REPORT

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

Contact person
Martin Theorin
Electronics
+46 10 516 58 85
Martin.Theorin@sp.se

Date	Reference	Page
2013-06-04	3P03539-03-F27	1 (2)

Ericsson AB
Camilla Karlsson
PDU HW
164 80 Stockholm

Radio measurements on RRUS 12 B4 1700/2100 MHz radio equipment with FCC ID: TA8AKRC161349-2 and IC: 287AB-AS1613492

(5 appendices)

Test object

Product name: RRUS 12 B4
Product number: KRC 161 349/2

Summary

Standard		Compliant	Appendix
FCC CFR 47 / IC RSS-139 ISSUE 2			
2.1046 / RSS-139 6.4	RF power output	Yes	2
2.1051 / RSS-139 6.5	Spurious emission at antenna terminals	Yes	3
2.1053 / RSS-139 6.5	Field strength of spurious radiation	Yes	4

Note: Above RSS-139 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

Performed by

Martin Theorin

Examined by

Bengt Andersson

Table of contents

Appendix 1

Description of the test object

Equipment:	Radio equipment RRUS 12 B4 supporting mixed mode WCDMA+LTE
Antenna ports:	2 TX/RX ports
RF configurations	Single carrier, multi carrier, TX diversity and MIMO 2x2 (TX diversity only LTE)
Frequency bands:	TX: 2110 – 2155 MHz RX: 1710 – 1755 MHz
Nominal output power per antenna port:	1-2 LTE + 1-3 WCDMA (Total power 47.8dBm, 60W) Total number of carriers 4
LTE Modulations: Channel bandwidth:	 QPSK, 16QAM and 64QAM 1.4MHz, 3 MHz, 5 MHz, 10 MHz, and 15 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 100/200 kHz)
Nominal power voltage:	-48VDC

Operation mode 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 1.4MHz.

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

Conducted measurements

The test object was supplied with -48 VDC by an external power supply. Additional connections are documented in the set-up drawings below.
All measurements were made on RF A and additional measurements on RF B to verify that the ports were electrical identical, as declared by the client.

Radiated measurements

The test object 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-139 and RSS-Gen.

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 27, October 1st, 2012
3GPP TS 25.141, version 8.9.0
3GPP TS 36.141, version 8.4.0
RSS-Gen Issue 3
RSS-139 Issue 2

Measurement equipment

	Calibration Due	SP number
Test site Tesla	2014-01	503 881
R&S FSIQ 40	2013-07	503 738
R&S FSQ 40	2014-03	504 143
R&S ESI 26	2013-07	503 292
Control computer with R&S software EMC32 version 8.52.0	-	503 479
High pass filter	2013-07	901 501
High pass filter	2013-07	901 502
High pass filter	2013-07	504 199
High pass filter	2013-08	901 373
High pass filter	2014-08	503 739
High pass filter	2013-07	503 740
RF attenuator	2013-07	504 159
RF attenuator	2013-09	900 233
RF attenuator	2013-08	900 691
RF attenuator	2013-12	901 508
Chase Bilog Antenna CBL 6111A	2014-10	503 182
EMCO Horn Antenna 3115	2014-01	502 175
Std.gain horn FLANN model 20240-20	2014-03	503 674
Schwarzbeck preamplifier BBV 9742	2014-03	504 085
µComp Nordic, Low Noise Amplifier	2014-04	901 545
MITEQ Low Noise Amplifier	2013-08	503 285
Testo 635 Temperature and humidity meter	2013-06	504 203
Temperature and humidity meter, Testo 625	2013-06	504 188

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 2013-05-06.

Manufacturer’s representative

Mihai Simon, Ericsson AB.

Test engineers

Andreas Johnson, Tomas Lennhager, Kexin Chen, Tomas Isbring, Jörgen Wassholm and Martin Theorin, SP

Test participant

None

Appendix 1

Test frequencies during measurements

Configuration 1:

	WCDMA	LTE
	(30W)	(30W)
Downlink	1562 (2117.4 MHz)	2393 (2154.3 MHz)
Uplink	1362 (1717.4 MHz)	20393 (1754.3 MHz)
Test model	TM5	E-TM1.1
Bandwidth	5 MHz	1.4 MHz

Configuration 2:

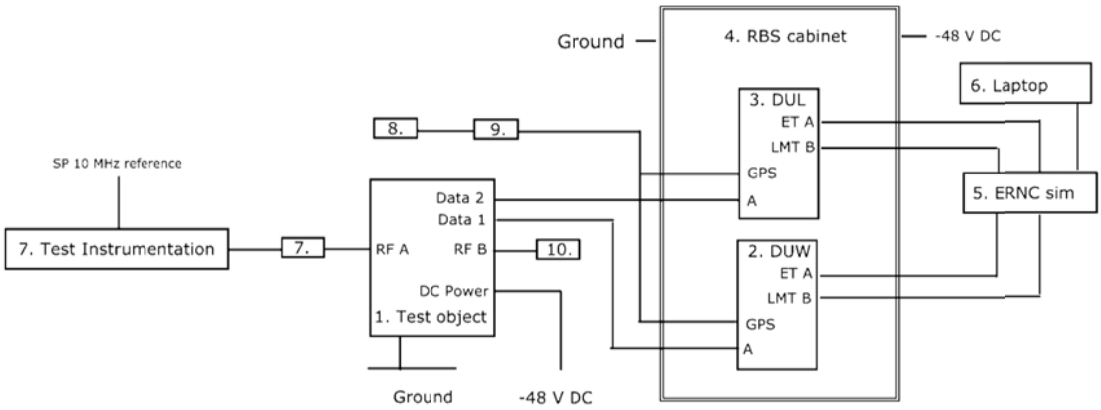
	WCDMA	LTE
	(30W)	(30W)
Downlink	1677 (2140.4 MHz)	2096 (2124.6 MHz)
Uplink	1452 (1740.4 MHz)	20096 (1724.6 MHz)
Test model	TM5	E-TM1.1
Bandwidth	5 MHz	1.4 MHz

Configuration 3:

	WCDMA	LTE	LTE
	(10W)	(25W)	(25W)
Downlink	1537 (2112.4 MHz)	2006 (2115.6 MHz)	2074 (2122.4 MHz)
Uplink	1312 (1712.4 MHz)	20006 (1715.6 MHz)	20074 (1722.4 MHz)
Test model	TM5	E-TM1.1	E-TM1.1
Bandwidth	5 MHz	1.4 MHz	1.4 MHz

All RX frequencies were configured 400 MHz below the corresponding TX frequency according the applicable duplex offset for the operating band.

