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Radio measurements on RUS 01 B2 1900 MHz radio equipment with FCC ID TA8CKRC118661 and IC 287AB-CS118661

(5 appendices)

Test object

Product name: RUS 01 B2
Product number: KRC 118 66/1, R2H

Summary

See appendix 1 for general information and appendix 5 for external photos.

Standard		Compliant	Appendix
FCC CFR 47 / IC RSS-133 Issue 6			
2.1046 / RSS-133 6.4	RF power output	Yes	2
2.1051 / RSS-133 6.5	Spurious emission at antenna terminals	Yes	3
2.1053 / RSS-133 6.5	Field strength of spurious radiation	Yes	4

Note: Above RSS-133 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

Signed by: Jörgen Wassholm
Reason: I am the author of this document
Date & Time: 2014-05-27 15:12:39 +02:00

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Anders Nordlöf

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Appendix 1

Description of the test object

Equipment:	Product name: RUS 01 B2 Product number KRC 118 66/1 FCC ID: TA8CKRC11866-1 IC: 287AB-CS118661 IC MODEL NO: CS118661
Tested configuration	Mulit RAT (MR) WCDMA+GSM
Frequency range:	TX: 1930 – 1990 MHz RX: 1850 – 1910 MHz
Antenna ports:	1 TX/RX port 1 RX port
RF configurations Multi RAT:	WCDMA + GSM, MIMO 2x2 (MIMO WCDMA only)
Nominal output power per antenna port:	Primary RUS RF A port: 1-2 carriers WCDMA + 1-3 carriers GSM (total power 47.8 dBm, 60 W) Secondary RUS RF A port: 1-2 carriers WCDMA (total power 44.8 dBm, 30 W) Total number of carriers: 4
Antenna type:	No dedicated antenna, handled during licensing
GSM modulations:	GMSK, 16QAM, 32QAM, AQPSK and 8PSK
WCDMA modulations:	QPSK, 16QAM and 64QAM
WCDMA channel bandwidths	4.2 MHz to 5 MHz (configurable in steps of 100/200 kHz)
WCDMA channel spacing:	4.4 MHz to 5 MHz (configurable in steps of 100/200 kHz)
Nominal supply voltage:	-48VDC

Operation modes during measurements

MR, WCDMA + GSM

WCDMA measurements were performed with the test object transmitting test models as defined in 3GPP TS 25.141. Test model 1 (TM1) represent QPSK modulation, test model 5 (TM5) represent 16QAM modulation and test model 6 (TM6) represent 64QAM modulation. Measurements were performed with the test object configured for the maximum transmit power applicable for the tested configuration.

GSM measurements were performed with the test object transmitting pseudorandom data in all timeslots and settings for maximum transmitter output power applicable for each configuration. For AQPSK modulation the SCPIR is 0 dB

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

GSM: GMSK modulation

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 setup diagram), running in primary mode. All TX parameters were measured at port RF A

Radiated measurements

The test object was tested stand-alone. It was powered with -48 VDC. RF A port was terminated into 50 ohm.

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-133 and RSS-Gen.

References

Measurements were done according to relevant parts of the following standards:
ANSI C63.4-2009
ANSI/TIA/EIA-603-C-2004
3GPP TS 37.141, version 11.4.0
CFR 47 part 2, October 1st , 2013
CFR 47 part 24 Subpart E, October 1st, 2013
RSS-Gen Issue 3
RSS-133 Issue 6

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 2014-03-28.

Manufacturer’s representative

Christer Gustavsson, Ericsson AB.

Test engineers

Andreas Johnson, Tomas Isbring, Maulo Rivera, Kexin Chen, Tomas Lennhager, Jörgen Wassholm and Rolf Kühn, SP.

Test participant

None.

Appendix 1

Measurement equipment

	Calibration Due	SP number
Test site Tesla	2017-01	503 881
R&S FSIQ 40	2014-07	503 738
R&S ESIB 26	2014-07	503 292
R&S FSQ 40	2014-07	504 143
Control computer with R&S software EMC32 version 8.52.0	-	503 899
High pass filter	2015-01	BX40074
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	2014-09	503 739
High pass filter	2014-07	503 740
RF attenuator	2014-07	504 159
RF attenuator	2014-07	900 233
RF attenuator	2014-07	900 691
RF attenuator	2014-07	901 384
RF attenuator	2014-11	901 508
Chase Bilog Antenna CBL 6111A	2014-10	503 182
EMCO Horn Antenna 3115	2015-09	502 175
Std.gain horn FLANN model 20240-20	-	503 674
µComp Nordic, Low Noise Amplifier	2014-04	901 545
Miteq Low Noise Amplifier	2014-09	503 285
Schwartzbeck preamplifier BBV 9742	2014-04	504 085
Temperature and humidity meter, Testo 635	2015-03	504 203
Temperature and humidity meter, Testo 625	2014-06	504 188
Temperature Chamber	2015-03	503 360
Multimeter Fluke 87	2014-08	502 190

Appendix 1

Test frequencies used for conducted and radiated measurements

Configuration 1:

Primary RU (RF A)				**Secondary RU (RF A)**
GSM			**WCDMA**	**WCDMA**
TRX	1 (15 W)	2 (15 W)	1 (30 W)	1 (30 W)
Downlink	513 (1930.4 MHz)	521 (1932 MHz)	9725 (1945 MHz)	9725 (1945 MHz)
Uplink	513 (1850.4 MHz)	521 (1852 MHz)	9325 (1865 MHz)	9325 (1865 MHz)

Configuration 2:

Primary RU (RF A)				**Secondary RU (RF A)**
GSM			**WCDMA**	**WCDMA**
TRX	1 (15 W)	2 (15 W)	1 (30 W)	1 (30 W)
Downlink	513 (1930.4 MHz)	521 (1932 MHz)	9674 (1934.8 MHz)	9674 (1934.8 MHz)
Uplink	513 (1850.4 MHz)	521 (1852 MHz)	9274 (1854.8 MHz)	9274 (1854.8 MHz)

Configuration 3:

Primary RU (RF A)				**Secondary RU (RF A)**
GSM			**WCDMA**	**WCDMA**
TRX	1 (15 W)	2 (15 W)	1 (30 W)	1 (30 W)
Downlink	801 (1988 MHz)	809 (1989.6 MHz)	9883 (1976.6 MHz)	9883 (1976.6 MHz)
Uplink	801 (1908 MHz)	809 (1909.6 MHz)	9483 (1896.6 MHz)	9483 (1896.6 MHz)

Configuration 4:

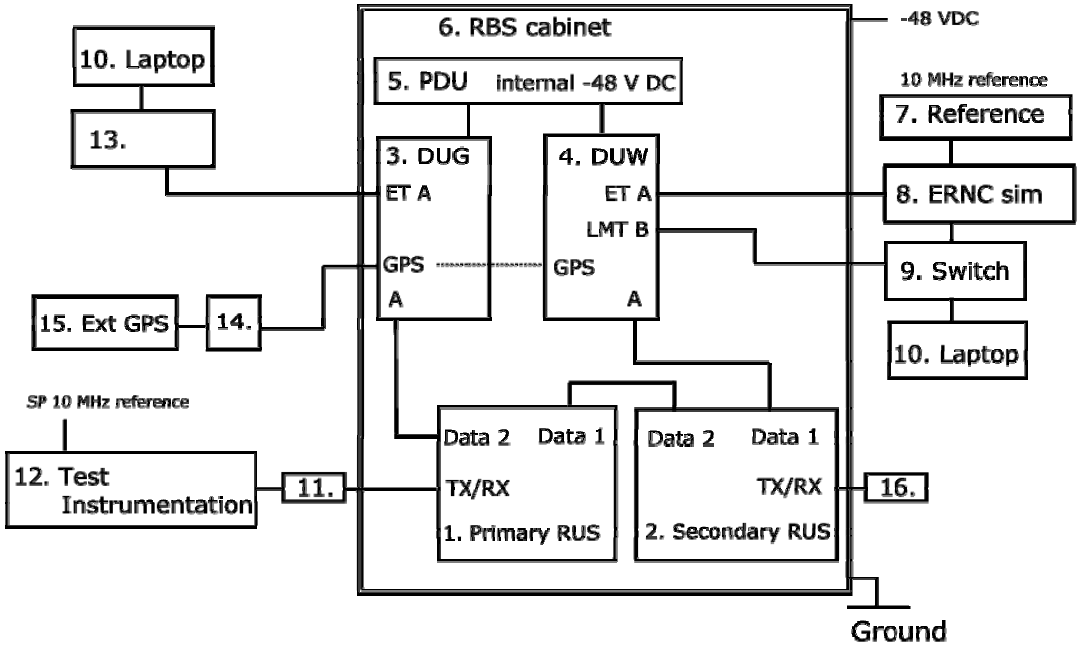
Primary RU (RF A)				**Secondary RU (RF A)**
GSM			**WCDMA**	**WCDMA**
TRX	1 (15 W)	2 (15 W)	1 (30 W)	1 (30 W)
Downlink	564 (1940.6 MHz)	623 (1952.4 MHz)	9732 (1946.6 MHz)	9732 (1946.6 MHz)
Uplink	564 (1860.6MHz)	623 (1872.4 MHz)	9332 (1866.6 MHz)	9332 (1866.6 MHz)

Configuration 5:

Primary RU (RF A)				**Secondary RU (RF A)**
GSM			**WCDMA**	**WCDMA**
TRX	1 (15 W)	2 (15 W)	1 (30 W)	1 (30 W)
Downlink	758 (1979.4 MHz)	699 (1967.6 MHz)	9868 (1973.6 MHz)	9868 (1973.6 MHz)
Uplink	758 (1899.4MHz)	699 (1887.6 MHz)	9468 (1893.5 MHz)	9468 (1893.5 MHz)

Appendix 1

Test set-up conducted measurements MR GSM + WCDMA



Test object:

