REPORT

issued by an FCC listed Laboratory Reg. no. 93866.
The test site complies with RSS-Gen, IC file no. 3482A-1.
issued by an Accredited Testing Laboratory.

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Date	Reference	Page
2013-12-12	3P06723-03-F24	1 (2)

1002
ISO/IEC 17025

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Radio measurements on mRRUS 12 B2 radio equipment with FCC ID: TA8AKRC161328 and IC: 287AB-AS161328

(5 appendices)

Test object

Product name: mRRUS 12 B2
Product number: KRC 161 328/X, see appendix 1 for details

Summary

Standard		Compliant	Appendix
FCC CFR 47 / IC RSS-133 ISSUE 6			
2.1046 / RSS-133 6.4	RF power output conducted	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

Jörgen Wassholm

Examined by

Anders Nordlöf

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Appendix 1

Description of the test object

Equipment:	Radio equipment mRRUS 12 B2 supporting WCDMA + LTE KRC 161 328/1, 110-240 VAC internal antenna KRC 161 328/2, -48 VDC internal antenna KRC 161 328/3, 110-240 VAC no internal antenna KRC 161 328/4, -48 VDC no internal antenna FCC ID: TA8AKRC161328 IC: 287AB-AS161328 IC model numbers: IC MODEL NO: AS1613281 IC MODEL NO: AS1613282 IC MODEL NO: AS1613283 IC MODEL NO: AS1613284
Frequency bands:	TX: 1930 – 1990 MHz RX: 1850 – 1910 MHz
Antenna ports:	2 TX/RX ports
RF configurations Multi RAT:	WCDMA + LTE, MIMO 2x2
Nominal output power per antenna port:	1-2 LTE + 1-3 WCDMA (Total power per port 37dBm, 5W) Total number of carriers 4
LTE Modulations:	QPSK, 16QAM and 64QAM
LTE channel bandwidth	3 MHz, 5 MHz and 10 MHz
WCDMA Modulations:	QPSK, 16QAM and 64QAM
WCDMA channel bandwidth:	4.2 to 5 MHz (configurable in steps of 100/200 kHz)
WCDMA Channel spacing:	4.4 to 5 MHz (configurable in steps of 100/200 kHz)
Nominal power voltage:	-48VDC 110-240 VAC

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 3 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 supplied with -48 VDC by an external power supply.
Frequency stability measurements were also tested using 120VAC.
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, IC RSS-133 and IC 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 24, 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-133 Issue 6

Measurement equipment

	Calibration Due	SP number
Test site Tesla	2014-01	503 881
R&S FSIQ 40	2014-07	503 738
R&S ESU 26	2014-05	901 553
R&S ESI 26	2014-07	503 292
R&S FSQ 40	2014-03	504 143
R&S ESU 40	2014-07	901 385
R&S SME 06	2014-07	502 755
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	2014-07	503 740
RF attenuator	2014-07	504 159
RF attenuator	2014-07	900 233
RF attenuator	2014-07	900 691
RF attenuator	2013-12	901 508
Chase Bilog Antenna CBL 6111A	2014-10	503 182
EMCO Horn Antenna 3115	2015-09	502 175
ETS Lindgren Horn Antenna 3115	2015-03	902 212
EMCO Horn Antenna 3115	2015-09	501 548
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
Multimeter Fluke 87	2014-08	502 190
Temperature and humidity meter, Testo 635	2014-06	504 203
Temperature and humidity meter, Testo 635	2014-06	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 2013-10-21.

Manufacturer’s representative

Christer Gustavsson, Ericsson AB.

Test engineers

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

Test participant

Mihai Simon.

Appendix 1

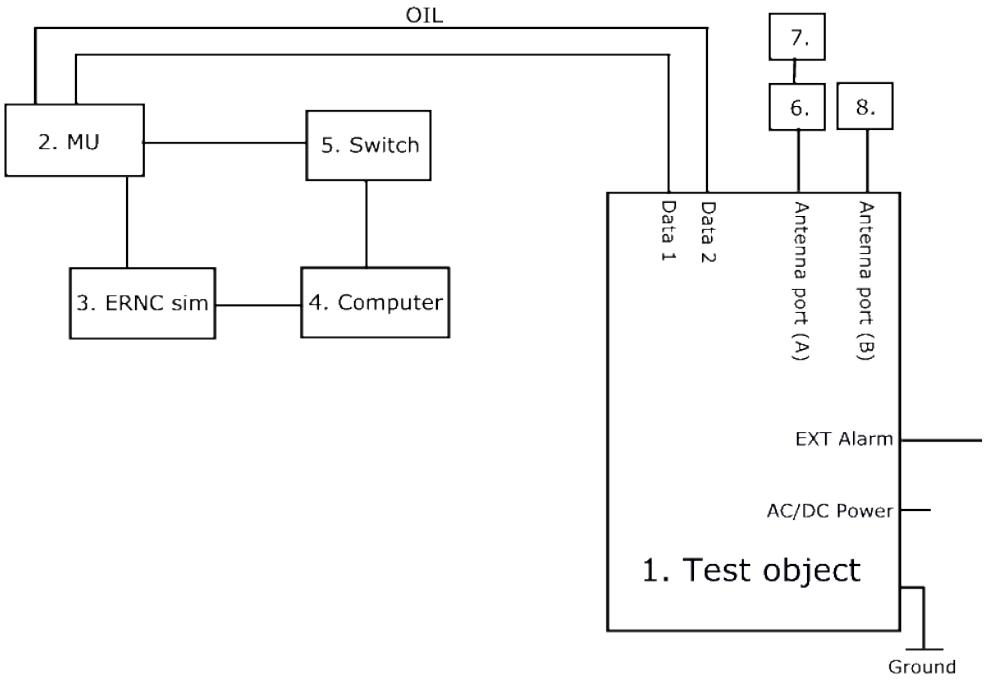
Test frequencies during measurements

MSR, WCDMA+ LTE TX test frequencies

WCDMA			LTE				
UARFCN Downlink	Frequency [MHz]	BW [MHz]	EARFCN Downlink	Frequency [MHz]	BW [MHz]	Configurations	Comment
9662	1932.4	5	785	1948.5	3	1	TX bottom constellation per LTE BW
9763	1952.6	5 5 5	1000 975 950	1970.0 1967.5 1965.0	3 5 10	2 3 4	TX midle constellation per LTE BW
9863	1972.6	5	1185	1988.5	3	5	TX top constellation per LTE BW

Appendix 1

Test set-up conducted measurements



Test object

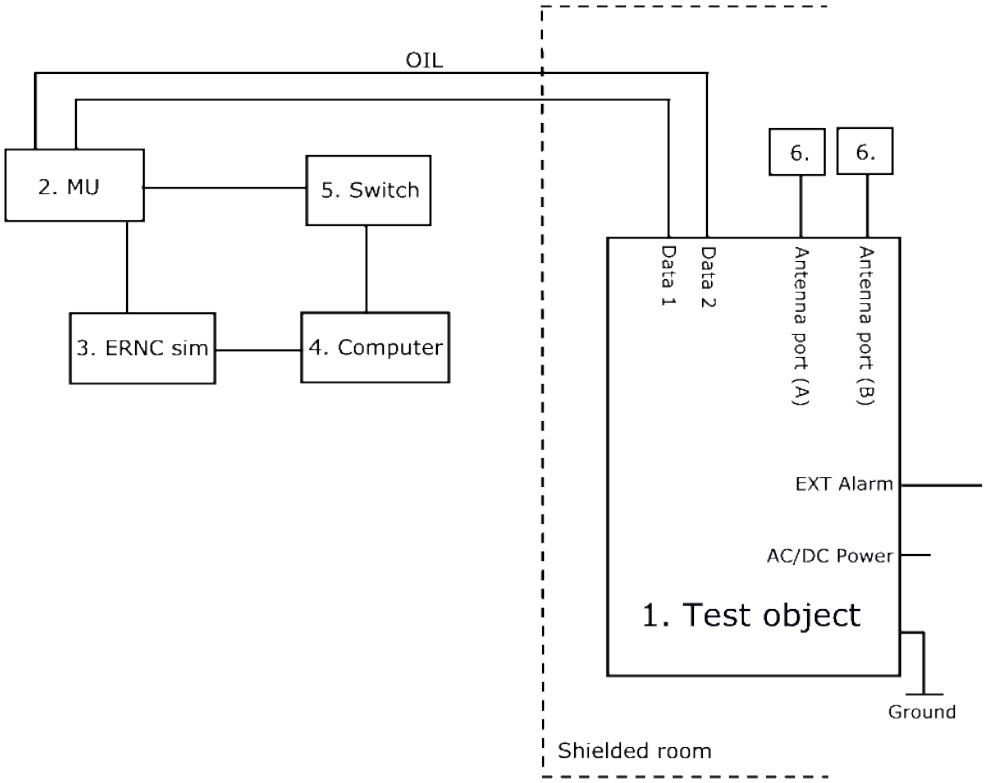
1.	mRRUS 12 B2, KRC 161 328/4, revision R1A, s/n: D16A183078 working software CXP 901 7316/2, rev. R51NK with FCC ID: TA8AKRC161328 and IC: 287AB-AS161328

Functional test equipment

2.	Main Unit SUP 6601 1/BFL 901 009/4, rev. R1E, s/n. BR88258944 DUS 41 01, KDU 137 624/1, rev. R5A, s/n: D168382181 SUP 6601 1/BFL 901 009/4, rev. R1E, s/n. BR88258668 DUW 30 01, KDU 127 161/3, rev. R4E, s/n: C825945801
3.	ERNC-SIM 145, BAMS – 1000707989 Netgear Switch GSM7224, BAMS – 1000517289 Symmetricom SyncServer S250, BAMS – 1000699484 Symmetricom 8040 Rubidium Frequency Standard, BAMS – 1001292861
4.	Computer Sun ultra27-01, BAMS – 1000758436
5.	Netgear Switch GSM7212, BAMS – 1000517299
6.	Attenuator, filter, directional coupler according respective appendix
7.	SP Test Instrumentation according to measurement equipment list
8.	Terminator, 50 ohm

Appendix 1

Test set-up radiated measurements



Test object:

1.	mRRUS 12 B2, KRC 161 328/4, revision R1A, s/n: D16A183078 working software CXP 901 7316/2, rev. R51NK with FCC ID: TA8AKRC161328 and IC: 287AB-AS161328

Functional test equipment:

2.	Main Unit SUP 6601 1/BFL 901 009/4, rev. R1E, s/n. BR88258944 DUS 41 01, KDU 137 624/1, rev. R5A, s/n: D168382181 SUP 6601 1/BFL 901 009/4, rev. R1E, s/n. BR88258668 DUW 30 01, KDU 127 161/3, rev. R4E, s/n: C825945801
3.	ERNC-SIM 145, BAMS – 1000707989 Netgear Switch GSM7224, BAMS – 1000517289 Symmetricom SyncServer S250, BAMS – 1000699484 Symmetricom 8040 Rubidium Frequency Standard, BAMS – 1001292861
4.	Computer Sun ultra27-01, BAMS – 1000758436
5.	Netgear Switch GSM7212, BAMS – 1000517299
6.	Terminator

Appendix 1

Interfaces:	**Type of port:**
Power: -48 VDC	DC Power
Data 1, optical interface	Signal
Data 2, optical interface	Signal
Ext Alarm, unshielded multi wire	Signal
Ground wire	Ground

RBS software:

	Software	**Revision**
DUS	CXP 102 051/19	R28AT
DUW	CXP 902 1719	R4G03

Appendix 2

RF power output measurements according to CFR 47 §2.1046 / IC RSS-133 6.4, conducted

Date	Temperature	Humidity
2013-04-25	23 °C ± 3 °C	24 % ± 5 %
2013-04-26	23 °C ± 3 °C	24 % ± 5 %

Test set-up and procedure

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

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

Measurement uncertainty: 1.1 dB

Results

Measured total output power

Rated output power level at RF connector 1x 37 dBm.

Tested configuration	Transmitter power [RMS dBm/ dB PAR]		
	Port RF A	Port RF B	Total power[1)]
1	36.81/ 7.26	36.70/ 7.28	39.77
2	36.88/ 7.16	36.86/ 7.19	39.88
3	36.64/ 6.85	36.65/ 6.88	39.65
4	36.64/ 6.85	36.67/ 6.85	39.66
5	36.78/ 7.16	36.77/ 7.19	39.67

[1)]: summed output power according to FCC KDB662911 Multiple transmitter output v02r01

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

DB662911 D01 Multiple transmitter output v02

Limits

§24.232: The maximum output power may not exceed 3280 W (e.i.r.p)/ MHz. The Peak to Average Ratio (PAR) may not exceed 13 dB.

RSS-133 6.4: The average equivalent isotropically radiated power (e.i.r.p.) limits in SRSP-510 apply, resulting in a maximum output power of 3280 W (e.i.r.p)/ MHz for the scope of this report. Moreover, base station transmitters operating in the band 1930-1995 MHz shall not have output power exceeding 100 watts. The peak-to-average ratio of the power shall not exceed 13 dB.

Complies?	Yes

Appendix 3

Conducted spurious emission measurements according to CFR 47 §2.1051 / IC RSS-133 6.5

Date	Temperature	Humidity
2013-04-25	23 °C ± 3 °C	24 % ± 5 %
2013-04-26	23 °C ± 3 °C	24 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §24.238. The output was connected to a spectrum analyser with a RBW setting of 1 MHz and RMS detector activated. The spectrum analyser 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
R&S FSW 43	902 073
RF attenuator	901 508
HP filter	901 502
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Diagram	Configuration	Tested port
1 a-e	1	RF A
2 a-e	2	RF A
3 a-e	3	RF A
4 a-e	4	RF A
5 a-e	5	RF A

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

CFR 47 §24.238 and IC 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.

Complies?	Yes

Appendix 3

Diagram 1a:

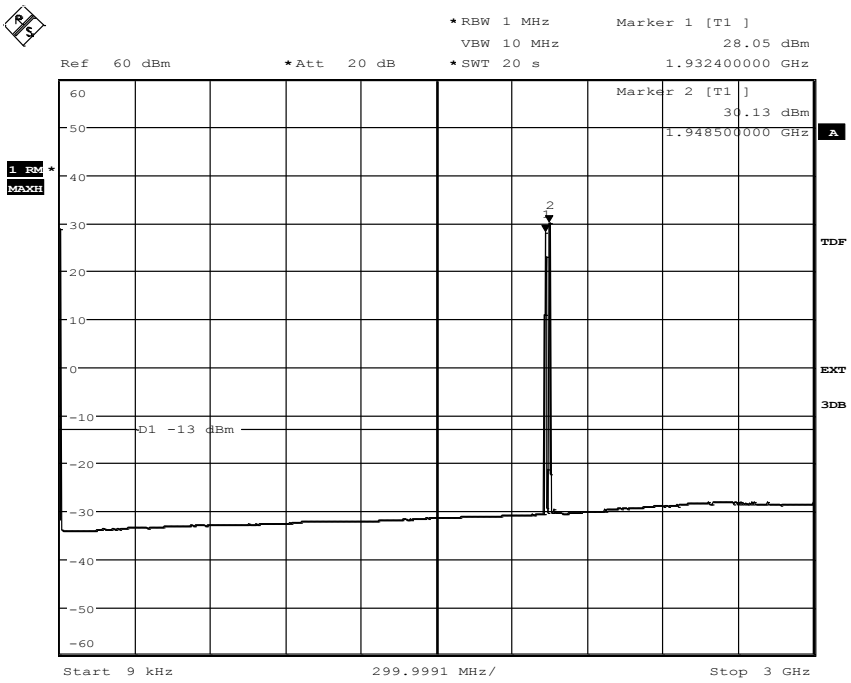


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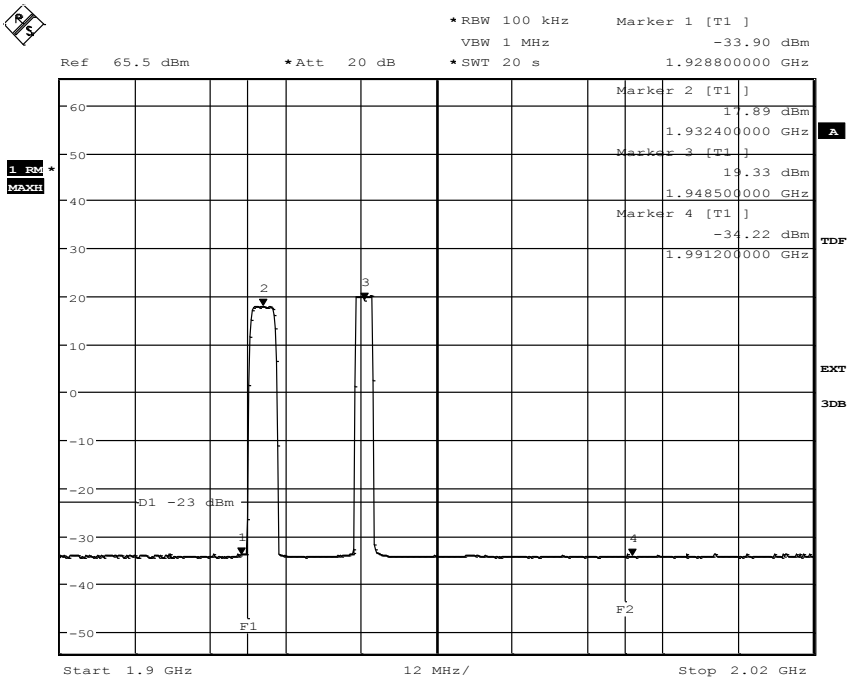
Diagram 1b:



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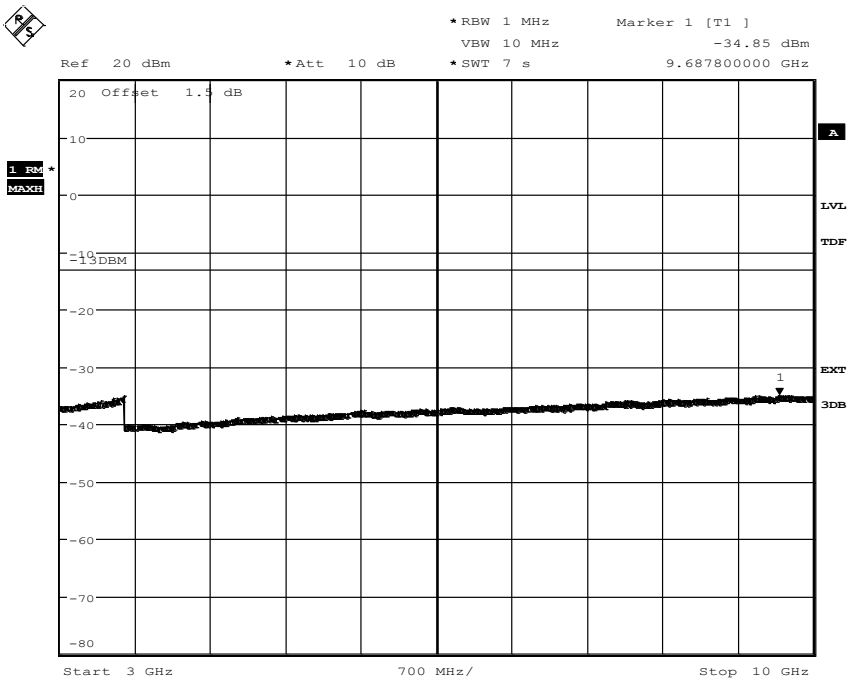
Appendix 3

Diagram 1c:



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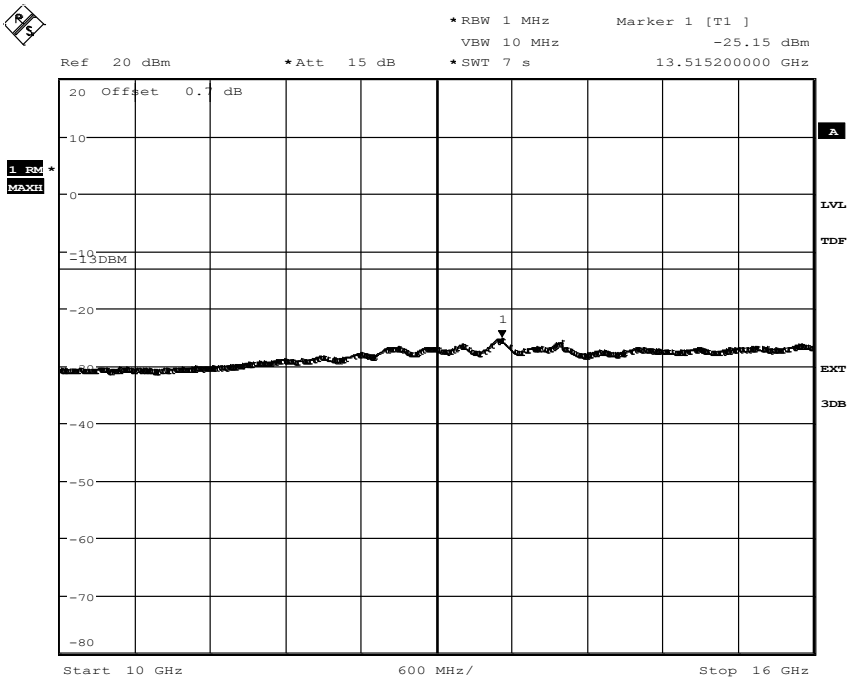

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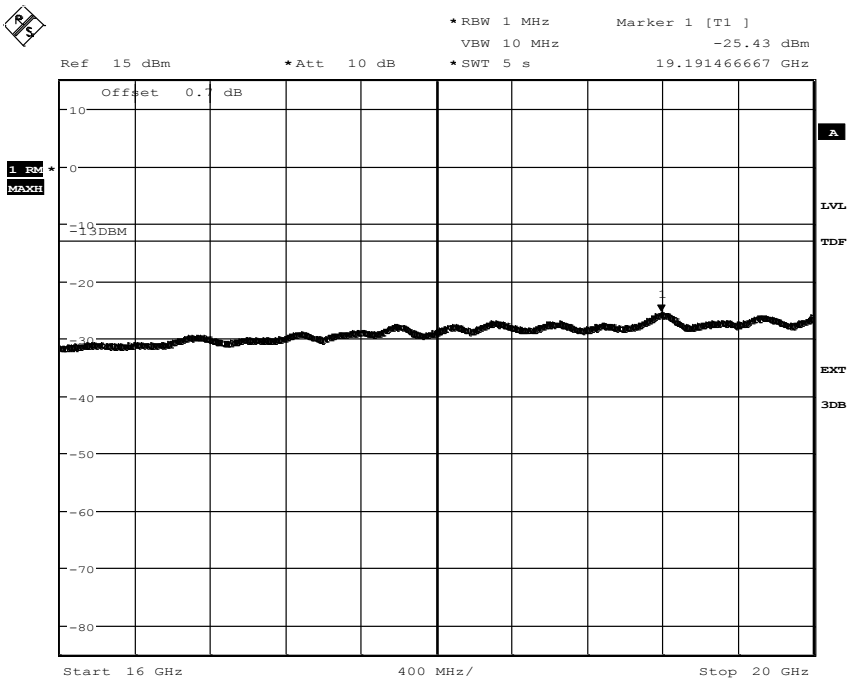
Appendix 3

Diagram 1e:



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Appendix 3

Diagram 2a:

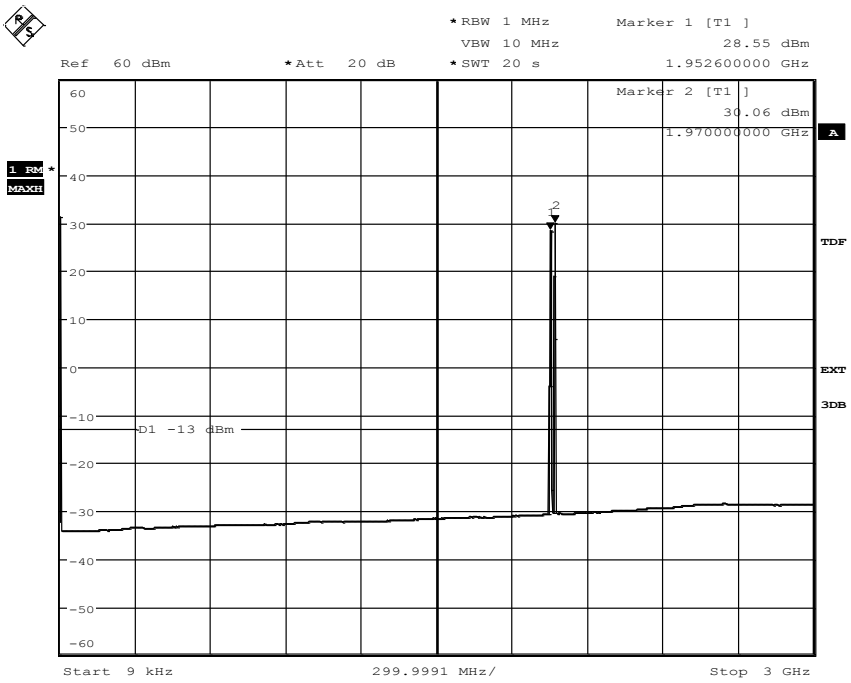

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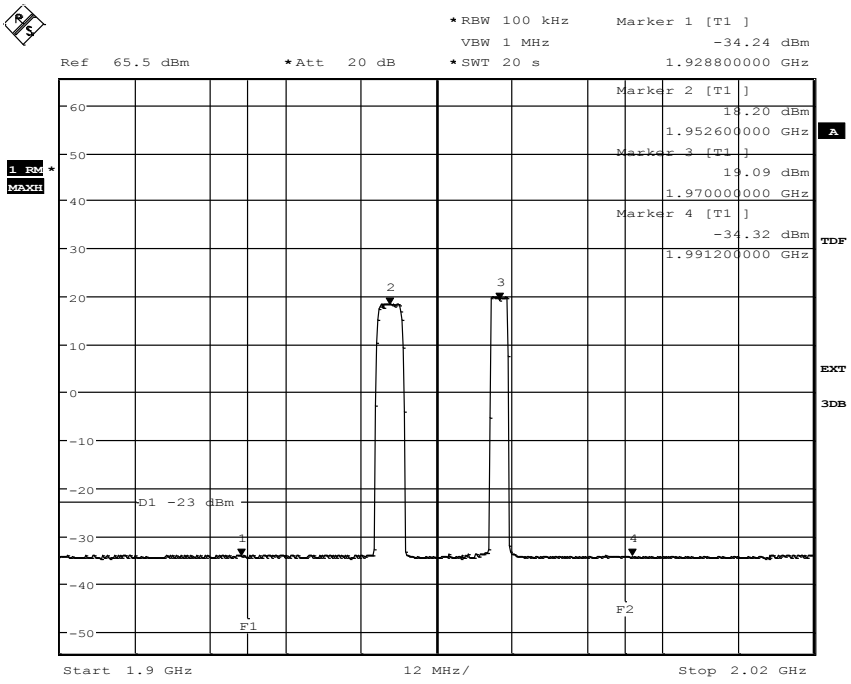
Diagram 2b:



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Appendix 3

Diagram 2c:

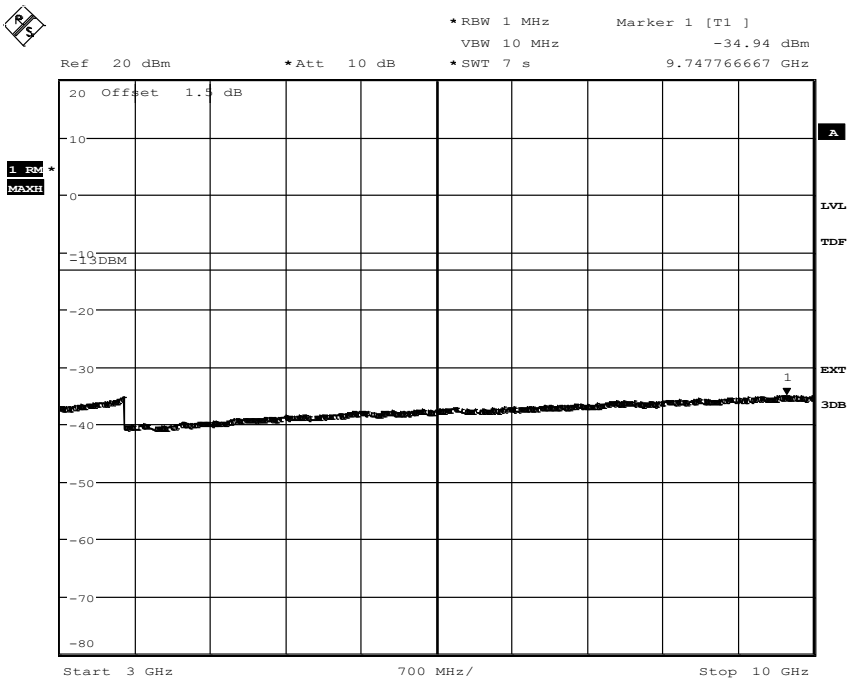

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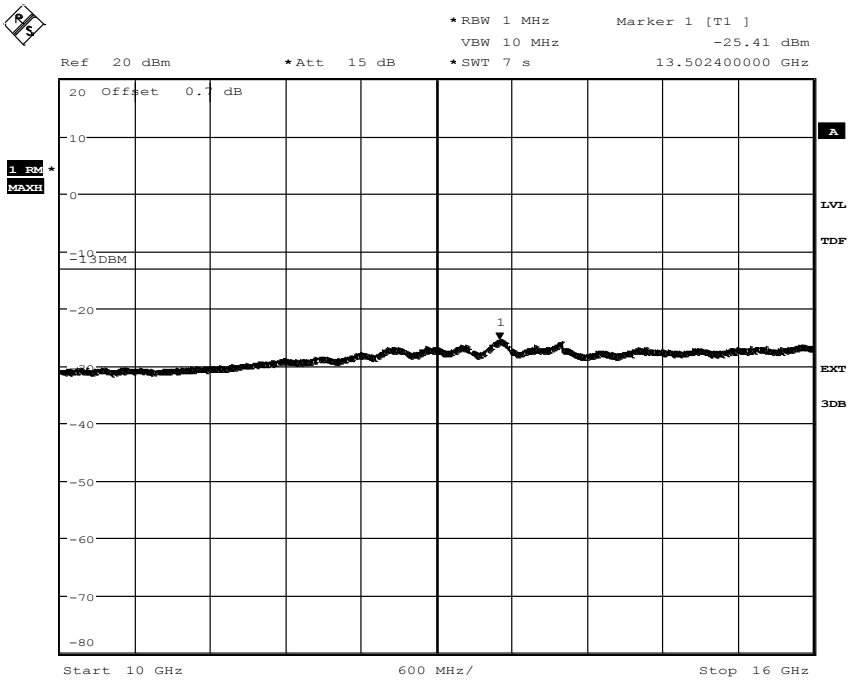
Diagram 2d:



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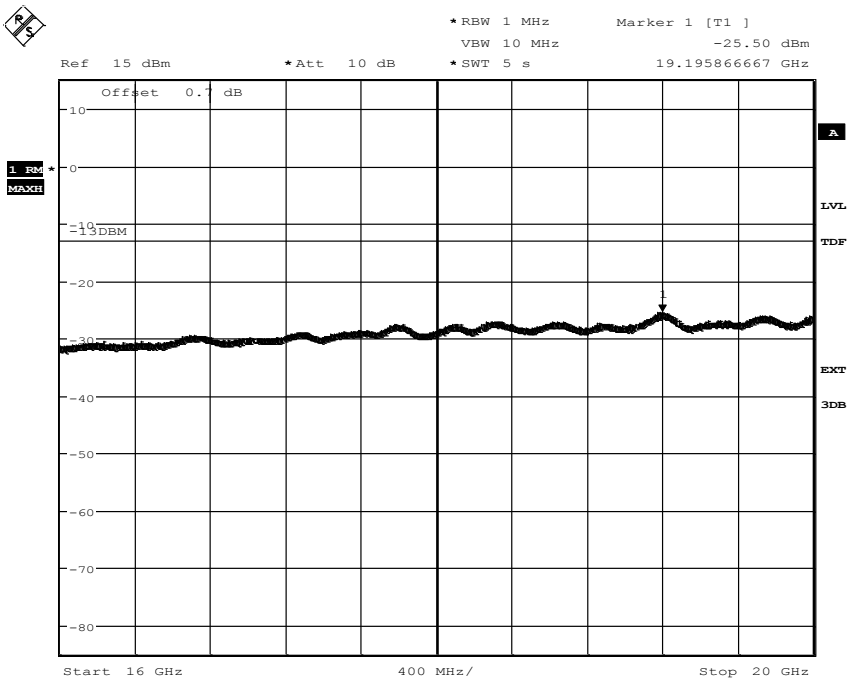
Appendix 3

Diagram 2e:



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Appendix 3

Diagram 3a:

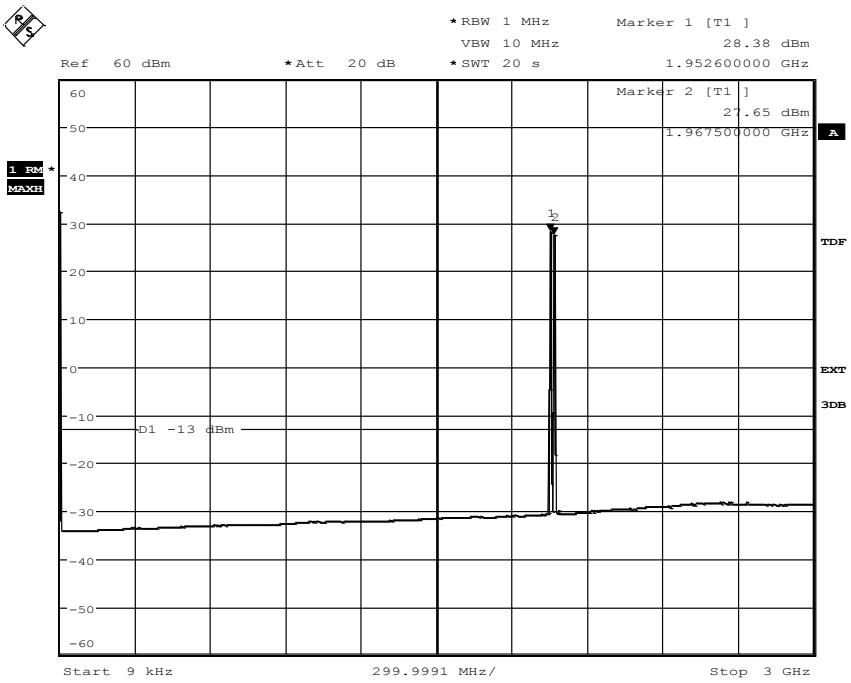

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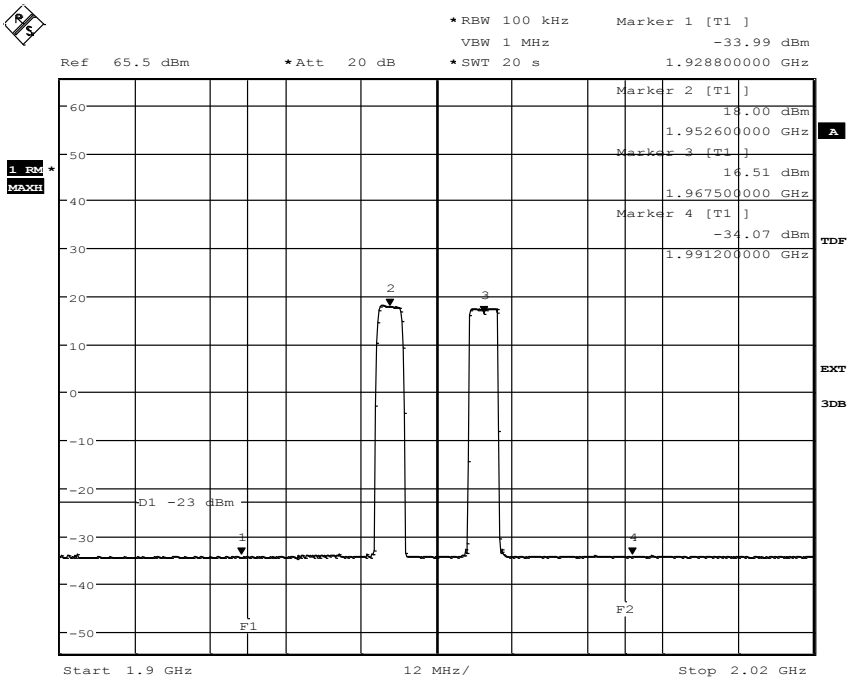
Diagram 3b:



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Appendix 3

Diagram 3c:

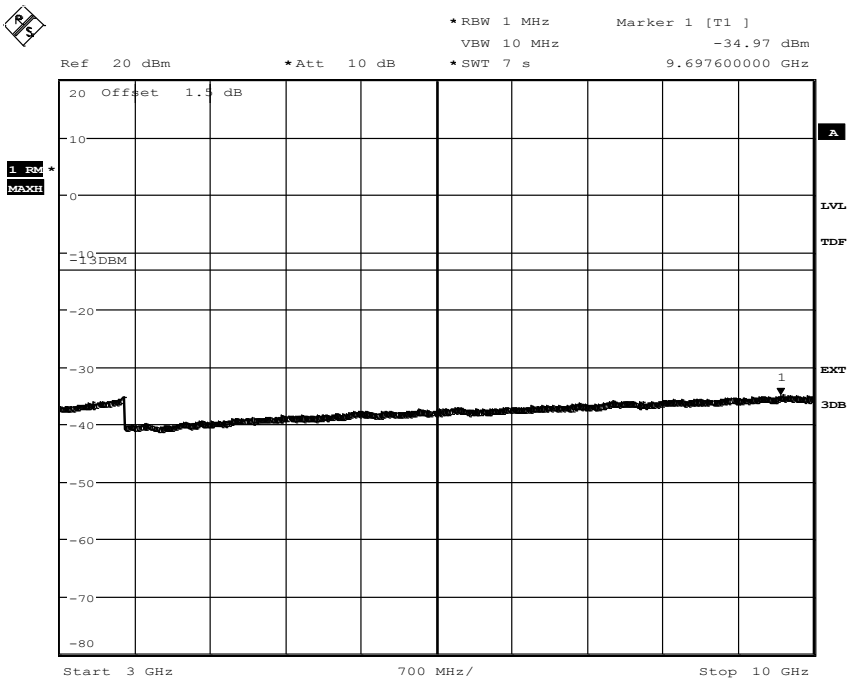

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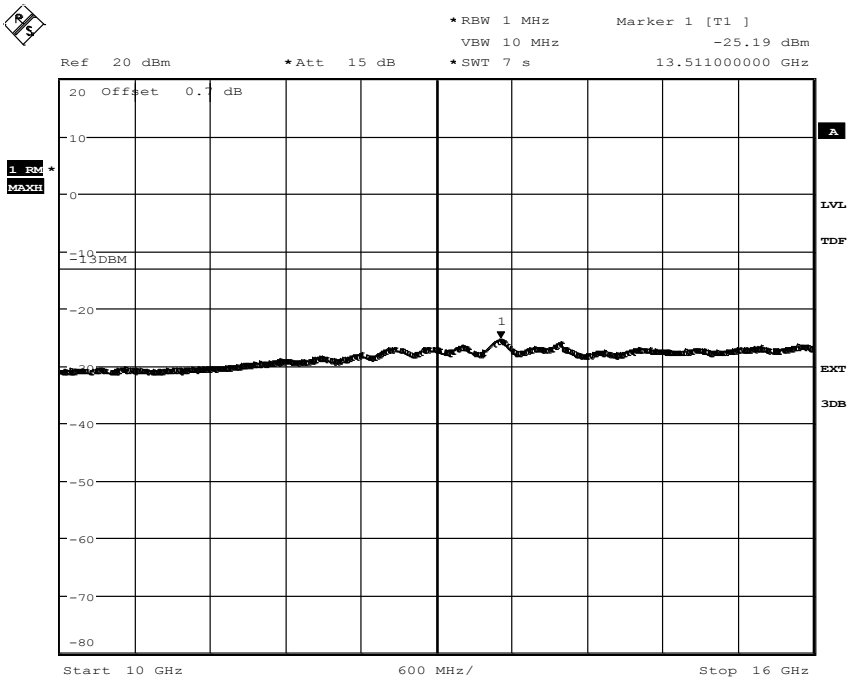
Diagram 3d:



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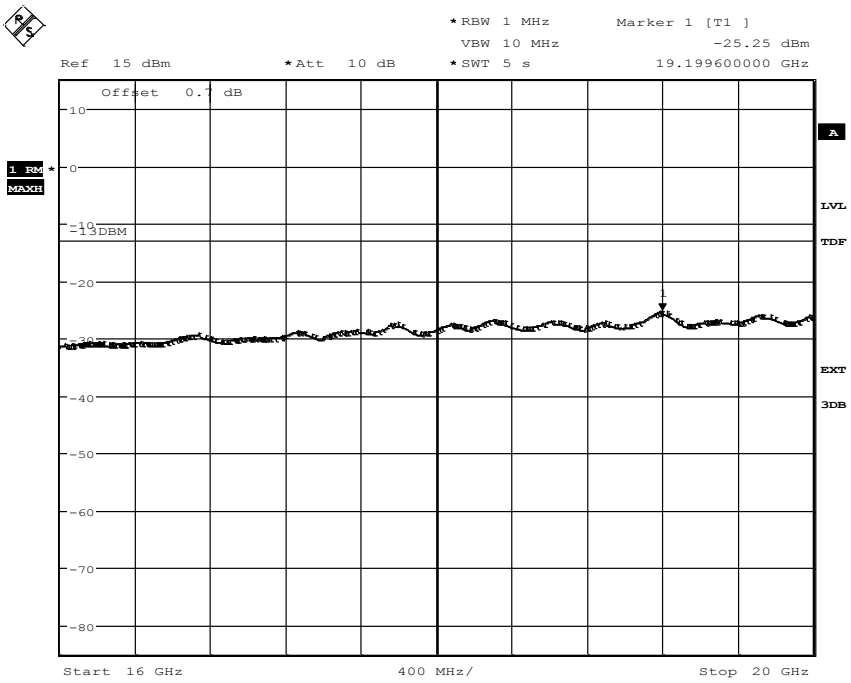
Appendix 3

Diagram 3e:



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Appendix 3

Diagram 4a:

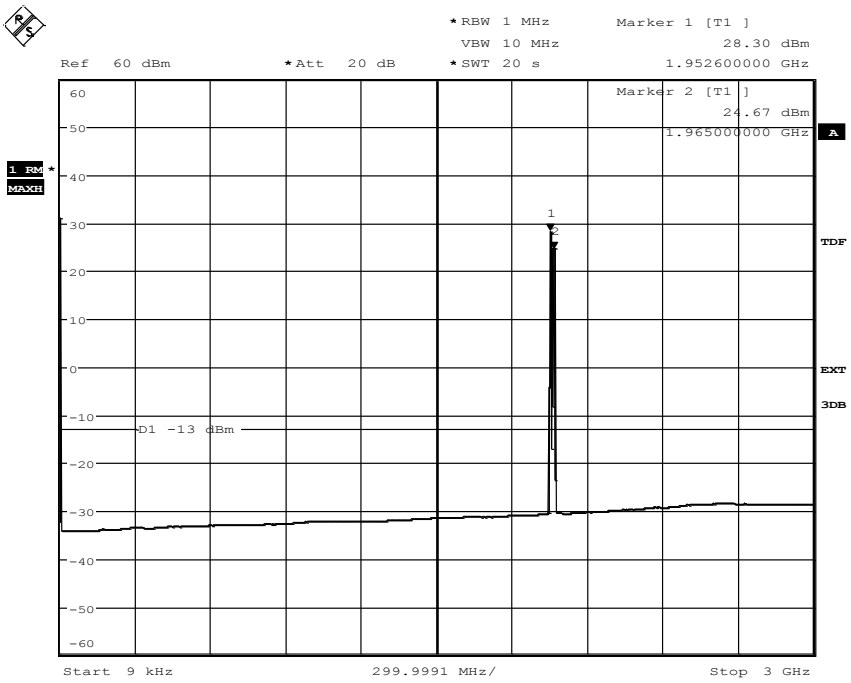

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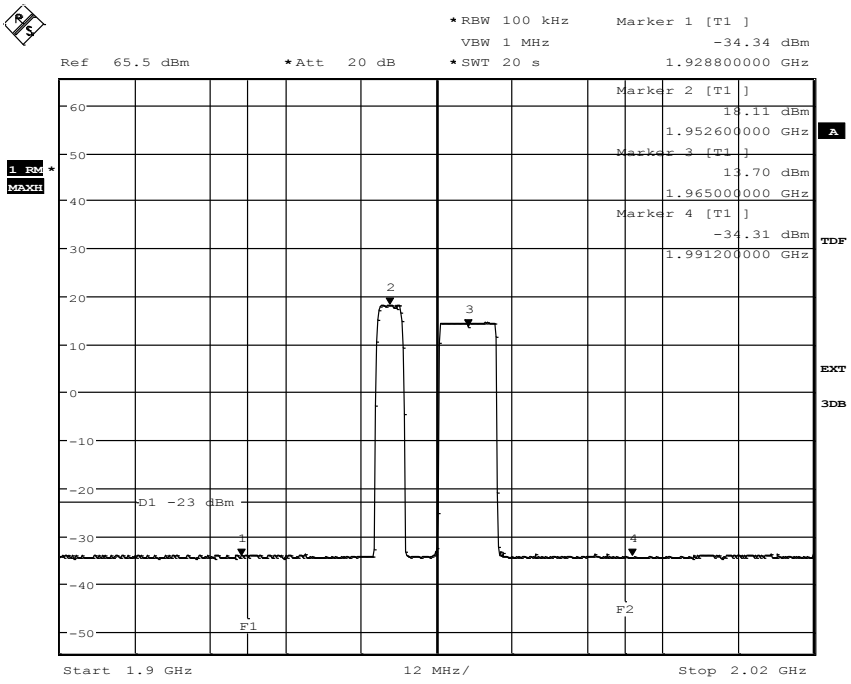
Diagram 4b:



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Appendix 3

Appendix 3

Diagram 4c:

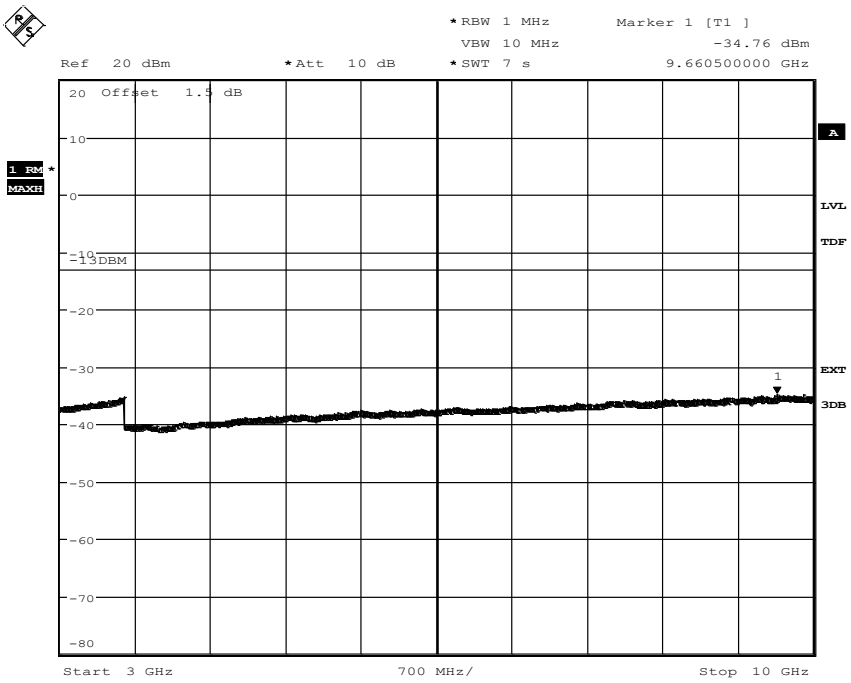

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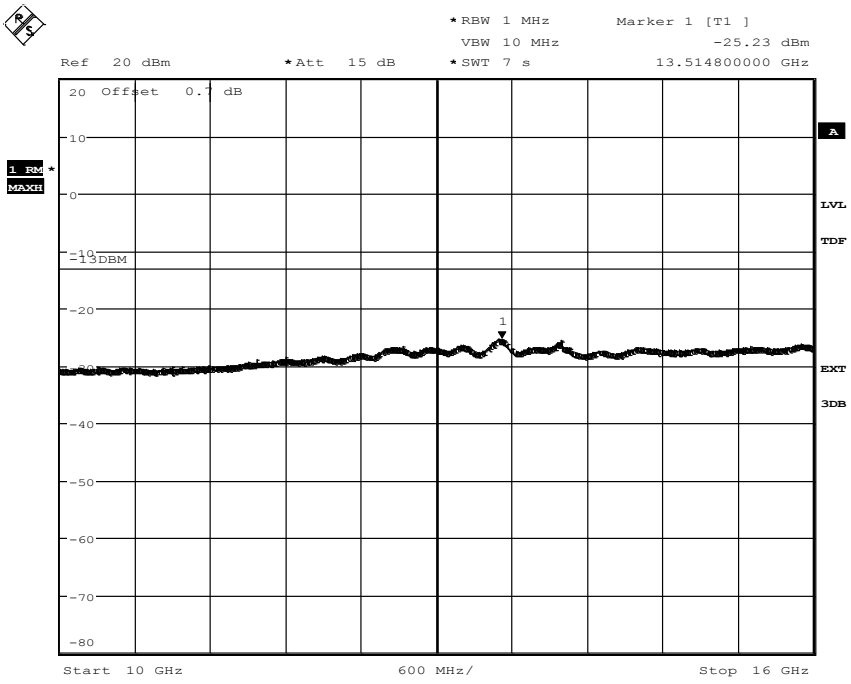
Diagram 4d:



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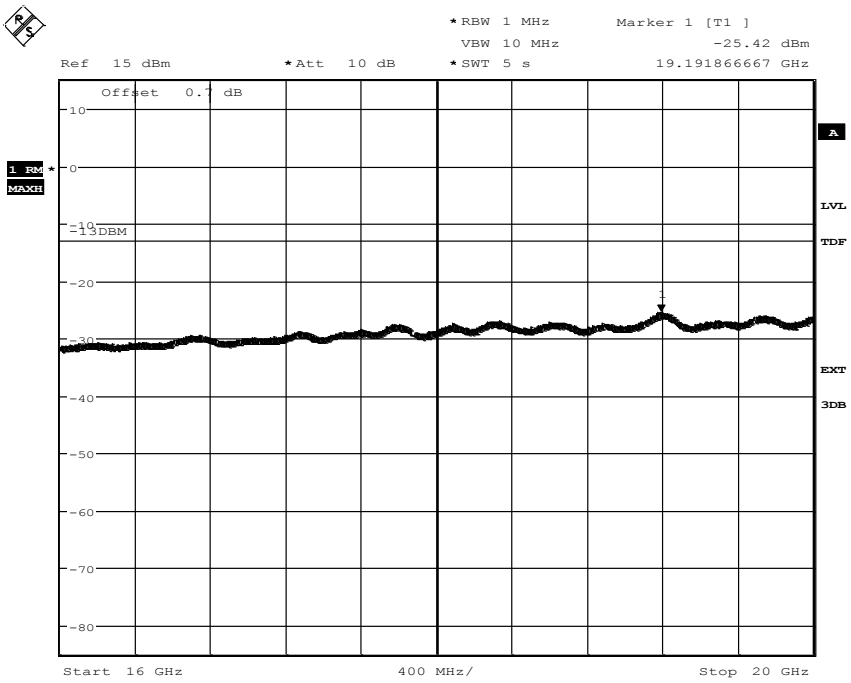
Appendix 3

Diagram 4e:



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Appendix 3

Diagram 5a:

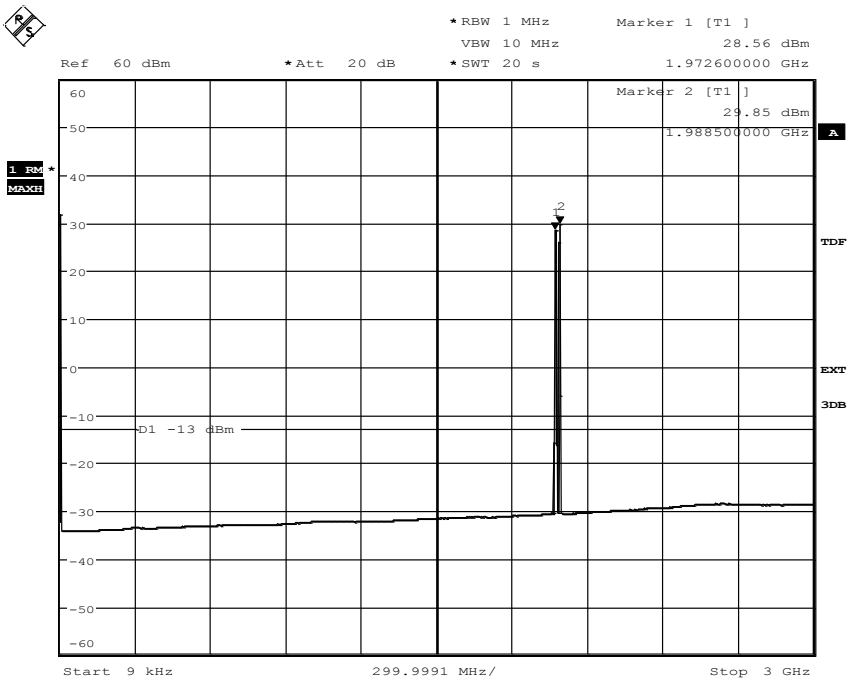

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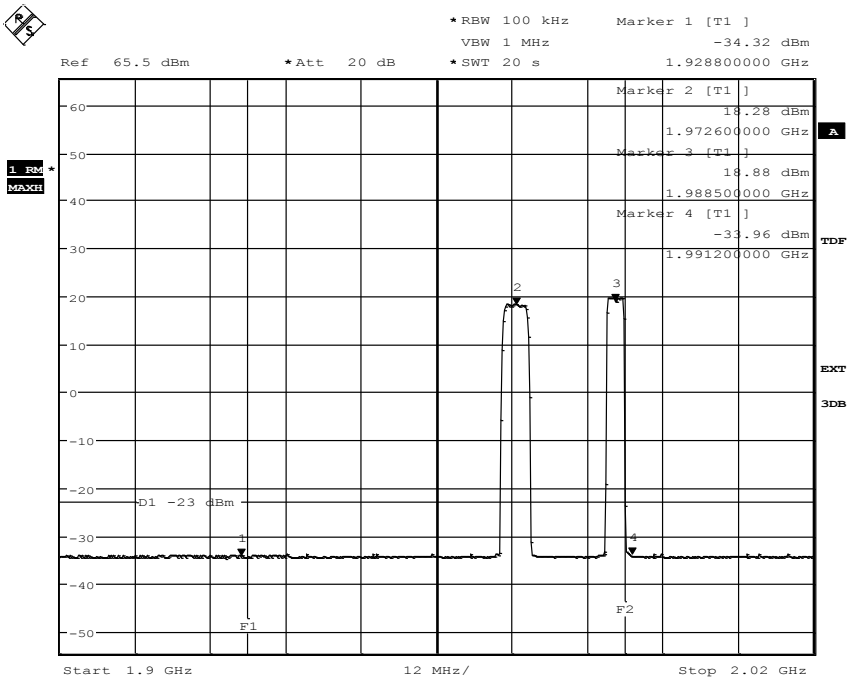
Diagram 5b:



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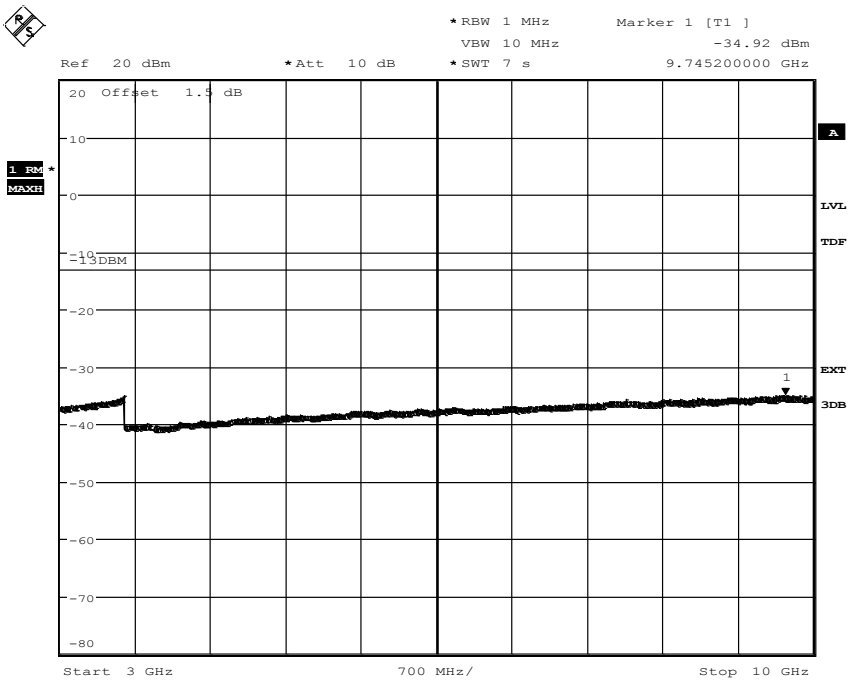
Appendix 3

Diagram 5c:



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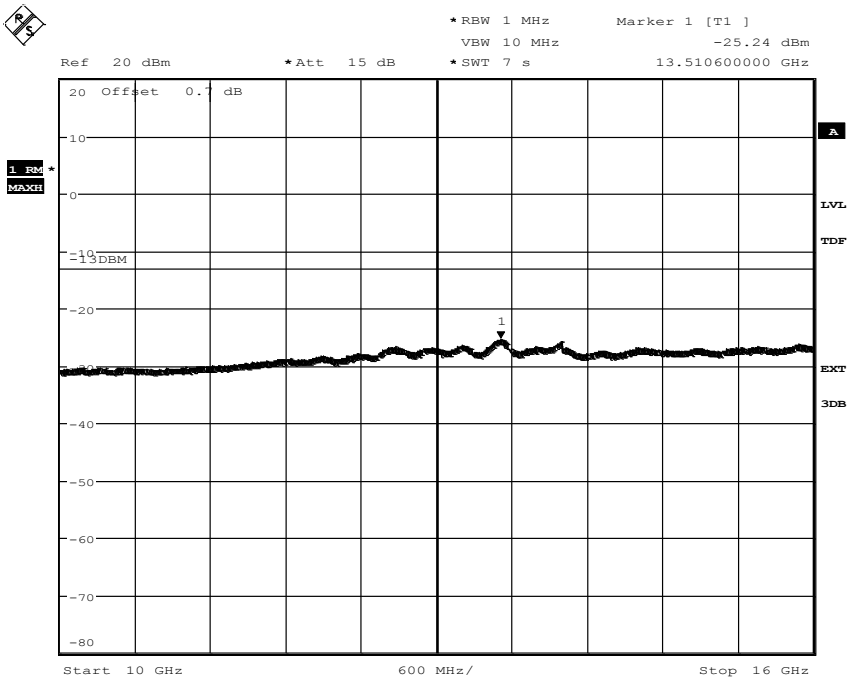

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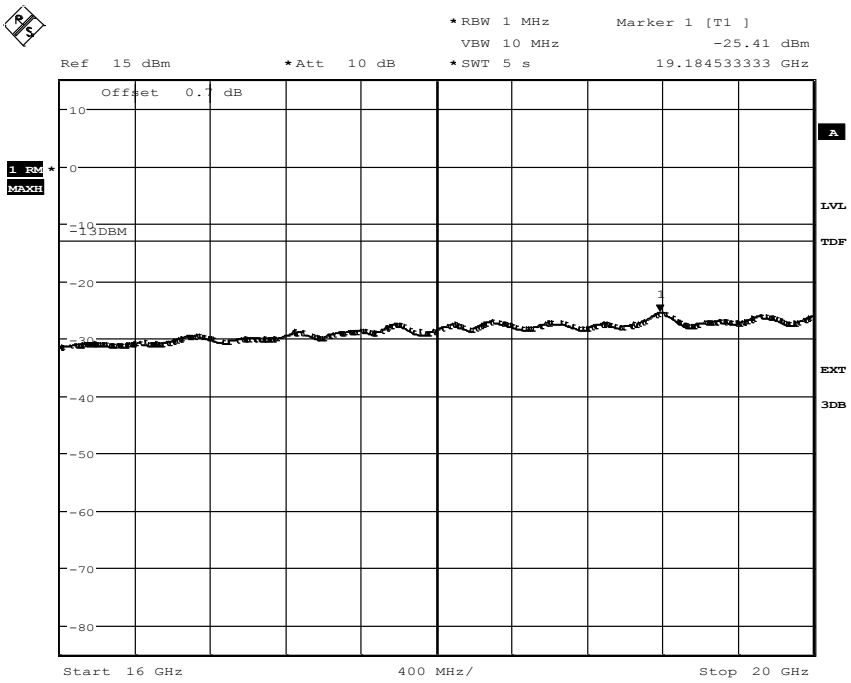
Appendix 3

Diagram 5e:



Date: 7.NOV.2013 15:19:36

Appendix 4

Field strength of spurious radiation measurements according to 47 CFR 2.1053 / IC RSS-133 6.5

Date	Temperature	Humidity
2013-10-26	23 °C ± 3°C	40 % ± 5 %
2013-10-27	23 °C ± 3°C	44 % ± 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 – 20 GHz.

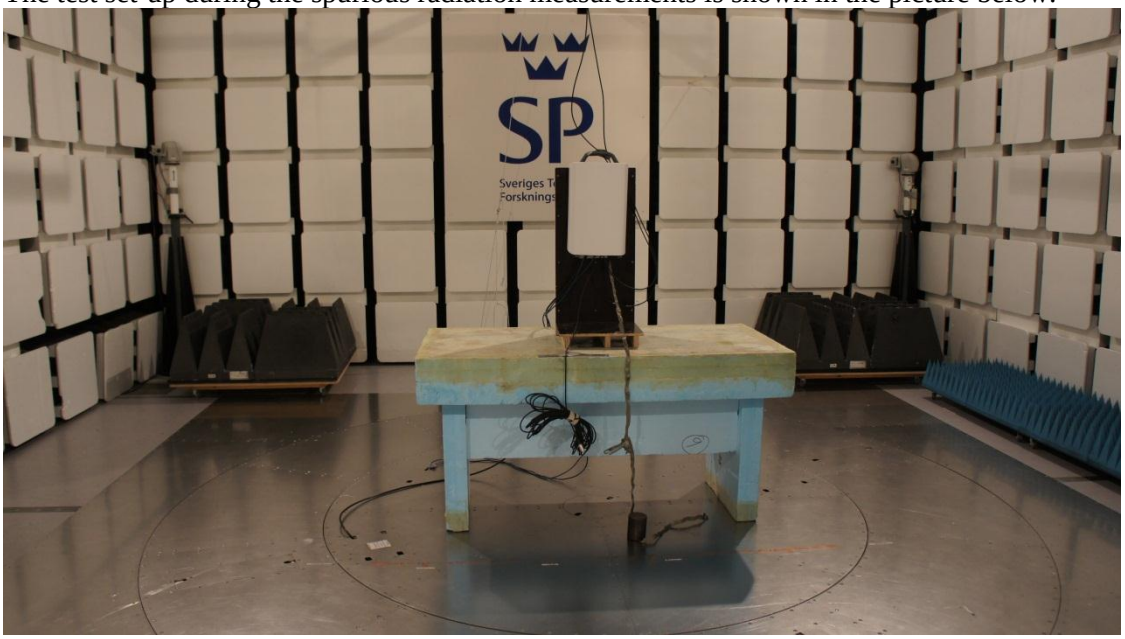
In the frequency range 30 MHz – 20 GHz the measurement was performed in power with a RBW of 1 MHz. A propagation loss in free space was calculated. The used formula was $\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

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.

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 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
Flann STD Gain Horn Antenna 20240-20	503 674
Miteq, Low Noise Amplifier	503 285
µComp Nordic, Low Noise Amplifier	901 545
Testo 635 temperature and humidity meter	504 188

Tested configurations

1
2
3
4
5

Results, representing worst case

Diagram	BW configuration[MHz]	Configuration
1 a-c	5 MHz	3

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-20 000	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

CFR 47 §24.238 and IC 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 1a:

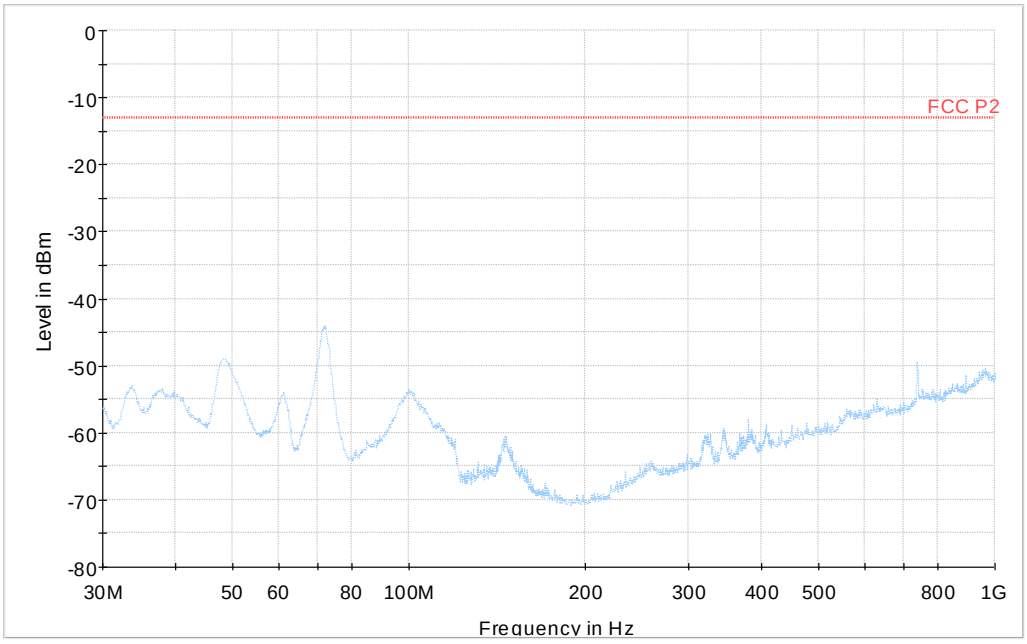
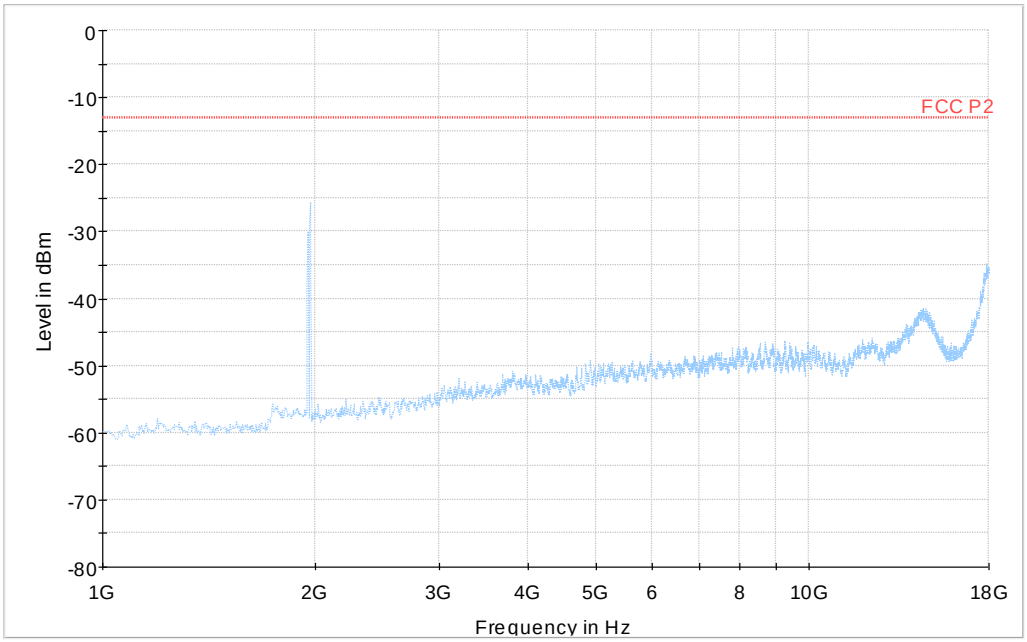


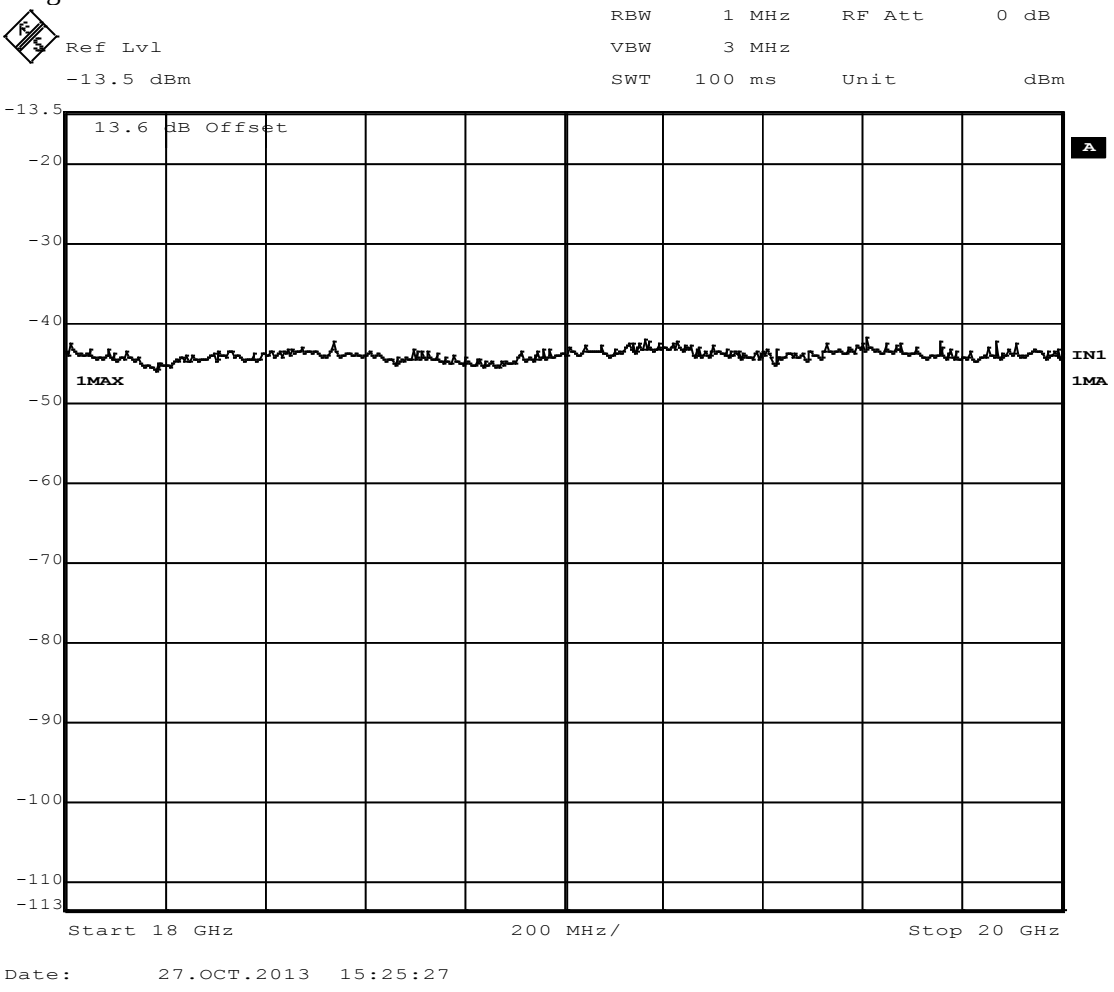
Diagram 1b:



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

Appendix 4

Diagram 1c:



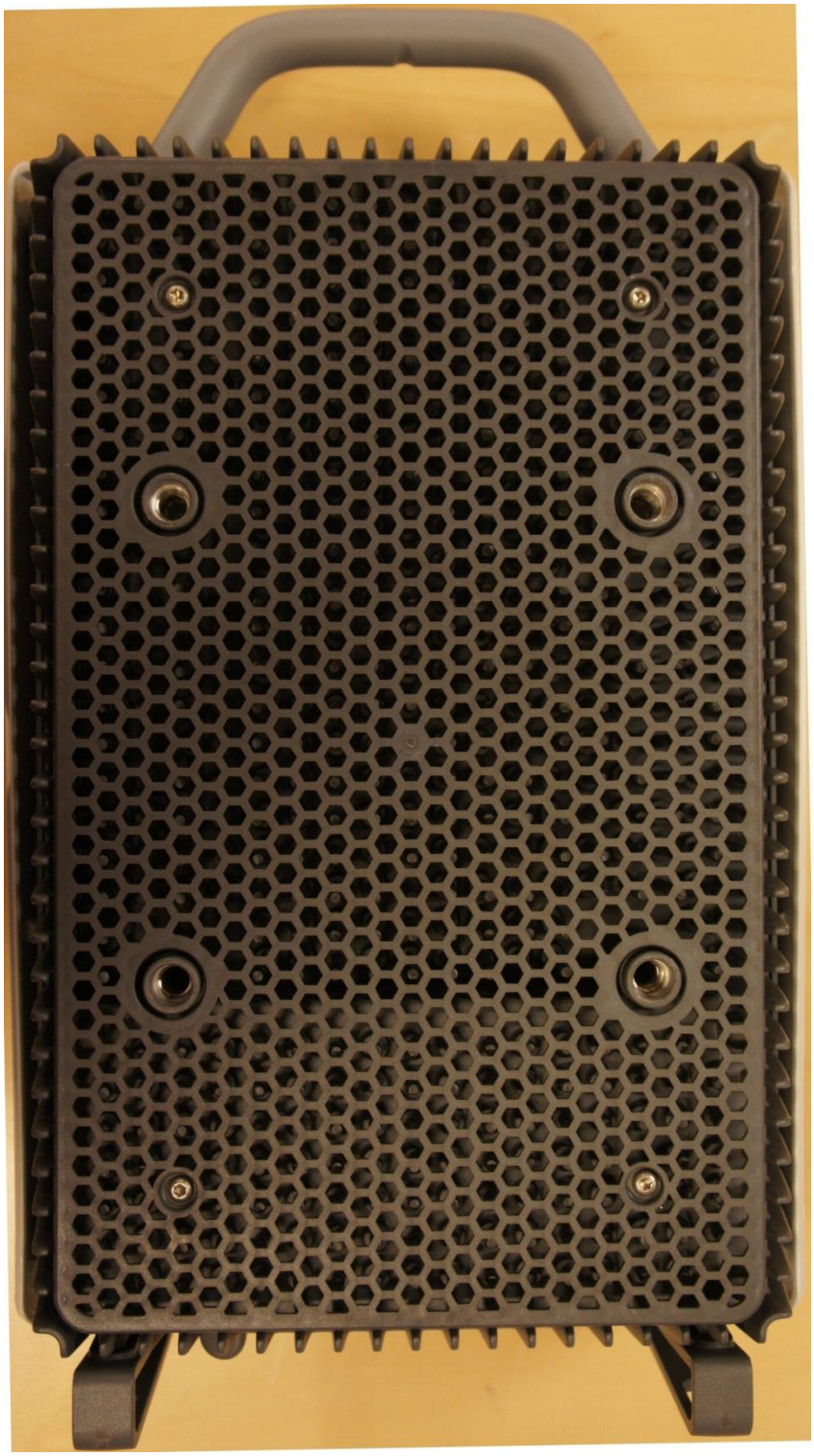
Appendix 5

External photos

Front side

Appendix 5

Rear side



Appendix 5

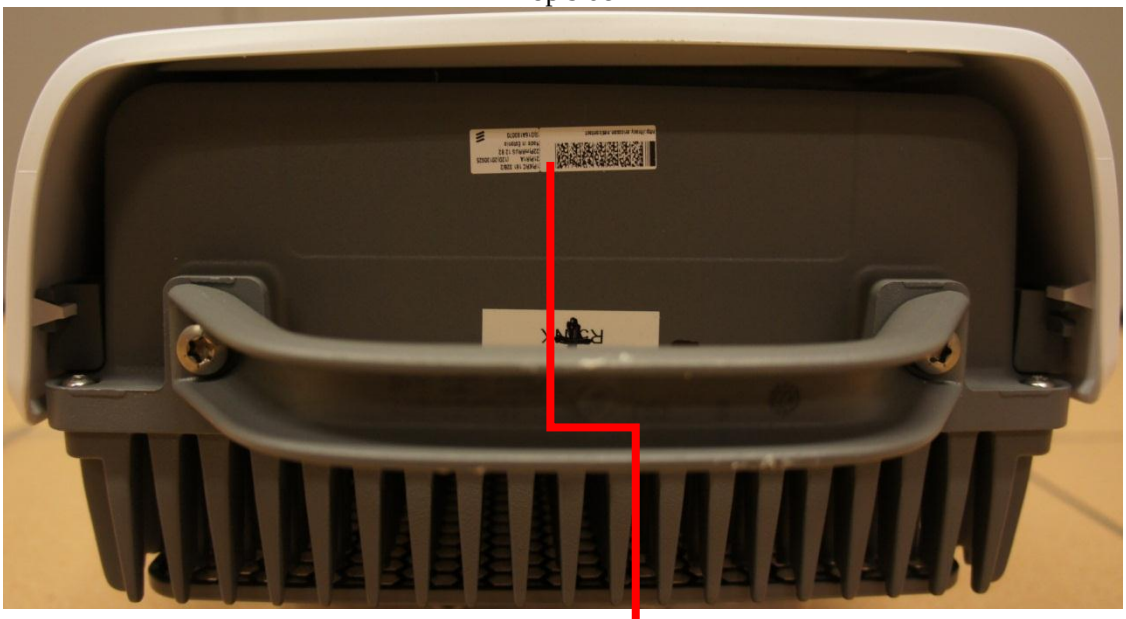
Left side

Right side

Appendix 5

Bottom side

Top side



Product label