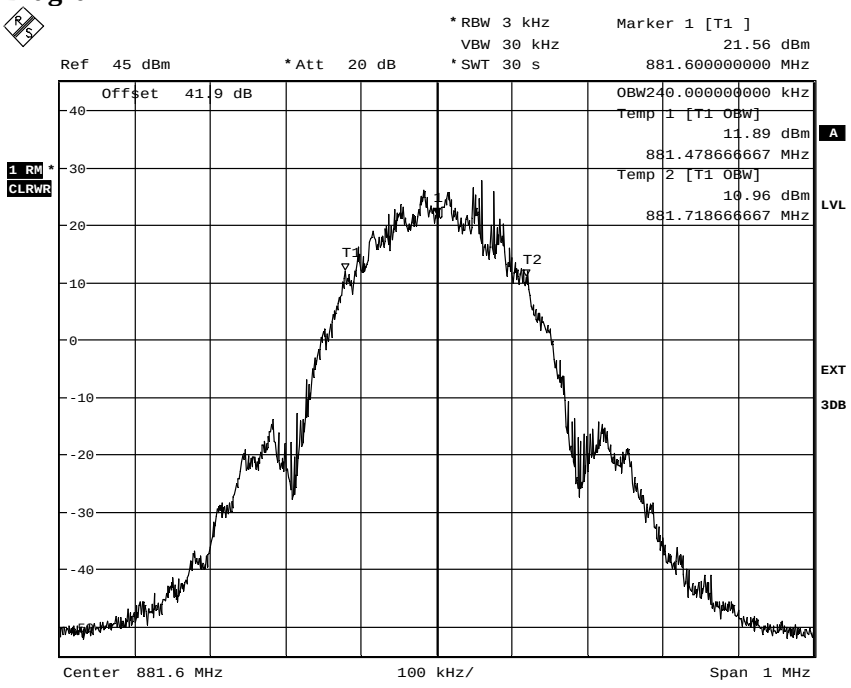
Diagram 2



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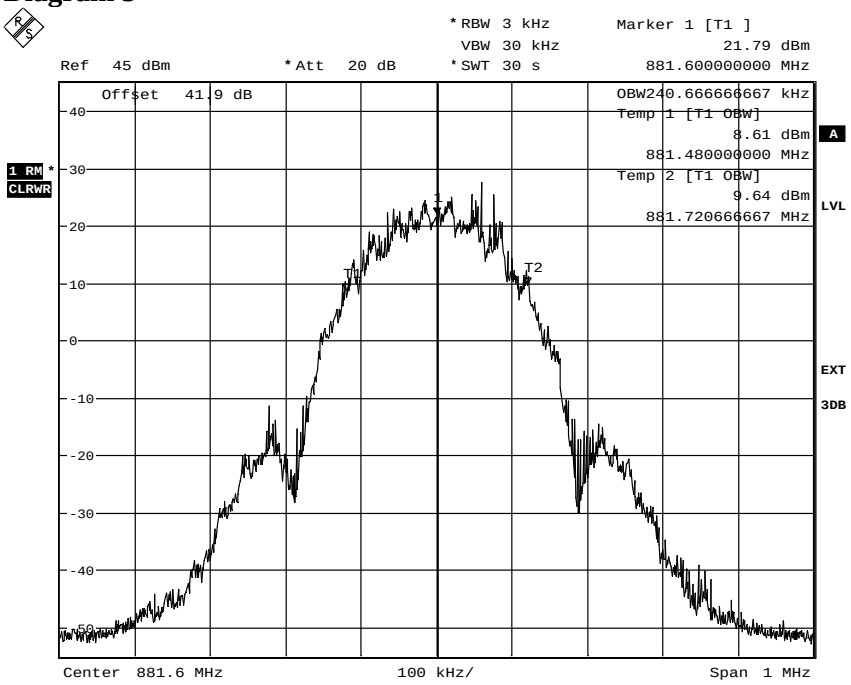
FCC ID: WODFKRC161170-4 Appendix 3.1
IC: 287AH-FG1611704

Diagram 3



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FCC ID: WODFKRC161170-4
IC: 287AH-FG1611704

Appendix 4

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

Date	Temperature	Humidity
2010-06-14	23 °C ± 3 °C	37 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §22.917, with ANT 1 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*log(3/100) to -28.2 dBm for frequencies >1 MHz away from the band edges.

Measurement equipment	SP number
Rohde & Schwarz FSQ40	504 143
Attenuator	504 159
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

The results are shown in appendix 4.1

Reduced output power by 2 dB to nominal 41 dBm (setting “41” 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) Lower band edge, reduced output power,
Diagram 2 16QAM, Ch 251 (893.8 MHz) Upper band edge, reduced output power
Diagram 3 32QAM, Ch 128 (869.2 MHz) Lower band edge, reduced output power
Diagram 4 32QAM, Ch 251 (893.8 MHz) Upper band edge, reduced output power

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) Lower band edge + 1 channel
Diagram 6 16QAM, Ch 250 (893.6 MHz) Upper band edge - 1 channel
Diagram 7 32QAM, Ch 129 (869.4 MHz) Lower band edge + 1 channel
Diagram 8 32QAM, Ch 250 (893.6 MHz) Upper band edge - 1 channel

Remark

On the channels adjacent to the band edges the output power must be reduced by 2 dB to nominal 41 dBm for 16QAM and 32QAM modulation in order to comply to the applicable limit.

Limits

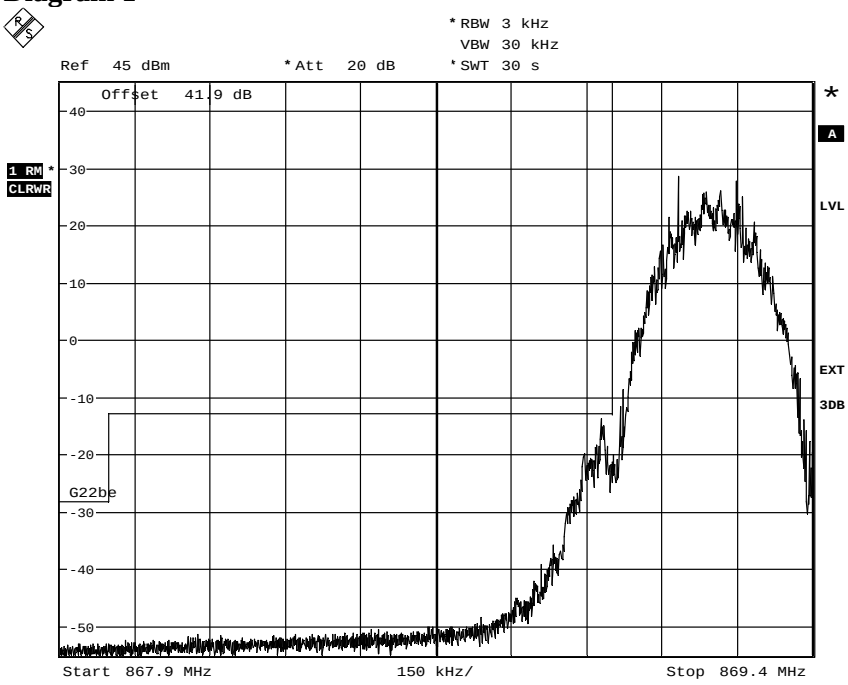
The power of any emission outside the frequency band shall be attenuated below the transmitter power (P) by at least 43 + 10 log P dB.