Test set-up conducted measurements TX, MSR



Test object:

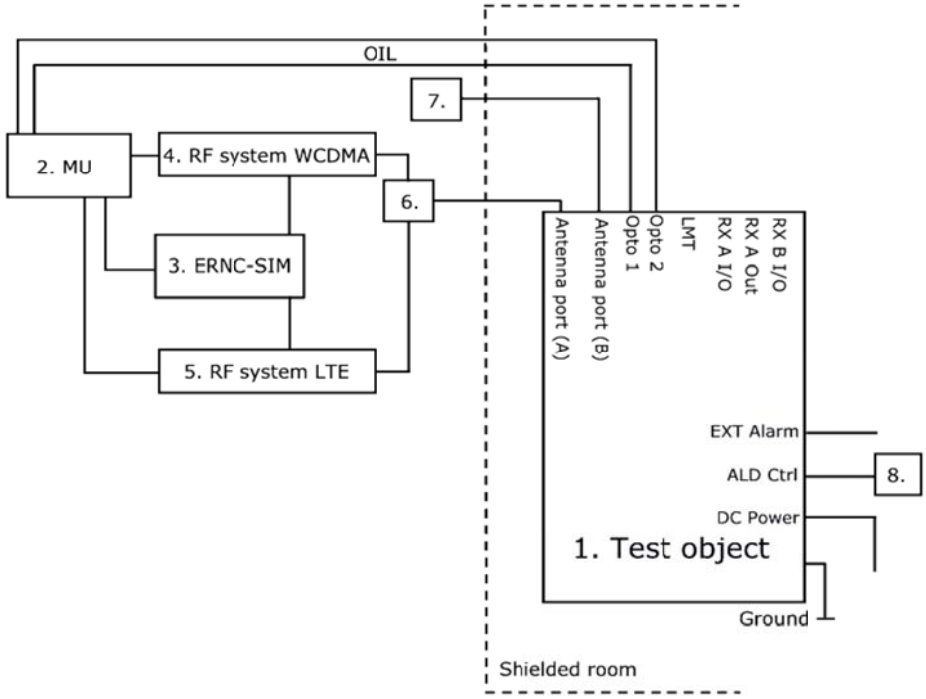
1.	RRUS 12 B4, KRC 161 349/2, revision R1B, S/N: C827003190 working software CXP 901 7316/2, Rev. R49EG

Functional test equipment

2.	DUW 30 01, KDU 127 161/3, rev:R4E, s/n: TU8X621366
3.	DUL 20 01, KDU 137 533/4, Rev R1C, S/N: C824321475
4.	SUP 6601 1/BFL 901 009/1, rev. R3B, s/n. BR881078499
5	ERNC Sim 072, BAMS – 1000579045 Fast Ethernet switch, Netgear GSM7224, BAMS – 1001252309 Fast Ethernet switch, Netgear GSM7212, BAMS – 1000517295 NTP Symmetricom sync server S250, BAMS – 1000690719 10 MHz reference, Symmetricom model 8040, BAMS – 1000645316
6.	Controlling computer SUN ULTRA 27, BAMS 1000758346 running software MOSHELL V9.0s
7.	SP Test Instrumentation according to measurement equipment list
8.	GPS Active Antenna, KRE 101 2082/1
9.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K474887
10.	Terminator, 50 ohm

Appendix 1

Test set-up radiated measurements



Test object:

1.	RRUS 12 B4, KRC 161 349/2, rev. R1B, s/n: C827003180 working software: CXP 901 7316/2, rev: R49EG

Functional test equipment:

2.	Main Unit SUP 6601, 1/BFL 901 009/1, rev. R3B, s/n: BR80901309 DUW 30 01, KDU 127 161/3, rev. R4E, s/n: TU8X621350 SUP 6601, 1/BFL 901 009/1, rev. R3B, s/n: BR81066805 DUW 30 01, KDU 127 161/3, rev. R4E, s/n: C825945806 SUP 6601, 1/BFL 901 009/1, rev. R3B, s/n: BR80989745 DUL 20 01, KDU 137 533/4, rev. R1C, s/n: C824484447
3.	ERNC-SIM 065, BAMS – 1000579038 Symmetricom SyncServer S250, BAMS – 1000491896 Switch Netgear GSM 7224, BAMS – 1000850751 10 MHz reference Symmetricom 8040, BAMS – 1000645315
4.	RF system WCDMA Computer, w-ultra27-14 standalone, BAMS – 1000758439 Anritsu MS2691A, BAMS – 1000698364 Switch Netgear GSM 7212, BAMS – 1000517298
5.	RF system LTE Computer, w-ultra27-06 standalone, BAMS – 1000861874 Anritsu MS2691A, BAMS – 1000698363 Switch Netgear GSM7224, BAMS – 1000850754
6.	Directional Coupler, BAMS – 1000739626
7.	Terminator
8.	RET – Remote Electrical Tilt unit, KRY 121 67/2, rev. R1N

Interfaces:

Power: -48 VDC	DC Power
Antenna port (A), 7/16 connector	Antenna
Antenna port (B), 7/16 connector	Antenna
Opto 1, Optical Interface Link, single mode opto fibre	Telecom
Opto 2, Optical Interface Link, single mode opto fibre	Telecom
LMT, for maintenance use only	Telecom
RX A Out, no cable attached	Antenna
RX A I/O, no cable attached	Antenna
RX B I/O, no cable attached	Antenna
EXT Alarm, shielded multi-wire	Signal
ALD Ctrl, shielded multi-wire	Signal
Ground wire	Ground

RAT software:

RAT	**Software**	**Revision**
LTE	CXP 102 151/18	R25Y
WCDMA	CXP 902 171/9	R1CA15

Appendix 2

RF power output measurements according to CFR 47 §27.50 / IC RSS-139 6.4

Date	Temperature	Humidity
2013-05-21	23 °C ± 3 °C	50 % ± 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 resolution bandwidth of 50 MHz was used.

Measurement equipment	SP number
R&S FSQ 40	504 143
RF attenuator	901 508
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

MSR, WCDMA + LTE:

Rated output power level at RF connector 47.8 dBm/RF port. Total nominal RF power 50.8 dBm.

Test configurations	Transmitter power RMS (dBm)		
	Port RF A	Port RF B	Total power[1)]
Configuration 2	47.69 (Diagram 1)	Not tested [2)]	50.69
Configuration 3	46.73 (Diagram 2)	Not tested [2)]	49.73

[1)]: Since port B isn't measured 3dB has been added to the result on port RFA.
[2)]: Note:Measurements were limited to port RF A due to the measurement result in WCDMA and LTE single RAT mode that shows that the ports are electrical identical as declared by the client.

Limits

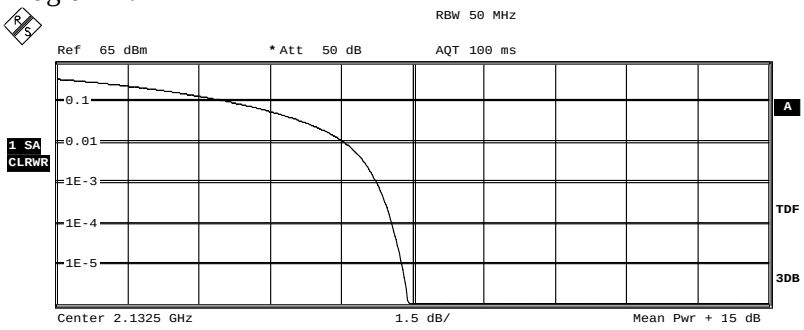
§27.50: The maximum output power may not exceed 1640 W (EIRP)/ MHz. The Peak to Average Ratio (PAR) may not exceed 13 dB.

RSS-139 6.4: The average equivalent isotropically radiated power (e.i.r.p.) limits in SRSP-513 apply, resulting in a maximum EIRP of 1640 W/ MHz for the scope of this report. The peak-to-average ratio of the power shall not exceed 13 dB.

Complies?	Yes

Appendix 2

Diagram 1:

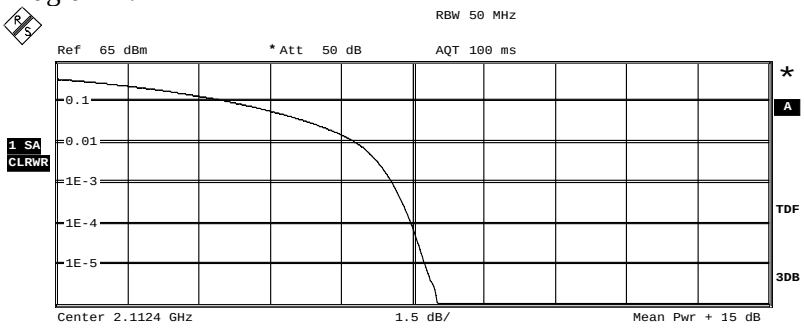


Complementary Cumulative Distribution Function
NOF samples: 6400000, Usable BW: 37.9MHz

	Trace 1
Mean	47.69 dBm
Peak	55.15 dBm
Crest	7.47 dB
10 %	3.73 dB
1 %	6.08 dB
.1 %	6.75 dB
.01 %	7.07 dB

Date: 21.MAY.2013 15:39:10

Diagram 2:



Complementary Cumulative Distribution Function
NOF samples: 6400000, Usable BW: 37.9MHz

	Trace 1
Mean	46.73 dBm
Peak	54.89 dBm
Crest	8.15 dB
10 %	3.70 dB
1 %	6.30 dB
.1 %	7.07 dB
.01 %	7.48 dB

Date: 21.MAY.2013 11:55:45

Appendix 3

Conducted spurious emission measurements according to CFR 47 §27.53(h)/ IC RSS-139 6.5

Date	Temperature	Humidity
2013-05-21	23 °C ± 3 °C	50 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53(h). The output was connected to a spectrum analyzer with a RBW setting of 1 MHz and 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 2 “measure and add 10 log(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output v01r02

Measurement equipment	SP number
R&S FSQ 40	504 143
RF attenuator	901 508
HP filter	901 502
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

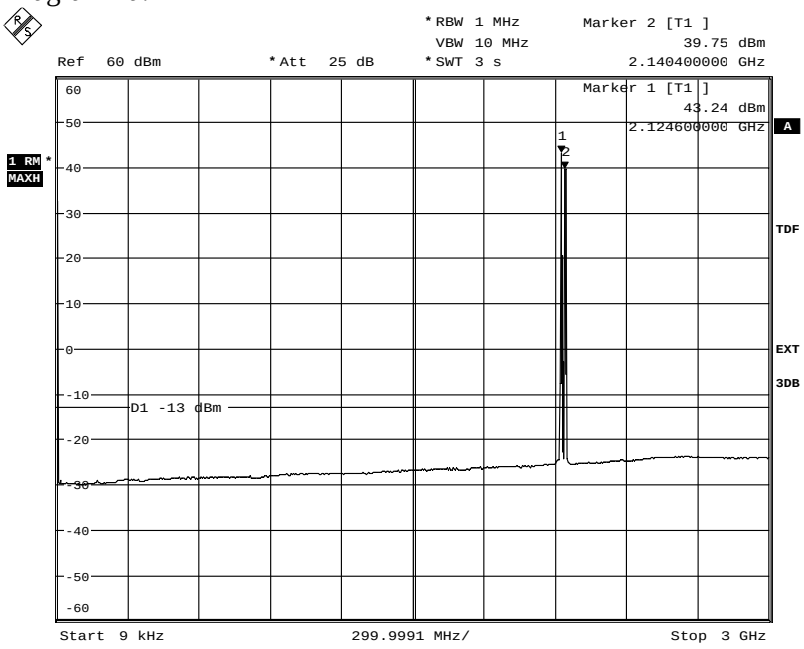
MSR, WCDMA + LTE:

Diagram	Tested configuration	Tested Port
1 a+b+c+d+e	Configuration 2	RF A
2 a+b+c+d+e	Configuration 3	RF A

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

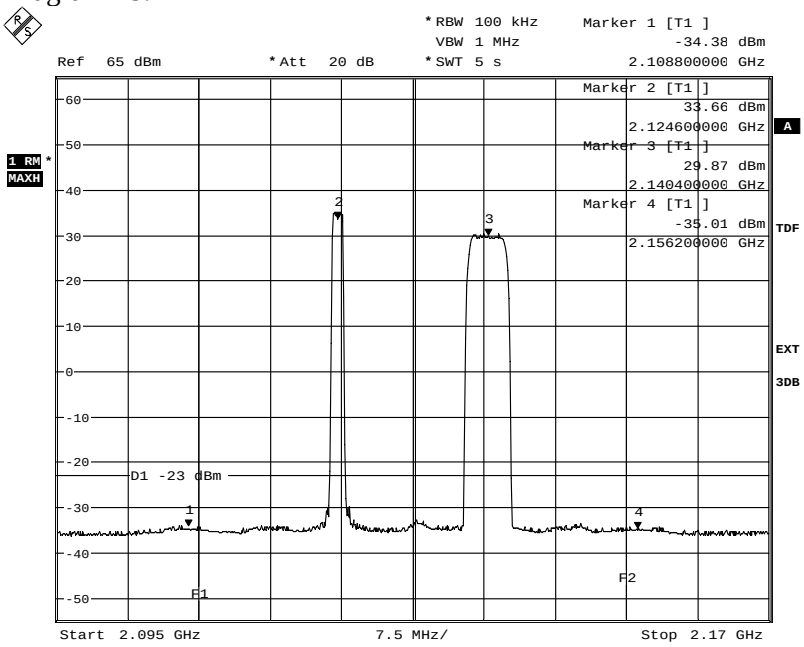
Appendix 3

Diagram 1a:



Date: 21.MAY.2013 15:40:12

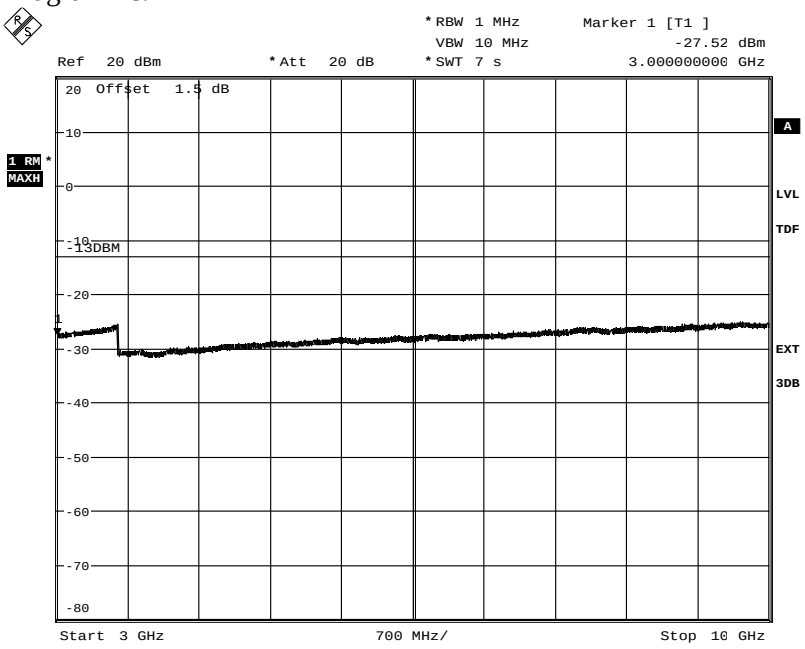
Diagram 1b:



Date: 21.MAY.2013 15:37:28

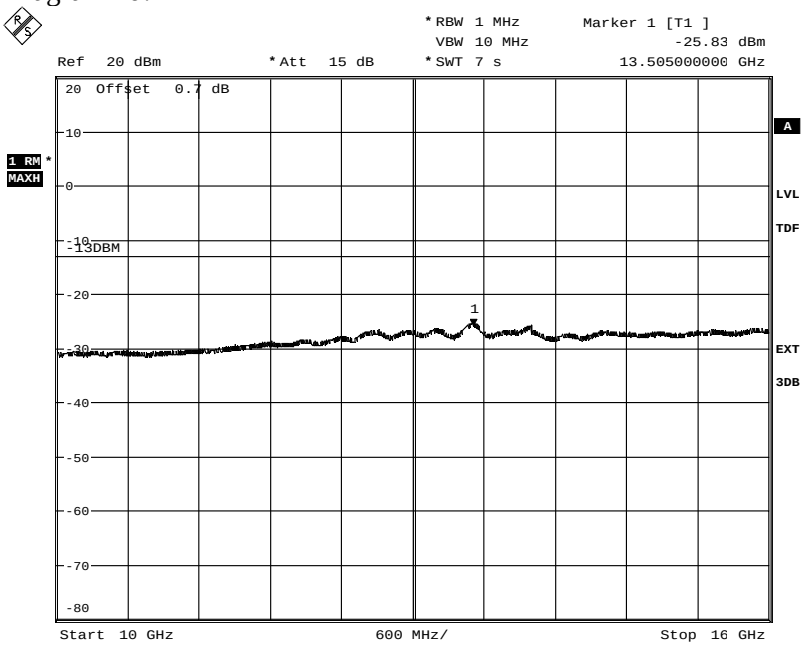
Appendix 3

Diagram 1c:



Date: 21.MAY.2013 15:41:31

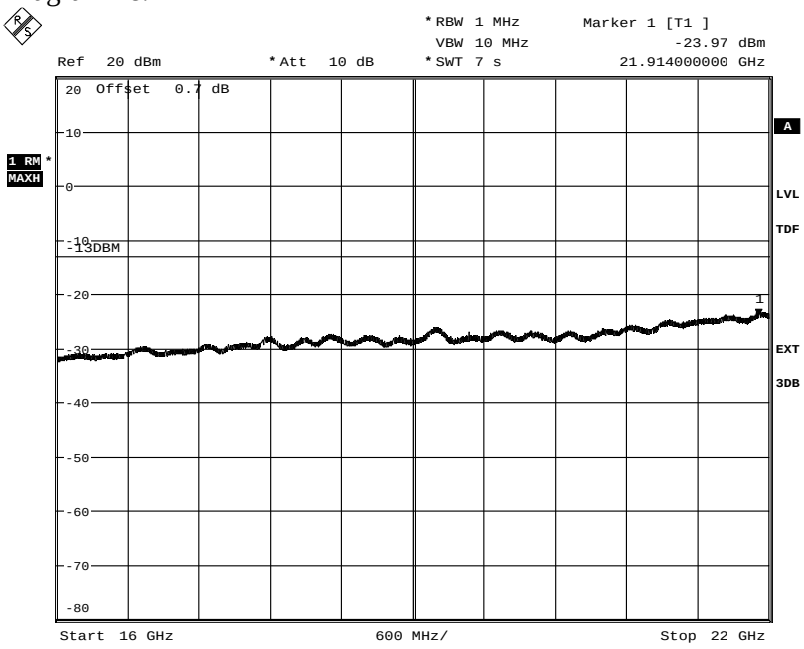
Diagram 1d:



Date: 21.MAY.2013 15:42:46

Appendix 3

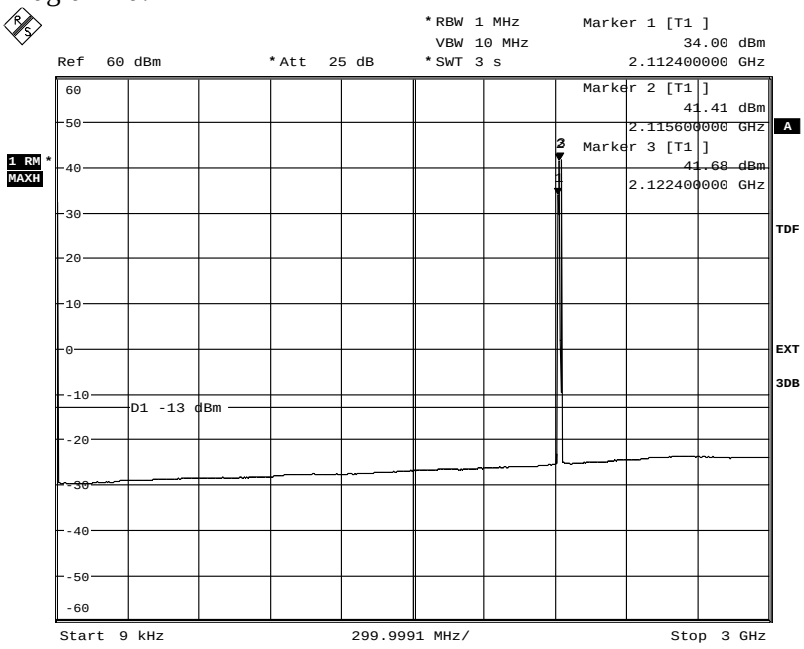
Diagram 1e:



Date: 21.MAY.2013 15:43:39

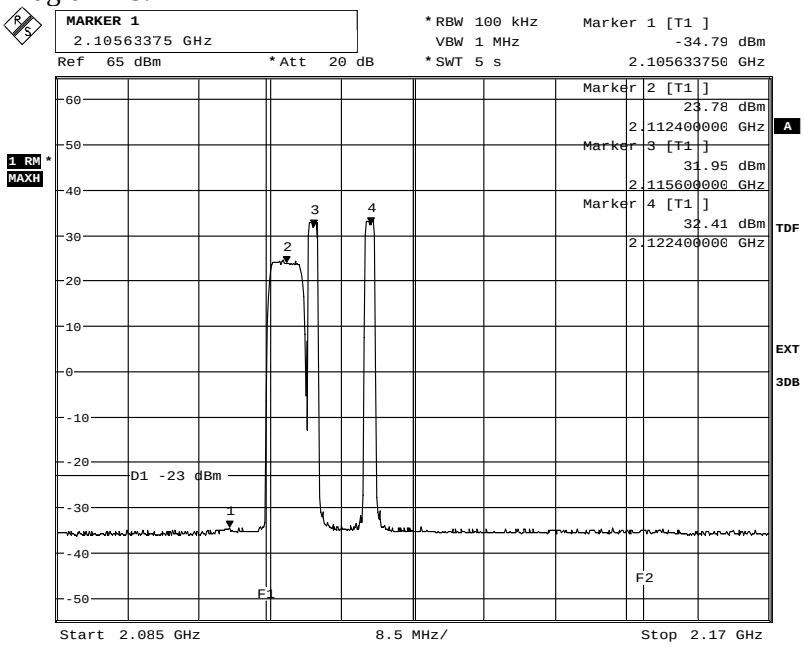
Appendix 3

Diagram 2a:



Date: 21.MAY.2013 11:59:23

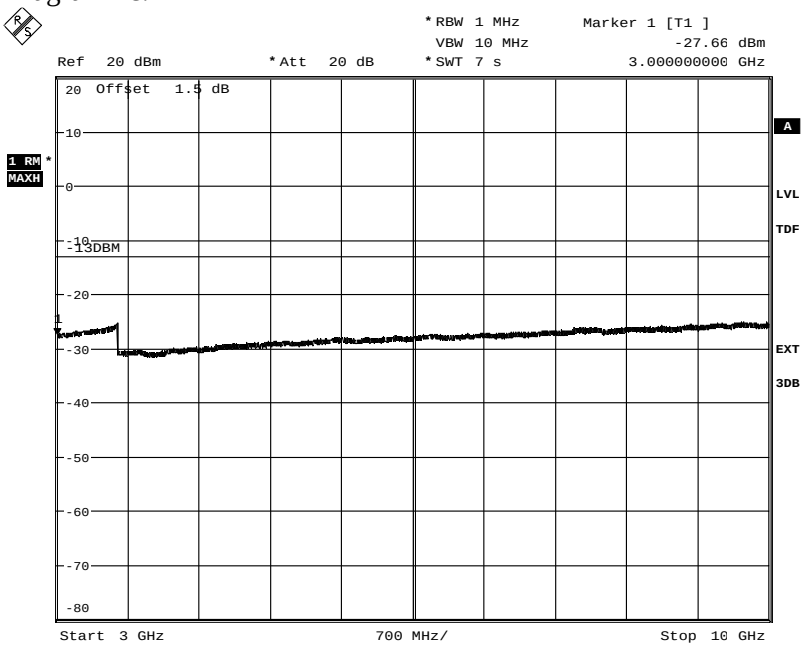
Diagram 2b:



Date: 21.MAY.2013 12:01:36

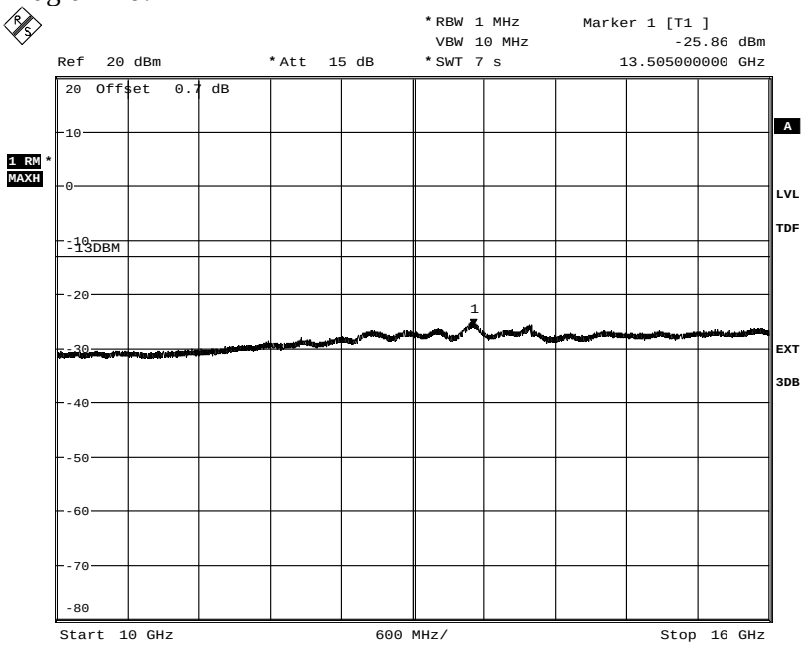
Appendix 3

Diagram 2c:



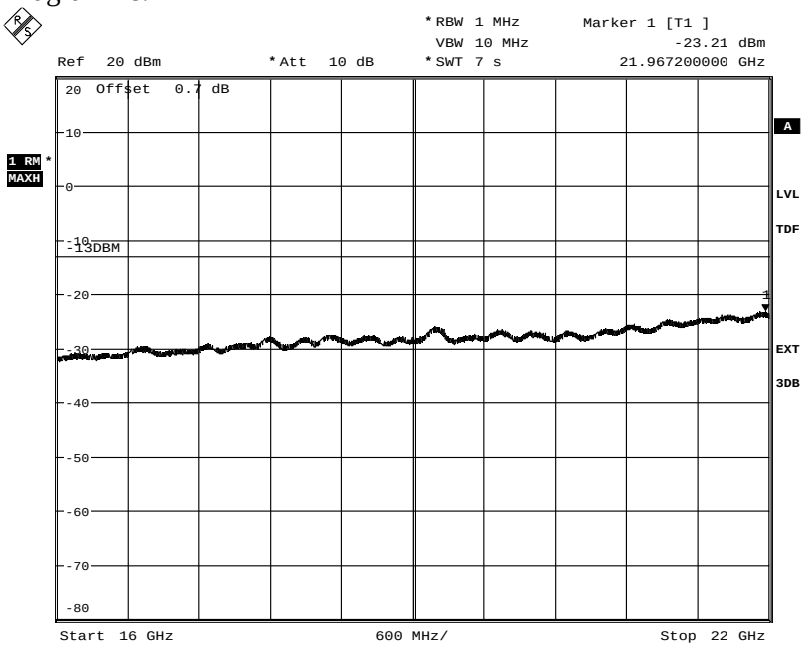
Date: 21.MAY.2013 12:02:51

Diagram 2d:



Date: 21.MAY.2013 12:03:36

Diagram 2e:



Date: 21.MAY.2013 12:04:28

Remark

The emission at 9 kHz on 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 highest fundamental frequency is 2.155 GHz. The measurements were made up to 22 GHz (10x2.155 GHz = 21.55 GHz).

Limits

§27.53(h) and RSS-139 6.5

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 1 MHz RBW.

Complies?	Yes

Appendix 4

Field strength of spurious radiation measurements according to 47 CFR 27.53 (h) / IC RSS-139 6.5

Date	Temperature	Humidity
2013-05-16	22.0°C ± 3°C	37 % ± 5 %
2013-05-17	22.5°C ± 3°C	52 % ± 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 – 18 GHz and 1m in the frequency range 18 - 22 GHz.

In the frequency range 30 MHz – 22 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 $\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

The measurement procedure was as the following:

1. The pre-measurement was first performed with peak detector. The EUT 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 measured with the substitution method according to the standard.

The 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 ESI 26	503 292
EMC 32 ver. 8.52.0	503 745
Chase Bilog Antenna CBL 6111A	502 181
EMCO Horn Antenna 3115	502 175
Flann STD Gain Horn Antenna 20240-20	503 674
High pass filter, RLC Electronics	503 739
Miteq, Low Noise Amplifier	503 285
µComp Nordic, Low Noise Amplifier	901 545
Temperature and humidity meter, Testo 625	504 188

Results, representing worst case

Configuration 1: Diagram 1 a-d

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-22 000	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty:

3.2 dB up to 18 GHz, 3.6 dB above 18 GHz

Limits

§27.53(h) and RSS-139 6.5

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 1 MHz RBW.

Complies?	Yes

Appendix 4

Diagram 1a:

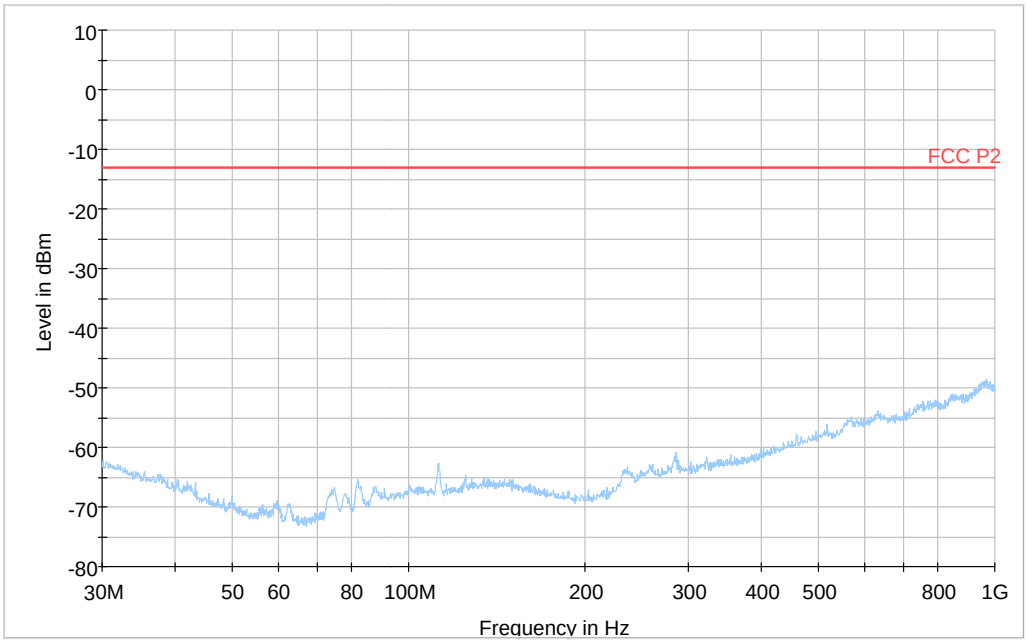
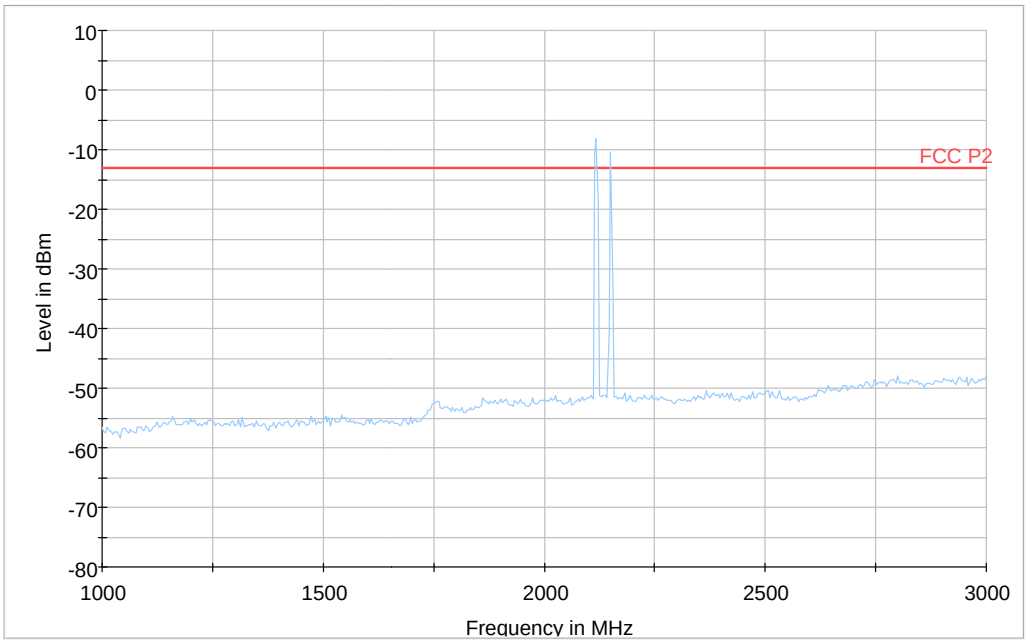


