

Ericsson AB
Klaes Holm
PDU HW
164 80 Stockholm

Radio measurements on RUS 01 B5 850 MHz radio equipment with FCC ID TA8AKRC11864-3 and IC 287AB-AS118643 (5 appendices)

Test object

Product name: RUS 01 B5
Product number: KRC 118 64/3, R1E

Summary

See appendix 1 for details.

Standard	Compliant	Appendix
FCC CFR 47 / IC RSS-132 ISSUE 3		
2.1046 / RSS-132 5.4 RF power output	Yes	2
2.1051 / RSS-132 5.5 Spurious emission at antenna terminals	Yes	3
2.1053 / RSS-132 5.5 Field strength of spurious radiation	Yes	4

Note: 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

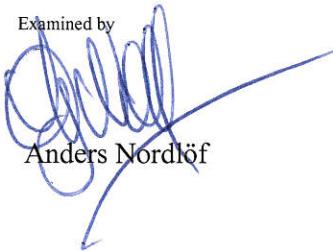
Electronics – EMC

Prepared by



Jörgen Wassholm

Examined by



Anders Nordlöf

SP Technical Research Institute of Sweden

Postal address

SP
Box 857
SE-501 15 BORÅS
Sweden

Office location

Västeråsen
Brinellgatan 4
SE-504 62 BORÅS

Phone / Fax / E-mail

+46 10 516 50 00
+46 33 13 55 02
info@sp.se

Laboratories are accredited by the Swedish Board for Accreditation and Conformity Assessment (SWEDAC) under the terms of Swedish legislation. This report may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Table of contents

Description of the test object	Appendix 1
Purpose of test	Appendix 1
Operation modes during measurements	Appendix 1
RF power output	Appendix 2
Spurious emission at antenna terminals	Appendix 3
Field strength of spurious radiation	Appendix 4
External photos	Appendix 5

Appendix 1**Description of the test object**

Equipment: Product name: RUS 01 B5 supporting mixed mode
WCDMA + LTE

Product number KRC 118 64/3

FCC ID TA8AKRC11864-3

IC: 287AB-AS118643

IC MODEL NO: AS118643

Frequency range: TX: 869 - 894 MHz
RX: 824 - 849 MHz

Antenna ports: 1 TX/RX port
1 RX port

RF configurations: Single carrier, multi carrier, TX diversity and MIMO 2x2
(TX diversity only LTE)

Nominal output power per antenna port: 1-2 LTE + 1-3 WCDMA (Total power 49 dBm, 80W)
Total number of carriers 4

Antenna: No dedicated antenna, handled during licensing

LTE

Modulations: QPSK, 16QAM and 64QAM

Channel bandwidth: 5 MHz and 10 MHz

WCDMA

Modulations: QPSK, 16QAM and 64QAM

Channel bandwidth: 4.2 to 5 MHz (configurable in steps of 100/200 kHz)

Channel spacing: 4.4 to 5 MHz (configurable in steps of 100/200kHz)

Nominal supply voltage: -48VDC

Appendix 1

Operation modes during measurements

MSR, WCDMA + LTE

WCDMA measurements were performed with the test object transmitting test models as defined in 3GPP TS 25.141. Test model 1 (TM1) was used to represent QPSK. Test model 5 (TM5) to represent 16QAM modulation and Test model 6 (TM6) to represent 64QAM modulation.

LTE measurements were performed with the test object transmitting test models as defined in 3GPP TS 36.141. Test model E-TM1.1 was used to represent QPSK, test model E-TM3.2 to represent 16QAM and test model E-TM3.1 to represent 64QAM modulation.

The settings below were deemed representative for all traffic scenarios when settings with different modulations, channel bandwidths, number of carriers and RF configurations has been tested to find the worst case setting. The settings below were used for all measurements if not otherwise noted.

WCDMA MIMO mode

TM5:8 HS-PDSCH at 240ksps + 30 DPCH:s at 30 ksps (SF=128)
Channel bandwidth 5 MHz

LTE MIMO mode

E-TM1.1

Channel bandwidth 5 and 10 MHz.

Measurements were performed with the test object configured for the maximum transmit power applicable for the tested configuration.

Conducted measurements

The test object was hosted in a RBS 6201 powered with -48 VDC. Additional connections are documented in the set-up drawings below.

All measurements were performed on test object 1 (described in the Test set-up diagram), running in primary mode.

Radiated measurements

The test object was tested stand-alone. It was powered with -48 VDC. All measurements were performed with the test object configured for maximum transmit power.

Purpose of test

The purpose of the tests is to verify compliance to the performance characteristics specified in applicable items of FCC CFR 47 and Industry Canada RSS-132 and RSS-Gen when the test object is configured for mixed mode operation (MSR) with WCDMA+LTE.

Appendix 1

References

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

ANSI 63.4-2009
 ANSI/TIA/EIA-603-C-2004
 CFR 47 part 2, October 1st , 2012
 CFR 47 part 22, October 1st, 2012
 3GPP TS 25.141, version 11.4.0
 3GPP TS 36.141, version 11.4.0
 3GPP TS 37.141, version 11.3.0
 RSS-Gen Issue 3
 RSS-132 Issue 3

Measurement equipment

	Calibration Due	SP number
Test site Tesla	2014-01	503 881
R&S ESU 26	2014-05	901 553
R&S FSQ 40	2014-03	504 143
R&S FSW 43	2014-03	902 073
Control computer with R&S software EMC32 version 8.52.0	-	503 899
High pass filter	2014-07	901 501
High pass filter	2014-07	901 502
High pass filter	2014-07	504 199
High pass filter	2014-09	901 373
High pass filter	2014-08	503 739
High pass filter	2014-07	503 740
RF attenuator	2014-09	503 248
RF attenuator	2014-09	503 249
RF attenuator	2014-07	504 159
RF attenuator	2014-07	900 233
RF attenuator	2014-07	901 384
RF attenuator	2013-12	901 508
Chase Bilog Antenna CBL 6111A	2014-10	503 182
EMCO Horn Antenna 3115	2014-01	502 175
µComp Nordic, Low Noise Amplifier	2014-04	901 545
Temperature and humidity meter, Testo 635	2014-06	504 203
Temperature and humidity meter, Testo 625	2014-06	504 188
Temperature Chamber	--	503 360
Multimeter Fluke 87	2014-08	502 190

Appendix 1

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).

Compliance evaluation is based on a shared risk principle with respect to the measurement uncertainty.

Reservation

The test results in this report apply only to the particular test object as declared in the report.

Delivery of test object

The test object was delivered 2013-08-29.

Manufacturer's representative

Christer Gustavsson, Ericsson AB.

Test engineers

Andreas Johnson, Tomas Lennhager, Kexin Chen, Tomas Isbring, Jörgen Wassholm and Hyder Khalaf, SP.

Test participant

None.

Appendix 1

Test frequencies used for conducted measurements

MSR, MIMO WCDMA + LTE TX test frequencies

Configuration 1:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4385	877.0	5	2572	886.2	5

Configuration 2:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4385	877.0	5	2572	886.2	10

Configuration 3:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4357	871.4	5	2574	886.4	5

Configuration 4:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4357	871.4	5	2524	881.4	10

Configuration 5:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4383	876.6	5	2625	891.5	5

All RX frequencies were configured 45 MHz below the corresponding TX frequency according the applicable duplex offset for the operating band.