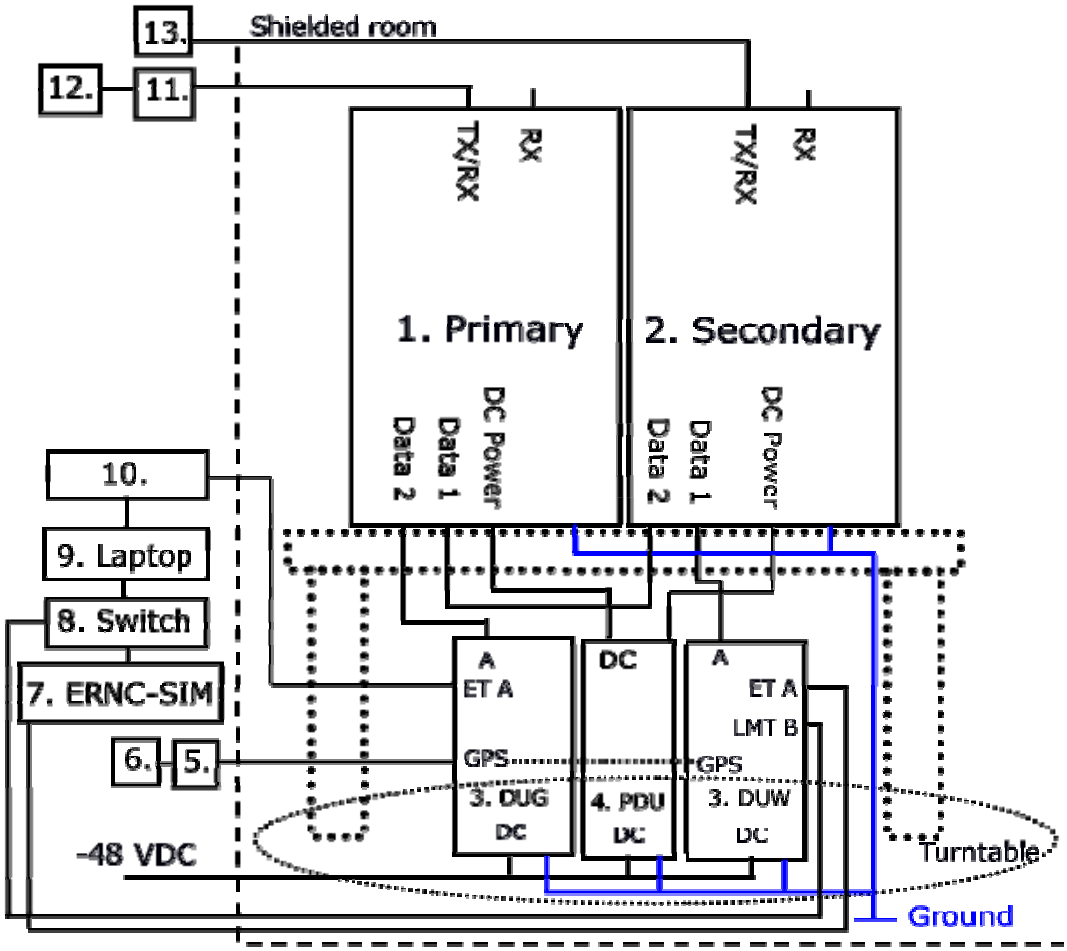
1.	RUS 01 B2, KRC 118 66/1, rev. R2H, s/n: : CB4J994518, Test object: primary/ secondary
2.	RUS 01 B2, KRC 118 66/1, rev. R2H, s/n: : CB4J994533, Dummy (secondary/ primary) software CXP 901 3268/6, rev. R57CA FCC ID: TA8CKRC11866-1 and IC: 287AB-CS118661

Functional test equipment

3.	DUG 20 01 KDU 137 569/1, R2B, s/n: C824442777
4.	DUW 41 01, KDU 127 174/4, rev.R2C, s/n: A401998222
5.	PDU 02 02, BMG 980 336/5, rev. R1F, s/n: X051445683
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.	Laptop, EliteBook 8560w, BAMS – 1001236856
11.	Attenuator, filter, according respective appendix
12.	SP test instrument according measurement equipment list
13.	RBS master 2E, LPY 107 1007/3, BAMS – 1001195170
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 setup radiated measurements MR GSM + WCDMA



Test object:

1.	RUS 01 B2, KRC 118 66/1, rev. R2H, s/n: : CB4J994518, Test object: primary/ secondary
2.	RUS 01 B2, KRC 118 66/1, rev. R2H, s/n: : CB4J994533, Dummy (secondary/ primary) software CXP 901 3268/6, rev. R57CA FCC ID: TA8CKRC11866-1 and IC: 287AB-CS118661

Functional test equipment:

3.	DUW 41 01, KDU 127 174/4, rev.R2C, s/n: A401998222 DUG 20 01 KDU 137 569/1, rev. R2B, s/n: C824442777
4.	RBS 6202: PDU 02 02, BMG 980 336/5, rev. R1F, s/n: X051445683
5.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K356428
6.	GPS Active Antenna, KRE 101 2082/1
7.	ERNC-SIM 131, BAMS – 1000660992
8.	Switch Netgear FS726T
9.	Laptop, EliteBook 8560w, BAMS – 1001236856
10.	RBS master 2E, LPY 107 1007/3, BAMS – 1001195170
11.	Attenuator
12.	FSIQ 40, SP number: 503 738, for supervision purpose only
13.	Terminator

Appendix 1

Interfaces:	**Type of port:**
Supply 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, unused	RF
RX A I/O, unused	RF
RX B I/O, unused	RF
Ground wire	Ground

RBS software:

RAT	**Software**	**Revision**
GSM	DXP R73FZ	R52E
WCDMA	CXP 902 1719	R1DG07

Appendix 2

RF power output measurements according to CFR 47 §24.232 / IC RSS-133 6.4

Date	Temperature	Humidity
2014-04-15	24 °C ± 3 °C	17 % ± 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	902 282
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

Measured total output power.
Nominal output power at Primary RU RFA: 47.8 dBm
Nominal output power at Secondary RU RFA: 44.8 dBm

Tested configuration	Primary RU RFA W+G [RMS dBm/ dB PAR]	Secondary RU RFA W [RMS dBm/ dB PAR]
1	48.16/ 6.85	45.22/ 7.14
2	47.94/ 6.71	45.15/ 7.14
3	47.93/ 6.88	45.05/ 7.14
4	48.08/ 6.80	45.15/ 7.14
5	47.97/ 6.78	45.10/ 7.14

Note: The PAR value is the 0.1 % Peak to Average Ratio.

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

§24.232 The maximum output power may not exceed 3280 W/MHz (EIRP).
The Peak to Average Ratio (PAR) may not exceed 13 dB.

RSS-133 Base station transmitters operating in the band 1930-1995 MHz shall not have output power exceeding 100 watts. When the transmitter power is measured in terms of average value, the peak-to-average ratio(PAR) of the power shall not exceed 13 dB

There is no EIRP limit specified for base station equipment in the RSS-133.

EIRP compliance is addressed at the time of licensing, as required by the responsible IC Bureau. Licensee's are required to take into account the antenna gain to get the maximum usable power settings to prevent the radiated output power to exceed the EIRP limits specified in SRSP-510

Complies?	Yes

Appendix 3

Conducted spurious emission measurements according to CFR 47 §24.238 / IC RSS-133 6.5

Date	Temperature	Humidity
2014-04-15	24 °C ± 3 °C	17 % ± 5 %
2014-05-27	22 °C ± 3 °C	31 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §24.238. 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 E), 3), a), (iii) Measure and add 10 log(N_{ANT})" of FCC KDB662911 D01 Multiple Transmitter Output v02r01.

Measurement equipment	SP number
Rohde & Schwarz signal analyzer FSQ40	504 143
RF attenuator	902 282
High pass filter	BX40074
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Diagram	Tested configuration	Tested Port
1 a-e	1	Primary RU RFA
2 a-e	2	Primary RU RFA
3 a-e	3	Primary RU RFA
4 a-e	4	Primary RU RFA
5 a-e	5	Primary RU RFA

Remarks

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.

Limits

§24.238 and RSS-133 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 3

Diagram 1 a:

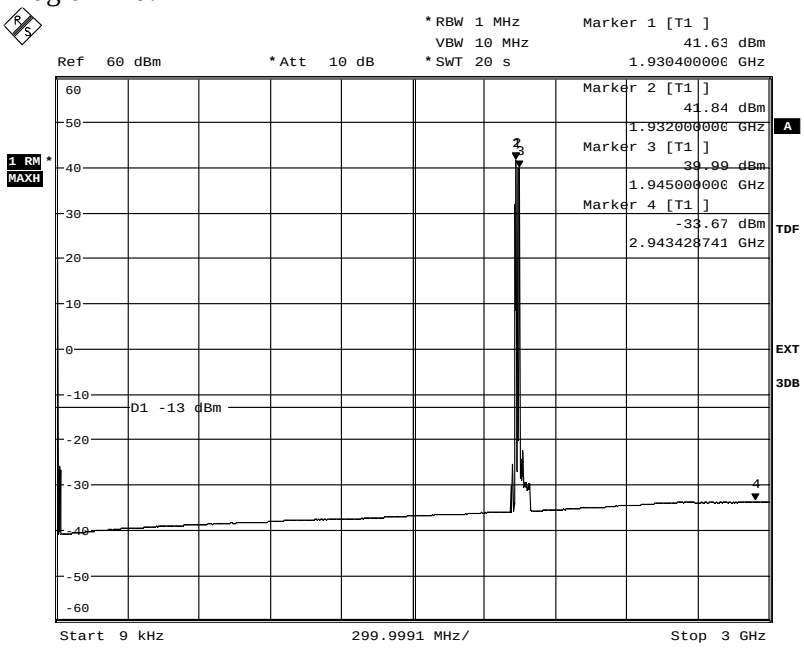


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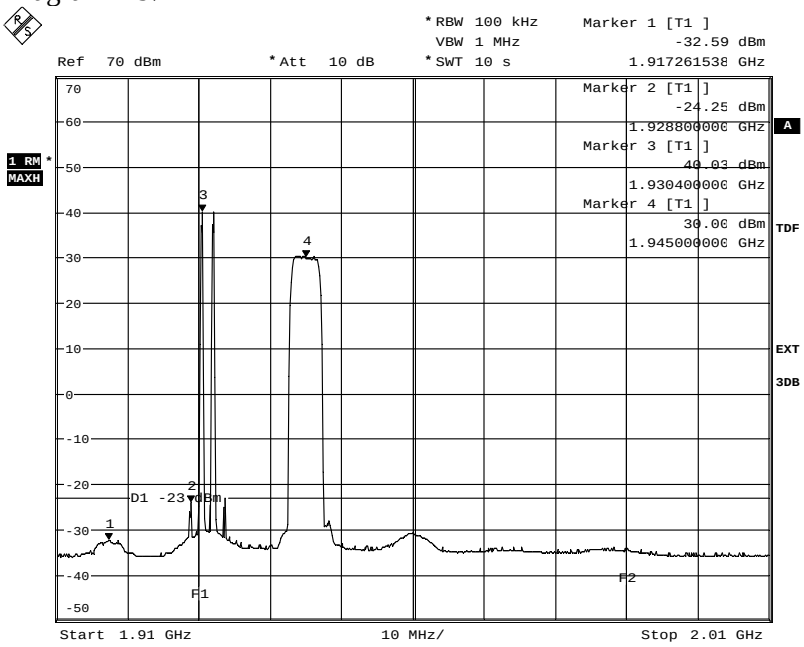
Diagram 1 b:



Date: 15.APR.2014 12:41:13

The emission at 1928.8 MHz was –20.84 dBm, measured with the channel power method with 1 MHz channel bandwidth.

Appendix 3

Diagram 1 c:

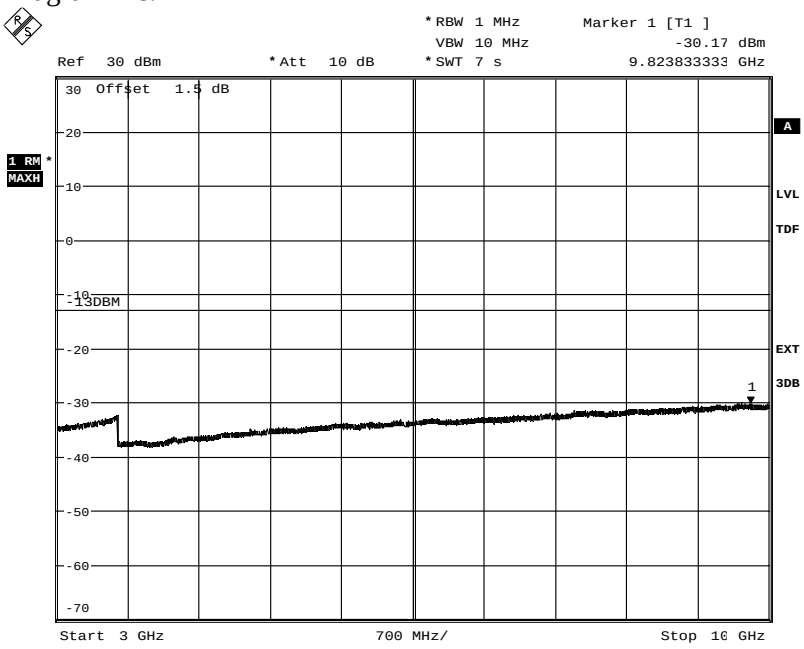


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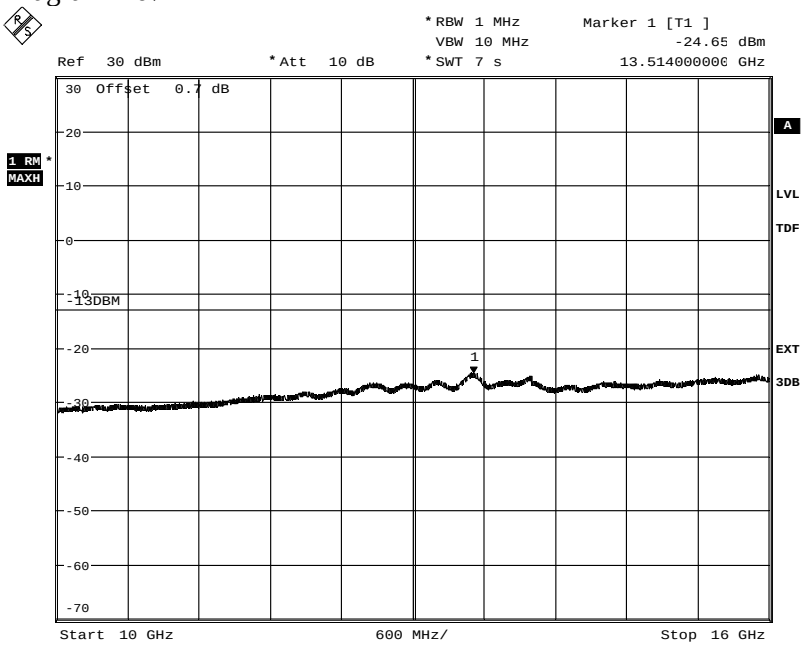
Diagram 1 d:



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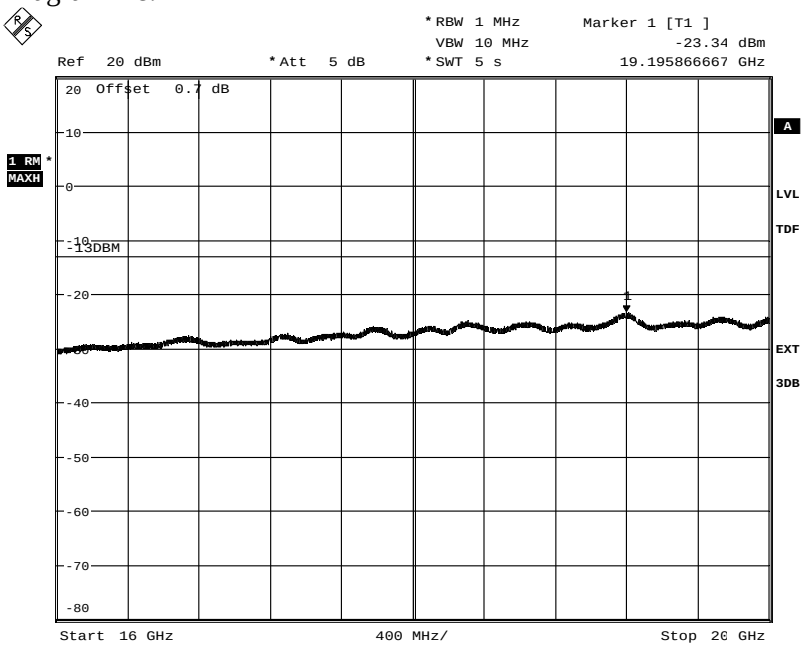
Appendix 3

Diagram 1 e:



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Appendix 3

Diagram 2 a:

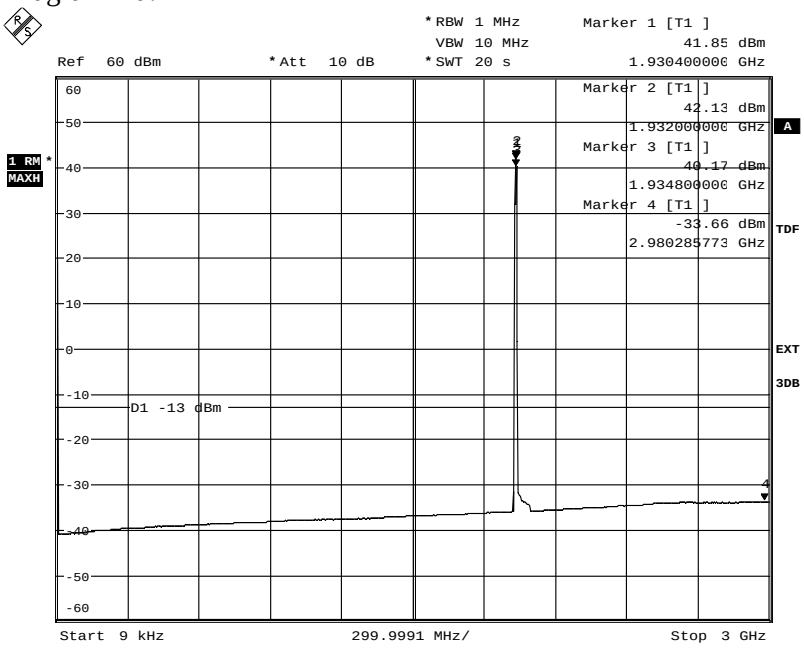

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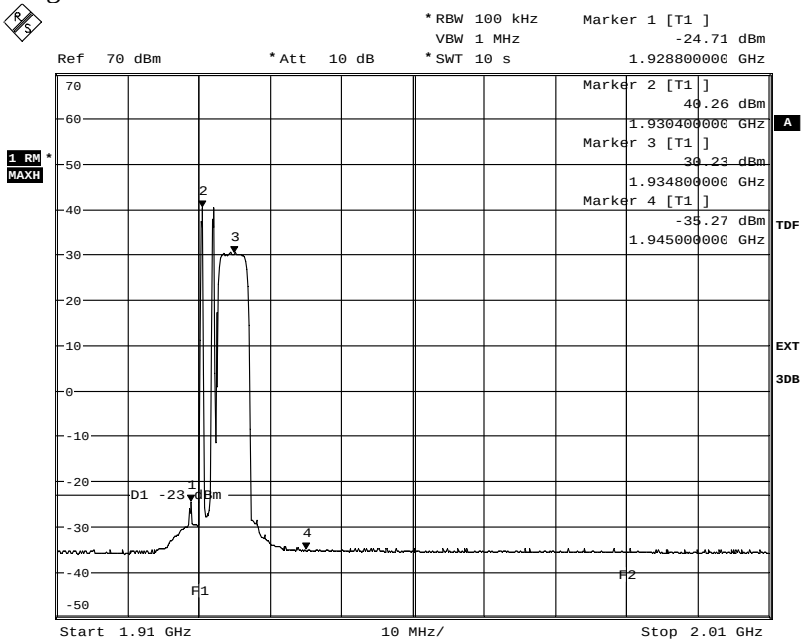
Diagram 2 b:



Date: 15.APR.2014 13:20:46

The emission at 1928.8 MHz was –24.60 dBm, measured with the channel power method with 1 MHz channel bandwidth.