Diagram 1b:



Note: The emission between 2110 and 2150 MHz are the carrier frequencies and shall be ignored in the context.

Appendix 4

Diagram 1c:

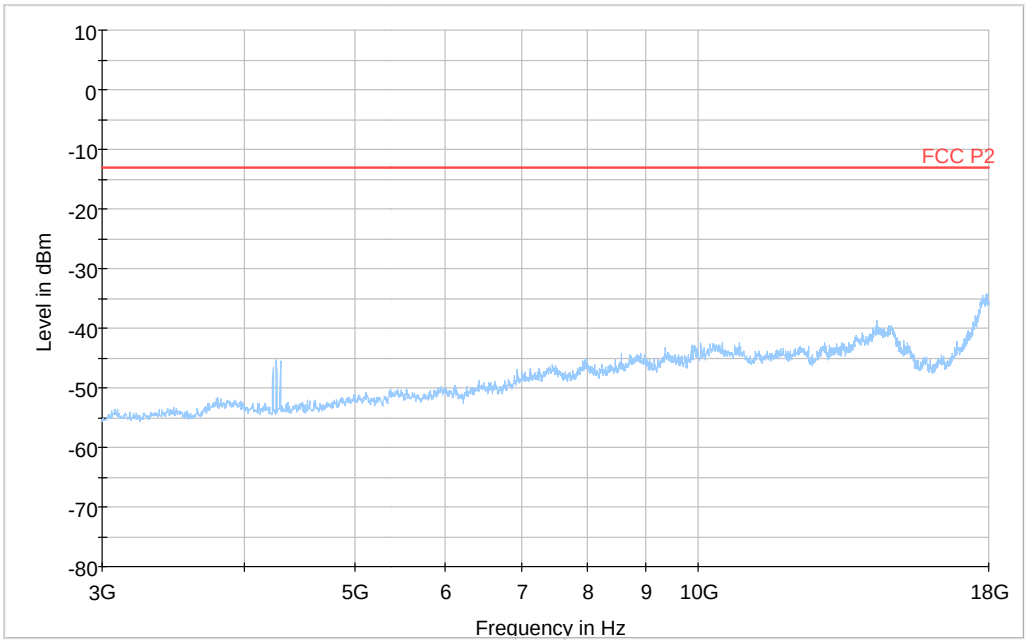
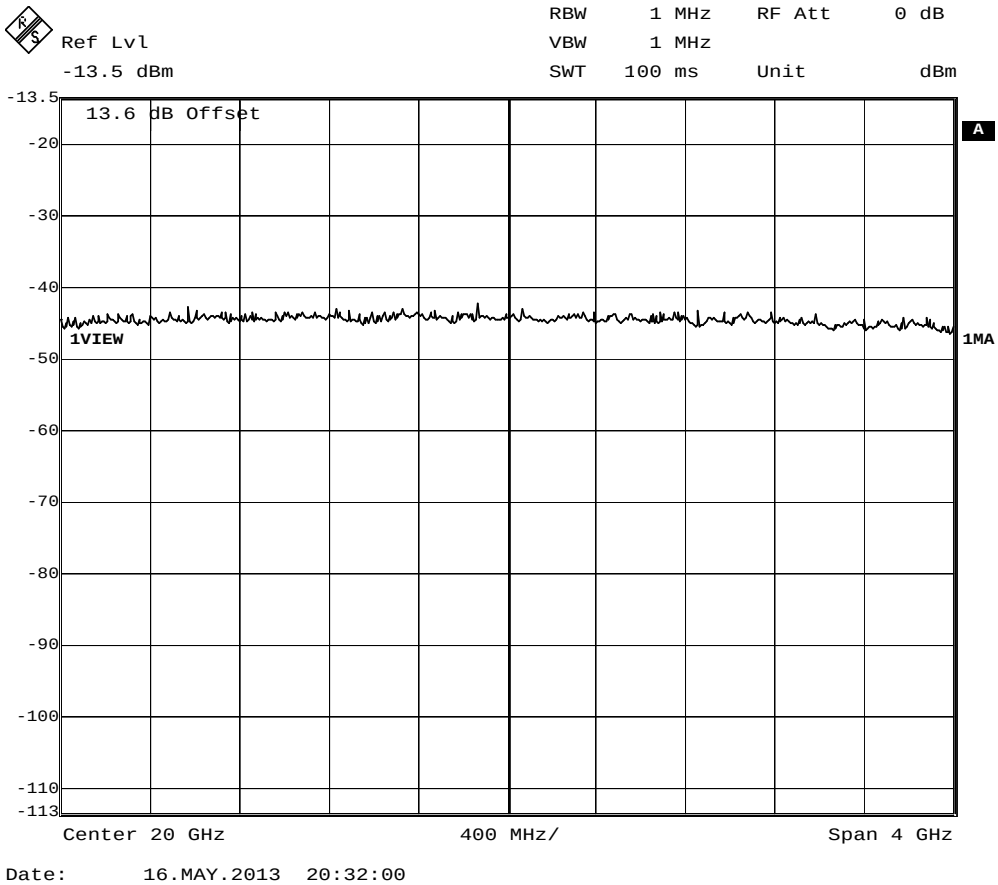


