Contact person
Jörgen Wassholm
Electronics
+46 10 516 57 06
Jörgen.Wassholm@sp.se

Ericsson AB
Niklas Warnström
PDU HW
Torshamnsgatan 21
164 83 Stockholm

Radio measurements on RD 2242 B2 with FCC ID TA8AKRY901328-1 and IC:287AB-AS9013281

(9 appendices)

Test object

Product name: RD 2242 B2
Product number: KRC 901 328/1

Summary

See appendix 1 for general information and appendix 9 for external photos.

Standard		Compliant	Appendix
FCC CFR 47 Part 2 and 24/ IC RSS-133 Issue 6			
2.1046 / RSS-133 6.4	RF power output conducted	Yes	2
2.1046 / RSS-133 6.4	RF power output radiated	Yes	3
2.1049 / RSS-Gen 6.6	Occupied bandwidth	Yes	4
2.1051 / RSS-133 6.5	Band edge	Yes	5
2.1051 / RSS-133 6.5	Spurious emission at antenna terminals	Yes	6
2.1053 / RSS-133 6.5	Field strength of spurious radiation	Yes	7
2.1055 / RSS-133 6.3	Frequency stability	Yes	8

Note: Above RSS-133 items are given as cross-reference only. Measurements were performed according to ANSI procedures referenced by FCC and covered by SP's accreditation.

SP Technical Research Institute of Sweden

Electronics – EMC

Performed by

Signed by: Jörgen Wassholm
Reason: I am the author of this document
Date & Time: 2015-02-13 10:43:35 +01:00

Jörgen Wassholm

Examined by

Signed by: Anders Nordlöf
Reason: I have reviewed this document
Date & Time: 2015-02-13 12:38:36 +01:00

Anders Nordlöf

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Appendix 1

Description of the test object

Radio equipment:	RD 2242 B2 Product number: KRY 901 328/1 FCC ID TA8AKRY901328-1 IC 287AB-AS9013281 IC MODEL NO: AS9013281
Hardware revision state:	R2B
Tested configuration:	WCDMA single RAT
Frequency range:	TX: 1930 – 1990 MHz RX: 1850 – 1910 MHz
Antenna ports:	2 TX/RX ports, (internally connected to integrated Omni directional antenna elements)
RF configuration:	Single Antenna (Multiple port), MIMO 2x2
RF power tolerance	+2.7/ -4.3dB
Nominal output power per antenna port:	Single carrier: 1x 17 dBm (1 x 50mW) 2 carrier: 2 x 14 dBm (2 x 25mW) 3 carrier: 3 x 12.2 dBm (3 x 16.7mW) 4 carrier: 4 x 11 dBm (4 x 12.5mW)
Antenna type:	Omni directional antenna
Antenna gain:	+3 dBi
Modulations:	QPSK, 16QAM and 64QAM
Channel bandwidth:	5 MHz
Channel spacing:	5 MHz
Nominal supply voltage:	-48VDC (associated equipment)

Operation mode during measurements

Test models as defined in 3GPP TS 25.141. Test model 1 (TM1) represent QPSK modulation. Test model 5 (TM5) includes the 16QAM modulation and Test model 6 (TM6) includes the 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.

Single Antenna (Multiple port)
TM1: 64 DPCH:s at 30 ksps (SF=128)

Cable configurations between RD and IRU

The cables, used during tests, correspond to minimum and maximum length, according to clause 2.9 in Exhibit 12 – Technical Circuit Description. The following cable configurations has been used:

RDI Cable 20 m: total cable length 20 m patch cables included.

RDI Cable 92 m: total cable length 92 m patch cables included.

RDI Cable 200 m: total cable length 200 m patch cables included.

Patch cable	Cat 6a Schneider Electric Actassi CL-MNC6A
RDI cable	Cat 6a Schneider Electric Actassi CL-MXC6A

Conducted measurements

The conducted measurements were performed on RD 2242 B2 with
product number KRY 901 328/1.

The test object was mounted in a fixture and powered by the RBS Main Unit via the RDI LAN cable.
All TX parameters were measured at port RF B with port RF A terminated into 50 ohm.
Complete measurements were made on RF B, limited measurements on RF A.

Radiated measurements

The test object was mounted in a fixture and powered by the RBS Main Unit via the RDI LAN cable. In field strength of spurios radiation both RF ports were terminated into 50 ohm. For RF power output measurement the internal antenna was used. For the spurious radiated measurements the 200 m RDI cable was used to represent worst case and for the RF power output measurements the 200 m RDI cable was used to represent worst case.

Purpose of test

The purpose of the tests is to verify compliance to the performance characteristics specified in applicable items of FCC CFR 47 and Industry Canada RSS-133 and RSS-Gen.

References

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

ANSI C63.4 2009
ANSI/TIA-603-C 2004
3GPP TS 25.141, version 11.4.0
CFR 47 part 2, October 1st , 2013
CFR 47 part 24 Subpart E, October 1st, 2013
RSS-Gen Issue 4
RSS-133 Issue 6

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation ”SP-QD 10885”. The uncertainties are calculated with a coverage factor k=2 (95% level of confidence).
Compliance evaluation is based on a shared risk principle with respect to the measurement uncertainty.

Reservation

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

Delivery of test object

The test objects was delivered 2015-01-19.

Manufacturer’s representative

Lars Wallin, Ericsson AB.

Test engineers

Andreas Johnson, Maulo Rivera, Tomas Isbring, Patric Augustson and Jörgen Wassholm, SP.

Test participant

None.

Measurement equipment

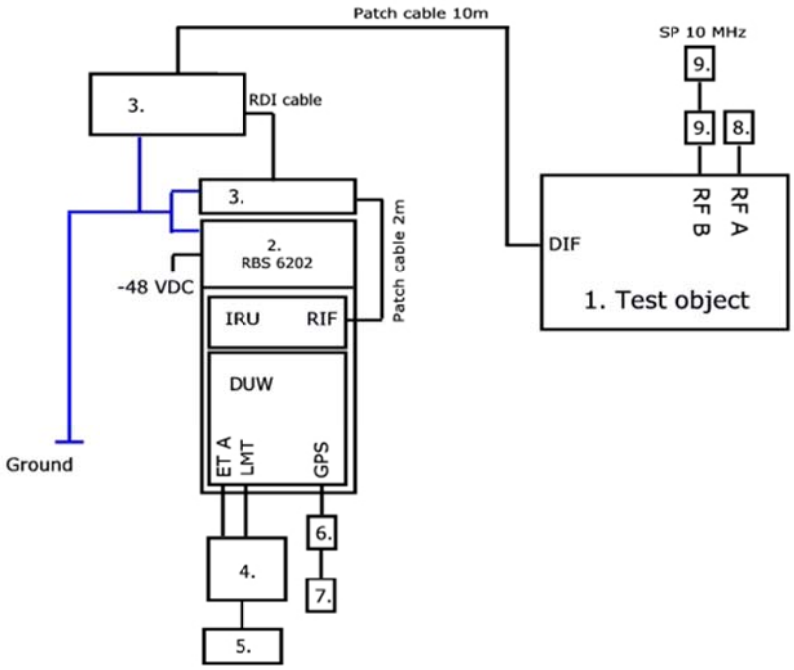
	Calibration Due	SP number
Semi anechoic chamber, Tesla	2015-12	503 881
R&S ESU 26	2015-08	901 553
R&S FSQ 40	2015-07	504 143
R&S FSW 43	2015-07	902 073
Control computer with R&S software EMC32 ver. 9.15.0	-	- 503 889
High pass filter	2015-12	BX40074
High pass filter	2015-07	901 501
High pass filter	2015-07	901 502
High pass filter	2015-07	504 199
High pass filter	2015-07	901 373
High pass filter	2016-07	503 739
High pass filter	2015-07	503 740
High pass filter	2015-07	504 200
RF attenuator	2016-07	503 248
RF attenuator	2016-06	503 249
RF attenuator	2015-08	504 159
RF attenuator	2015-07	900 233
RF attenuator	2015-11	900 691
RF attenuator	2015-06	901 384
Chase Bilog Antenna CBL 6111A	2017-10	503 182
EMCO Horn Antenna 3115	2016-09	502 175
µComp Nordic, Low Noise Amplifier	2016-01	901 545
Flann STD Gain Horn Antenna 16-240	-	503 939
Flann STD Gain Horn Antenna 18-240	-	503 900
Flann STD Gain Horn Antenna 20240-20	-	503 674
Schwarzbeck preamplifier BBV 9742	2015-12	504 085
Temperature and humidity meter, Testo 635	2015-03	504 203
Temperature and humidity meter, Testo 625	2015-06	504 188
Temperature Chamber	-	503 360
Multimeter Fluke 87	2015-08	502 190

Test frequencies during conducted and radiated measurements:

UARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
9662	1932.4	B	Single carrier TX bottom frequency
9800	1960.0	M	Single carrier TX band mid frequency
9938	1987.6	T	Single carrier TX band top frequency
9662 9687	1932.4 1937.4	$B2_1$	2-carriers TX band bottom configuration
9662 9712	1932.4 1942.4	$B2_2$	2-carriers TX band bottom configuration
9788 9813	1957.6 1962.6	$M2_1$	2-carriers TX band mid configuration
9775 9825	1955.0 1965.0	$M2_2$	2-carriers TX band mid configuration
9938 9913	1987.6 1982.6	$T2_1$	2-carriers TX band top configuration
9938 9888	1987.6 1977.6	$T2_2$	2-carriers TX band top configuration
9688 9732	1937.6 1946.4	B2im1	2-carriers TX band bottom configuration
9868 9912	1973.6 1982.4	T2im1	2-carriers TX band top configuration
9748 9852	1949.6 1970.4	B2/T2im2	2-carriers TX band mid configuration
9662 9687 9712 9737	1932.4 1937.4 1942.4 1947.4	B4	4-carriers TX band bottom configuration
9775 9800 9825 9850	1955.0 1960.0 1965.0 1970.0	M4	4-carriers TX band mid configuration
9938 9913 9888 9863	1987.6 1982.6 1977.6 1972.6	T4	4-carriers TX band top configuration

All RX frequencies were configurated 80 MHz below the corresponding TX frequency according to the applicable duplex offset for the operating band.

Test setup conducted measurements



Test object

1.	RD 2242 B4, KRY 901 328/1, revision R2B, s/n: C828953704 (FCC ID: TA8AKRY901328-1 and IC: 287AB-AS9013281) with software: CXP 901 3268/14, revision R59FC

Associated equipment:

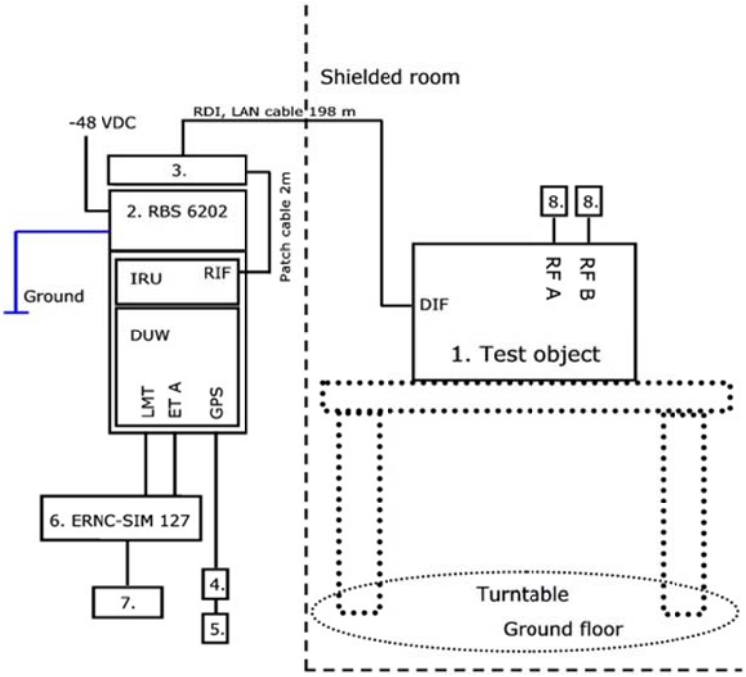
2.	RBS 6202: BYB 911 40/1, revision R3B, s/n: TU8J525857 DUW 41 01, KDU 127 174/4, revision R2D, s/n: A402039680 IRU 2242, KRC 161 444/1, revision R1C, s/n: C828558497
3.	Patch panel, BGK 901 55/1, revision R1A, s/n: -
6.	GPS 02 01, NCD 901 41/1, revision R1D, s/n: TU8K474887
7.	GPS Active Antenna, KRE 101 2082/1

Functional test equipment:

4.	ERNC-SIM 127, BAMS – 1000660988: Netgear switch FS726T Netgear switch GSM 7212 Symmetricom NTP-server Symmetricom 8040
5.	Laptop EliteBook 8540w
8.	Attenuator/ Terminator 50 ohm
9.	SP test instrument according measurement equipment list

Appendix 1

Test setup radiated measurements



Test object

1.	RD 2242 B4, KRY 901 328/1, revision R2B, s/n: C828953704 (FCC ID: TA8AKRY901328-1 and IC: 287AB-AS9013281) with software: CXP 901 3268/14, revision R59FC

Associated equipment:

2.	RBS 6202: BYB 911 40/1, revision R3B, s/n: TU8J525857 DUW 41 01, KDU 127 174/4, revision R2D, s/n: A402039680 IRU 2242, KRC 161 444/1, revision R1C, s/n: C828558497
3.	Patch panel, BGK 901 55/1, revision R1A, s/n: -
4.	GPS 02 01, NCD 901 41/1, revision R1D, s/n: TU8KH76616
5.	GPS Active Antenna, KRE 101 2082/1

Functional test equipment:

6.	ERNC-SIM 127, BAMS – 1000660988: Netgear switch FS726T Netgear switch GSM 7212 Symmetricom NTP-server Symmetricom 8040
7.	Laptop EliteBook 8540w
8.	Attenuator/ Terminator 50 ohm

Appendix 1

Interfaces:	**Type of port:**
Antenna port (A), hirose connector	Antenna
Antenna port (B), hirose connector	Antenna
DIF, Patch cable Cat 6a Schneider Electric Actassi CL-MNC6A	Signal

RBS software:

Software	**Revision**
CXP 902 3291/3	R2CA13

Appendix 2

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

Date	Temperature	Humidity
2015-01-26	22 °C ± 3 °C	18 % ± 5 %
2015-01-27	22 °C ± 3 °C	19 % ± 5 %
2015-01-28	22 °C ± 3 °C	19 % ± 5 %

Test set-up and procedure

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

Measurement equipment	SP number
R&S FSQ 40	504 143
RF attenuator	900 691
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

Configuration: RDI Cable 200 m

Single Antenna (Multiple port), single carrier

Rated output power level at RF connector 1x 17 dBm.

Symbolic name	Transmitter power [RMS (dBm)/ PAR dB]		
	Port RF A	Port RF B	Total power[1)]
B	13.85/ 7.64	14.16/ 7.72	17.02
M	16.45/ 7.62	16.73/ 7.64	19.60
T	16.26/ 7.64	17.39/ 7.74	19.87

Single Antenna (Multiple port), 2-carrier

Rated output power 2 x 44.8 dBm per RF port.

Symbolic name	Transmitter power [RMS (dBm)/ PAR dB]		
	Port RF A	Port RF B	Total power[1)]
$B2_1$	15.07/ 7.67	15.57/ 7.69	18.34
$M2_1$	16.73/ 7.60	17.72/ 7.64	20.26
$T2_1$	16.79/ 7.62	18.55/ 7.69	20.77

Single Antenna (Multiple port), 4-carrier

Rated output power 4 x 41.8 dBm per RF port.

Symbolic name	Transmitter power [RMS (dBm)/ PAR dB]		
	Port RF A	Port RF B	Total power[1)]
T4	17.33/ 7.81	18.48/ 7.84	20.95

[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.

Configuration: RDI Cable 92 m

Single Antenna (Multiple port), single carrier

Rated output power level at RF connector 1x 17 dBm.

Symbolic name	Transmitter power [RMS (dBm)/ PAR dB]		
	Port RF A	Port RF B	Total power[1)]
B	14.33/ 7.69	15.07/ 7.64	17.73
M	16.06/ 7.62	17.68/ 7.62	19.95
T	15.02/ 7.64	17.19/ 7.69	19.25

Single Antenna (Multiple port), 2-carrier

Rated output power 2 x 44.8 dBm per RF port.

Symbolic name	Transmitter power [RMS (dBm)/ PAR dB]		
	Port RF A	Port RF B	Total power[1)]
$M2_1$	16.73/ 7.62	17.77/ 7.62	20.29

Configuration: RDI Cable 20 m

Single Antenna (Multiple port), single carrier

Rated output power level at RF connector 1x 17 dBm.

Symbolic name	Transmitter power [RMS (dBm)/ PAR dB]		
	Port RF	Port RF B	Total power[1)]
B	15.63/ 7.72	15.80/ 7.64	18.73
M	15.84/ 7.67	17.01/ 7.67	19.47
T	14.29/ 7.62	15.24/ 7.69	17.80

Single Antenna (Multiple port), 2-carrier

Rated output power 2 x 44.8 dBm per RF port.

Symbolic name	Transmitter power [RMS (dBm)/ PAR dB]		
	Port RF A	Port RF B	Total power[1)]
$M2_1$	16.78/ 7.64	17.12/ 7.64	19.96

[1)]: 2 outputs summed power according to FCC KDB662911 D01 Multiple transmitter output v02r01

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

Configuration: RDI Cable 200 m

Measured output power per 1 MHz.

Symbolic name	[RMS dBm]		Total power[1)] [RMS dBm]
	Port RF A	Port RF B	
B	8.90	9.30	12.30
M	11.23	11.37	14.37
T	11.23	12.39	15.39

Configuration: RDI Cable 92 m

Measured output power per 1 MHz.

Symbolic name	[RMS dBm]		Total power[1)] [RMS dBm]
	Port RF A	Port RF B	
B	9.32	10.41	13.41
M	10.81	12.40	15.40
T	9.91	12.24	15.24

Configuration: RDI Cable 20 m

Measured output power per 1 MHz.

Symbolic name	[RMS dBm]		Total power[1)] [RMS dBm]
	Port RF A	Port RF B	
B	10.53	10.86	13.86
M	10.70	11.35	14.35
T	9.23	10.61	13.61

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

Appendix 2

Limits

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

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

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

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

Complies?	Yes

Appendix 3

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

Date	Temperature	Humidity
2015-02-03	22 °C ± 3°C	18 % ± 5 %
2015-02-04	22 °C ± 3°C	20 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI/TIA-603-C.

The test was performed with continuous transmission.

The test of radiated emission was performed in a semi anechoic chamber. The measurements were performed with both horizontal and vertical polarizations of the antenna. The antenna distance was 3.0 m.

The fundamental was scanned with PEAK-detector with the antenna height was varied between 1-4 m and the turntable was rotated between 0-360 degrees for maximum response. The carrier power was measured with RMS- detector activated with a RBW of 1 MHz. The output power was verified with the substitution method according ANSI/TIA-603-C. The antenna distance during the measurements was 3.0 m.

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
EMCO Horn Antenna 3115	502 175
EMCO Horn Antenna 3115	902 212
Coaxial cable	503 936
R&S SMB 100A	900 120
Attenuator	BX41643
Testo 635 temperature and humidity meter	504 188

Measurement uncertainty:

3.1 dB

Appendix 3

The test set-up during the effective radiated output power measurements is shown in the picture below, side position.

The test set-up during the effective radiated output power measurements is shown in the picture below, upright position.

Results

Configuration: RDI Cable 92 m

Upright position

Symbolic name B		Symbolic name M		Symbolic name T	
Vertical/Horizontal RMS power (EIRP)		Vertical/Horizontal RMS power (EIRP)		Vertical/Horizontal RMS power (EIRP)	
dBm/ MHz	mW/ MHz	dBm/ MHz	mW/ MHz	dBm/ MHz	mW/ MHz
11.1/ 9.8	12.9/ 9.6	12.6/ 14.2	18.2/ 26.3	12.5/ 13.4	17.8/ 21.9

Side position

Symbolic name B		Symbolic name M		Symbolic name T	
Vertical/Horizontal RMS power (EIRP)		Vertical/Horizontal RMS power (EIRP)		Vertical/Horizontal RMS power (EIRP)	
dBm/ MHz	mW/ MHz	dBm/ MHz	mW/ MHz	dBm/ MHz	mW/ MHz
10.8/ 13.0	12.0/ 20.0	10.9/ 14.8	12.3/ 30.2	10.4/ 14.5	11.0/ 28.2

Limits

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

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

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

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

Complies?	Yes

Appendix 4

Occupied bandwidth measurements according to 47 CFR 2.1049 /IC RSS-Gen 6.6

Date	Temperature	Humidity
2015-01-26	22 °C ± 3 °C	18 % ± 5 %
2015-01-27	22 °C ± 3 °C	19 % ± 5 %

Test set-up and procedure

The measurements were made per definition in FCC: KDB: 971168 D01 Power Meas Licens, v02r02 and IC: RSS-Gen section 6.6. The output was connected to a signal analyzer with the Peak detector activated and max hold. The signal analyser was connected to an external 10 MHz reference standard during the measurements.

Measurement equipment	SP number
R&S FSQ 40	504 143
RF attenuator	900 691
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Configuration: RDI Cable 200 m

Single Antenna (Multiple port), single carrier

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
1	B	RF B	4.16
2	M	RF B	4.18
3	T	RF A	4.16
4	T	RF B	4.17

Configuration: RDI Cable 92 m

Single Antenna (Multiple port), single carrier

Diagram	Symbolic name	Tested port	Occupied BW (99%) [MHz]
5	B	RF B	4.16
6	M	RF B	4.18
7	T	RF B	4.17

Configuration: RDI Cable 20 m

Single Antenna (Multiple port), single carrier

Diagram	Symbolic name	Tested port	Occupied BW (99%) [MHz]
8	B	RF B	4.15
9	M	RF B	4.19
10	T	RF B	4.15

Appendix 4

Diagram 1:

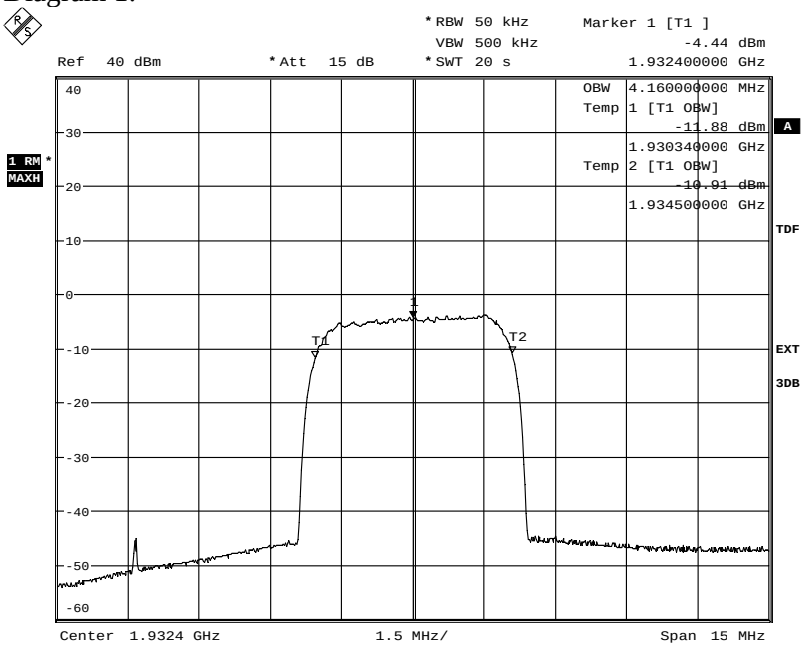


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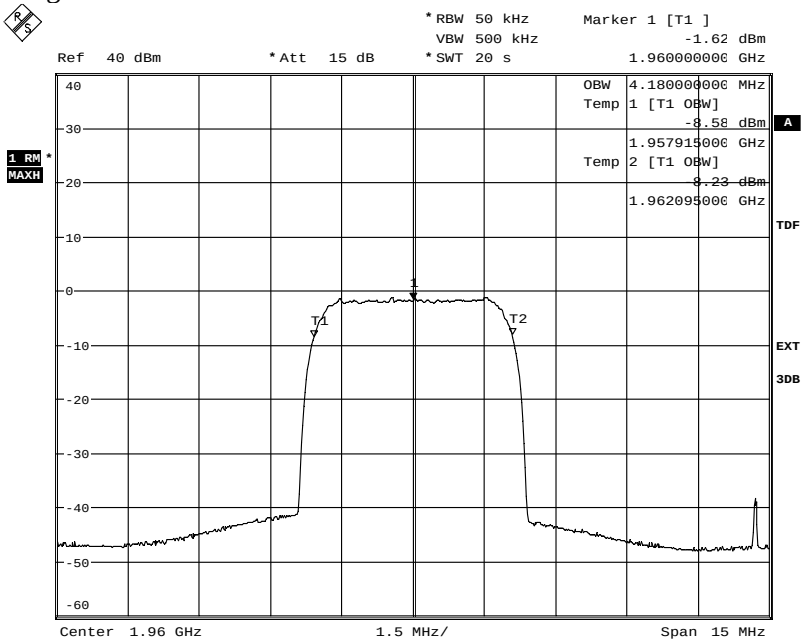
Diagram 2:



Date: 27.JAN.2015 07:39:08

Appendix 4

Diagram 3:

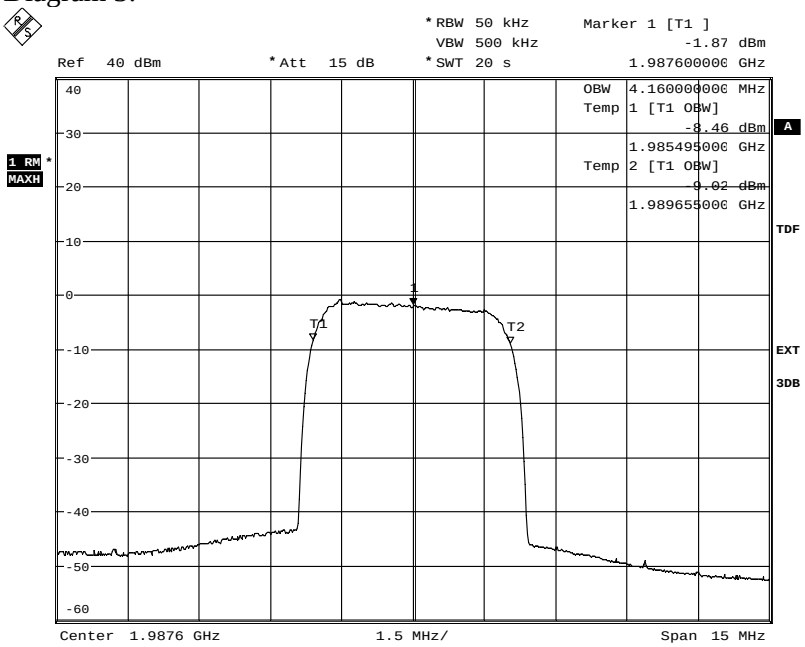


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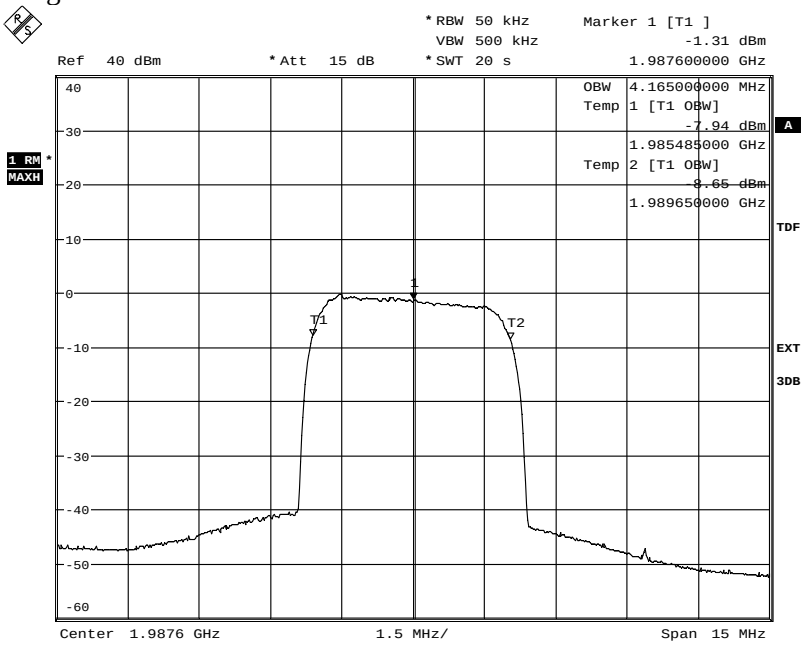
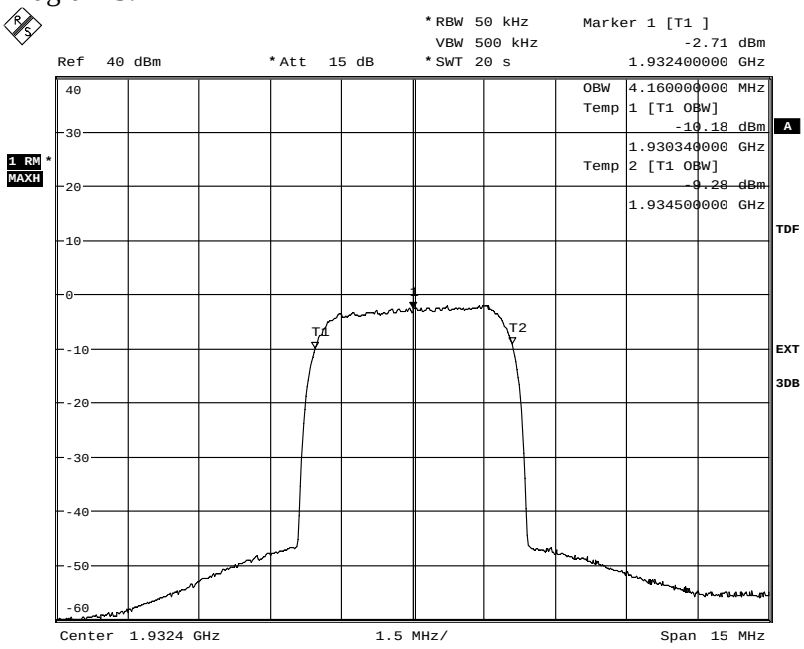
Diagram 4:



Date: 27.JAN.2015 08:07:18

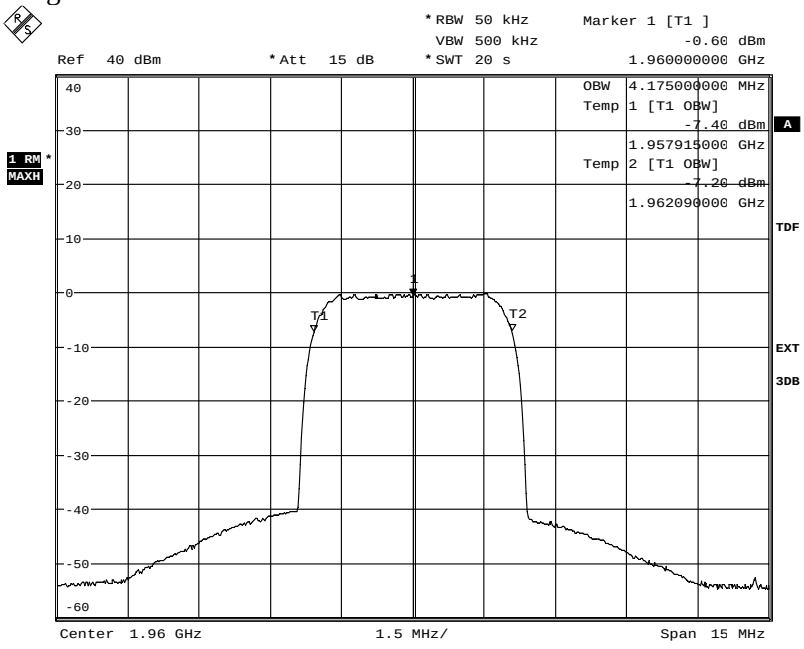
Appendix 4

Diagram 5:



Date: 26.JAN.2015 12:44:15

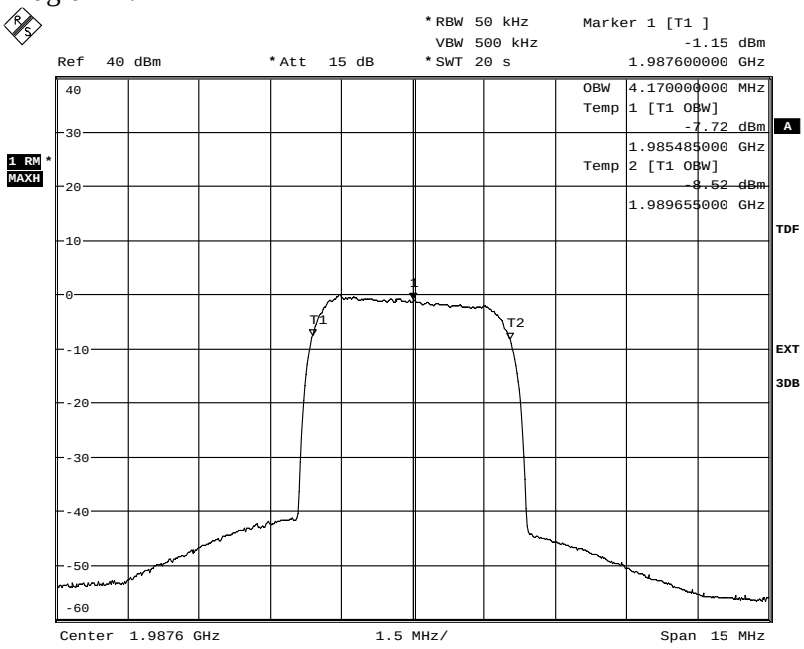
Diagram 6:



Date: 26.JAN.2015 13:16:46

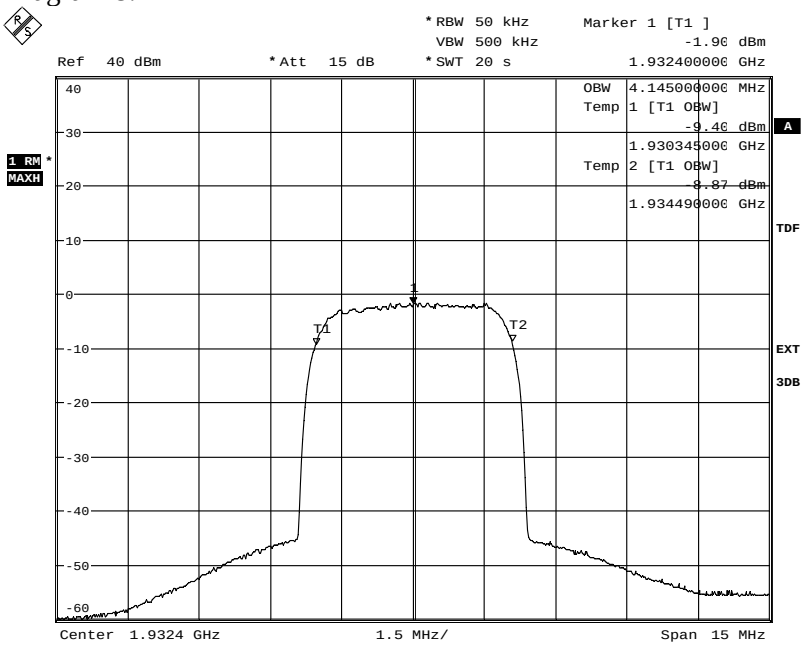
Appendix 4

Diagram 7:



Date: 26.JAN.2015 13:30:19

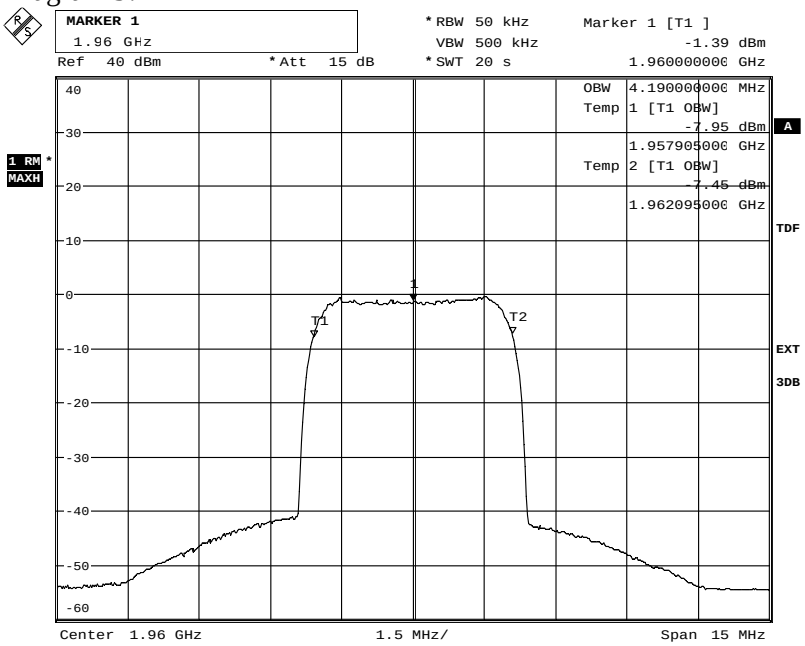
Diagram 8:



Date: 27.JAN.2015 12:23:42

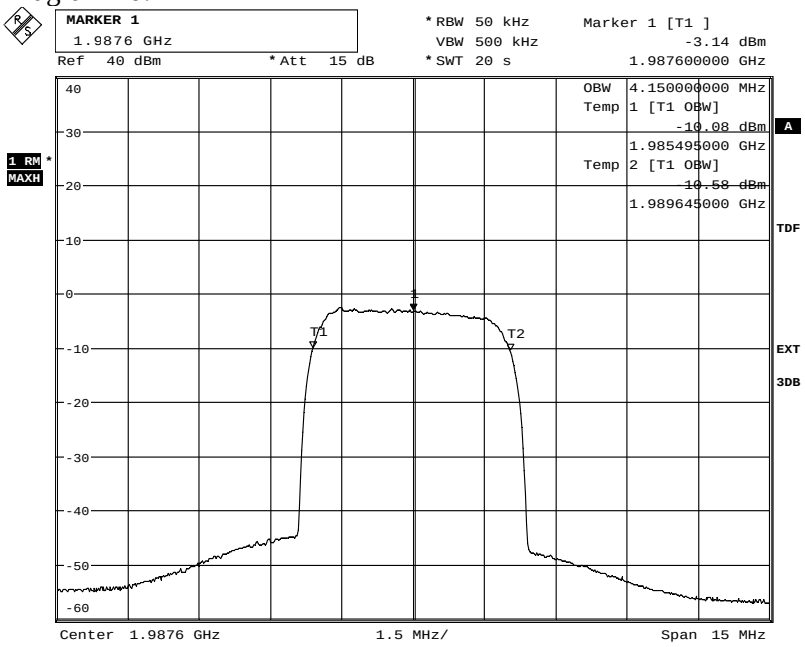
Appendix 4

Diagram 9:



Date: 27.JAN.2015 14:21:53

Diagram 10:



Date: 27.JAN.2015 12:33:14

Appendix 5

Band edge measurements according to CFR 47 §24.238 / IC RSS-133 6.5

Date	Temperature	Humidity
2015-01-26	22 °C ± 3 °C	18 % ± 5 %
2015-01-27	22 °C ± 3 °C	19 % ± 5 %
2015-01-28	22 °C ± 3 °C	19 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §24.238. The test object was connected to a spectrum analyser with the RMS detector activated. The spectrum analyzer 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.
A resolution bandwidth of 200 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 7 dB to -20 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 43	504 143
RF attenuator	900 691
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Configuration: RDI Cable 200 m

Single Antenna (Multiple port), single carrier

Diagram	BW configuration	Symbolic name	Tested Port
1 a-c	5 MHz	B	RF B
2 a-c	5 MHz	B	RF A
3 a-c	5 MHz	T	RF A
4 a-c	5 MHz	T	RF B

Single Antenna (Multiple port), 2-carriers

Diagram	BW configuration	Symbolic name	Tested Port
5 a-c	5 MHz	$B2_1$	RF B
6 a-c	5 MHz	$T2_1$	RF B

Single Antenna (Multiple port), 4-carriers

Diagram	BW configuration	Symbolic name	Tested Port
7 a-c	5 MHz	T4	RF B

Configuration: RDI Cable 92 m

Single Antenna (Multiple port), single carrier

Diagram	BW configuration	Symbolic name	Tested Port
7 a-c	5 MHz	B	RF B
8 a-c	5 MHz	T	RF B

Single Antenna (Multiple port), 2-carriers

Diagram	BW configuration	Symbolic name	Tested Port
9 a-c	5 MHz	$B2_1$	RF B
10 a-c	5 MHz	$T2_1$	RF B

Configuration: RDI Cable 20 m

Single Antenna (Multiple port), single carrier

Diagram	BW configuration	Symbolic name	Tested Port
11 a-c	5 MHz	B	RF B
12 a-c	5 MHz	T	RF B

Limits

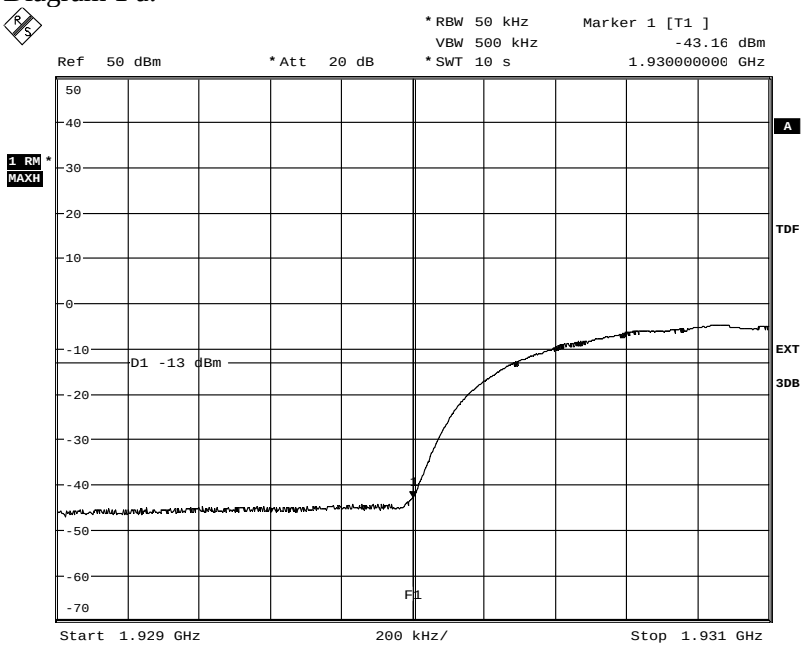
CFR 47 §24.238 and RSS-133 6.5

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

Complies?	Yes

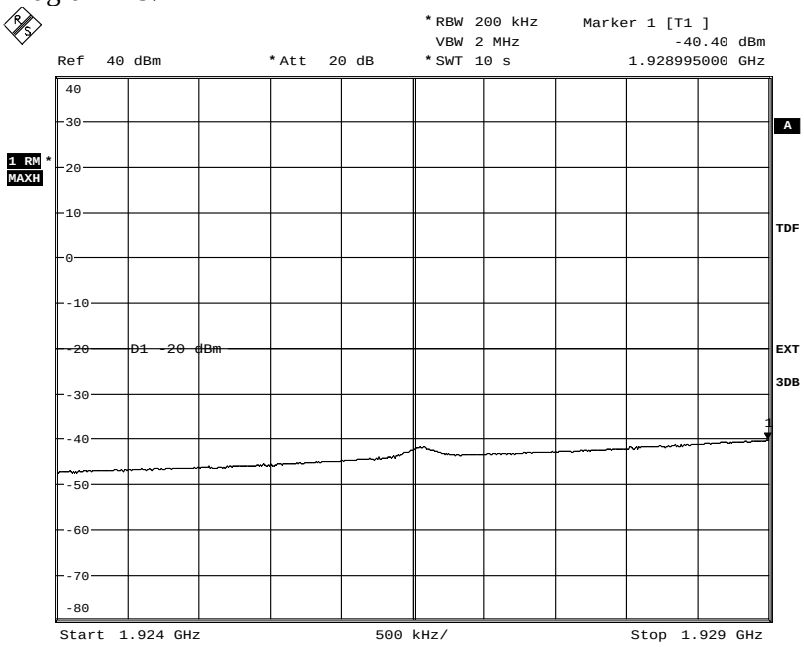
Appendix 5

Diagram 1 a:



Date: 26.JAN.2015 15:31:43

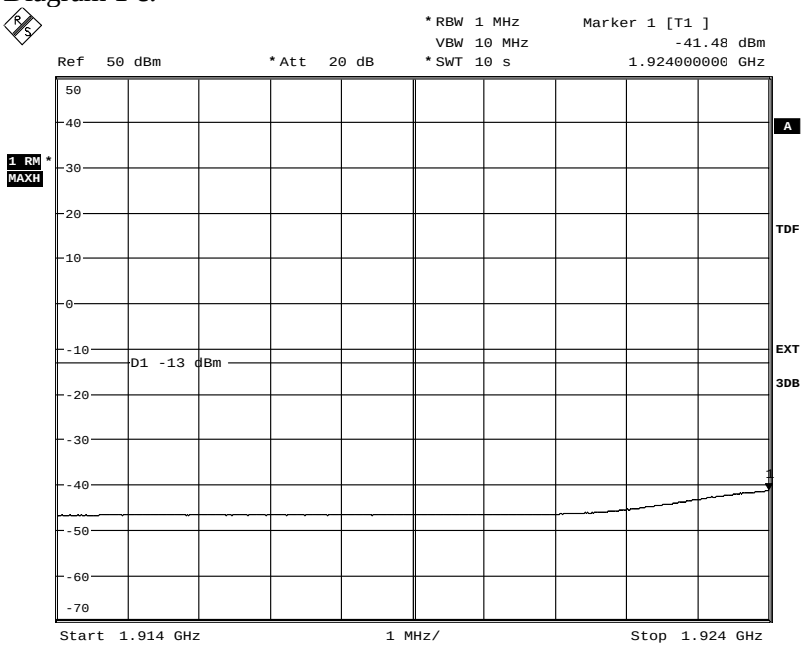
Diagram 1 b:



Date: 26.JAN.2015 15:32:44

Appendix 5

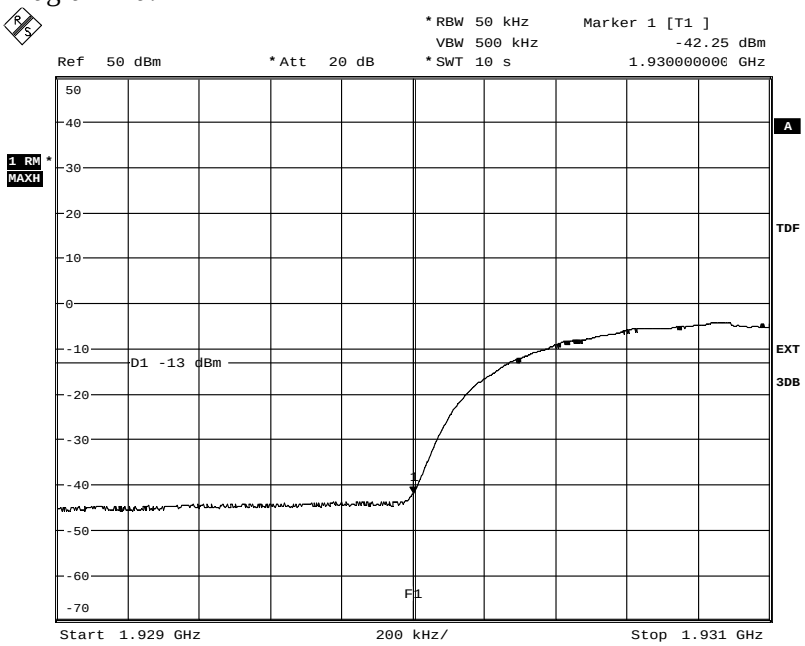
Diagram 1 c:



Date: 26.JAN.2015 15:34:13

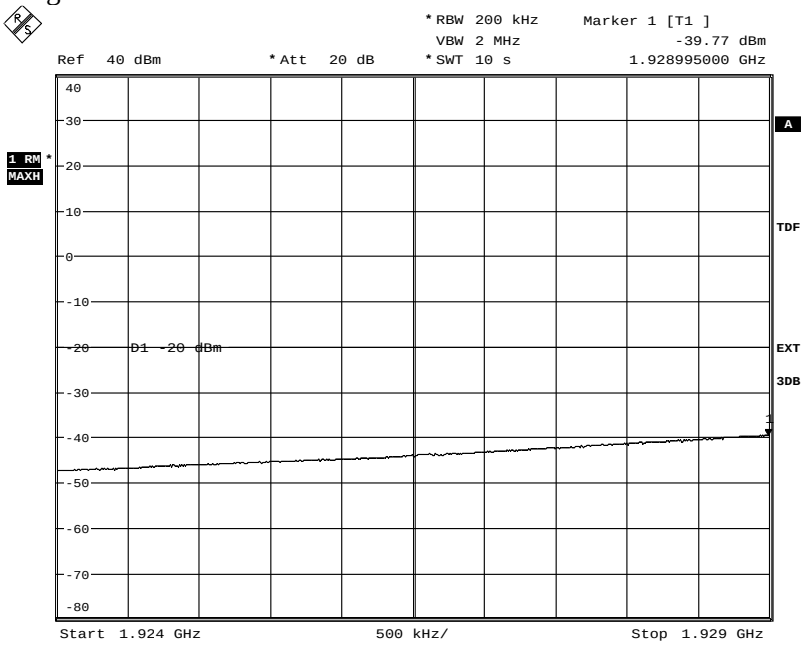
Appendix 5

Diagram 2 a:



Date: 27.JAN.2015 10:00:28

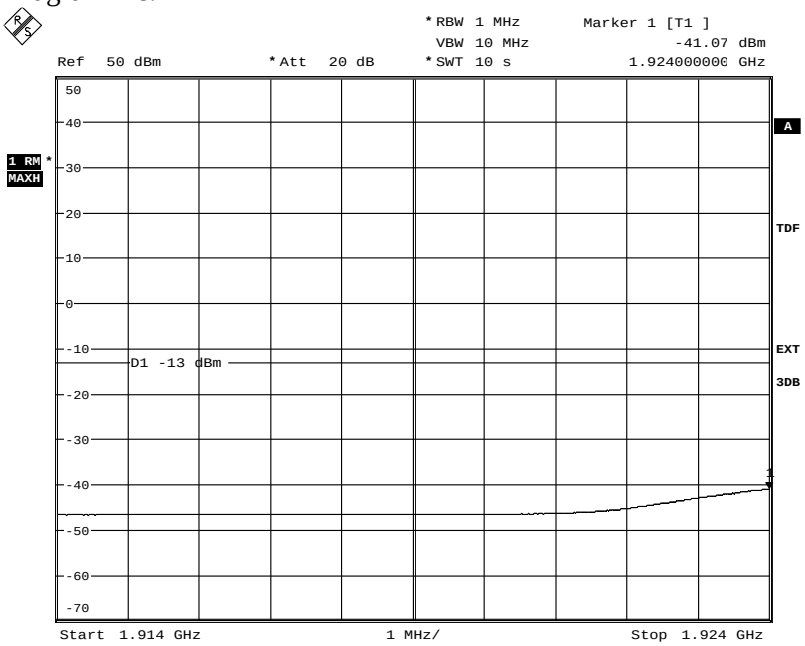
Diagram 2 b:



Date: 27.JAN.2015 09:59:09

Appendix 5

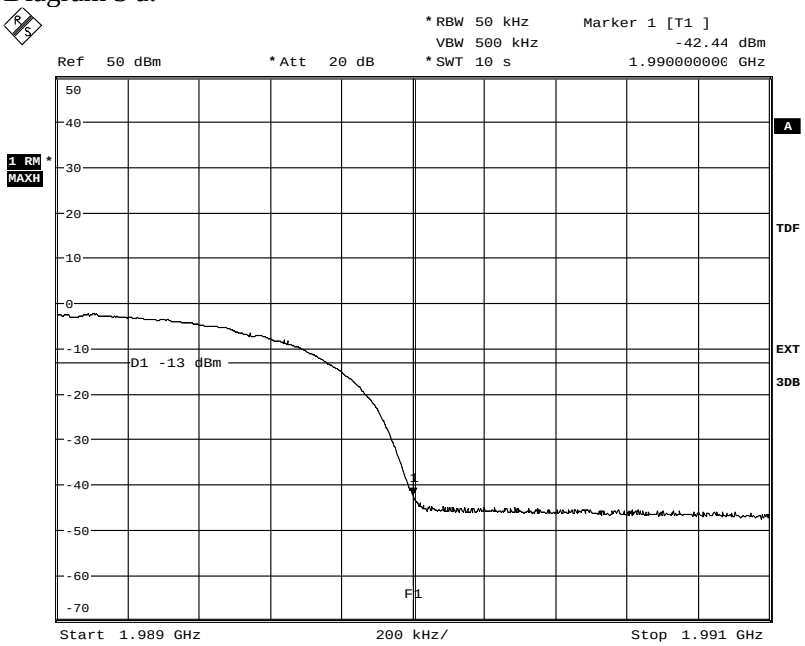
Diagram 2 c:



Date: 27.JAN.2015 08:46:01

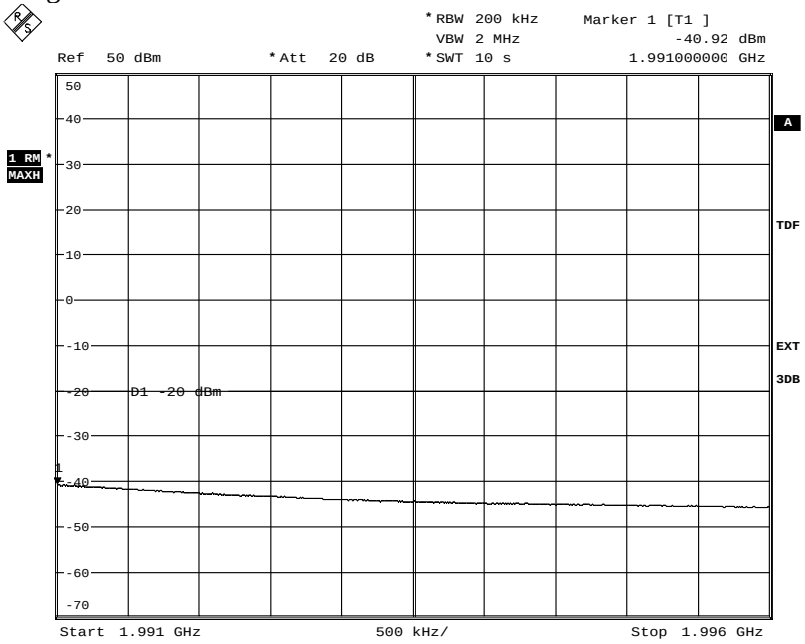
Appendix 5

Diagram 3 a:



Date: 27.JAN.2015 10:44:12

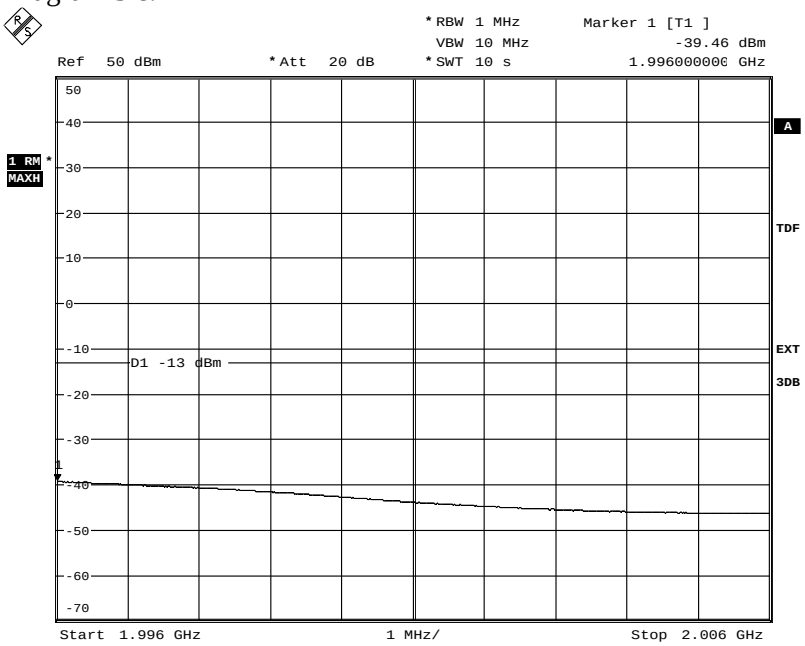
Diagram 3 b:



Date: 27.JAN.2015 10:45:08

Appendix 5

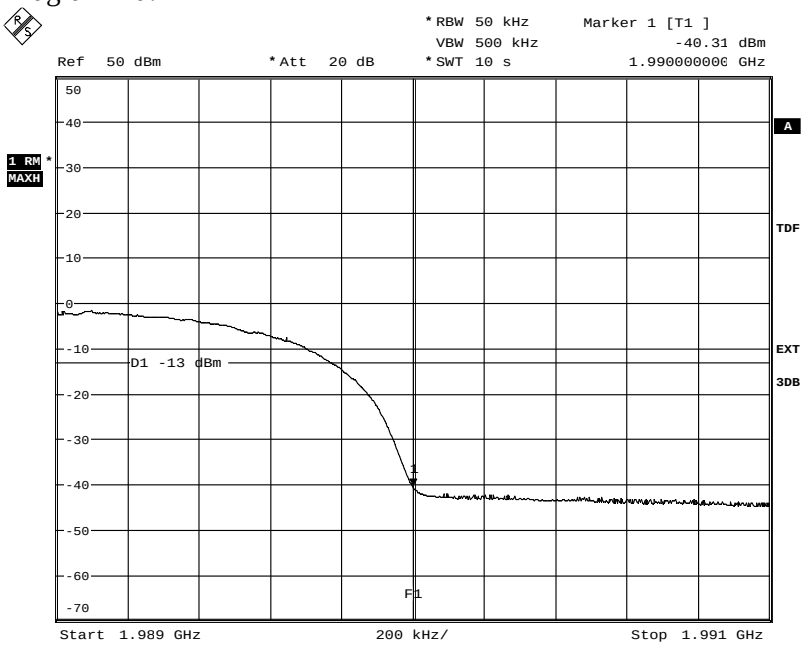
Diagram 3 c:



Date: 27.JAN.2015 10:46:11

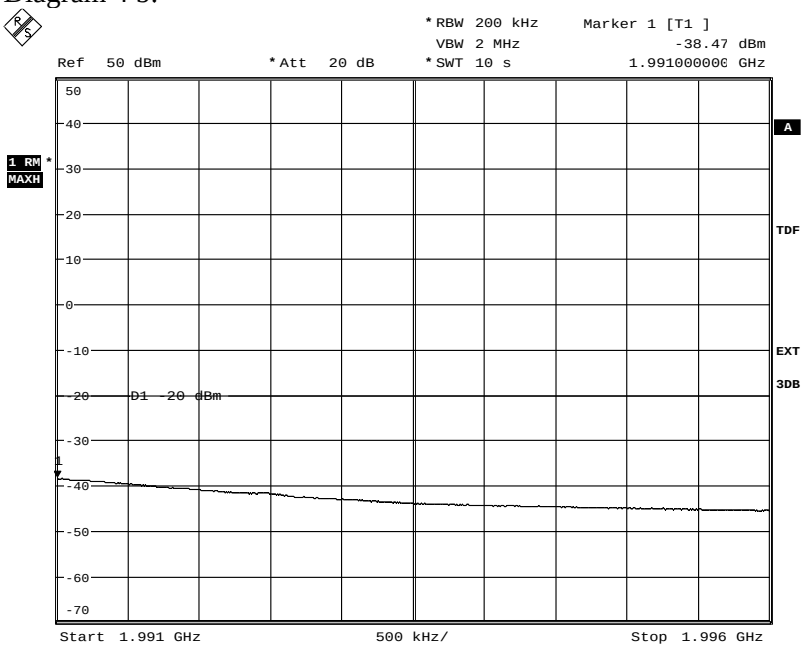
Appendix 5

Diagram 4 a:



Date: 27.JAN.2015 08:10:34

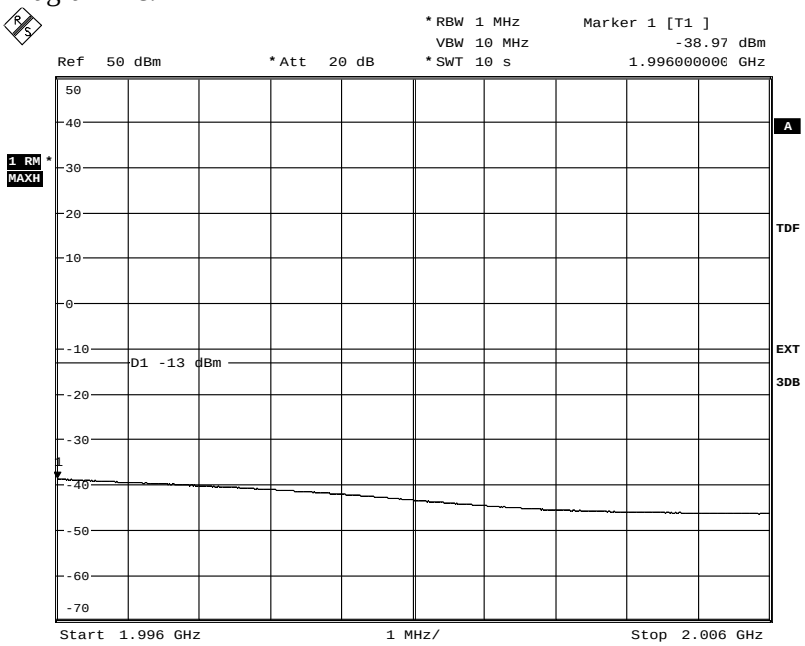
Diagram 4 b:



Date: 27.JAN.2015 08:11:51

Appendix 5

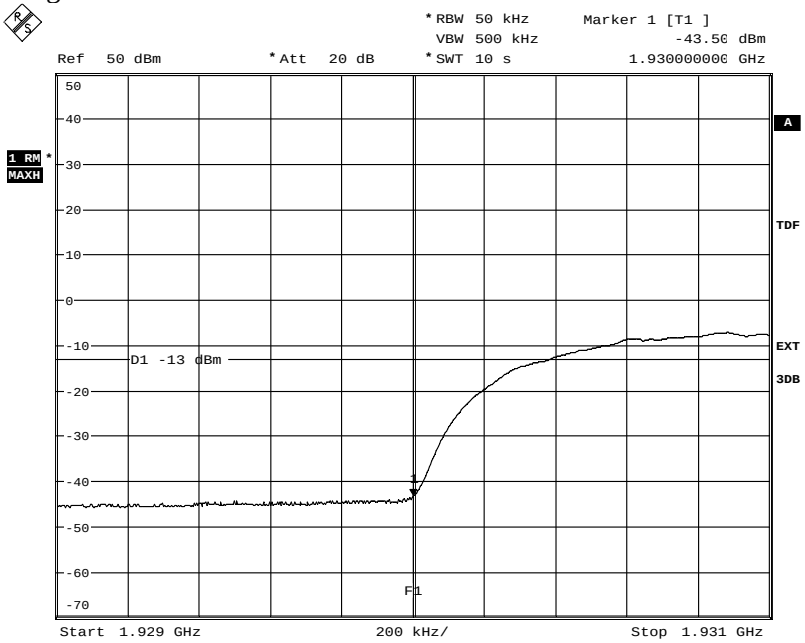
Diagram 4 c:



Date: 27.JAN.2015 08:12:49

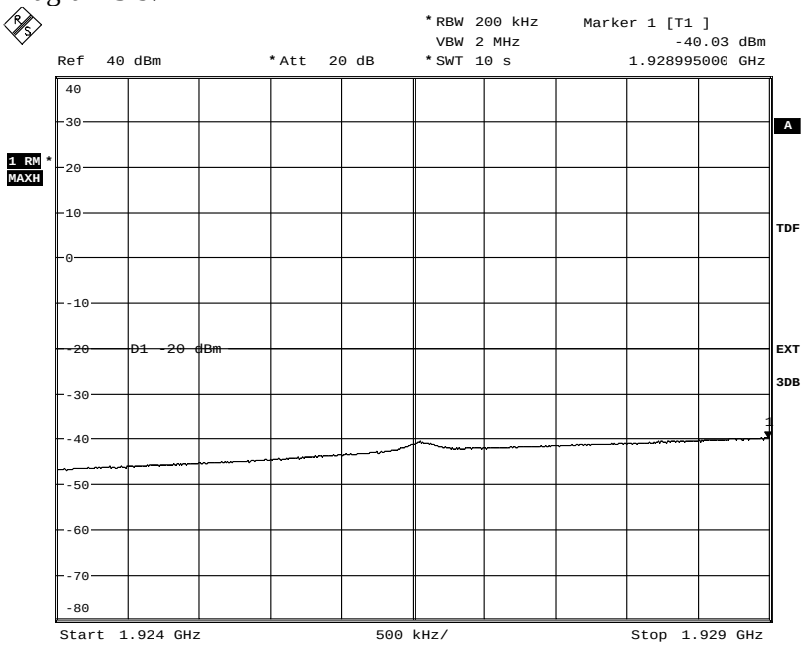
Appendix 5

Diagram 5 a:



Date: 27.JAN.2015 14:52:08

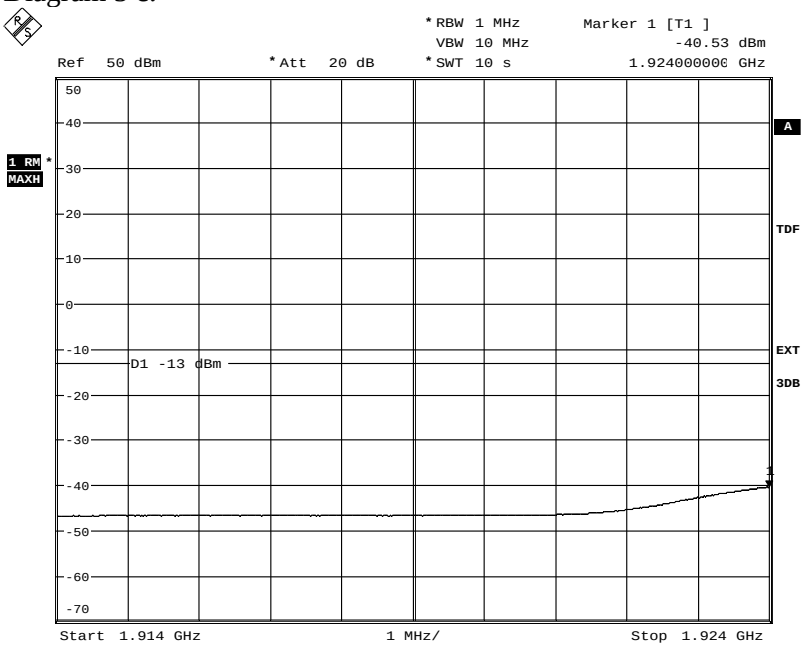
Diagram 5 b:



Date: 27.JAN.2015 14:53:35

Appendix 5

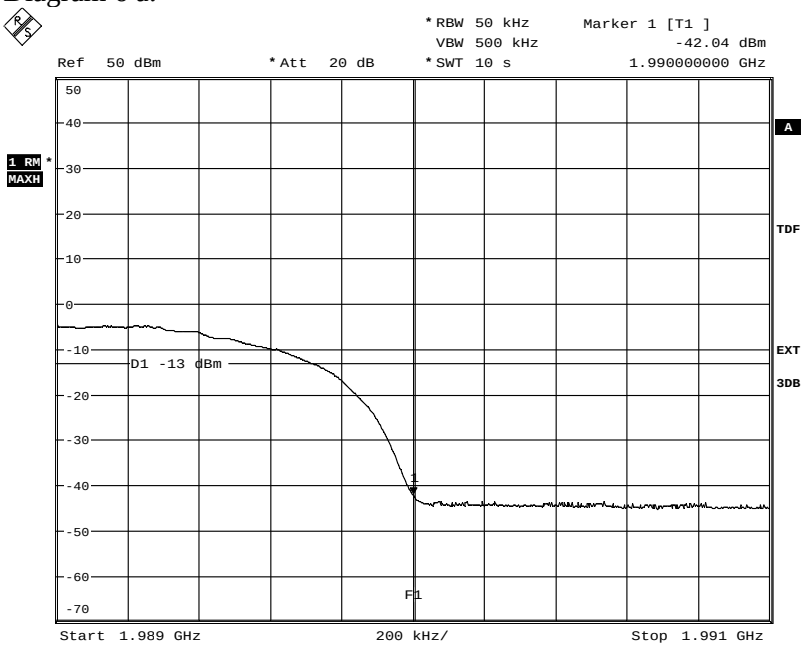
Diagram 5 c:



Date: 27.JAN.2015 14:54:30

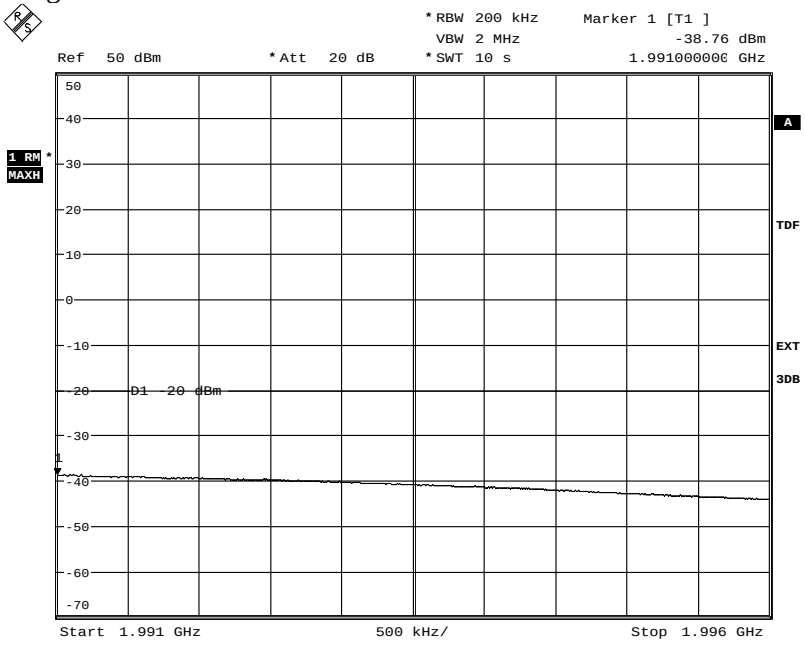
Appendix 5

Diagram 6 a:



Date: 27.JAN.2015 15:15:42

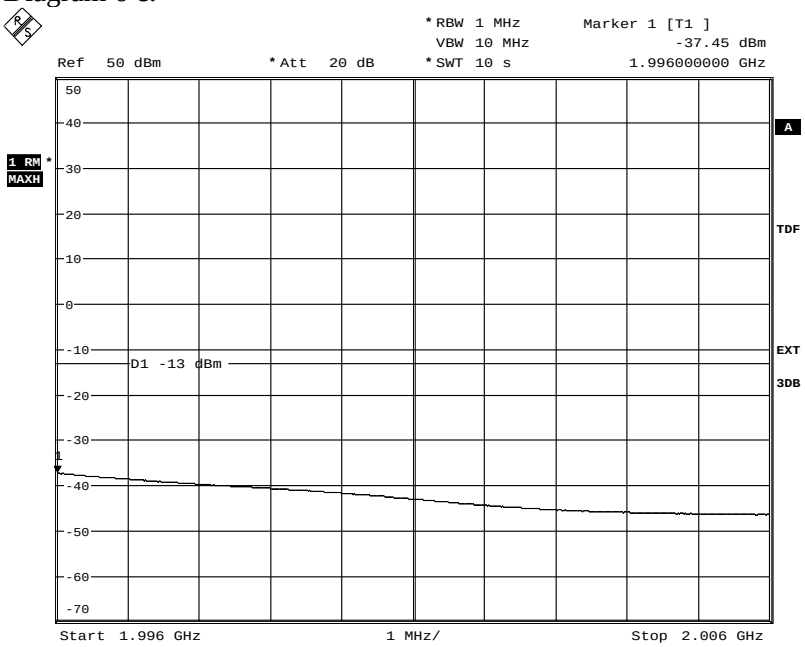
Diagram 6 b:



Date: 27.JAN.2015 15:16:48

Appendix 5

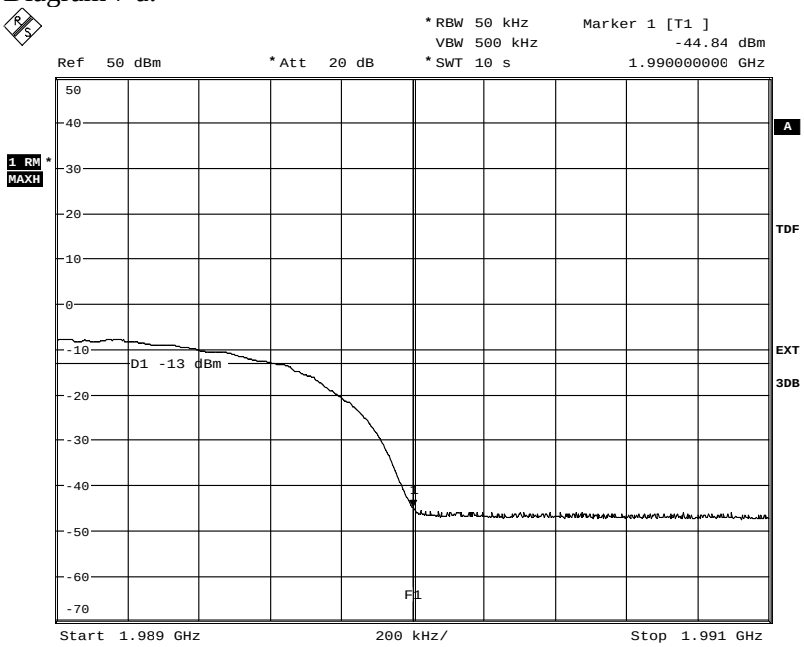
Diagram 6 c:



Date: 27.JAN.2015 15:18:14

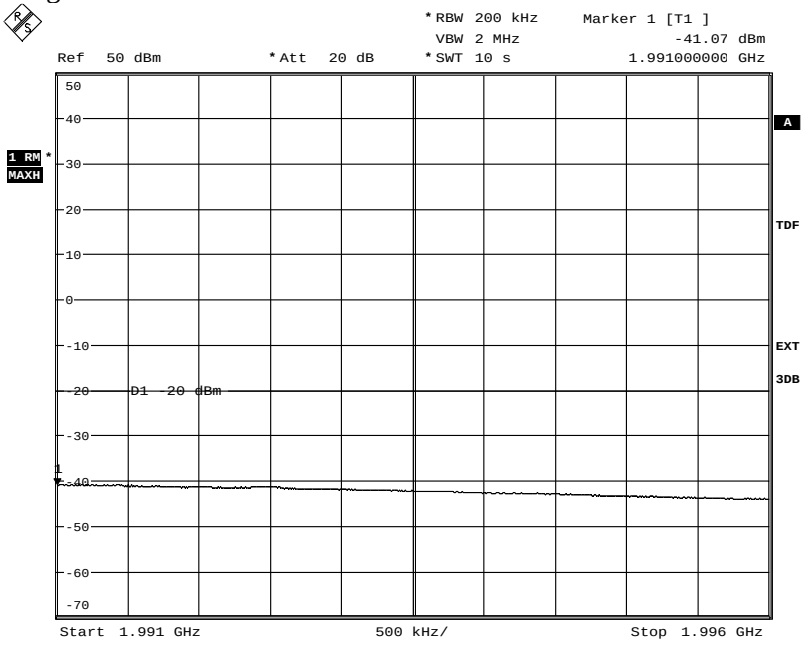
Appendix 5

Diagram 7 a:



Date: 28.JAN.2015 09:59:22

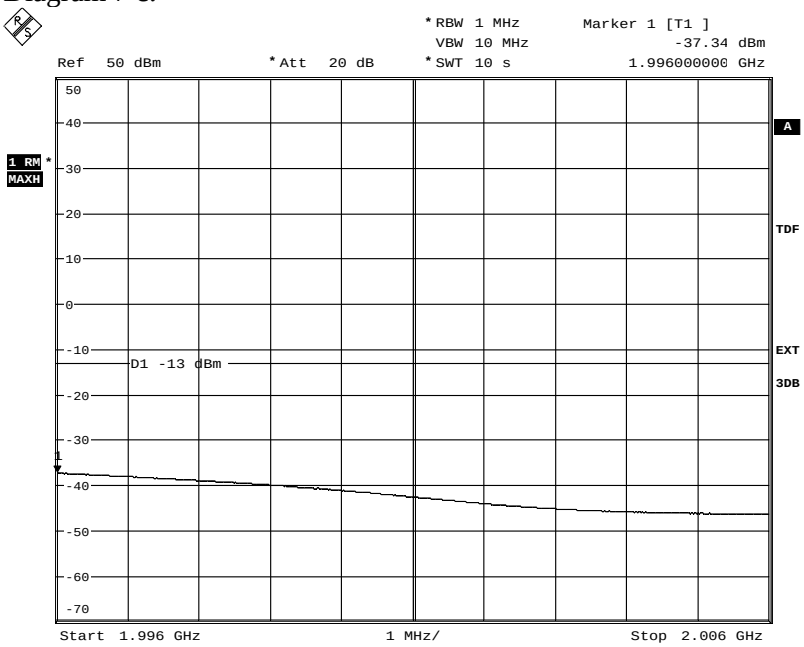
Diagram 7 b:



Date: 28.JAN.2015 10:00:13

Appendix 5

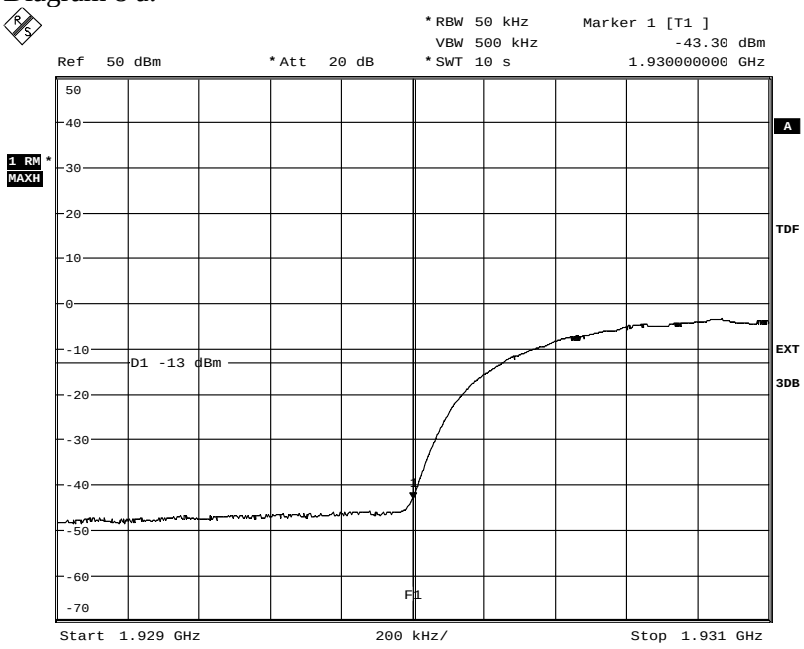
Diagram 7 c:



Date: 28.JAN.2015 10:01:00

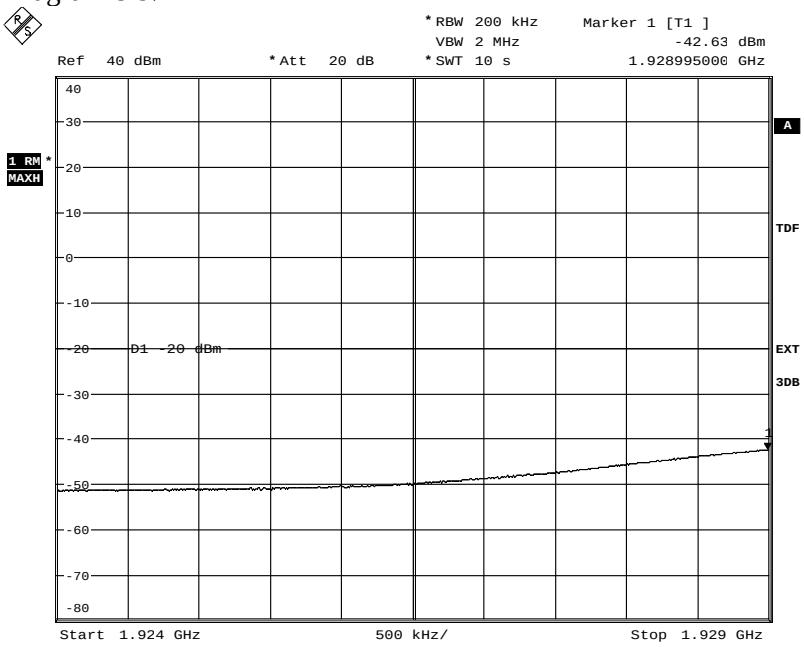
Appendix 5

Diagram 8 a:



Date: 26.JAN.2015 12:49:24

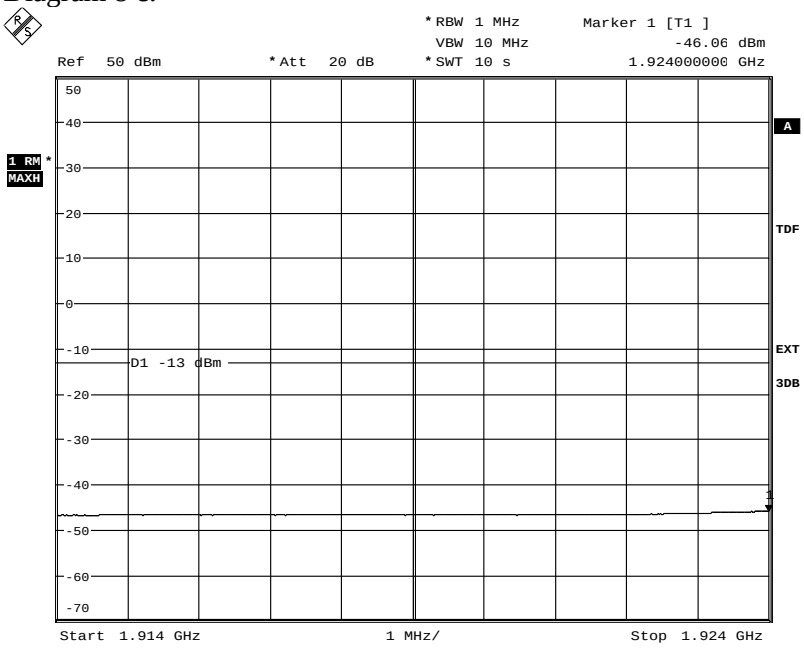
Diagram 8 b:



Date: 26.JAN.2015 12:50:43

Appendix 5

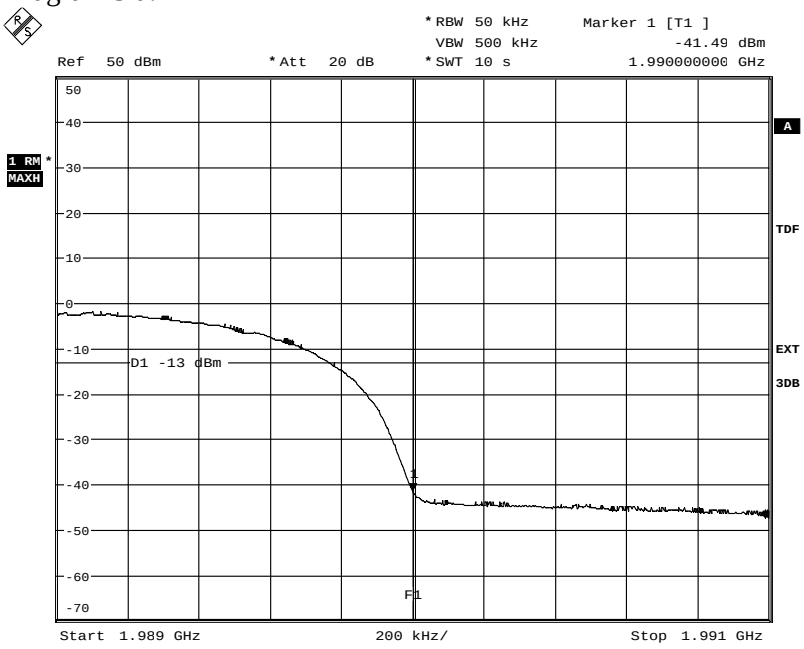
Diagram 8 c:



Date: 26.JAN.2015 12:51:49

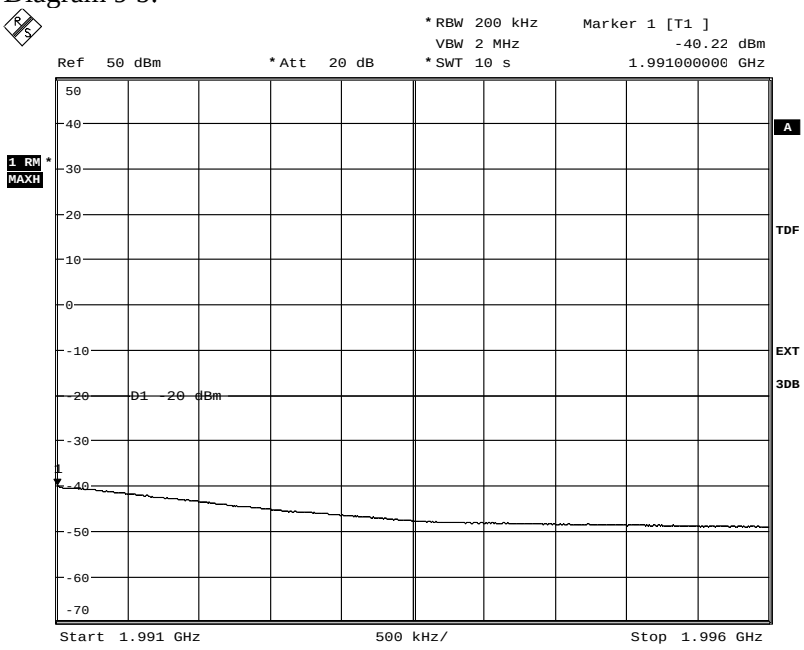
Appendix 5

Diagram 9 a:



Date: 26.JAN.2015 13:31:54

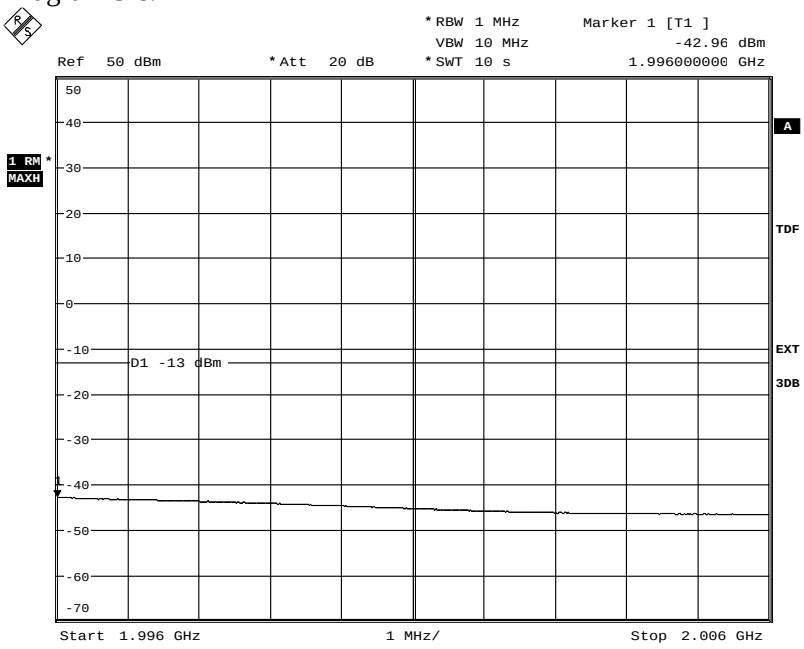
Diagram 9 b:



Date: 26.JAN.2015 13:32:44

Appendix 5

Diagram 9 c:



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Appendix 5

Diagram 10 a:

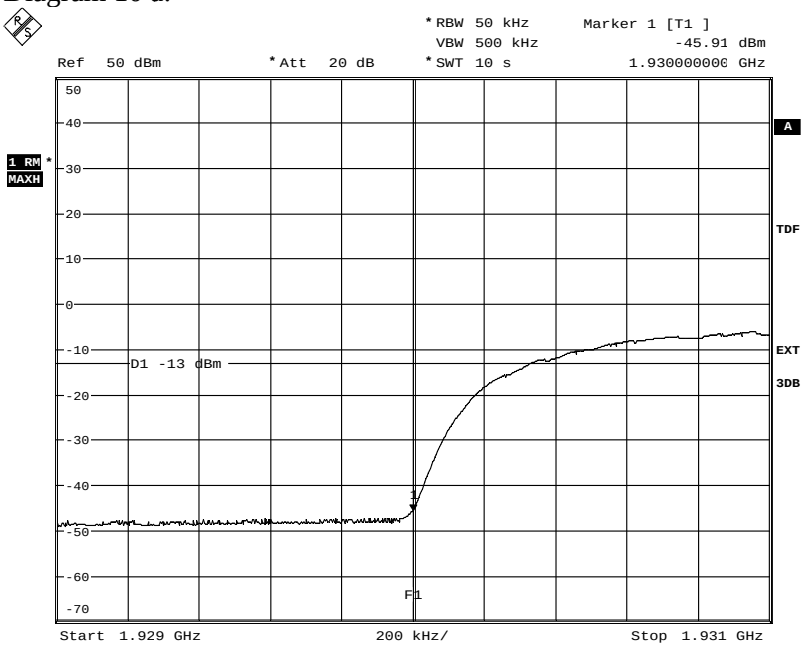

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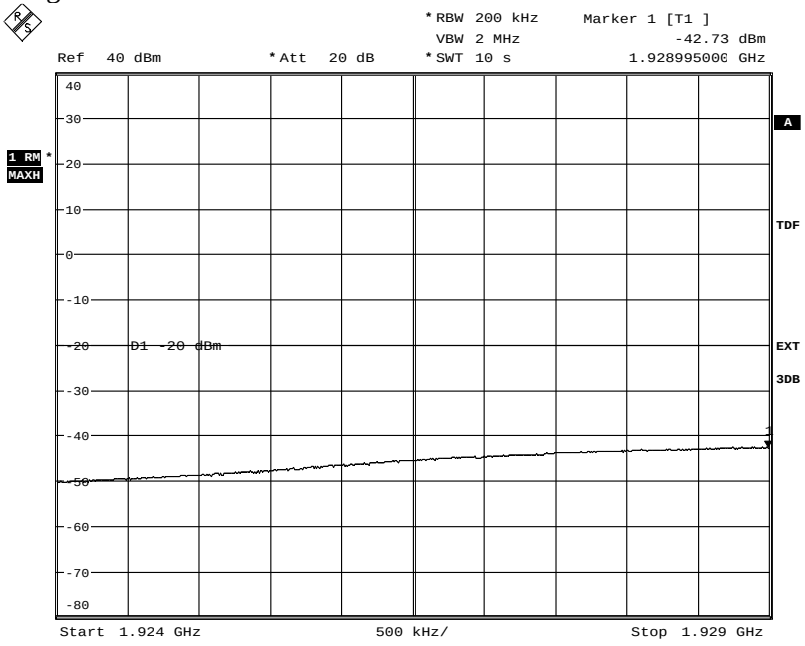
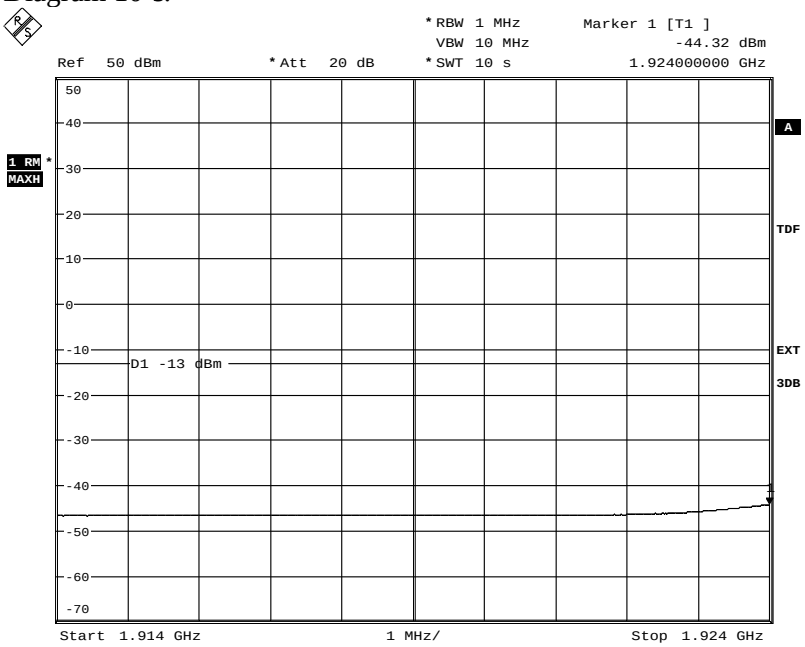
Diagram 10 b:



Date: 28.JAN.2015 08:49:12

Appendix 5

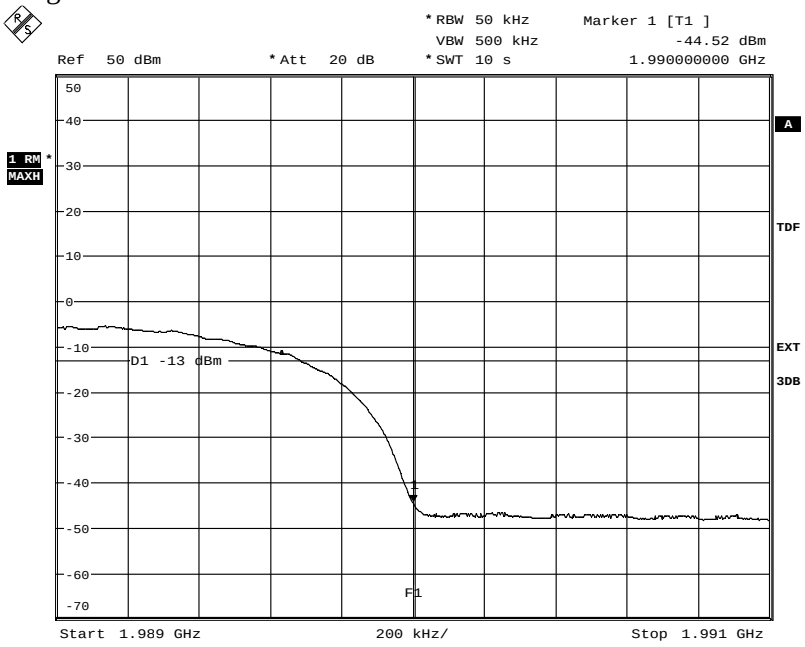
Diagram 10 c:



Date: 28.JAN.2015 08:50:28

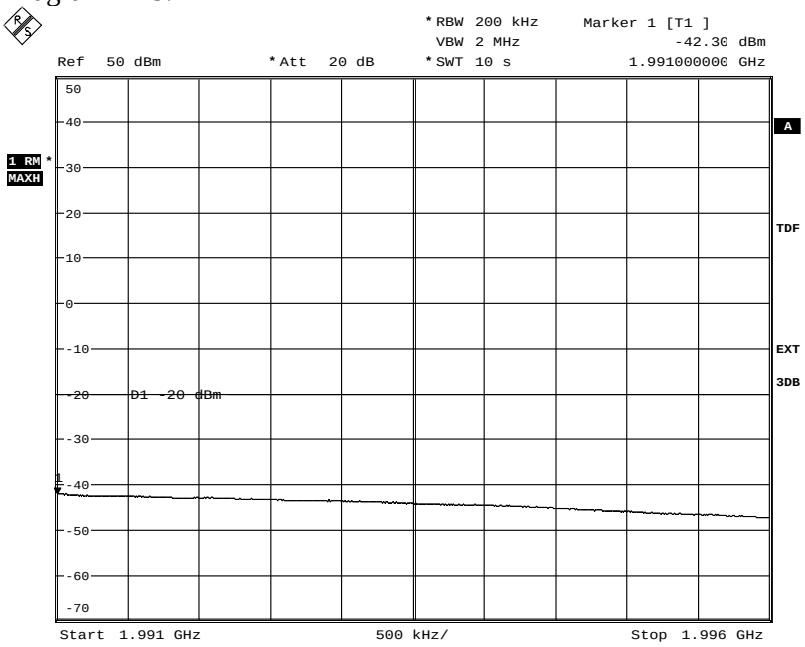
Appendix 5

Diagram 11 a:



Date: 28.JAN.2015 09:17:29

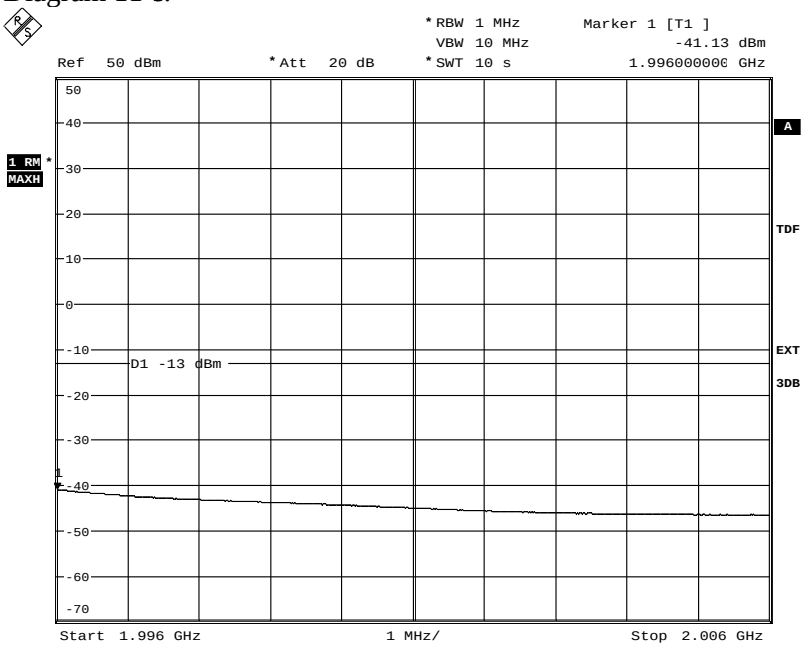
Diagram 11 b:



Date: 28.JAN.2015 09:19:17

Appendix 5

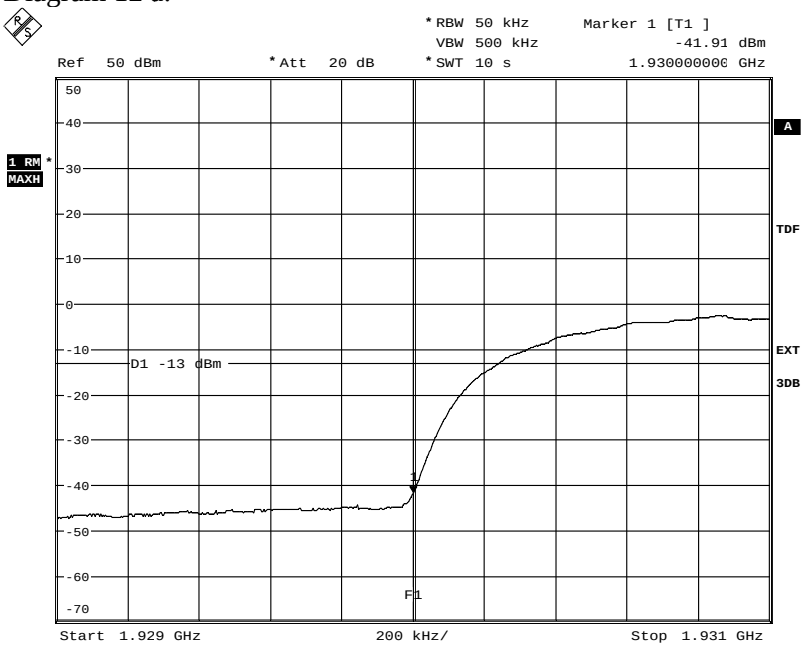
Diagram 11 c:



Date: 28.JAN.2015 09:20:12

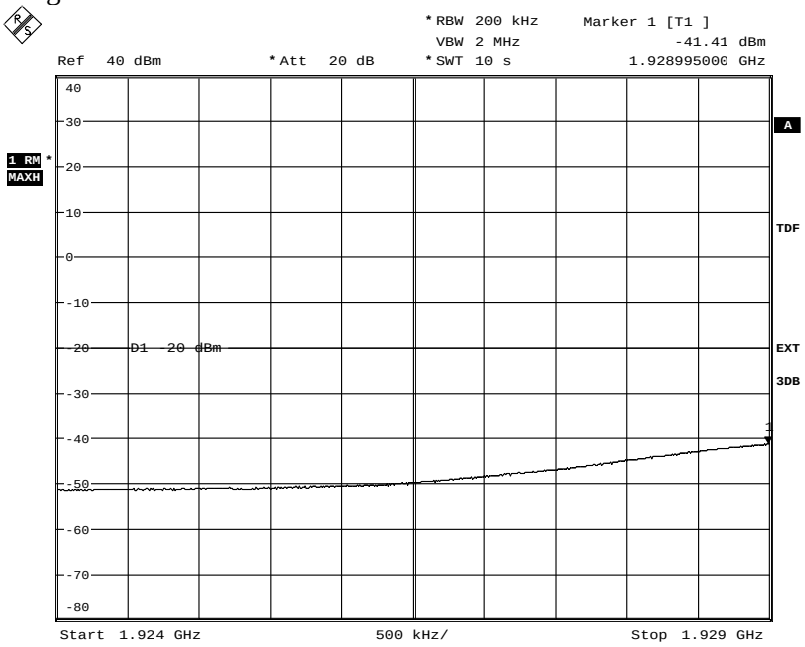
Appendix 5

Diagram 12 a:



Date: 27.JAN.2015 12:05:23

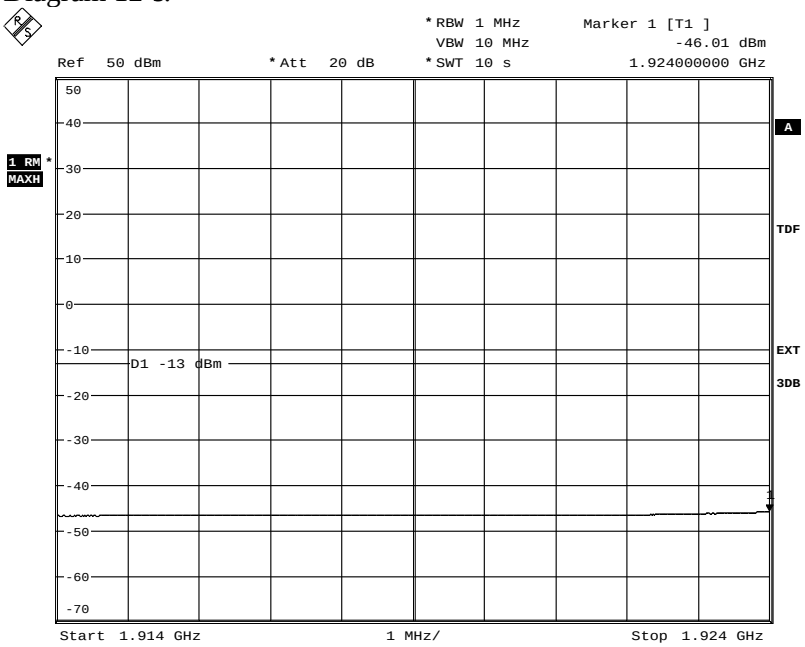
Diagram 12 b:



Date: 27.JAN.2015 12:06:29

Appendix 5

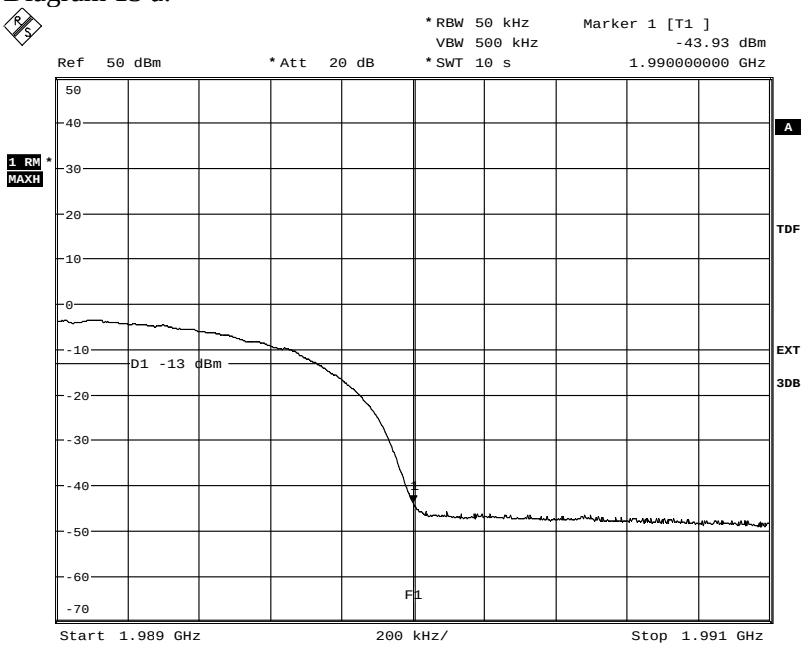
Diagram 12 c:



Date: 27.JAN.2015 12:07:26

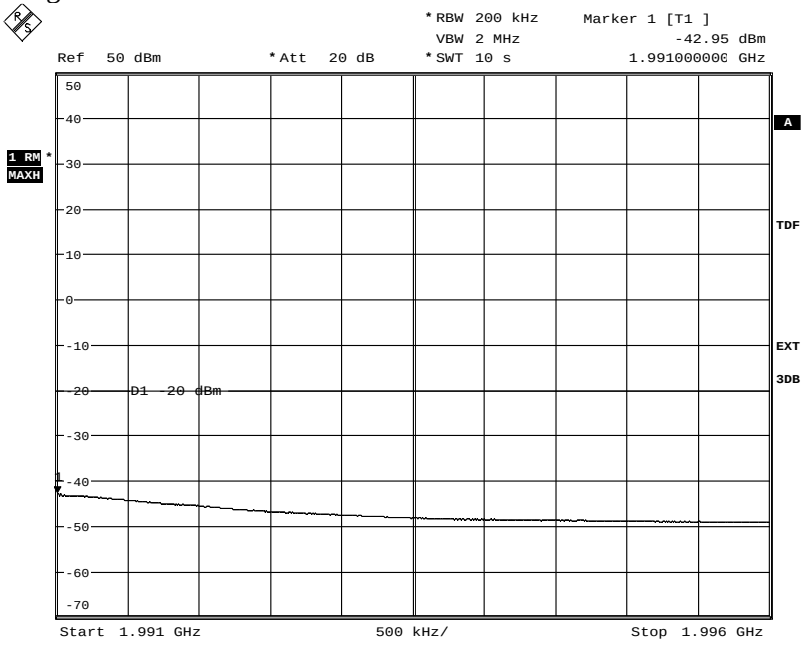
Appendix 5

Diagram 13 a:



Date: 27.JAN.2015 12:35:36

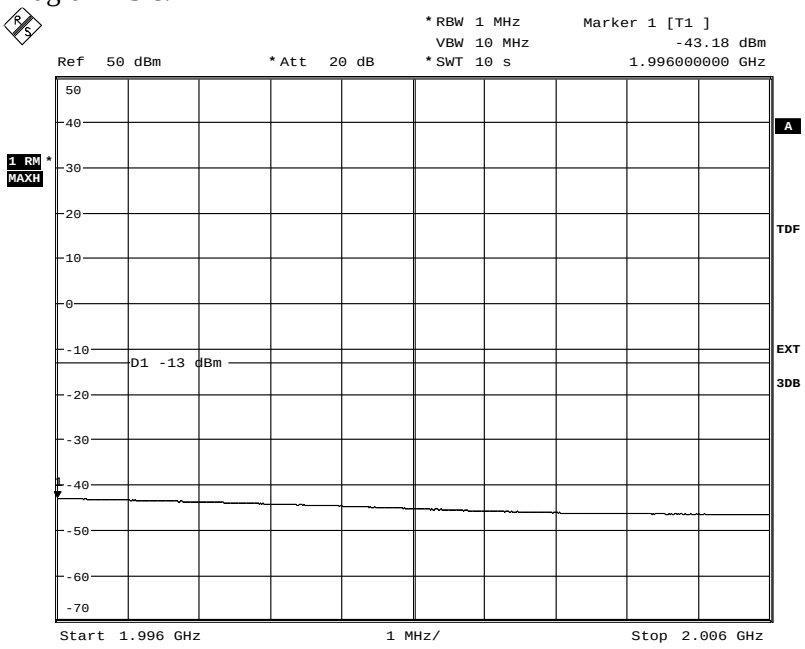
Diagram 13 b:



Date: 27.JAN.2015 12:37:08

Appendix 5

Diagram 13 c:



Date: 27.JAN.2015 12:38:02

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

Date	Temperature	Humidity
2015-01-26	22 °C ± 3 °C	18 % ± 5 %
2015-01-27	22 °C ± 3 °C	19 % ± 5 %
2015-01-28	22 °C ± 3 °C	19 % ± 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), (iii) “measure and add 10 log(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output v02r01.

Measurement equipment	SP number
R&S FSQ 40	504 143
RF attenuator	900 691
HP filter	BX40074
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Configuration: RDI Cable 200 m

Single Antenna (Multiple port), single carrier

Diagram	Symbolic name	Tested Port
1 a+b+c+d+e	B	RF B
2 a+b+c+d+e	M	RF B
3 a+b+c+d+e	T	RF A
4 a+b+c+d+e	T	RF B

Single Antenna (Multiple port), 2-carrier

Diagram	Symbolic name	Tested Port
5 a+b+c+d	B2im1	RF B
6 a+b+c+d	T2im1	RF B
7 a+b+c+d	B2/T2im2	RF B

Single Antenna (Multiple port), 4-carriers

Diagram	BW configuration	Symbolic name	Tested Port
8 a+b+c+d+e	5 MHz	T4	RF B

Configuration: RDI Cable 92 m

Single Antenna (Multiple port), single carrier

Diagram	Symbolic name	Tested Port
9 a+b+c+d	B	RF B
10 a+b+c+d	M	RF B
11 a+b+c+d	T	RF B

Single Antenna (Multiple port), 2-carrier

Diagram	Symbolic name	Tested Port
12 a+b+c+d+e	B2/T2im2	RF B

Configuration: RDI Cable 20 m

Single Antenna (Multiple port), single carrier

Diagram	Symbolic name	Tested Port
13 a+b+c+d	M	RF B

Single Antenna (Multiple port), 2-carrier

Diagram	Symbolic name	Tested Port
14 a+b+c+d+e	B2/T2im2	RF B

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 1.99 GHz. The measurements were made up to 20 GHz (10x1.99 GHz = 19.90 GHz).

Limits

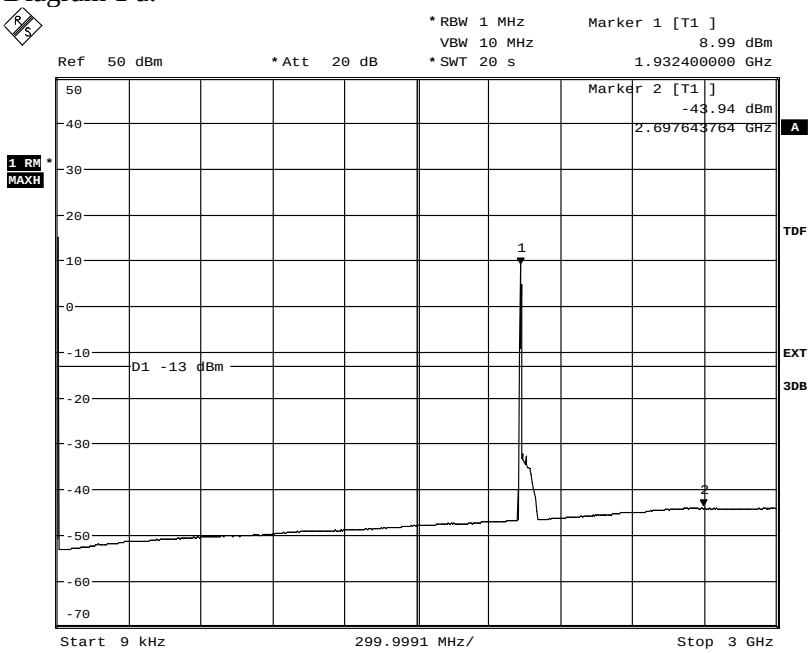
§24.238 and RSS-133 6.5

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, resulting in a limit of -13 dBm per 1 MHz RBW.

Complies?	Yes

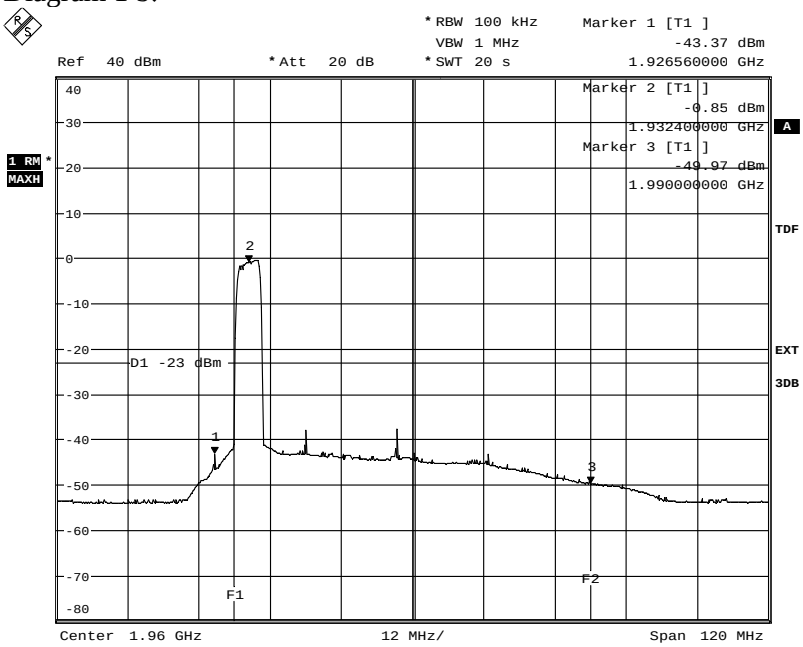
Appendix 6

Diagram 1 a:



Date: 26.JAN.2015 15:38:36

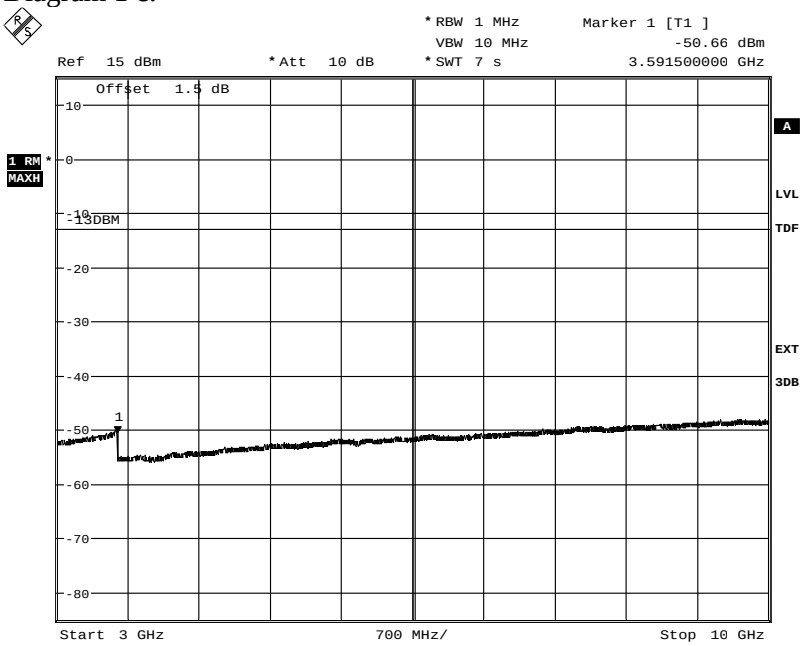
Diagram 1 b:



Date: 26.JAN.2015 15:36:23

Appendix 6

Diagram 1 c:



Date: 26.JAN.2015 15:40:11

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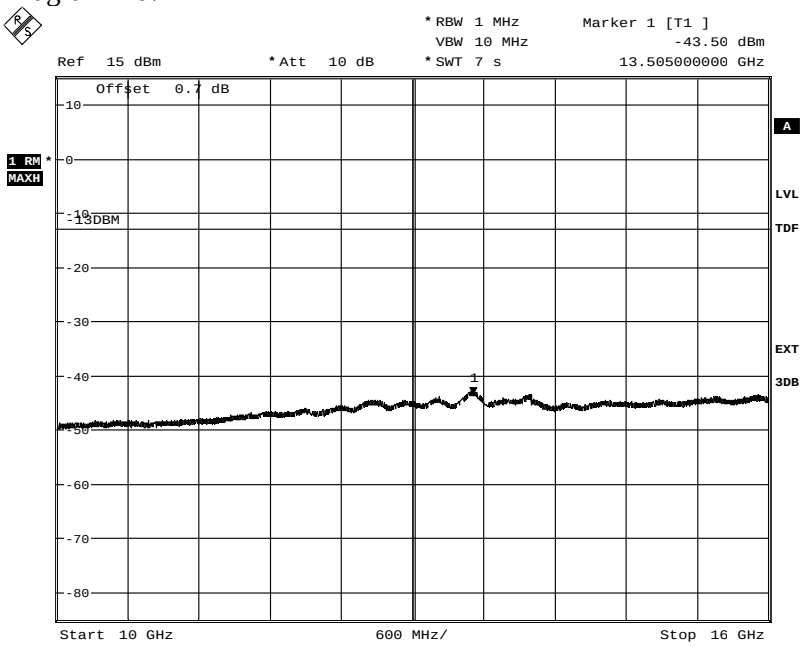
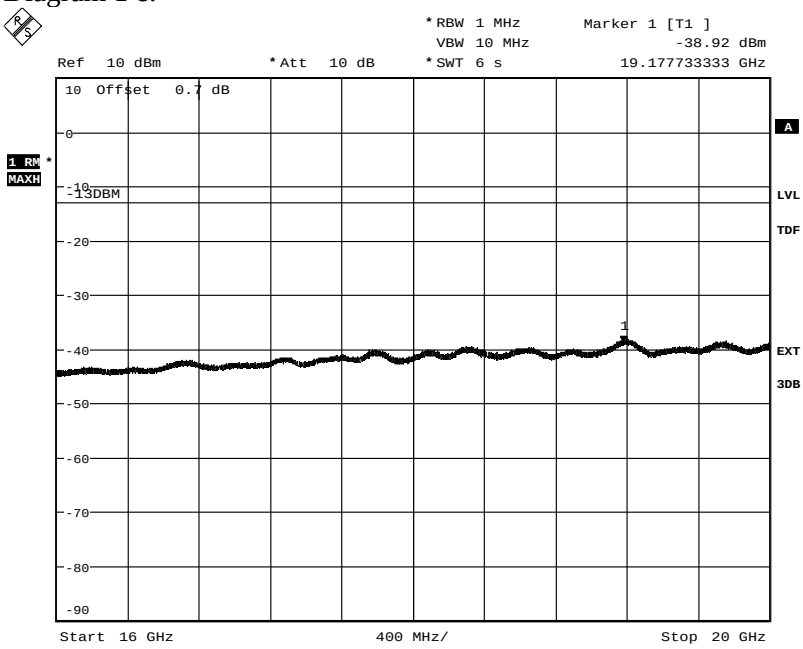


Date: 26.JAN.2015 15:41:51

Appendix 6

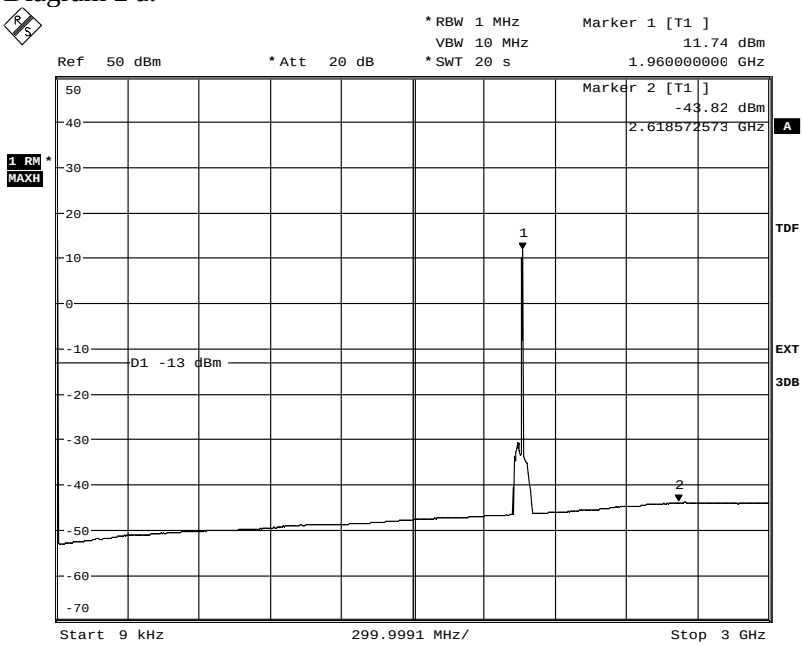
Diagram 1 e:



Date: 26.JAN.2015 15:40:50

Appendix 6

Diagram 2 a:



Date: 27.JAN.2015 07:28:00

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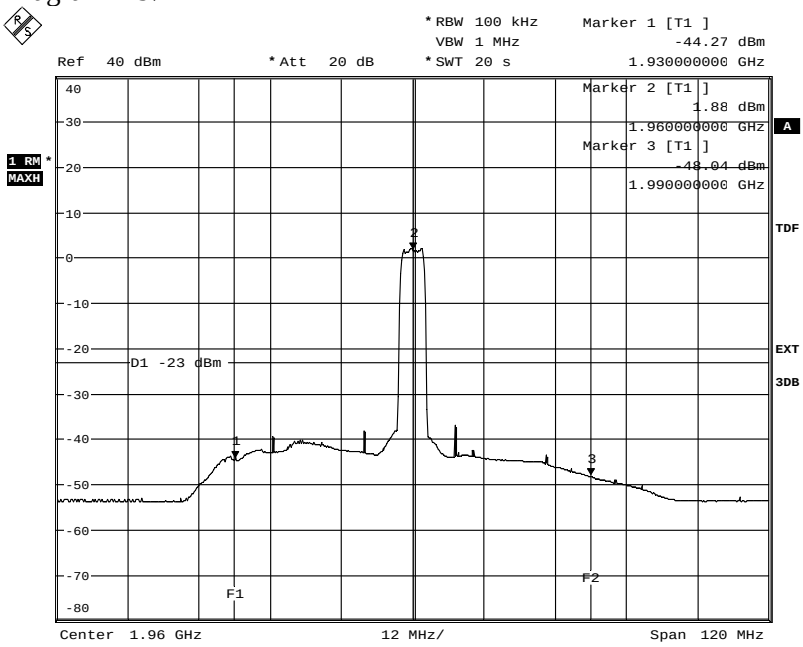
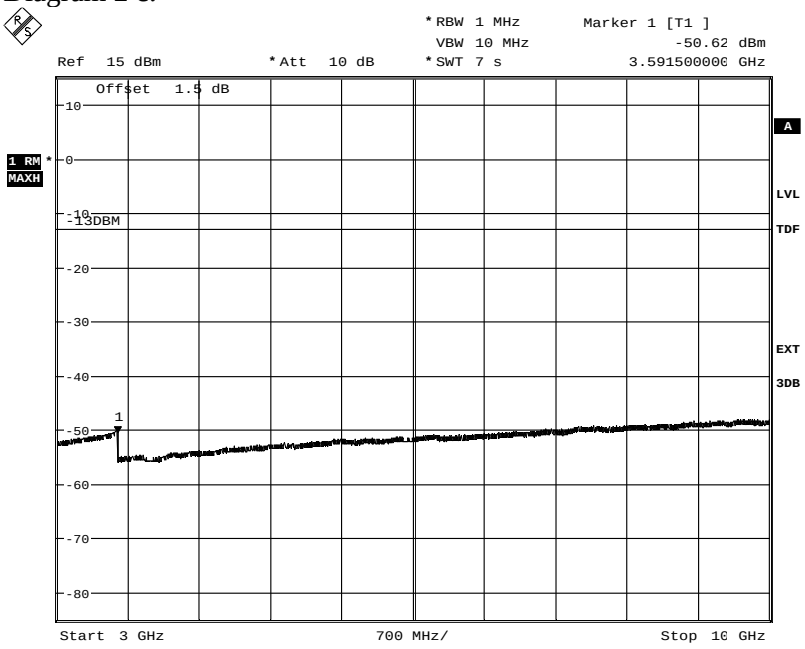


Date: 27.JAN.2015 07:31:25

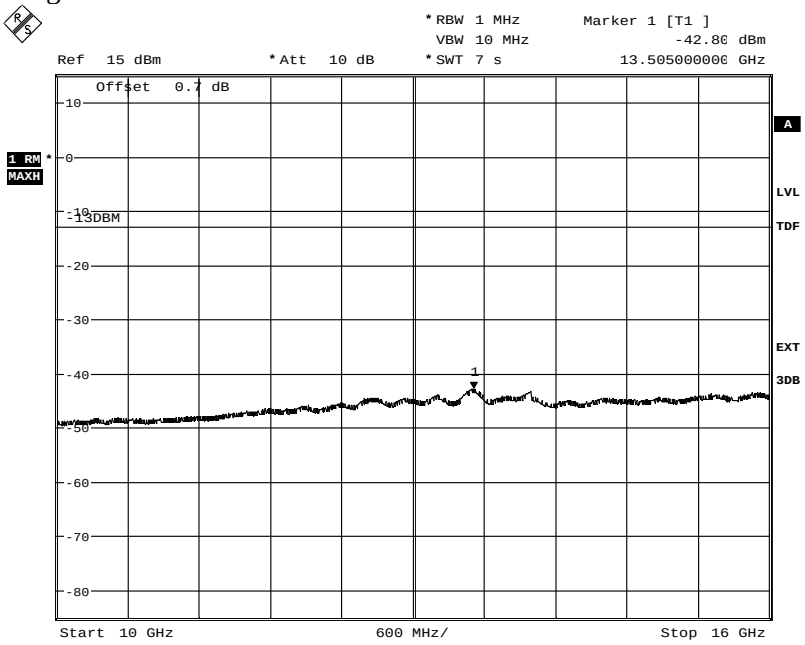
Appendix 6

Diagram 2 c:



Date: 27.JAN.2015 07:17:43

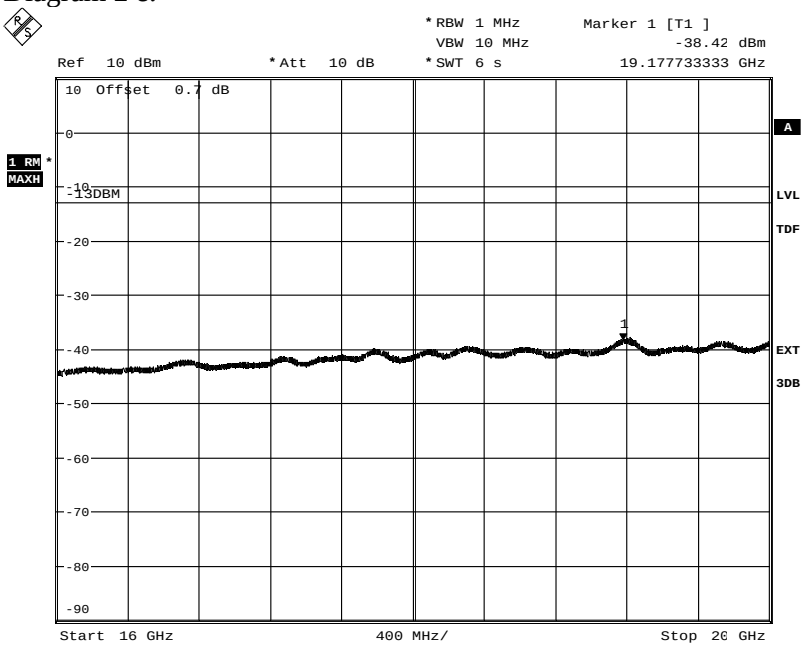
Diagram 2 d:



Date: 27.JAN.2015 07:15:34

Appendix 6

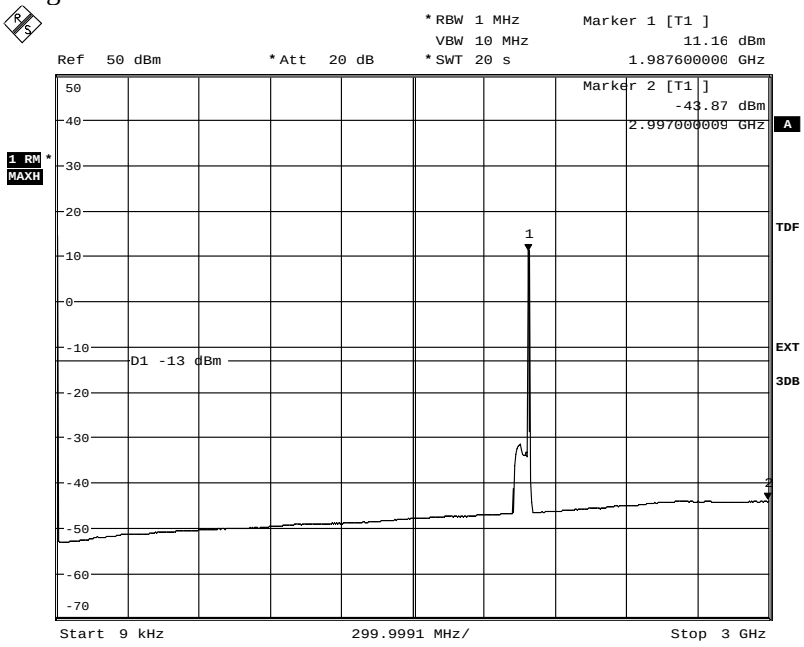
Diagram 2 e:



Date: 27.JAN.2015 07:16:48

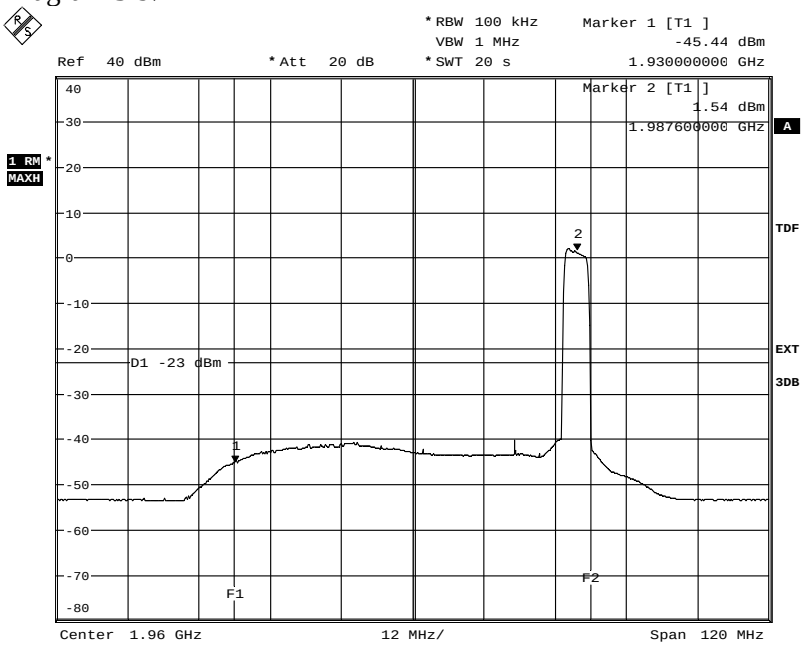
Appendix 6

Diagram 3 a:



Date: 27.JAN.2015 11:11:31

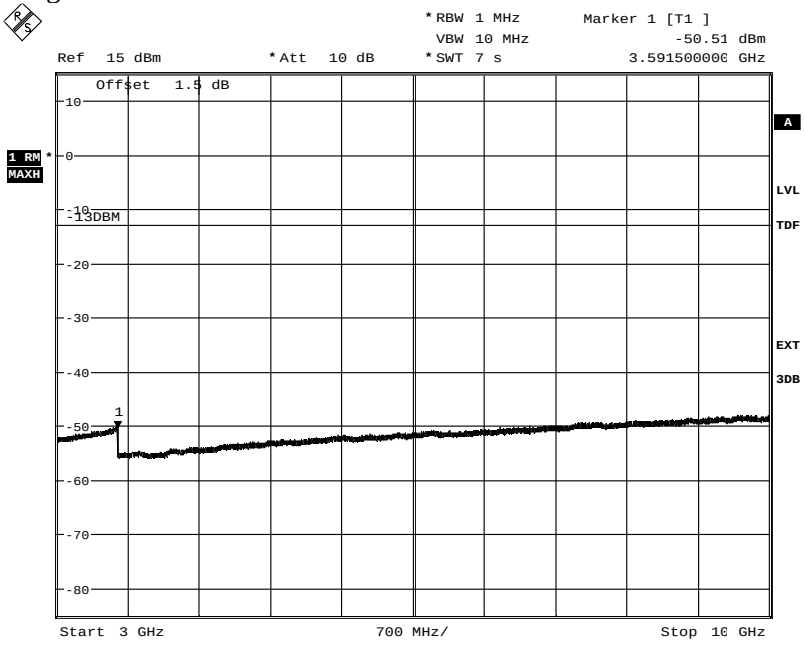
Diagram 3 b:



Date: 27.JAN.2015 11:10:02

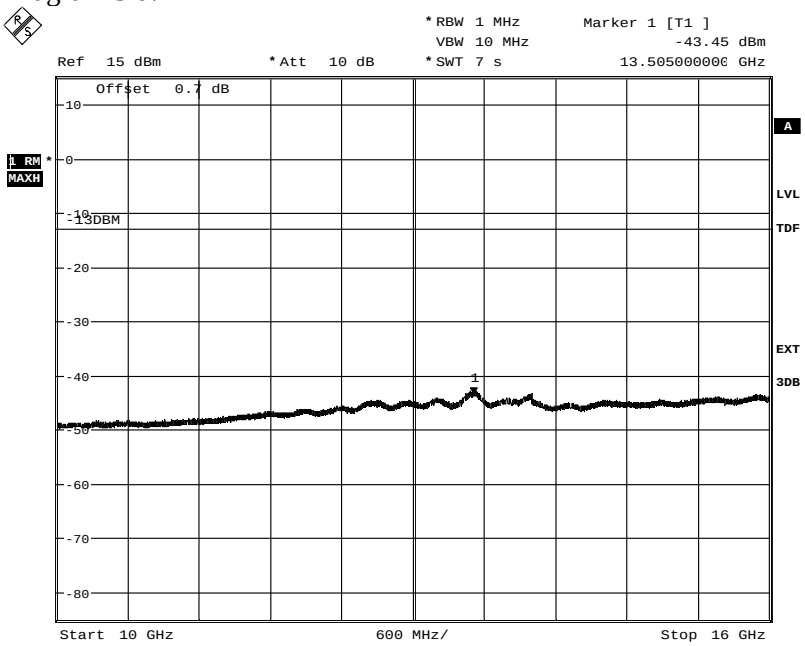
Appendix 6

Diagram 3 c:



Date: 27.JAN.2015 07:21:22

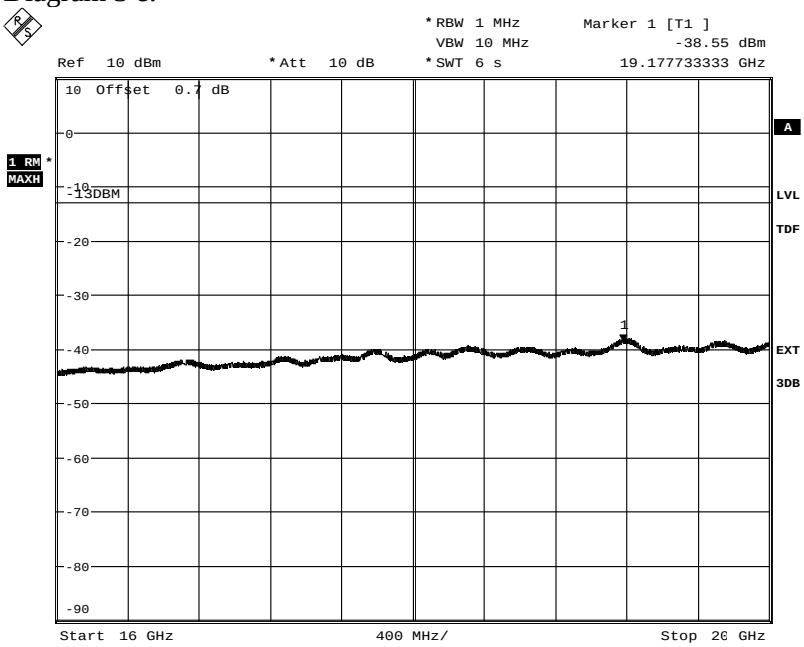
Diagram 3 d:



Date: 27.JAN.2015 07:20:27

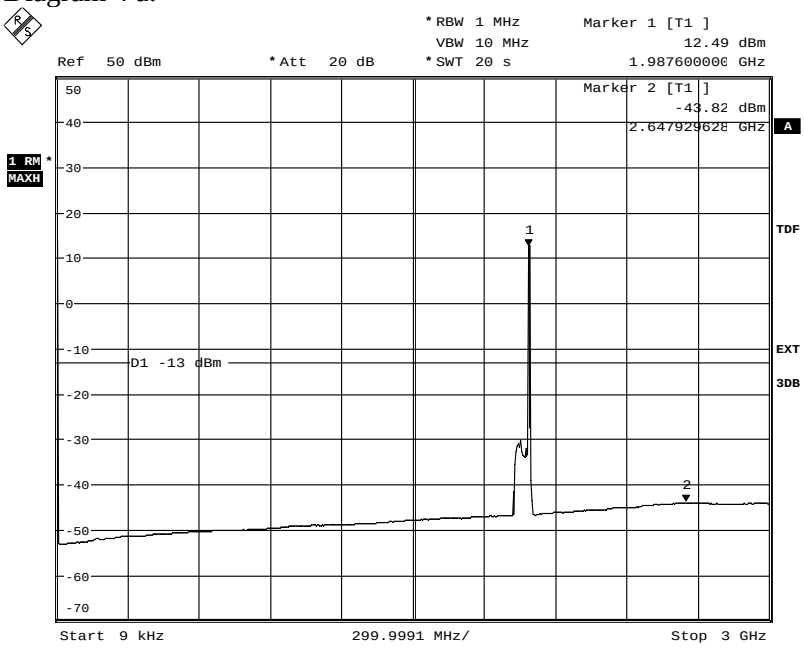
Appendix 6

Diagram 3 e:



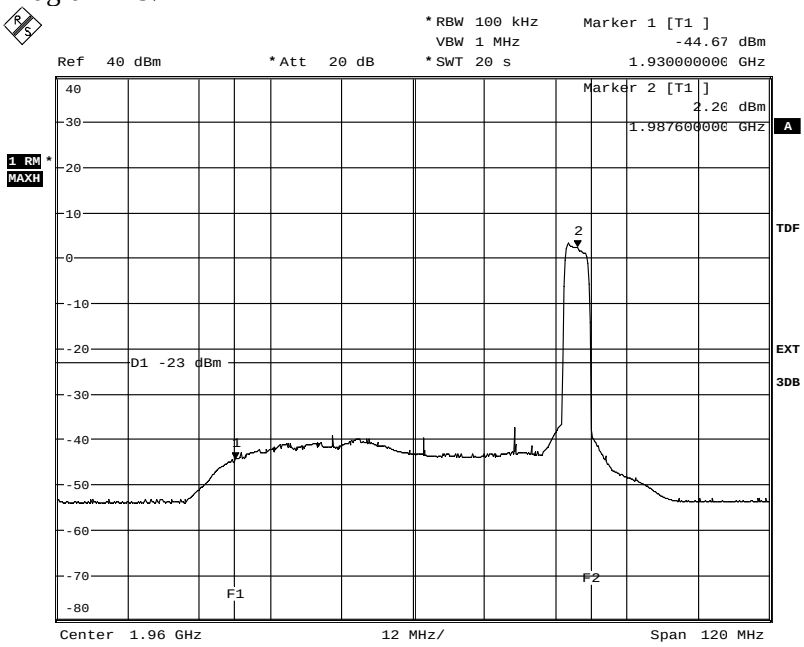
Appendix 6

Diagram 4 a:



Date: 27.JAN.2015 08:19:28

Diagram 4 b:



Date: 27.JAN.2015 08:17:50

Appendix 6

Diagram 4 c:

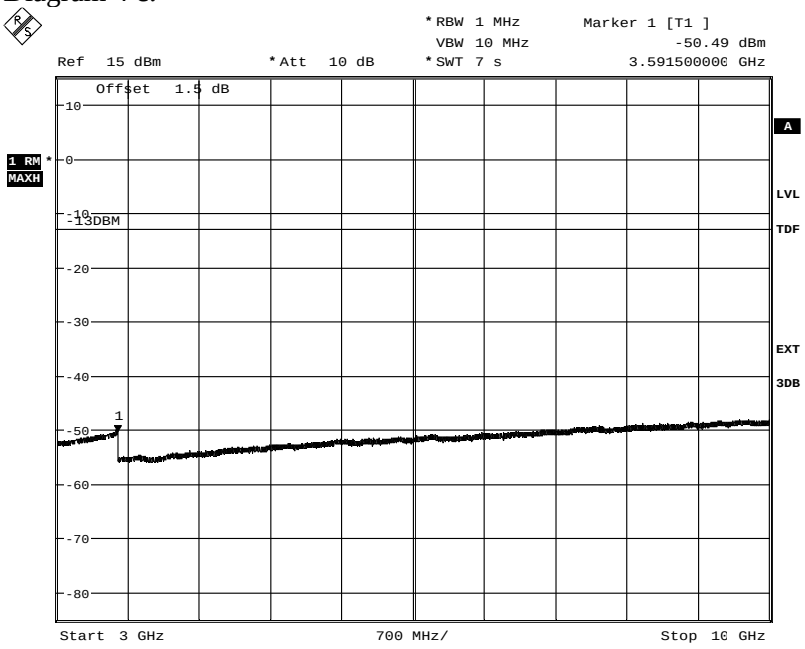


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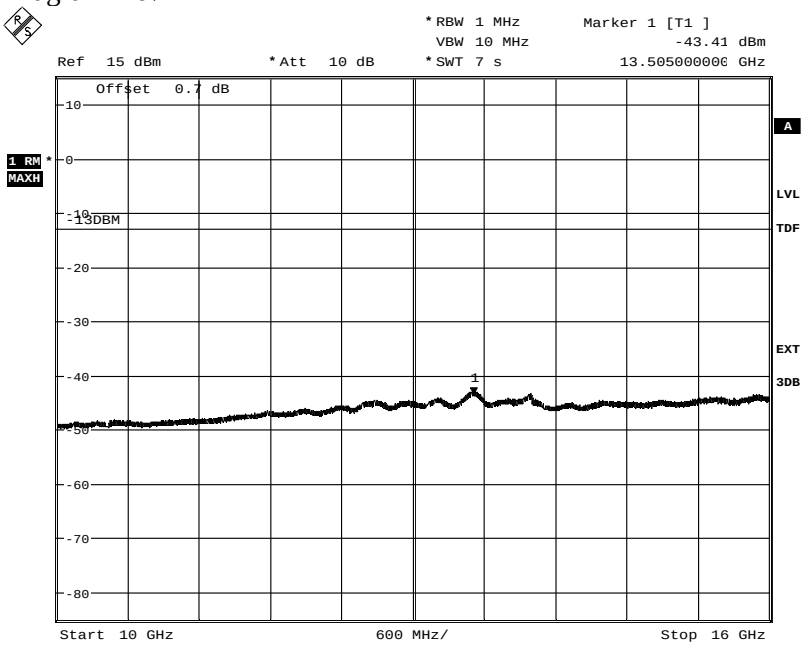
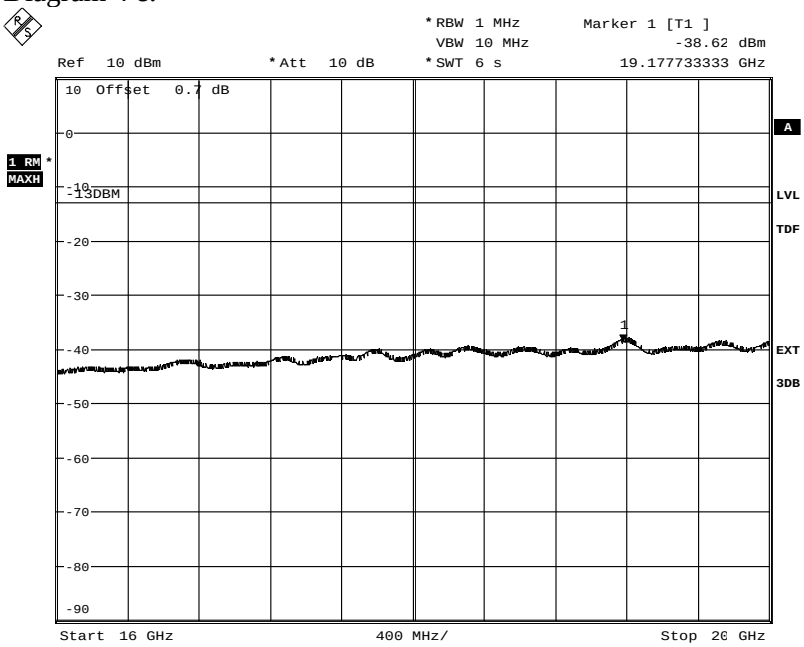
Diagram 4 d:



Date: 27.JAN.2015 07:24:06

Appendix 6

Diagram 4 e:



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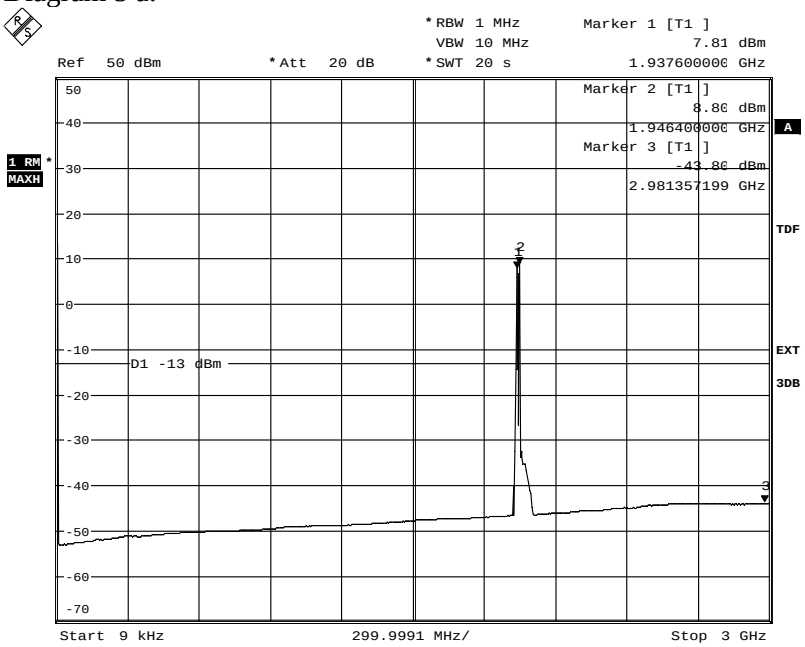
Appendix 6

Diagram 5 a:



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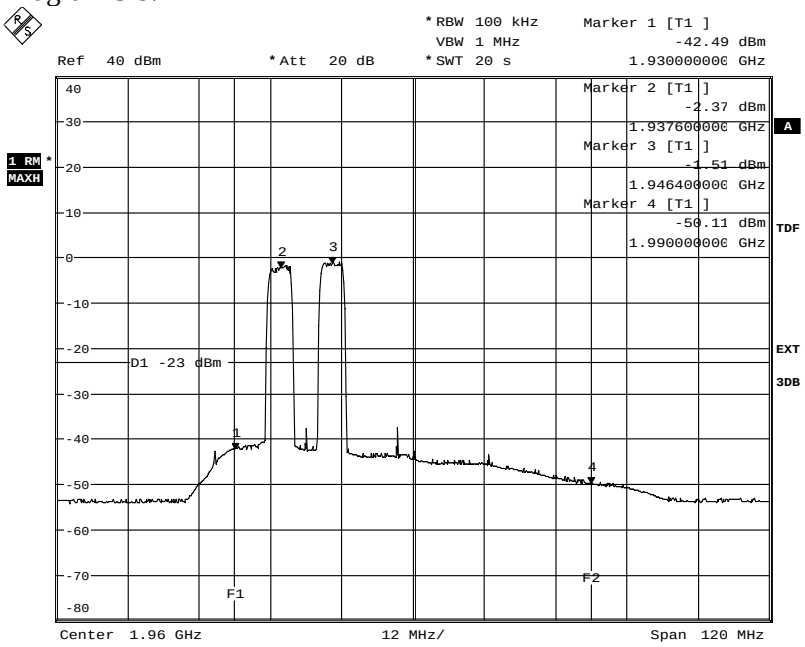
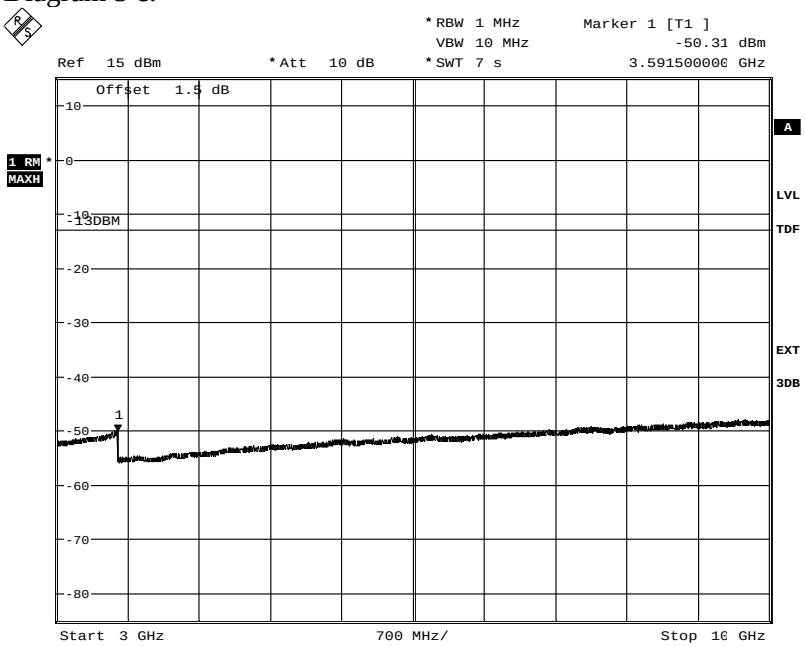


Date: 28.JAN.2015 07:22:54

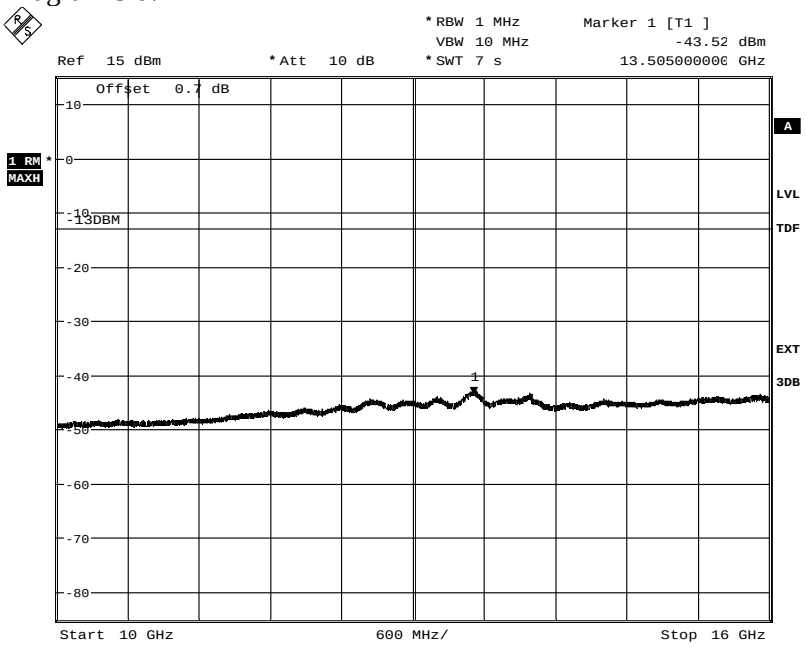
Appendix 6

Diagram 5 c:



Date: 28.JAN.2015 07:09:09

Diagram 5 d:



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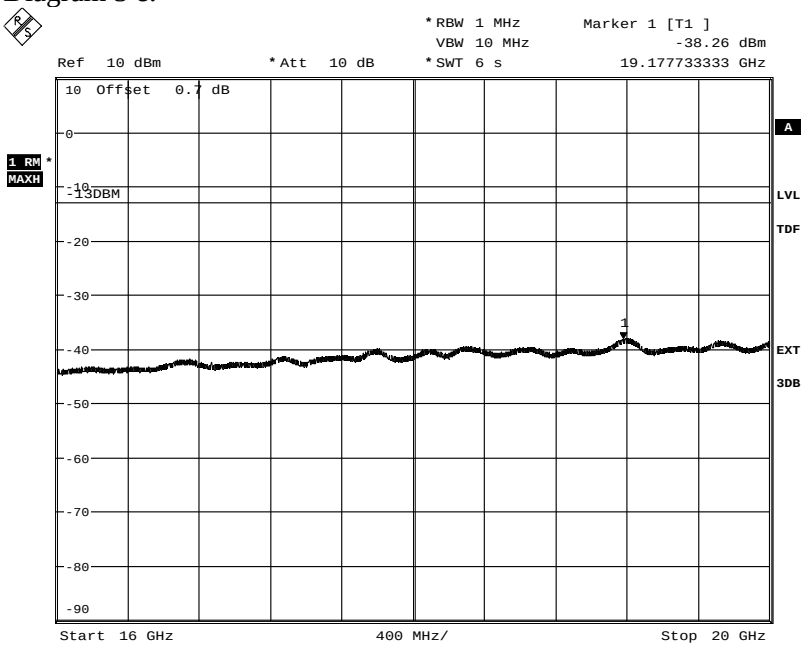
Appendix 6

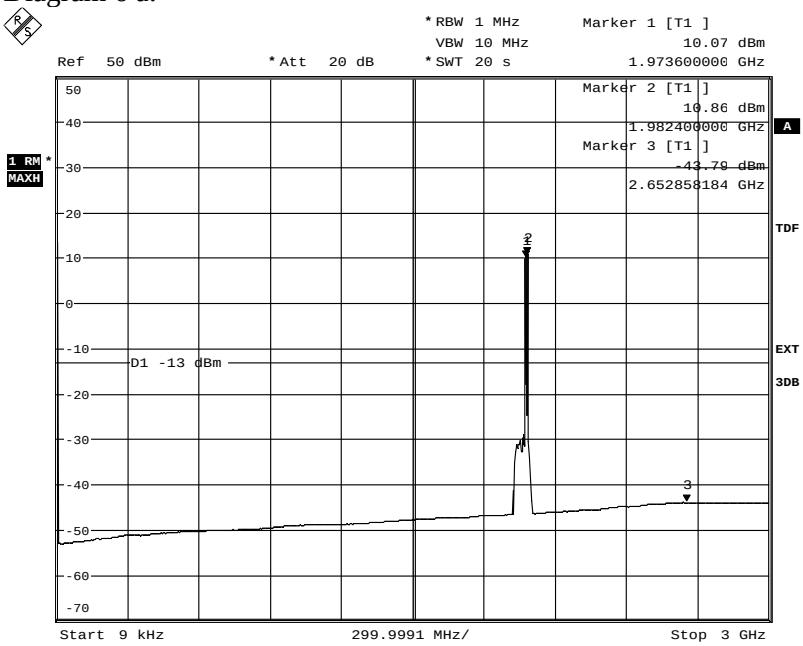
Diagram 5 e:



Date: 28.JAN.2015 07:11:23

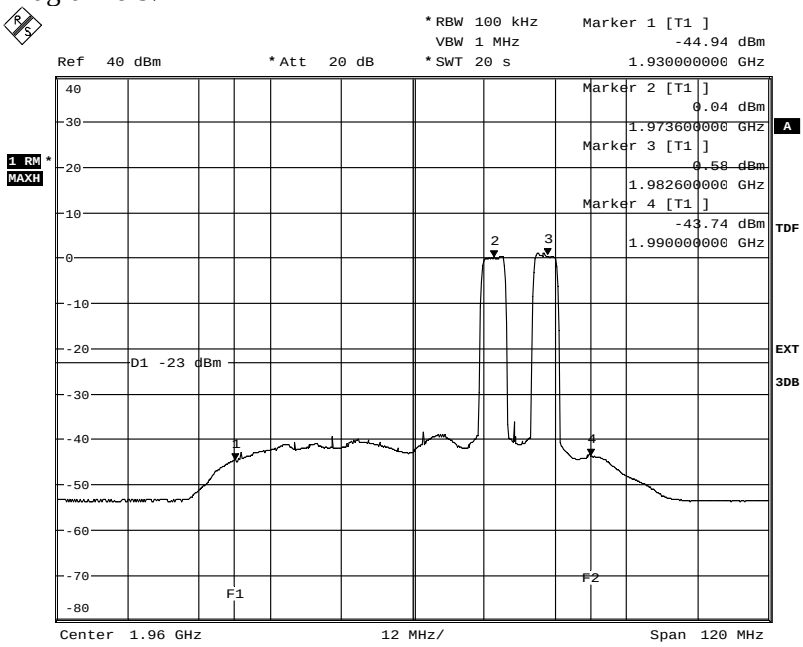
Appendix 6

Diagram 6 a:



Date: 28.JAN.2015 07:38:09

Diagram 6 b:



Date: 28.JAN.2015 07:35:11

Appendix 6

Diagram 6 c:

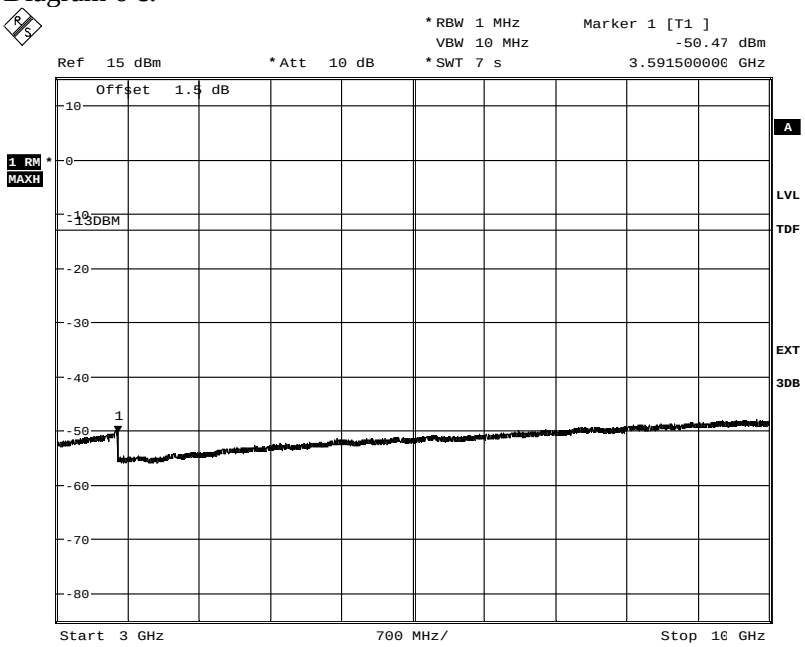


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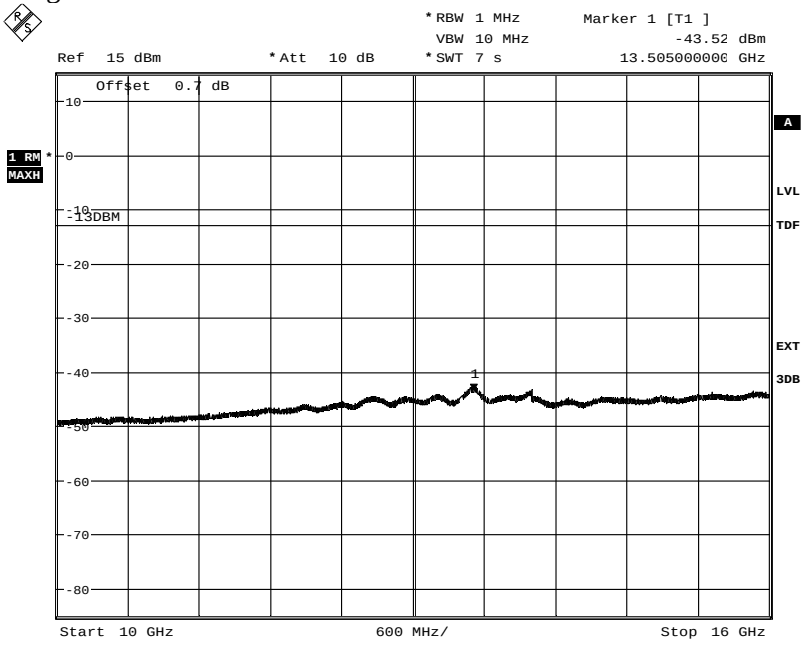
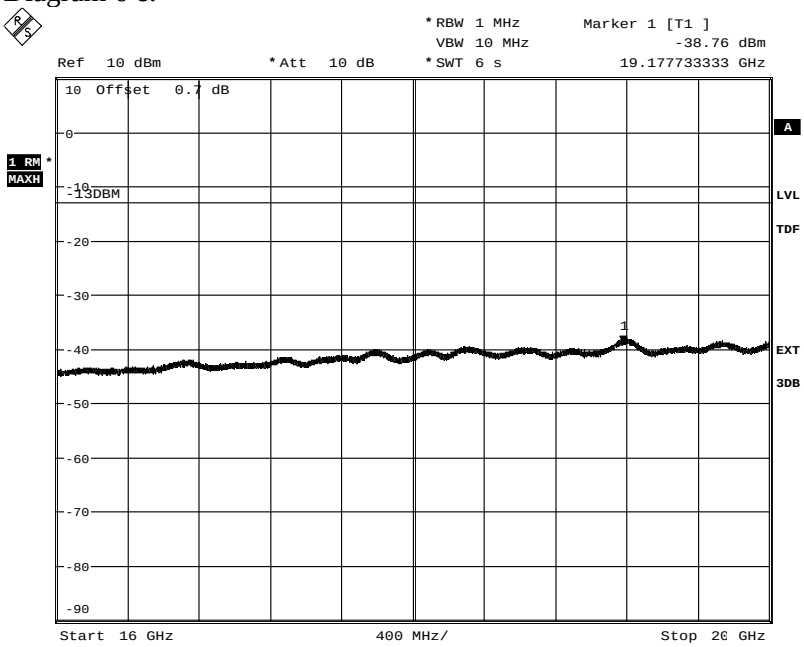
Diagram 6 d:



Date: 28.JAN.2015 07:14:30

Appendix 6

Diagram 6 e:



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Appendix 6

Diagram 7 a:

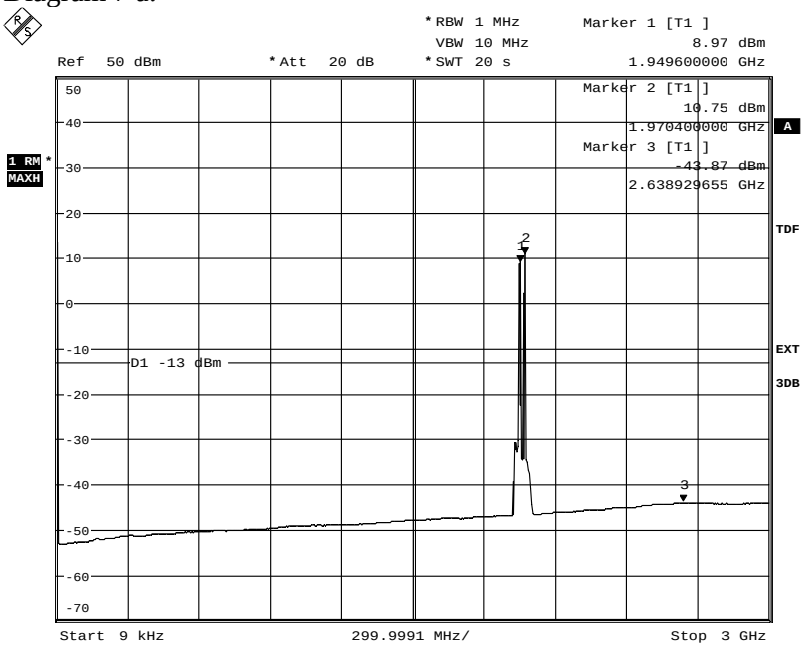

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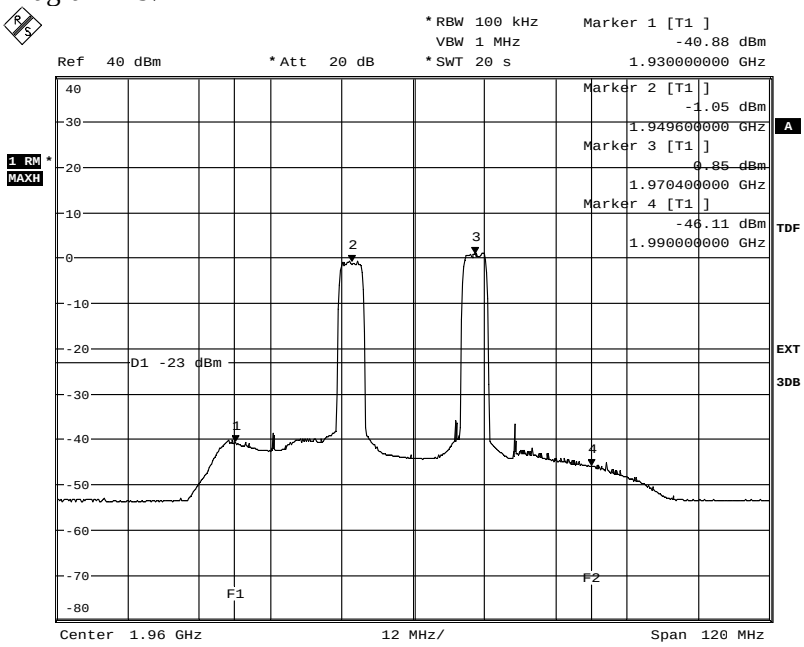
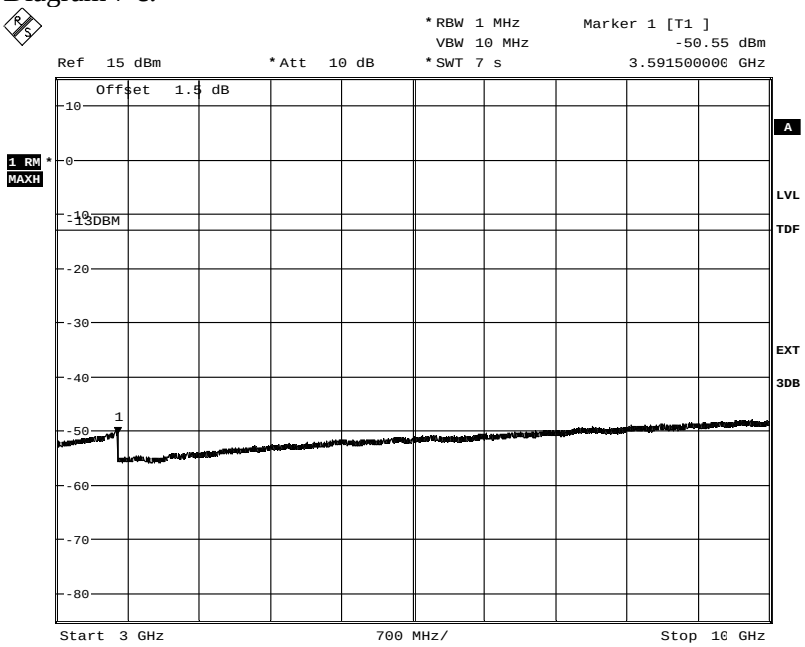
Diagram 7 b:



Date: 28.JAN.2015 07:47:21

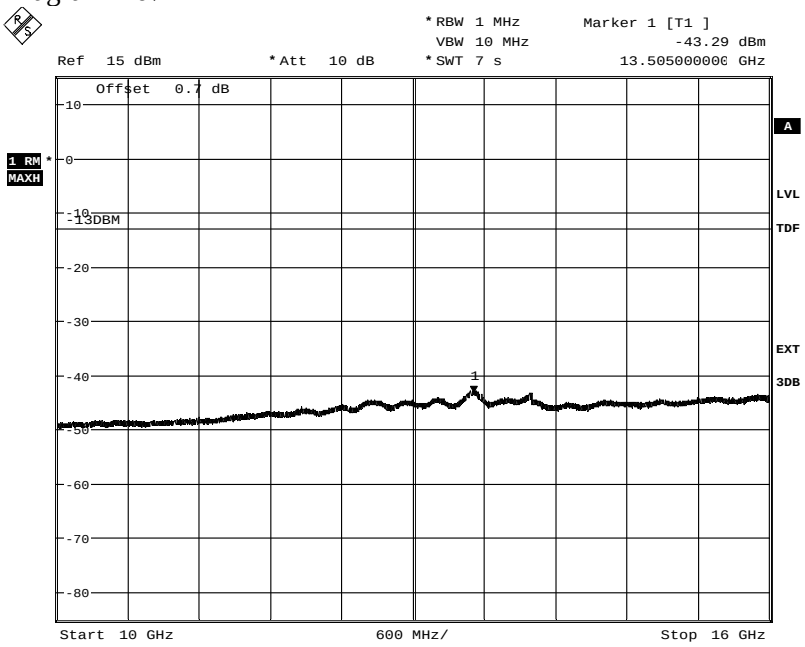
Appendix 6

Diagram 7 c:



Date: 28.JAN.2015 07:19:37

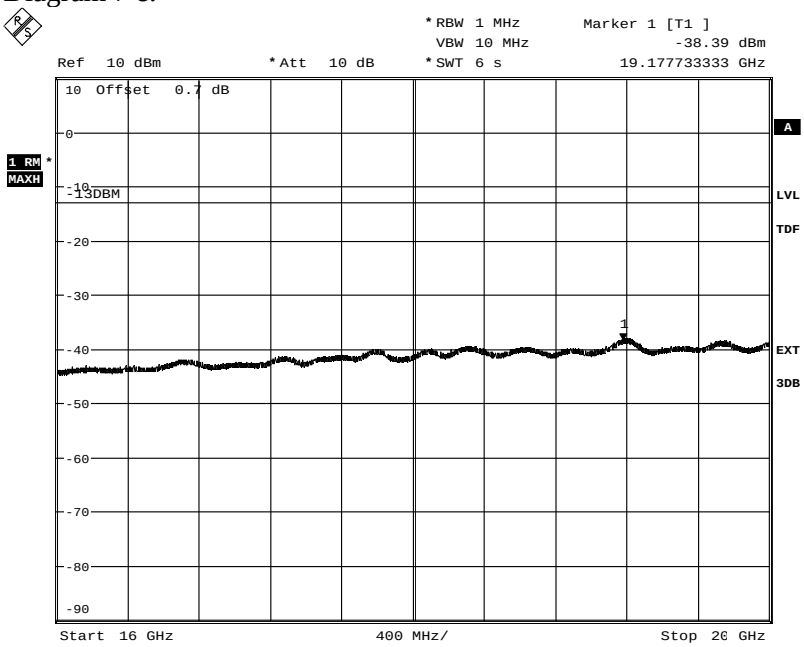
Diagram 7 d:



Date: 28.JAN.2015 07:18:11

Appendix 6

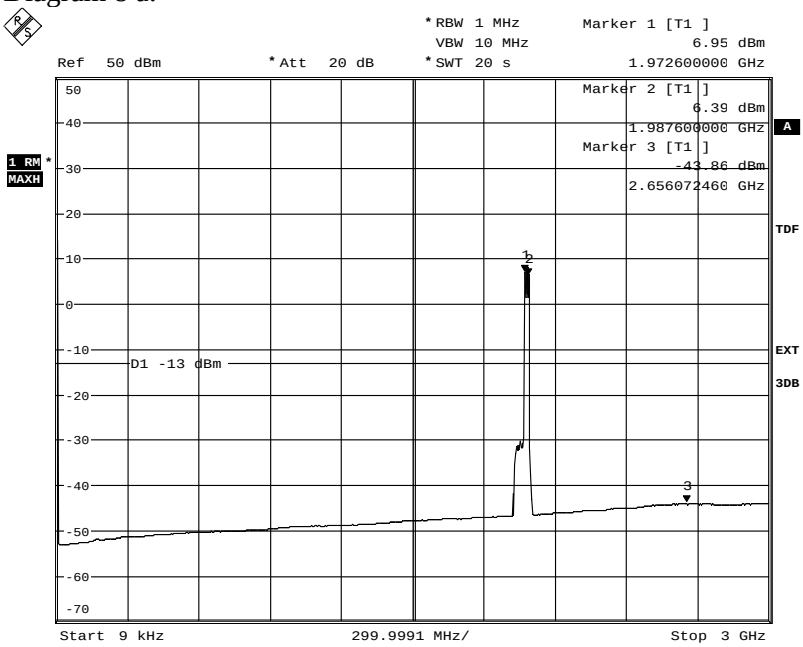
Diagram 7 e:



Date: 28.JAN.2015 07:16:50

Appendix 6

Diagram 8 a:



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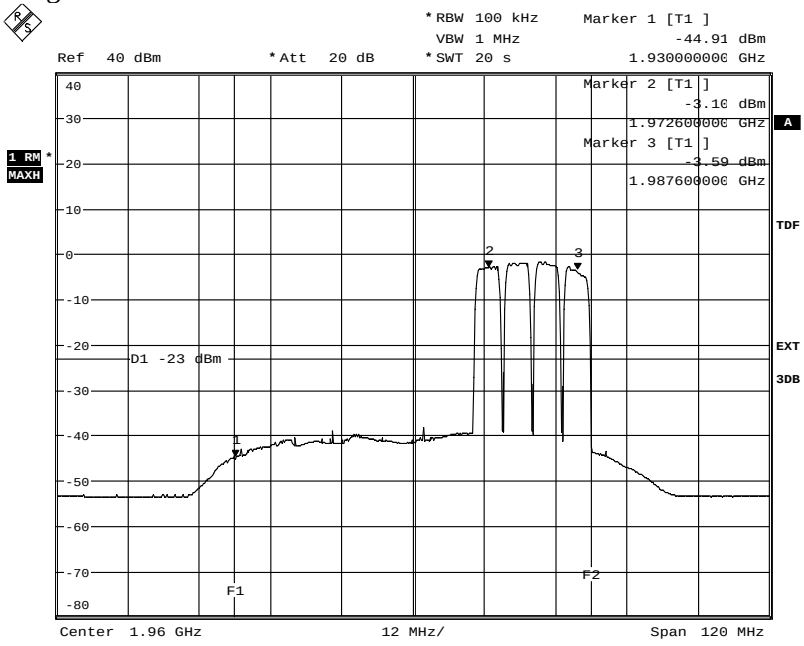
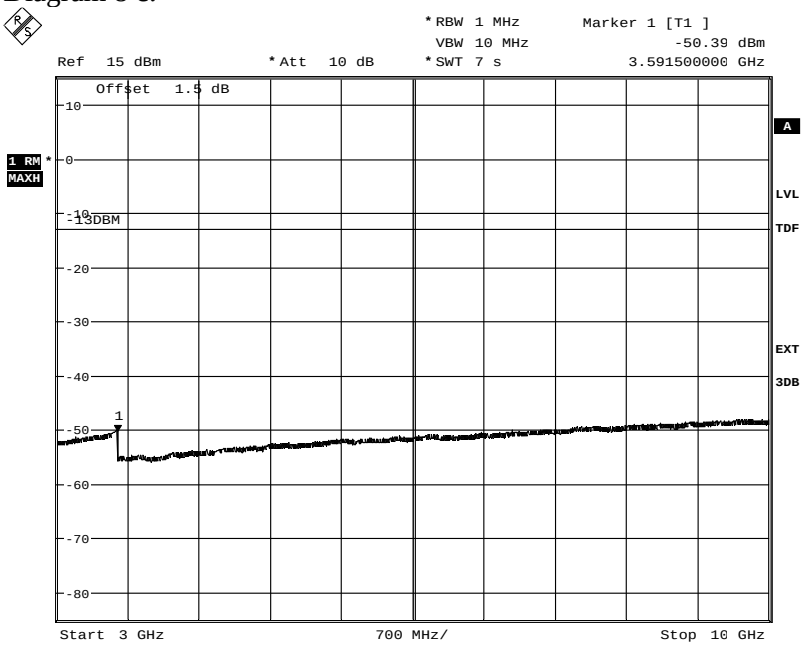


Date: 28.JAN.2015 09:56:14

Appendix 6

Diagram 8 c:



Date: 28.JAN.2015 08:17:05

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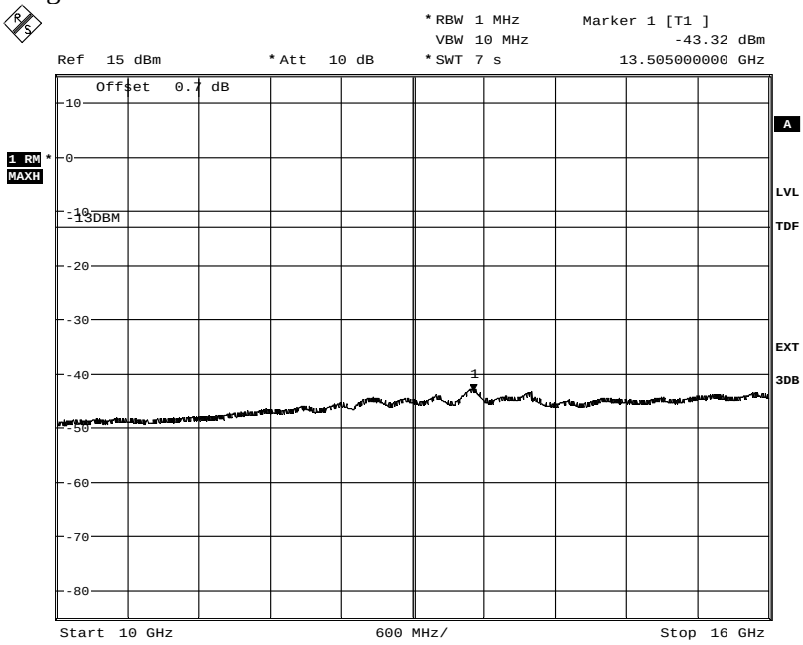
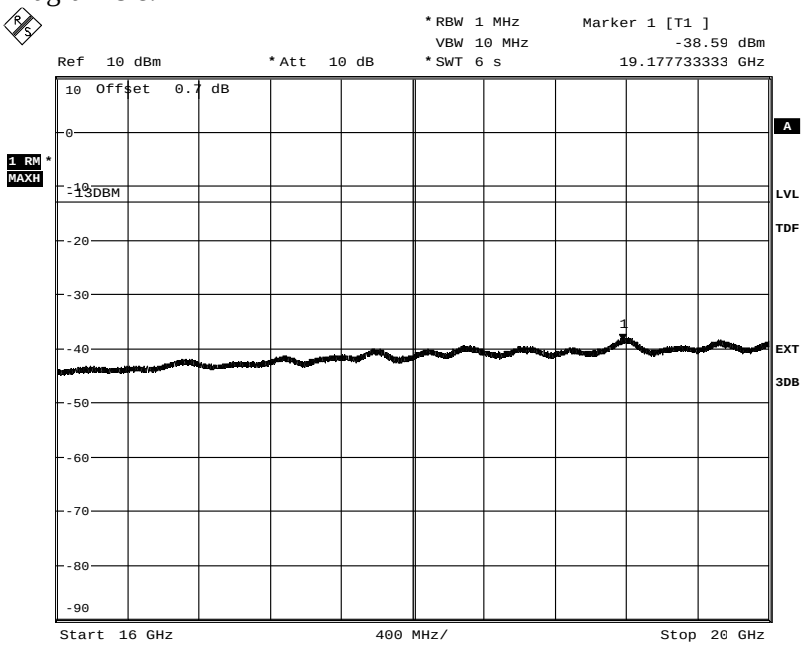


Date: 28.JAN.2015 08:19:03

Appendix 6

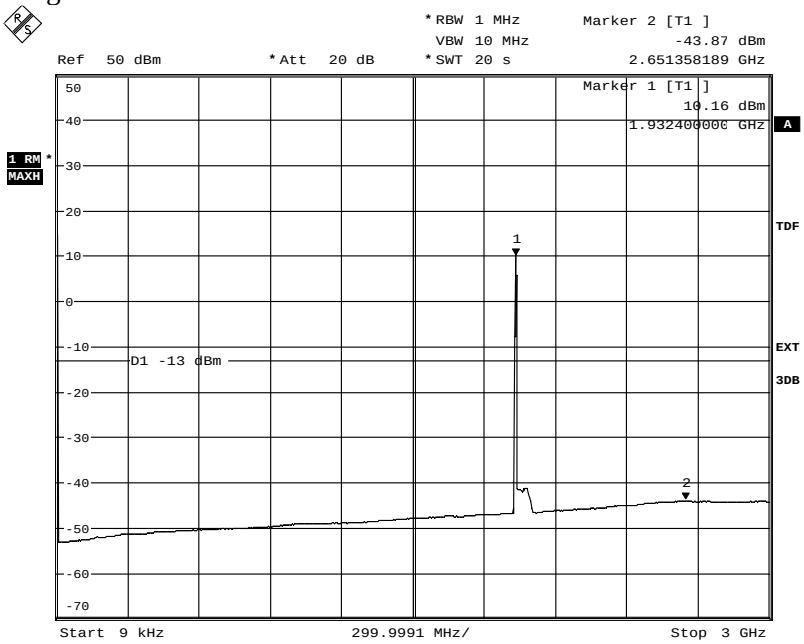
Diagram 8 e:



Date: 28.JAN.2015 08:20:11

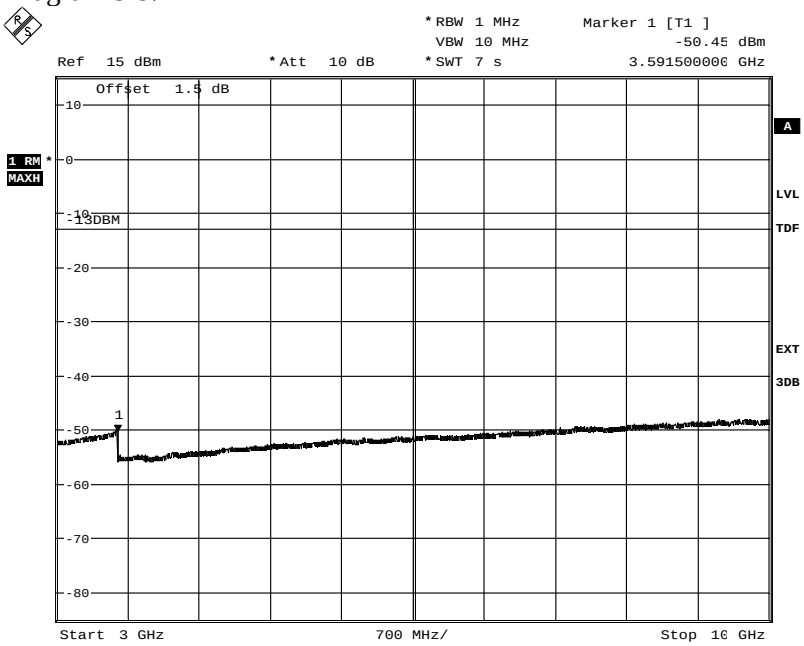
Appendix 6

Diagram 9 a:



Date: 26.JAN.2015 12:54:09

Diagram 9 b:



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Appendix 6

Diagram 9 c:

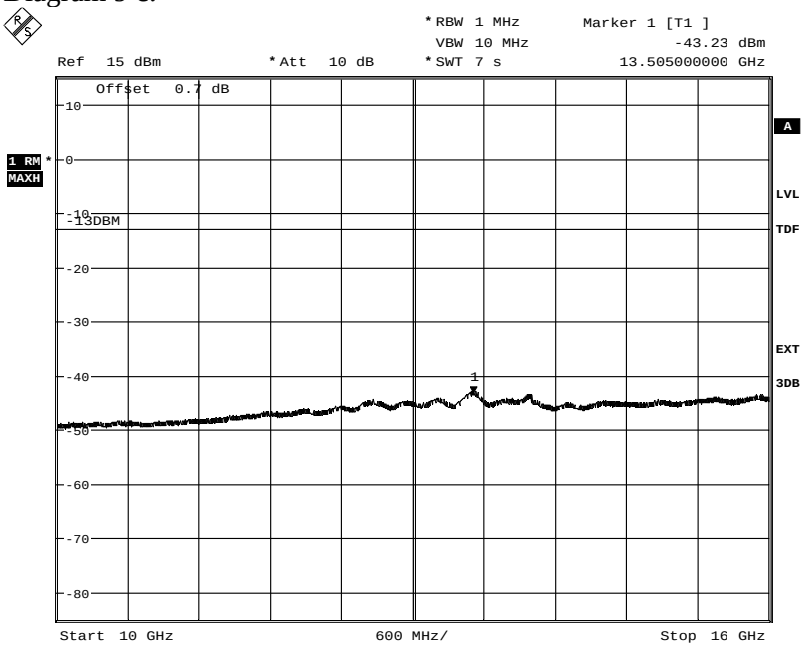

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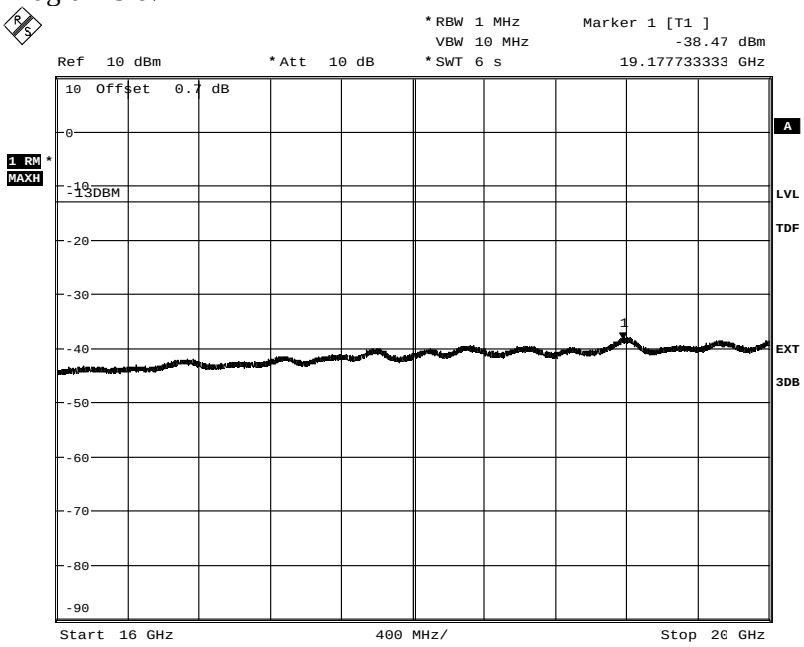
Diagram 9 d:



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Appendix 6

Diagram 10 a:

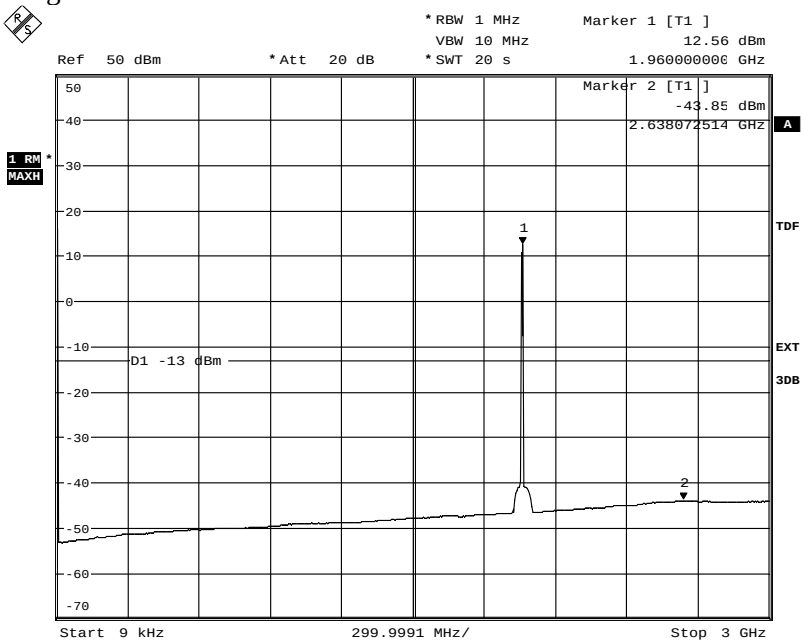

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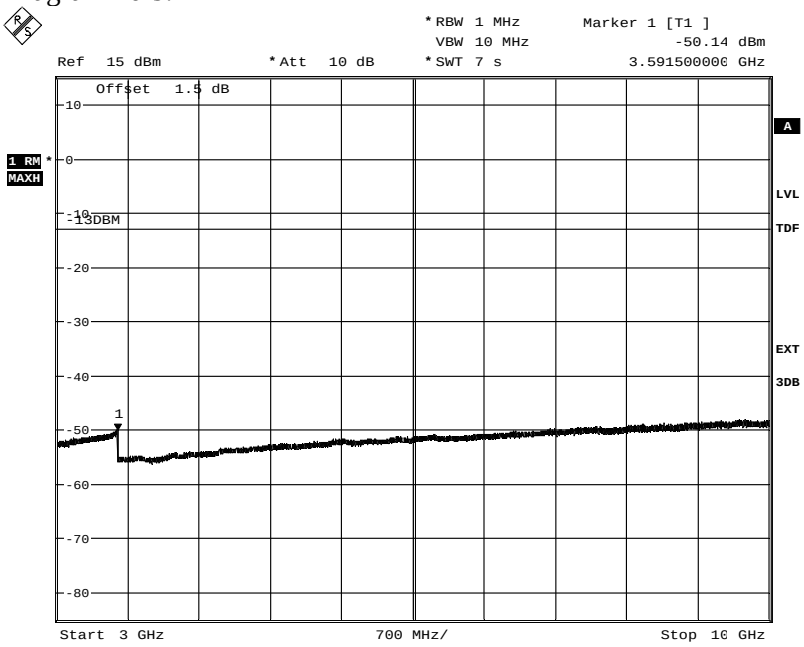
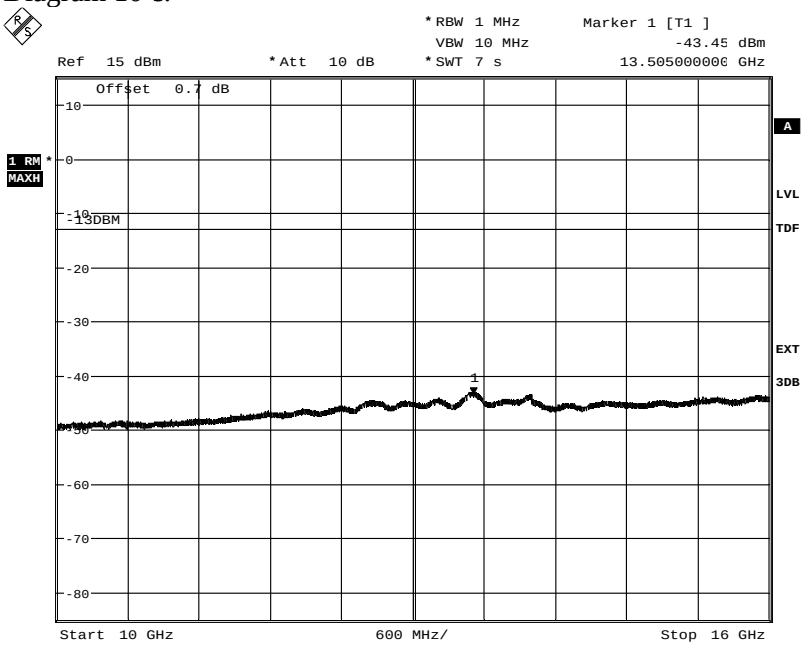
Diagram 10 b:



Date: 26.JAN.2015 13:08:58

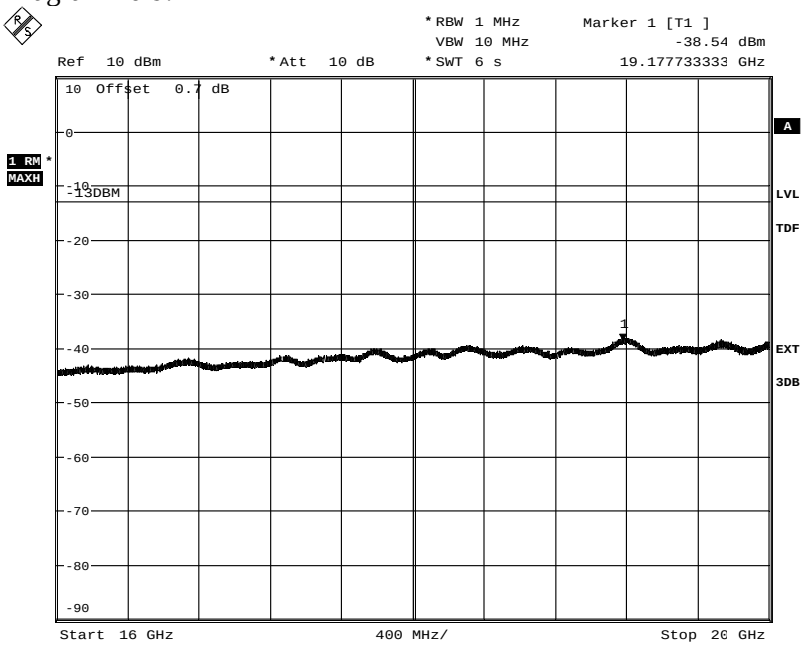
Appendix 6

Diagram 10 c:



Date: 26.JAN.2015 13:07:36

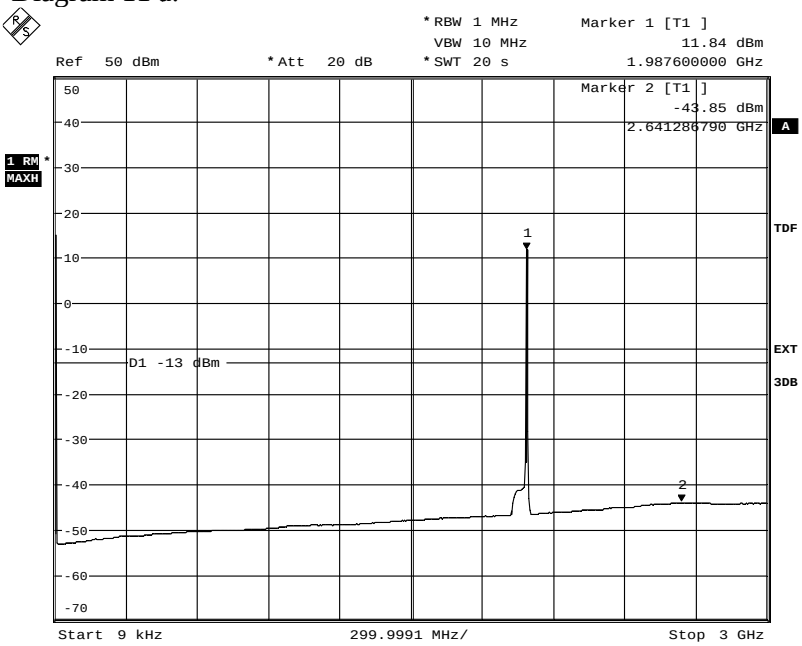
Diagram 10 d:



Date: 26.JAN.2015 13:06:35

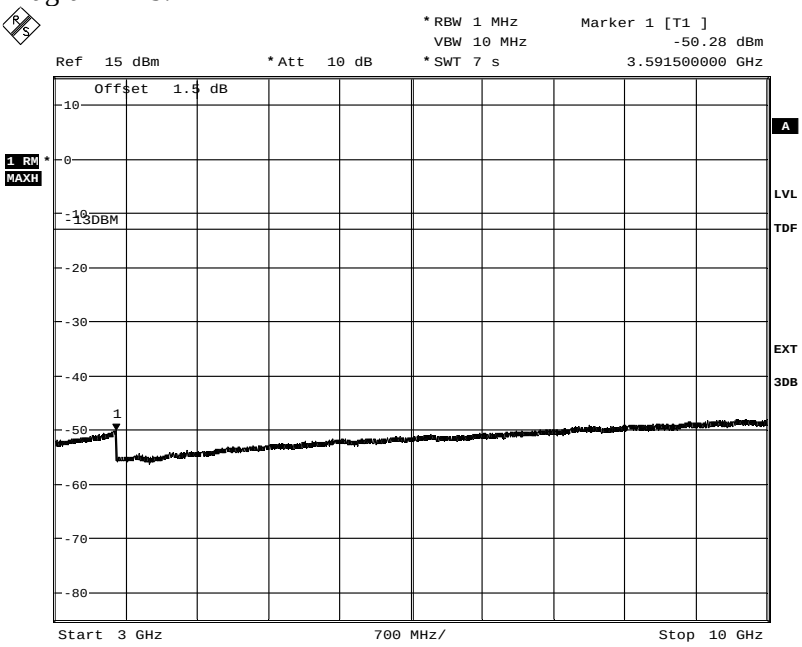
Appendix 6

Diagram 11 a:



Date: 26.JAN.2015 13:35:52

Diagram 11 b:



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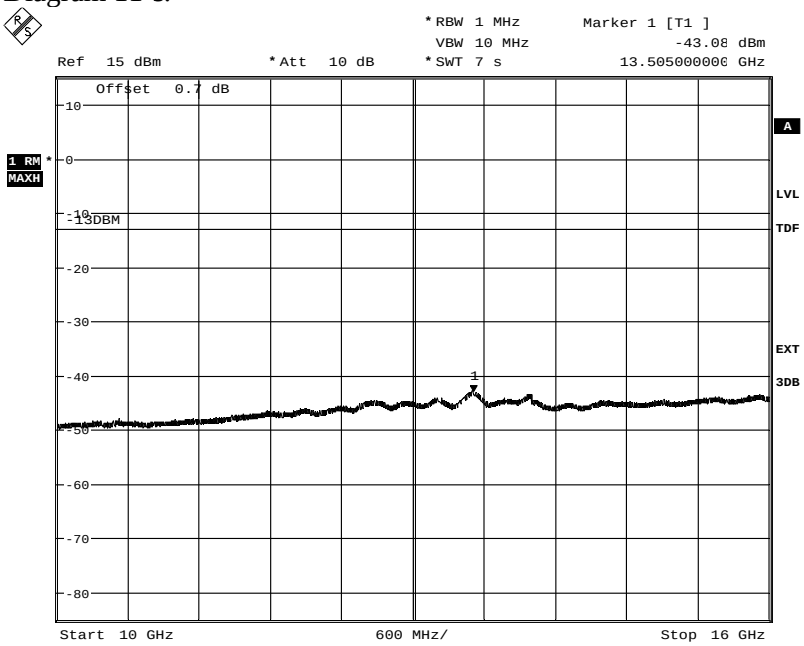
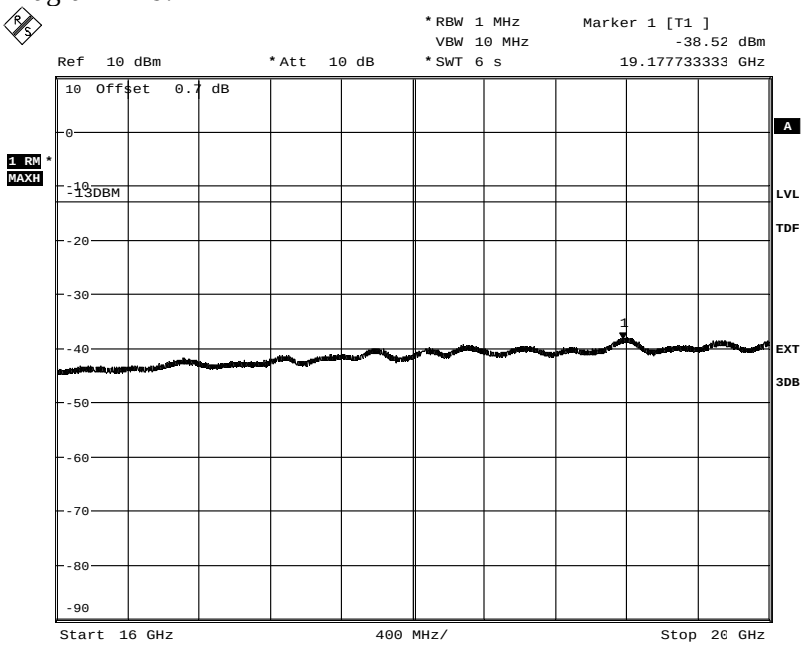
Appendix 6

Diagram 11 c:



Date: 26.JAN.2015 13:11:05

Diagram 11 d:



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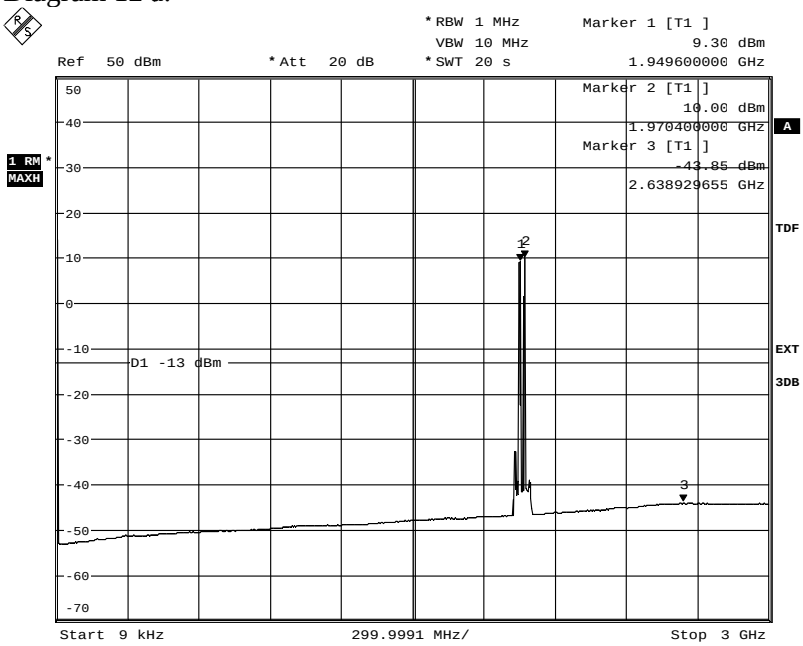
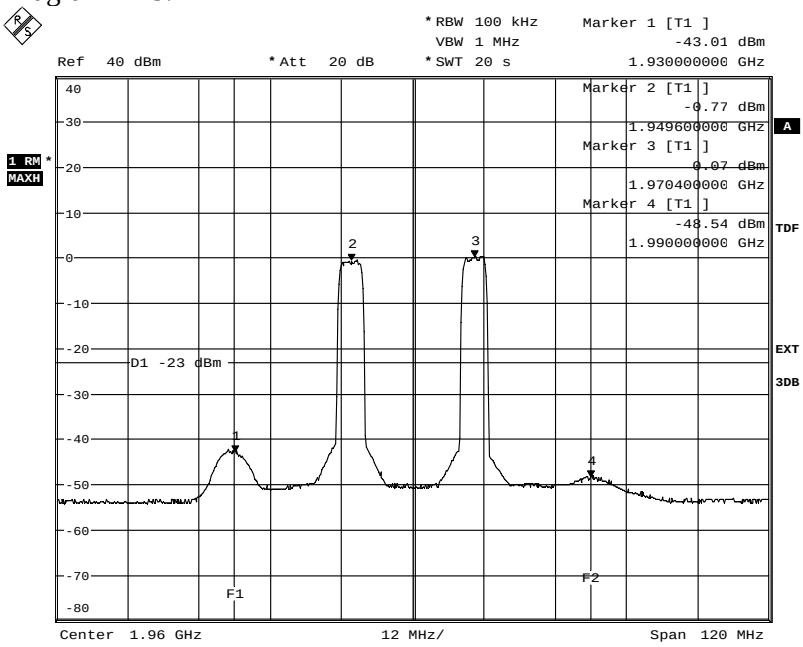
Appendix 6

Diagram 12 a:



Date: 28.JAN.2015 08:01:51

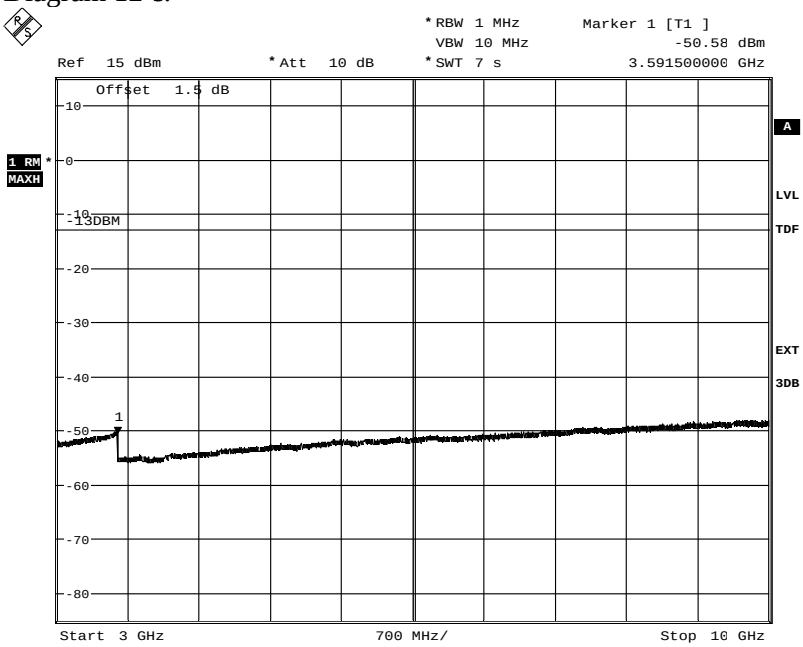
Diagram 12 b:



Date: 28.JAN.2015 08:03:48

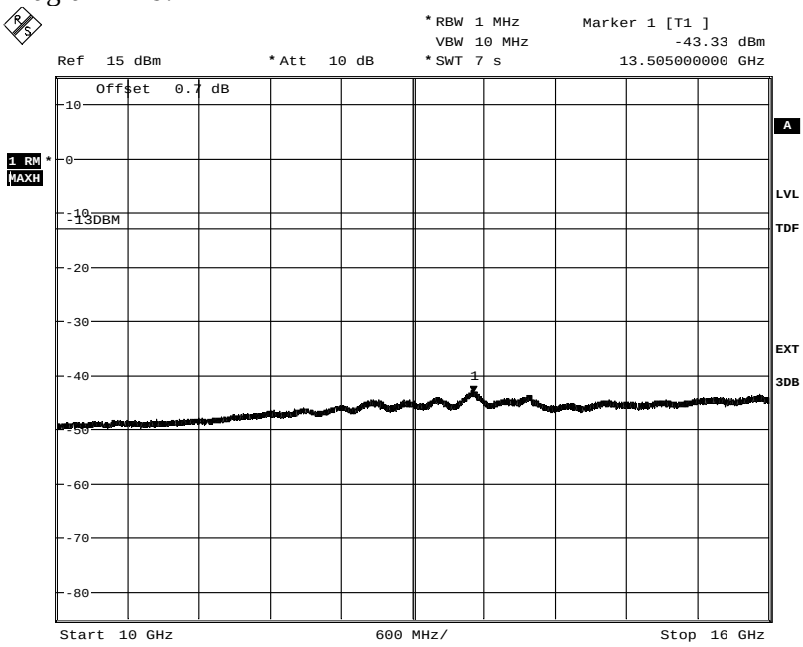
Appendix 6

Diagram 12 c:



Date: 28.JAN.2015 08:05:30

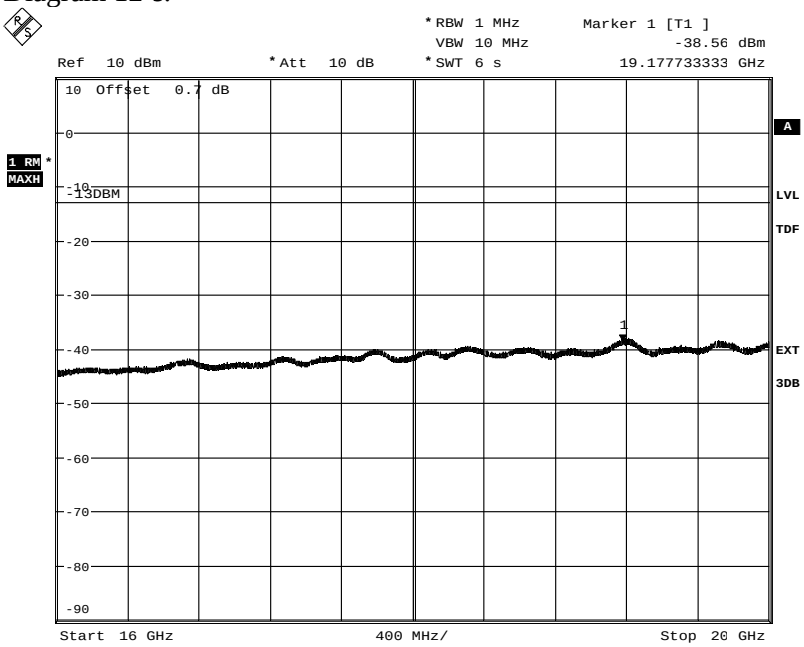
Diagram 12 d:



Date: 28.JAN.2015 08:06:27

Appendix 6

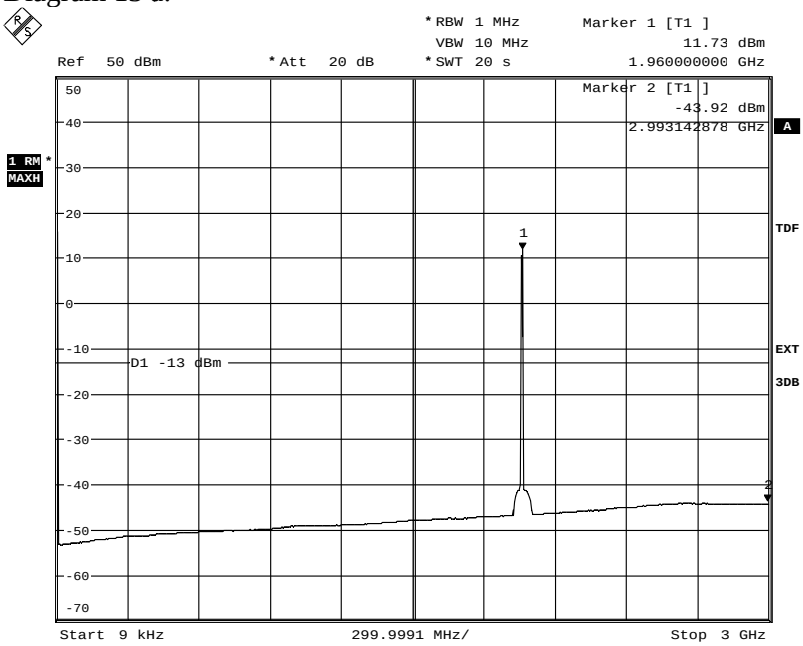
Diagram 12 e:



Date: 28.JAN.2015 08:07:25

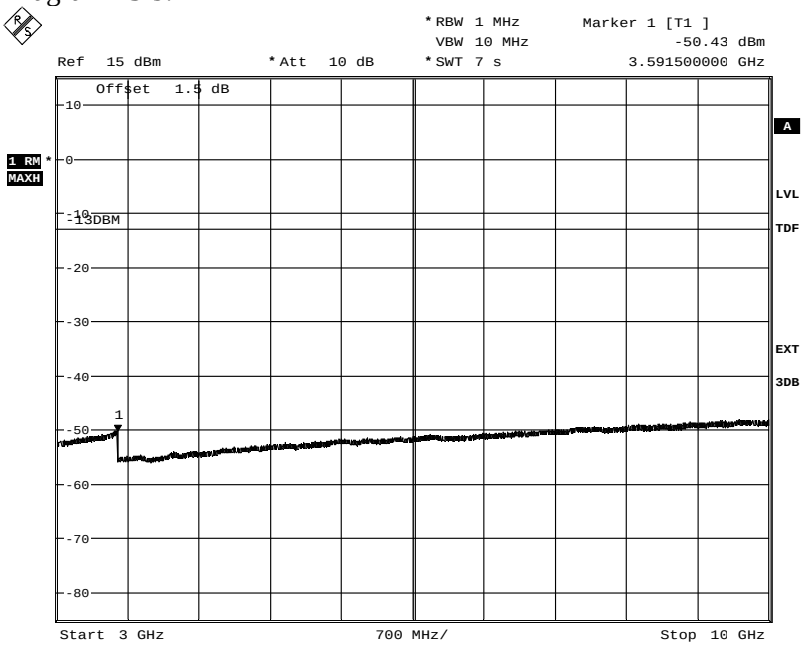
Appendix 6

Diagram 13 a:



Date: 27.JAN.2015 14:25:32

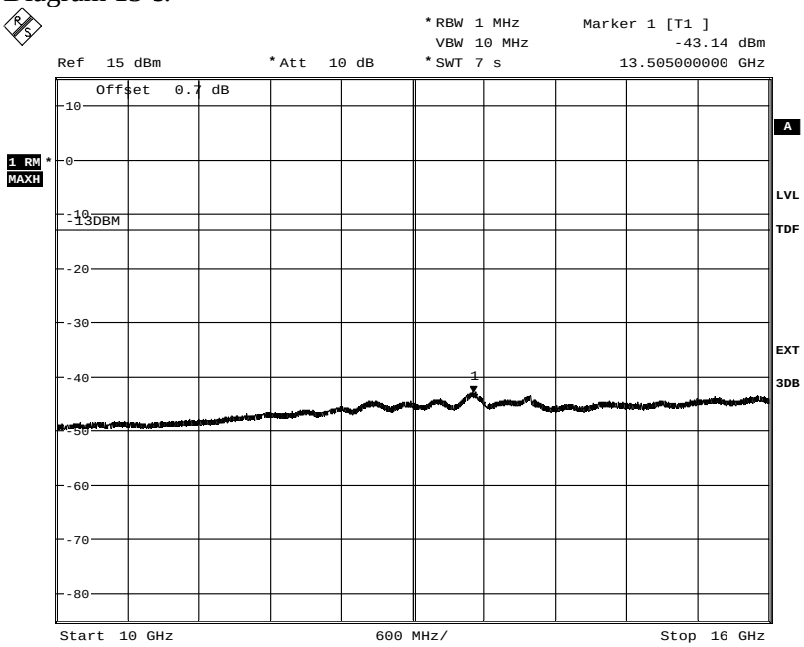
Diagram 13 b:



Date: 27.JAN.2015 14:27:07

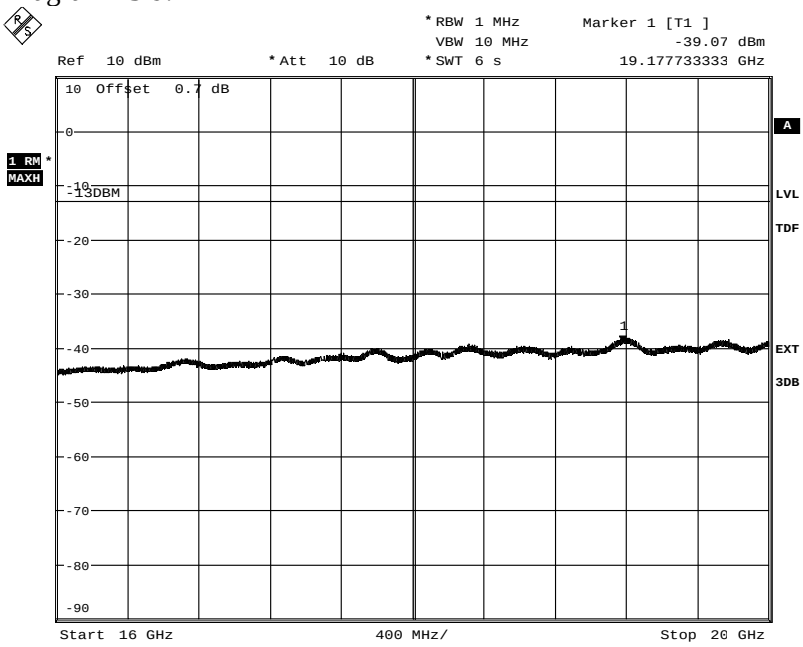
Appendix 6

Diagram 13 c:



Date: 27.JAN.2015 14:28:06

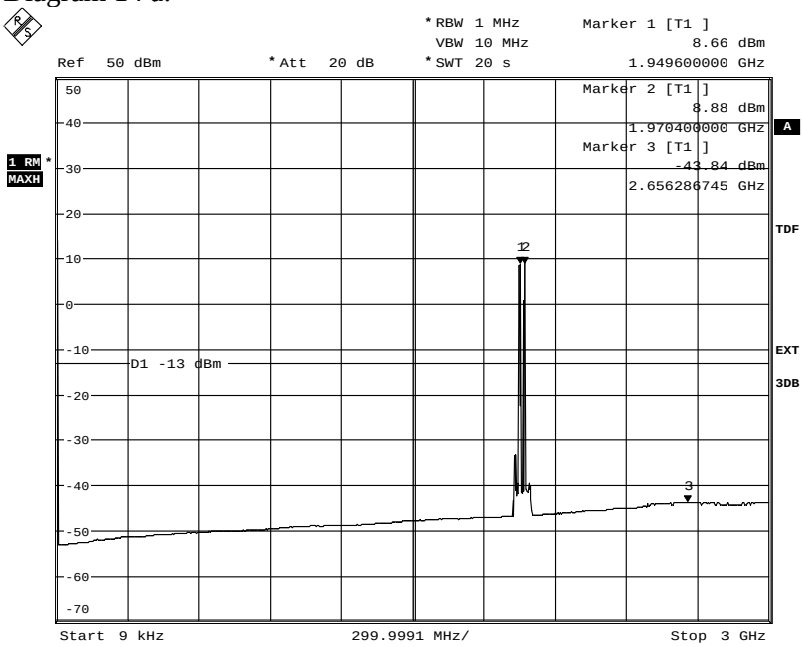
Diagram 13 d:



Date: 27.JAN.2015 14:29:27

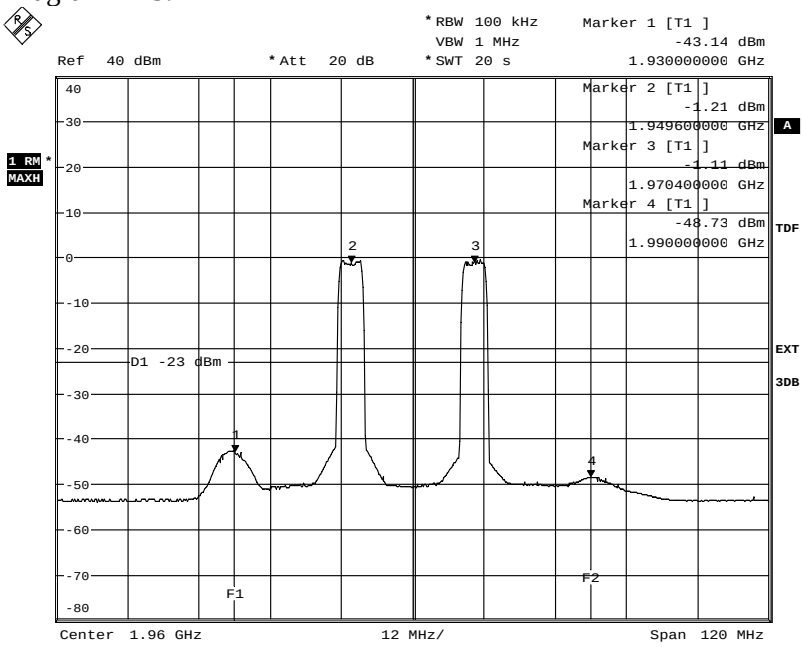
Appendix 6

Diagram 14 a:



Date: 28.JAN.2015 09:06:32

Diagram 14 b:

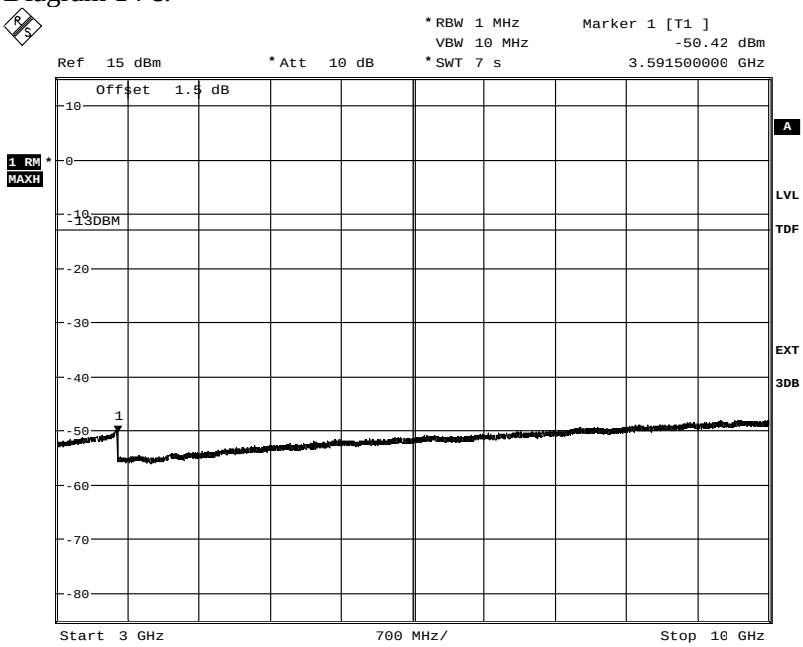


Date: 28.JAN.2015 09:01:26

Appendix 6

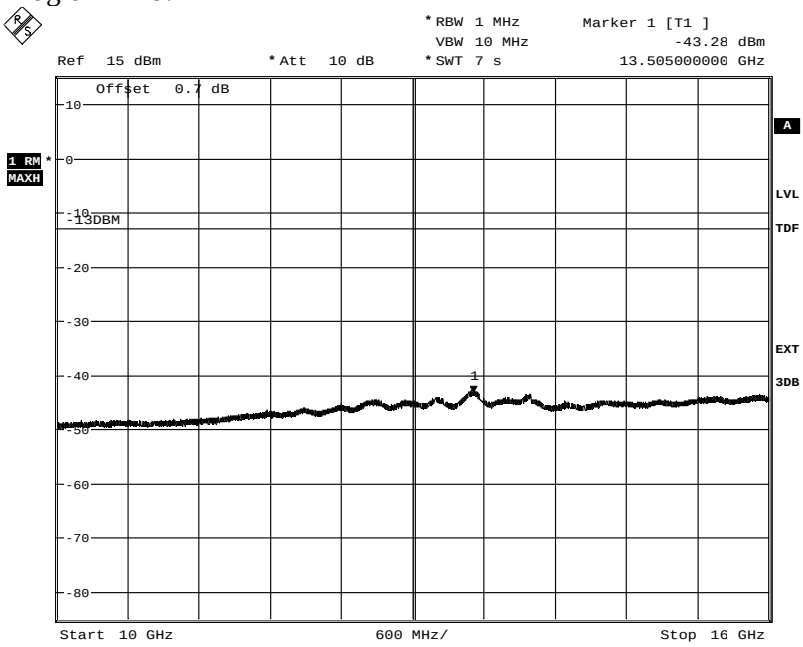
Appendix 6

Diagram 14 c:



Date: 28.JAN.2015 08:13:53

Diagram 14 d:

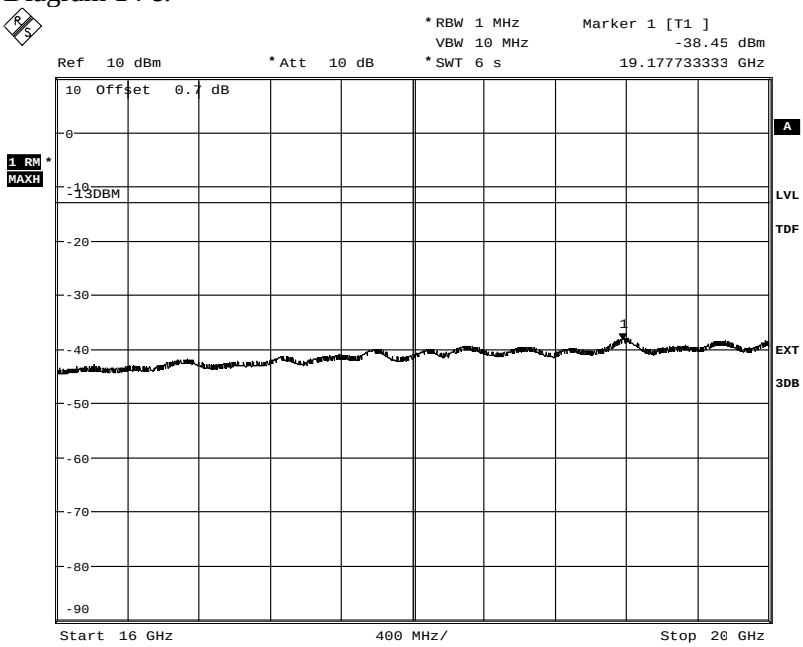


Date: 28.JAN.2015 08:12:38

Appendix 6

Appendix 6

Diagram 14 e:



Date: 28.JAN.2015 08:09:30

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

Date	Temperature	Humidity
2015-01-30	23 °C ± 3°C	27 % ± 5 %
2015-02-02	23 °C ± 3°C	18 % ± 5 %
2015-02-03	22 °C ± 3°C	18 % ± 5 %

Test set-up and procedure

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

The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz – 18 GHz and 1 m in the frequency range 18 - 20 GHz.

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

The measurement procedure was as the following:

1. The pre-measurement was first performed with peak detector. The EUT was measured in eight directions and with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m.
2. Spurious radiation on frequencies closer than 20 dB to the limit in the pre-measurement is scanned 0-360 degrees and the antenna is scanned 1- 4 m for maximum response. The emission is then measured with the RMS detector and the RMS value is reported. Frequencies closer than 10 dB to the limit when measured with the RMS detector were measured with the substitution method according ANSI/TIA-603-C.

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
EMC32 ver. 9.15.0	503 899
Chase Bilog Antenna CBL 6111A	503 182
EMCO Horn Antenna 3115	502 175
Flann STD Gain Horn Antenna 16-240	503 939
Flann STD Gain Horn Antenna 18-240	503 900
Flann STD Gain Horn Antenna 20240-20	503 674
µComp Nordic, Low Noise Amplifier	901 545
Schwarzbeck BBV9742, Low Noise Amplifier	504 085
HP Filter 3-18 GHz	504 200
Temperature and humidity meter, Testo 625	504 188

Tested configurations

Symbolic name
B
M
T
$T2_2$
T4

Results, representing worst case

Diagram	Symbolic name Single mode
1 a-d	T

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, 3.1 dB above 18 GHz

Limits

CFR 47 §24.238 and RSS-133 6.5

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, resulting in a limit of -13 dBm per 1 MHz RBW.

Complies?	Yes

Appendix 7

Diagram 1a:

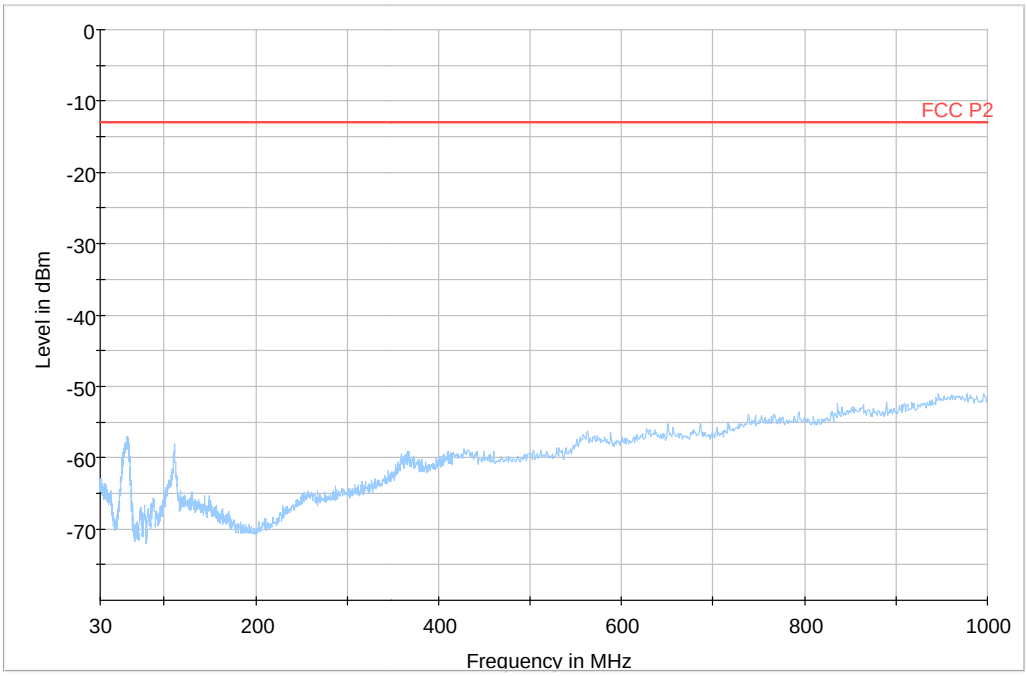
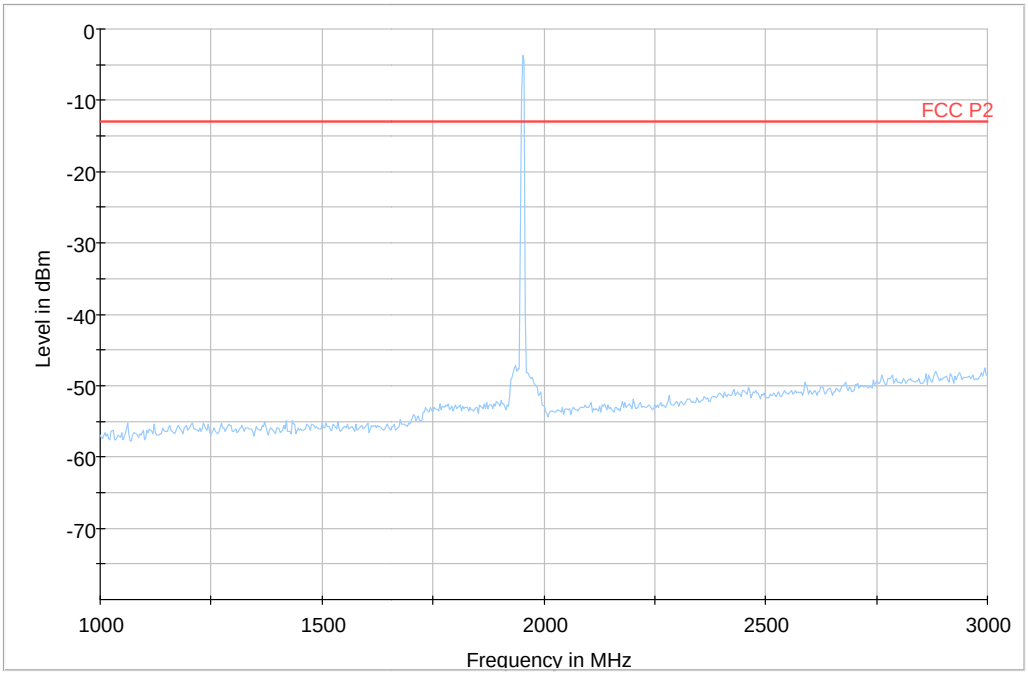


Diagram 1b:



Note: The emission at 1987.6 MHz is the carrier frequency and shall be ignored in the context.

Diagram 1c:

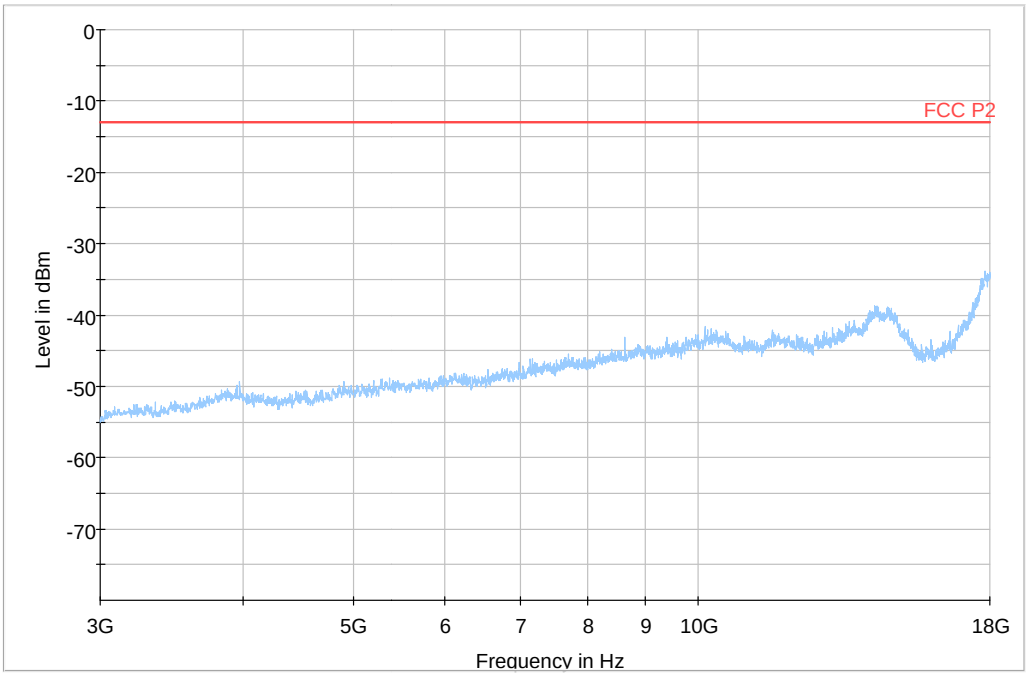
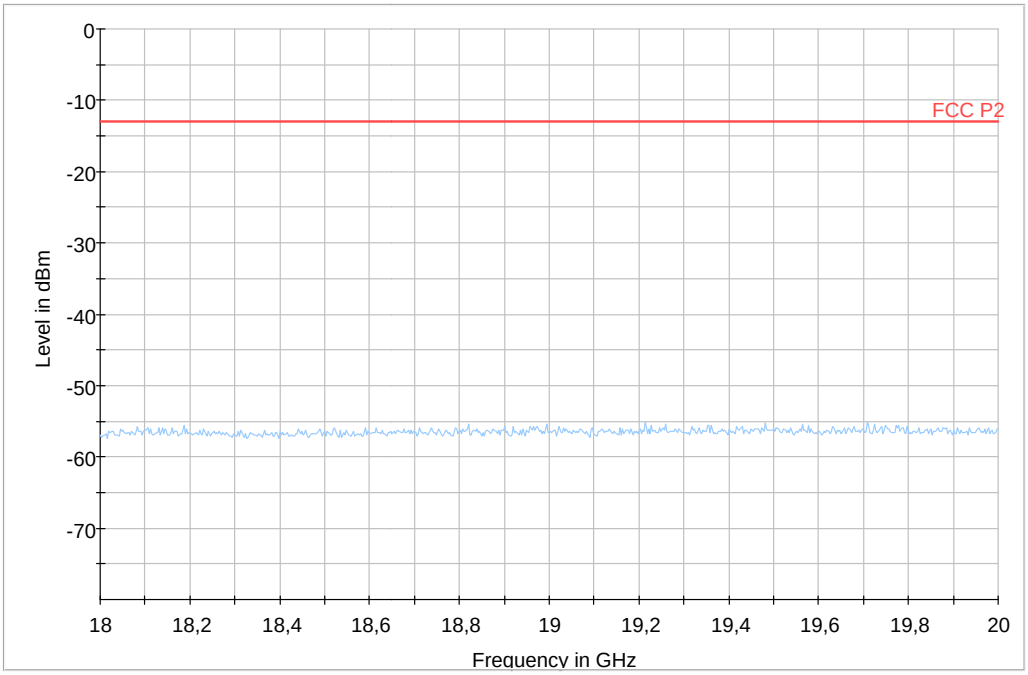


Diagram 1d:



Frequency stability measurements according to CFR 47 §24.235 / IC RSS 133 6.3

Date	Temperature (test equipment)	Humidity (test equipment)
2014-02-05 to 2014-02-09	21-22 °C ± 3 °C	25-29 % ± 5 %

Test set-up and procedure

The measurement was made per 3GPP TS 25.141. The output was connected to a spectrum analyzer. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.
The measurement was also made using a resolution bandwidth of 1% of the emission bandwidth, a reference point at the unwanted emission level which complies with the attenuation of 43 + 10 log10 p (watts) (i.e. -13dBm) (Single Antenna (Multiple port) -16dBm) at the band edge of the lowest and highest channel was selected, and the frequency at these points was recorded as fL and fH respectively.

Measurement equipment	SP number
Rohde & Schwarz signal analyzer FSQ 40	504 143
RF attenuator	900 691
Testo 635, Temperature and humidity meter	504 203
Temperature cabinet	503 360

Results

Nominal transmitter frequency was 1960.0 MHz (M) with a bandwidth of 5 MHz. Rated output power level at connector RF A (maximum): 17 dBm.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
-48.0	+20	-6
-55.2	+20	+10
-40.8	+20	-10
-48.0	+30	+8
-48.0	+40	-9
-48.0	+50	+11
-48.0	+10	+9
-48.0	0	-9
-48.0	-10	Not possible to activate transmitter
Maximum freq. error (Hz)		11
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Configuration: RDI Cable 200 m

Test conditions			Frequency margin to band edge at -16dBm			
			Test frequency Symbolic name B		Test frequency Symbolic name T	
Supply voltage DC [V]	Temp [°C].	Carrier Bandwidth [MHz]	fL [MHz]	Offset to lower band edge (1930 MHz) [kHz]	fH [MHz]	Offset to upper band edge (1990 MHz) [kHz]
-48.0	+20	5	1930.218	218.0	1989.830	170.0

The frequency error results clearly shows that the frequency stability is good enough to ensure that the transmitted carrier stay within the operating band.

Remark

It was deemed sufficient to test one combination of TX frequency modulation, as all combinations share a common internal reference to derive the TX frequency from.

Limit according to:

§24.235
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

RSS-133 6.3 Frequency stability:
The carrier frequency shall not depart from the reference frequency in excess of ± 1.0 ppm (± 1960 Hz) for base stations when tested to the temperature and supply voltage variations specified in RSS-Gen.

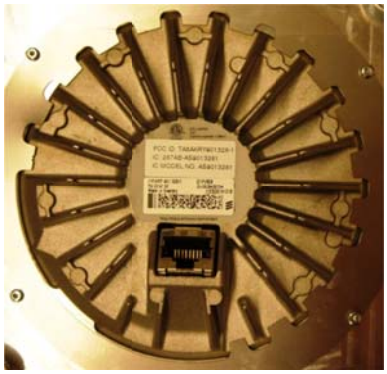
Complies?	Yes

Appendix 9

External photos

Top side

Bottom side



Side

Label