Appendix 3

Diagram 2 c:

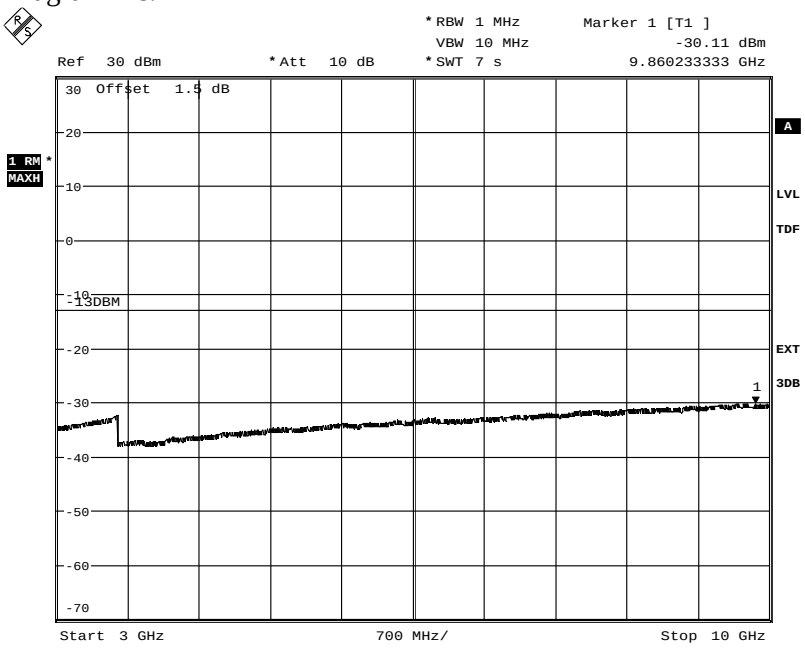


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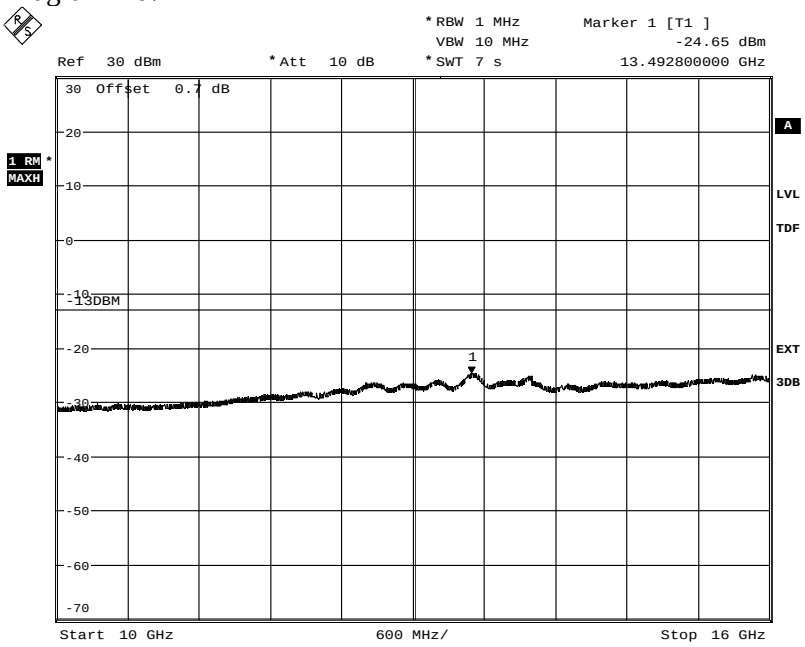
Diagram 2 d:



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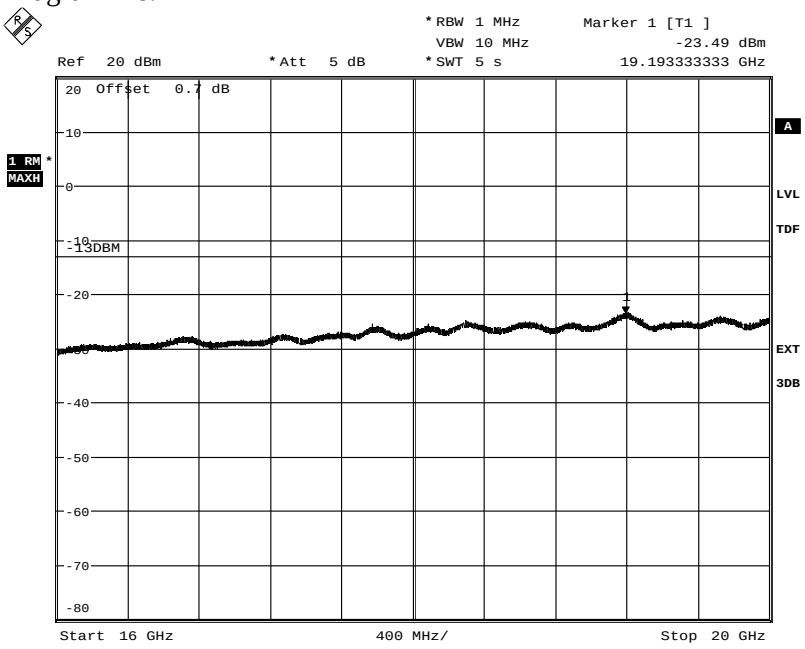
Appendix 3

Diagram 2 e:



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Appendix 3

Diagram 3 a:

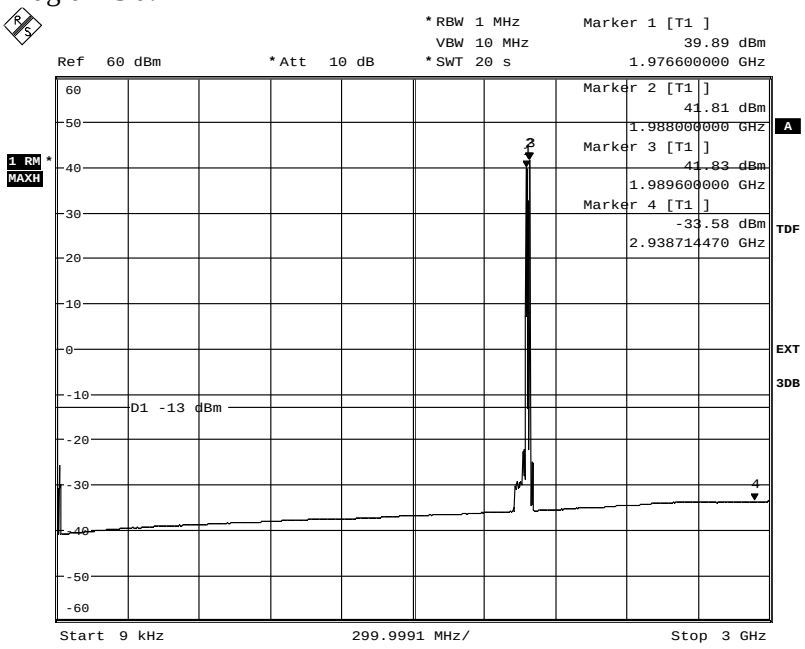

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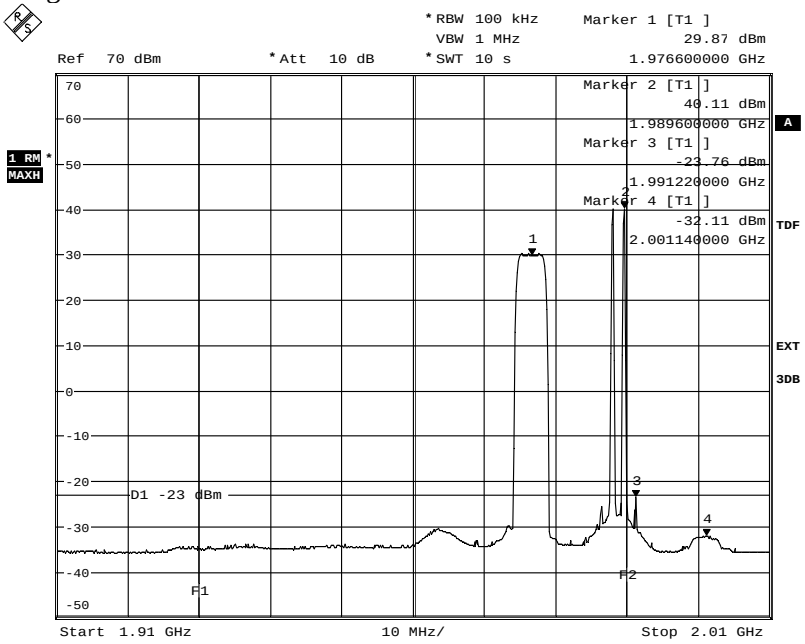
Diagram 3 b:



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The emission at 1991.2 MHz was –20.89 dBm, measured with the channel power method with 1 MHz channel bandwidth.