Diagram 1d:



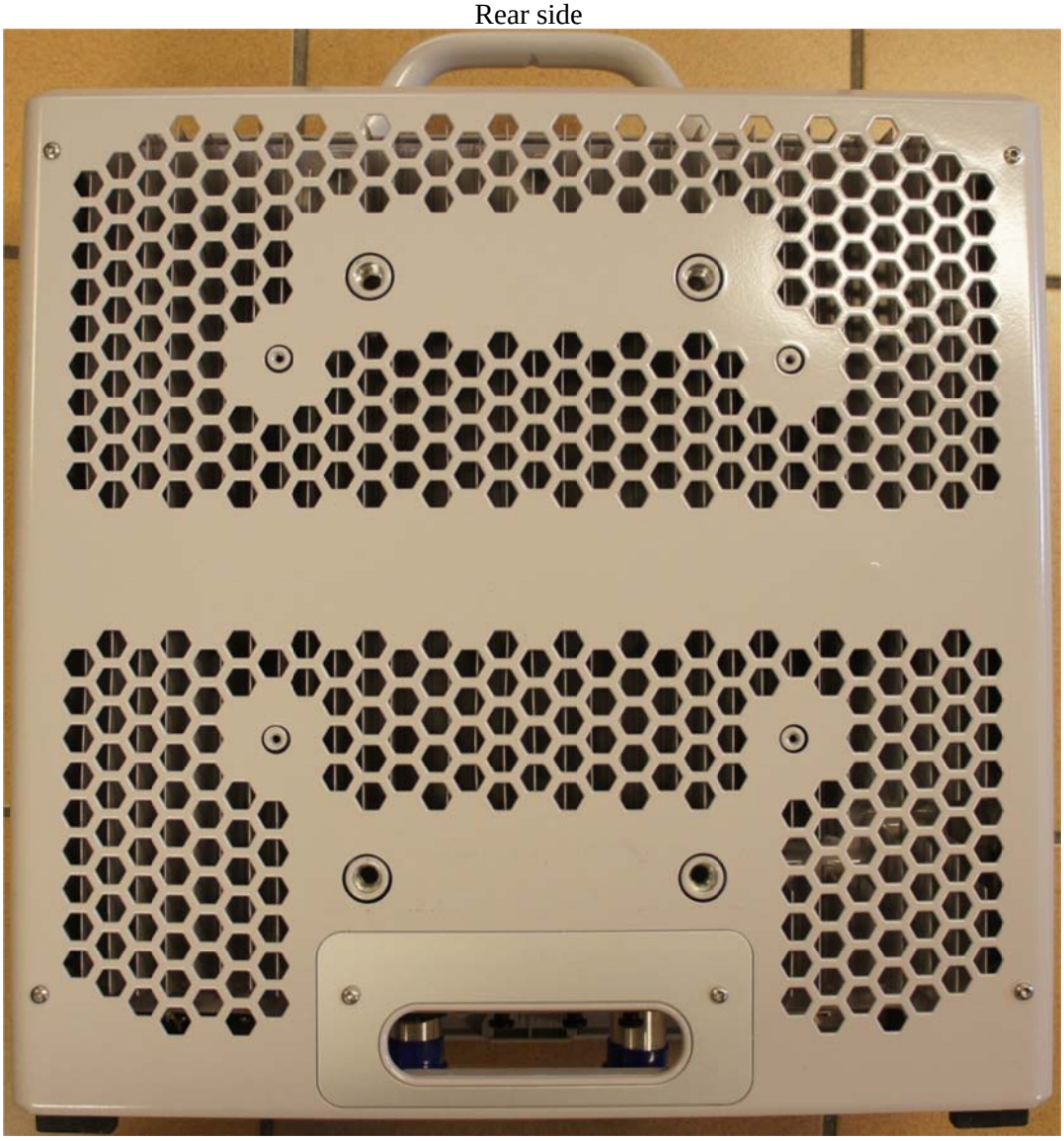
Appendix 5

External photos

Front side

Appendix 5

Rear side



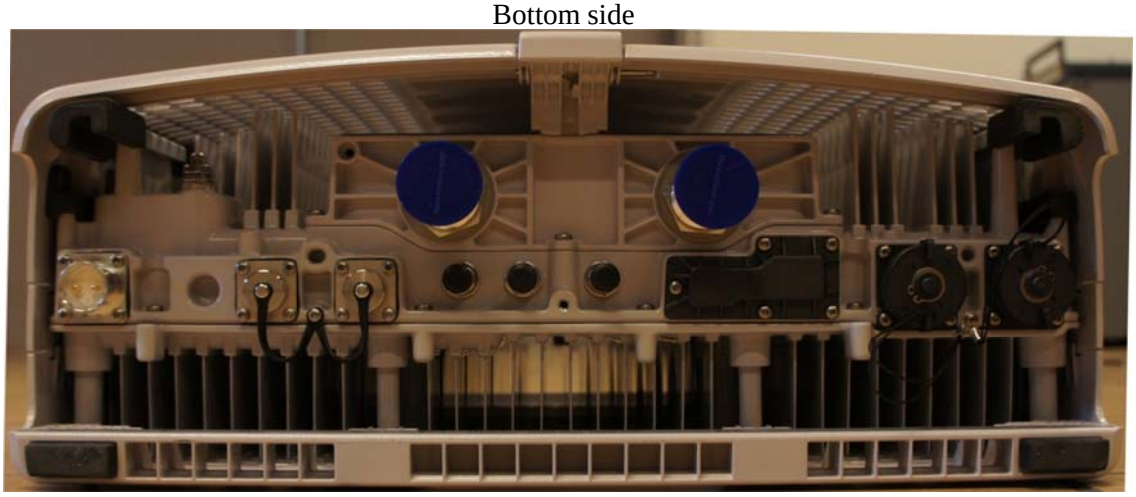
Appendix 5

Left side

Right side

Appendix 5

Bottom side



Top side

Product label