Tested configurations comply?	Yes

FCC ID: WODFKRC161170-4
IC: 287AH-FG1611704

Appendix 4.1

Diagram 1



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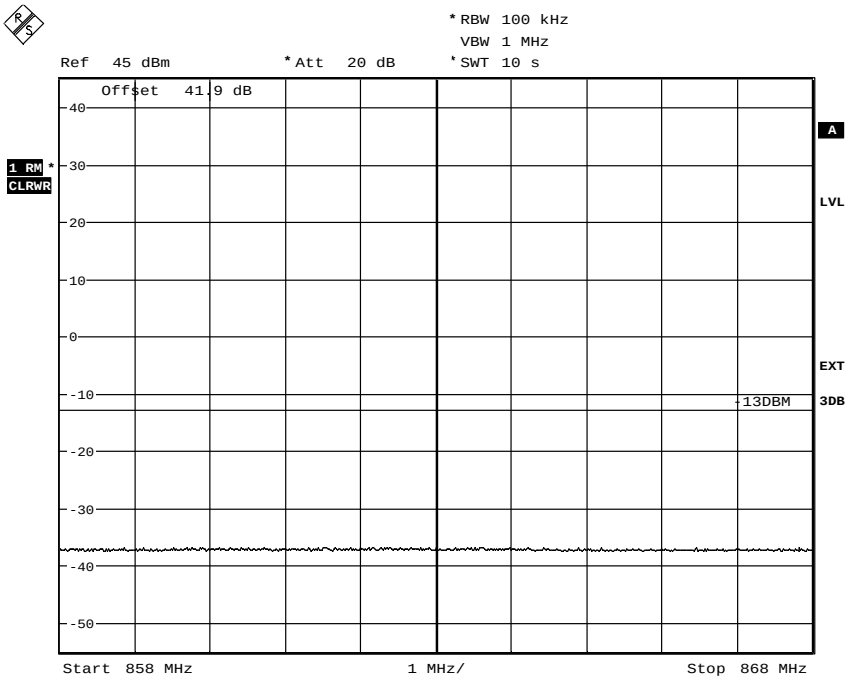

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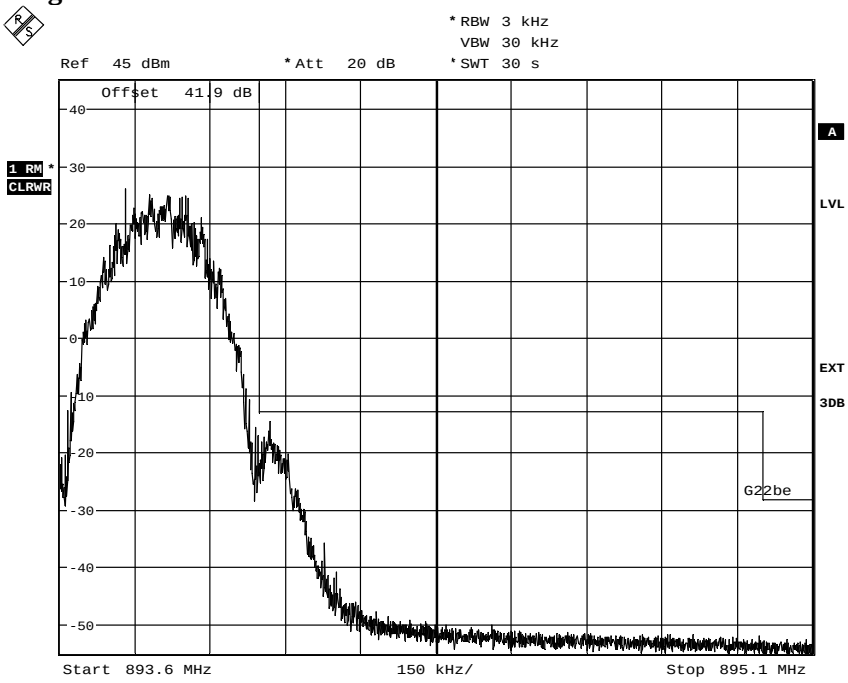

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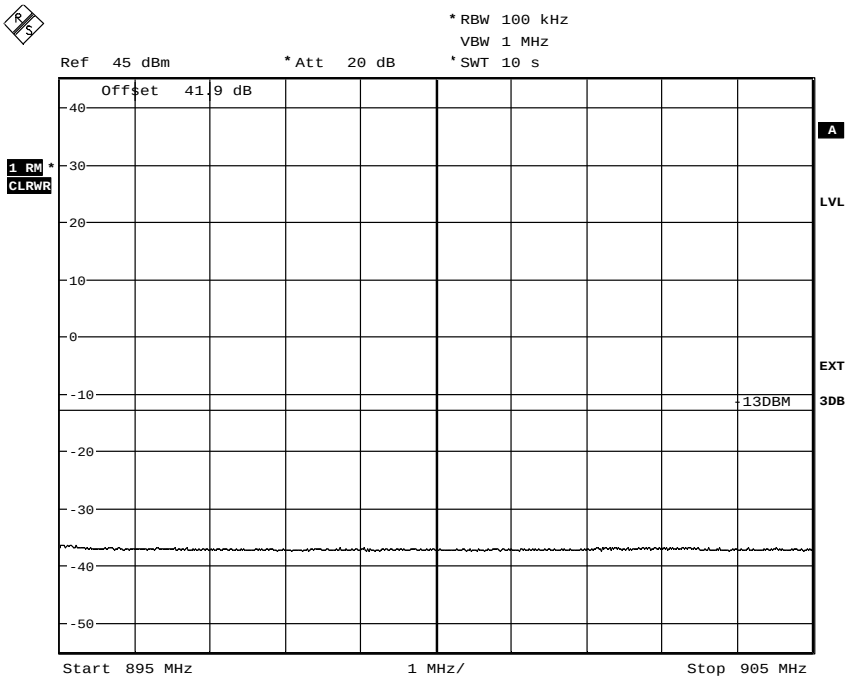

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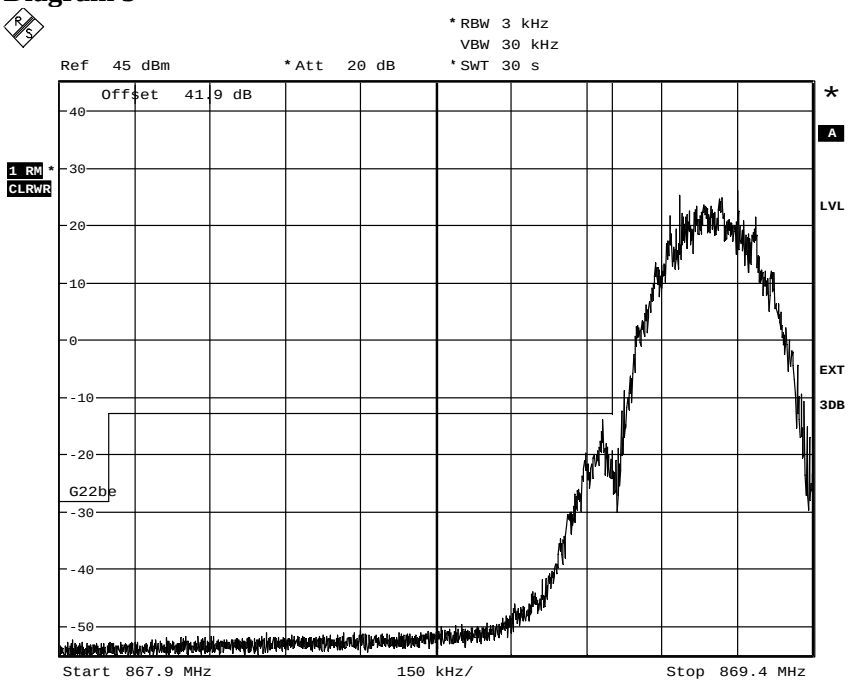
Diagram 3