Appendix 3

Diagram 3 c:

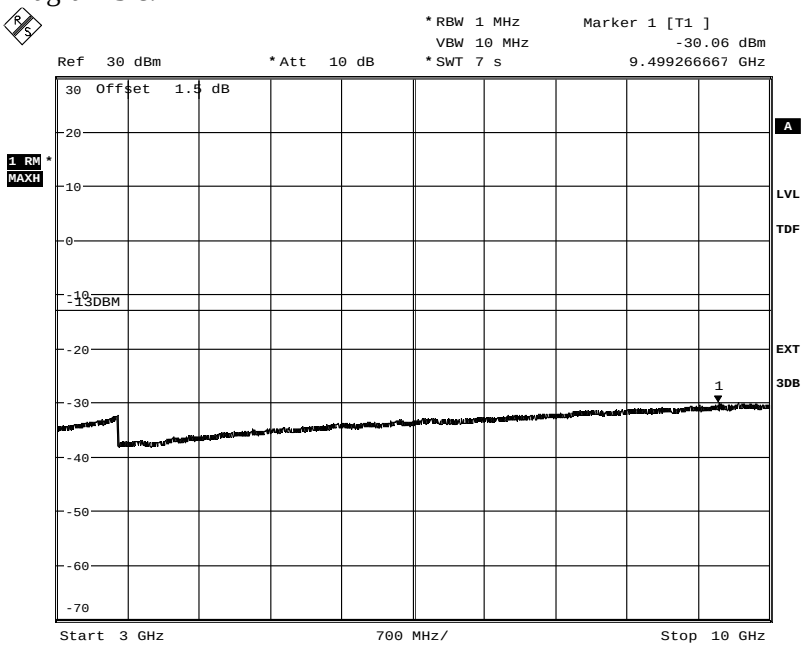

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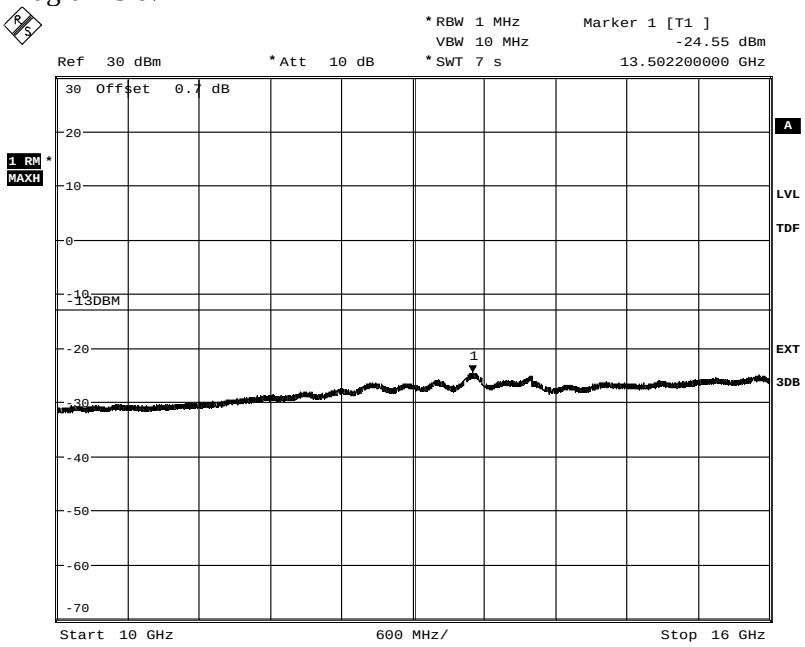
Diagram 3 d:



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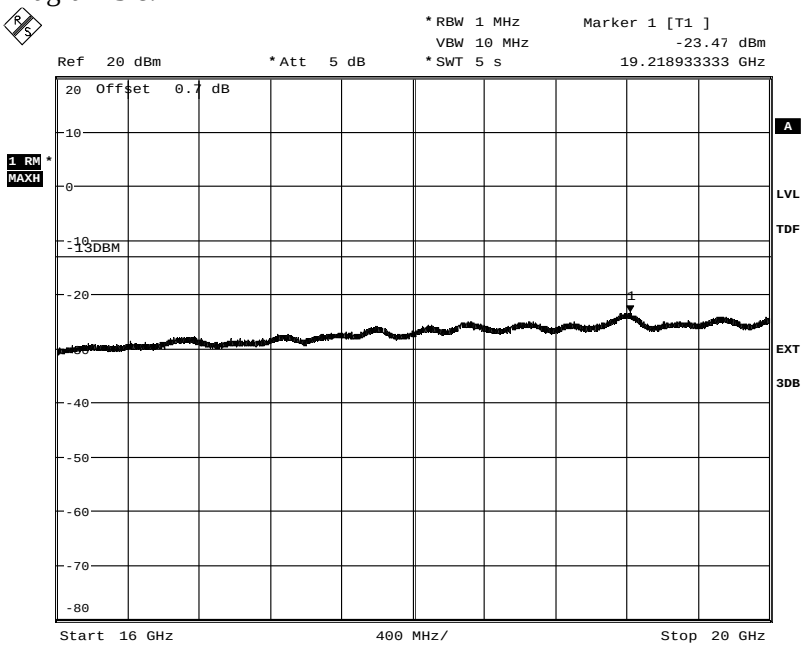
Appendix 3

Diagram 3 e:



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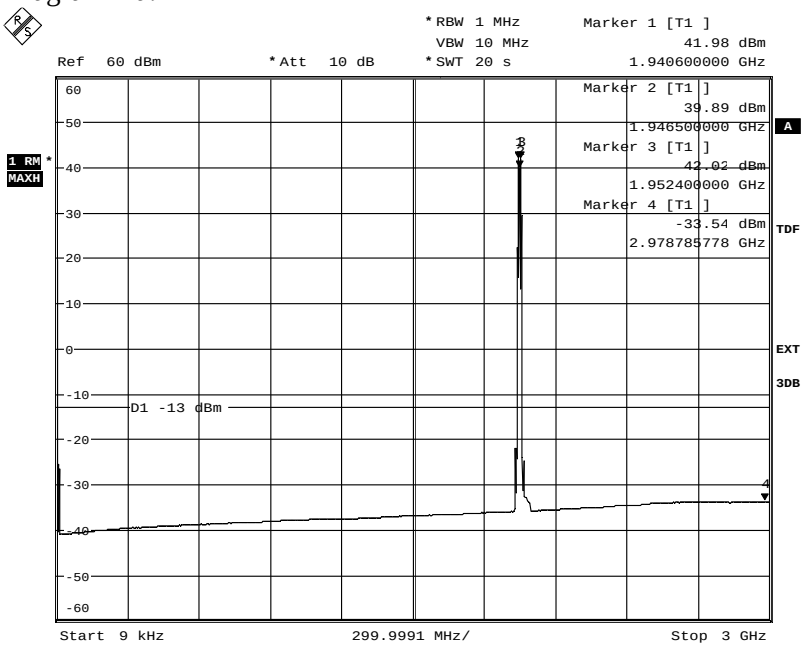
Appendix 3

Diagram 4 a:



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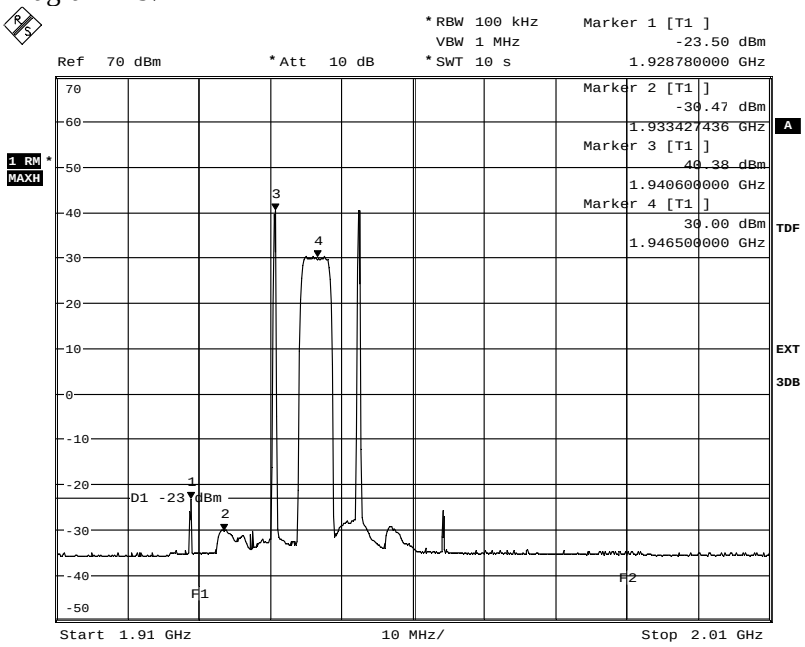

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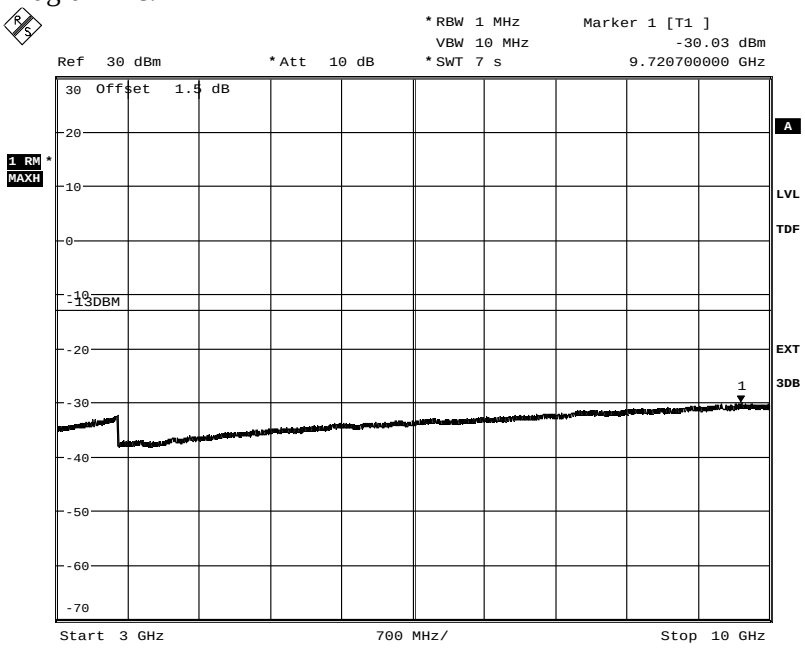
The emission at 1928.8 MHz was –21.8 dBm, measured with the channel power method with 1 MHz channel bandwidth.