Appendix 1

Test frequencies used for radiated measurements

MSR MIMO, WCDMA + LTE TX test frequencies

Configuration 6:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4395	879.0	5	2550	884.0	5

Configuration 7:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4370	874.0	5	2600	889.0	5

Configuration 8:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4383	876.6	5	2625	891.5	5

Configuration 9:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4357	871.4	5	2574	886.4	5

Configuration 10:

WCDMA 1x40W			LTE 1x40W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4357	871.4	5	2574	886.4	10

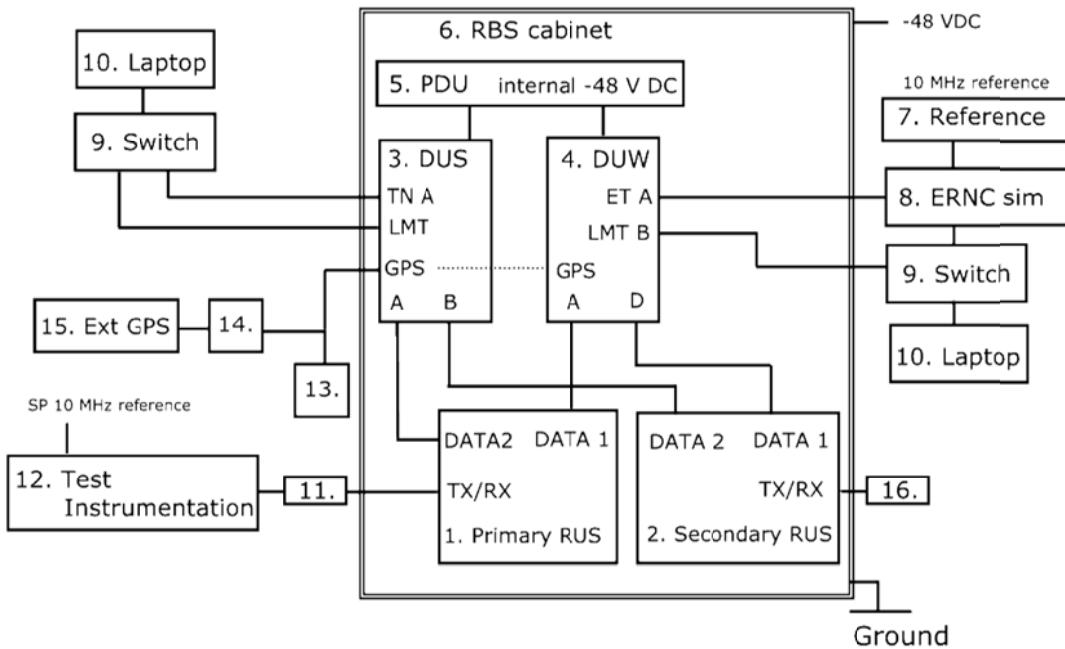
Configuration 11:

WCDMA 2x20W			LTE 2x20W		
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]
4357	871.4	5	2525	881.5	5
4382	876.4	5	2575	886.5	5

All RX frequencies were configured 45 MHz below the corresponding TX frequency according the applicable duplex offset for the operating band.

Appendix 1

Test set-up conducted measurements MSR WCDMA + LTE



Note: Unconnected interfaces were omitted in the picture for simplicity, but are listed in the interface table on page 7.

Test object:

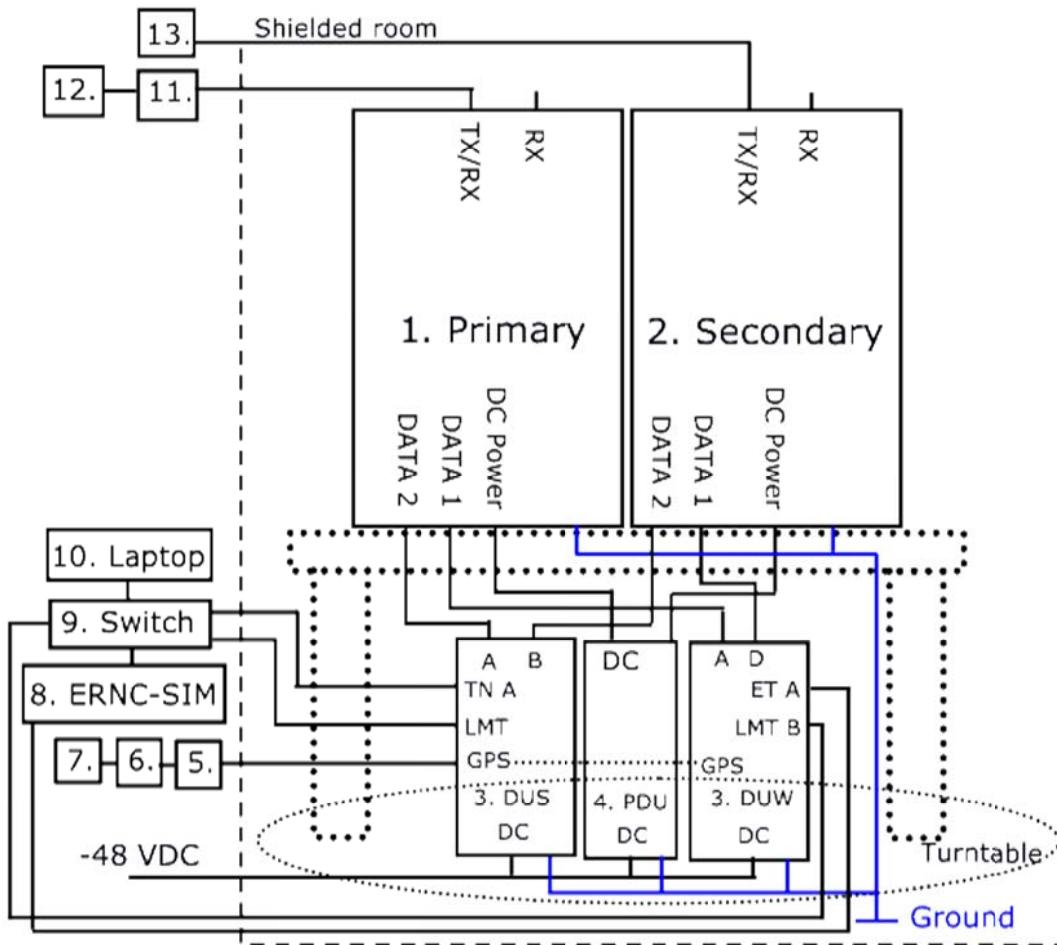
1.	RUS 01 B5, KRC 118 64/3, rev. R1E, s/n: D169066003, primary/ secondary
2.	RUS 01 B5, KRC 118 64/3, rev. R1E, s/n: D169066025, Dummy: secondary/ primary working software CXP 901 3268/6, rev. R49FF with FCC ID TA8AKRC11864-3 and IC: 287AB-AS118643

Functional test equipment:

3.	DUS 41 01, KDU 137 624/1, rev:R5A, s/n: D165724695
4.	DUW 30 01, KDU 127 161/3, rev:R4C, s/n: C825194294
5.	PDU 02 01, BMG 980 336/4, rev: R2A, s/n: BJ31528316
6.	RBS 6201 cabinet, BAMS 1000778792
7.	Symmetricon 8040 reference, BAMS – 1000714189
8.	ERNC Sim 130, BAMS – 100066091
9.	Fast Ethernet switch, Netgear FS726T
10.	Controlling laptop HP EliteBook 8560 w, BAMS 1001236858
11.	Attenuator, filter, according respective appendix
12.	SP test instrument according measurement equipment list
13.	Power supply, Mascot Type 719
14.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K474887
15.	GPS Active Antenna, KRE 101 2082/1
16.	Terminator