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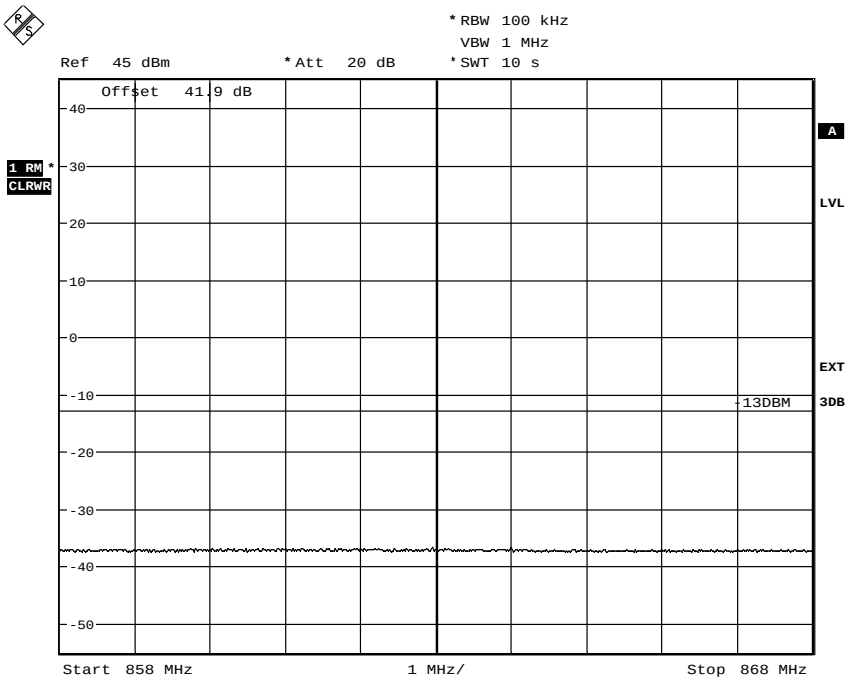

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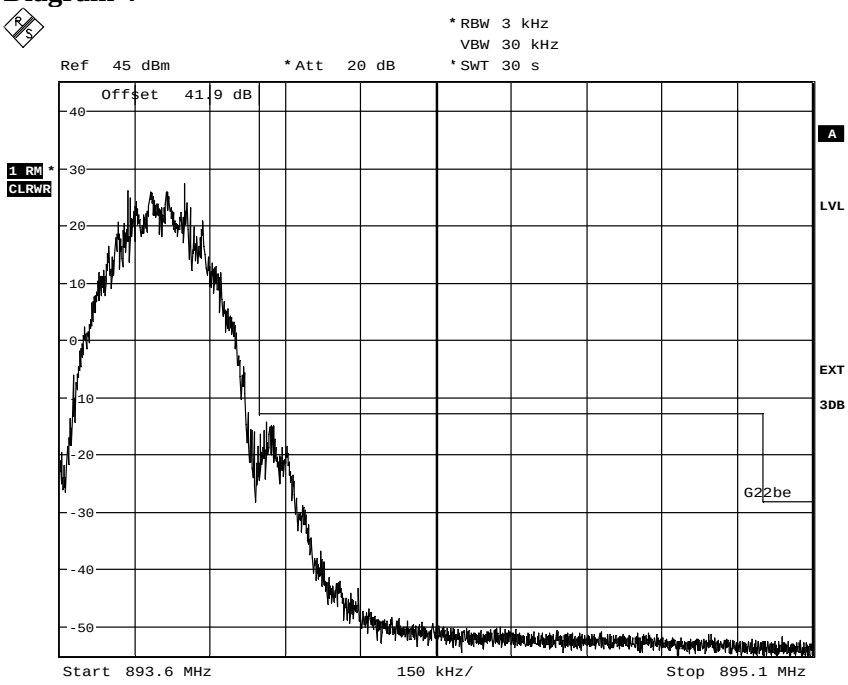
Diagram 4



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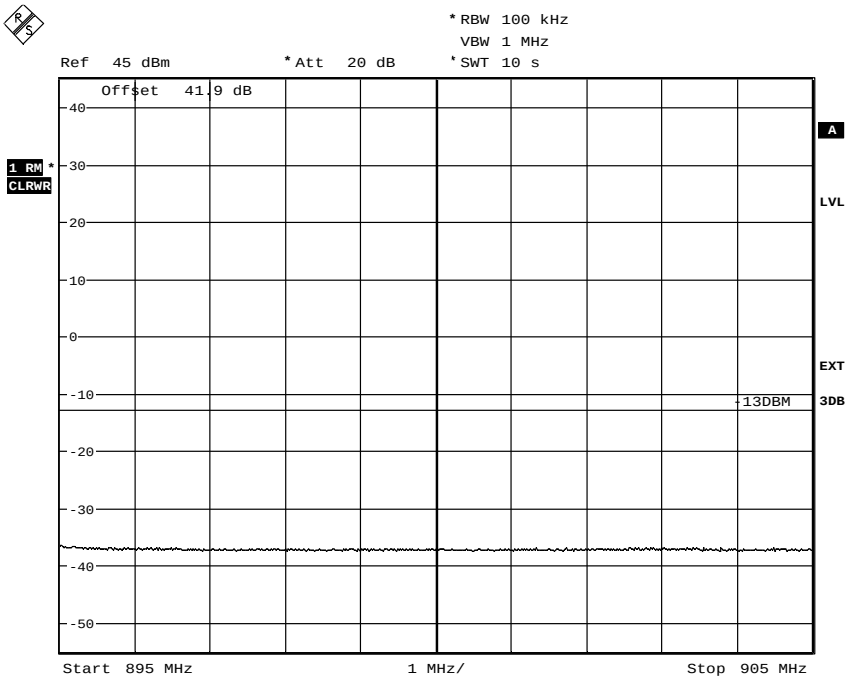