Appendix 3

Diagram 4 c:



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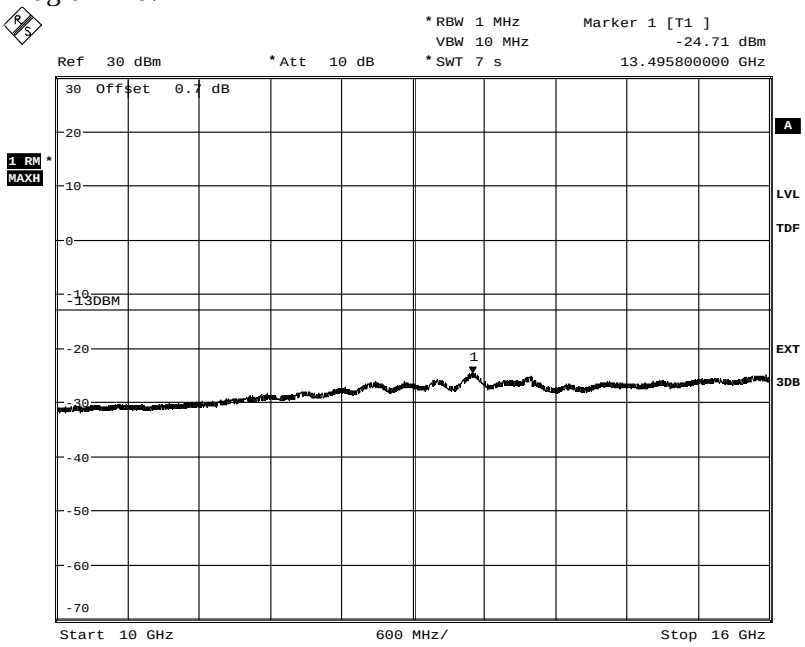

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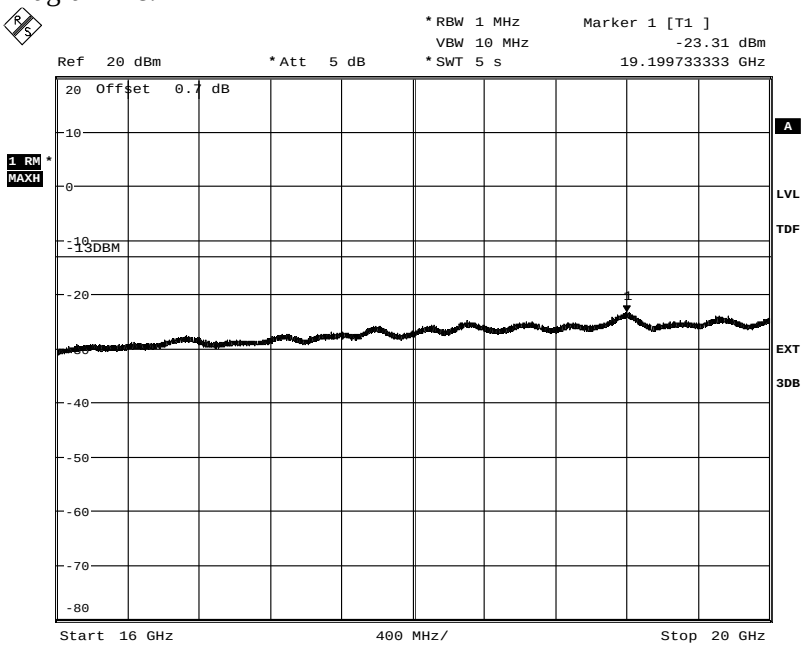
Appendix 3

Diagram 4 e:



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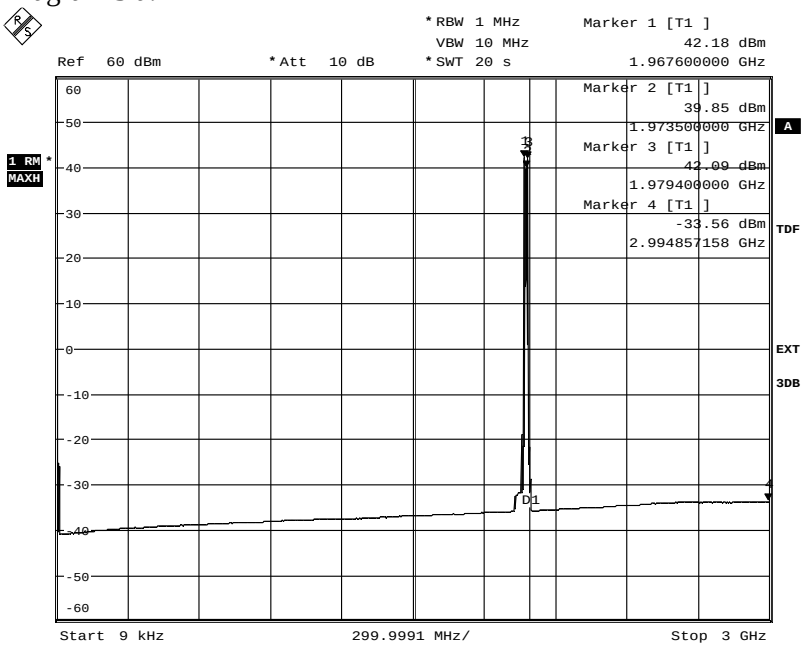
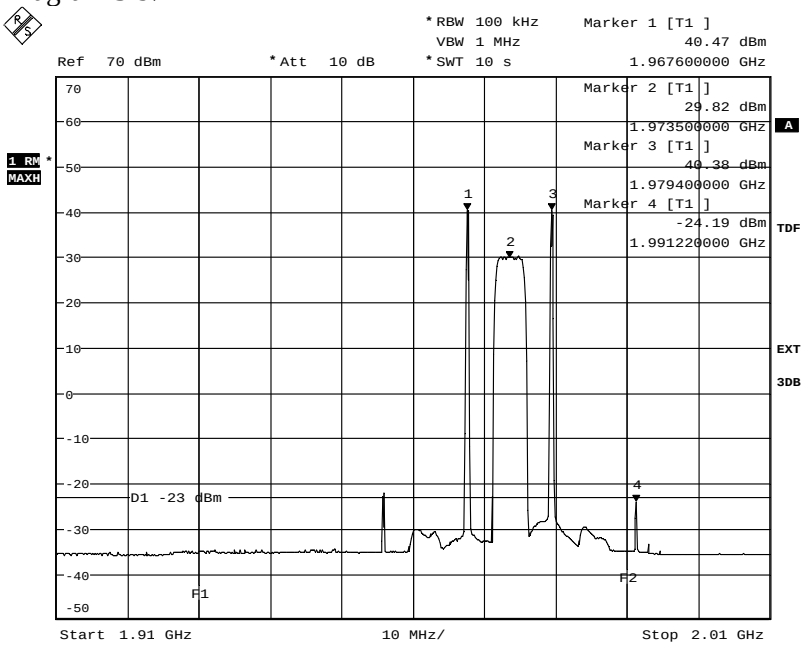
Appendix 3

Diagram 5 a:



Date: 15.APR.2014 15:14:02

Diagram 5 b:

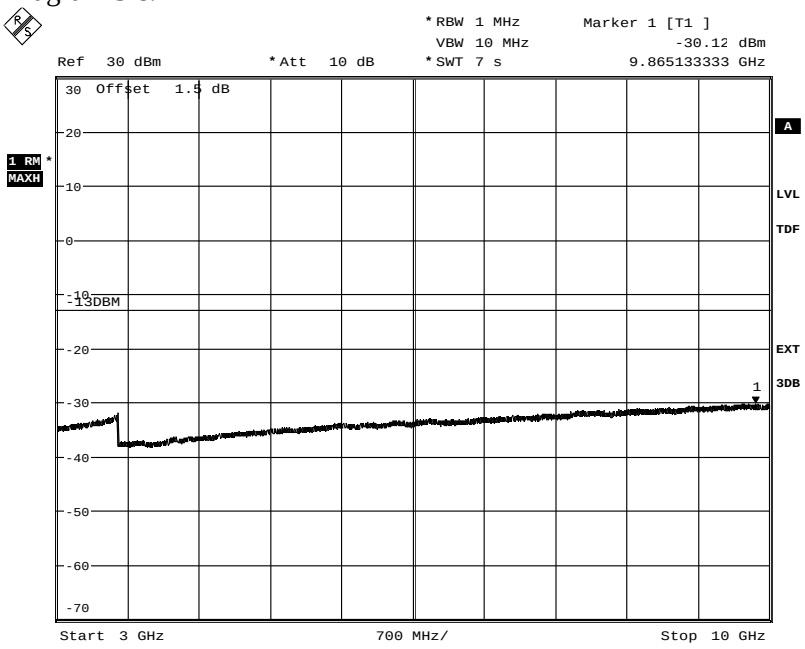


Date: 27.MAY.2014 10:46:20

The emission at 1991.2 MHz was –22.34 dBm, measured with the channel power method with 1 MHz channel bandwidth.

