REPORT

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

ISO/IEC 17025 1002

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Date	Reference	Page
2013-12-16	3P08326-01-F27	1 (2)

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Radio measurements on RRUS 12 B4 1700/2100 MHz radio equipment with FCC ID: TA8BKRC161349-2 and IC: 287AB-BS1613492

(8 appendices)

Test object

Product name: RRUS 12 B4
Product number: KRC 161 349/2, R1C

Summary

See appendix 1 for general information and appendix 8 for external photos.

Standard		Compliant	Appendix
FCC CFR 47 / IC RSS-139 ISSUE 2			
2.1046 / RSS-139 6.4	RF power output conducted	Yes	2
2.1049 / RSS-Gen 4.6.1	Occupied bandwidth	Yes	3
2.1051 / RSS-139 6.5	Band edge	Yes	4
2.1051 / RSS-139 6.5	Spurious emission at antenna terminals	Yes	5
2.1053 / RSS-139 6.5	Field strength of spurious radiation	Yes	6
2.1055 / RSS-139 6.3	Frequency stability	Yes	7

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

Tomas Lennhager

Examined by

Anders Nordlöf

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Appendix 1

Description of the test object

Equipment:	Product name: RRUS 12 B4 Product number: KRC 161 349/2,R1C FCC ID TA8BKRC161349-2 IC 287AB-BS1613492 IC MODEL NO: BS1613492
Tested configuration:	LTE single RAT
Frequency bands:	TX: 2110 – 2155 MHz RX: 1710 – 1755 MHz
Antenna ports:	2 TX/RX ports
RF configuration:	Single carrier, multi carrier and MIMO mode 2x2
Nominal output power per antenna port:	Single carrier: 1x 47.8 dBm (1 x 60W) Multi carrier: 2x 44.8 dBm (2 x 30W) 3x 43.0 dBm (3 x 20W) 4x 41.8 dBm (4 x 15W)
Antenna:	No dedicated antenna, handled during licensing
Channel bandwidths:	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz
Modulations:	QPSK, 16QAM and 64QAM
Nominal supply voltage:	-48VDC

Operation mode during measurements

Measurements were performed with the test object transmitting test models as defined in 3GPP TS 36.141. Test model E-TM1.1 represent QPSK modulation, test model E-TM3.2 represent 16QAM modulation and test model E-TM3.1 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. All measurements were performed with the test object configured for maximum transmit power. The settings below were used for all measurements if not otherwise noted.

MIMO mode, single carrier: E-TM1.1
MIMO mode, multi carrier: 2 carriers E-TM1.1

Conducted measurements

The test object was supplied with -48 VDC by an external power supply. Additional connections are documented in the setup drawings below. Complete measurements were made on RF A with additional measurements on RF B to verify that the ports are identical.

Radiated measurements

Test object was powered with -48 VDC. Additional connections are documented in the setup drawings below.

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 IC RSS-139 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
3GPP TS 36.141, version 11.4.0
CFR 47 part 2, October 1st , 2012
CFR 47 part 27, October 1st, 2012
RSS-Gen Issue 3
RSS-139 Issue 2

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 2013-11-13.

Manufacturer’s representative

Mihai Simon, Ericsson AB.

Test engineers

Tomas Isbring, Kexin Chen, Jörgen Wassholm, Tomas Lennhager and Rolf Kühn, SP.

Test participant

Mihai Simon, Ericsson AB.

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 FSQ 40	2014-03	504 143
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	2014-09	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	2014-07	902 282
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	2014-14	504 085
Temperature and humidity meter, Testo 635	2014-06	504 203
Temperature and humidity meter, Testo 625	2014-06	504 188
Temperature Chamber	2013-11	501 031
Multimeter Fluke 87	2014-08	502 190

Test frequencies used for conducted and radiated measurements

Single RAT TX test frequencies

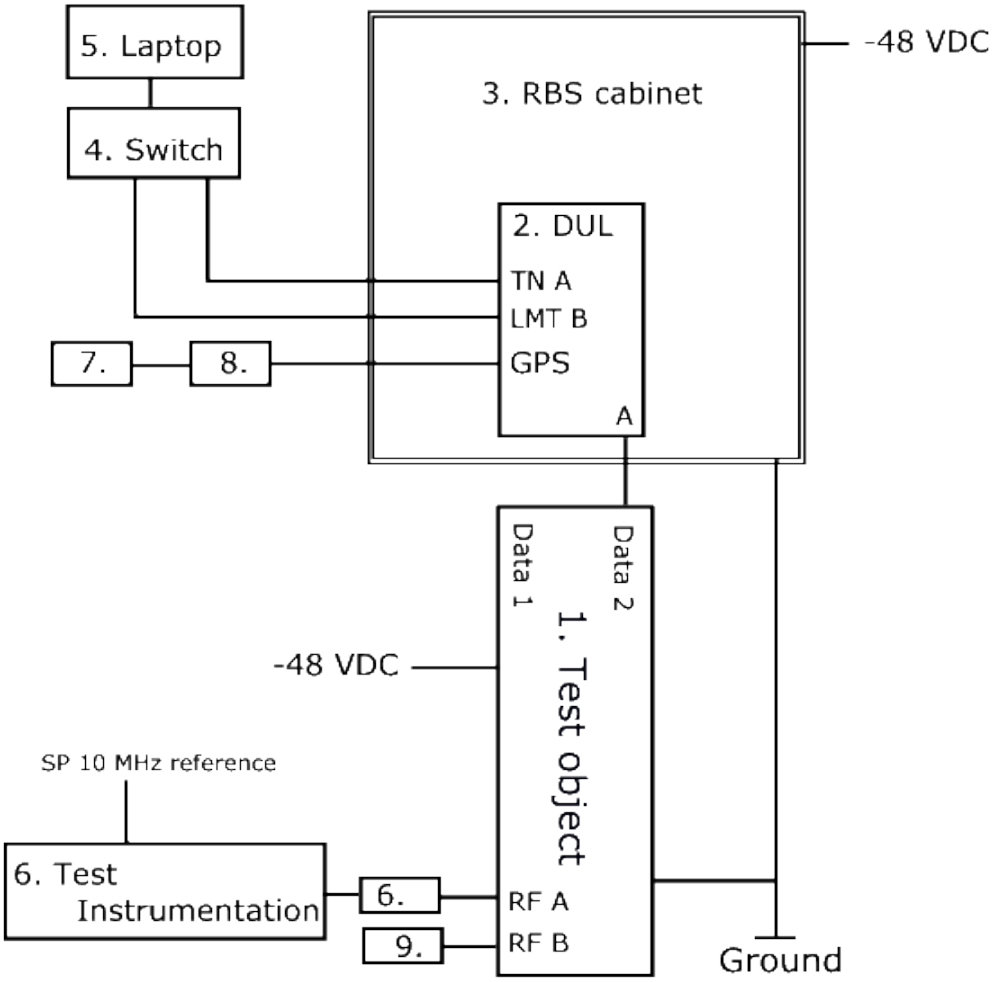
EARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
1957	2110.7	B	TX bottom frequency in 1.4 MHz BW configuration
1957 1971	2110.7 2112.1	B2-1.4	2 carrier TX band bottom constellation 1.4 MHz BW configuration
1965 1995	2111.5 2114.5	B2-3	2 carrier TX band bottom constellation 3 MHz BW configuration
1965 1990 2015 2040	2111.5 2114.0 2116.5 2119.0	B4-3	4 carrier TX band top constellation 3 MHz BW configuration
1965	2111.5	B	TX bottom frequency in 3 MHz BW configuration
1975	2112.5	B	TX bottom frequency in 5 MHz BW configuration
2000	2115.0	B	TX bottom frequency in 10 MHz BW configuration
2025	2117.5	B	TX bottom frequency in 15 MHz BW configuration
2050	2120.0	B	TX bottom frequency in 20 MHz BW configuration
2175	2132.5	M	TX band mid frequency all BW configurations
2168 2182	2131.8 2133.2	M2	2 carrier TX band mid constellation 1.4 MHz BW configuration
2154 2168 2182 2196	2130.4 2131.8 2133.2 2134.6	M4-1.4	4 carrier TX band mid constellation 1.4 MHz BW configuration
2150 2175 2200 2225	2130.0 2132.5 2135.0 2137.5	M4-3	4 carrier TX band top constellation 3 MHz BW configuration
2393	2154.3	T	TX top frequency in 1.4 MHz BW configuration
2385	2153.5	T	TX top frequency in 3 MHz BW configuration
2375	2152.5	T	TX top frequency in 5 MHz BW configuration
2350	2150.0	T	TX top frequency in 10 MHz BW configuration
2325	2147.5	T	TX top frequency in 15 MHz BW configuration
2300	2145.0	T	TX top frequency in 20 MHz BW configuration
2379 2393	2152.9 2154.3	T2-1.4	2 carrier TX band top constellation 1.4 MHz BW configuration
2385 2355	2153.5 2150.5	T2-3	2 carrier TX band top constellation 3 MHz BW configuration
2385 2360 2335 2310	2153.5 2151.0 2148.5 2146.0	T4-3	4 carrier TX band top constellation 3 MHz BW configuration
1980 2022	2113.0 2117.2	B2im1	2 carrier TX band 1.4 MHz BW configuration
2328 2370	2147.8 2152.0	T2im1	2 carrier TX band 1.4 MHz BW configuration
2100 2262	2125.0 2141.2	B2im2	2 carrier TX band 1.4 MHz BW configuration

Appendix 1

EARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
2088 2250	2123.8 2140.0	T2im2	2 carrier TX 1.4 MHz BW configuration
1980 2022 2100 2262	2113.0 2117.2 2125.0 2141.2	B4im	4 carrier TX 1.4 MHz BW configuration
2328 2370 2088 2250	2147.8 2152.0 2123.8 2140.0	T4im	4 carrier TX 1.4 MHz BW configuration

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

Test setup conducted measurements



Test object:

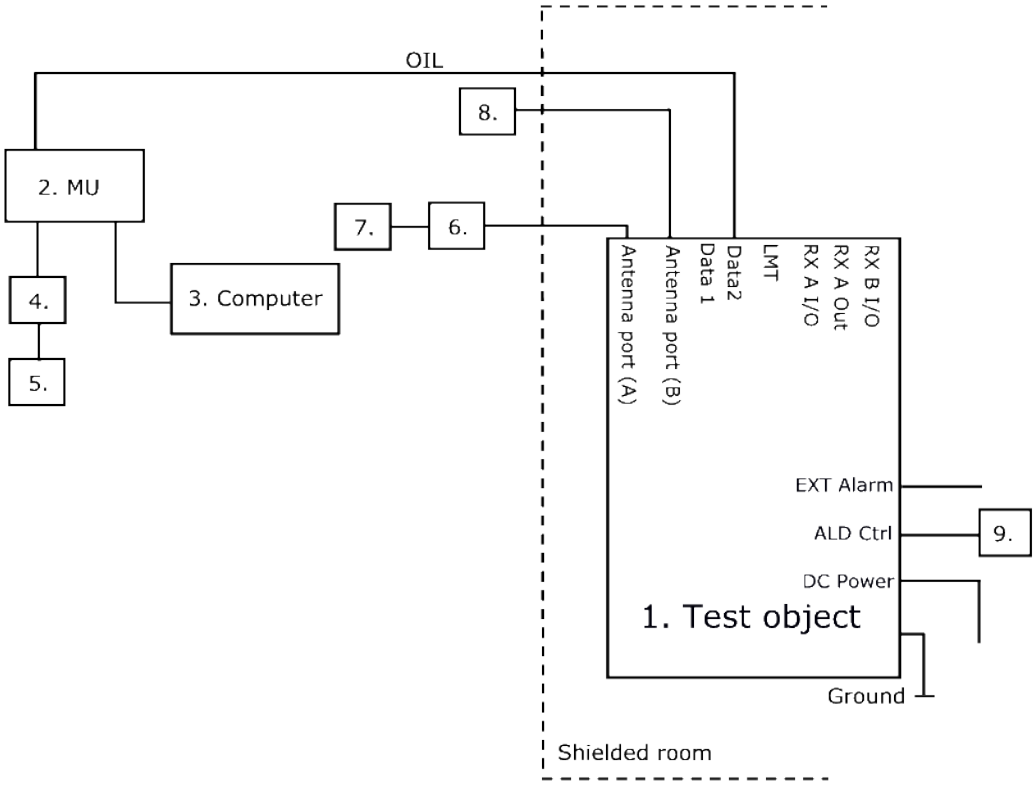
1.	RRUS 12 B4, KRC 161 349/2, revision R1C, s/n: C827491665 Software CXP 901 7316/2, revision R51NS FCC ID TA8BKRC161349-2 and IC 287AB-BS1613492

Functional test equipment

2.	DUL 20 01, KDU 137 533/4, revison R1C, s/n: C824279715
3.	RBS 6201 cabinet, BAMS 1000778792. PDU 02 01, BMG 980 336/4, revision R2A, s/n: BJ31528316
4	Fast Ethernet switch, Netgear GSM7224, BAMS – 1000517289
5.	Controlling computer SUN ULTRA 27, BAMS 1000758436
6.	SP Test Instrumentation according to measurement equipment list
7.	GPS Active Antenna, KRE 101 2082/1
8.	GPS 02 01, NCD 901 41/1, revision R1D, s/n: TU8K475230
9.	Terminator, 50 ohm

Appendix 1

Test setup radiated measurements



Test object:

1.	RRUS 12 B4, KRC 161 349/2, revision R1C, s/n: C827491666 Software CXP 901 7316/2 revision R51NS FCC ID TA8BKRC161349-2 and IC 287AB-BS1613492

Functional test equipment:

2.	Main Unit SUP 6601, 1/BFL 901 009/4, revision R1E, s/n: BR88237597 DUL 20 01, KDU 137 533/4, revision R1C, s/n: C824321475
3.	Computer Computer, I-ultra27-06 standalone, BAMS – 1000758439 Switch Netgear GSM7212, BAMS – 1000517298
4.	GPS 02 01, NCD 901 41/1, revision R1D, s/n: TU8K367383
5.	GPS Active Antenna, KRE 101 2082/1
6.	Attenuator
7.	R&S ESI 26, for supervision purposes only
8.	Terminator
9.	RET – Remote Electrical Tilt unit, KRY 121 67/2, revision R1N

Appendix 1

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

RBS software:

Software	**Revision**
CXP 102051/19	R31U

Appendix 2

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

Date	Temperature	Humidity
2013-11-21	19 °C ± 3 °C	26 % ± 5 %
2013-11-22	22 °C ± 3 °C	23 % ± 5 %
2013-11-27	21 °C ± 3 °C	33 % ± 5 %
2013-11-28	21 °C ± 3 °C	21 % ± 5 %
2013-11-29	21 °C ± 3 °C	20 % ± 5 %
2013-12-02	23 °C ± 3 °C	22 % ± 5 %
2013-12-03	19 °C ± 3 °C	33 % ± 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	902 282
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

Single carrier, MIMO

Rated output power level at RF connector 1x 47.8 dBm.

Carrier BW [MHz]	Symbolic name	[RMS dBm/ PAR dB]		
		Port RF A	Port RF B	Total power[1)]
1.4	B	47.35/ 6.90	47.03/ 6.92	50.20
20	B	47.59/ 6.78	47.67/ 6.80	50.64
1.4	M	47.67/ 6.90	47.64/ 6.92	50.67
3.0	M	47.64/ 6.80	44.70/ 6.83	49.42
5.0	M	47.73/ 6.78	47.71/ 6.80	50.73
10.0	M	47.78/ 6.75	47.73/ 6.75	50.77
15.0	M	47.66/ 6.75	47.71/ 6.75	50.69
20.0	M	47.70/ 6.73	47.74/ 6.73	50.73
1.4	T	47.20/ 6.90	47.11/ 6.92	50.17
20	T	47.59/ 6.85	47.68/ 6.83	50.64

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

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

MIMO mode, multicarrier

Rated output power level at RF connector 2x 44.8 dBm.

Carrier BW [MHz]	Symbolic name	[RMS dBm/ PAR dB]		
		Port RF A	Port RF B	Total power[1)]
1.4	B2-1.4	47.30/ 7.02	47.08/ 7.04	50.20
1.4	M2	47.57/ 7.00	47.53/ 7.02	50.56
1.4	T2-1.4	47.15/ 7.02	47.16/ 7.04	50.16

[1)]: Summed output power according to FCC KDB662911 D01 Multiple transmitter output v02r01.

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

Rated output power level at RF connector 4x 41.8 dBm(1 dB power back-off at BW 1.4 MHz).

Carrier BW [MHz]	Symbolic name	[RMS dBm/ PAR dB]		
		Port RF A	Port RF B	Total power[1)]
1.4	B4-im	46.60/ 7.72	46.46/ 7.74	49.54
3.0	B4-3	47.62/ 6.80	47.48/ 6.80	50.56
1.4	M4-1.4	46.58/ 7.07	46.51/ 7.26	49.56
3.0	M4-3	47.77/ 6.75	47.73/ 6.78	50.76
1.4	T4-im	46.69/ 7.72	46.57/ 7.76	49.64
3.0	T4-3	47.57/ 6.80	47.57/ 6.83	50.58

[1)]: Summed output power according to FCC KDB662911 D01 Multiple transmitter output v02r01.

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

MIMO mode, single carrier

Measured output power per 1 MHz.

Carrier BW [MHz]	Symbolic name	[RMS dBm]		Total power[1)] [RMS dBm]
		Port RF A	Port RF B	
1.4	B	45.90	45.96	48.96
20	B	35.78	35.91	38.91
1.4	M	46.63	46.54	49.63
3.0	M	43.69	43.79	46.79
5.0	M	41.77	41.74	44.77
10.0	M	38.89	38.69	41.89
15.0	M	36.96	37.09	40.09
20.0	M	35.82	35.94	38.94
1.4	T	46.08	46.03	49.08
20	T	35.68	35.72	38.72

[1)]: Measured according to FCC KDB662911 D01 Multiple Transmitter Output v02r01. Method E), 2), c). “Measure and add 10 log(N_{Ant})”.

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

§27.50:

There is no maximum output power specified for base stations transmitting in the 2110-2155 MHz band. However, a licensee operating a base or fixed station in the 2110-2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance with the parties addressed in the rules.
In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission 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 3280 W/ MHz for the scope of this report. The peak-to-average ratio PAR of the power shall not exceed 13 dB.

Complies?	Yes

Occupied bandwidth measurements according to 47 CFR 2.1049 / RSS-Gen 4.6.1

Date	Temperature	Humidity
2013-11-21	19 °C ± 3 °C	26 % ± 5 %
2013-11-22	22 °C ± 3 °C	23 % ± 5 %
2013-11-27	21 °C ± 3 °C	33 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §2.1049. The output was connected to a signal analyser with the RMS detector activated. The signal analyser was connected to an external 10 MHz reference standard during the measurements.

Measurement equipment	SP number
R&S FSQ	504 143
RF attenuator	902 282
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

MIMO mode, single carrier

Diagram	BW configuration	Tested frequency	Tested Port	Occupied BW (99%) [MHz]
1	1.4 MHz	B	RF A	1.09
2	20 MHz	B	RF A	17.86
3	1.4 MHz	M	RF A	1.09
4	1.4 MHz	M	RF B	1.09
5	3 MHz	M	RF A	2.69
6	5 MHz	M	RF A	4.48
7	10 MHz	M	RF A	8.94
8	15 MHz	M	RF A	13.43
9	20 MHz	M	RF A	17.86
10	20 MHz	M	RF B	17.87
11	1.4 MHz	T	RF A	1.09
12	20 MHz	T	RF A	17.86

Appendix 3

Diagram 1:

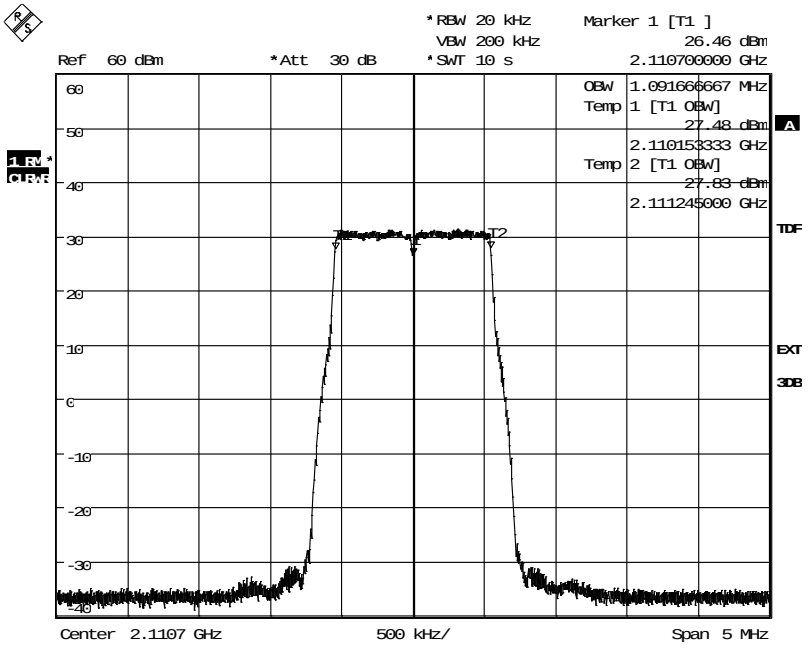


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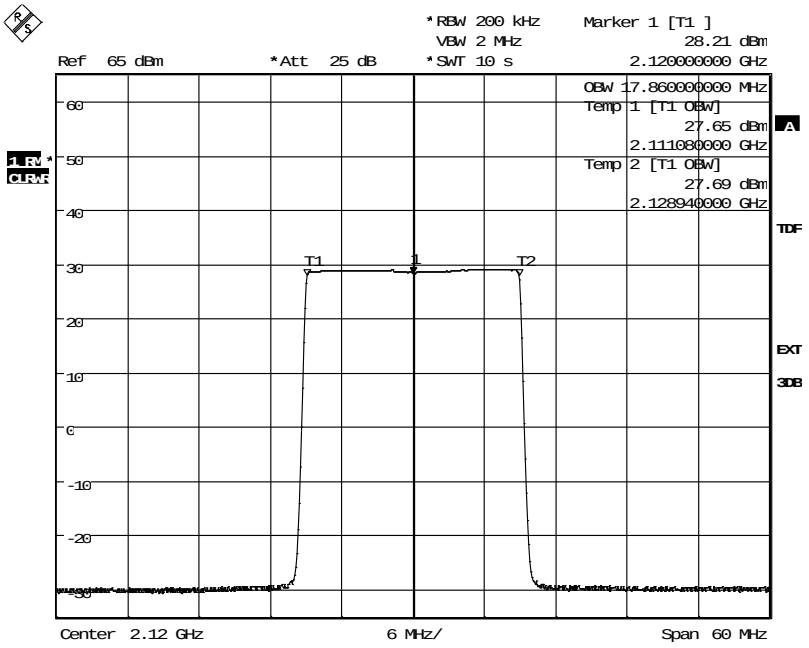
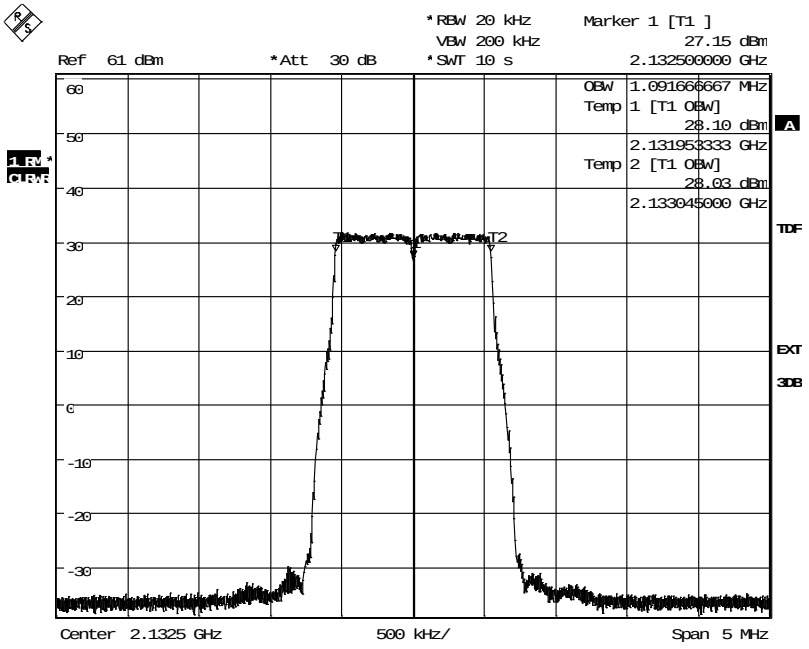
Diagram 2:



Date: 21.NOV.2013 15:47:23

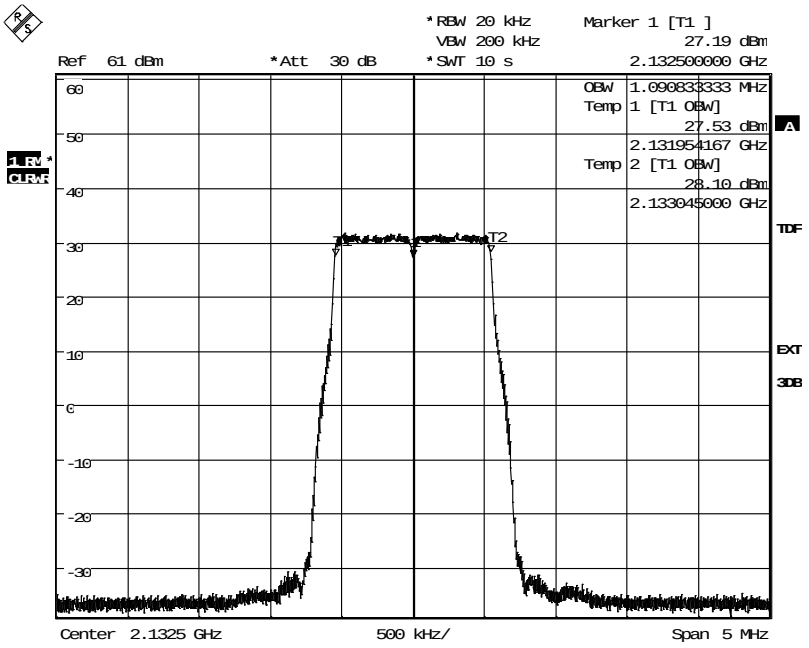
Appendix 3

Diagram 3:



Date: 22.NOV.2013 08:11:57

Diagram 4:



Date: 22.NOV.2013 08:24:11

Appendix 3

Diagram 5:

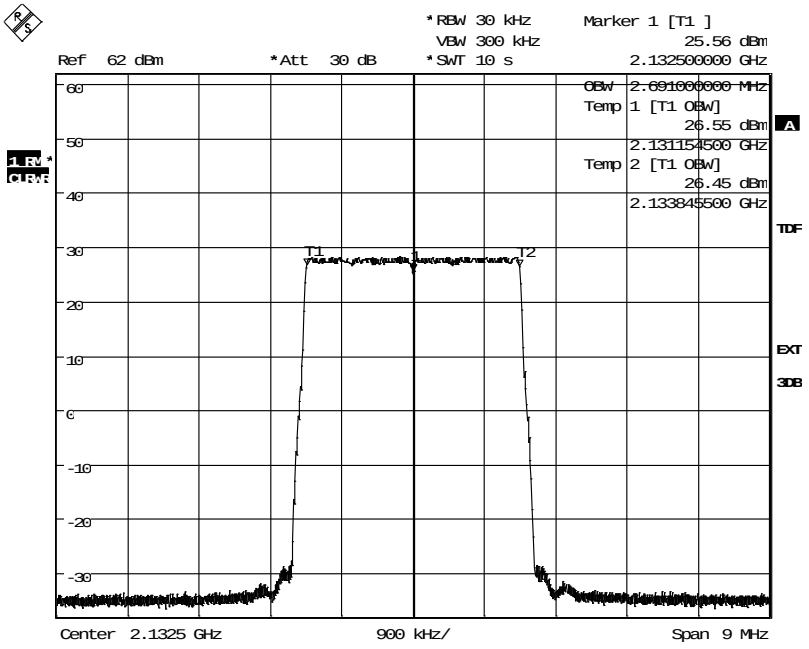


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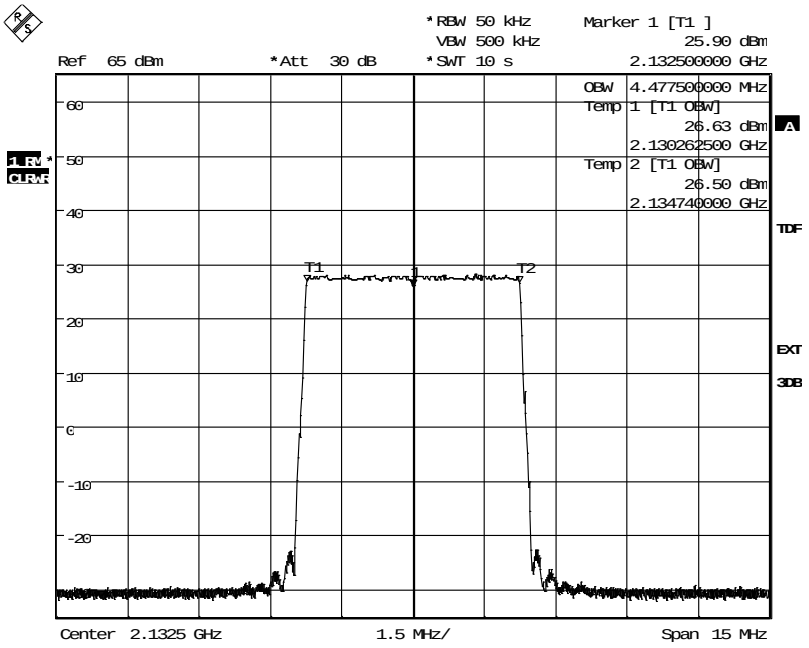
Diagram 6:



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Appendix 3

Diagram 7:

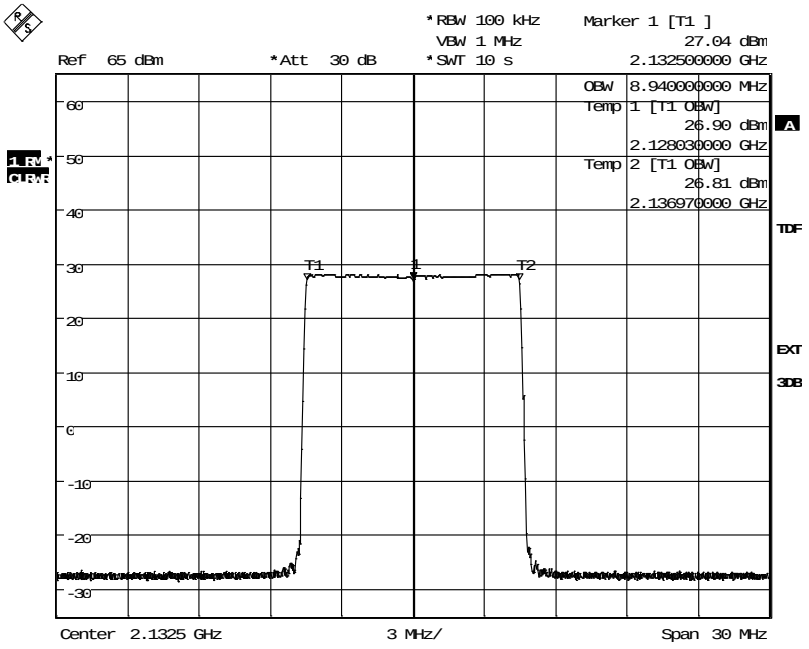

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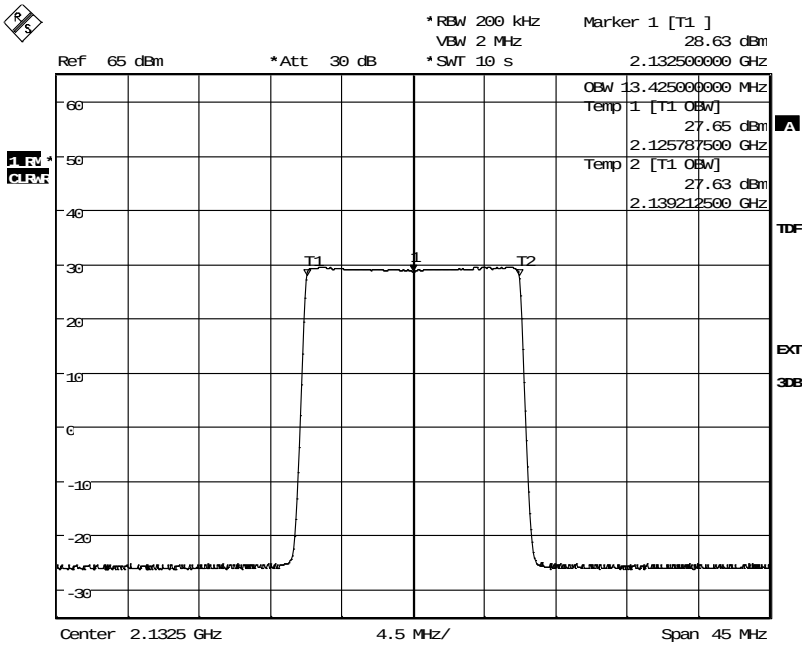
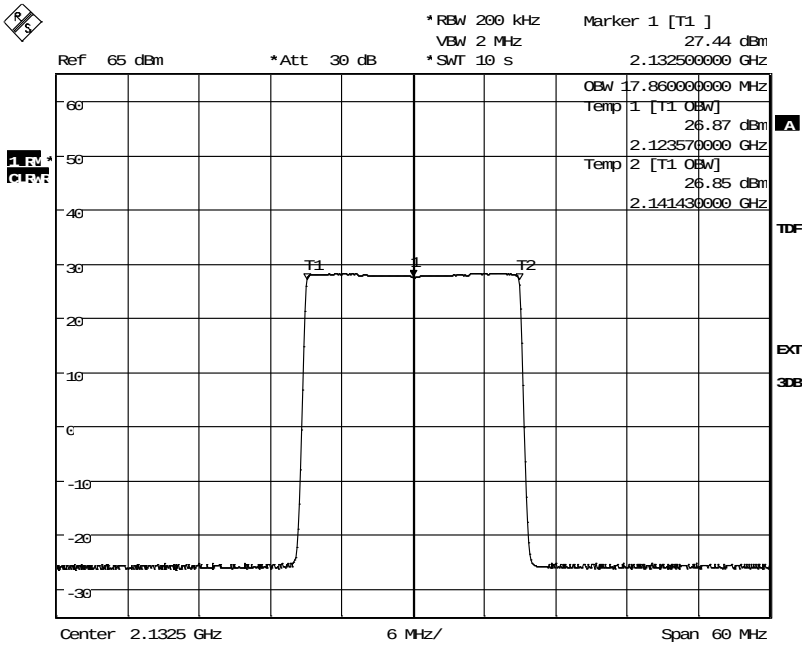
Diagram 8:



Date: 22.NOV.2013 09:19:14

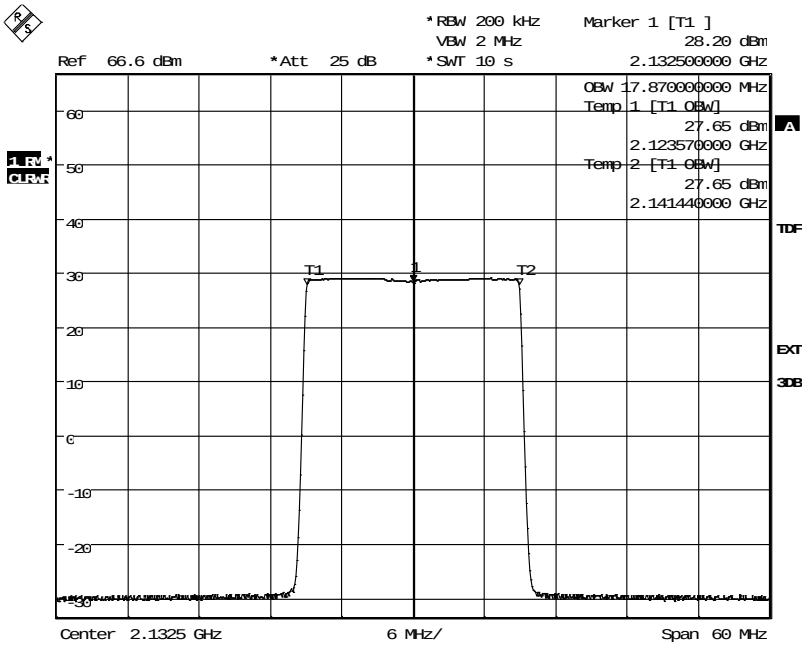
Appendix 3

Diagram 9:



Date: 22.NOV.2013 09:05:58

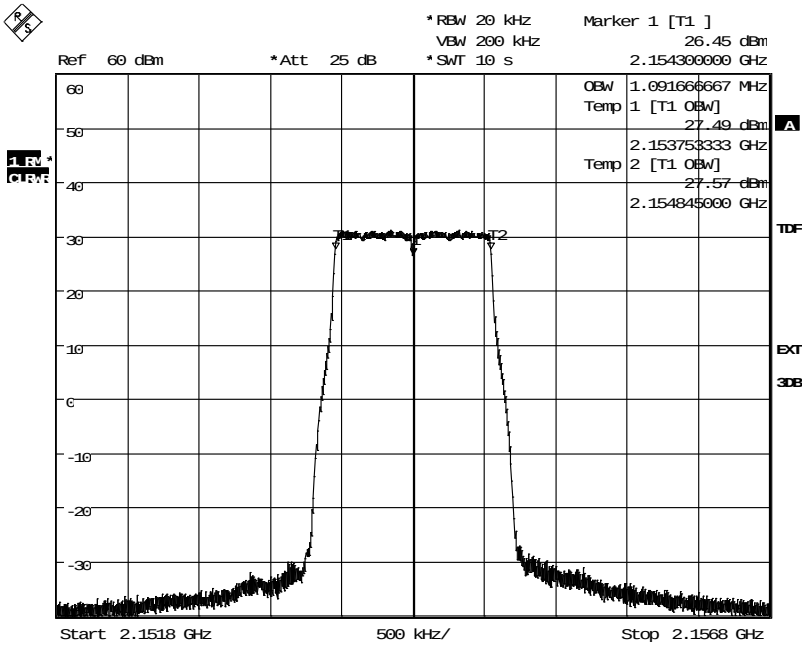
Diagram 10:



Date: 22.NOV.2013 08:50:58

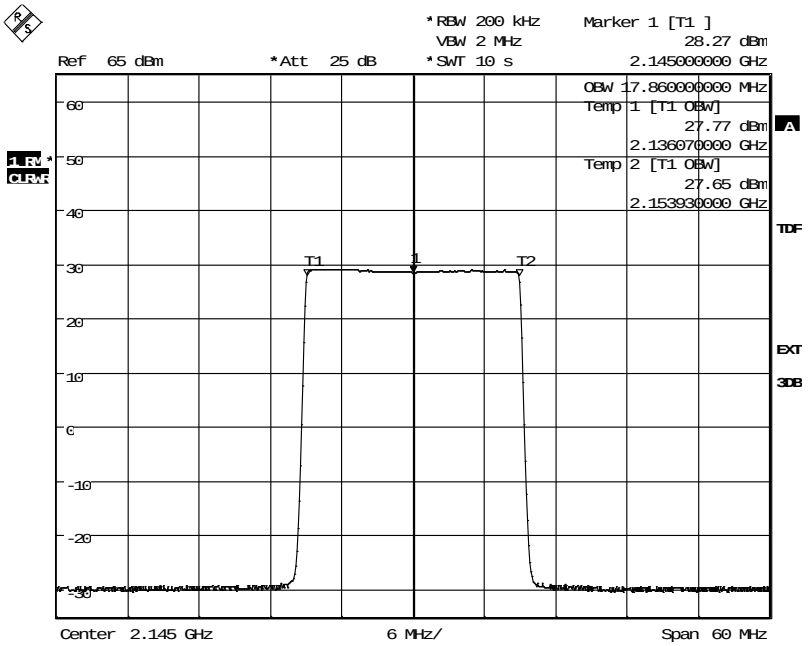
Appendix 3

Diagram 11:



Date: 27.NOV.2013 17:17:17

Diagram 12:



Date: 27.NOV.2013 17:43:49

Appendix 4

Band edge measurements according to CFR 47 §27.53(h) / IC RSS-139 6.5

Date	Temperature	Humidity
2013-11-21	19 °C ± 3 °C	26 % ± 5 %
2013-11-27	21 °C ± 3 °C	33 % ± 5 %
2013-11-28	21 °C ± 3 °C	21 % ± 5 %
2013-12-02	23 °C ± 3 °C	22 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53(h). The test object was connected to a spectrum analyser with the RMS detector activated. The spectrum analyser was connected to an external 10 MHz reference standard during the measurements.

Beyond the 1st MHz off the band edges the limit was adjusted to compensate for reduced measurement bandwidths pursuant to the FCC rules, specifying a RBW of at least 1% of the fundamental emission bandwidth up to 1 MHz away from the band edges and a RBW of 1 MHz for measurements of emissions more than 1 MHz away from the band edges.
Where a smaller RBW was used as compared to the rules, the limit in the plot is adjusted by 10 log ($RBW_{used}/RBW_{specified}$) [dB].

BW configuration [MHz]	Emission BW [MHz]	RBW_{used} [kHz]	Adjusted limit to [dBm]
3	2.73	10	-17.4
3	2.73	20	-14.4

A resolution bandwidth of 100 kHz was used 1 MHz to 6 MHz away from the band edges, to compensate for the reduced resolution bandwidth the limit was adjusted by 10 dB to -23 dBm.

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 FSQ	504 143
RF attenuator	902 282
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

MIMO mode, Single carrier

Diagram	BW configuration	Tested frequency	Tested Port
1 a-c	1.4 MHz	B	RF A
2 a-c	1.4 MHz	B	RF B
3 a-c	3 MHz	B	RF A
4 a-c	3 MHz	B	RF B
5 a-c	5 MHz	B	RF A
6 a-c	10 MHz	B	RF A
7 a-c	15 MHz	B	RF A
8 a-c	20 MHz	B	RF A
9 a-c	1.4 MHz	T	RF A
10 a-c	1.4 MHz	T	RF B
11 a-c	3 MHz	T	RF A
12 a-c	3 MHz	T	RF B
13 a-c	5 MHz	T	RF A
14 a-c	10 MHz	T	RF A
15 a-c	15 MHz	T	RF A
16 a-c	20 MHz	T	RF A

MIMO mode, multi carrier

Diagram	BW configuration	Testedfrequency	Tested Port
17 a-c	3 MHz	B2-3	RF A
18 a-c	3 MHz	T2-3	RF A

Limits

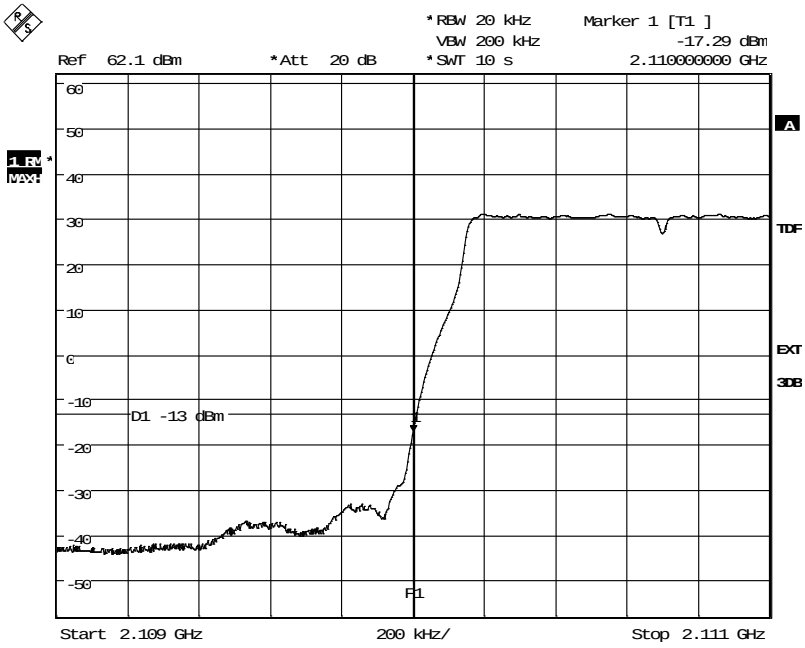
CFR 47 §27.53(h) and RSS-139 6.5

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.

Complies?	Yes

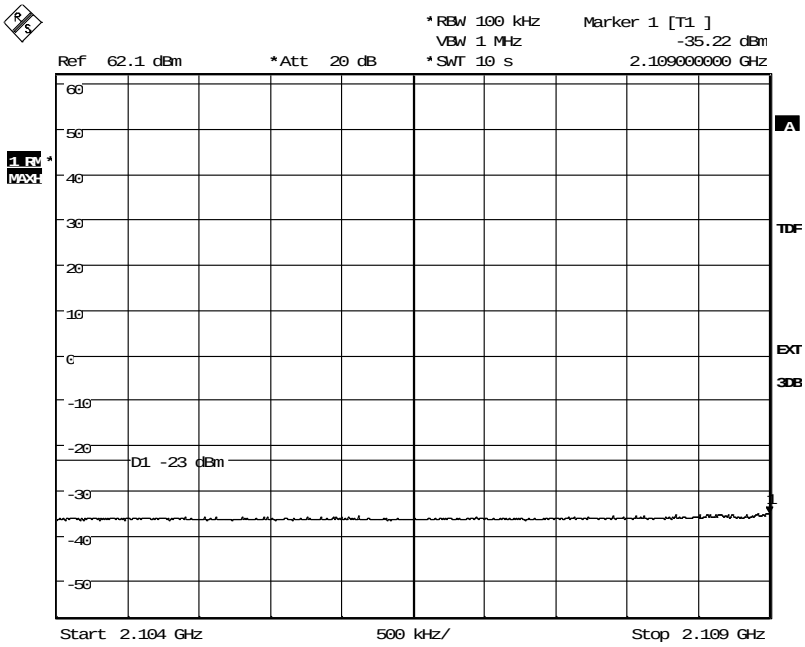
Appendix 4

Diagram 1 a:



Date: 21.NOV.2013 15:00:35

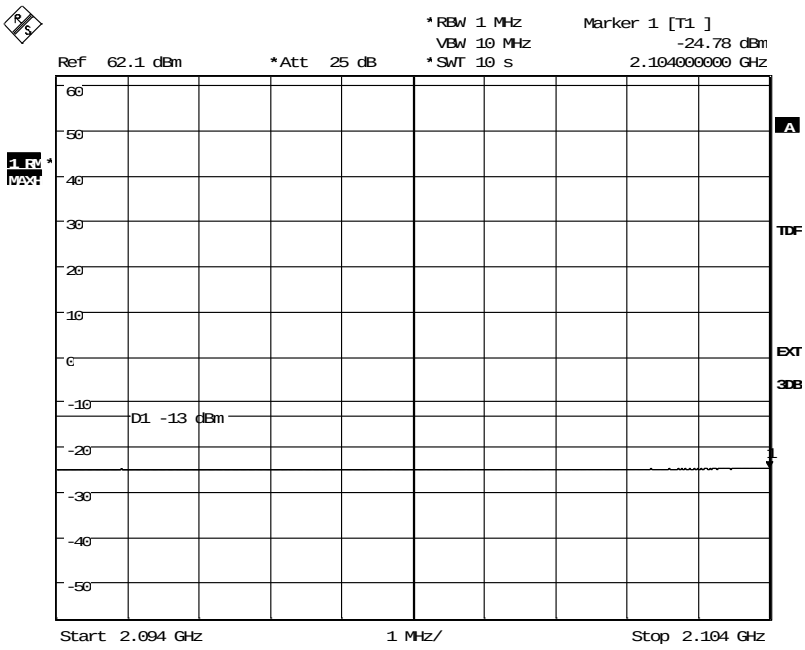
Diagram 1 b:



Date: 21.NOV.2013 14:57:42

Appendix 4

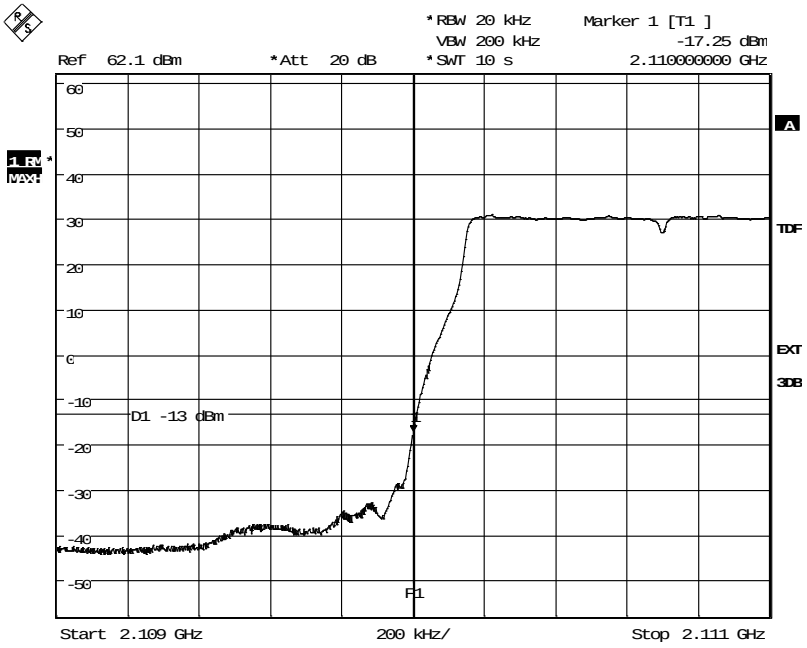
Diagram 1 c:



Date: 21.NOV.2013 15:02:36

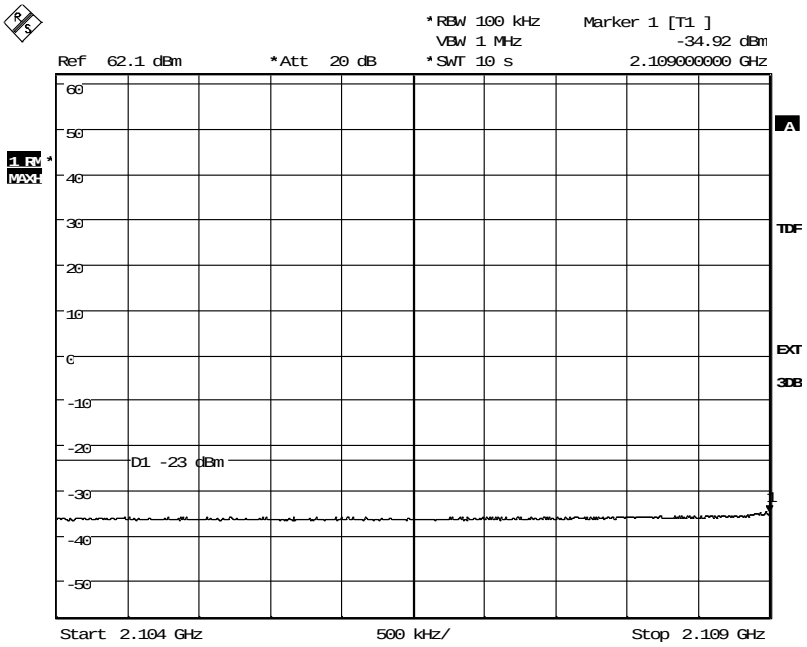
Appendix 4

Diagram 2 a:



Date: 21.NOV.2013 15:17:31

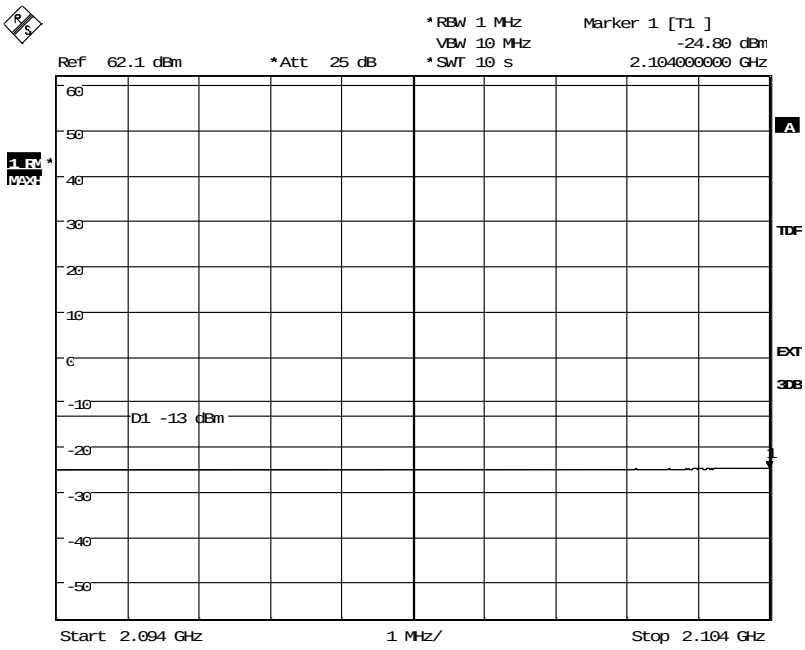
Diagram 2 b:



Date: 21.NOV.2013 15:18:14

Appendix 4

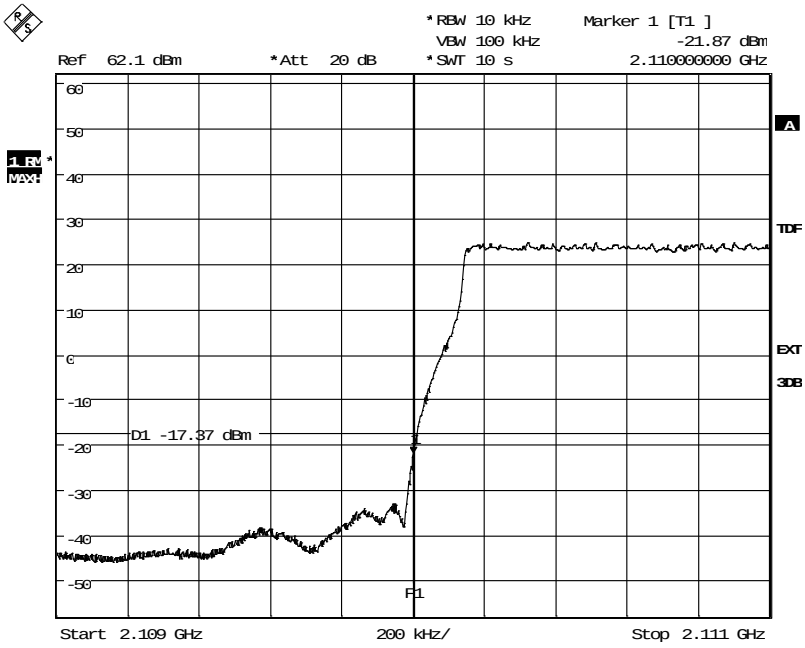
Diagram 2c:



Date: 21.NOV.2013 15:18:56

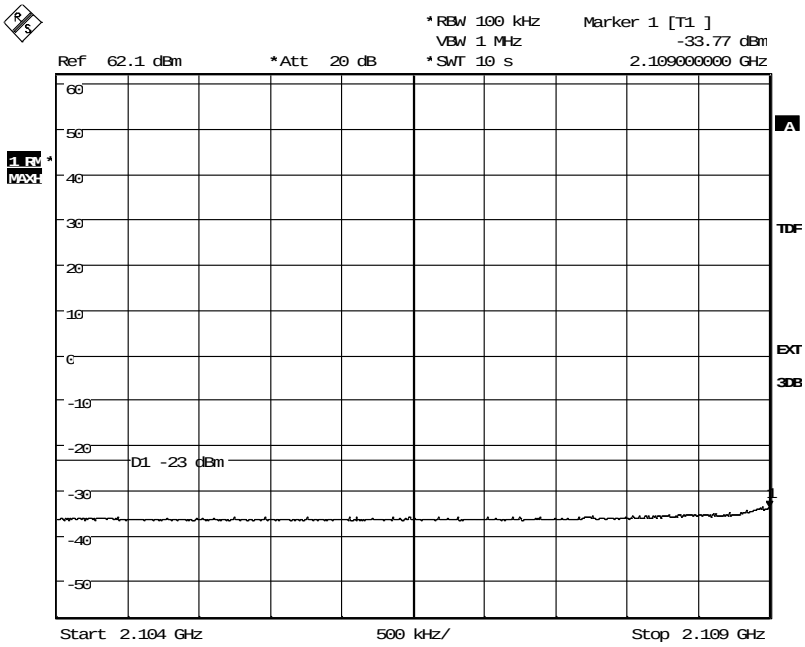
Appendix 4

Diagram 3 a:



Date: 21.NOV.2013 16:20:32

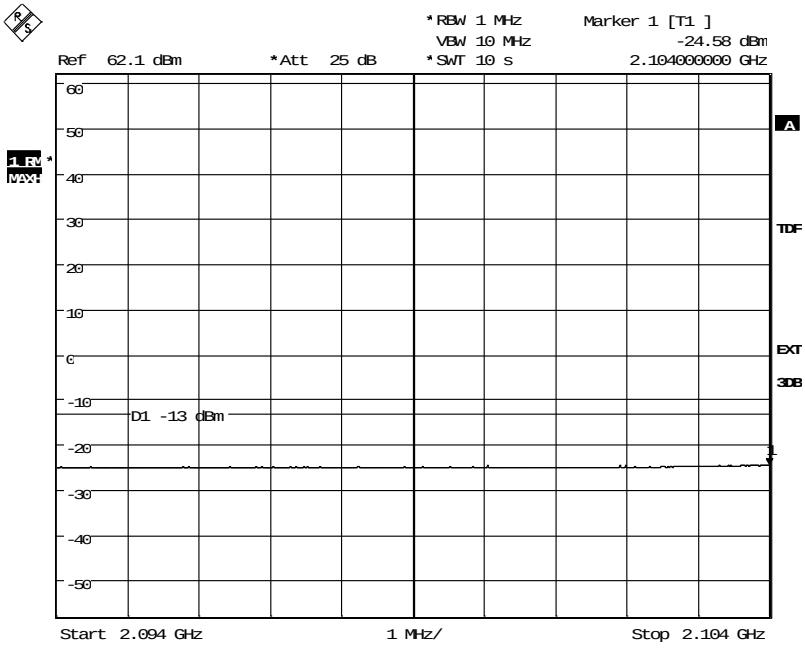
Diagram 3 b:



Date: 21.NOV.2013 16:17:38

Appendix 4

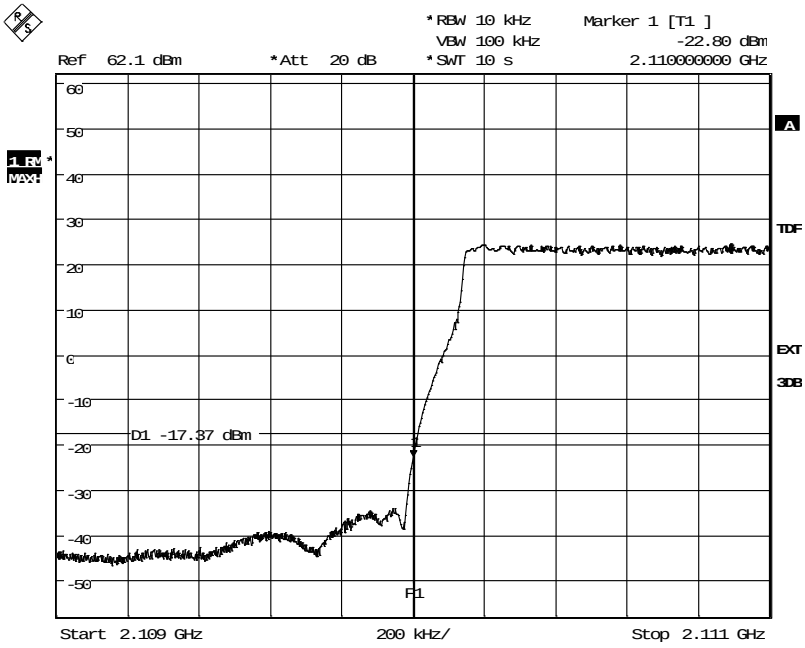
Diagram 3 c:



Date: 21.NOV.2013 16:16:44

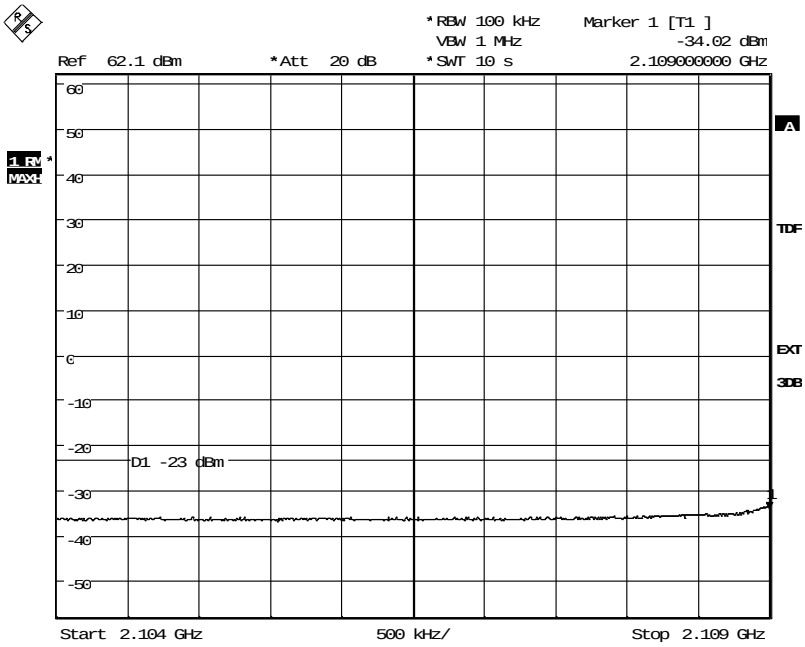
Appendix 4

Diagram 4 a:



Date: 21.NOV.2013 16:22:59

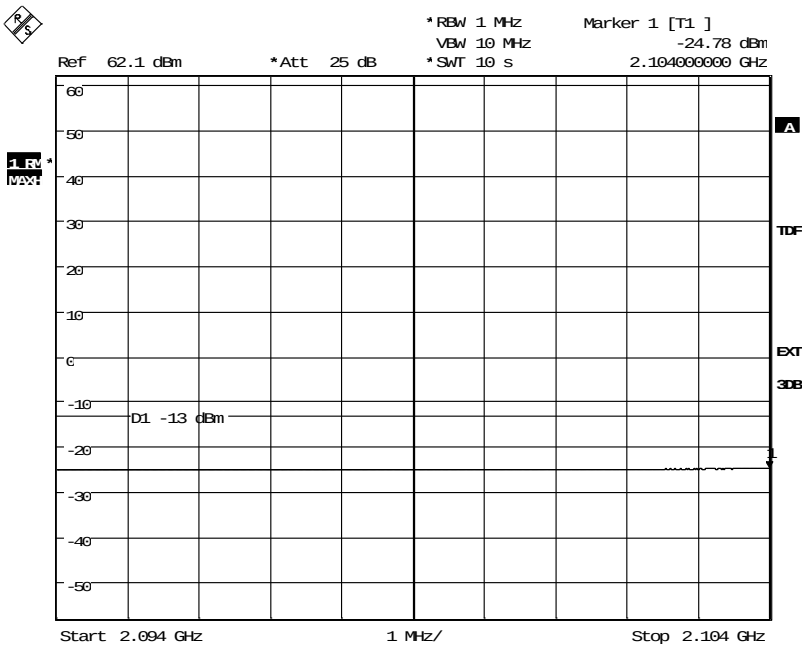
Diagram 4 b:



Date: 21.NOV.2013 16:23:56

Appendix 4

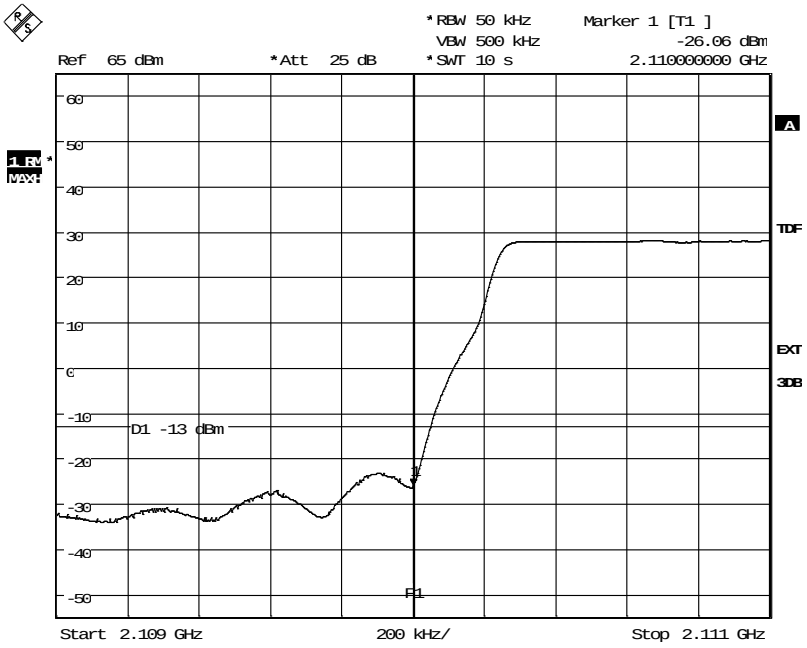
Diagram 4 c:



Date: 21.NOV.2013 16:24:46

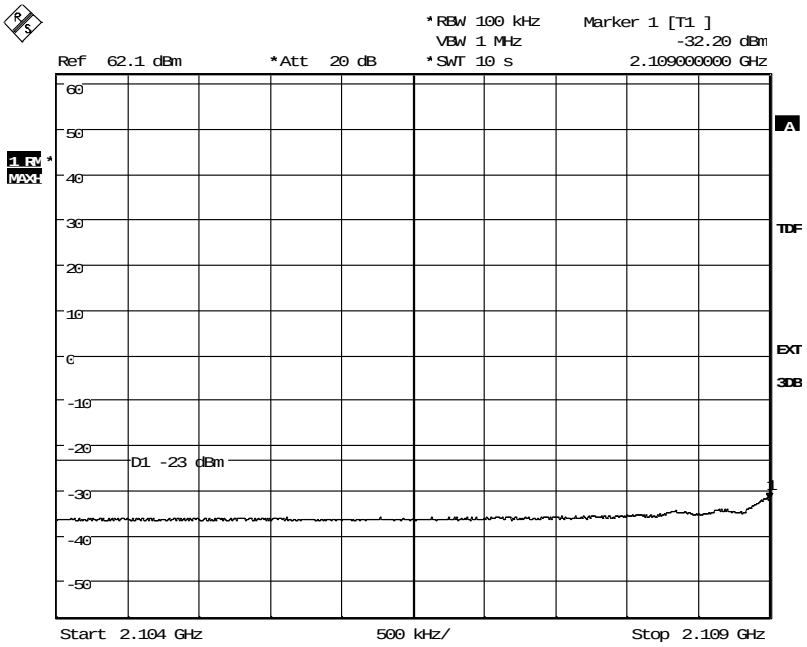
Appendix 4

Diagram 5 a:



Date: 21.NOV.2013 16:49:16

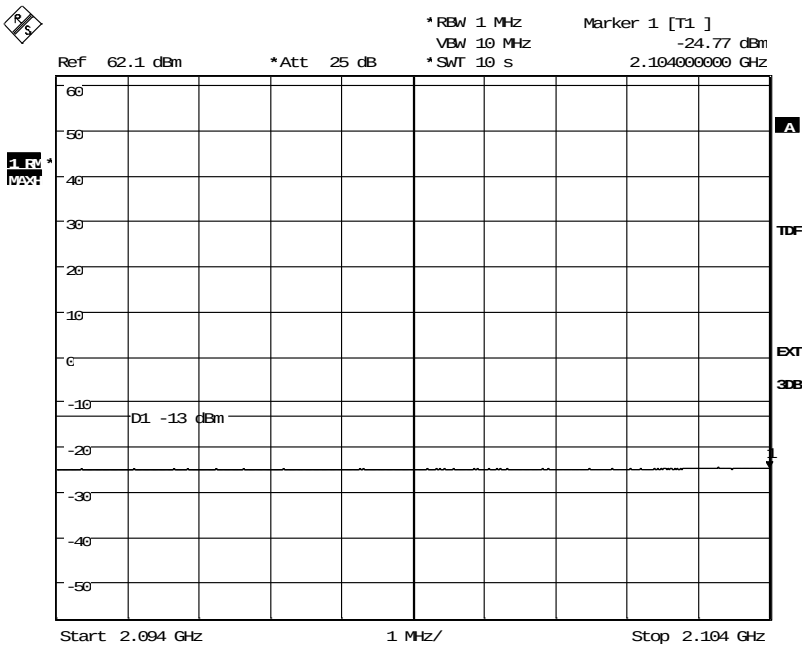
Diagram 5 b:



Date: 21.NOV.2013 16:35:06

Appendix 4

Diagram 5 c



Date: 21.NOV.2013 16:34:02

Appendix 4

Diagram 6 a:

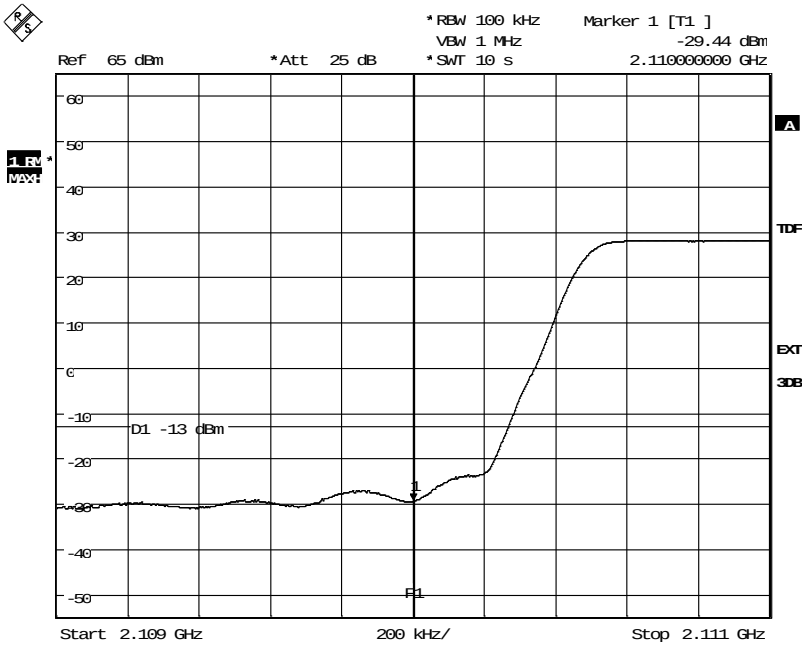


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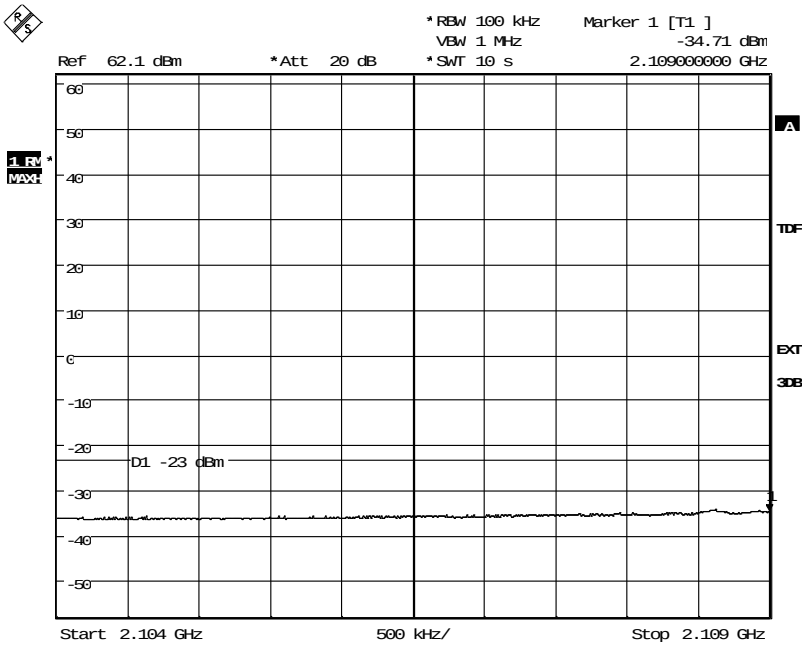
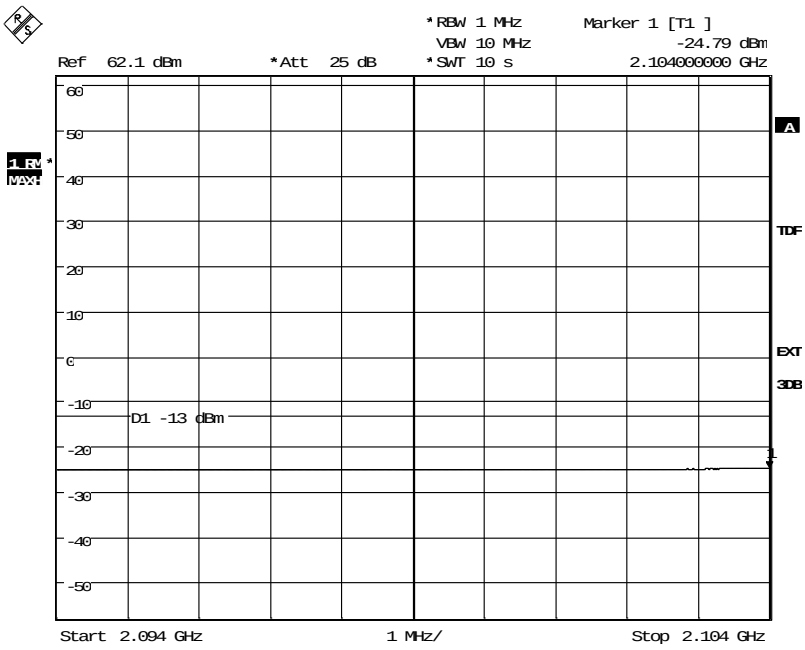
Diagram 6 b:



Date: 21.NOV.2013 17:06:58

Appendix 4

Diagram 6 c:



Date: 21.NOV.2013 17:07:57

Appendix 4

Diagram 7 a:

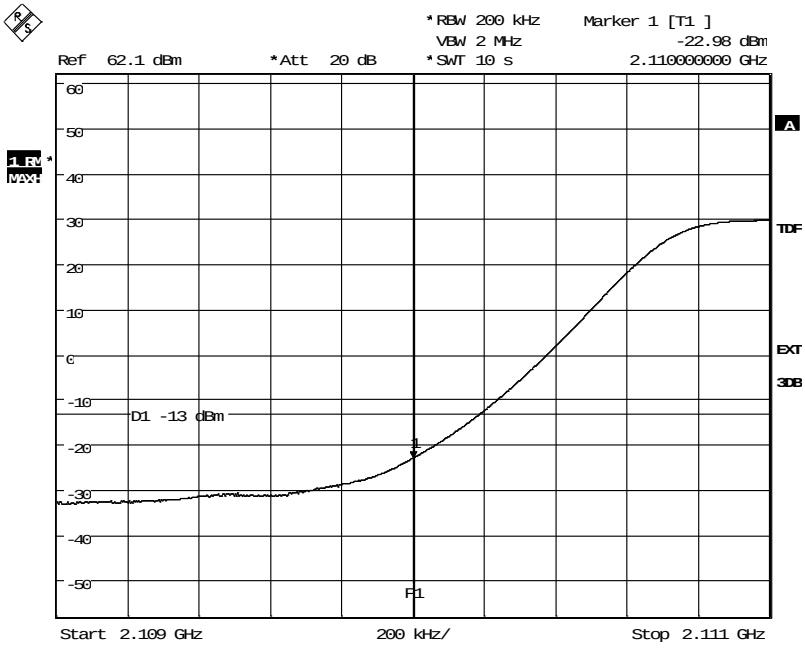


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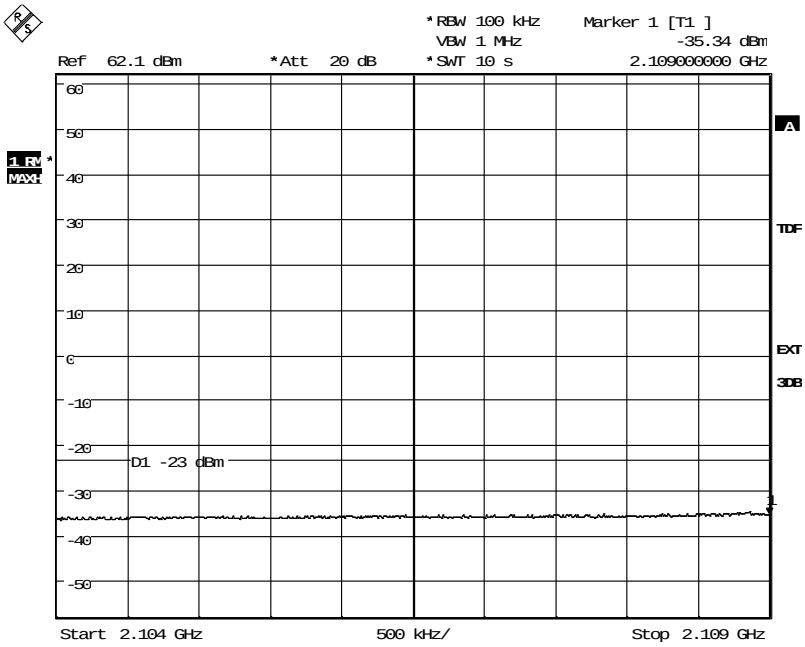
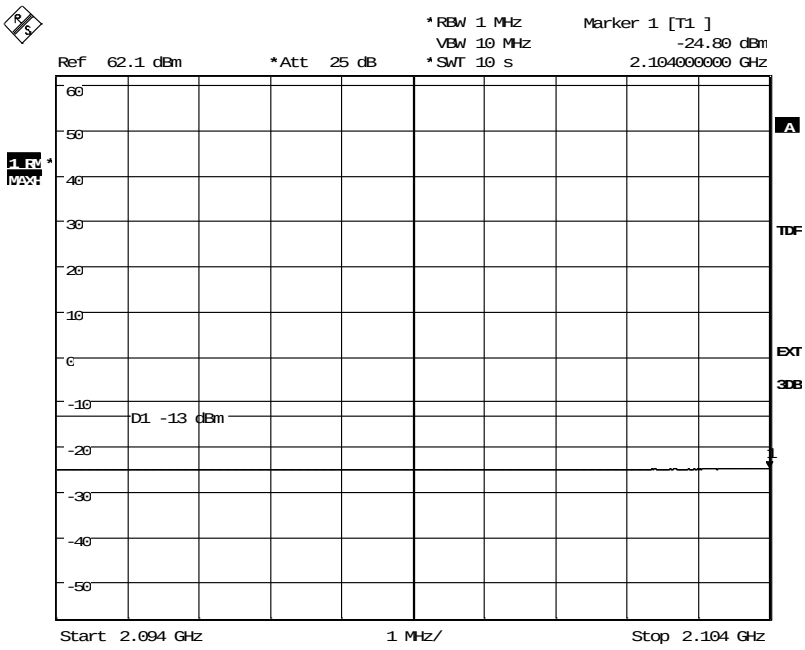
Diagram 7 b:



Date: 21.NOV.2013 17:14:41

Appendix 4

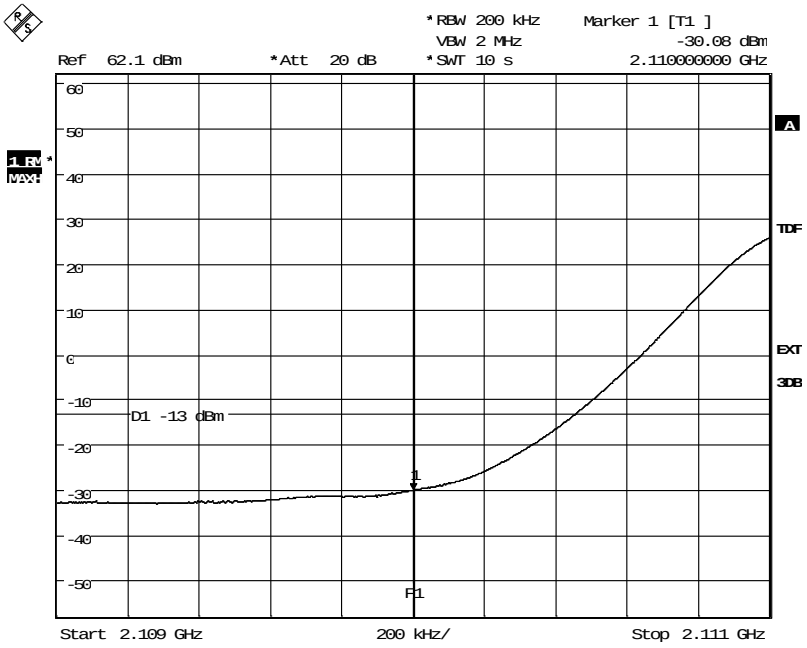
Diagram 7 c:



Date: 21.NOV.2013 17:13:30

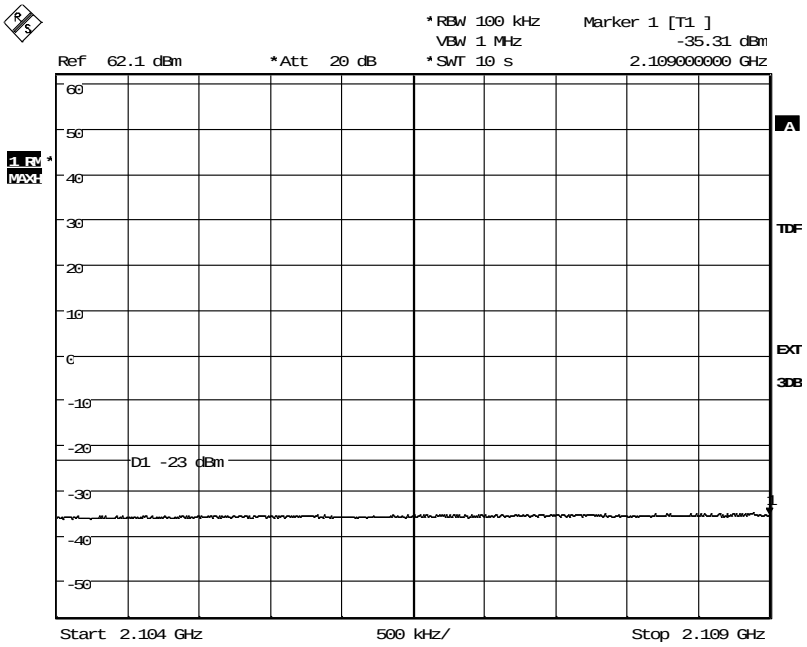
Appendix 4

Diagram 8 a:



Date: 21.NOV.2013 16:08:30

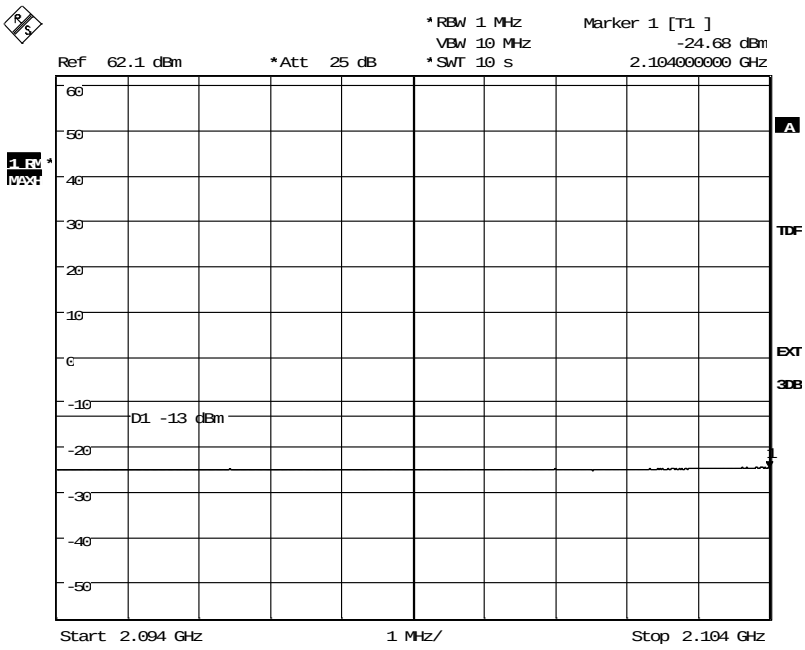
Diagram 8 b:



Date: 21.NOV.2013 16:10:47

Appendix 4

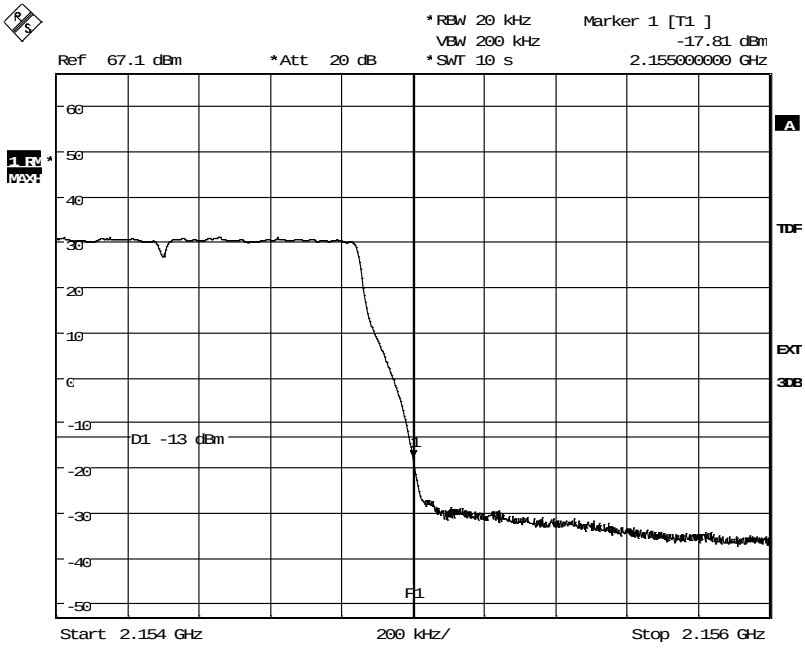
Diagram 8 c:



Date: 21.NOV.2013 16:11:30

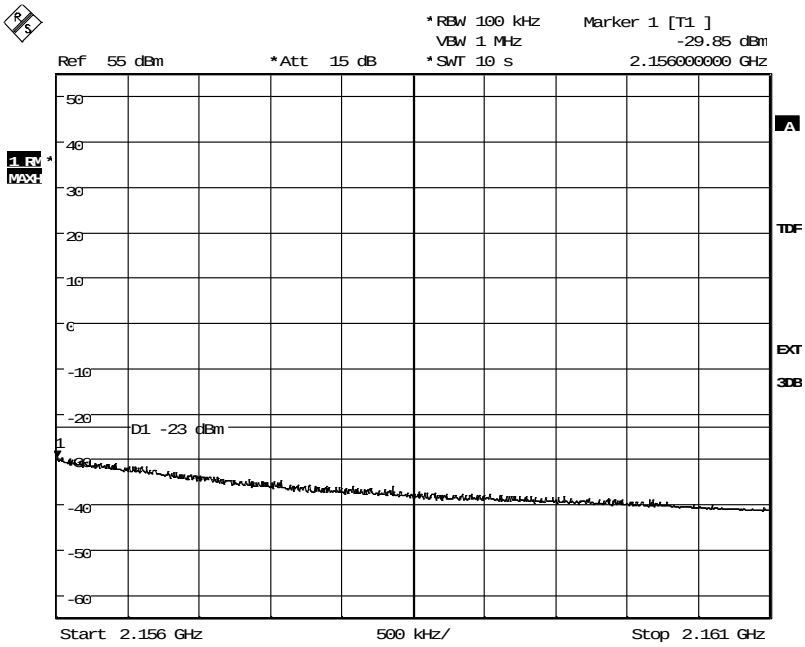
Appendix 4

Diagram 9 a:



Date: 27.NOV.2013 17:06:08

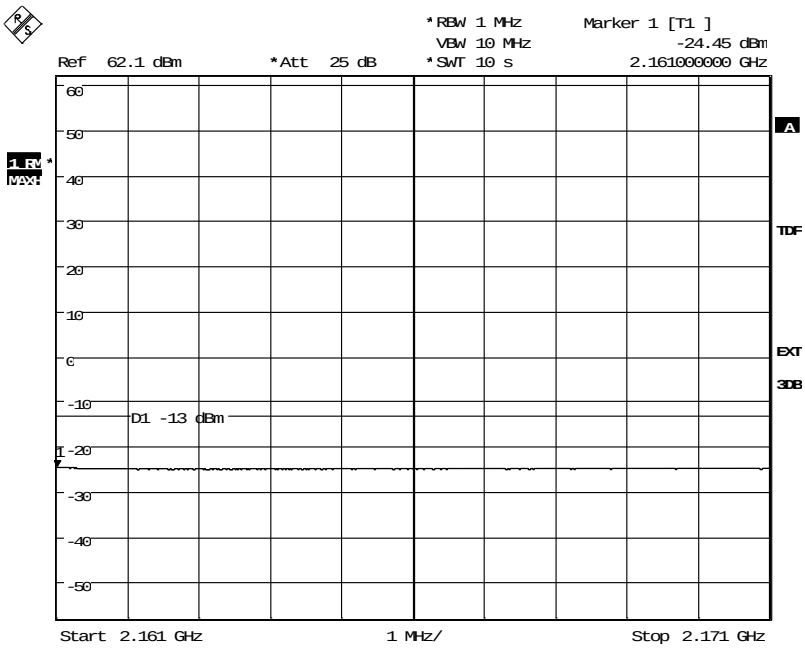
Diagram 9 b:



Date: 27.NOV.2013 17:04:29

Appendix 4

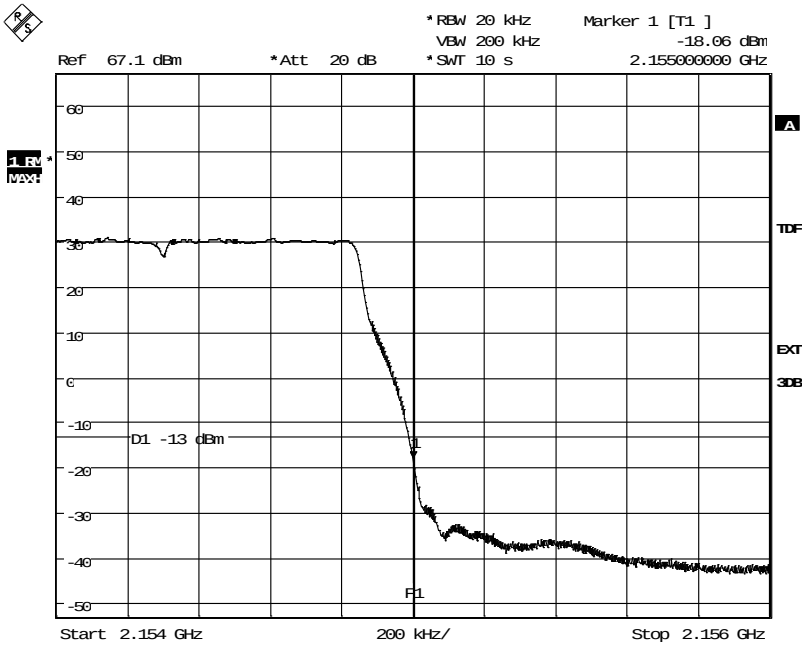
Diagram 9 c:



Date: 27.NOV.2013 17:07:22

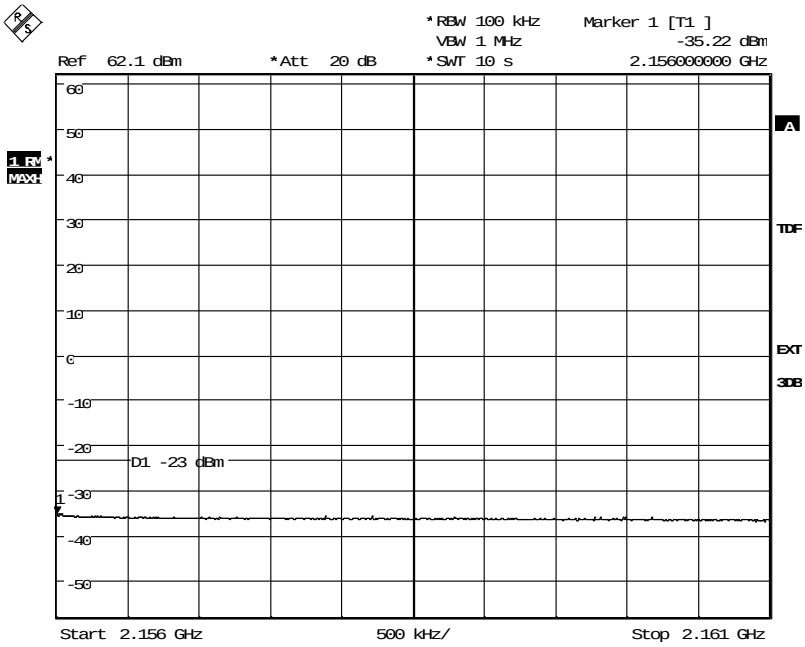
Appendix 4

Diagram 10 a:



Date: 27.NOV.2013 17:20:29

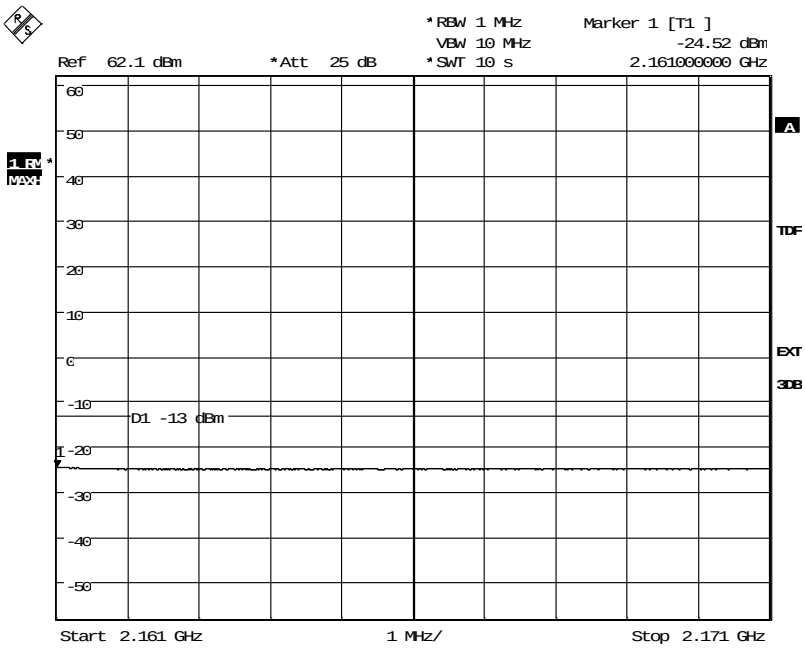
Diagram 10 b:



Date: 27.NOV.2013 17:22:49

Appendix 4

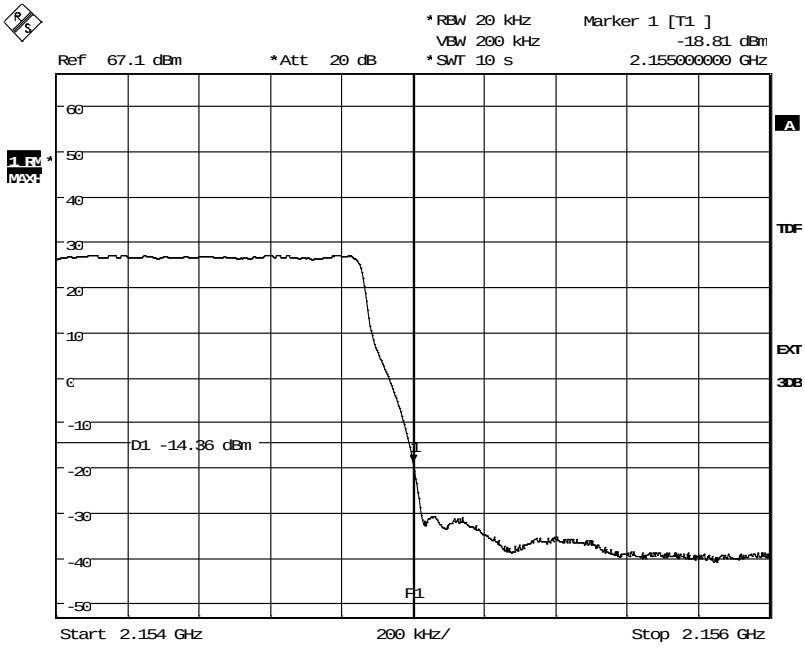
Diagram 10 c:



Date: 27.NOV.2013 17:23:48

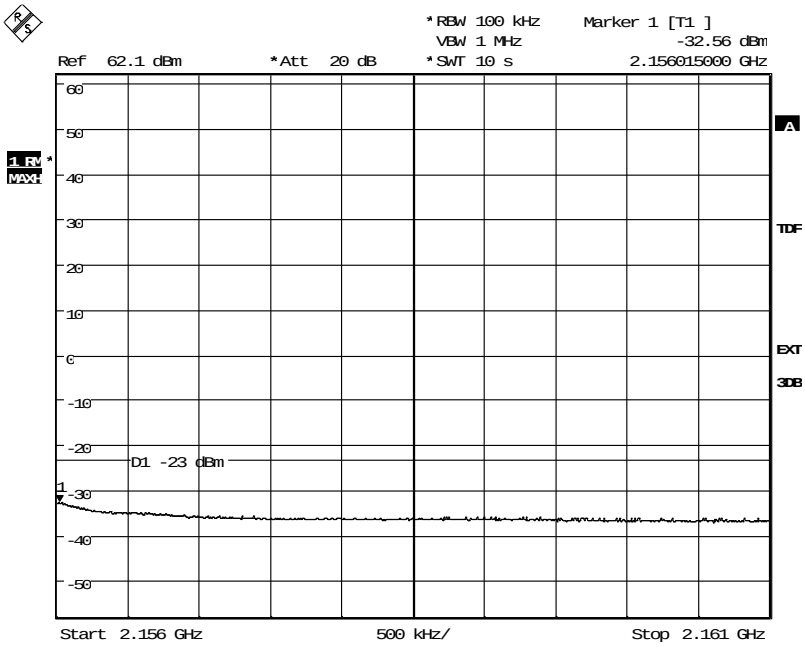
Appendix 4

Diagram 11 a:



Date: 27.NOV.2013 19:39:36

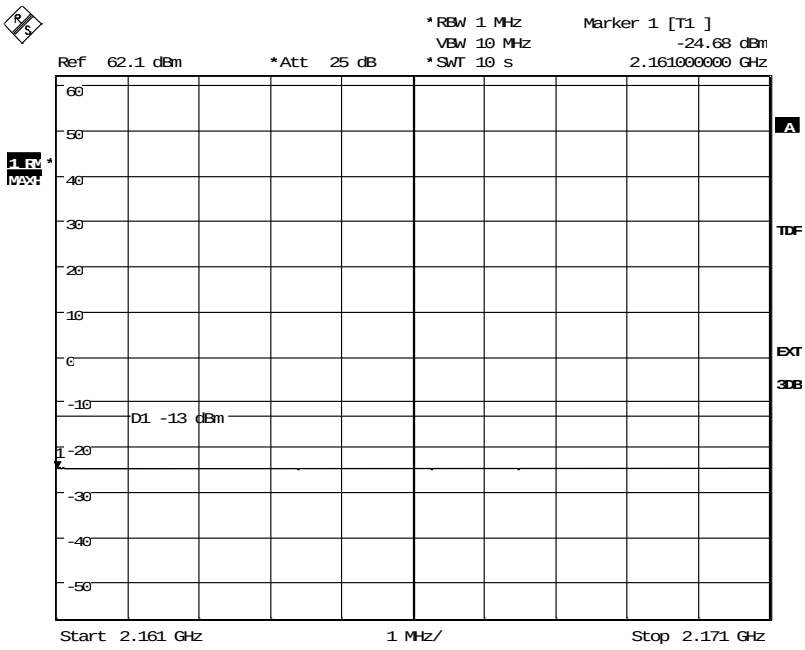
Diagram 11 b:



Date: 27.NOV.2013 19:40:34

Appendix 4

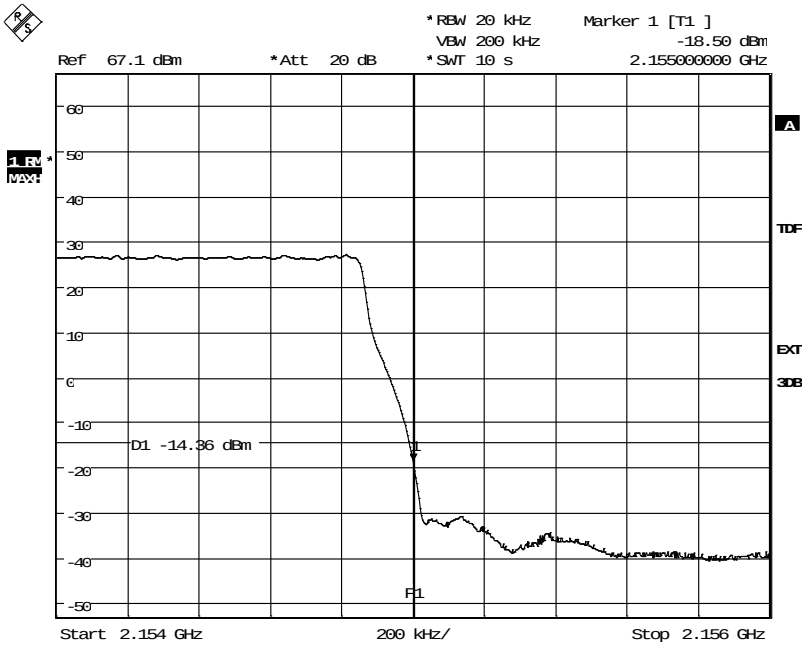
Diagram 11 c:



Date: 27.NOV.2013 19:41:26

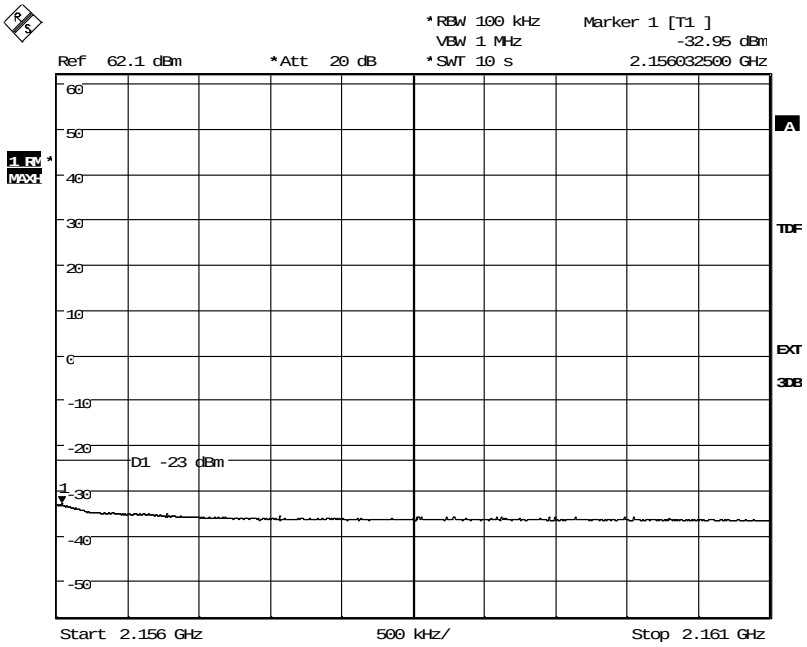
Appendix 4

Diagram 12 a:



Date: 27.NOV.2013 19:46:29

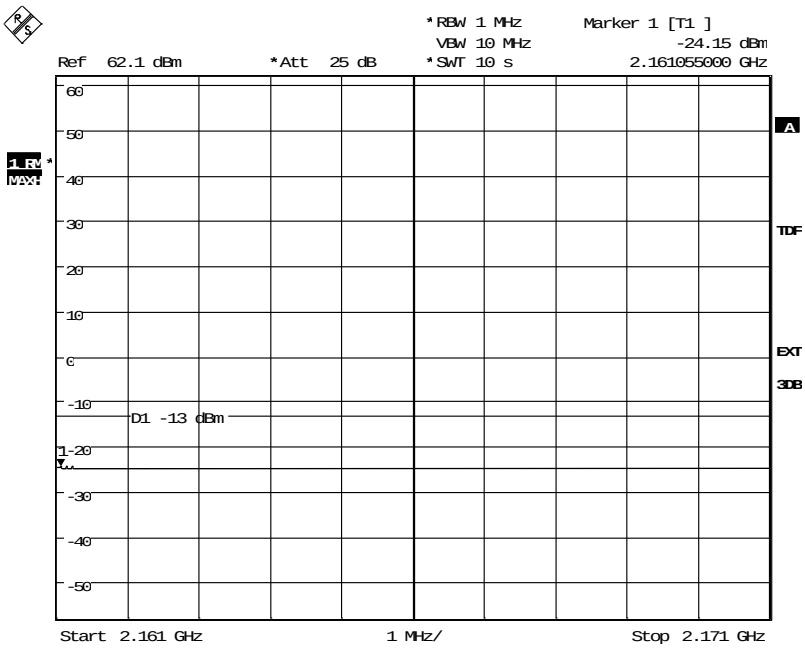
Diagram 12 b:



Date: 27.NOV.2013 19:44:43

Appendix 4

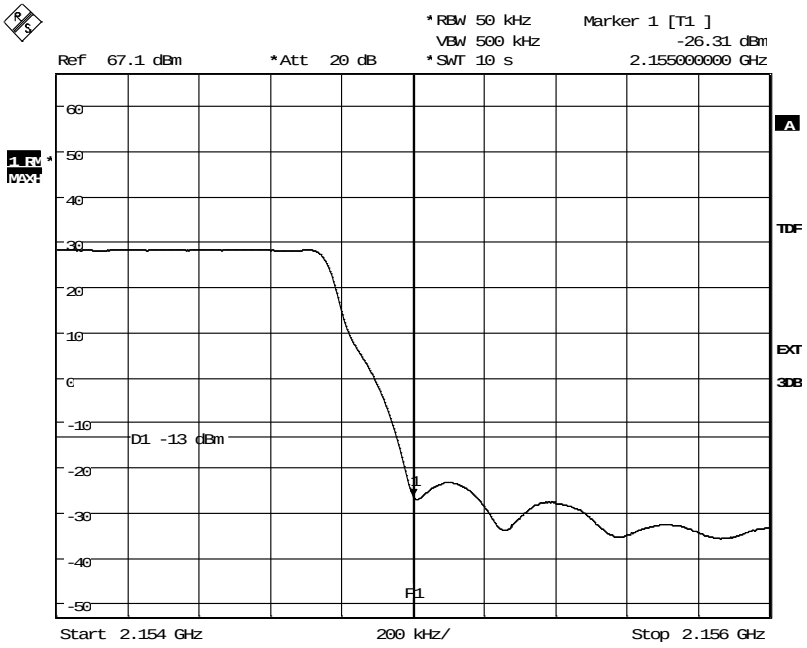
Diagram 12 c:



Date: 27.NOV.2013 19:44:00

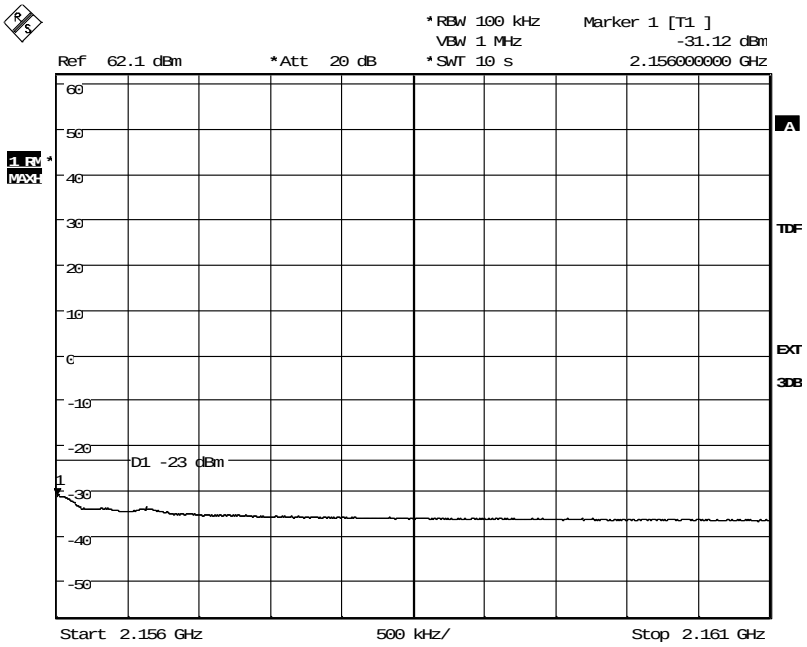
Appendix 4

Diagram 13a:



Date: 27.NOV.2013 20:17:28

Diagram 13 b:



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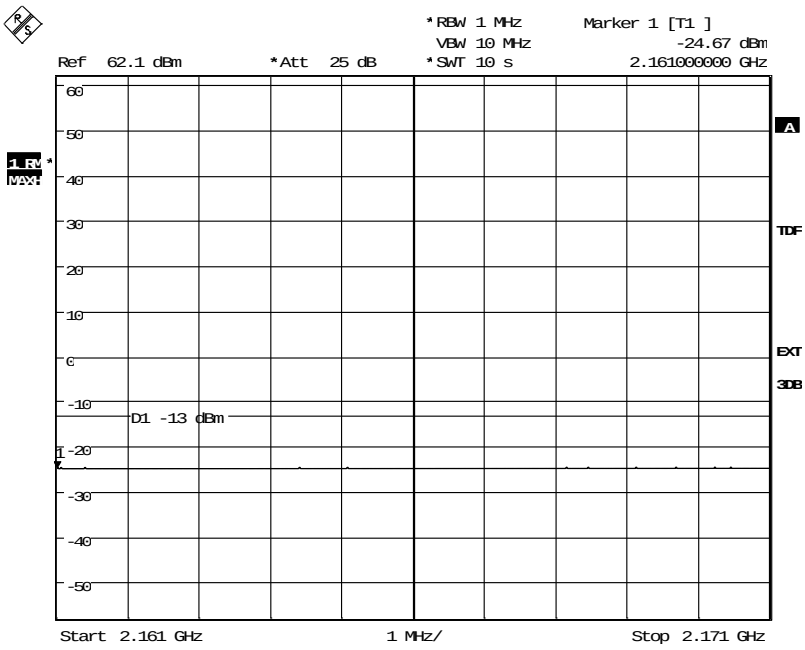
Appendix 4

Diagram 13 c:



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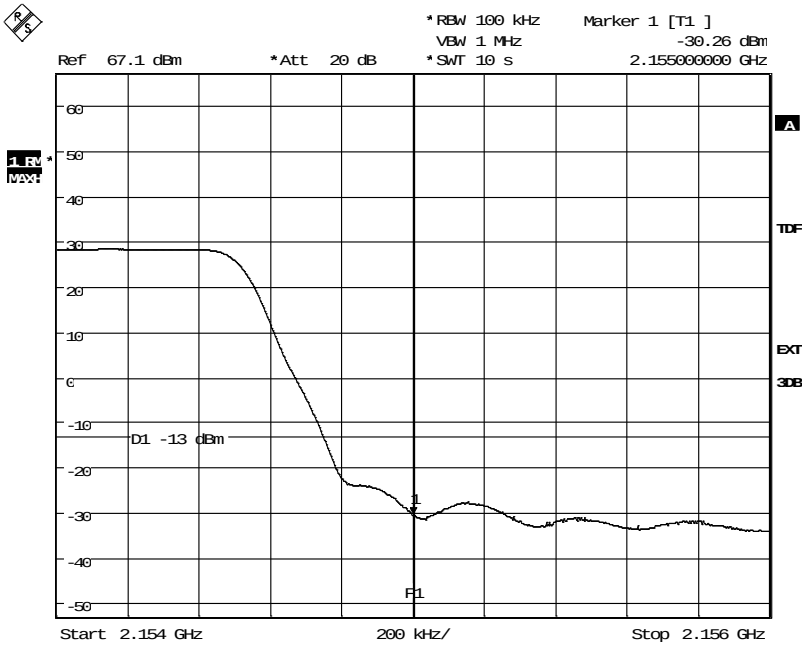
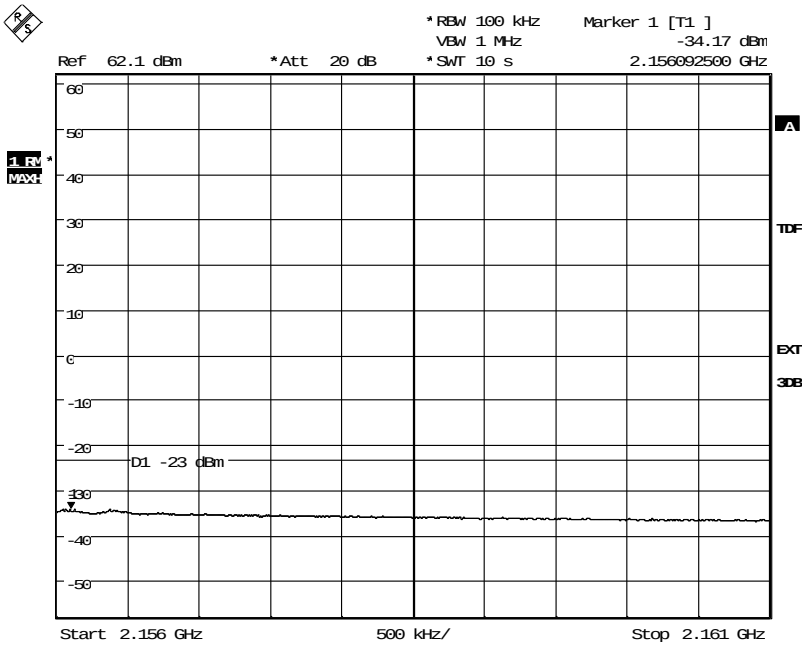
Appendix 4

Diagram 14 a:



Date: 27.NOV.2013 20:37:21

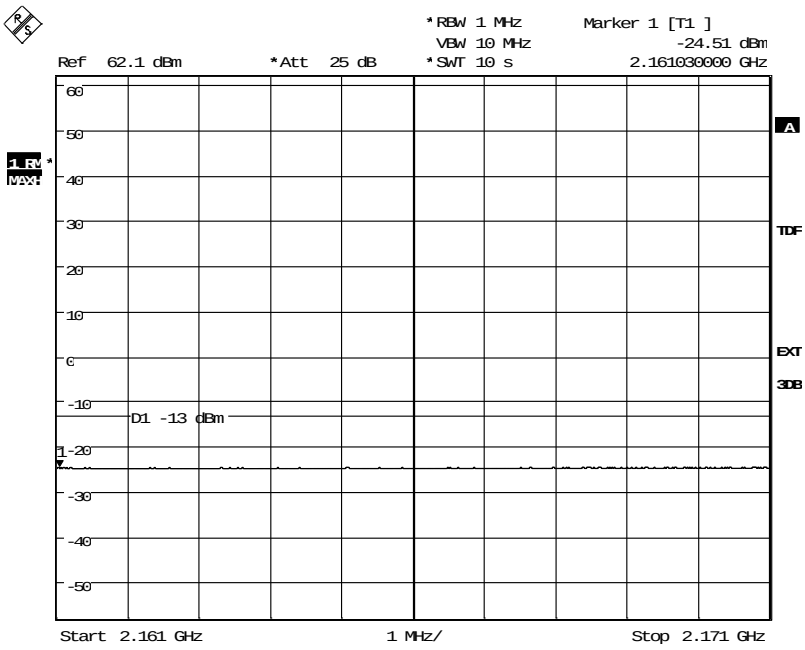
Diagram 14 b:



Date: 27.NOV.2013 20:35:59

Appendix 4

Diagram 14 c:



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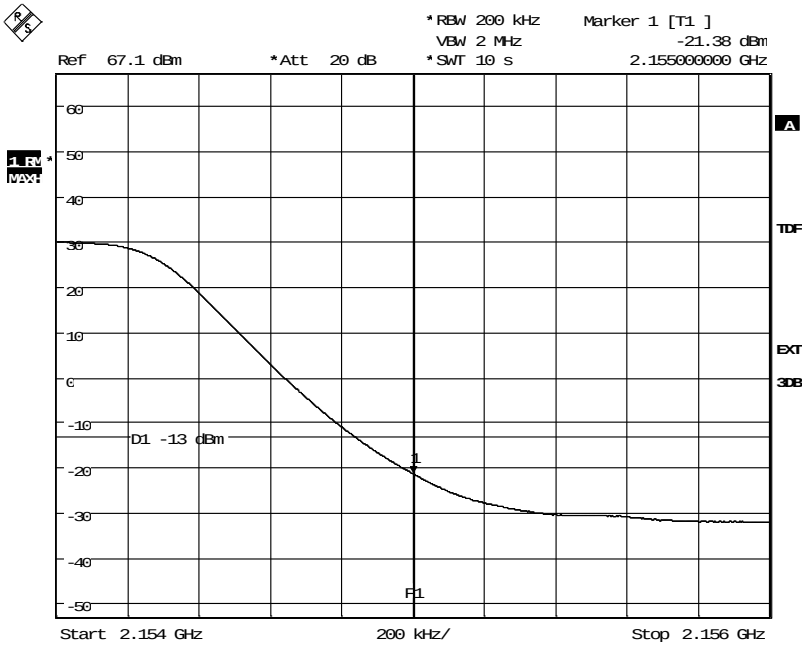
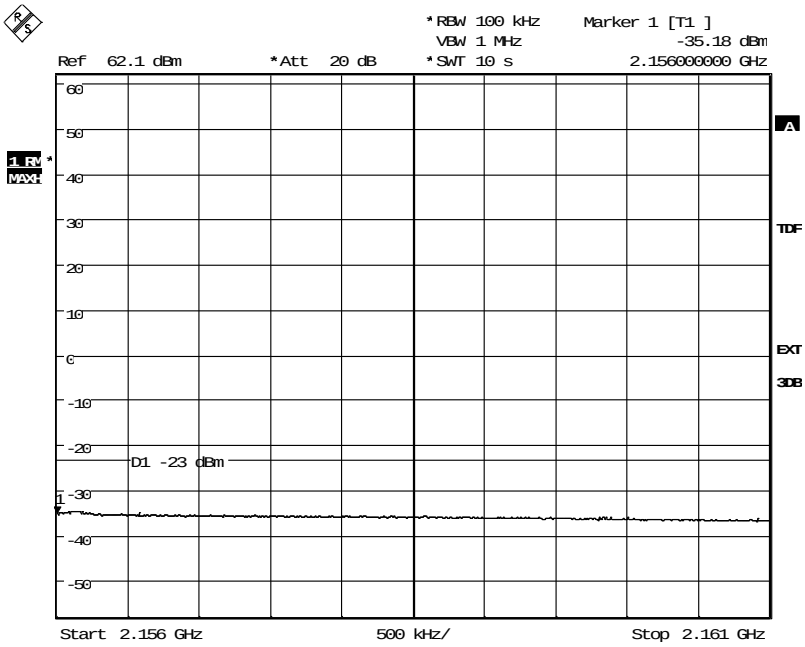
Appendix 4

Diagram 15 a:



Date: 27.NOV.2013 20:39:43

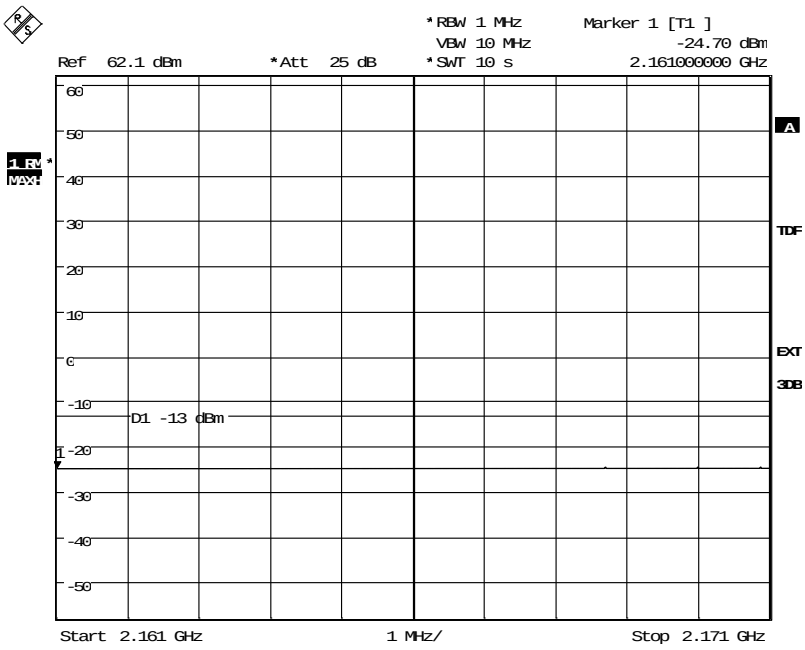
Diagram 15 b:



Date: 27.NOV.2013 20:40:33

Appendix 4

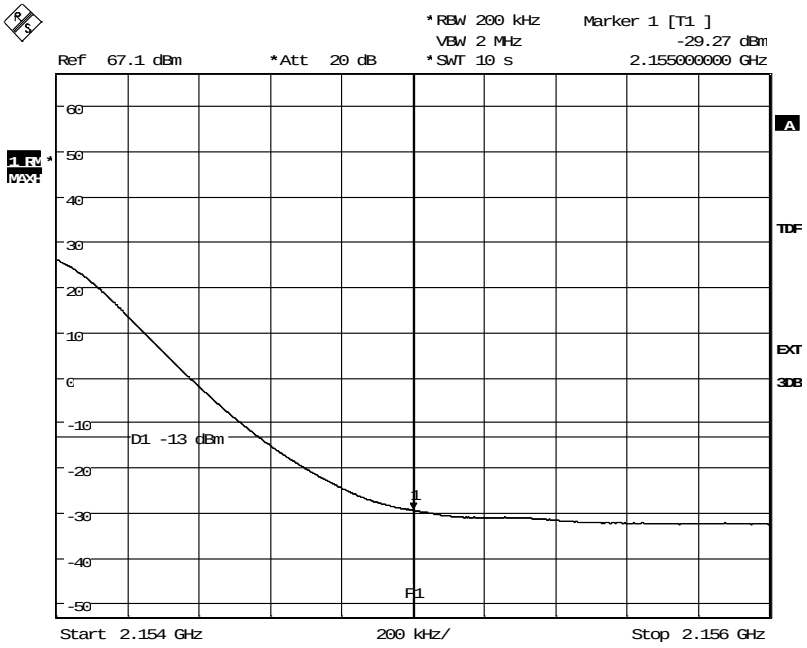
Diagram 15 c:



Date: 27.NOV.2013 20:41:22

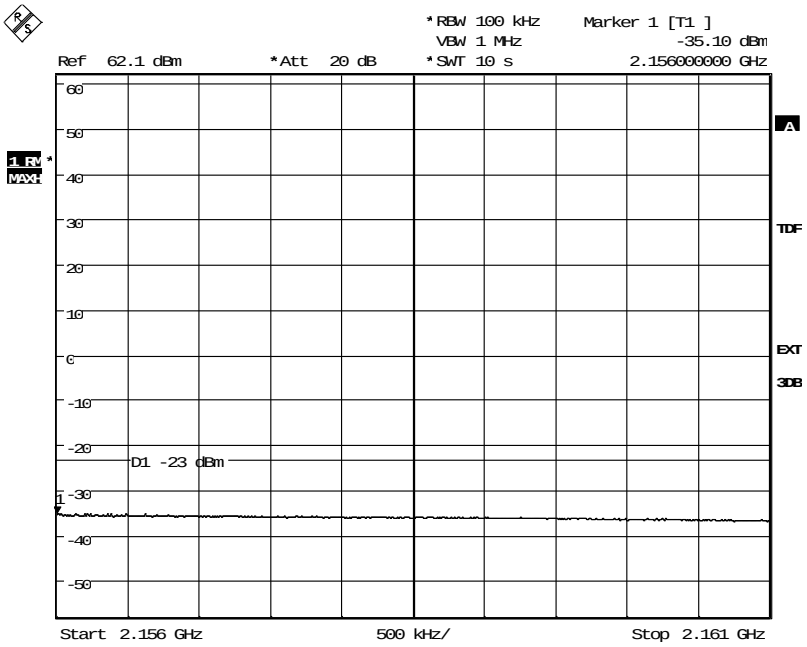
Appendix 4

Diagram 16 a:



Date: 27.NOV.2013 17:56:23

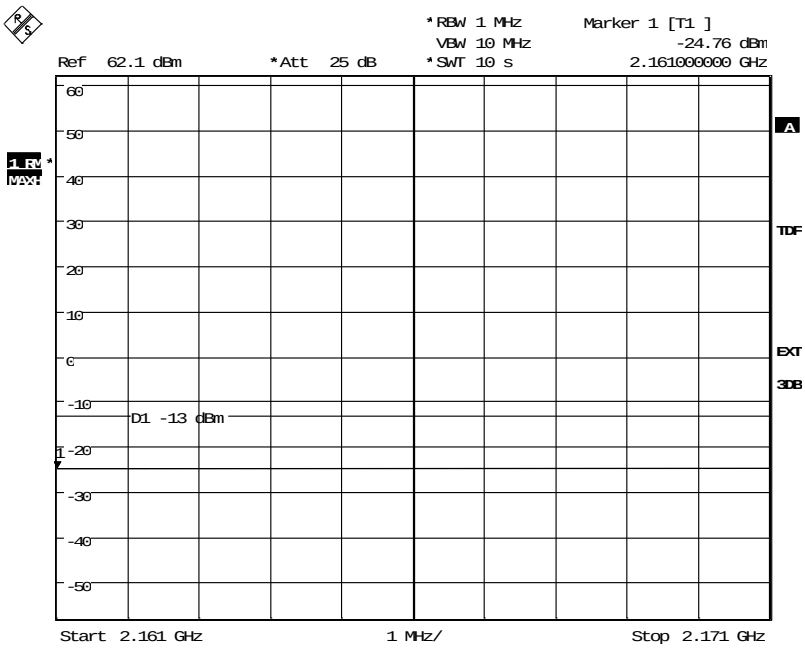
Diagram 16 b:



Date: 27.NOV.2013 17:57:48

Appendix 4

Diagram 16 c:



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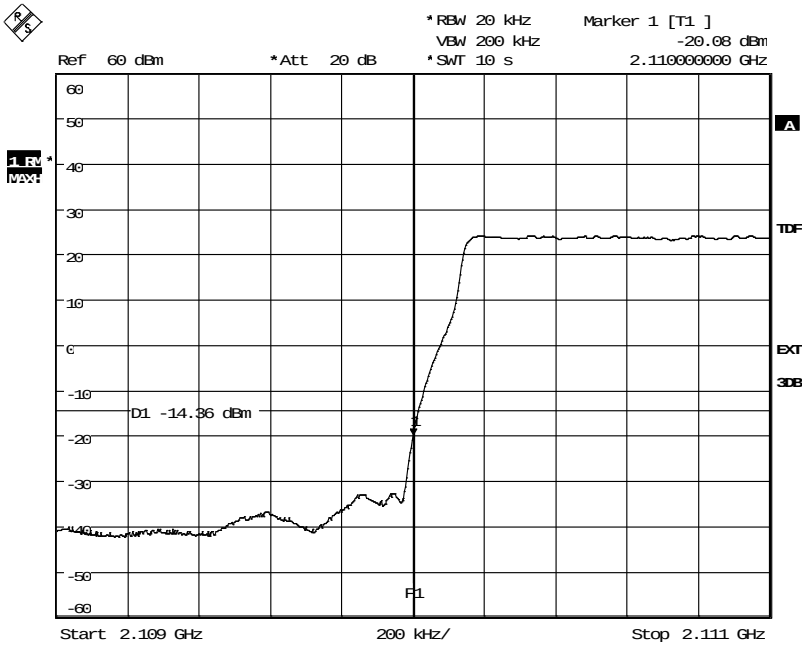
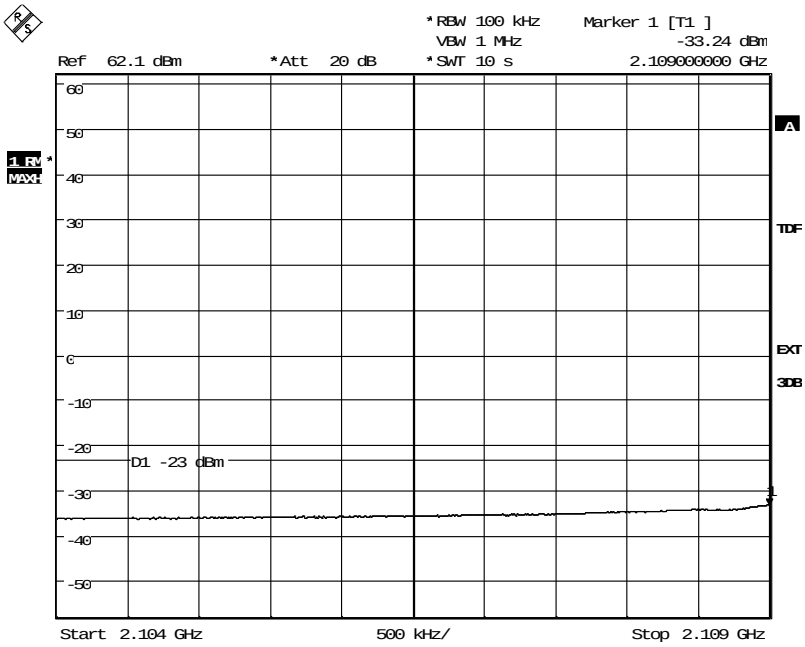
Appendix 4

Diagram 17 a:



Date: 28.NOV.2013 14:28:12

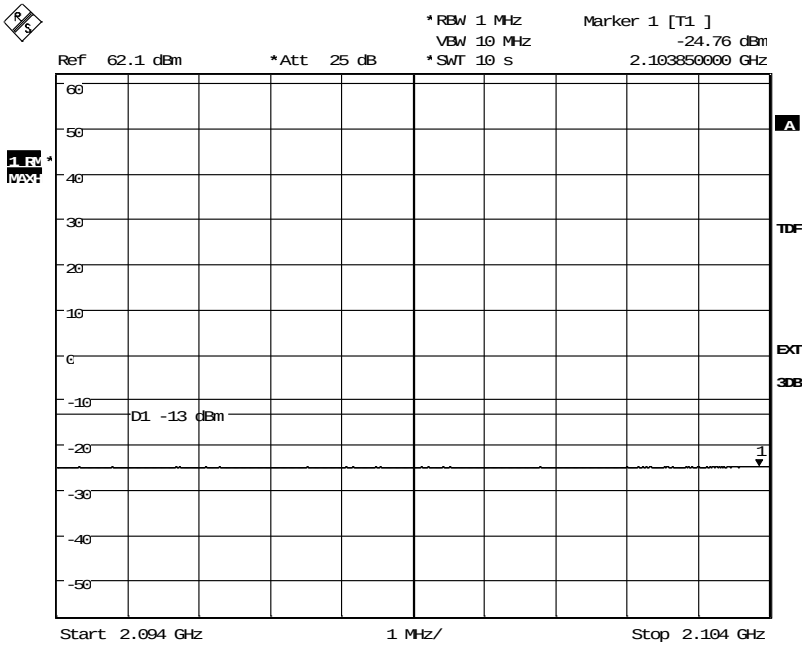
Diagram 17 b:



Date: 28.NOV.2013 14:36:46

Appendix 4

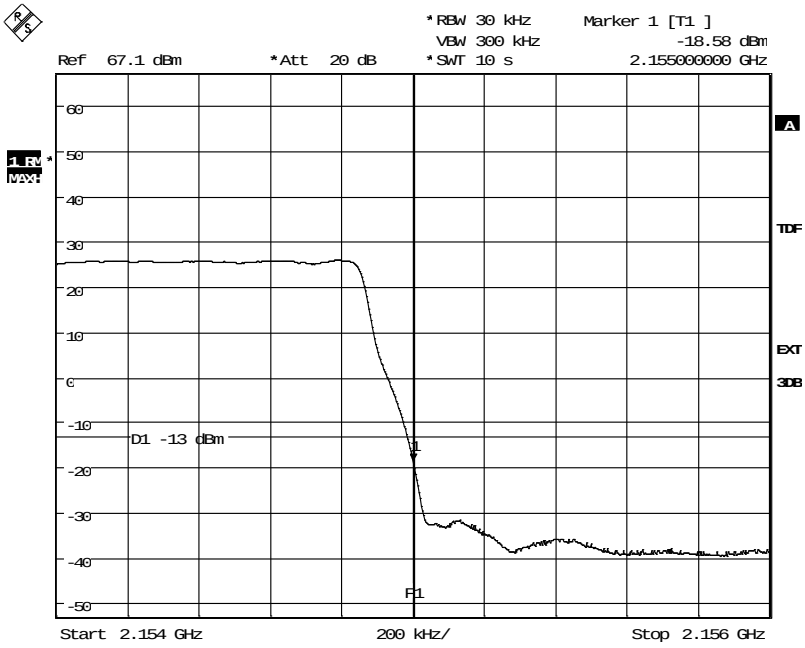
Diagram 17 c:



Date: 28.NOV.2013 14:37:40

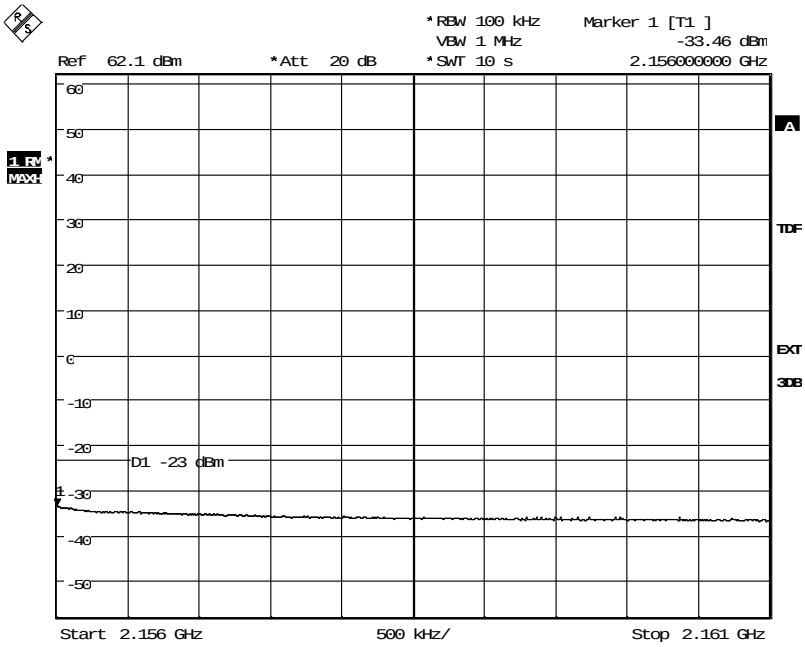
Appendix 4

Diagram 18 a:



Date: 28.NOV.2013 16:46:05

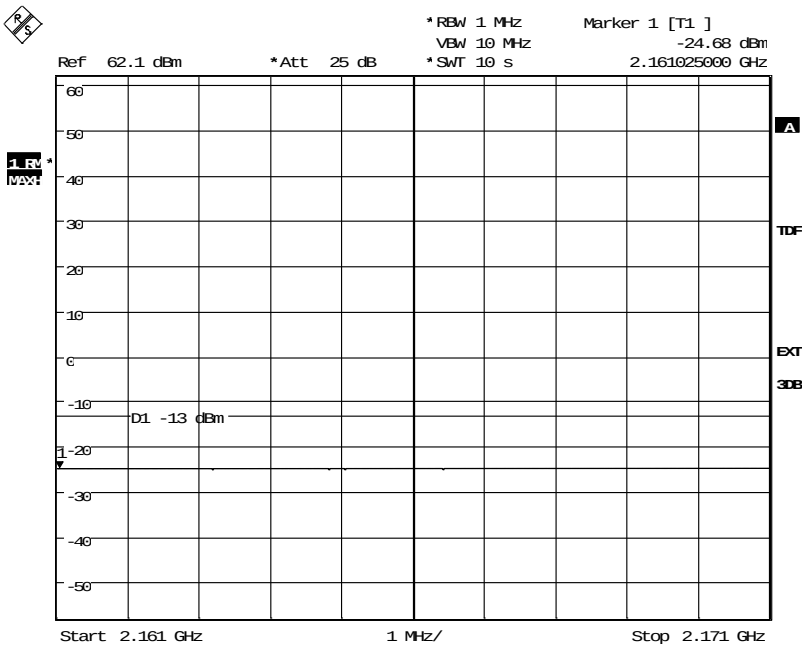
Diagram 18 b:



Date: 28.NOV.2013 16:47:30

Appendix 4

Diagram 18 c:



Date: 28.NOV.2013 16:48:17

Appendix 5

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

Date	Temperature	Humidity
2013-11-21	19 °C ± 3 °C	26 % ± 5 %
2013-11-22	22 °C ± 3 °C	23 % ± 5 %
2013-11-27	21 °C ± 3 °C	33 % ± 5 %
2013-11-29	21 °C ± 3 °C	20 % ± 5 %
2013-12-02	23 °C ± 3 °C	22 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53(h). 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), (iii) “measure and add 10 log(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output v02r01.

Measurement equipment	SP number
R&S FSQ	504 143
RF attenuator	902 282
HP filter	901 502
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

MIMO mode, single carrier

Diagram	BW configuration / [MHz]	Symbolic name	Tested Port
1 a+b+c+d	1.4 MHz	B	RF A
2 a+b+c+d	20 MHz	B	RF A
3 a+b+c+d	1.4 MHz	M	RF A
4 a+b+c+d	1.4 MHz	M	RF B
5 a+b+c+d	3 MHz	M	RF A
6 a+b+c+d	5 MHz	M	RF A
7 a+b+c+d	10 MHz	M	RF A
8 a+b+c+d	15 MHz	M	RF A
9 a+b+c+d	20 MHz	M	RF A
10 a+b+c+d	20 MHz	M	RF B
11 a+b+c+d	1.4 MHz	T	RF A
12 a+b+c+d	20 MHz	T	RF A

MIMO mode, 2 carrier

Diagram	BW configuration	Symbolic name	Tested Port
13 a+b+c+d+e	1.4 MHz	B2im1	RF A
14 a+b+c+d+e	1.4 MHz	B2im2	RF A
15 a+b+c+d+e	1.4 MHz	M2	RF A
16 a+b+c+d+e	1.4 MHz	T2im1	RF A
17 a+b+c+d+e	1.4 MHz	T2im2	RF A

MIMO mode, 4 carrier

Diagram	BW configuration	Symbolic name	Tested Port
18 a+b+c+d+e	1.4 MHz	B4im	RF A
19 a+b+c+d+e	1.4 MHz	M4	RF A
20 a+b+c+d+e	1.4 MHz	T4im	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

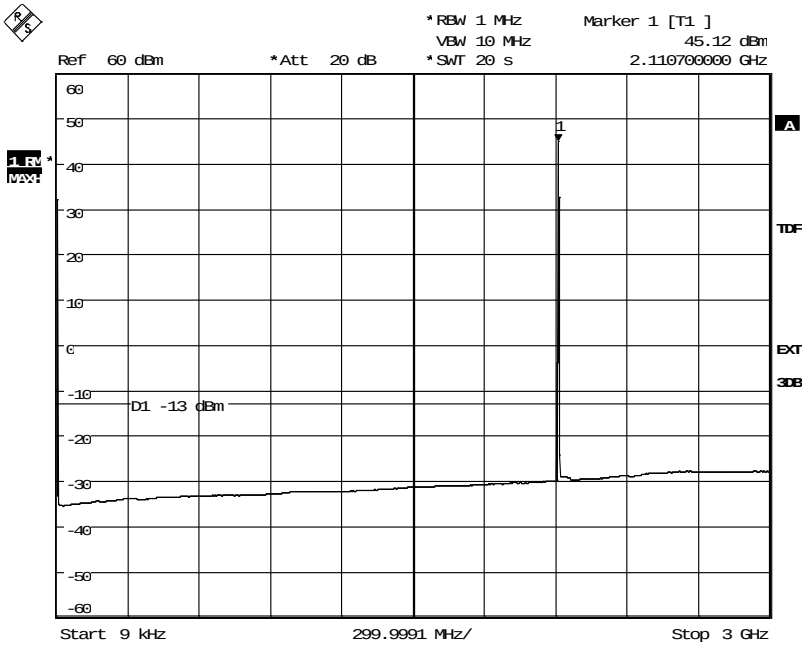
§27.53(h) and RSS-139 6.5

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

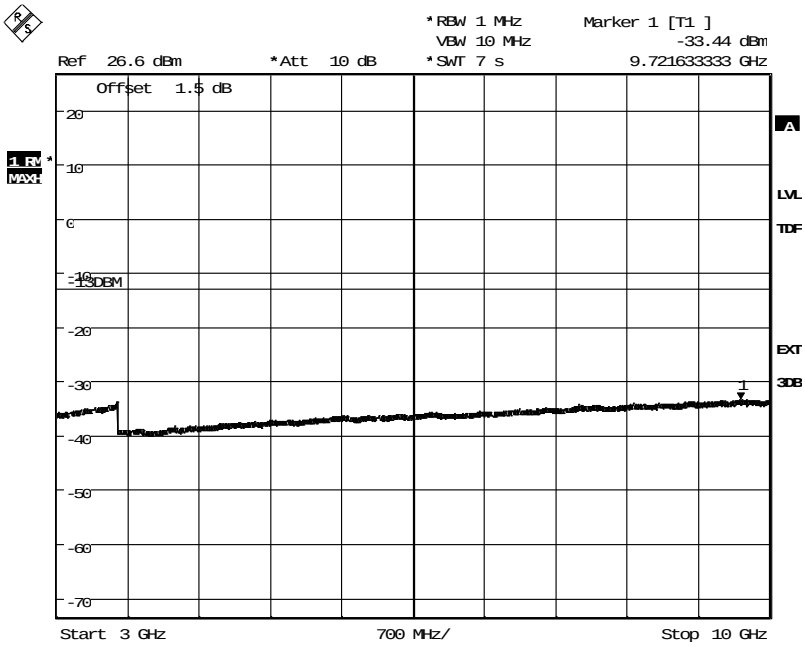
Appendix 5

Diagram 1 a:



Date: 21.NOV.2013 15:04:45

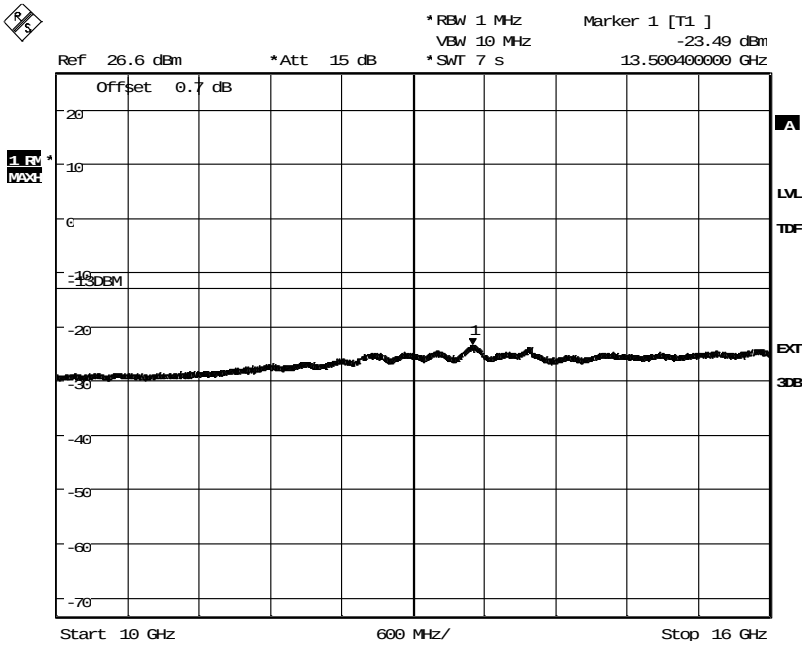
Diagram 1 b:



Date: 21.NOV.2013 15:07:13

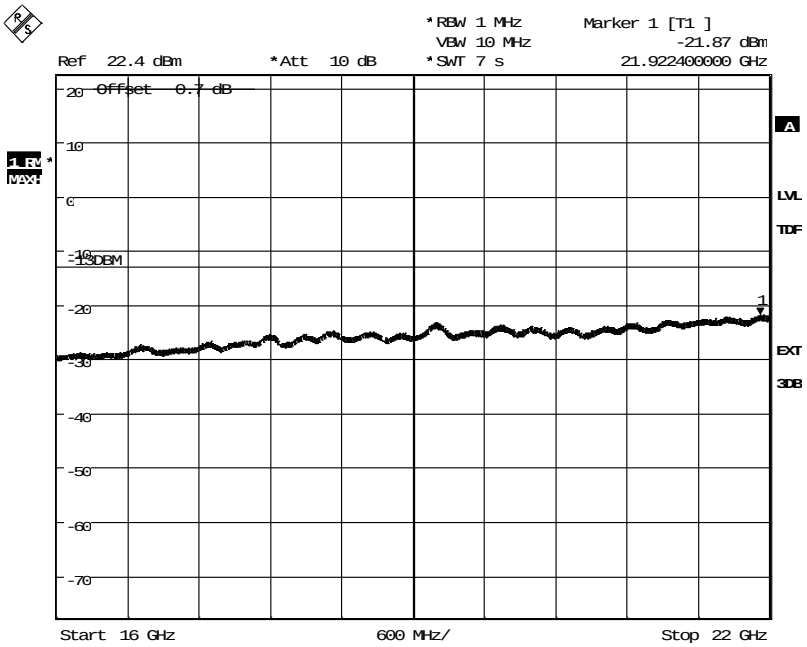
Appendix 5

Diagram 1 c:



Date: 21.NOV.2013 15:07:55

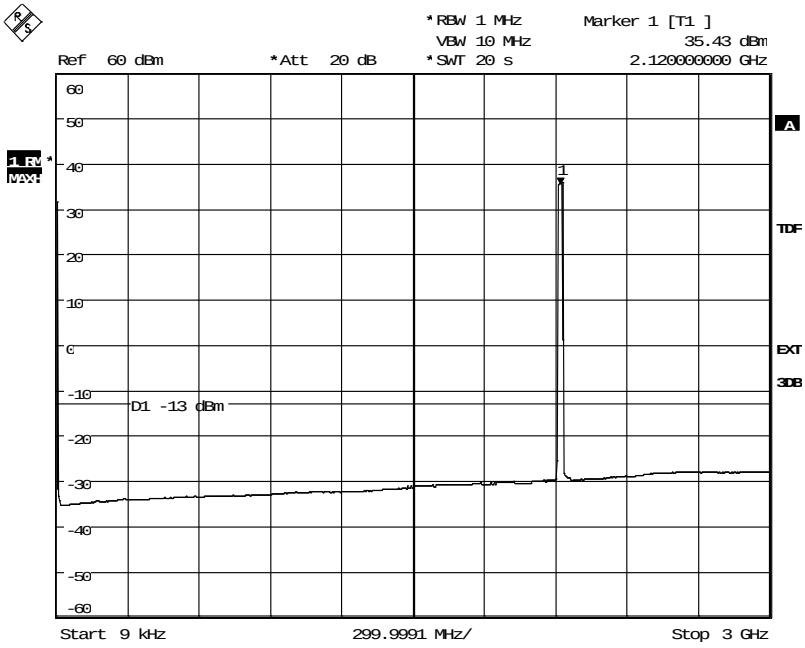
Diagram 1 d:



Date: 21.NOV.2013 15:08:33

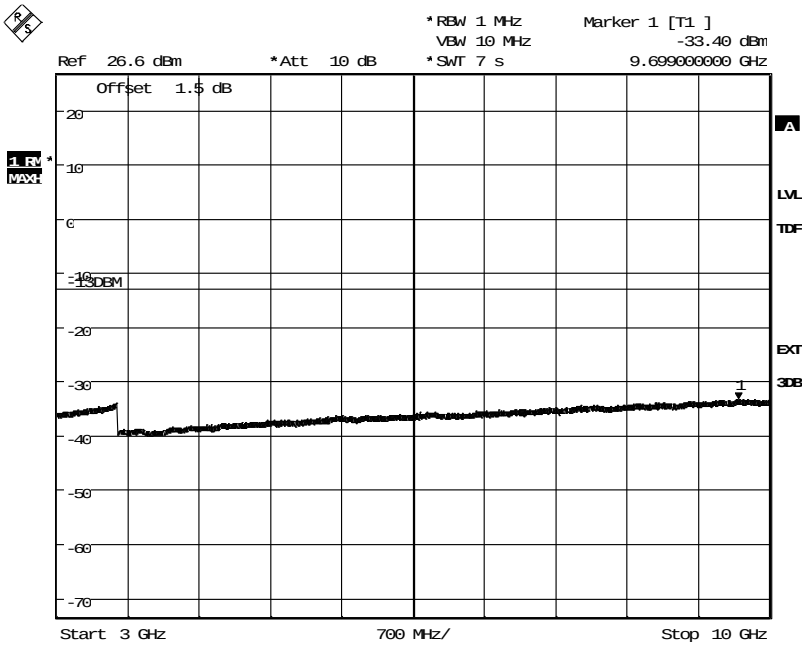
Appendix 5

Diagram 2 a:



Date: 21.NOV.2013 15:49:46

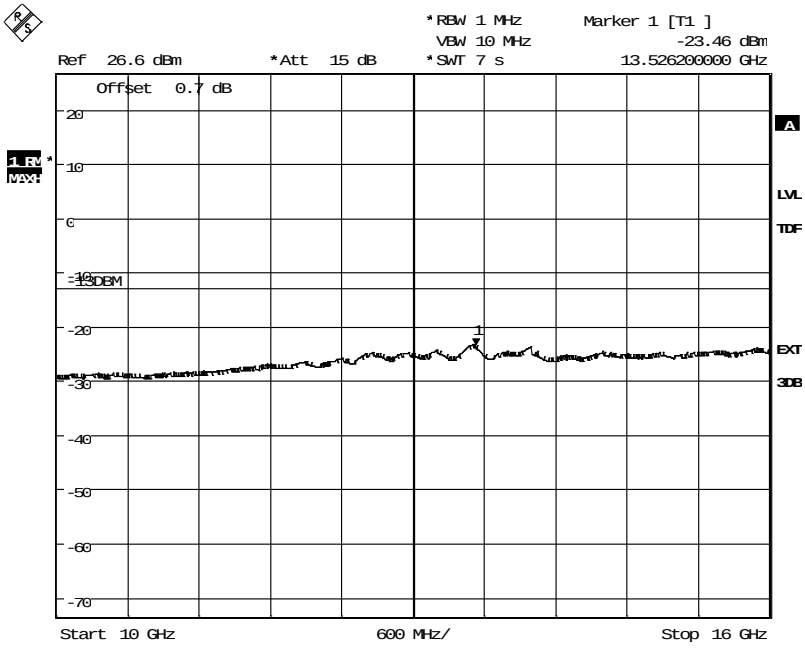
Diagram 2 b:



Date: 21.NOV.2013 15:51:40

Appendix 5

Diagram 2 c:



Date: 21.NOV.2013 15:53:46

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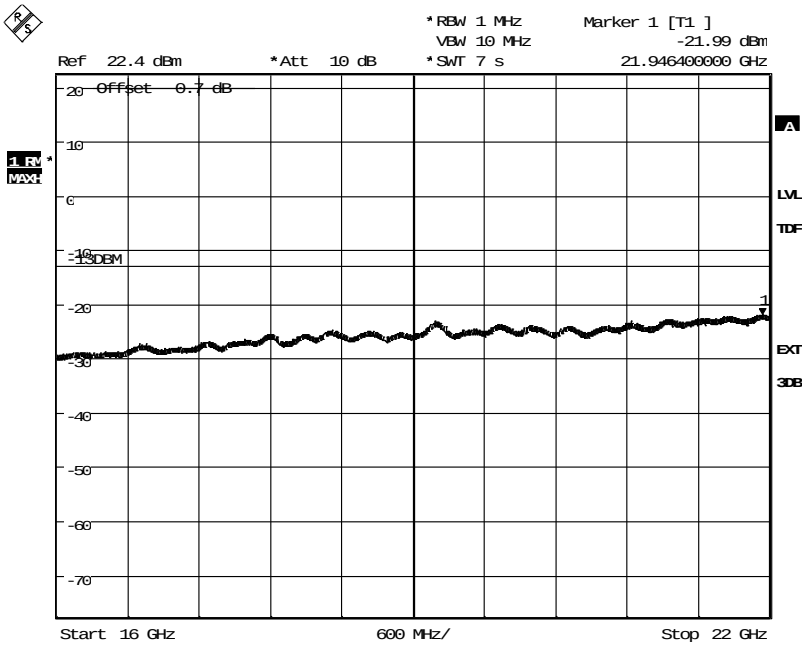

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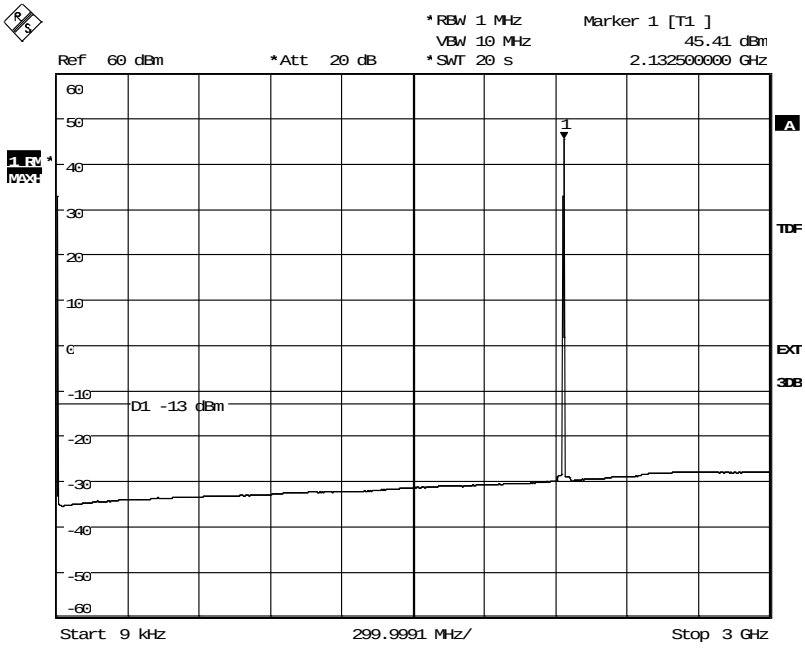
Appendix 5

Diagram 3 a:



Date: 22.NOV.2013 08:14:19

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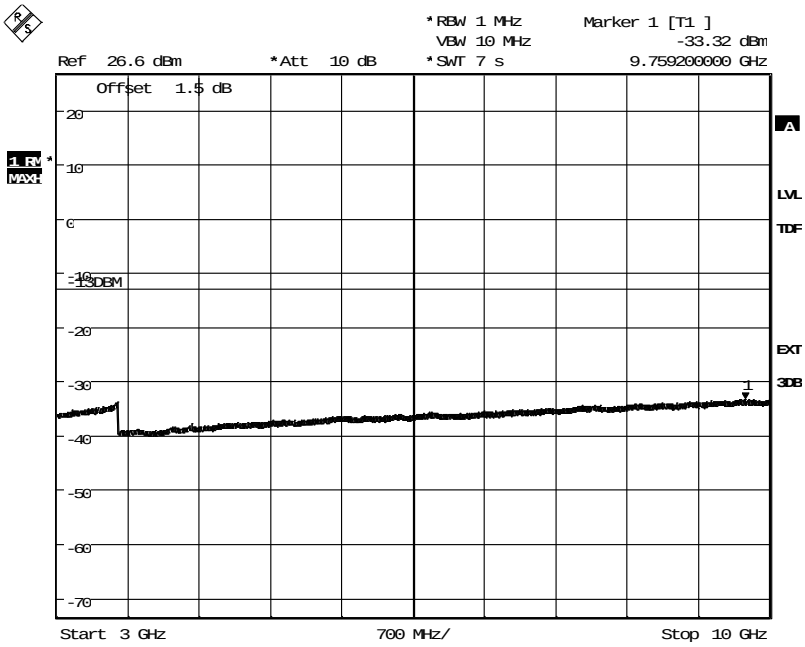
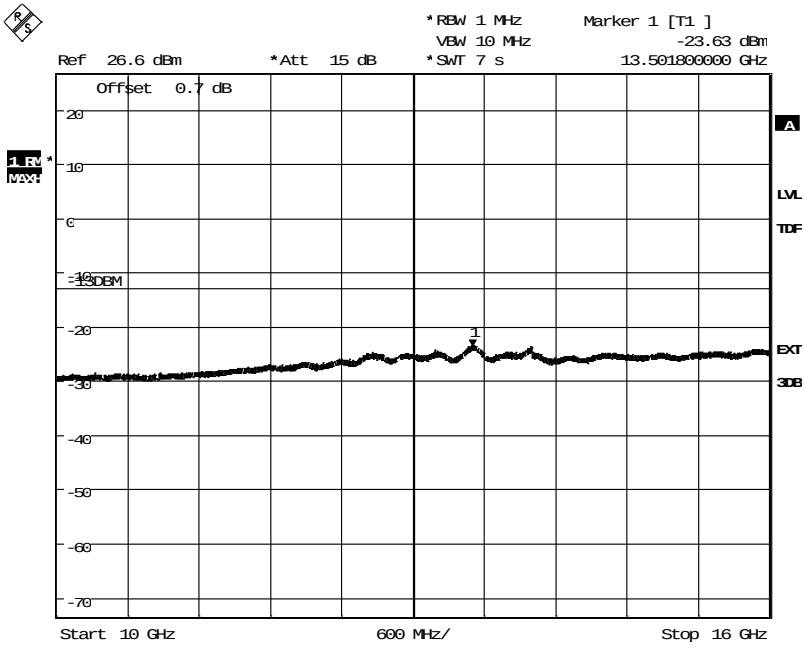


Date: 22.NOV.2013 08:15:54

Appendix 5

Diagram 3 c:



Date: 22.NOV.2013 08:16:39

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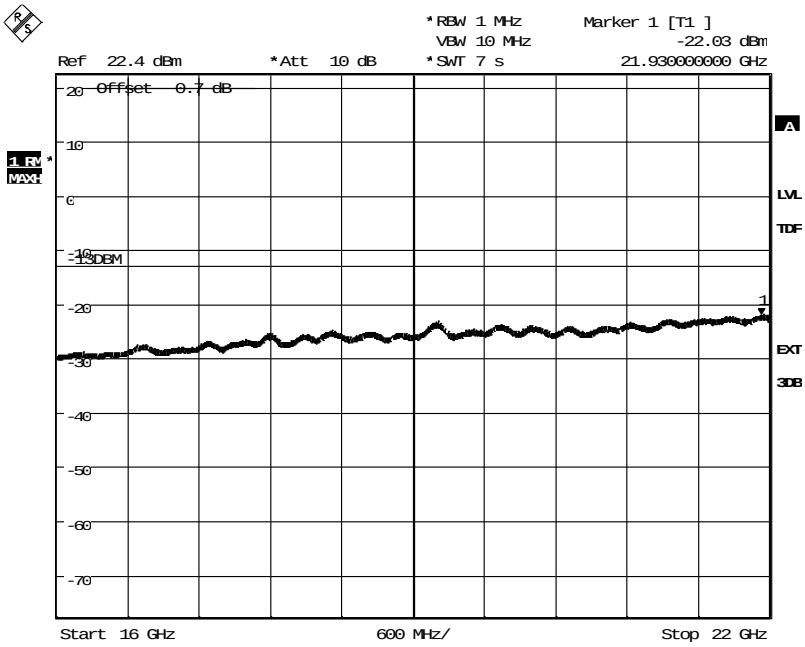
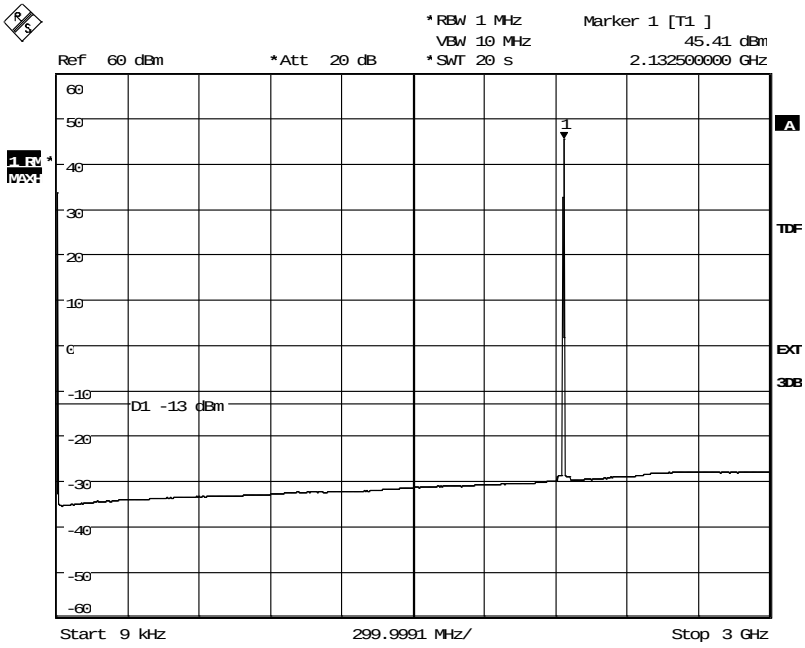


Date: 22.NOV.2013 08:17:14

Appendix 5

Diagram 4 a:



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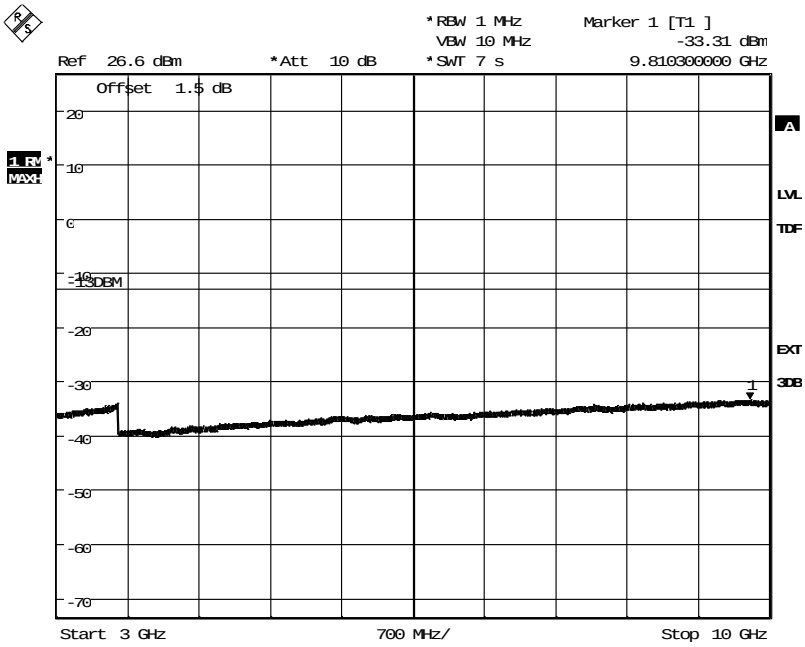
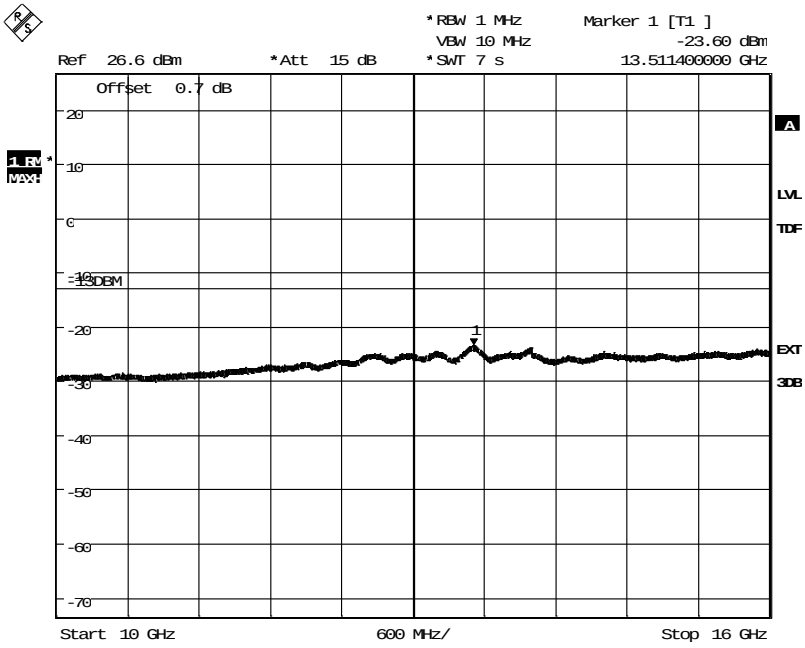


Date: 22.NOV.2013 08:20:48

Appendix 5

Diagram 4 c:



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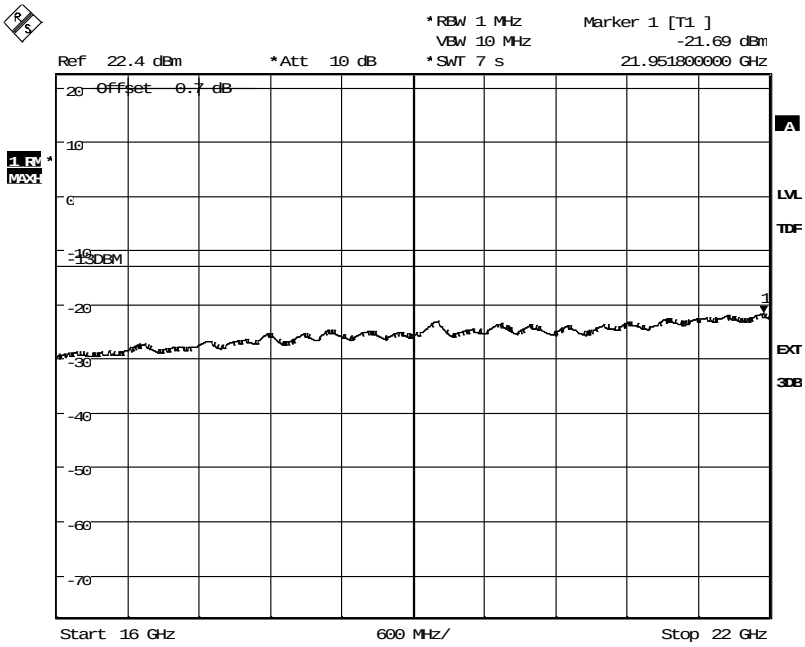

Date: 22.NOV.2013 08:19:37

Appendix 5

Diagram 5 a:

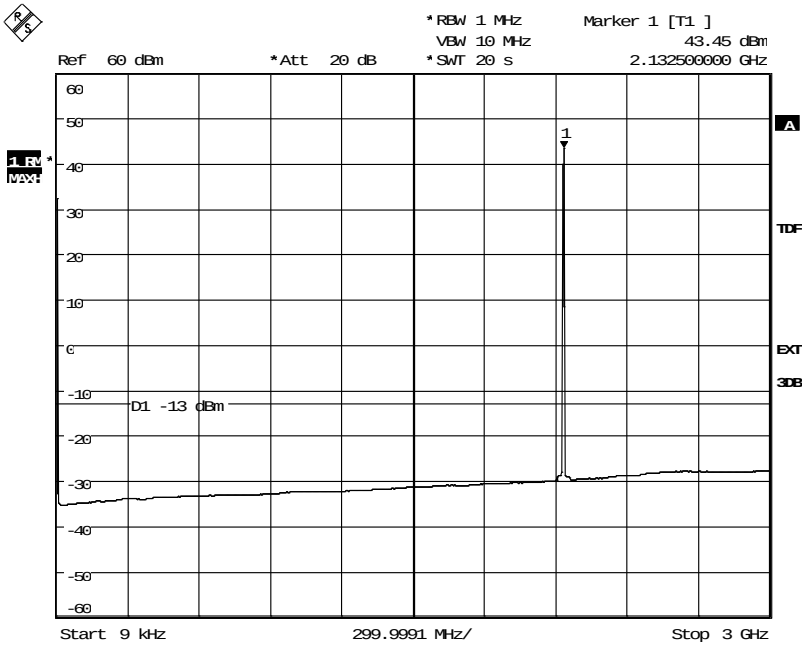

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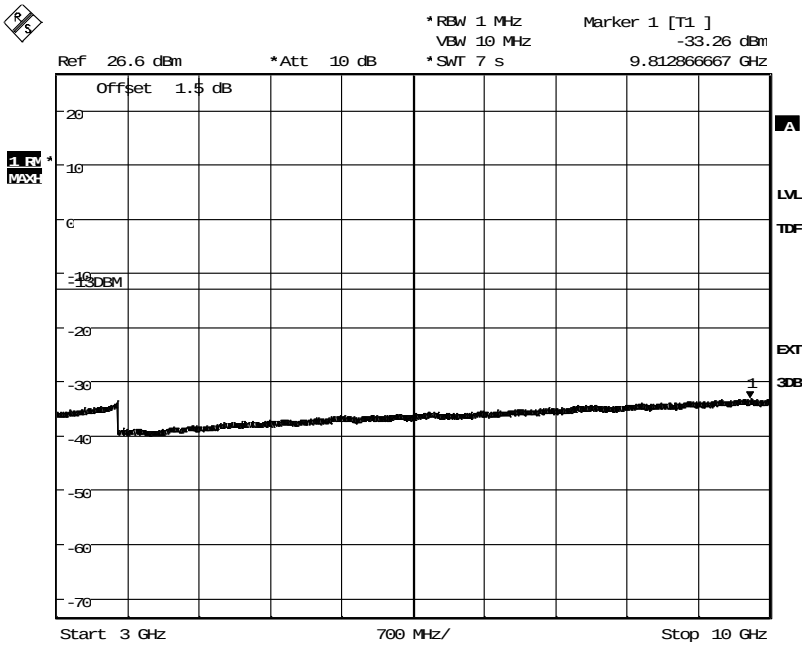
Diagram 5 b:



Date: 22.NOV.2013 10:22:25

Appendix 5

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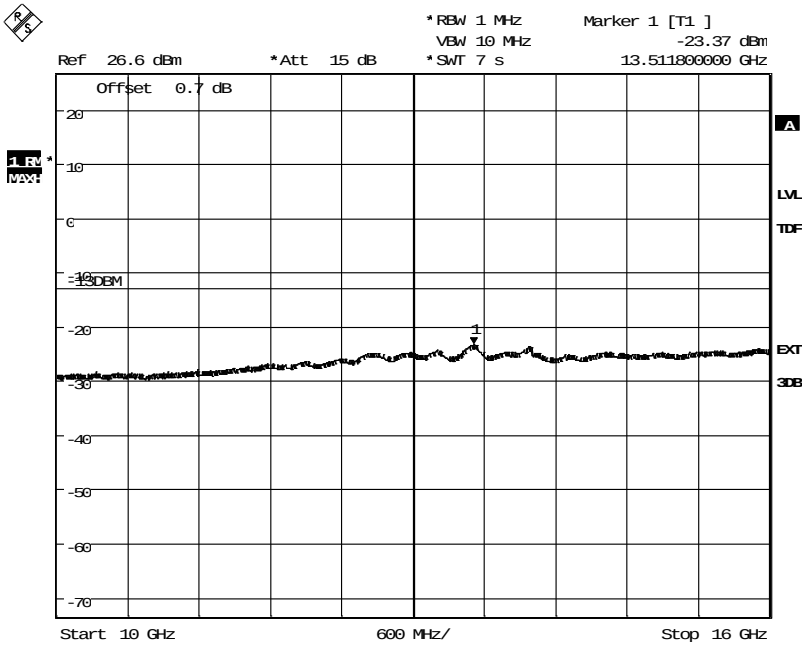

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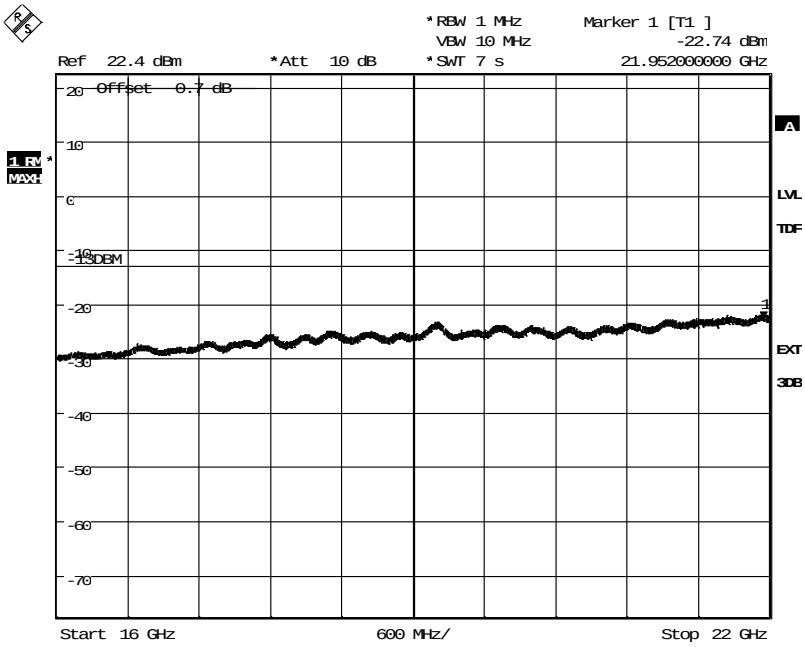
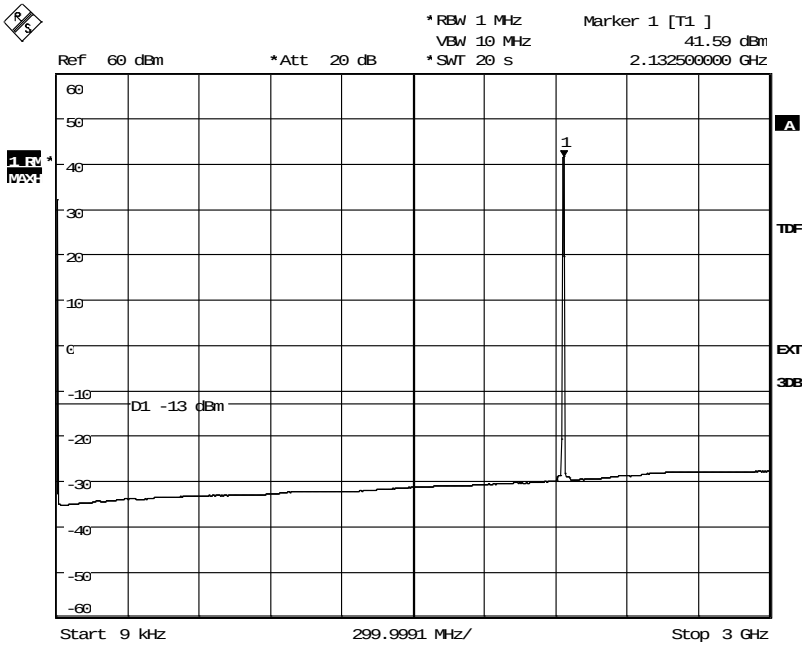


Date: 22.NOV.2013 10:19:46

Appendix 5

Diagram 6 a:



Date: 22.NOV.2013 10:15:56

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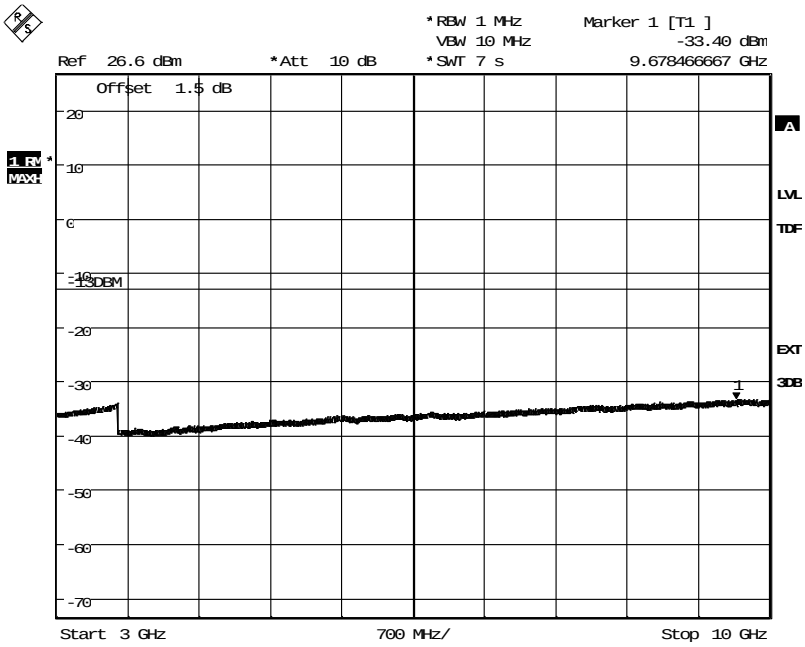
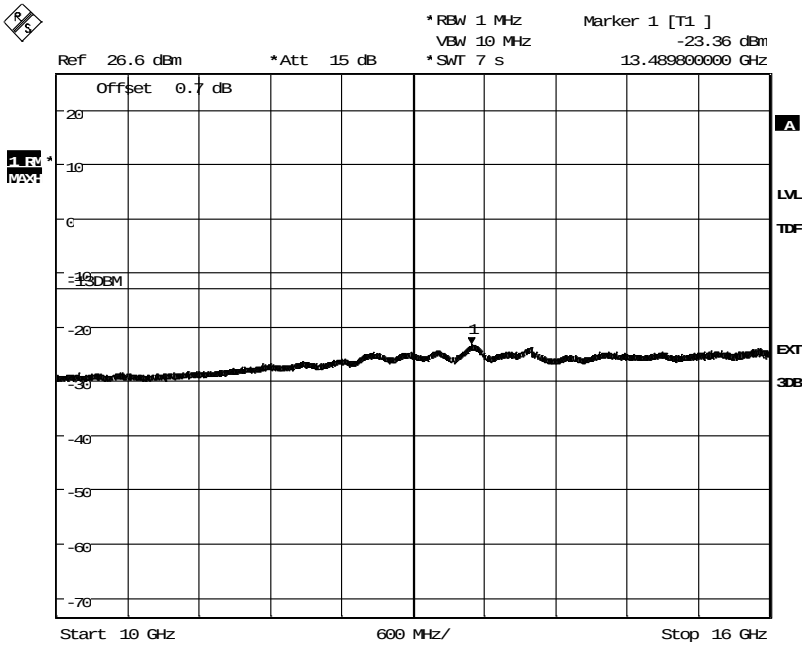


Date: 22.NOV.2013 10:17:33

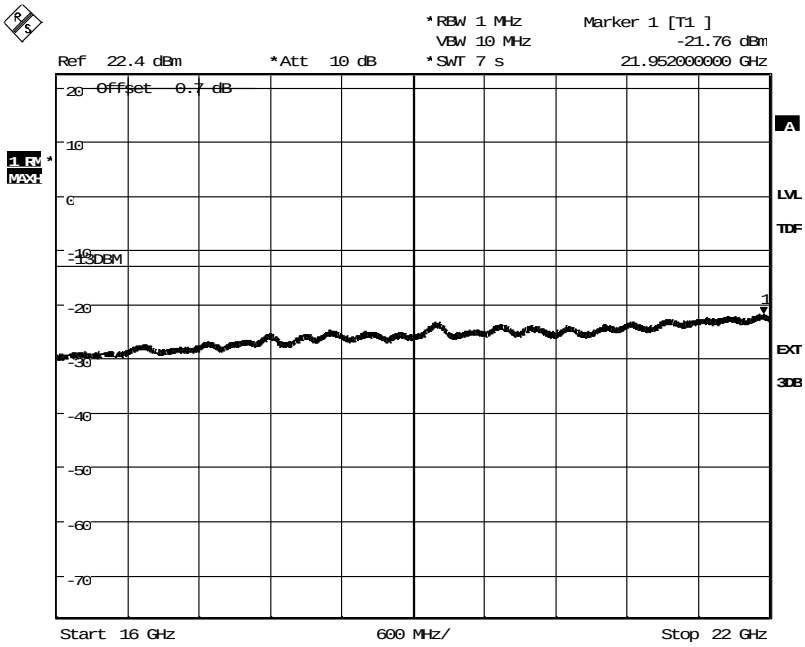
Appendix 5

Diagram 6 c:



Date: 22.NOV.2013 10:18:07

Diagram 6 d:



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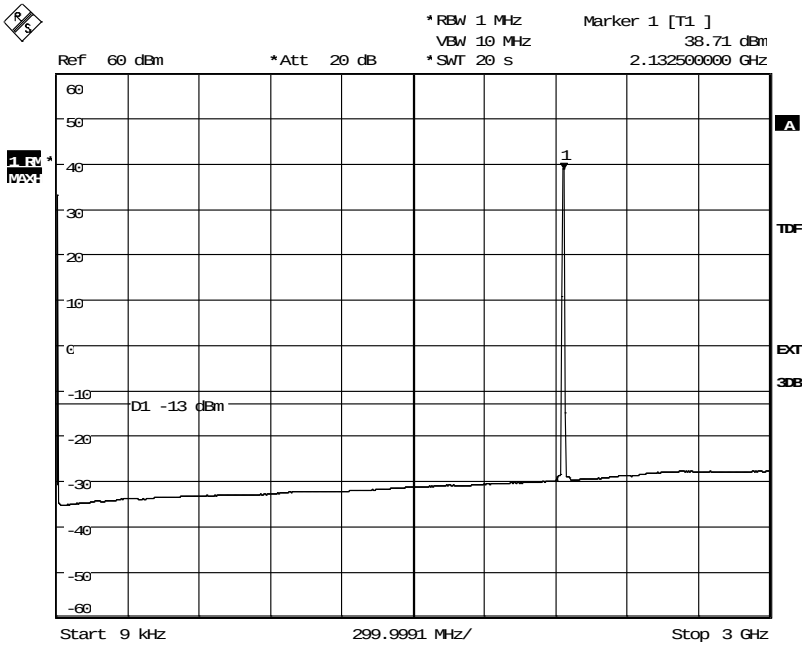
Appendix 5

Diagram 7 a:



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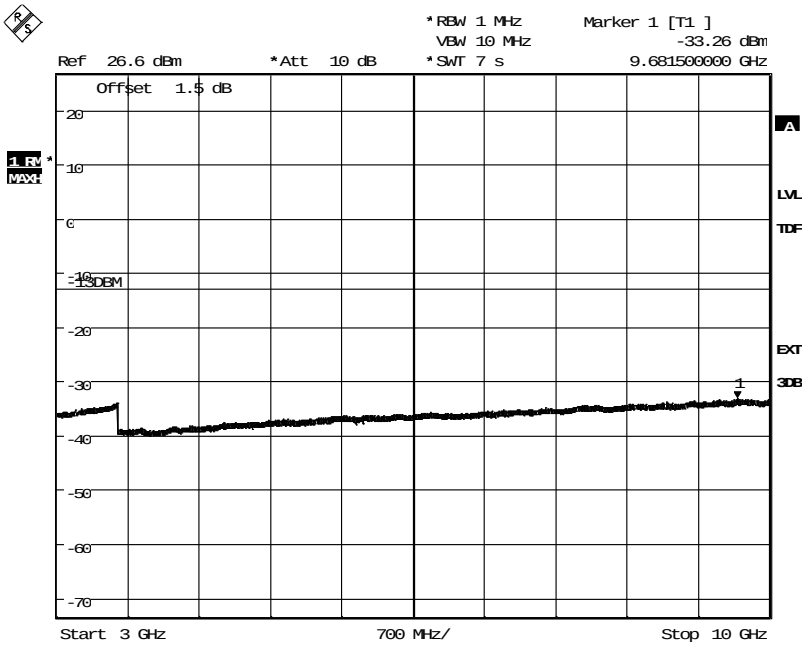

Date: 22.NOV.2013 10:05:44

Appendix 5

Diagram 7 c:

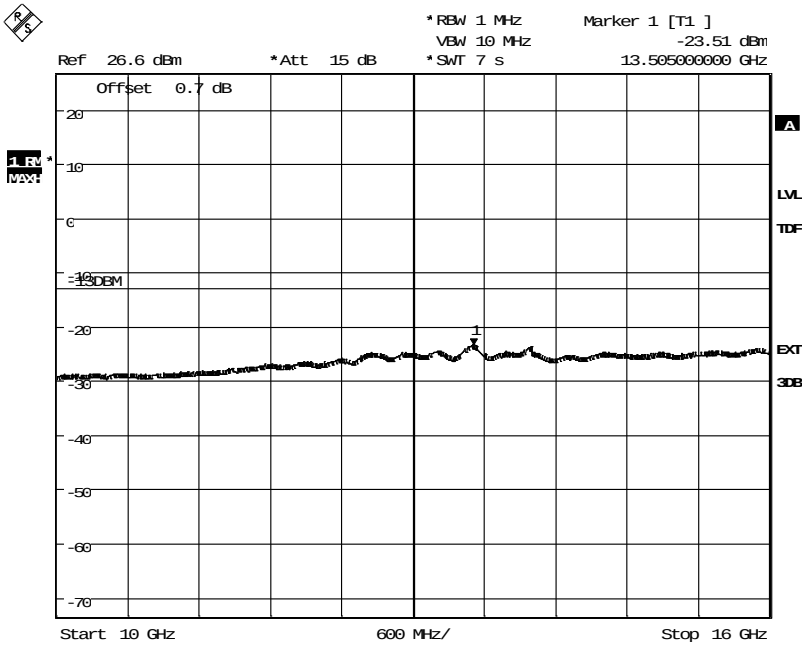

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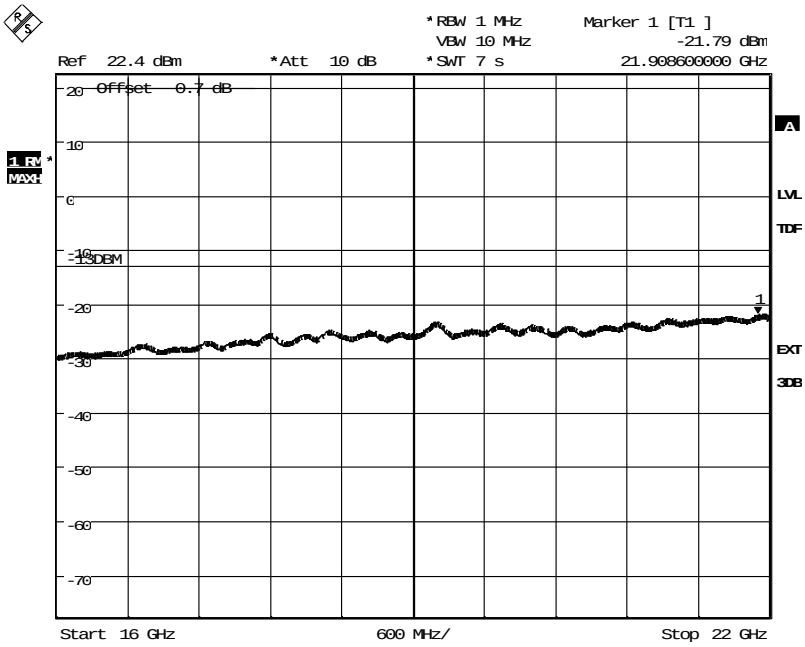
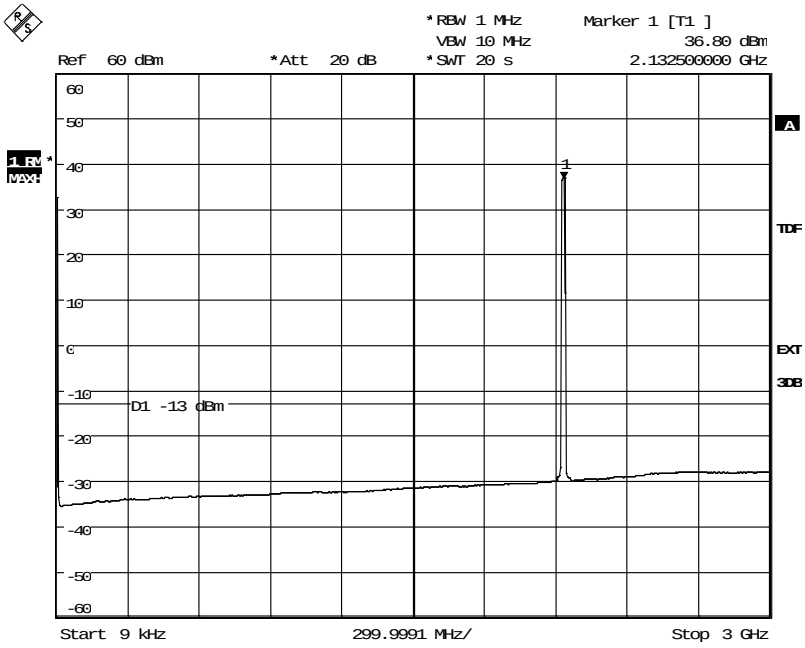
Diagram 7 d:



Date: 22.NOV.2013 10:03:34

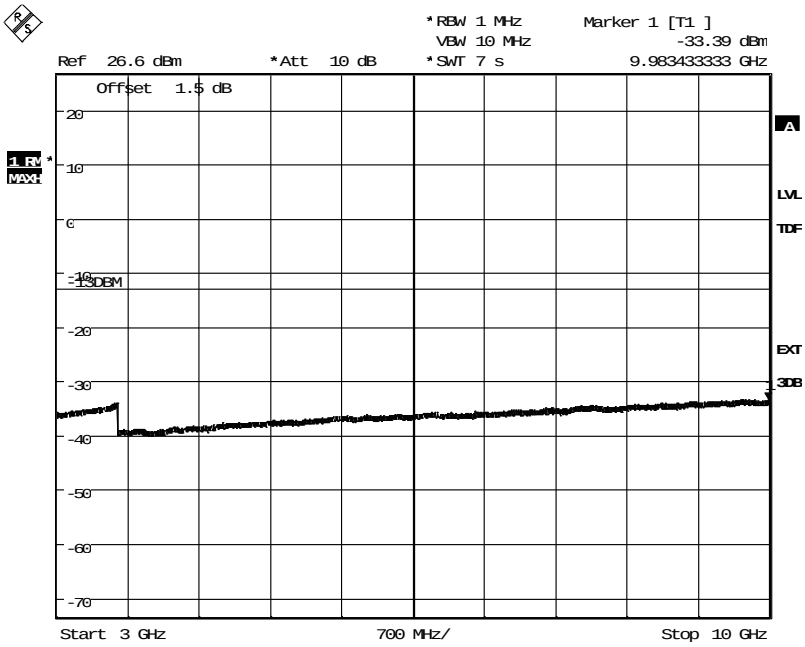
Appendix 5

Diagram 8 a:



Date: 22.NOV.2013 09:21:22

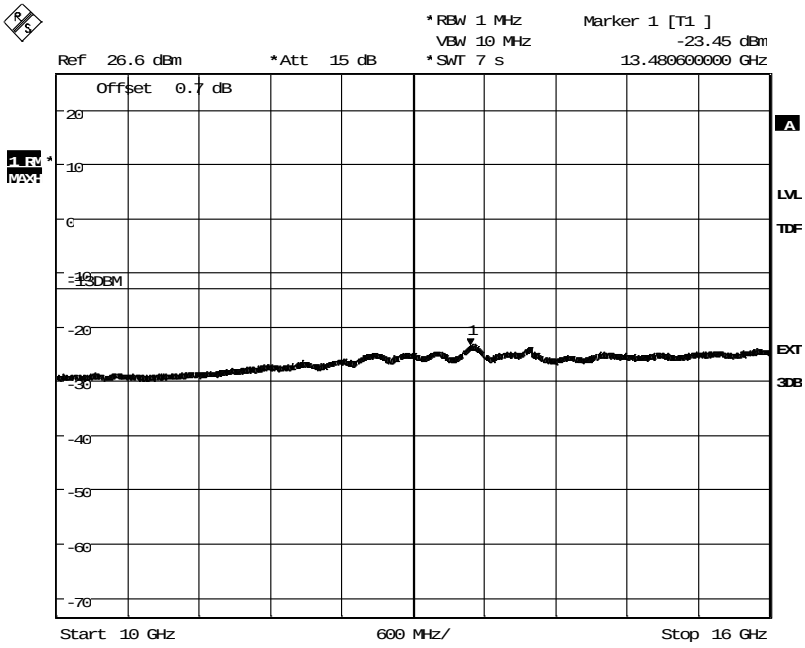
Diagram 8 b:



Date: 22.NOV.2013 09:22:32

Appendix 5

Diagram 8 c:



Date: 22.NOV.2013 09:23:13

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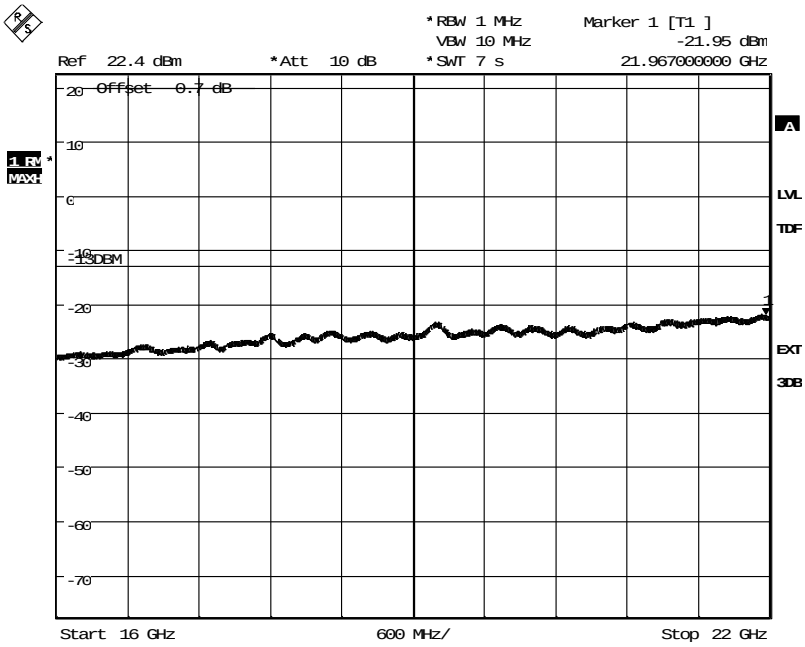
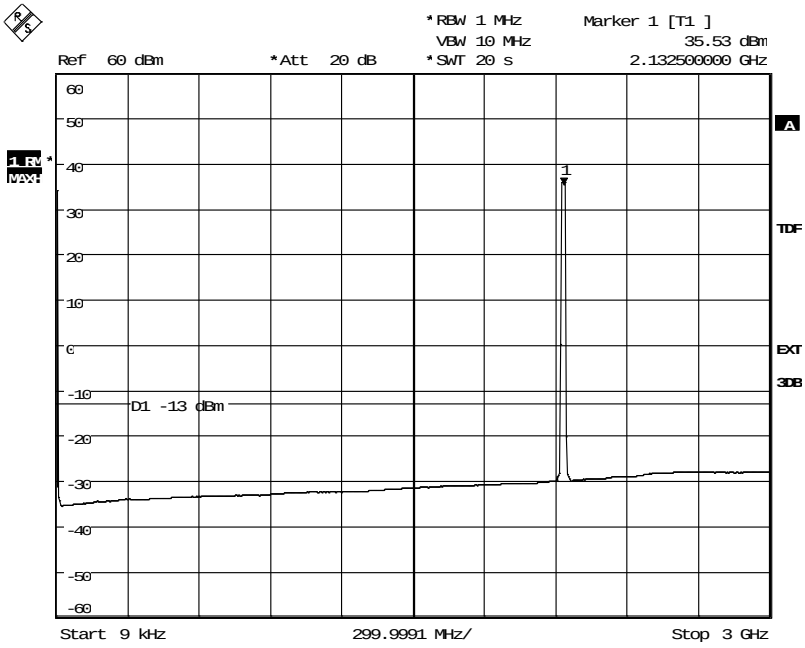


Date: 22.NOV.2013 09:23:53

Appendix 5

Diagram 9 a:



Date: 22.NOV.2013 09:02:10

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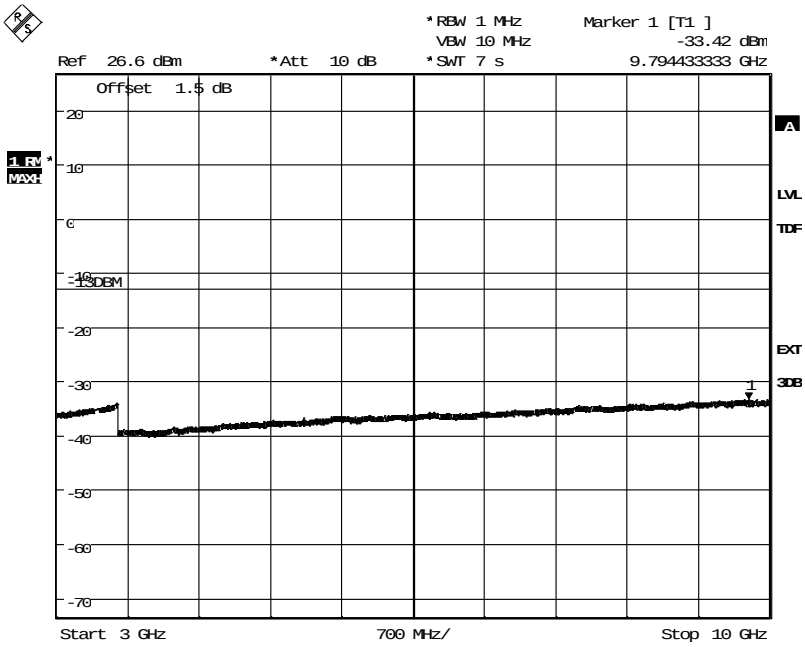

Date: 22.NOV.2013 09:00:42

Appendix 5

Diagram 9 c:

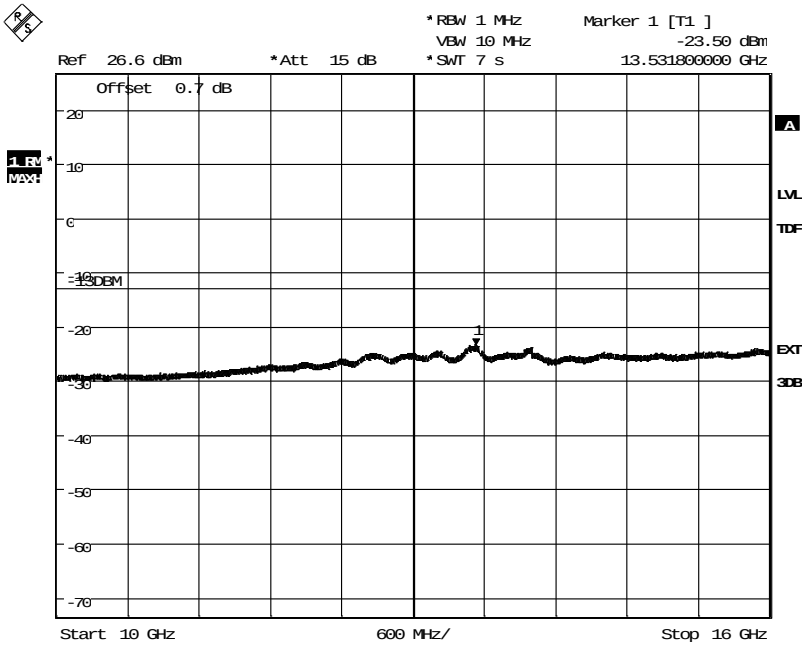

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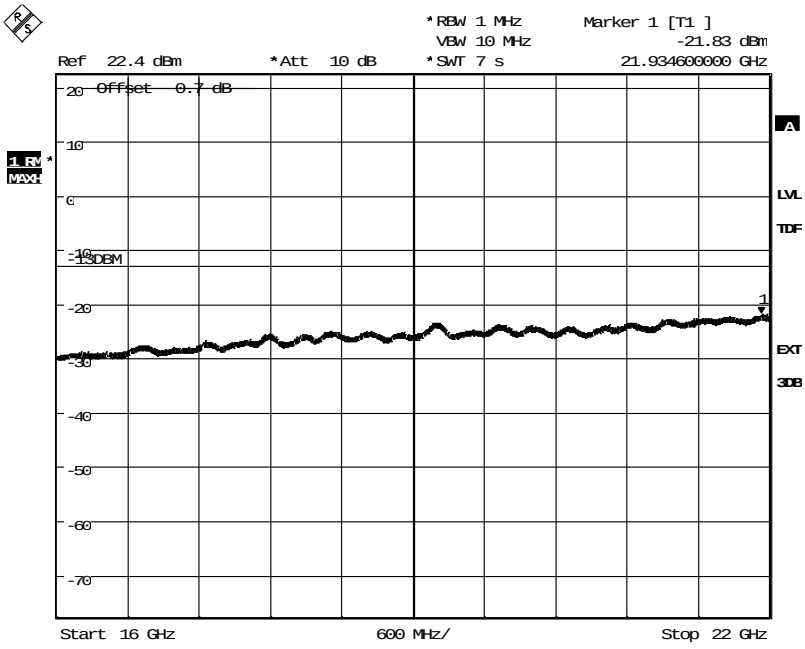
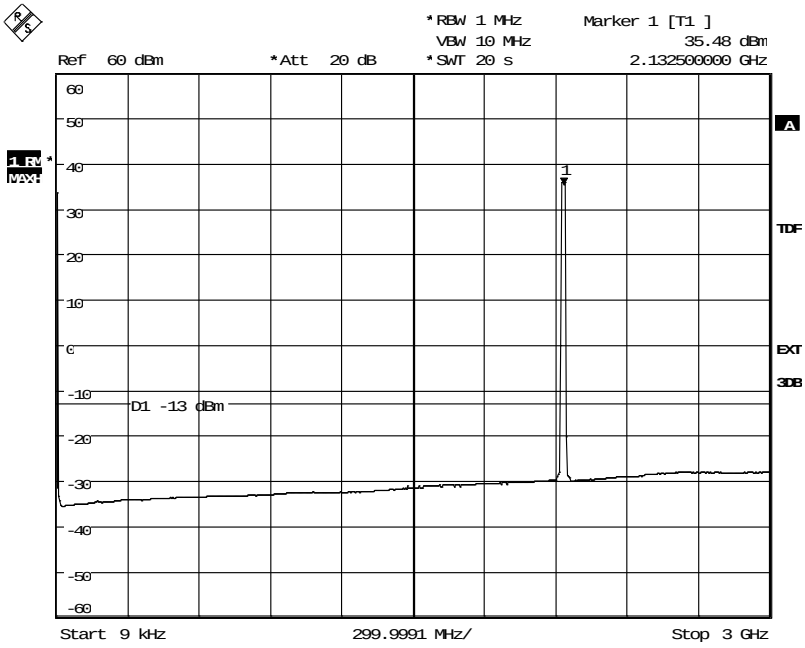
Diagram 9 d:



Date: 22.NOV.2013 08:59:17

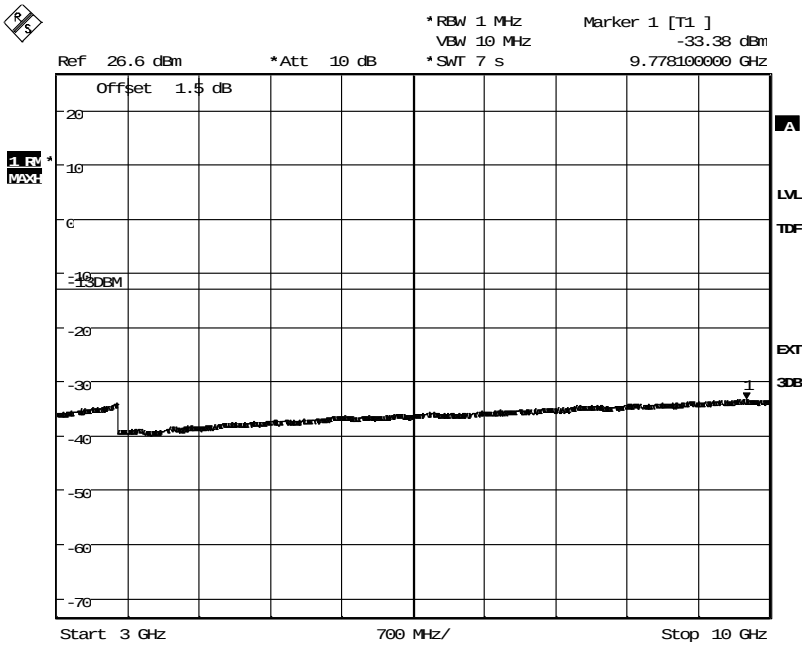
Appendix 5

Diagram 10 a:



Date: 22.NOV.2013 08:53:08

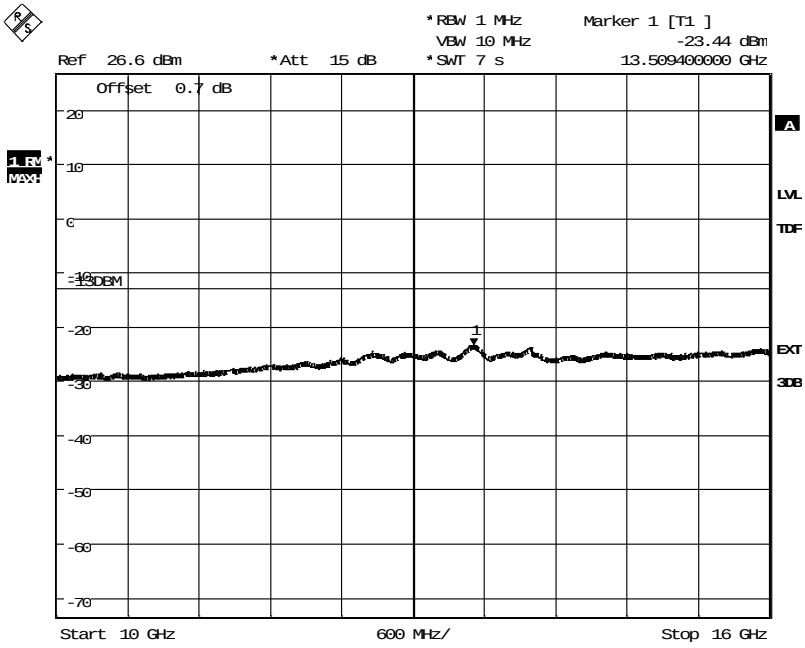
Diagram 10 b:



Date: 22.NOV.2013 08:55:33

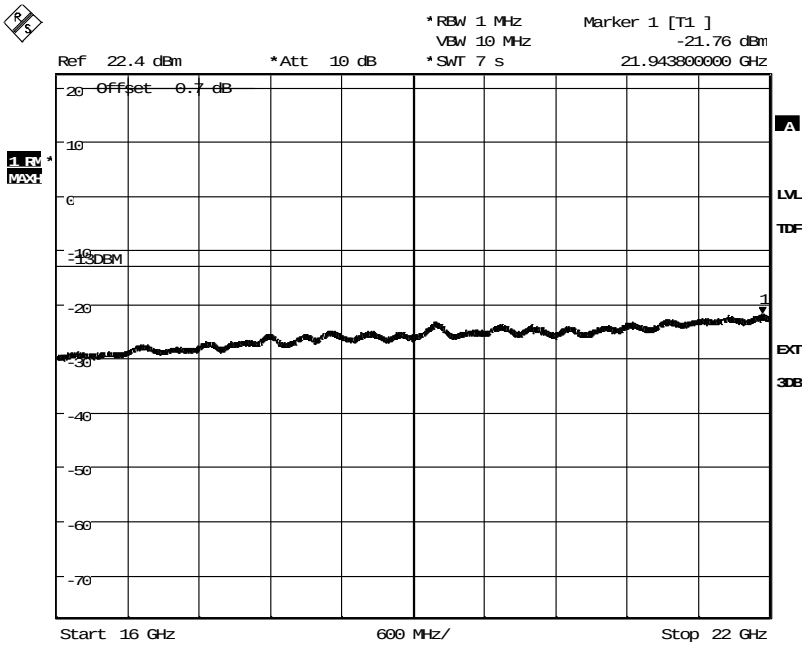
Appendix 5

Diagram 10 c:



Date: 22.NOV.2013 08:56:31

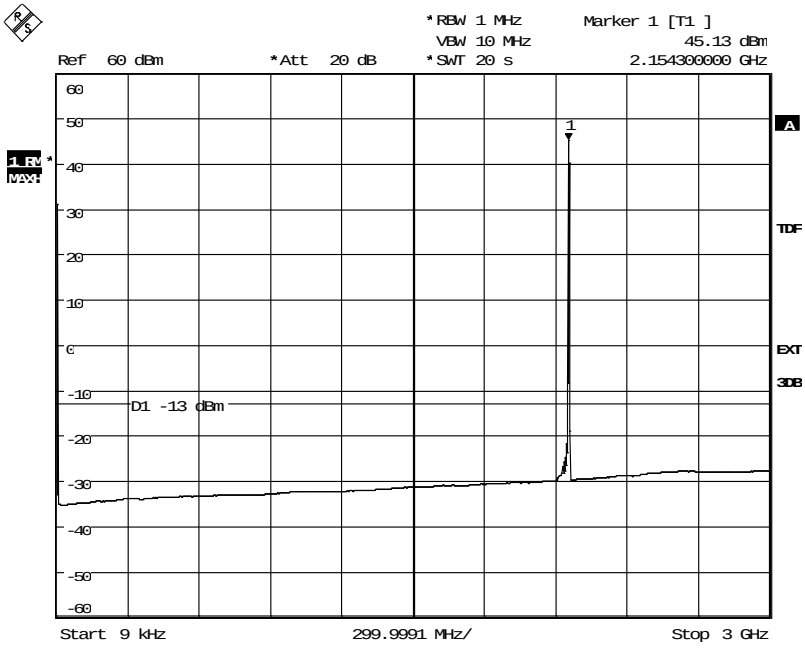
Diagram 10 d:



Date: 22.NOV.2013 08:57:06

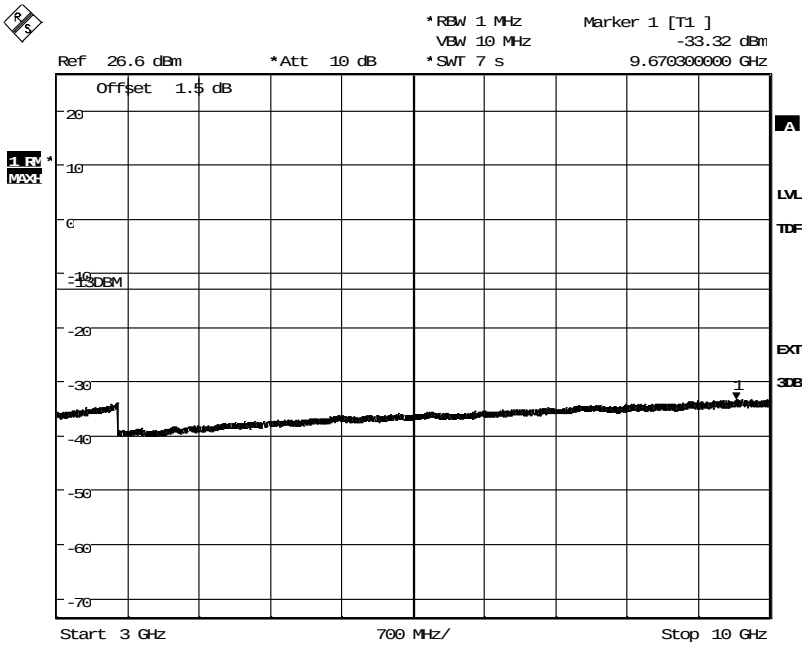
Appendix 5

Diagram 11 a:



Date: 27.NOV.2013 16:23:54

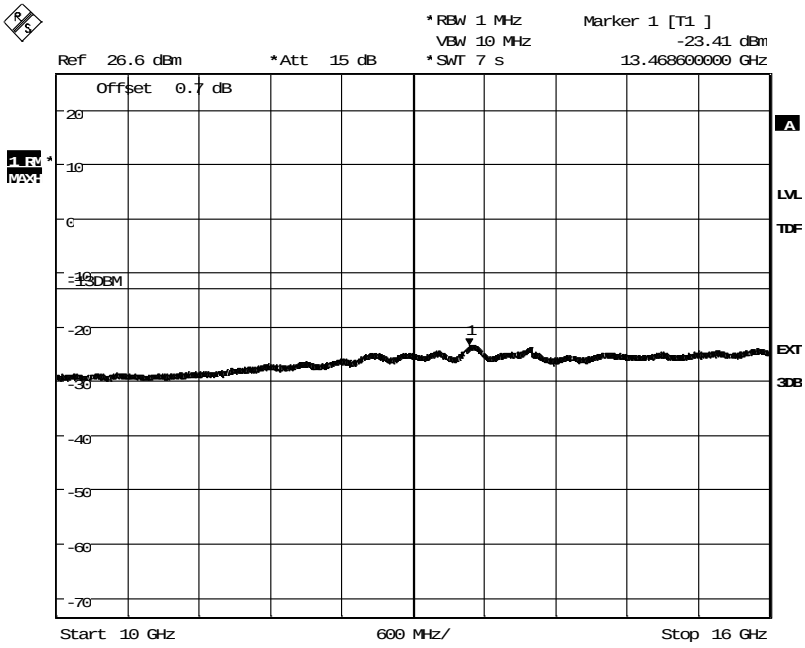
Diagram 11 b:



Date: 27.NOV.2013 16:22:31

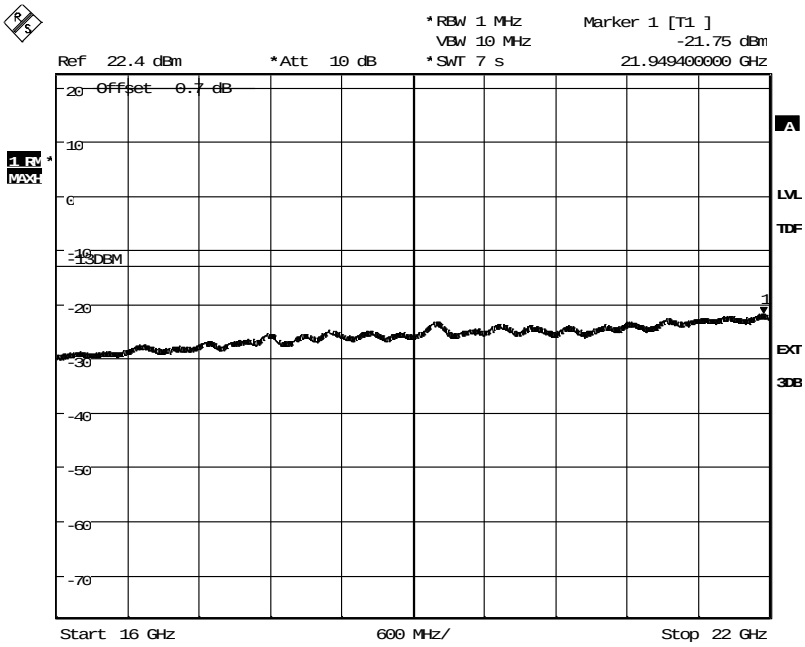
Appendix 5

Diagram 11 c:



Date: 27.NOV.2013 16:21:56

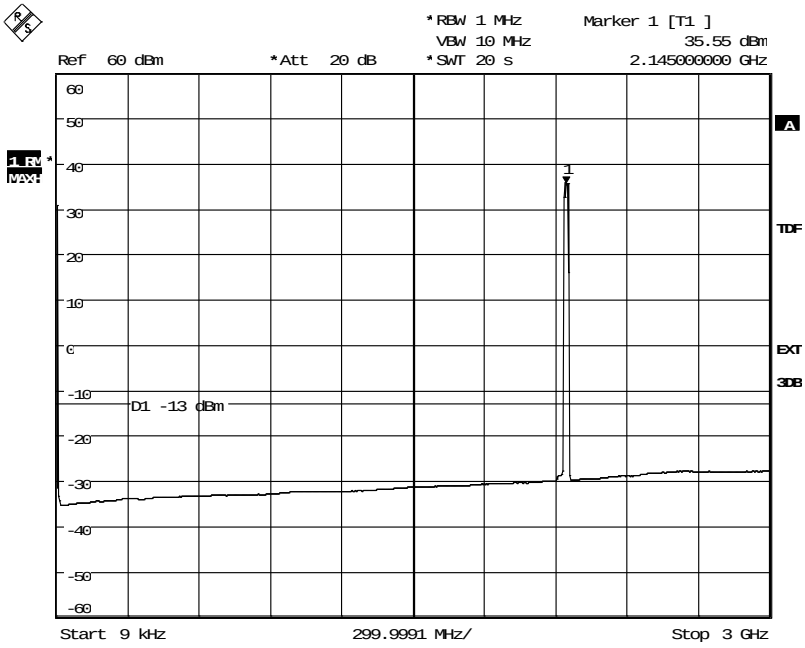
Diagram 11 d:



Date: 27.NOV.2013 16:21:00

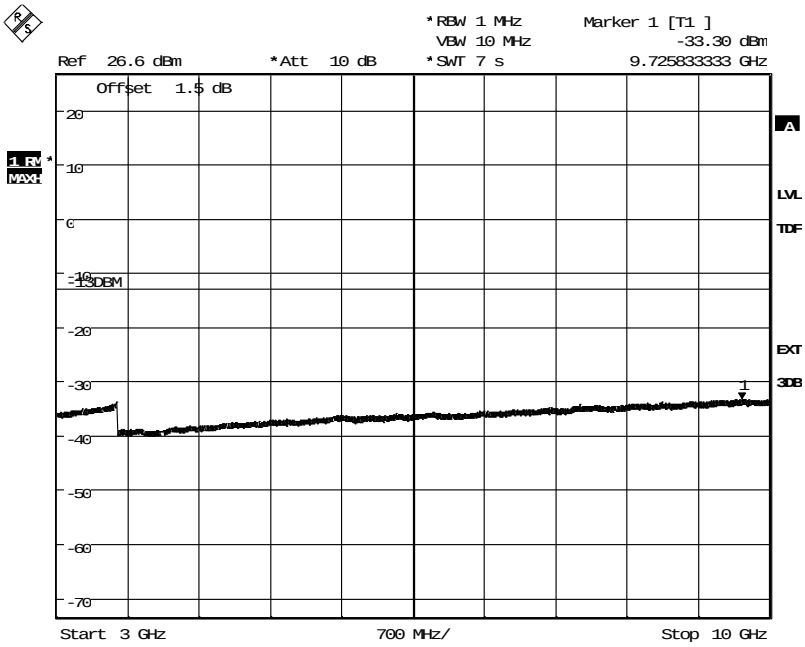
Appendix 5

Diagram 12 a:



Date: 27.NOV.2013 18:00:53

Diagram 12 b:



Date: 27.NOV.2013 18:02:34

Appendix 5

Diagram 12 c:

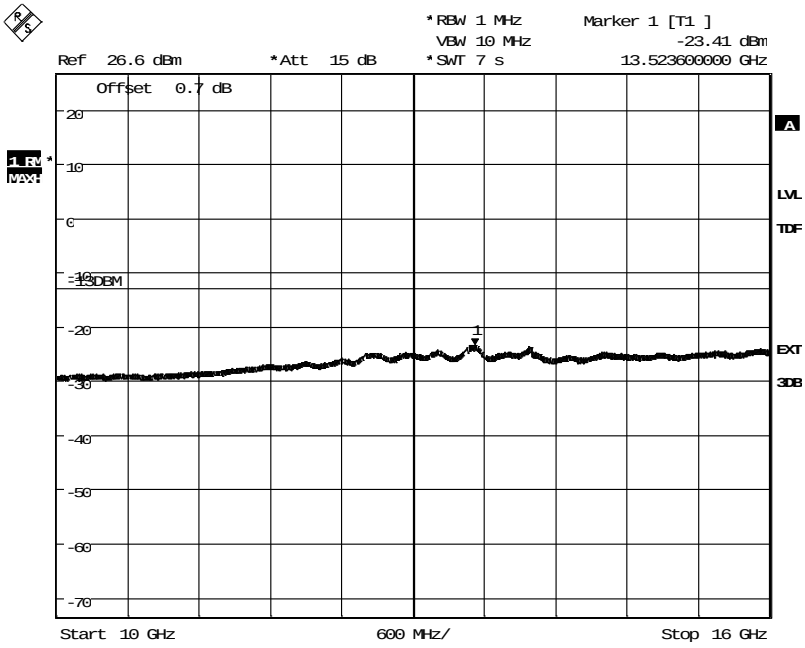


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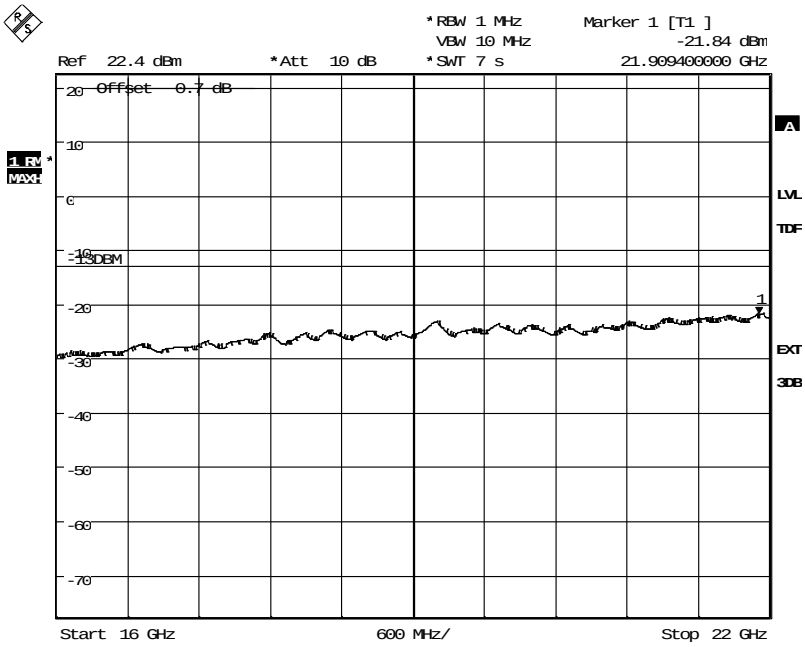
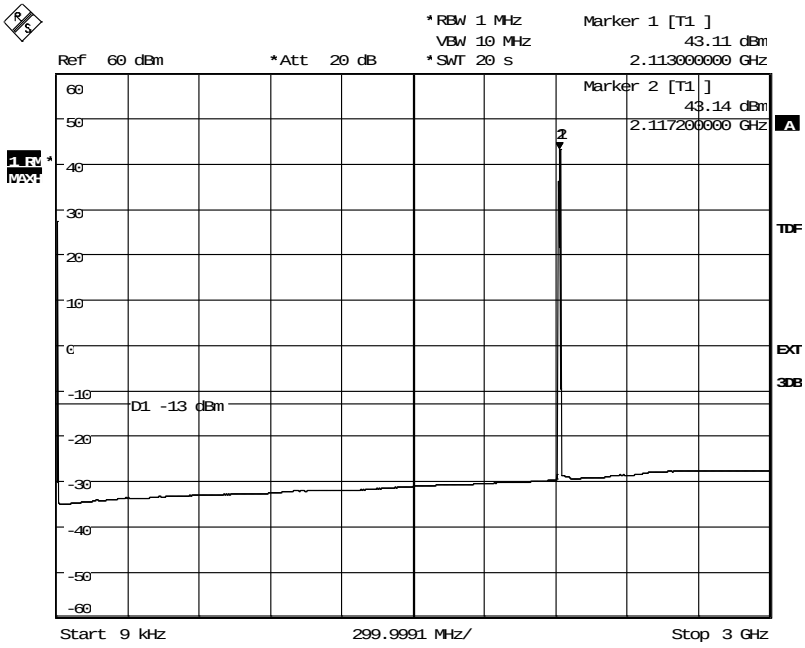
Diagram 12 d:



Date: 27.NOV.2013 18:08:37

Appendix 5

Diagram 13 a:



Date: 27.NOV.2013 21:25:41

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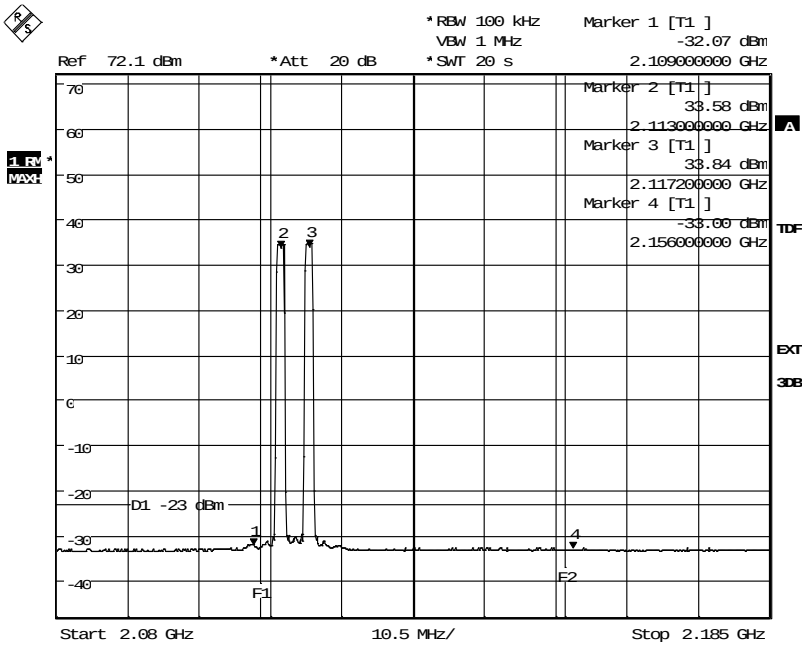

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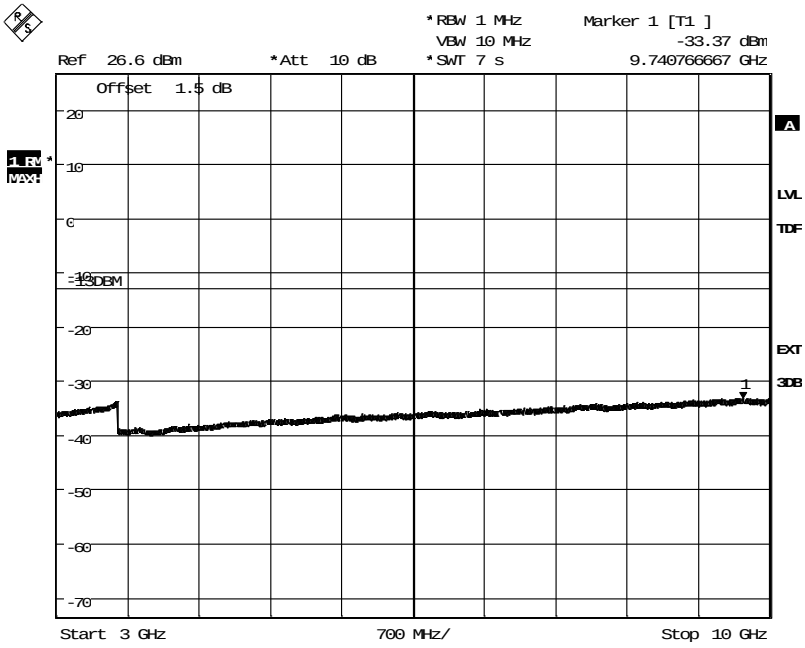
Appendix 5

Diagram 13 c:



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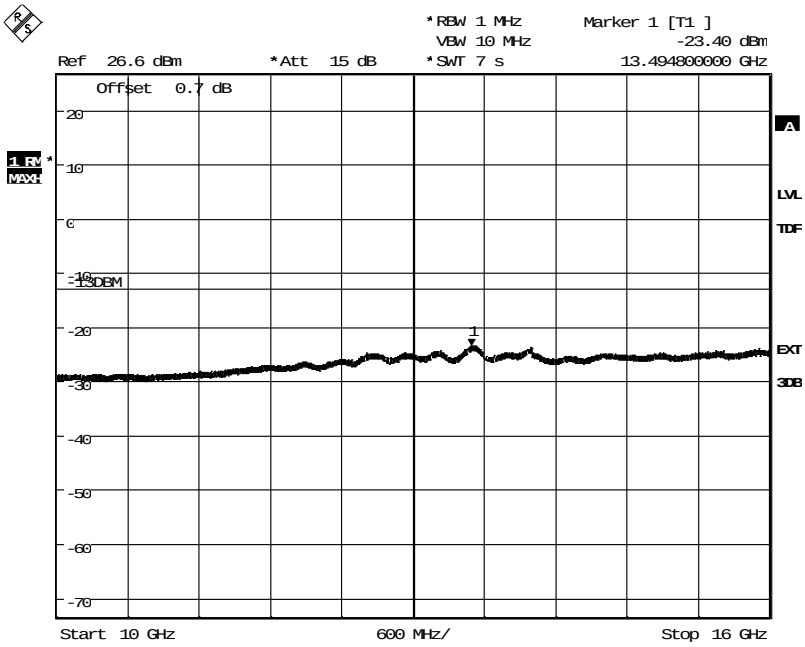
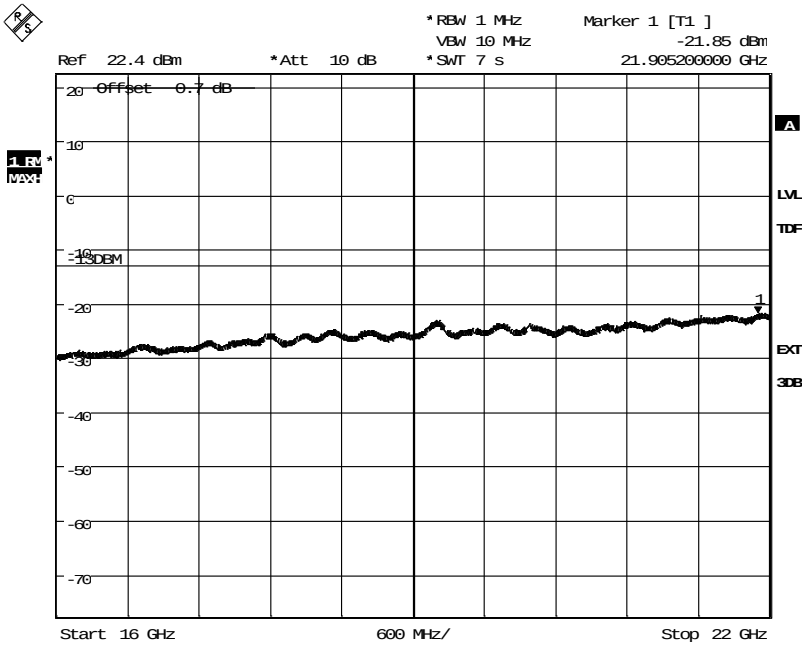


Date: 27.NOV.2013 21:45:44

Appendix 5

Diagram 13 e:



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Appendix 5

Diagram 14 a:

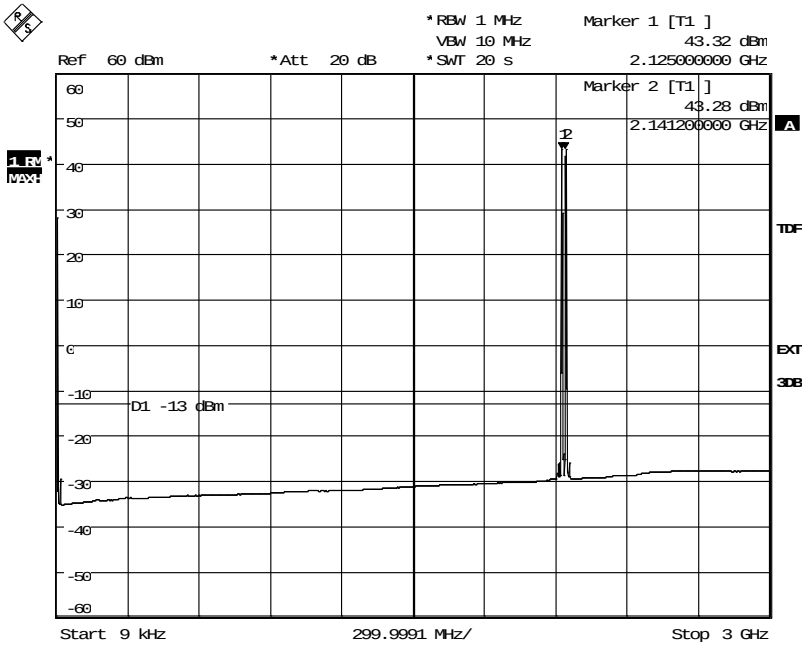

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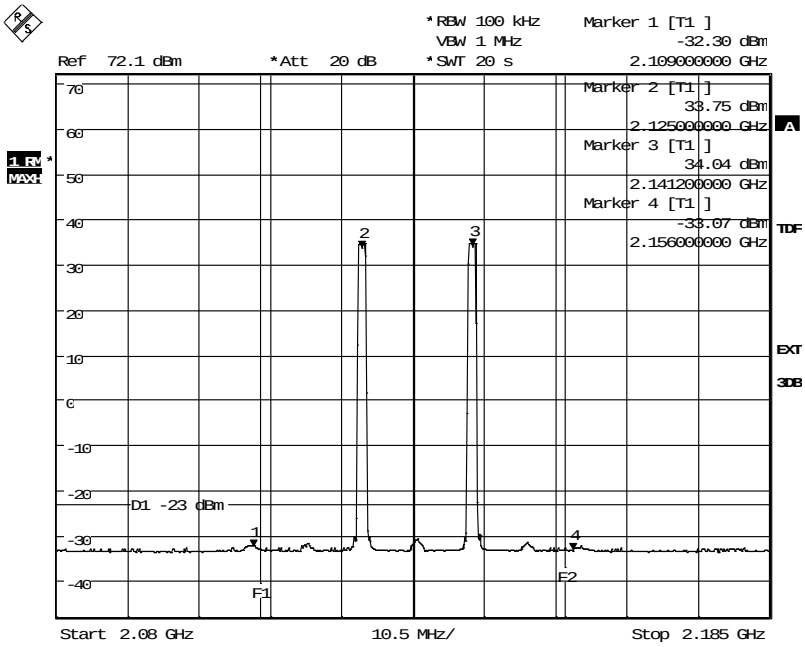
Diagram 14 b:



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Appendix 5

Diagram 14 c:

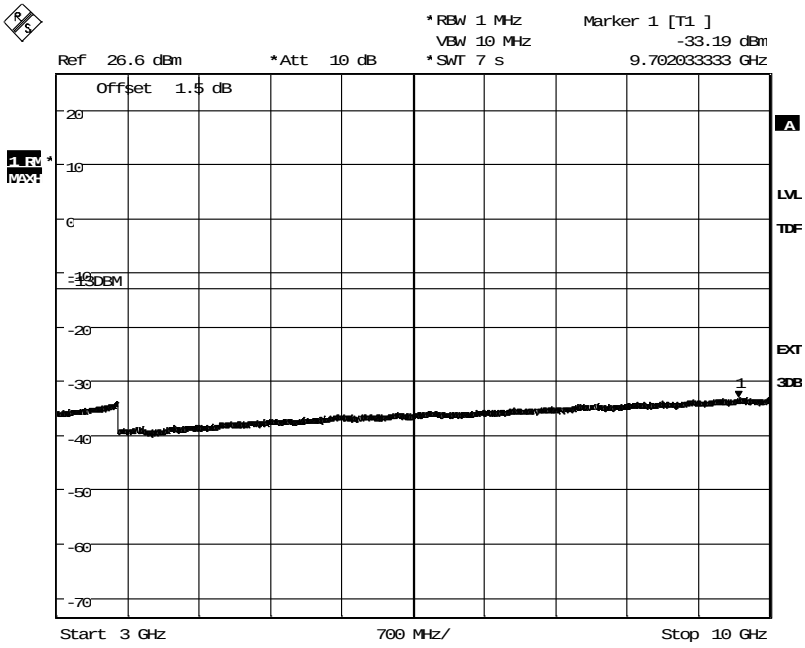

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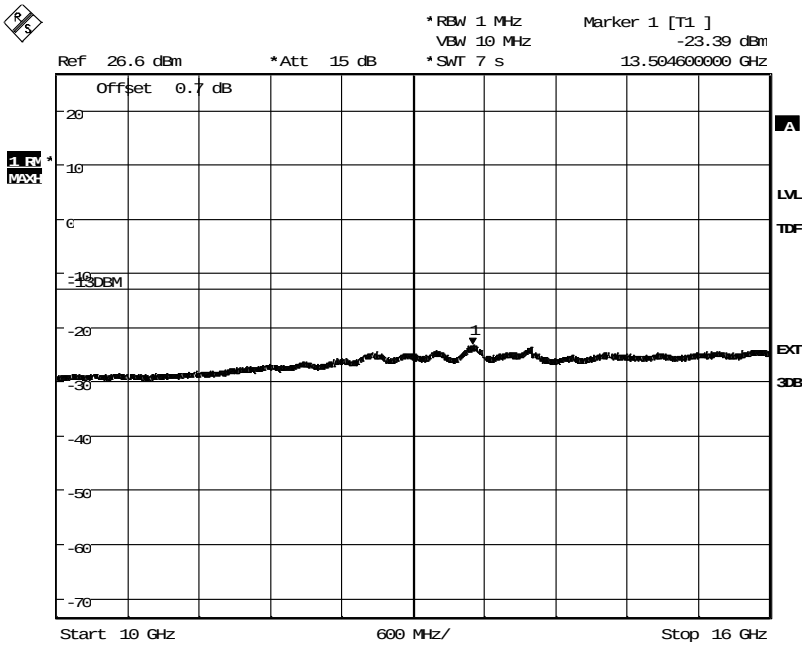
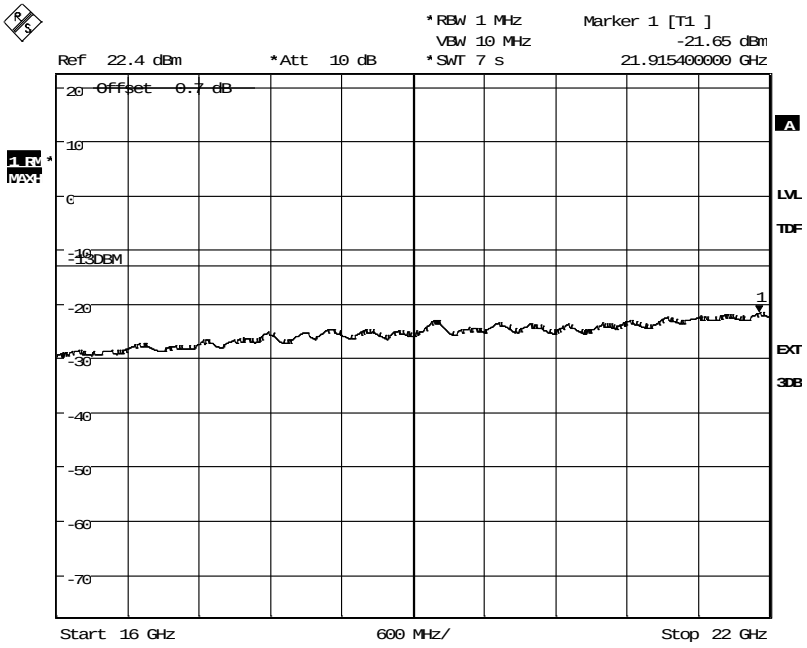
Diagram 14 d:



Date: 27.NOV.2013 21:50:56

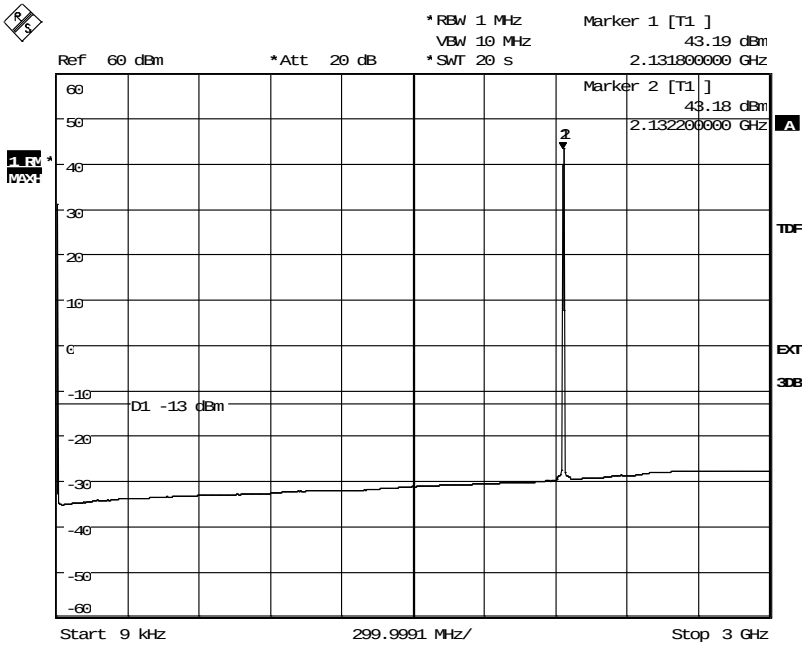
Appendix 5

Diagram 14 e:



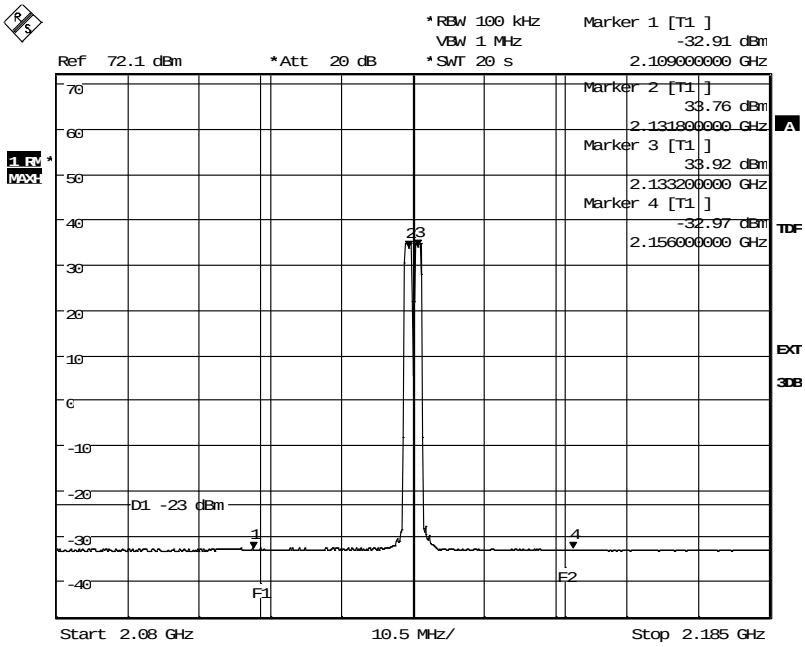
Appendix 5

Diagram 15 a:



Date: 28.NOV.2013 15:00:56

Diagram 15 b:



Date: 28.NOV.2013 15:07:30

Appendix 5

Diagram 15 c:

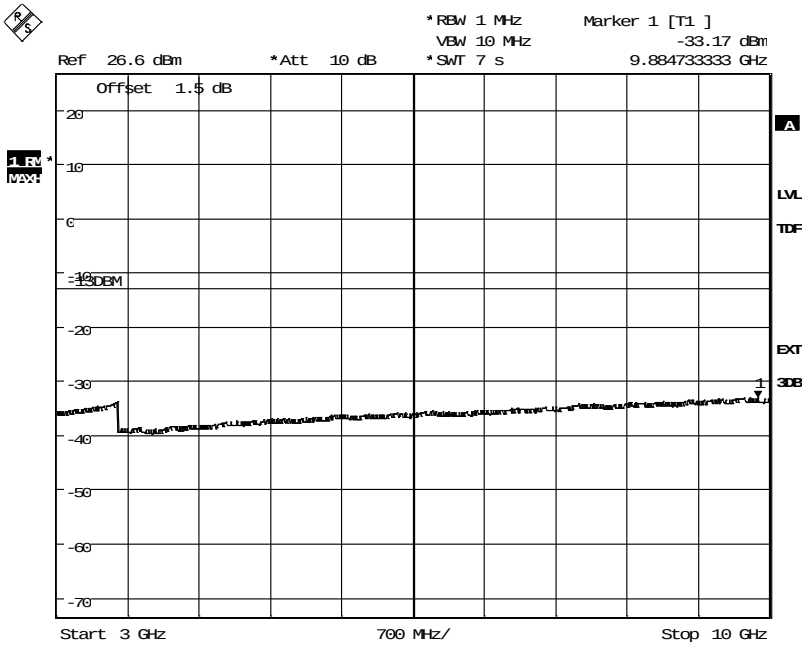


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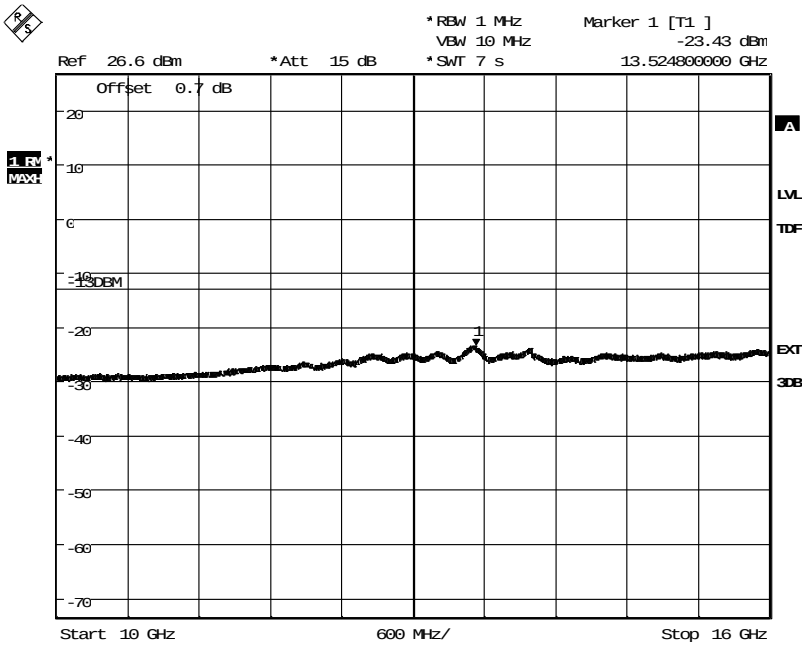
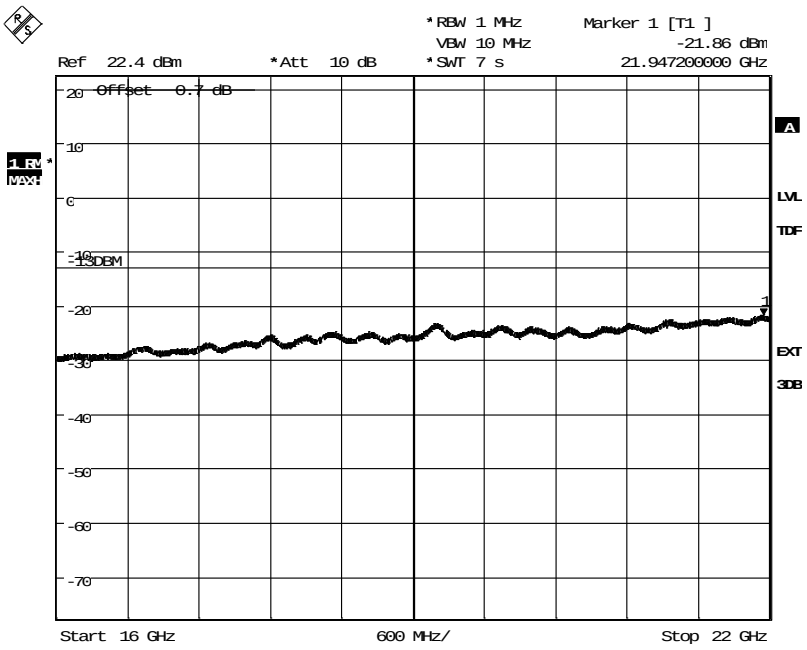
Diagram 15 d:



Date: 28.NOV.2013 15:11:37

Appendix 5

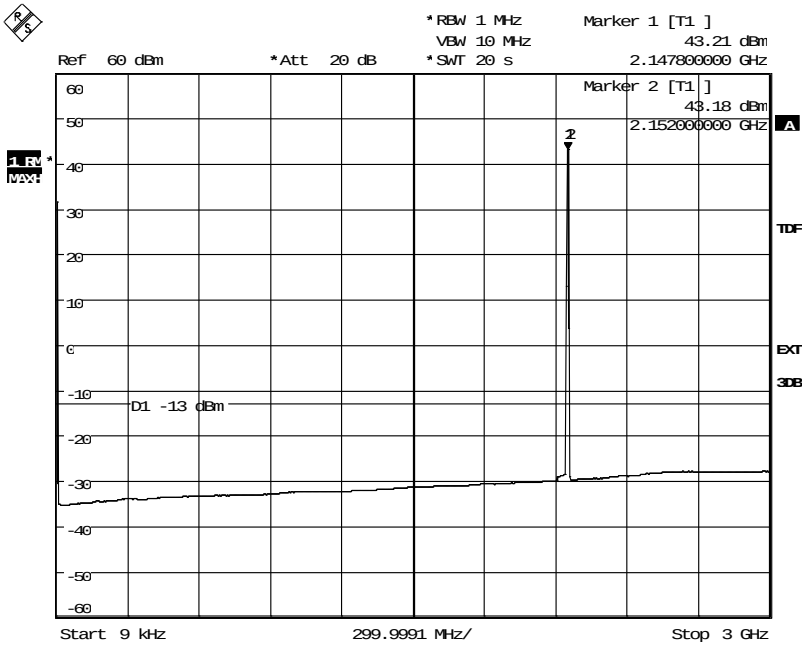
Diagram 15 e:



Date: 29.NOV.2013 20:19:43

Appendix 5

Diagram 16 a:



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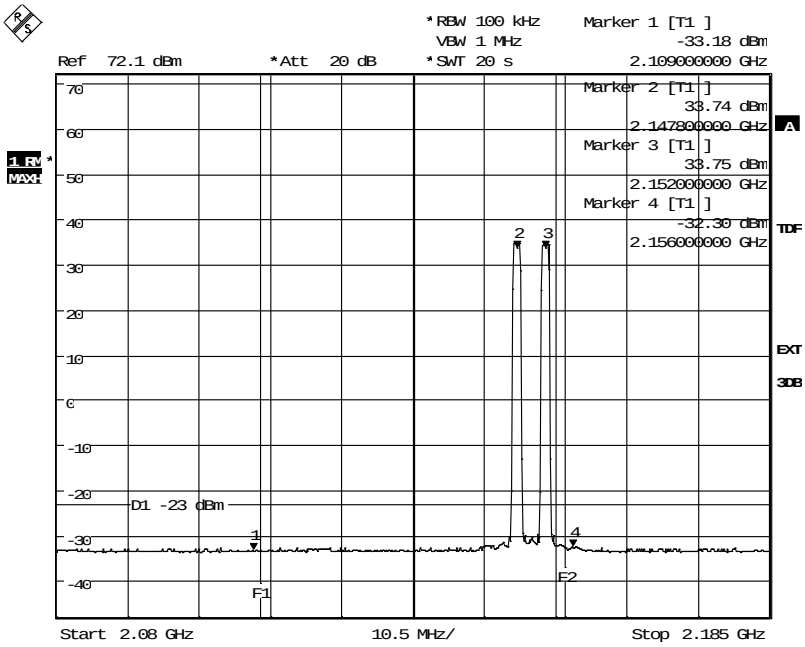

Date: 28.NOV.2013 16:59:03

Appendix 5

Diagram 16 c:

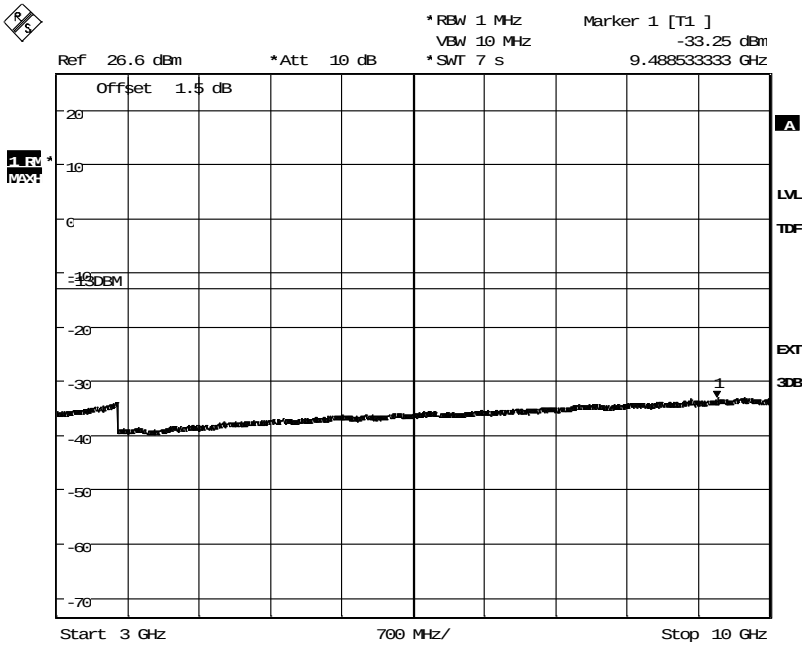

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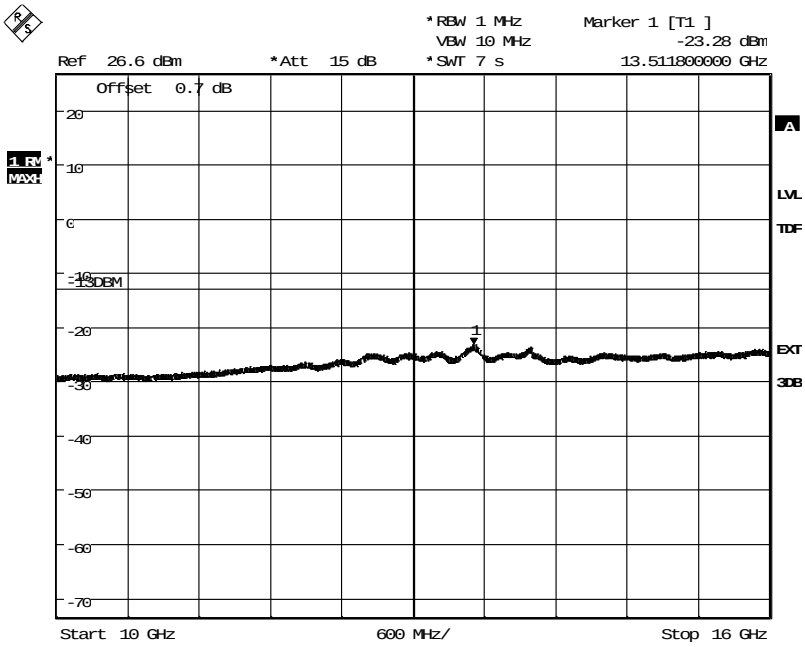
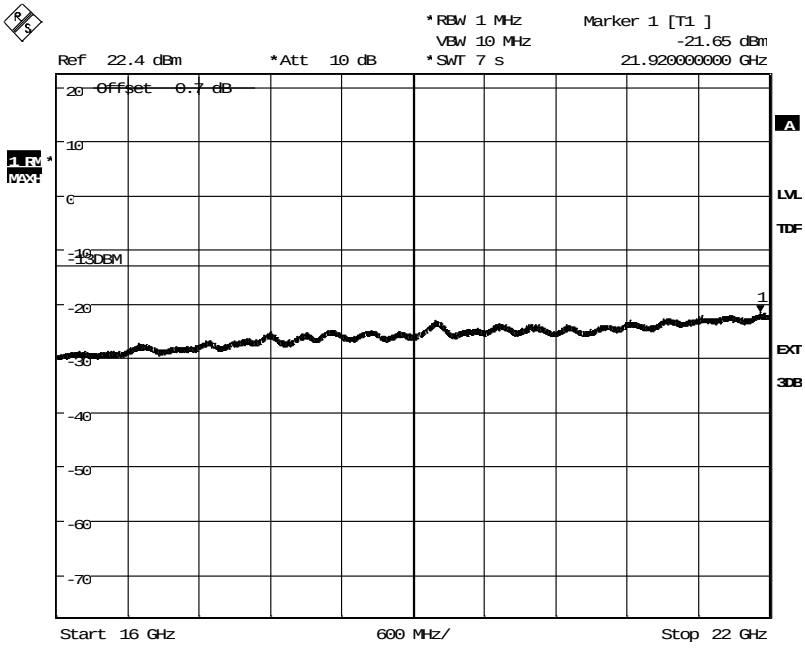
Diagram 16 d:



Date: 28.NOV.2013 17:02:39

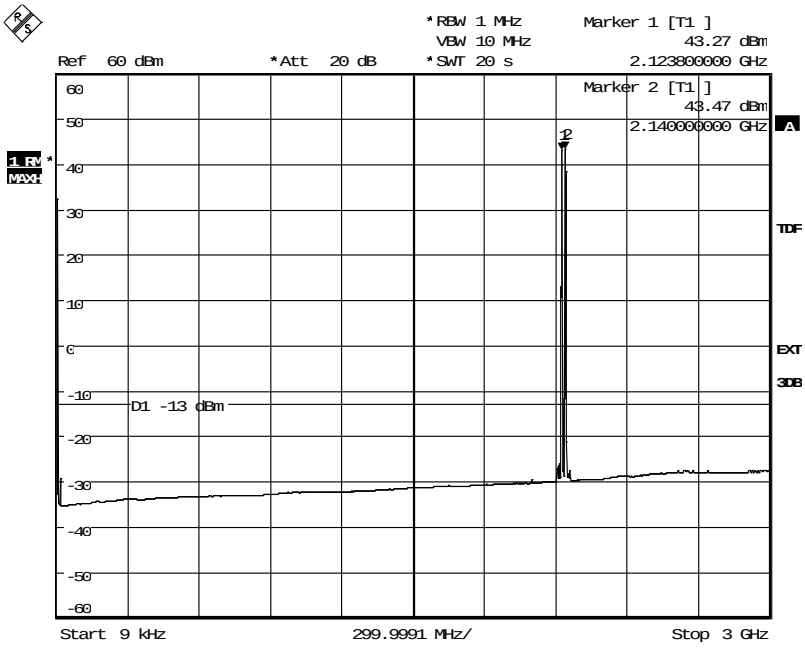
Appendix 5

Diagram 16 e:



Date: 28.NOV.2013 17:03:24

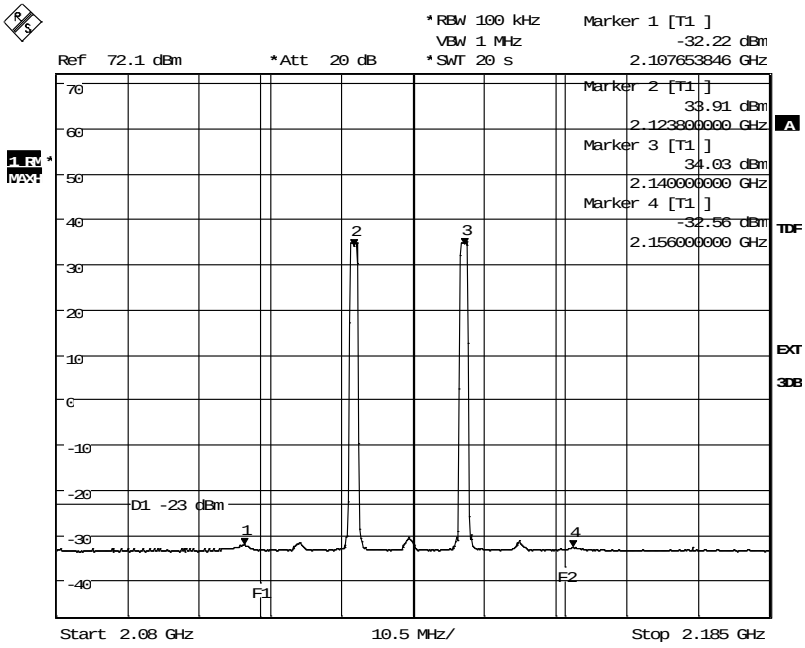
Diagram 17 a:



Date: 28.NOV.2013 17:11:49

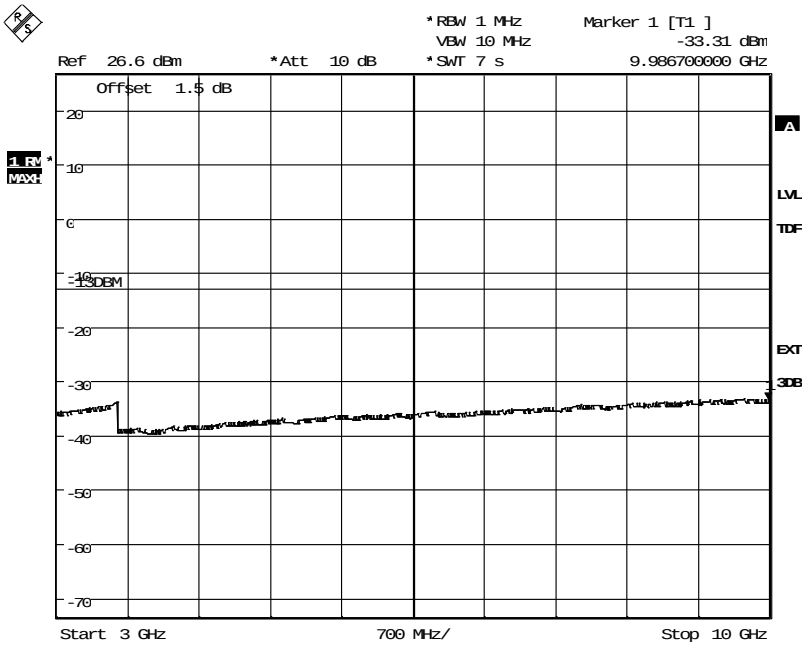
Appendix 5

Diagram 17 b:



Date: 28.NOV.2013 17:13:16

Diagram 17 c:



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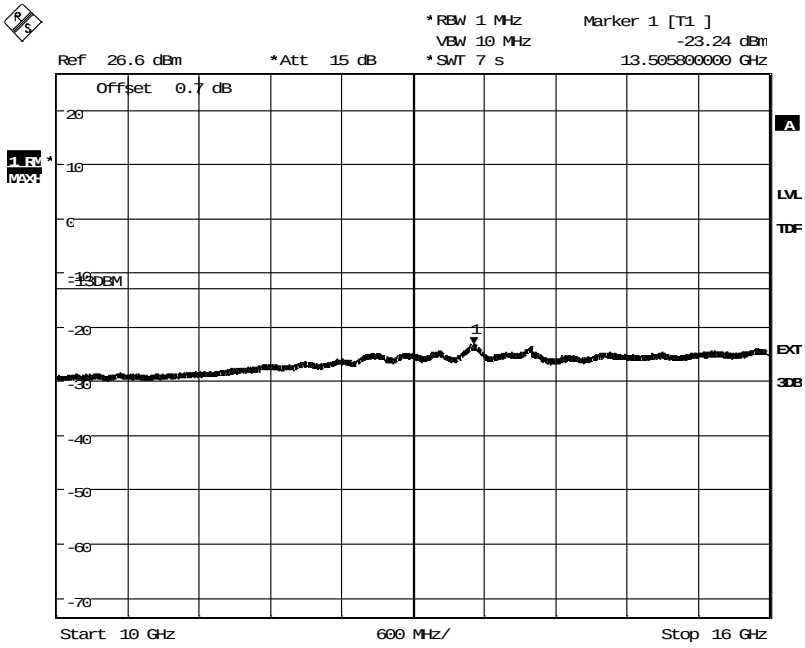
Appendix 5

Diagram 17 d:



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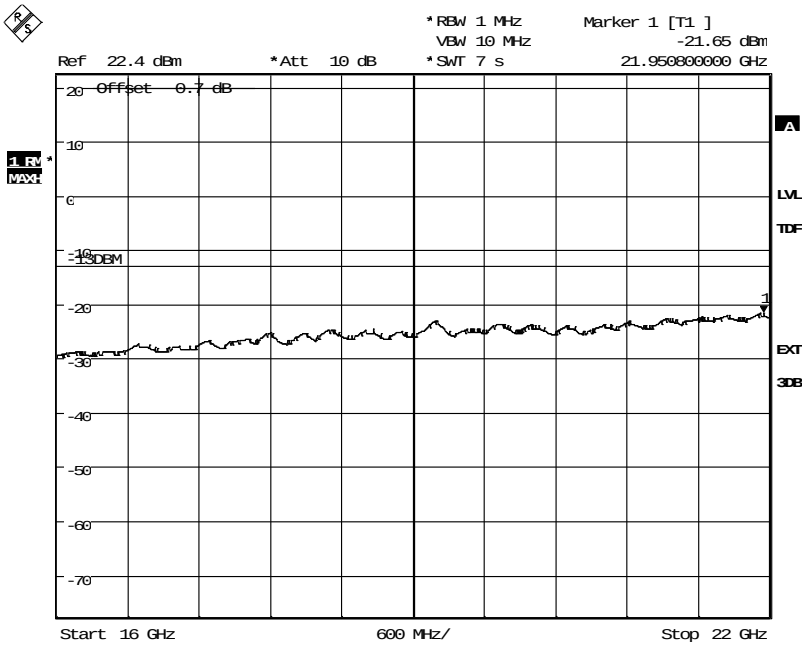

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Appendix 5

Diagram 18 a:

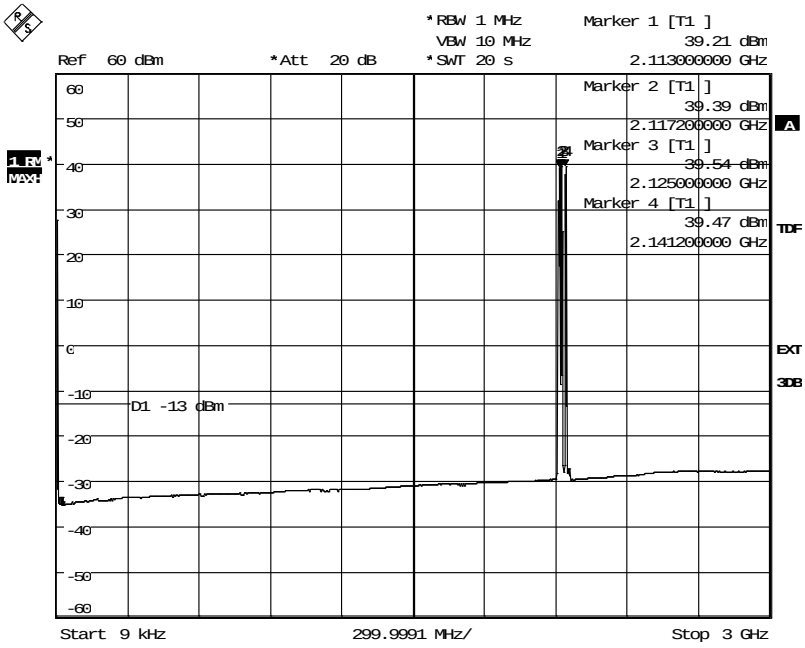

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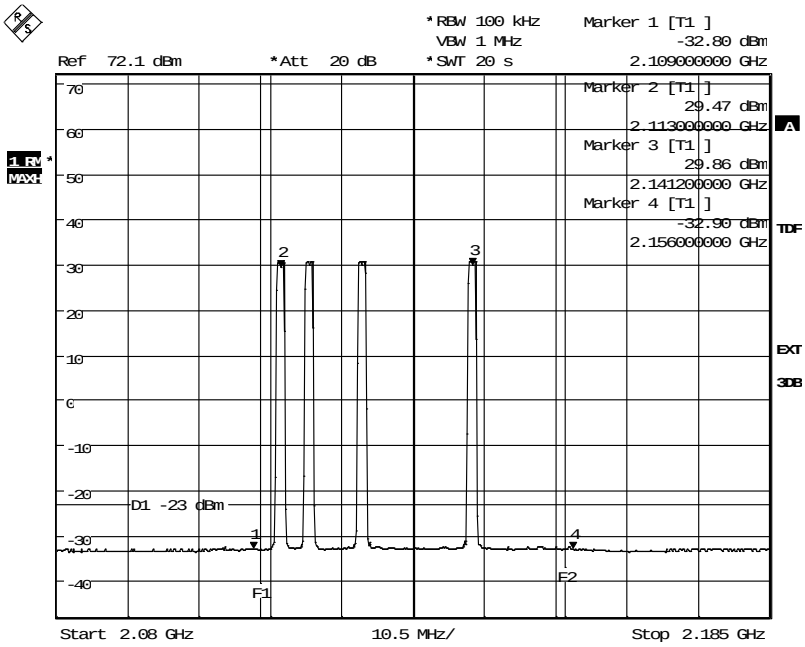
Diagram 18 b:



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Appendix 5

Diagram 18 c:

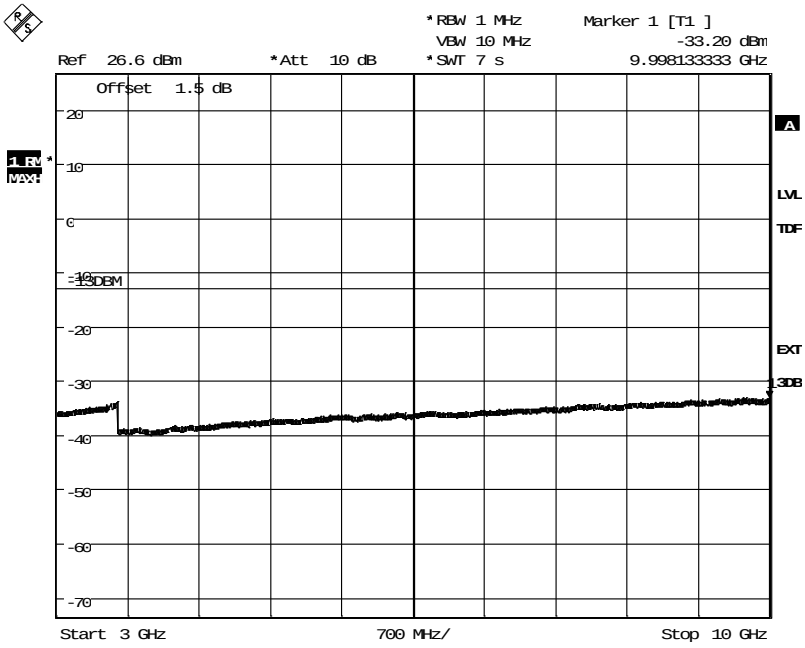

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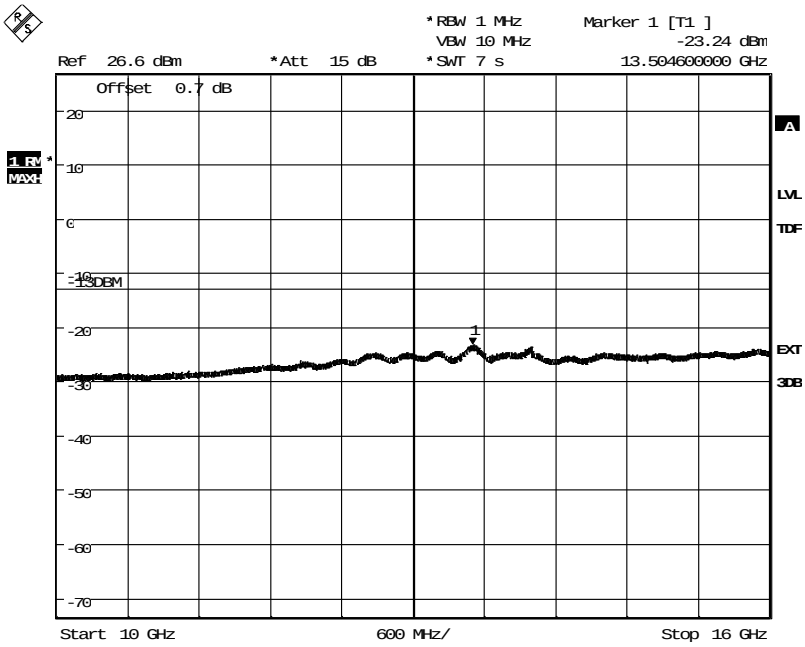
Diagram 18 d:



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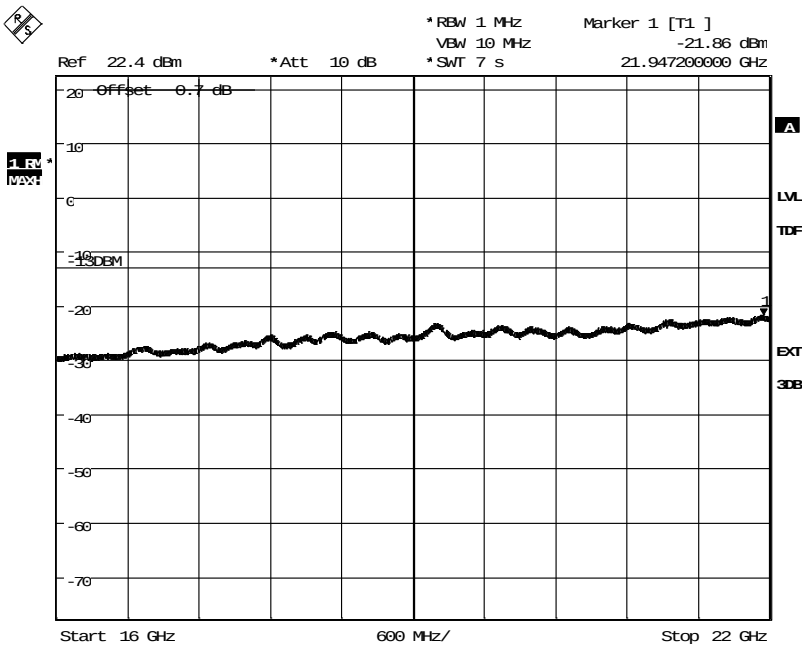
Appendix 5

Diagram 18 e:



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Appendix 5

Diagram 19 a:

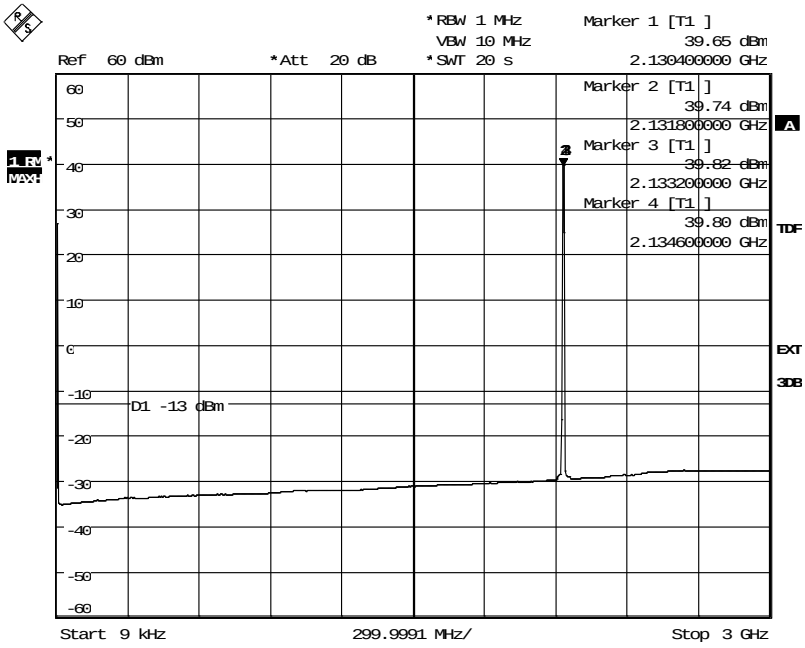

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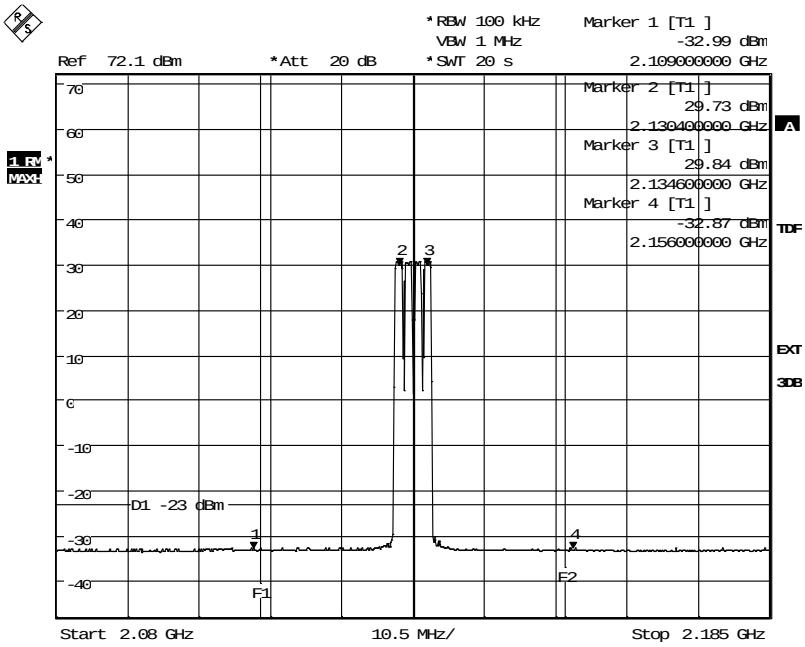
Diagram 19 b:



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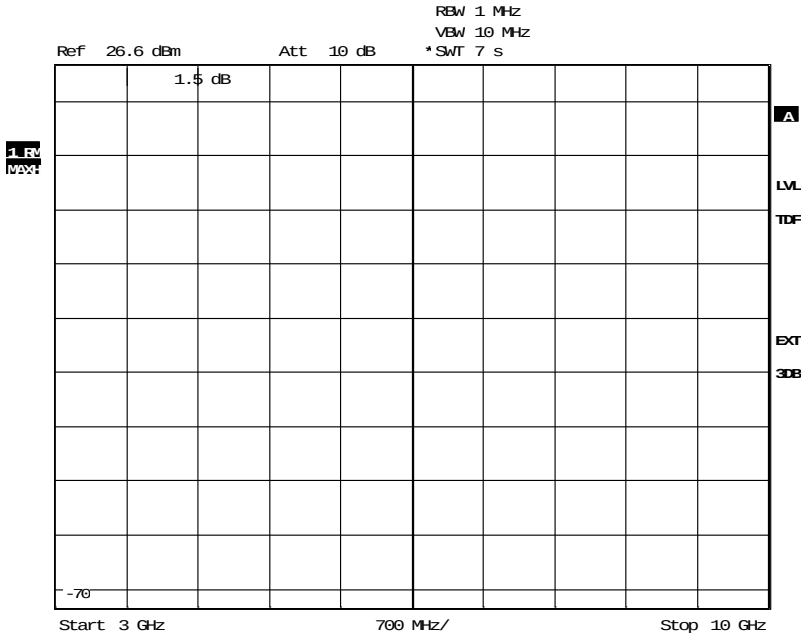
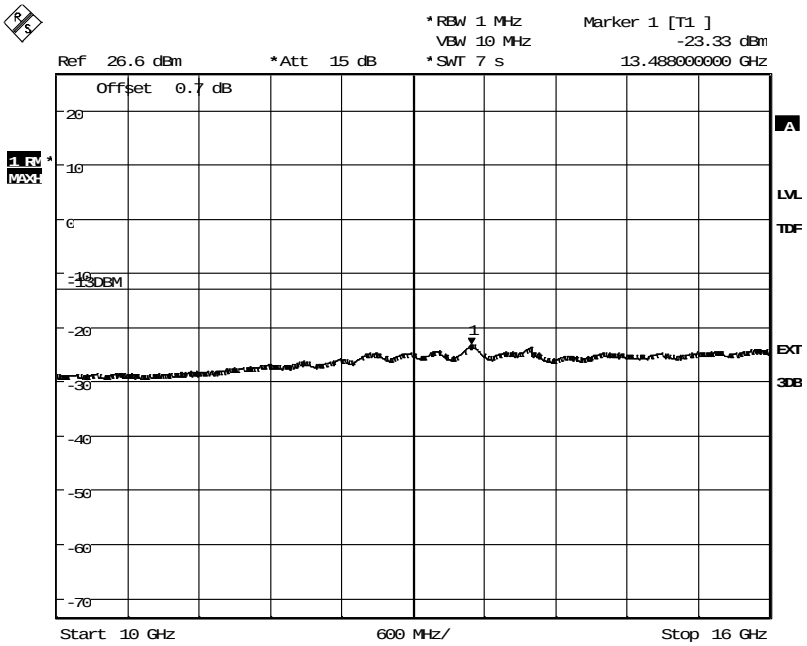
Appendix 5

Diagram 19 c:



Date: 29.NOV.2013 20:45:57

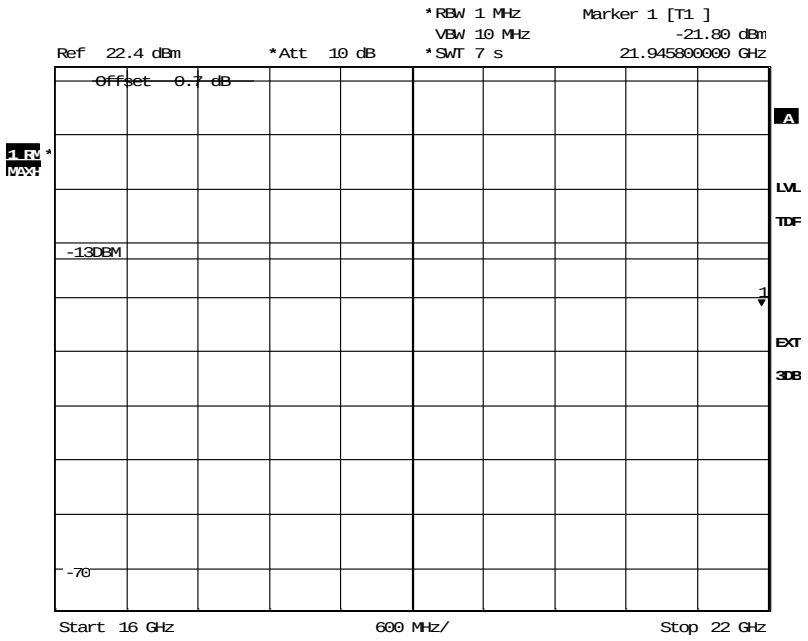
Diagram 19 d:



Date: 29.NOV.2013 20:47:38

Appendix 5

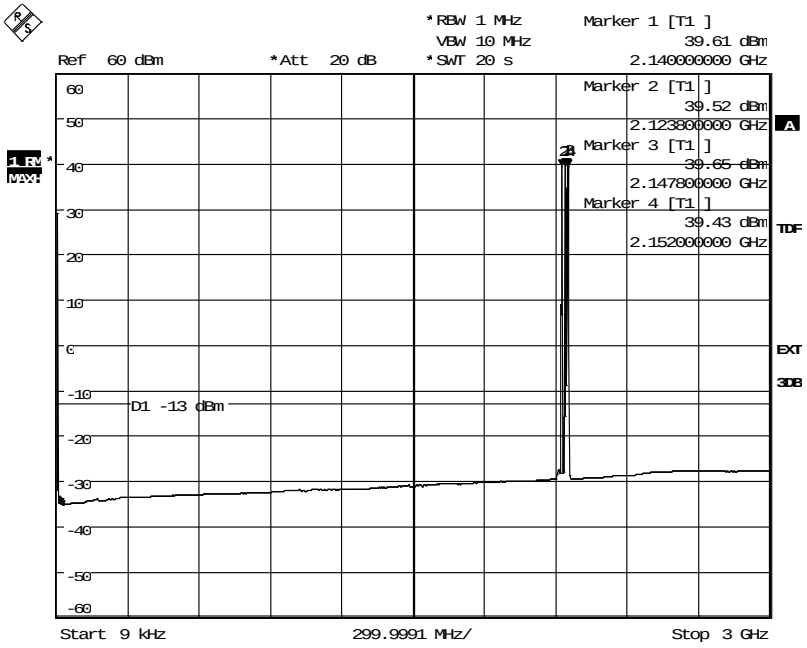
Diagram 19 e:



Date: 29.NOV.2013 20:49:17

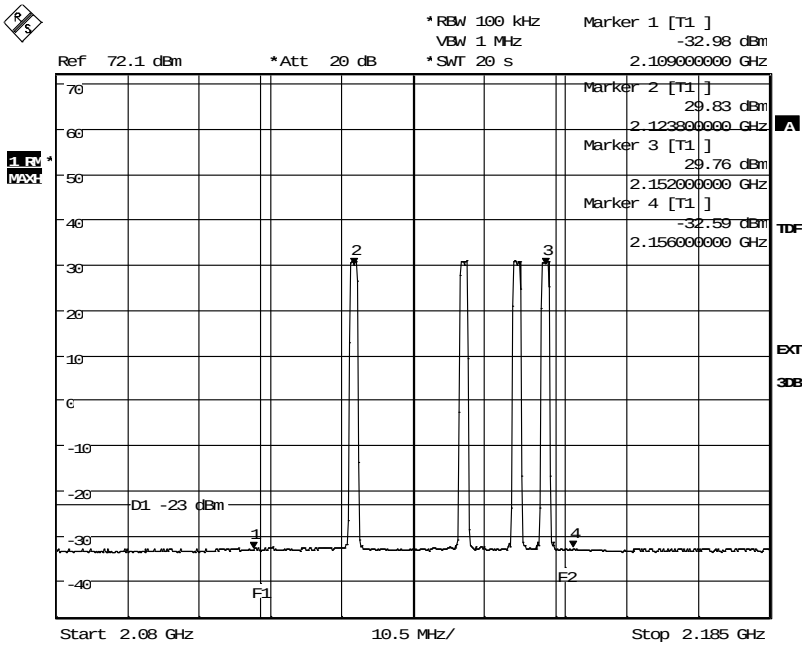
Appendix 5

Diagram 20 a:



Date: 29.NOV.2013 20:27:14

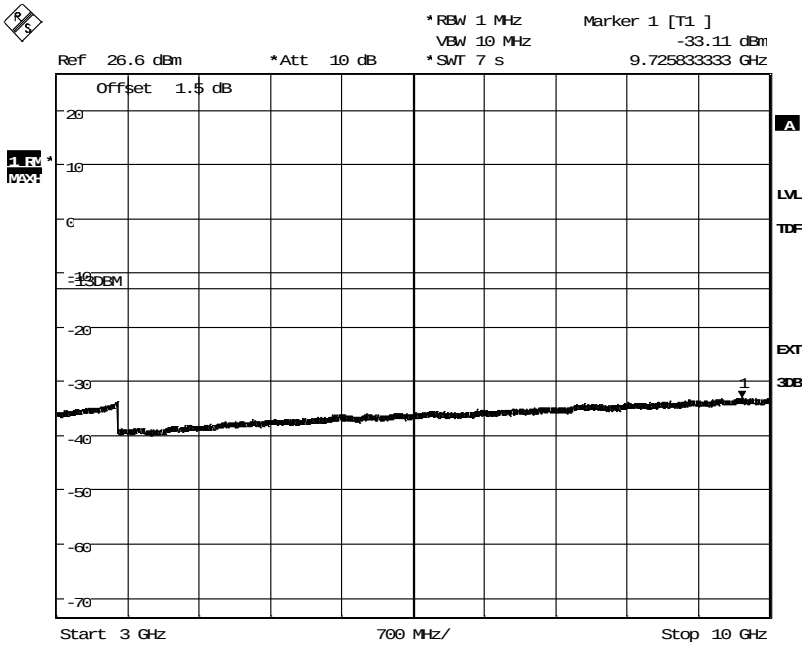
Diagram 20 b:



Date: 29.NOV.2013 20:28:29

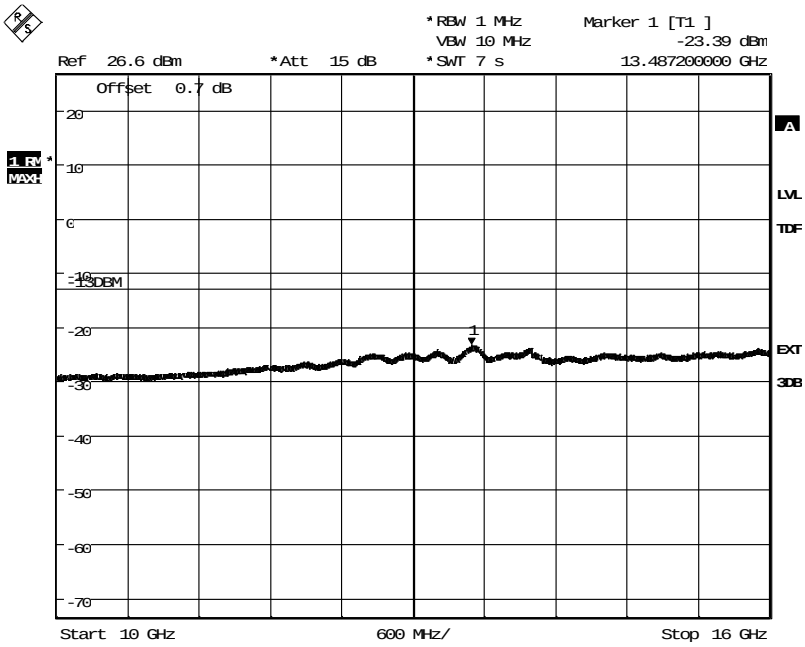
Appendix 5

Diagram 20 c:



Date: 29.NOV.2013 20:25:11

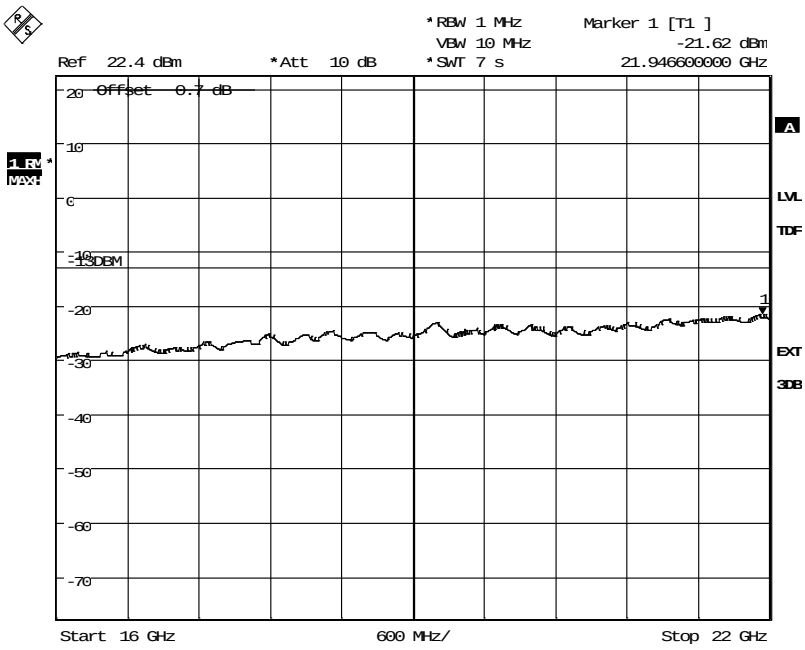
Diagram 20 d:



Date: 29.NOV.2013 20:24:26

Appendix 5

Diagram 20 e:



Appendix 6

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

Date	Temperature	Humidity
2013-11-14	23°C ± 3°C	34 % ± 5 %
2013-11-15	23°C ± 3°C	36 % ± 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.

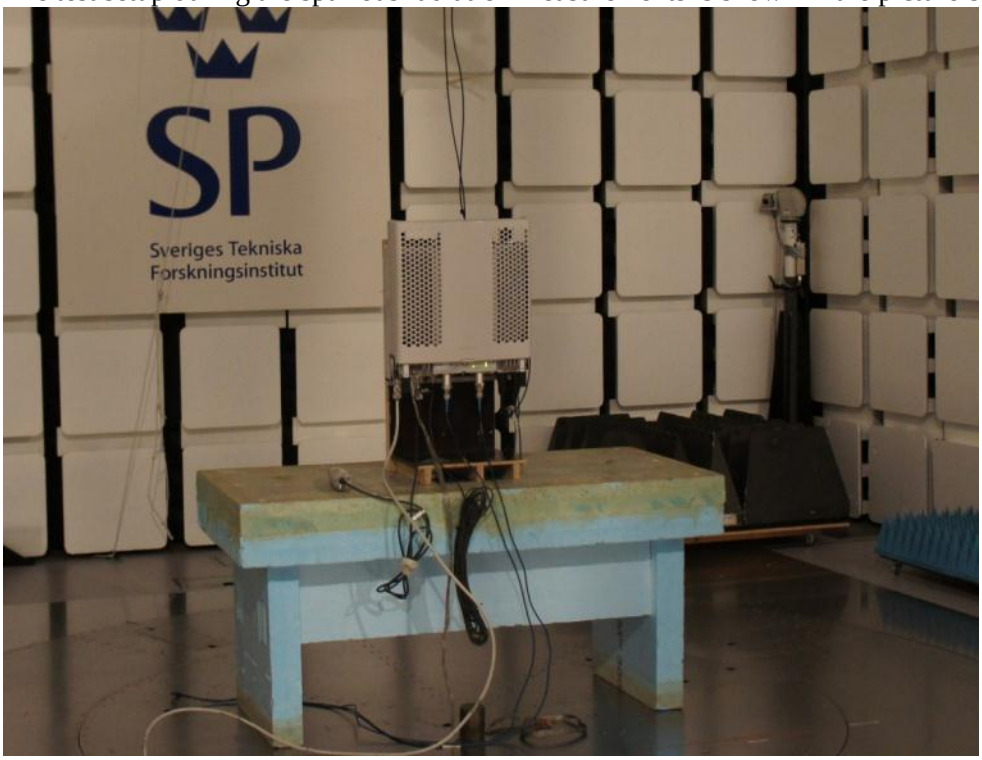
The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz – 18 GHz and 1m in the frequency range 18 – 22 GHz.

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 setup 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	502 182
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
Schwarzbeck preamplifier BBV 9742	504 085
µComp Nordic, Low Noise Amplifier	901 545
Temperature and humidity meter, Testo 625	504 188

Tested configurations

Symbolic name
B
M
T
M2
M4-1,4

Results, representing worst case

M, BW: 1.4 MHz 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 6

Diagram 1 a:

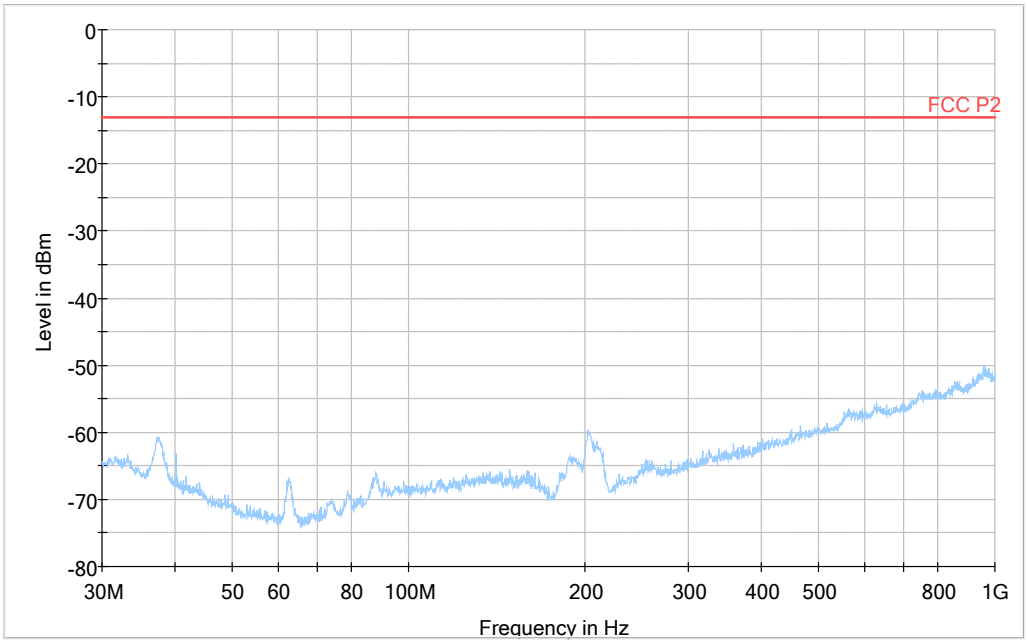
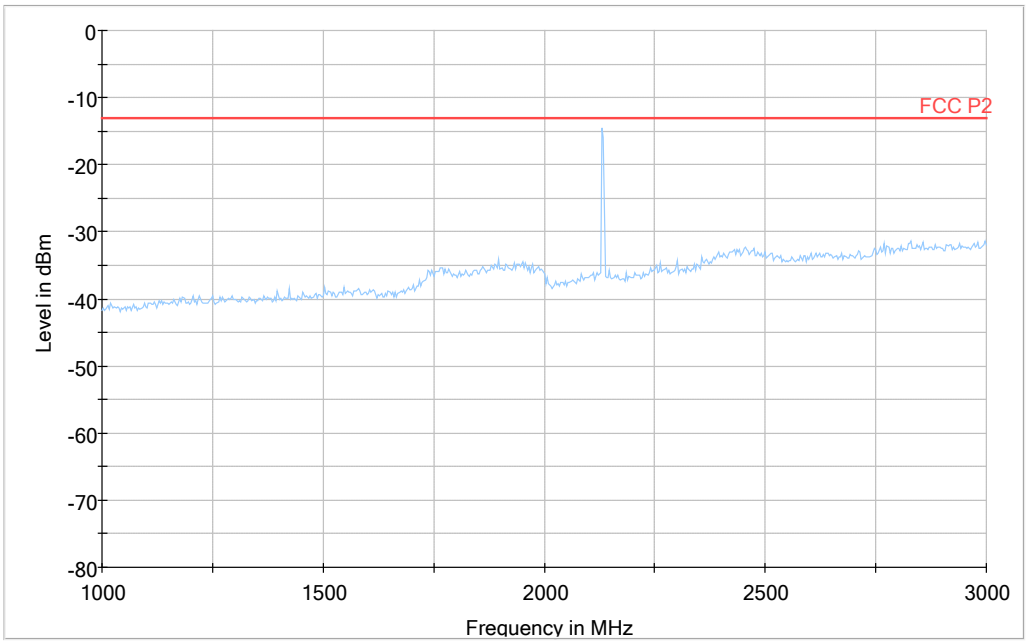


Diagram 1 b:



Note: The emission at 2132.5 MHz is the carrier frequency and shall be ignored in the context.

Appendix 6

Diagram 1 c:

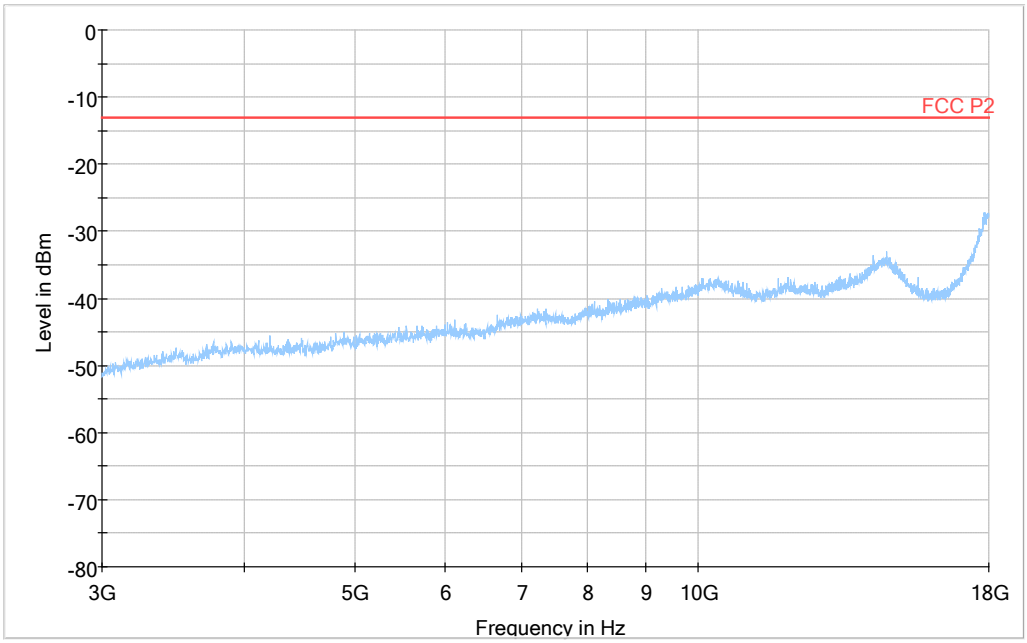
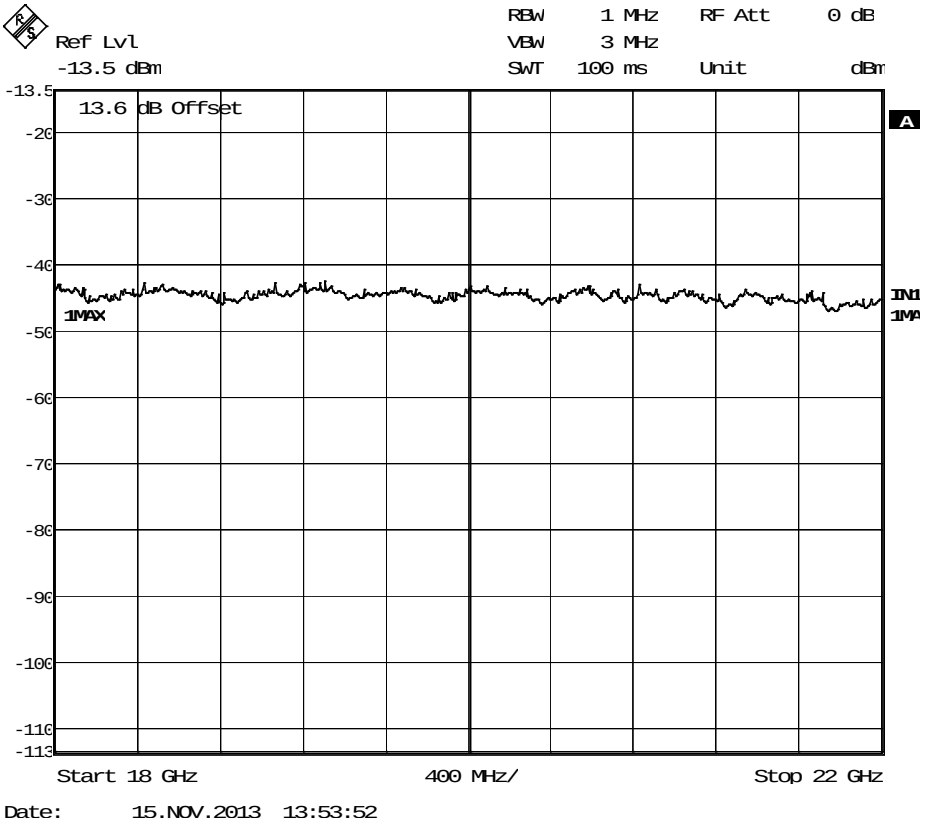


Diagram 1 d:



Frequency stability measurements according to CFR 47 §27.54 / IC RSS 139 6.3

Date	Temperature (test equipment)	Humidity (test equipment)
2013-11-29 to 2013-12-04	19-23 °C ± 3 °C	20-33 % ± 5 %

Test set-up and procedure

The measurement was made per 3GPP TS 36.141. The output was connected to a spectrum analyser. The spectrum analyser was connected to an external 10 MHz reference standard during the measurements.

Measurement equipment	SP number
R&S FSQ	504 143
RF attenuator	902 282
Testo 635, Temperature and humidity meter	504 203
Temperature cabinet	503 360

Results

Nominal transmitter frequency was 2132.5 MHz (M) with a bandwidth of 5 MHz. Rated output power level at connector RF A (maximum): 47.8 dBm (60 W).

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
-48.0	+20	-6
-55.2	+20	-6
-40.8	+20	-7
-48.0	+30	+4
-48.0	+40	+4
-48.0	+50	-4
-48.0	+10	-8
-48.0	0	+10
-48.0	-10	+12
-48.0	-20	-5
-48.0	-30	-13
Maximum freq. error (Hz)		13
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Remark

It was deemed sufficient to test one combination of TX frequency, channel bandwidth configuration and test model (modulation), as all combinations share a common internal reference to derive the TX frequency from.

Limits

Limit according to 3GPP TS 36.141:
The frequency error shall be within ± 0.05 PPM ± 12 Hz (±118.625Hz).

§27.54:
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-139 6.3 Frequency:
The frequency stability shall be sufficient to ensure that the emission bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

Complies?	Yes

Appendix 8

External photos

Front side

Rear side

Appendix 8

Top side

Bottom side