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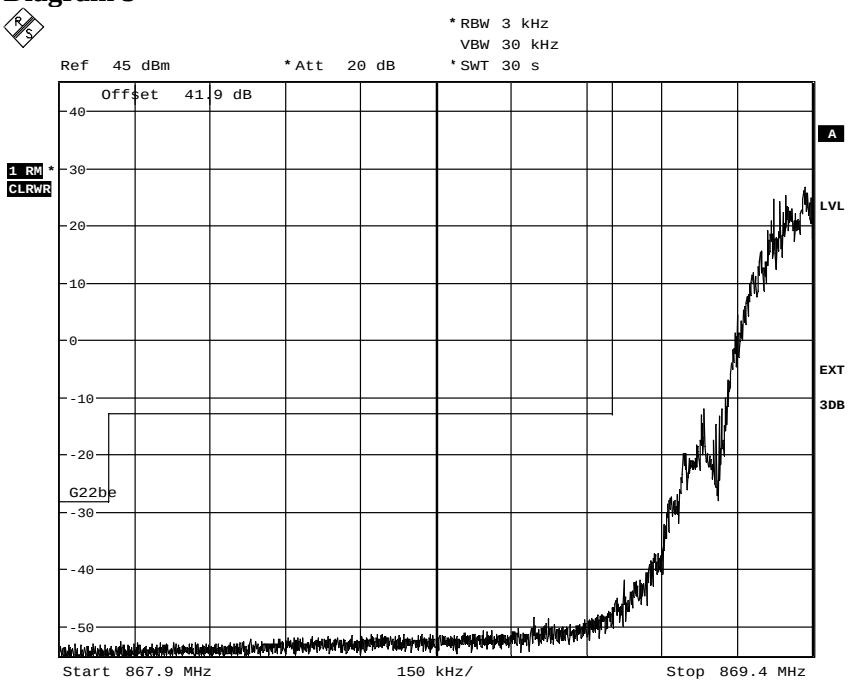

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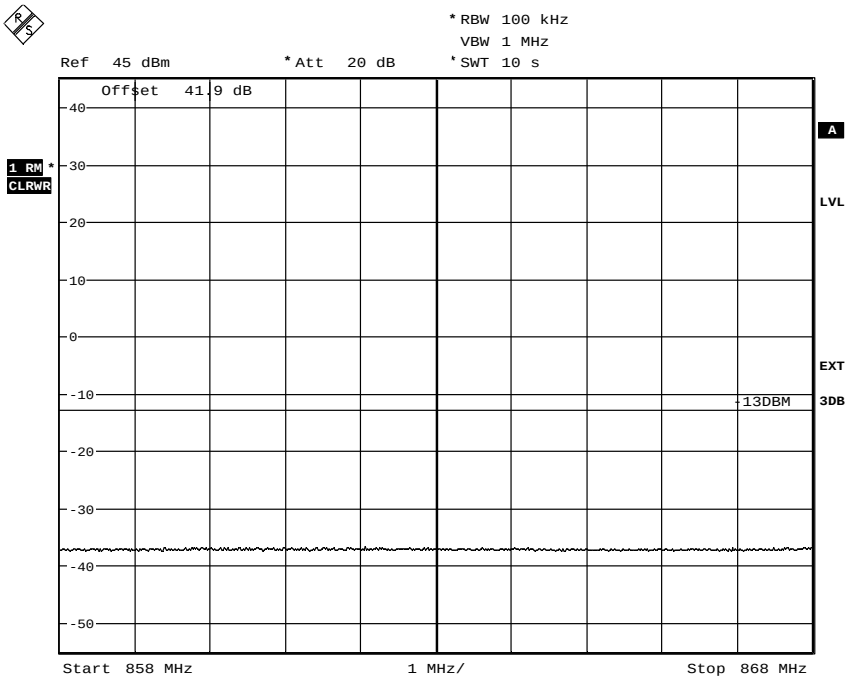

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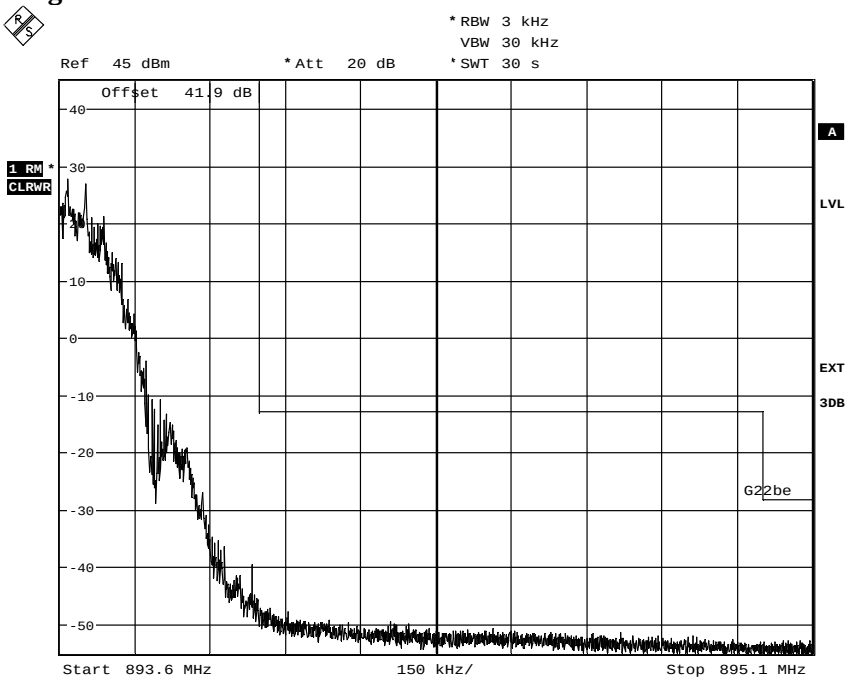

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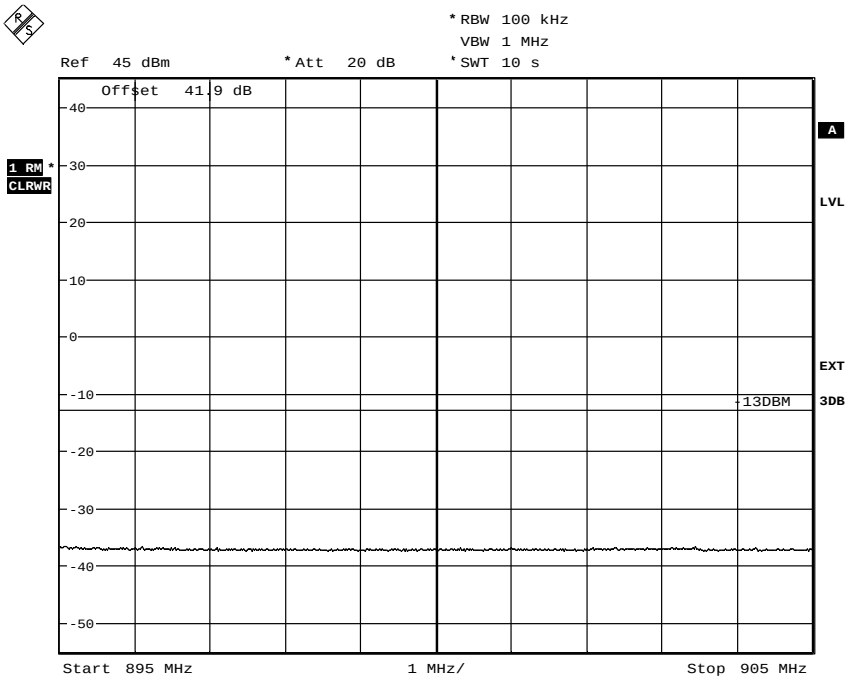