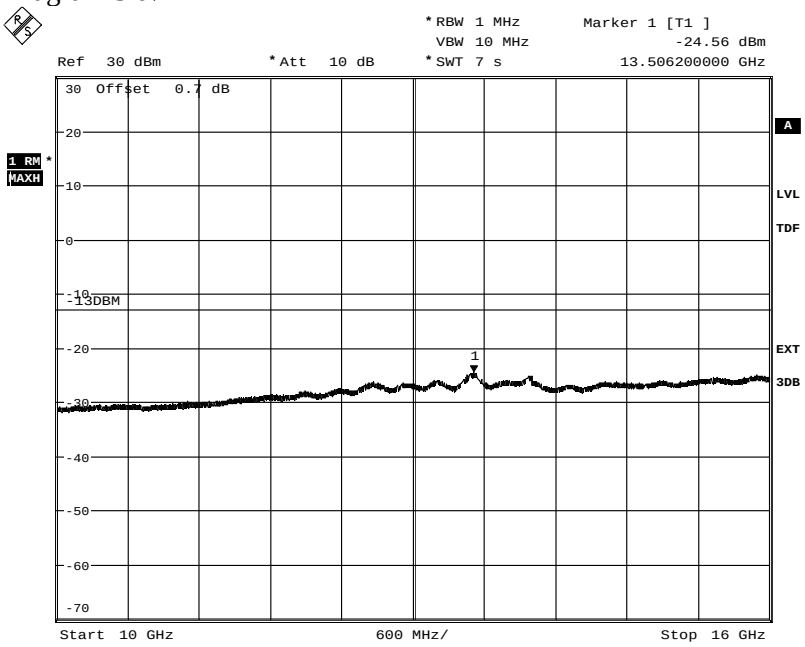
Appendix 3

Diagram 5 c:



Date: 15.APR.2014 15:15:35

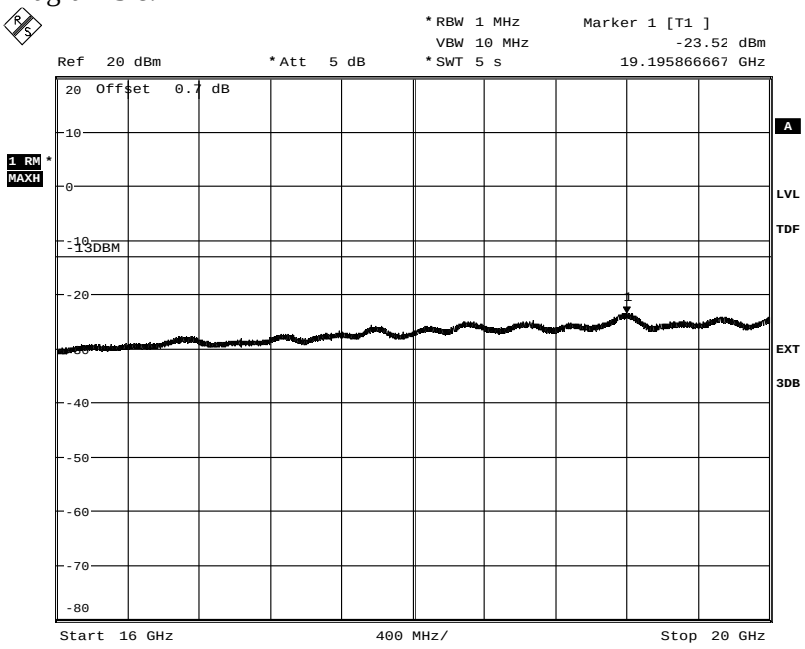
Diagram 5 d:



Date: 15.APR.2014 15:16:30

Appendix 3

Diagram 5 e:



Date: 15.APR.2014 15:17:19

Appendix 4

Field strength of spurious radiation measurements according to CFR 47 §24.238 / IC RSS-133 6.5

Date	Temperature	Humidity
2014-04-11	23 °C ± 3°C	28 % ± 5 %
2014-05-21	23 °C ± 3°C	42 % ± 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 1 m in the frequency range 18 - 20 GHz.

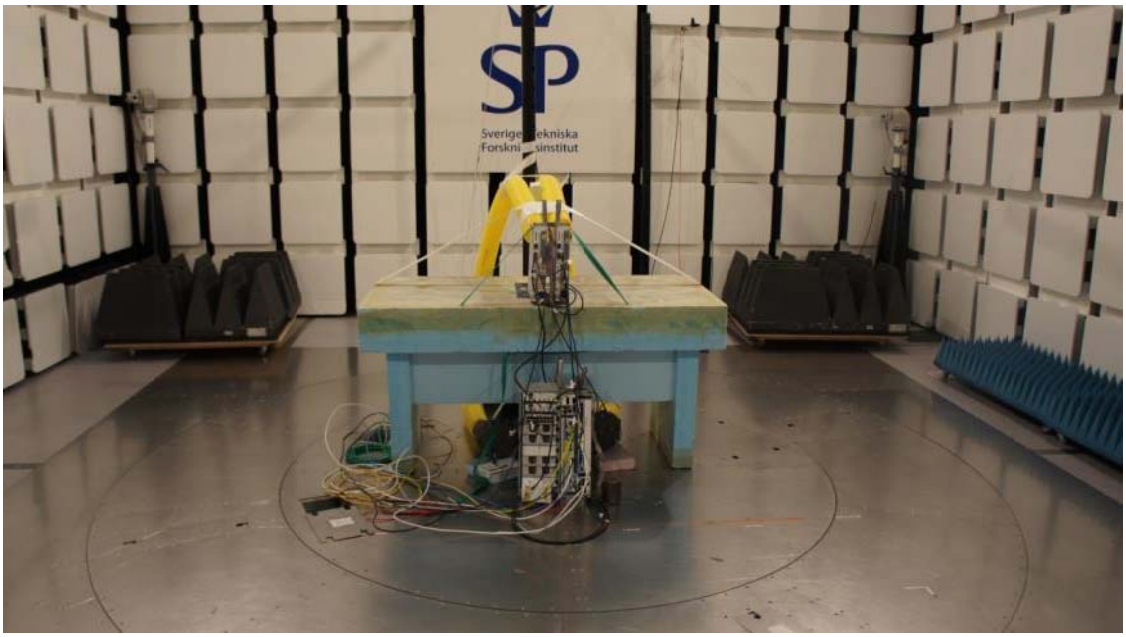
In the frequency range 30 MHz - 20 GHz the measurement was performed in power with a RBW of 1 MHz. A propagation loss in free space was calculated. The used formula was $\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

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.

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 ESIB 26	503 292
R&S FSIQ 40	503 738
EMC 32 ver. 8.52.0	503 899
Chase Bilog Antenna CBL 6111A	502 182
EMCO Horn Antenna 3115	502 175
Flann STD Gain Horn Antenna 20240-20	503 674
High pass filter, RLC Electronics, 3-18 GHz	503 739
Miteq, Low Noise Amplifier	503 285
µComp Nordic, Low Noise Amplifier	901 545
Schwarzbeck preamplifier BBV972	504 085
Temperature and humidity meter, Testo 625	504 188

Tested configurations

Configuration
1
2
3

Results, representing worst case

Diagram	Configuration
1 a-d	3

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

Measurement uncertainty:

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

Remarks

The upper frequency bound for verification was chosen as 20 GHz in order to cover 10 x the maximum fundamental TX frequency.

Limits

CFR 47 §24.238 and RSS-133 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 1 a:

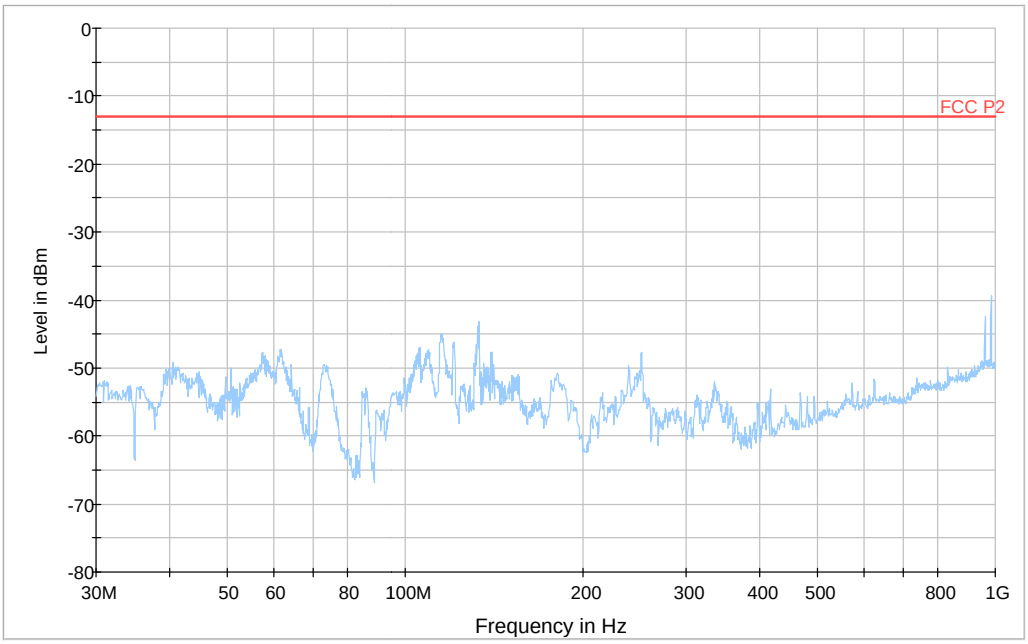
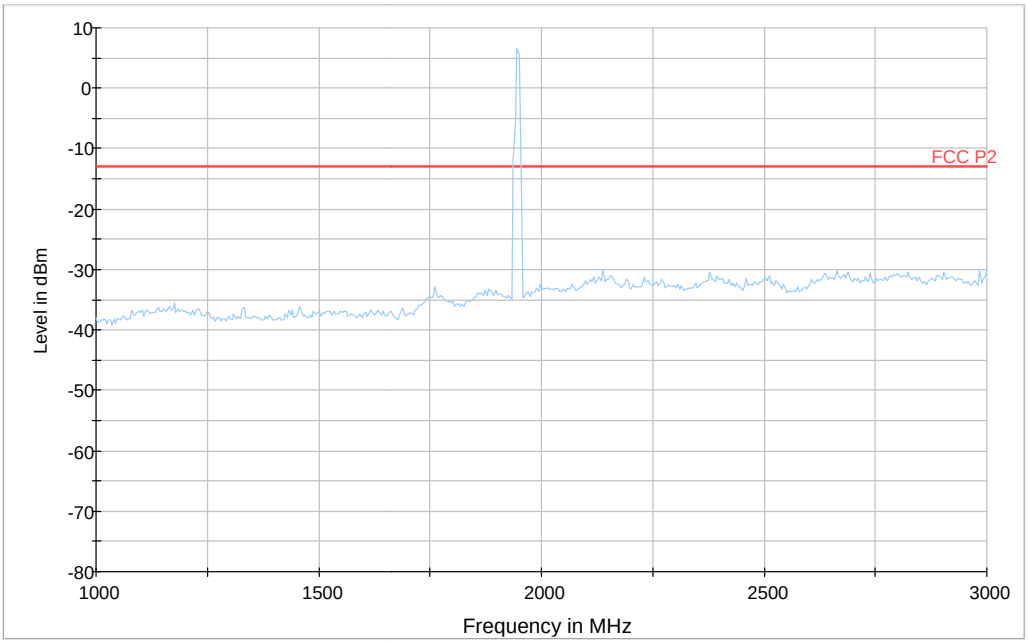