Appendix 1

Test set-up radiated measurements MSR WCDMA + LTE



Test object:

1.	RUS 01 B5, KRC 118 64/3, rev. R1E, s/n: D169066003 primary
2.	RUS 01 B5, KRC 118 64/3, rev. R1E, s/n: D169066025 secondary working software CXP 901 3268/6, rev. R49FF with FCC ID TA8AKRC11864-3 and IC: 287AB-AS118643

Functional test equipment:

3.	Main Unit SUP 6601, 1/BFL 901 009/4, rev. R1E, s/n: BR82081105 DUS 41 01, KDU 137 624/1, rev:R5A, s/n: D165724695 SUP 6601, 1/BFL 901 009/4, rev. R1E, s/n: BR88258668 DUW 30 01, KDU 127 161/3, rev:R4C, s/n: C825194294
4.	Power Subrack: PDU 01 01, BMG 980 336/2, R4F, BJ31532384 PDU 01 01, BMG 980 336/2, R4F, BJ31532382 SHU 01 01, BGK 901 18/1, R3C, BJ31446269 PFU 01 01, KFE 101 1162/1, R1B, BR80910495 PCF 02 01, KFE 101 1157/1, R1C, BW95301450 DUMMY x3, SXK 109 8257/1, R1D DUMMY x1, SXK 109 8257/1, R1F
5.	Power supply, Mascot Type 719

**Appendix 1**

6.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K356428
7.	GPS Active Antenna, KRE 101 2082/1
8.	ERNC-SIM 131, BAMS 1000660992
9.	Switch Netgear FS726T
10.	Laptop, EliteBook 8560w, BAMS 1001236856
11.	Attenuator
12.	ESI 26, SP number: 503 292, for supervision purpose only
13.	Terminator

Appendix 1

Interfaces:

	Type of port:
Power: -48 VDC	DC Power
Antenna port (A), 7/16 connector, combined TX/RX	Antenna
Antenna port (B), 7/16 connector, only RX	Antenna
Data 1, electrical interface	Signal
Data 2, electrical interface	Signal
RX A Out, no cable attached	Antenna
RX A I/O, no cable attached	Antenna
RX B I/O, no cable attached	Antenna
Ground wire	Ground

Softwares

RAT	Software	Revision
WCDMA	CXP 902 1719	R1DC14
LTE	CXP 102 051/18	R32AV

Appendix 2

RF power output measurements according to CFR 47 2.1046 / IC RSS-132 5.4

Date 2013-09-19	Temperature 22 °C ± 3 °C	Humidity 39% ± 5 %
--------------------	-----------------------------	-----------------------

Test set-up and procedure

The test object was connected to a signal analyzer measuring peak and RMS output power in CDF mode. A RBW of 50 MHz was used.

Measurement equipment	SP number
Rohde & Schwarz signal analyzer FSQ40	504 143
RF attenuator	901 508
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

Rated output power at RF connector 49 dBm.

Tested configuration	Port RFA primary [RMS dBm/ dB PAR]	Port RFA secondary ²⁾ [RMS dBm/ dB PAR]	Total power ¹⁾ [RMS dBm]
1	48.90/ 6.95	Not tested ²⁾	51.90
2	48.90/ 6.95	Not tested ²⁾	51.90
3	48.84/ 7.14	Not tested ²⁾	51.84
4	48.88/ 7.21	Not tested ²⁾	51.88
5	48.81/ 7.04	Not tested ²⁾	51.81

¹⁾: Since port A secondary isn't measured 3dB has been added to the result on port RFA primary. [10 log (2)] “measure and add 10 log(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output v02

²⁾: Measurements were limited to port RF A in primary mode due to the measurement result in LTE and WCDMA single carrier MIMO mode that shows that the ports are electrical identical as declared by the client.

Note: The highest PAR measured was 7.21 dB (0.1%). For multi-carrier constellations the measured “PAR” is informative only as to the definition of Peak to Average Ratio per carrier.



Appendix 2

Remark

This unit is tested without antenna. ERP/EIRP compliance is addressed at the time of licensing, as required by the responsible FCC/IC Bureau(s). Licensee's are required to take into account maximum allowed antenna gain used in combination with above power settings to prevent the radiated output power to exceed the limits.

Limits

CFR47 § 22.913: The effective radiated power ERP shall not exceed 1000 W.

RSS-132 5.4: The average equivalent isotropically radiated power (e.i.r.p.) limits in SRSP-503 apply, resulting in a maximum EIRP of 1640 W.
The PAR (0.1%) shall not exceed 13 dB.

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

Appendix 3

Conducted spurious emission measurements according to CFR 47 2.1051 / IC RSS-132 5.5

Date	Temperature	Humidity
2013-09-19	22 °C ± 3 °C	39% ± 5 %

Test set-up and procedure

The measurements were made per definition in § 22.917, but with a conservative 1 MHz RBW. 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.

Before comparing the results to the limit, 3 dB [10 log (2)] should be added according to method E, 3, (iii) measure and add 10 log(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output v02

Measurement equipment	SP number
Rohde & Schwarz signal analyzer FSQ40	504 143
RF attenuator	901 508
High pass filter	901 501
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Diagram	Tested configuration	Tested Port RF A
1 a+b+c	Config 1	Primary mode
2 a+b+c	Config 2	Primary mode
3 a+b+c	Config 3	Primary mode
4 a+b+c	Config 4	Primary mode
5 a+b+c	Config 5	Primary mode

Appendix 3

Remarks

The emission at 9 kHz on some of the 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.

The upper frequency boundary covers 10x the highest TX fundamental frequency. The highest fundamental frequency is 894MHz. The measurements were made up to 9 GHz (10x894 MHz = 8.94 GHz).

Limits

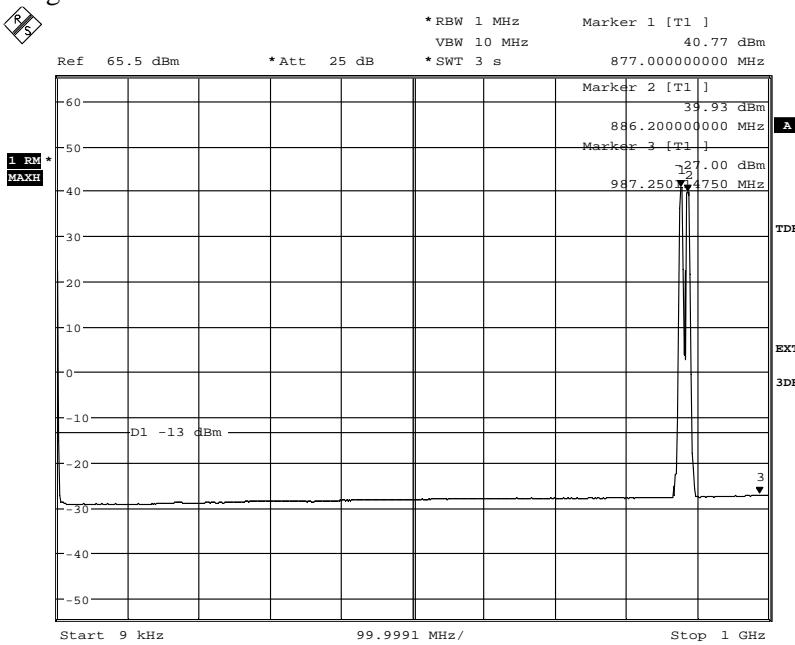
CFR 47 § 22.917: Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB, resulting in a limit of -13 dBm per 100 kHz RBW.

IC RSS-132 5.5.1.2: Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB per any 100 kHz RBW.

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

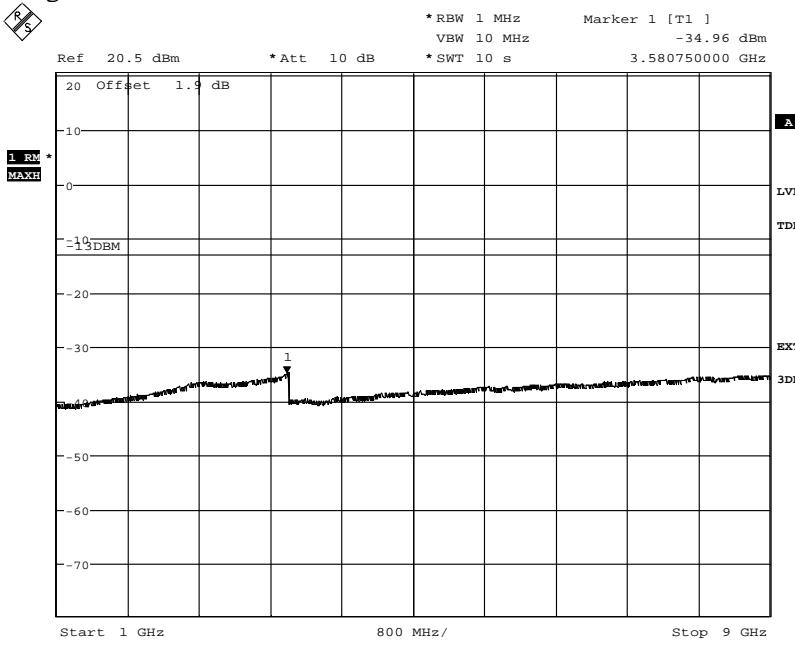
Appendix 3

Diagram 1 a:

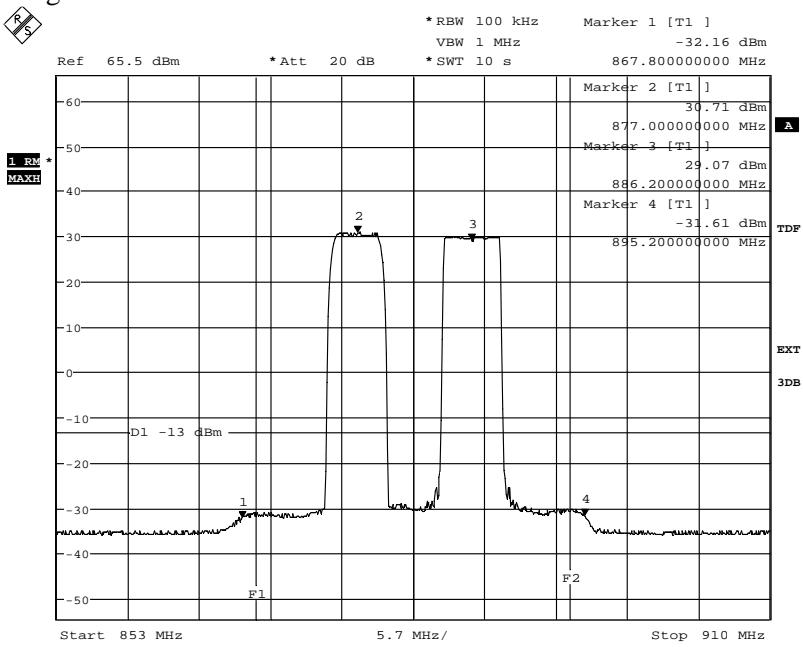


Date: 19.SEP.2013 14:02:21

Diagram 1 b:



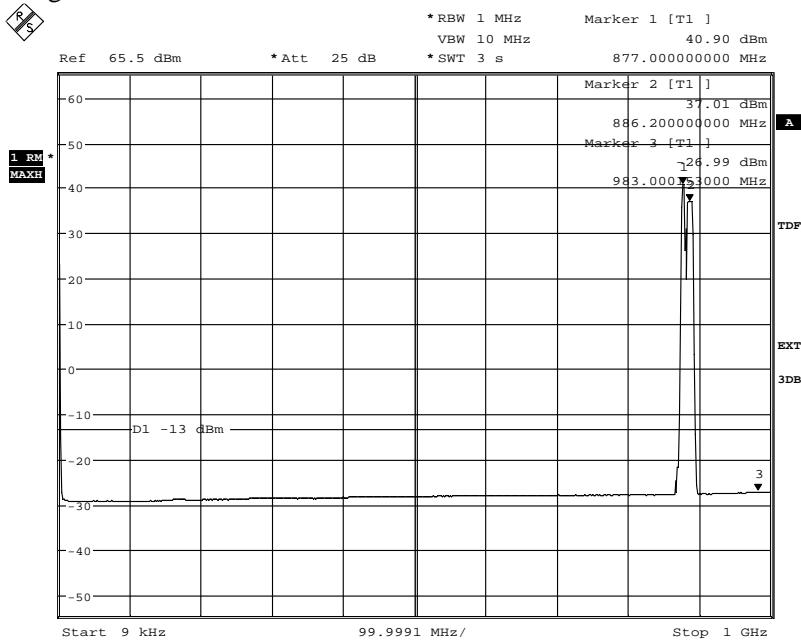
Date: 19.SEP.2013 12:06:31

Appendix 3
Diagram 1 c:


Date: 19.SEP.2013 12:13:03

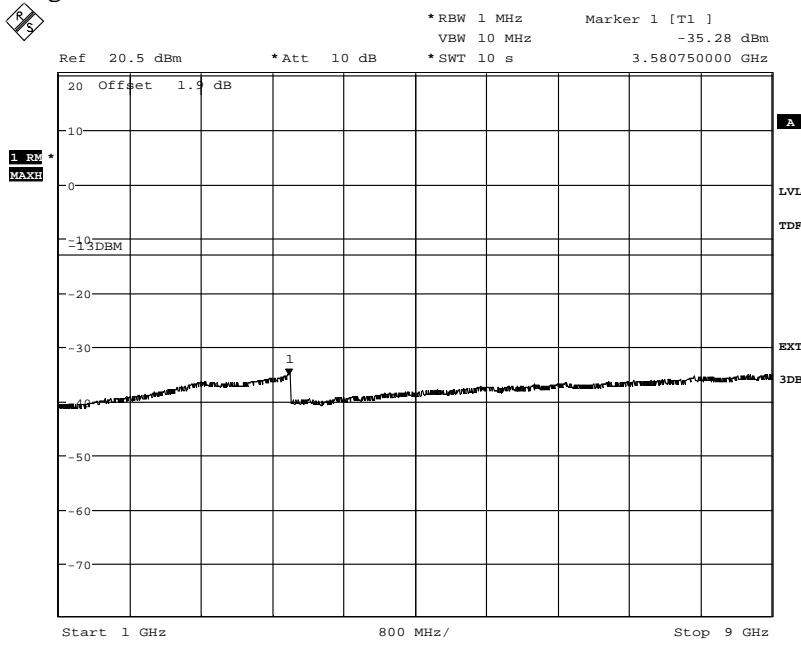
Appendix 3

Diagram 2 a:

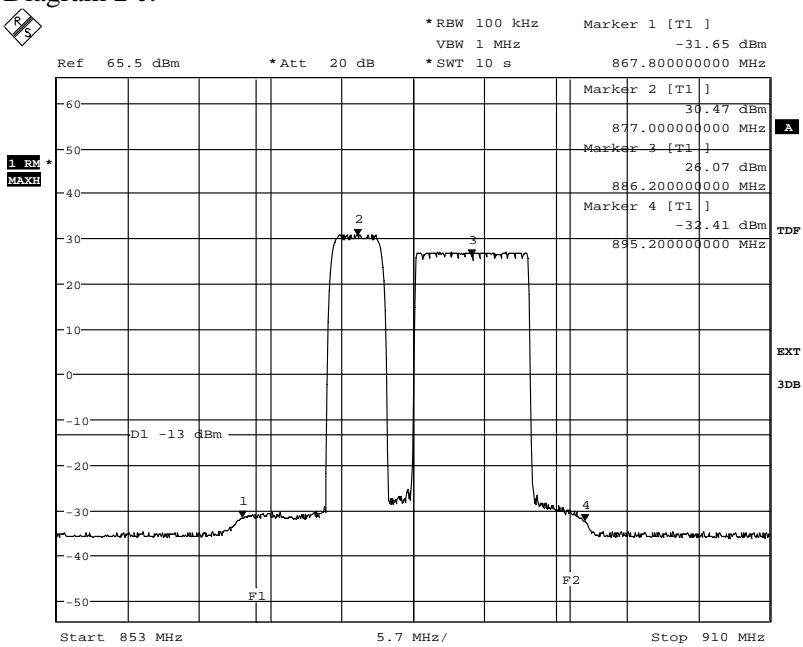


Date: 19.SEP.2013 14:03:20

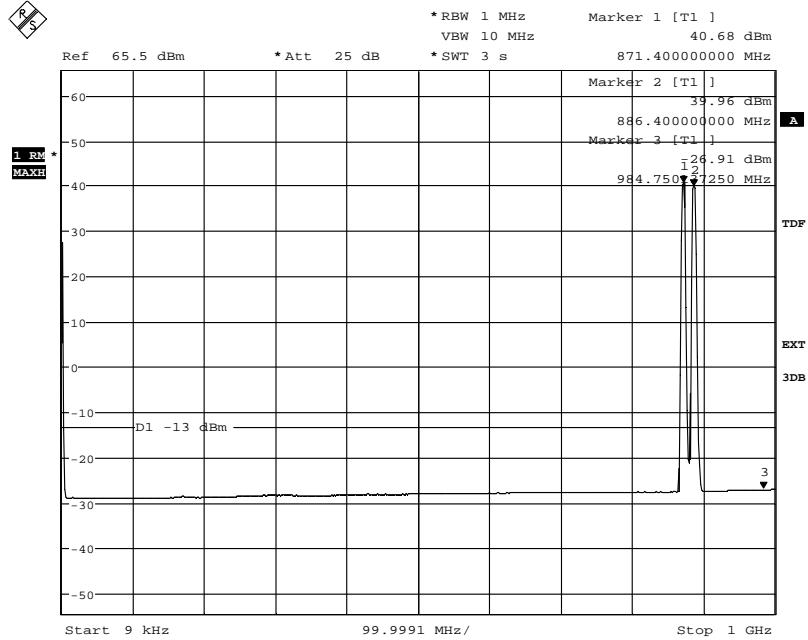
Diagram 2 b:



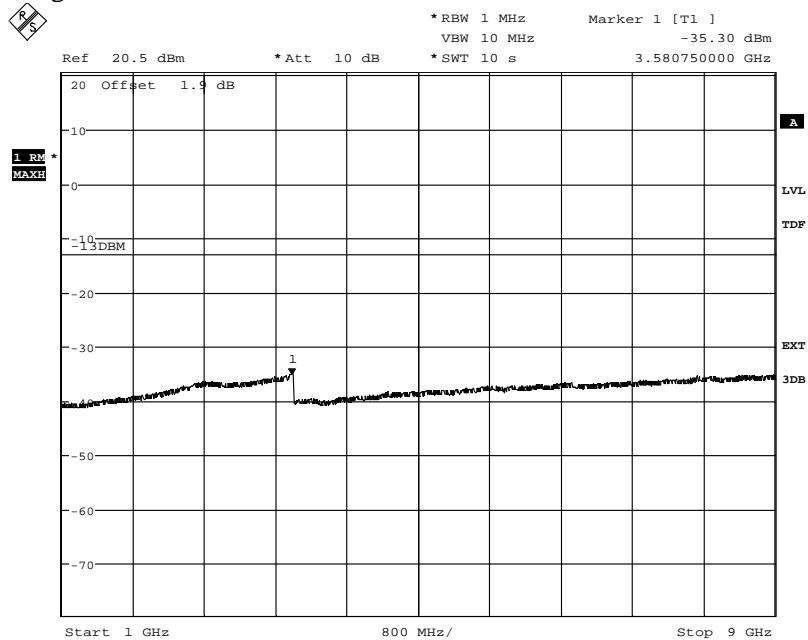
Date: 19.SEP.2013 12:08:10

Appendix 3
Diagram 2 c:


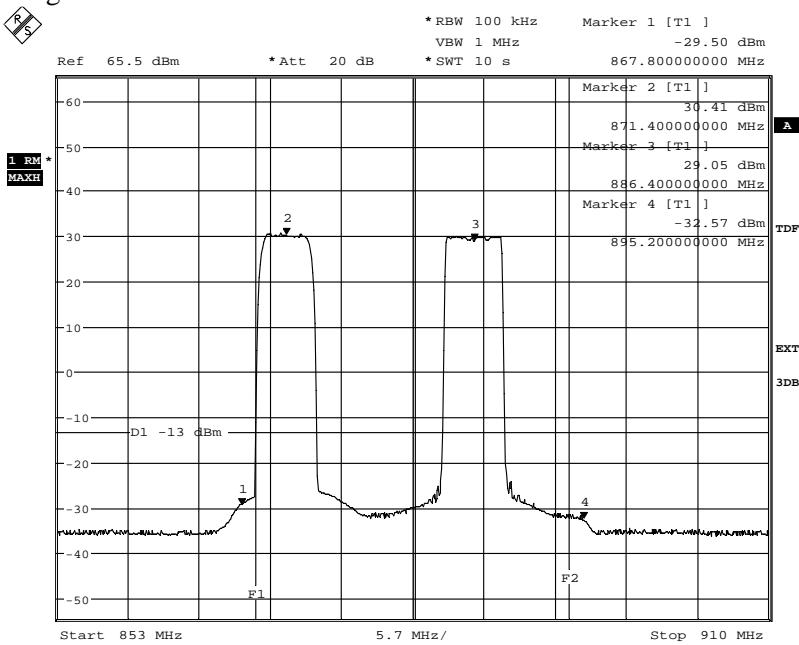
Date: 19.SEP.2013 12:11:43

Appendix 3
Diagram 3 a:


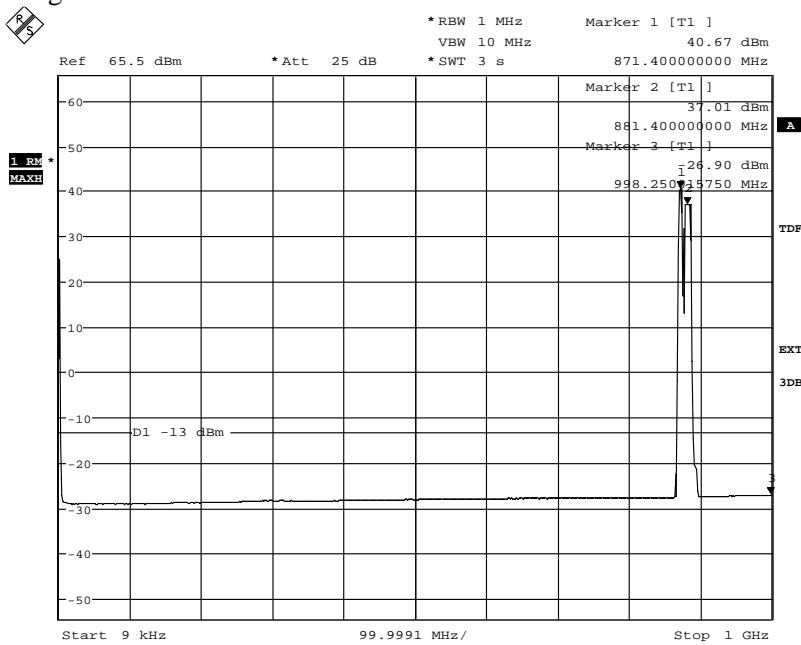
Date: 19.SEP.2013 12:24:06

Diagram 3 b:


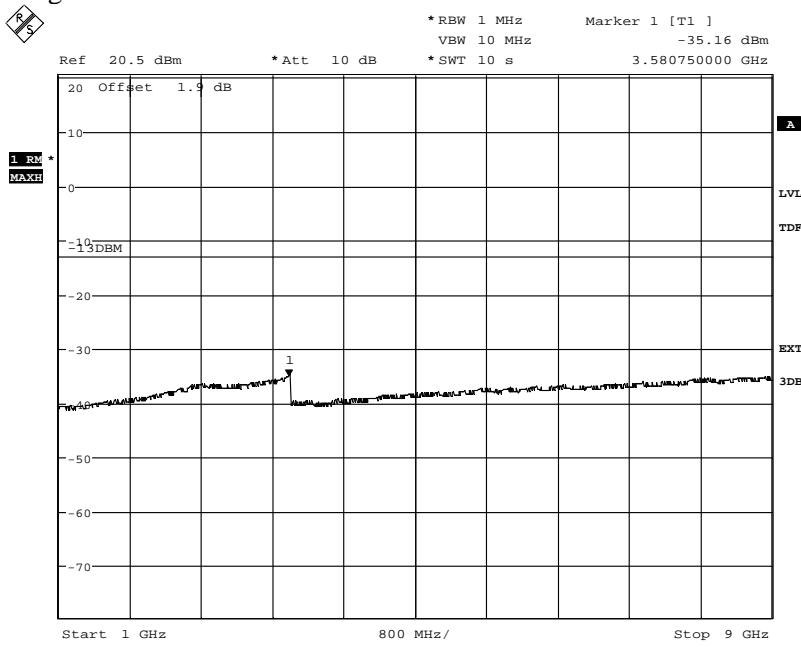
Date: 19.SEP.2013 12:37:30

Appendix 3
Diagram 3 c:


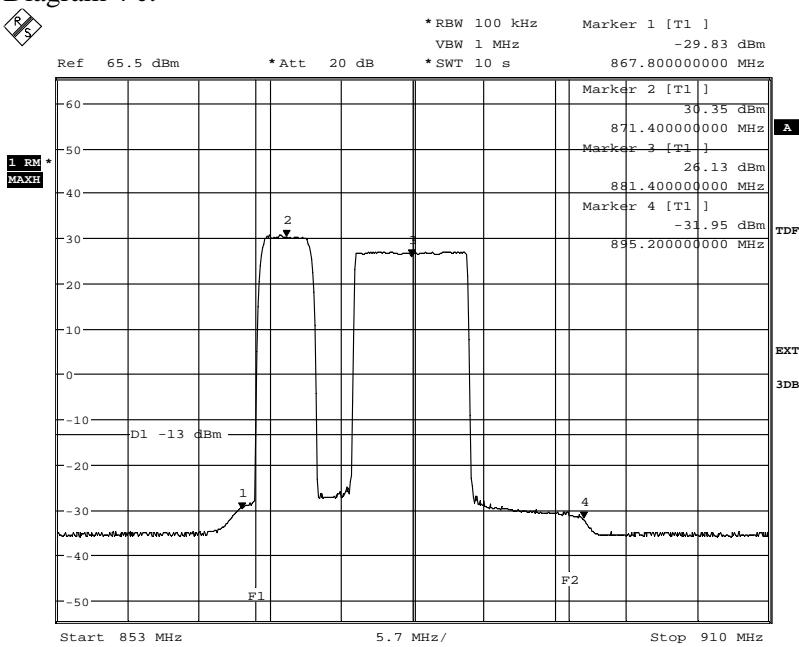
Date: 19.SEP.2013 12:42:23

Appendix 3
Diagram 4 a:


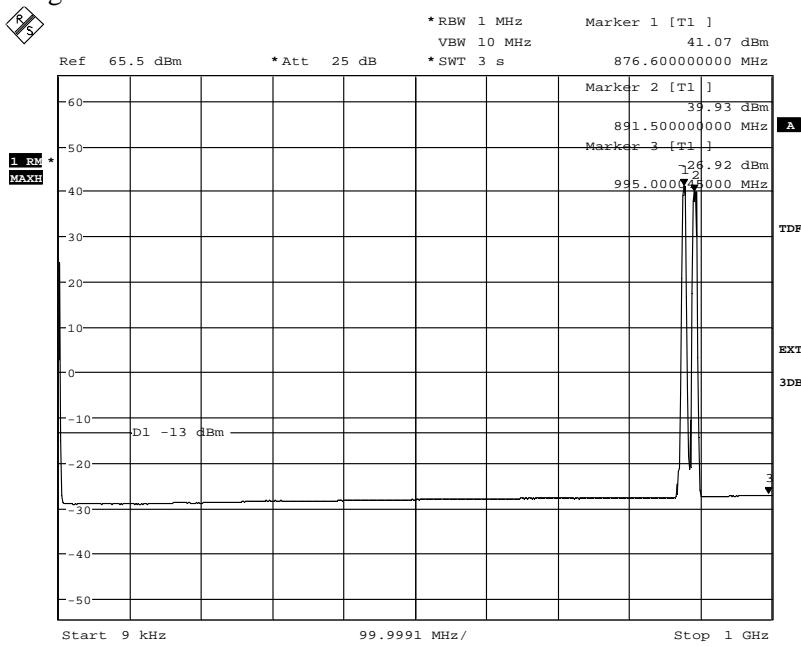
Date: 19.SEP.2013 12:30:36

Diagram 4 b:


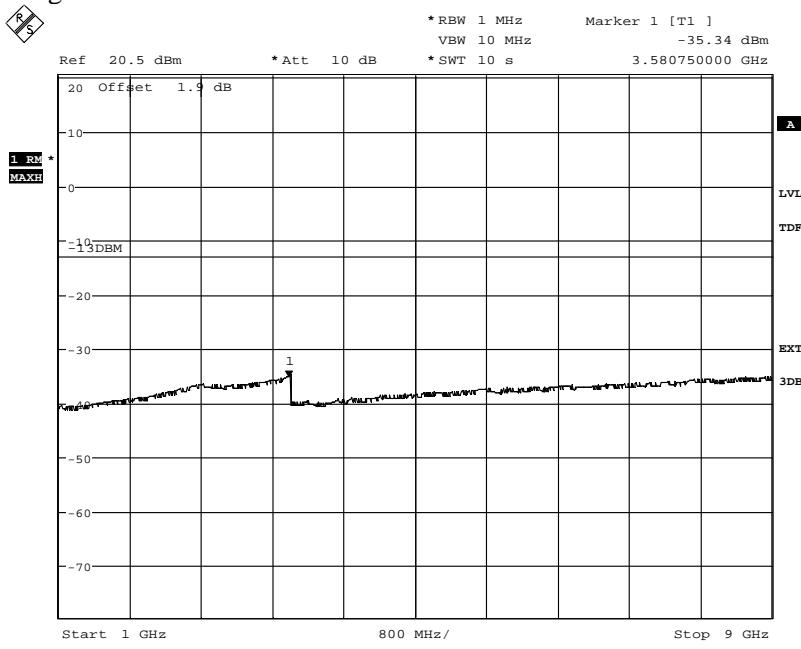
Date: 19.SEP.2013 12:35:10

Appendix 3
Diagram 4 c:


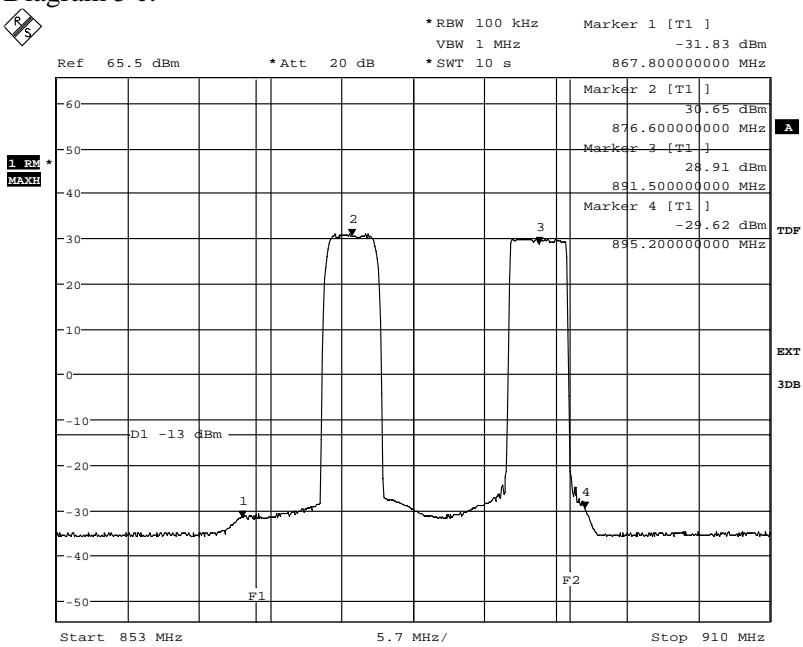
Date: 19.SEP.2013 12:31:47

Appendix 3
Diagram 5 a:


Date: 19.SEP.2013 13:50:56

Diagram 5 b:


Date: 19.SEP.2013 13:55:11

Appendix 3
Diagram 5 c:


Date: 19.SEP.2013 13:52:00

Appendix 4

Field strength of spurious radiation measurements according to 47 CFR 2.1053 / IC RSS-132 5.5

Date	Temperature	Humidity
2013-09-04	23°C ± 3°C	52 % ± 5 %
2013-09-05	22°C ± 3°C	58 % ± 5 %

Test set-up and procedure

The test sites are listed at FCC, Columbia with registration number: 93866. The test site complies with RSS-Gen, Industry Canada file no. 3482A-1.

The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz – 9 GHz. The upper frequency boundary was chosen to comprise 10x the highest fundamental TX frequency.

In the frequency range 30 MHz - 9 GHz the measurement was performed in power with a RBW of 1 MHz. A propagation loss in free space was calculated. The used formula was

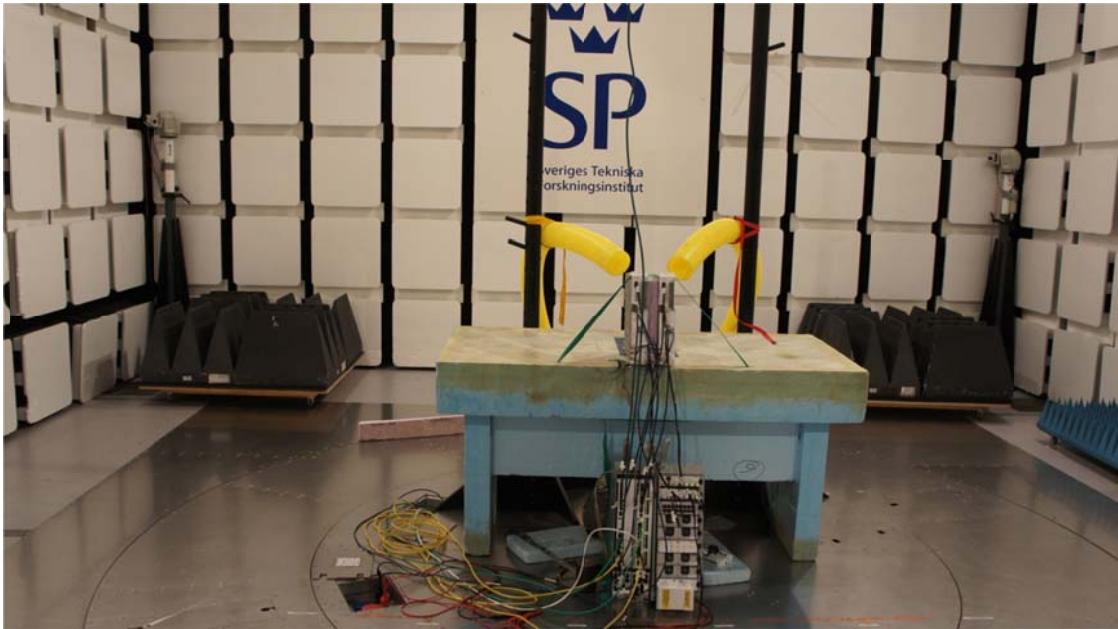
$$\gamma = 20 \log \left(\frac{4\pi D}{\lambda} \right), \quad \gamma \text{ is the propagation loss and } D \text{ is the antenna distance.}$$

The measurement procedure was as the following:

1. A pre-measurement was first performed with peak detector. The Test object was measured in eight directions and with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m.
2. Spurious radiation on frequencies closer than 20 dB to the limit in the pre-measurement is scanned 0-360 degrees and the antenna is scanned 1- 4 m for maximum response. The emission is then measured with the RMS detector and the RMS value is reported. Frequencies closer than 10 dB to the limit when measured with the RMS detector were with the substitution method according to the standard.

Appendix 4

Representative test set-up during the spurious radiation measurements is shown in the picture below:



Measurement equipment

Measurement equipment	SP number
Semi anechoic chamber	503 881
R&S ESU 26	901 553
EMC 32 ver. 8.52.0	503 899
Chase Bilog Antenna CBL 6111A	503 182
EMCO Horn Antenna 3115	502 175
μComp Nordic, Low Noise Amplifier	901 545
High pass filter	901 373
Temperature and humidity meter, Testo 625	504 188

Tested configurations

Config 6
Config 7
Config 8
Config 9
Config 10
Config 11

Appendix 4

Results, representing worst case

Diagram	Configuration
1 a+b	Config 9

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30 - 9 000	All emissions > 20 dB below limit	All emissions > 20 dB below limit

Measurement uncertainty: 3.2 dB

Remarks

The upper frequency bound for verification was chosen as 9 GHz in order to cover 10 x the maximum fundamental TX frequency.

Limits

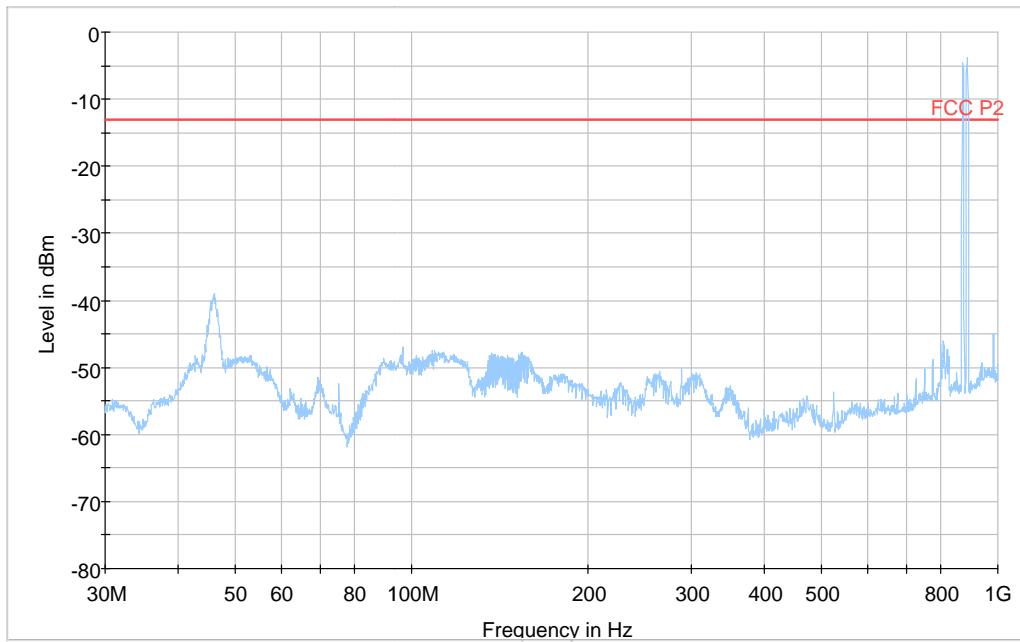
CFR 47 § 22.917 and IC RSS-132 5.5

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB, resulting in a limit of -13 dBm per any 100 kHz bandwidth.

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

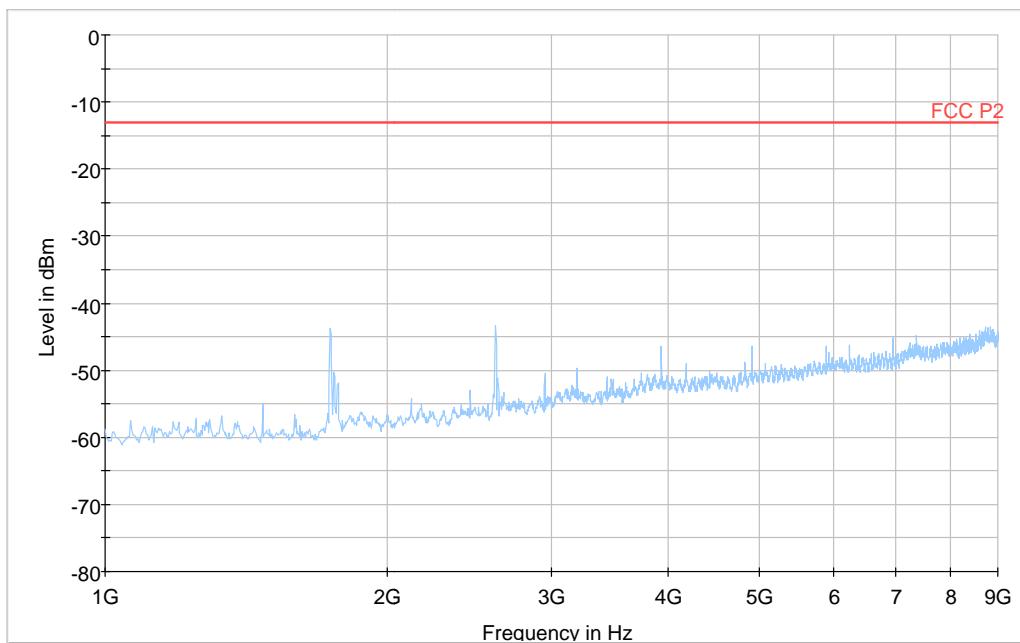
Appendix 4

Diagram 1 a:



Note: The emission between 869 MHz and 894 MHz is the carrier frequencies and shall be ignored in this context.

Diagram 1 b:



Appendix 5

External photos

Front side:



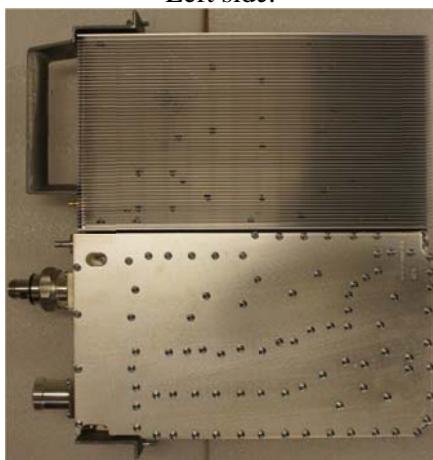
Back side:



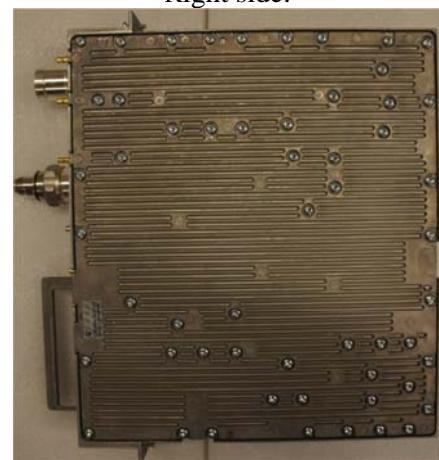
Product Label:



Left side:



Right side:



Appendix 5**Top side:****Bottom side:**