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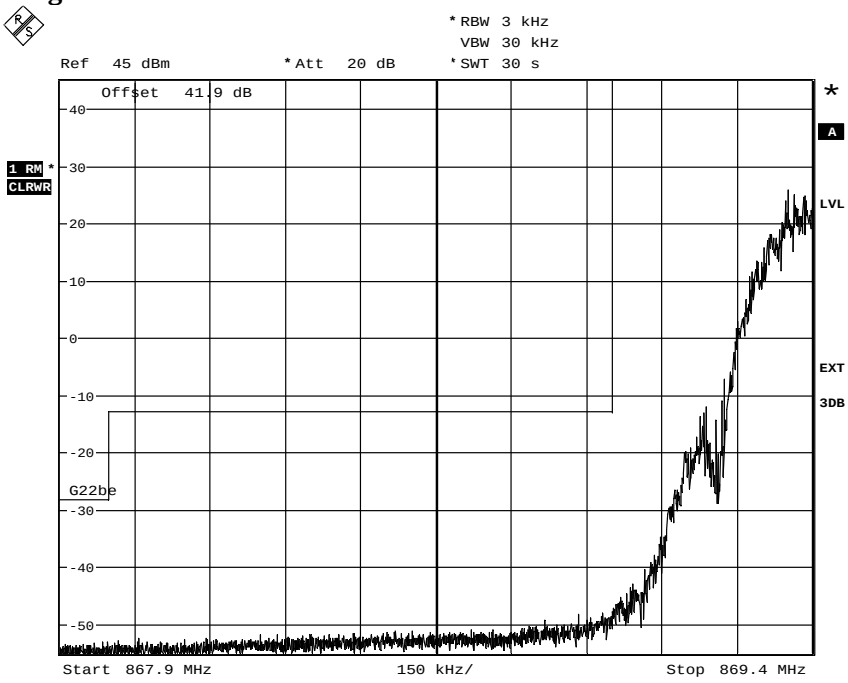
Diagram 7



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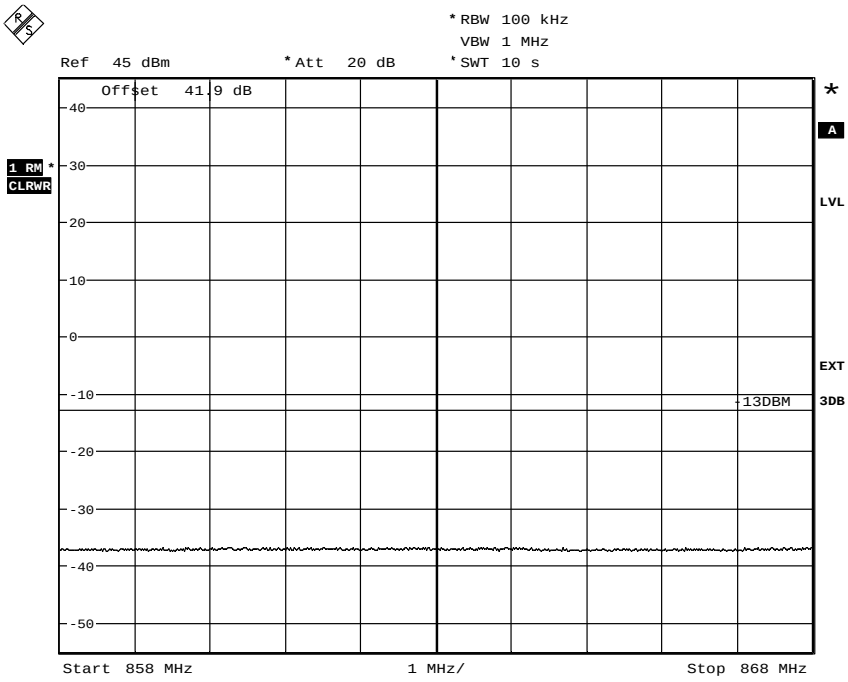

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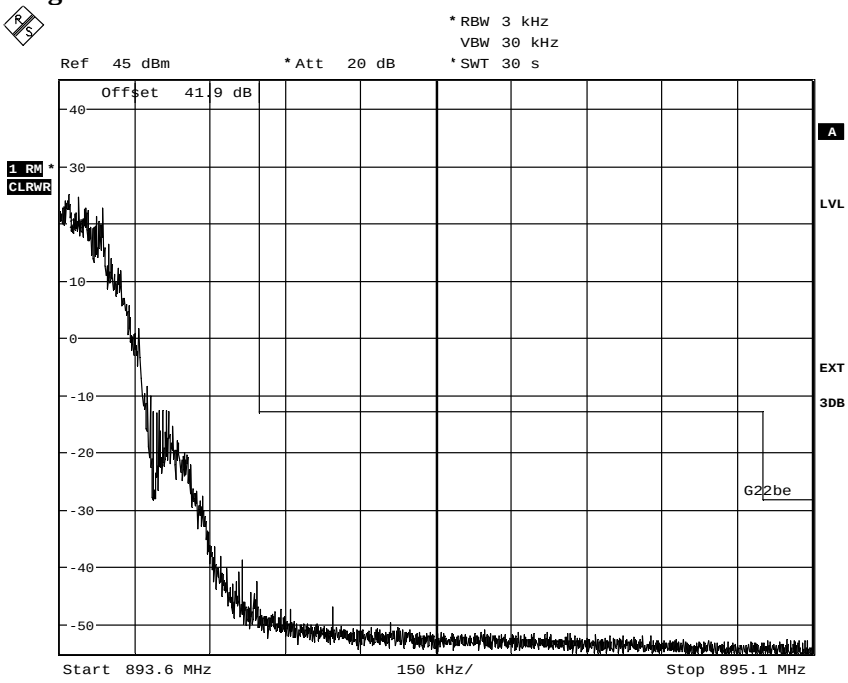
Diagram 8



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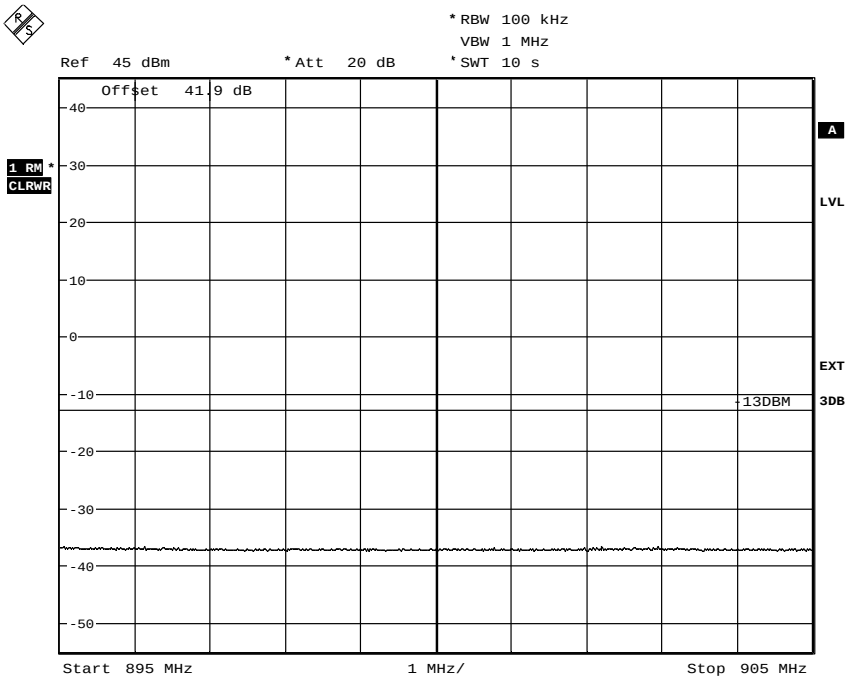

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FCC ID: WODFKRC161170-4
IC: 287AH-FG1611704

Appendix 5

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

Date	Temperature	Humidity
2010-06-14	23 °C ± 3 °C	37 % ± 5 %

Test set-up and procedure

The measurements were made at antenna connector ANT 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. The transmitter was activated at maximum output power and 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 635 temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

The results are shown in appendix 5.1

TX ARFCN 190 (881.6 MHz), configured for nominal maximum output power 43 dBm.

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

Diagram 1

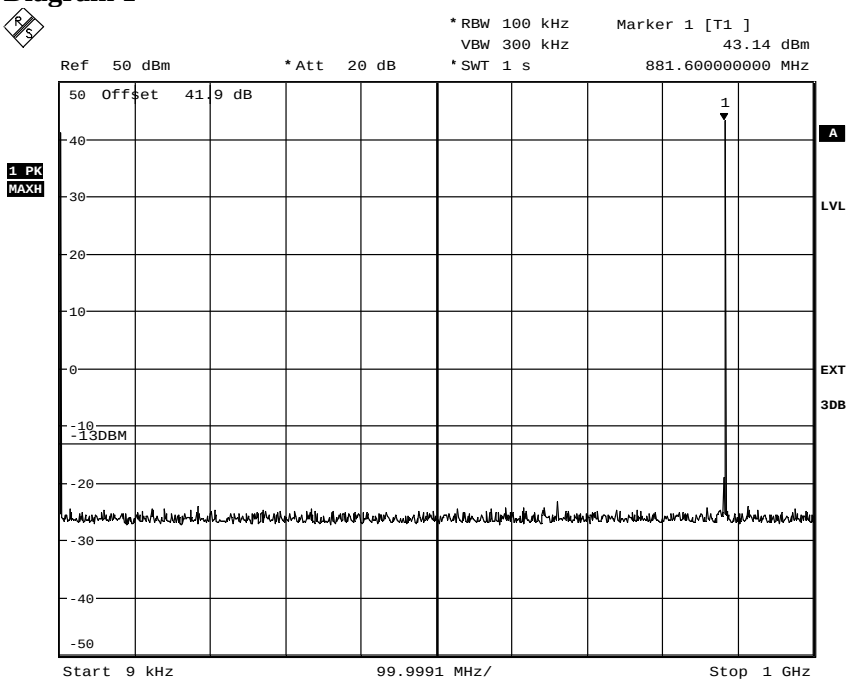

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Diagram 2

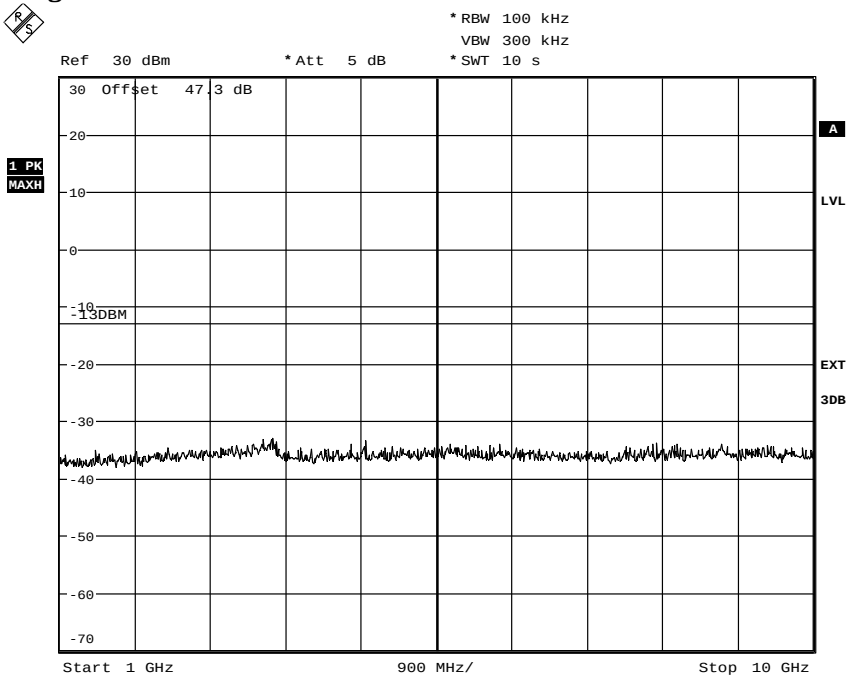

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Diagram 3

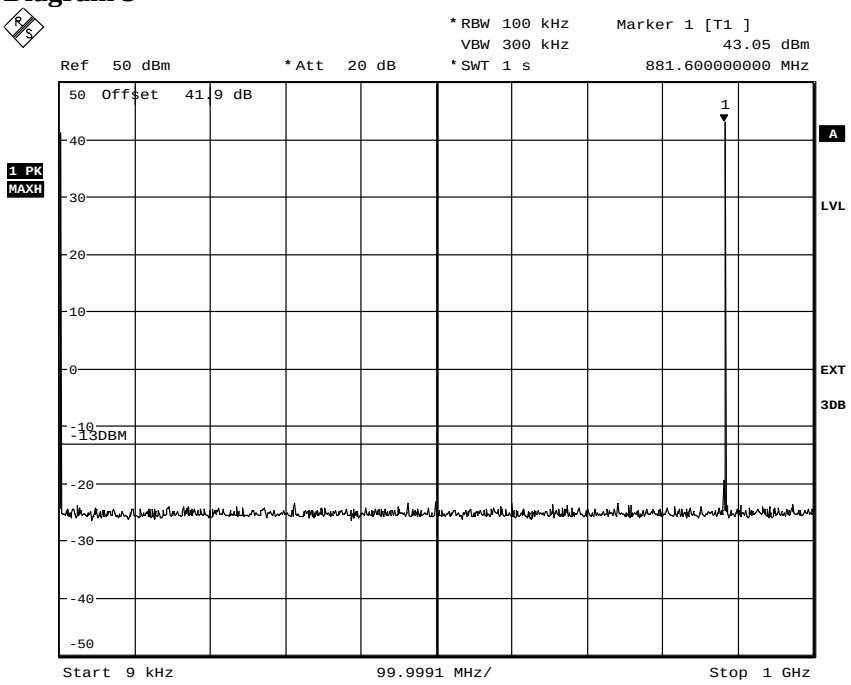

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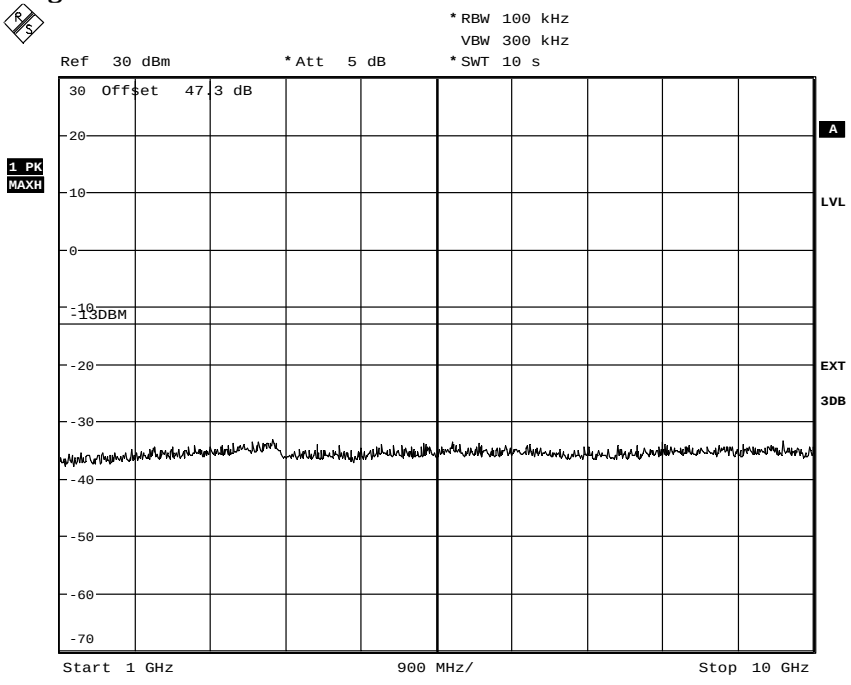
Diagram 4



Date: 14.JUN.2010 14:17:30

Diagram 5

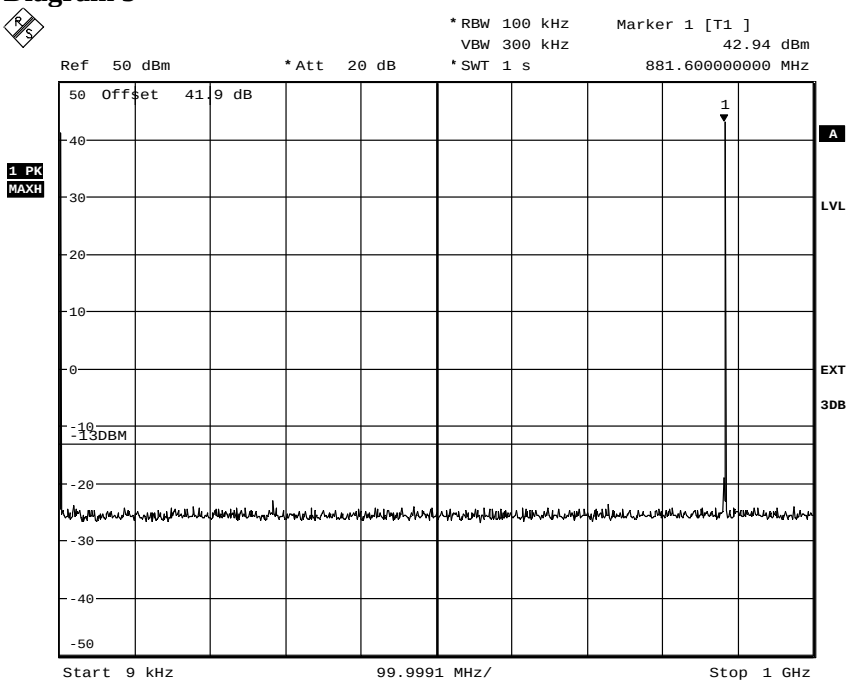


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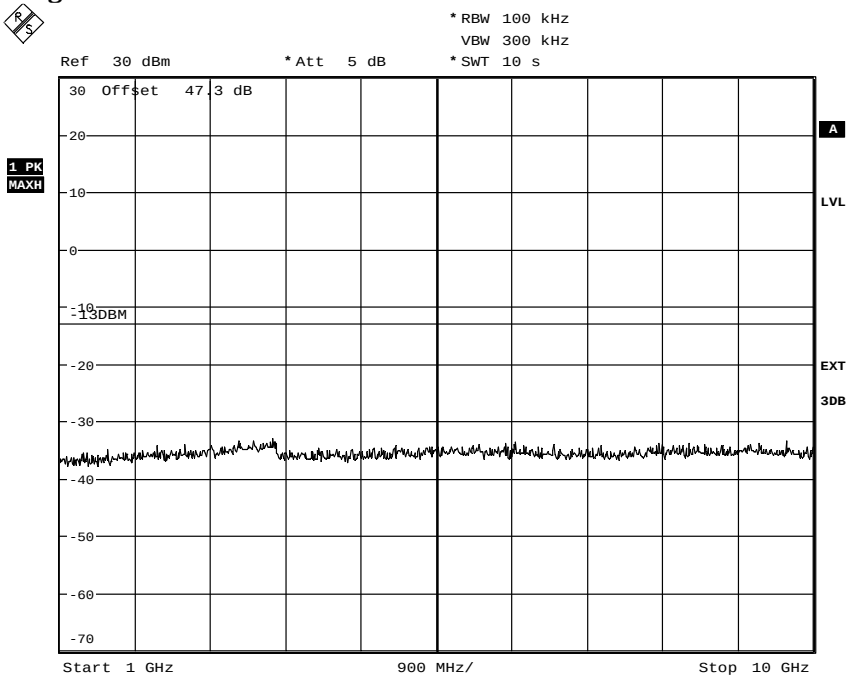
Diagram 6



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IC: 287AH-FG1611704

Appendix 6

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

Date	Temperature	Humidity
2010-06-17	23 °C ± 3 °C	37 % ± 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 – 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.

EUT configuration: RBS master 2E setting 43, TX ARFCN 190 (881.6 MHz)

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
MITEQ Low Noise Amplifier	503 277
ROHDE & SCHWARZ Vector Network Analyser	503 687
Wainwright high pass filter WHKY1.0/15G-12SS	504 199
Testo 615 temperature and humidity meter	503 498

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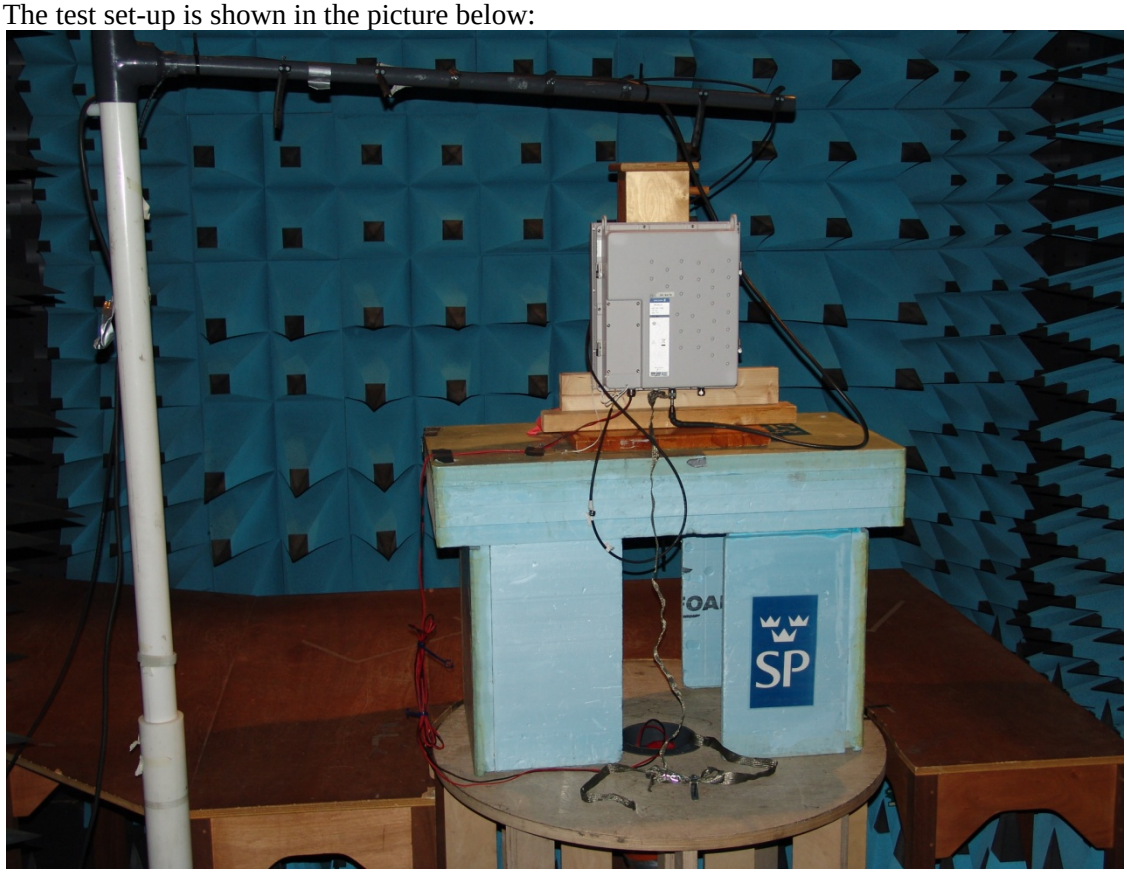
Appendix 6

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



Results

Modulation GMSK

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-10 000	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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Appendix 7

Hardware & software list

The same test sample was used for or both radiated and conducted measurements.

Unit	Product Number	Revision	Serial Number
MU-12	BFE 899 101/2	R2A	(S)CB4B944307
RRUN8-22	KRC 161 170/4	R1A	(S)CB47233131

Test object software during both radiated and conducted measurements

Software	Revision
CXP 104 0007/05	G11B

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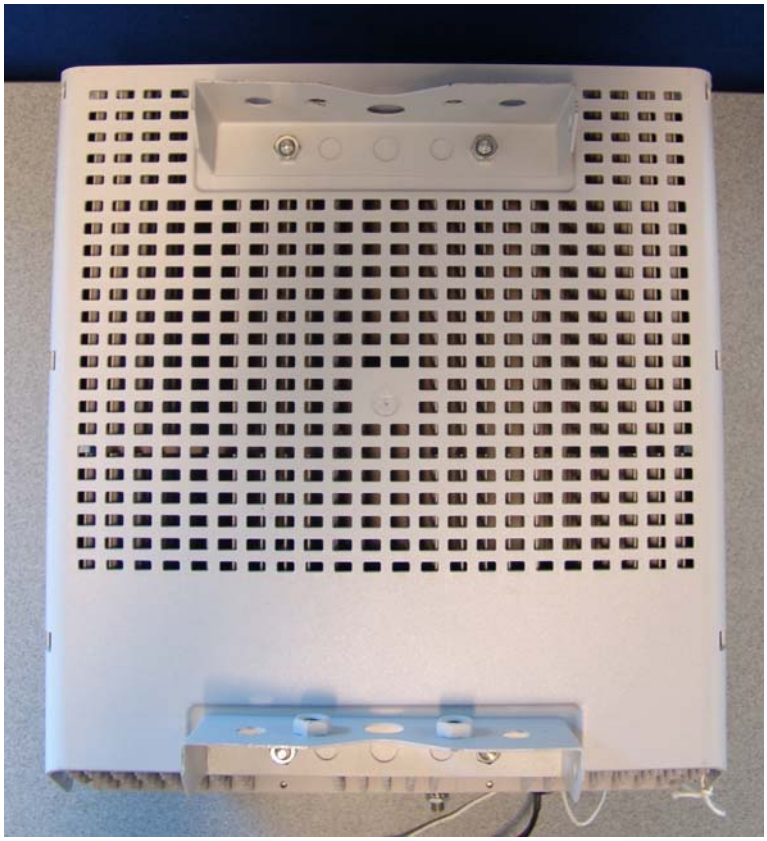
Appendix 8

Photos of the test object

Front side

Rear side



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Appendix 8

Left side

Right side

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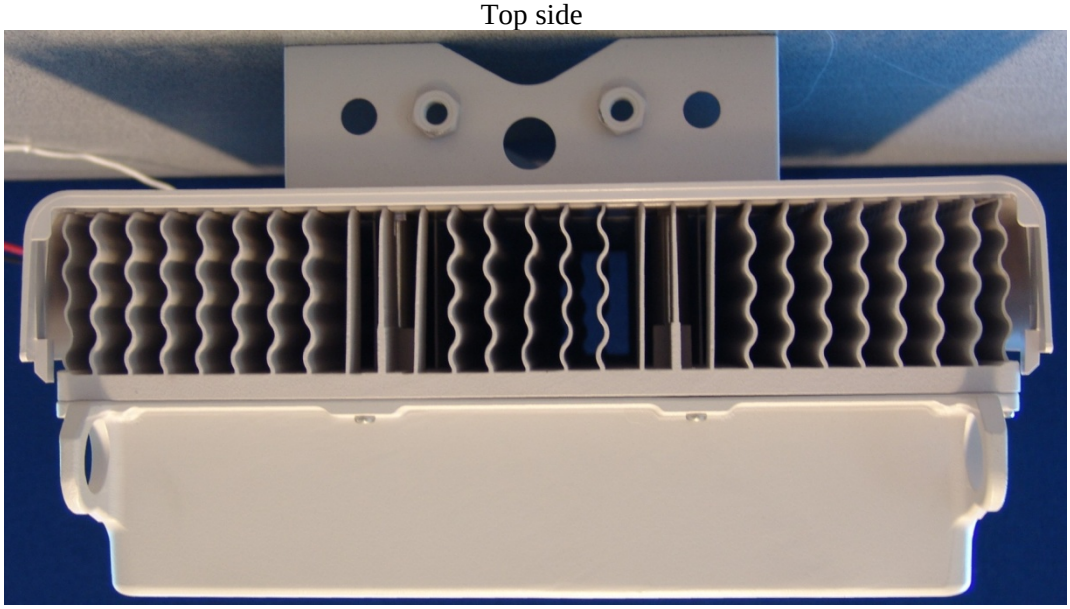
IC: 287AH-FG1611704

Appendix 8

Top side



Bottom side