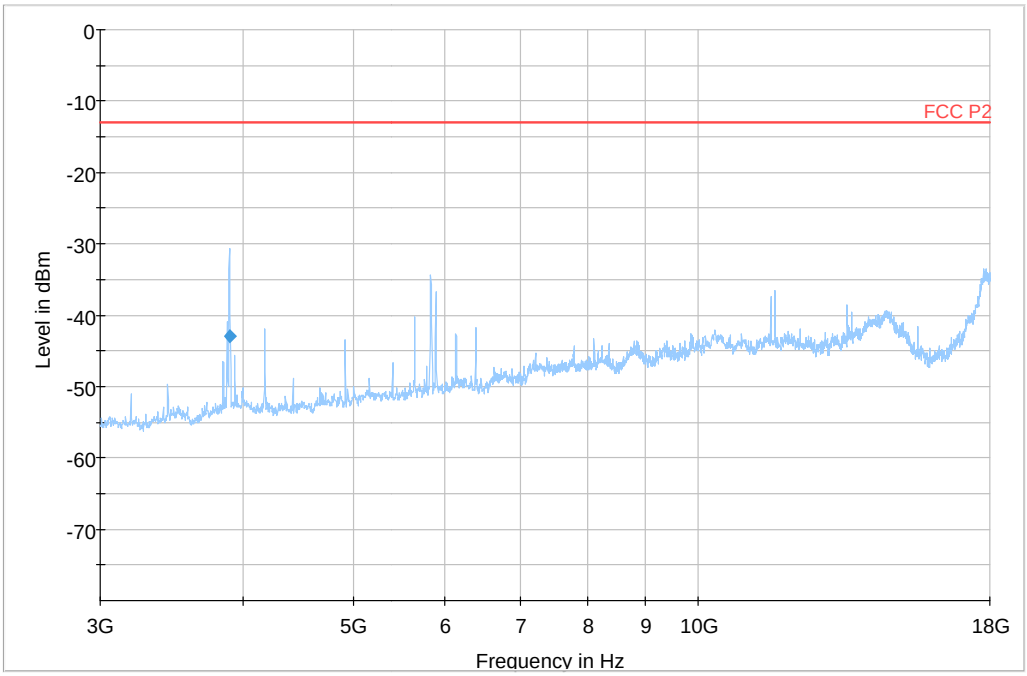
Diagram 1 b:



Note: The emission between 1930 and 1990 MHz are the carrier frequencies and shall be ignored in the context.

Appendix 4

Diagram 1 c:

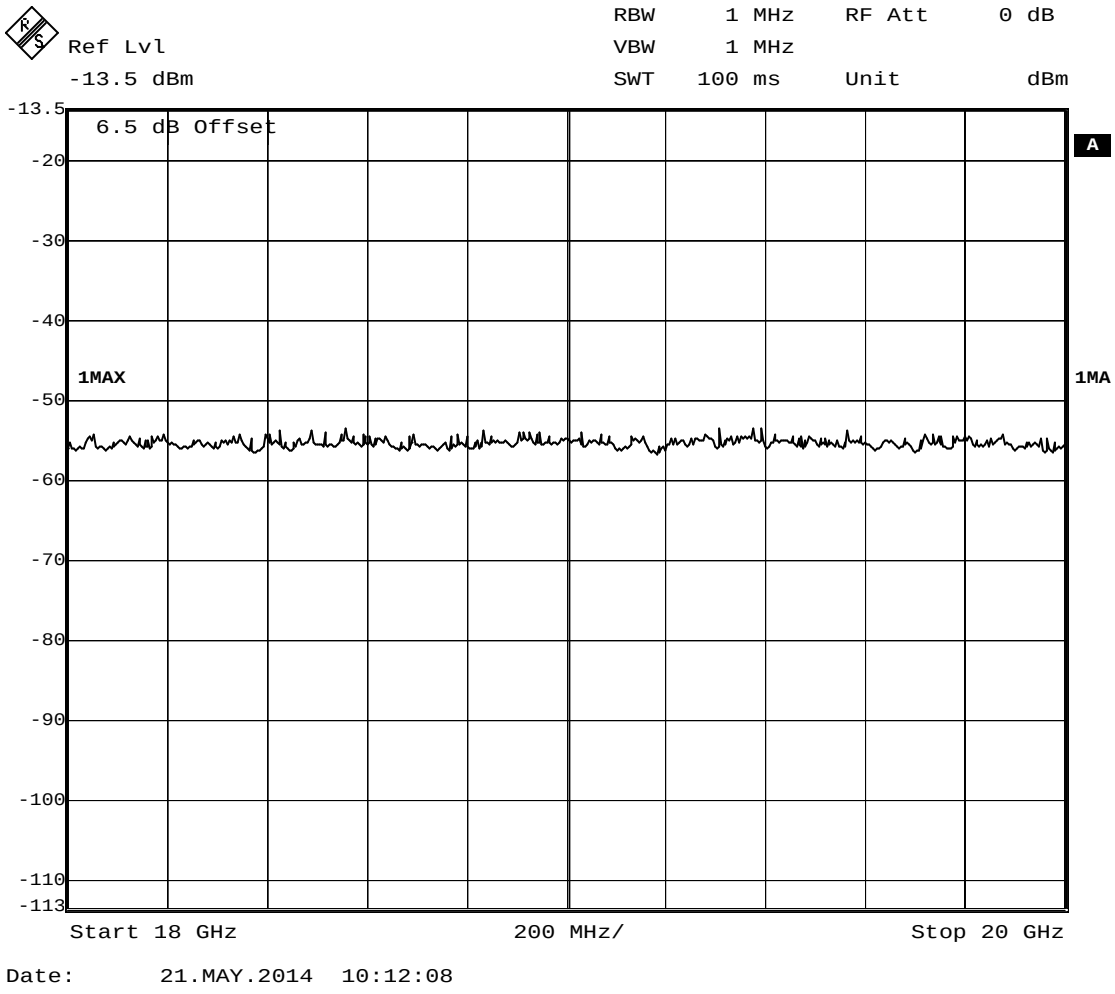


Final RMS Result

Frequency (MHz)	RMS (dBm)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)
3890.846693	-43.0	5000.0	1000.000	178.0	V	99.0	-104.4	30.0	-13.0

Appendix 4

Diagram 1 d:



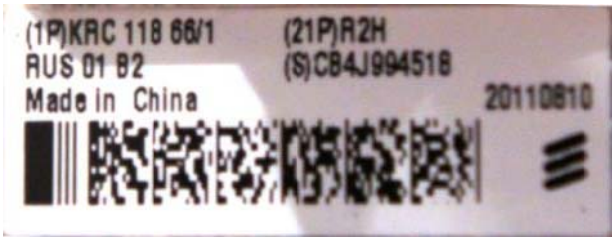
Appendix 5

External photos

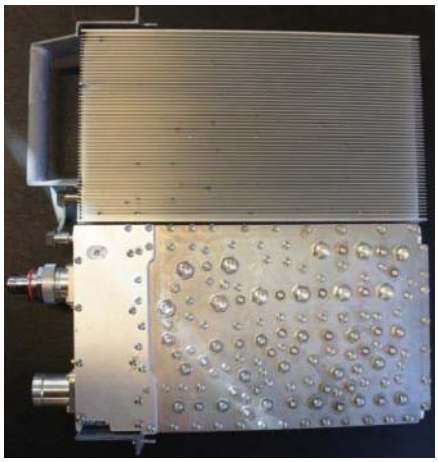
Front side:

Back side:

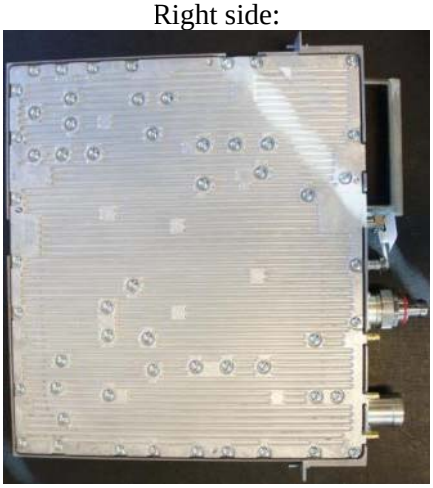
Product Label:



Left side:



Right side:



Appendix 5

Top side:

Bottom side: