REPORT
Issued by an FCC listed Laboratory Reg. no. 93866

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Reference 4P06569-F27
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1002
ISO/IEC 17025

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Radio measurements on RRUS 71 B41 radio equipment with FCC ID: TA8AKRC161410-1

(8 appendices)

Test object

Product name: RRUS 72 B41
Product number: KRC 161 410/1, see appendix 1 for details.

Summary

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

Standard		Compliant	Appendix
FCC CFR 47 part 2 and 27			
2.1046	RF power output conducted	Yes	2
2.1049	Occupied bandwidth	Yes	3
2.1051	Band edge	Yes	4
2.1051	Spurious emission at antenna terminals	Yes	5
2.1053	Field strength of spurious radiation	Yes	6
2.1055	Frequency stability	Yes	7

SP Technical Research Institute of Sweden
Electronics - EMC

Performed by

Signed by: Jörgen Wassholm
Reason: I am the author of this document
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Examined by

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Anders Nordlöf

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Appendix 1

Description of the test object

Equipment:	Product name: RRUS 72 B41 Product numbers: KRC 161 410/1 FCC ID TA8AKRC161410-1
Hardware revision state:	R1B
Tested configuration:	LTE TDD single RAT
Frequency bands TDD:	TX: 2496 – 2690 MHz
Antenna ports:	4 TX/RX ports
RF configurations:	Single carrier, multi carrier, MIMO 4x4, Dual Sector (2x) 2x2 MIMO
Nominal output power per antenna port:	Single carrier: 1x 46 dBm (1 x 40W) Multi carrier: 2 x 43 dBm (2 x 20W) 3 x 41.2 dBm (3 x 13.3W)
RF power Tolerance:	±0.6 dB
Frequency stability tolerance:	±0.05 PPM
Antenna:	No dedicated antenna, handled during licensing
Modulations:	QPSK, 16QAM and 64QAM
Channel bandwidth:	5 MHz, 10 MHz, 15 MHz and 20 MHz
Nominal power voltage:	-48VDC

Appendix 1

Operation mode during measurements

TDD configuration 3 and special sub frame configuration 8, defined in 3GPP 36.211 Table 4.2-1 and Table 4.2-2 was used.

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 if not noted otherwise. Additional connections are documented in the setup drawings below. Complete measurements were made on RF B with additional measurements on RF A, C and D to verify that the ports are identical. A trig signal was connected from the DUS to the signal analyser to ensure that all measurement was done when the unit was transmitting.

Radiated measurements

The test object was supplied with -48 VDC by an external power supply. 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.

References

Measurements were done according to relevant parts of the following standards:
ANSI 63.4-2009
ANSI/TIA/-603-C-2004
3GPP TS 36.141, version 12.4.0, (2014-06)
3GPP 36.211, version 11.6.0 2014-10
CFR 47 part 2, December 16th , 2013
CFR 47 part 27, December 16th, 2013

Uncertainties

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

Reservation

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

Delivery of test object

The test object was delivered 2014-11-27.

Manufacturer’s representative

Lars Walin, Ericsson AB.

Test engineers

Tomas Isbring, Tomas Lennhager, Rolf Kühn, Maulo Rivera-Avalos and Rani Karnabi, SP

Test participants

None

Measurement equipment

	Calibration Due	SP number
Test site Tesla	2017-01	503 881
R&S ESU 26	2015-05	901 553
R&S ESU 40	2015-07	901 385
R&S ESI 26	2015-07	503 292
R&S FSQ 40	2015-07	504 143
R&S FSW 43	2015-07	902 073
R&S FSIQ 40	2015-07	503 738
Control computer with R&S software EMC32 version 8.52.0	-	503 899
High pass filter	2015-01	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
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	2015-06	901 384
RF attenuator	2014-11	901 508
Directional coupler	2015-10	901 496
Chase Bilog Antenna CBL 6111A	2017-10	503 182
EMCO Horn Antenna 3115	2016-09	502 175
µComp Nordic, Low Noise Amplifier	2015-01	901 545
Flann STD Gain Horn Antenna 16240-25	-	503 939
Flann STD Gain Horn Antenna 18240-25	-	503 900
Flann STD Gain Horn Antenna 20240-20	-	503 674
Miteq, Low Noise Amplifier	2015-08	503 285
Schwarzbeck preamplifier BBV 9742	2015-01	504 085
Miteq 18-40 GHz, Low Noise Amplifier	2015-01	503 278
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

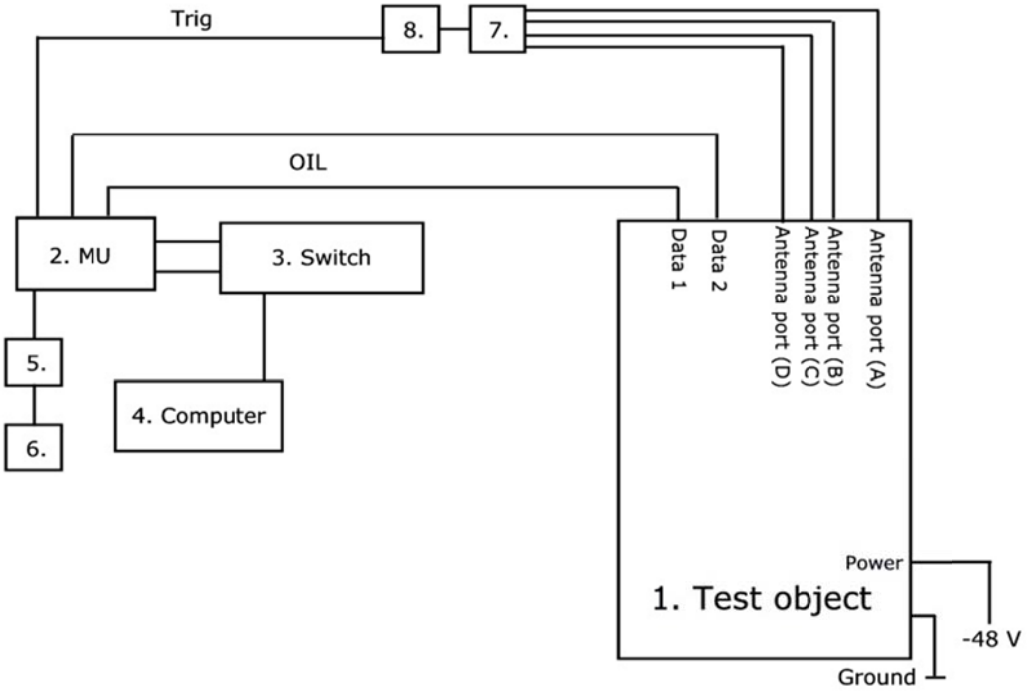
Appendix 1

Test frequencies during measurements

Single RAT TX test frequencies

EARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
39675	2498.5	B	TX bottom frequency in 5 MHz BW configuration
39700	2501.0	B	TX bottom frequency in 10 MHz BW configuration
39725	2503.5	B	TX bottom frequency in 15 MHz BW configuration
39750	2506.0	B	TX bottom frequency in 20 MHz BW configuration
40620	2593.0	M	TX middle frequency in 5, 10, 15 and 20 MHz BW configuration
41565	2687.5	T	TX top frequency in 5 MHz BW configuration
41540	2685.0	T	TX top frequency in 10 MHz BW configuration
41515	2682.5	T	TX top frequency in 15 MHz BW configuration
41490	2680.0	T	TX top frequency in 20 MHz BW configuration
39675 39725	2498.5 2503.5	B2 5	2 carrier TX band bottom constellation 5 MHz BW configuration
39727 39815	2503.7 2512.5	B2im	2 carrier TX band bottom constellation 5 MHz BW configuration
41565 41515	2687.5 2682.5	T2 5	2 carrier TX band top constellation 5 MHz BW configuration
41513 41425	2682.3 2673.5	T2im	2 carrier TX band top constellation 5 MHz BW configuration
39727 39815 39903	2503.7 2512.5 2521.3	B3im	3 carrier TX band bottom constellation 5 MHz BW configuration
41513 41425 41337	2682.3 2673.5 2664.7	T3im	3 carrier TX band top constellation 5 MHz BW configuration
40420 40620 40820	2573.0 2593.0 2613.0	M3 20	3 carrier TX band middle constellation 20 MHz BW configuration
41290 41490	2660.0 2680.0	T2 20	2 carrier TX band top constellation 20 MHz BW configuration
41090 41290 41490	2640.0 2660.0 2680.0	T3	3 carrier TX band top constellation 20 MHz BW configuration

Test setup conducted measurements



Test object:

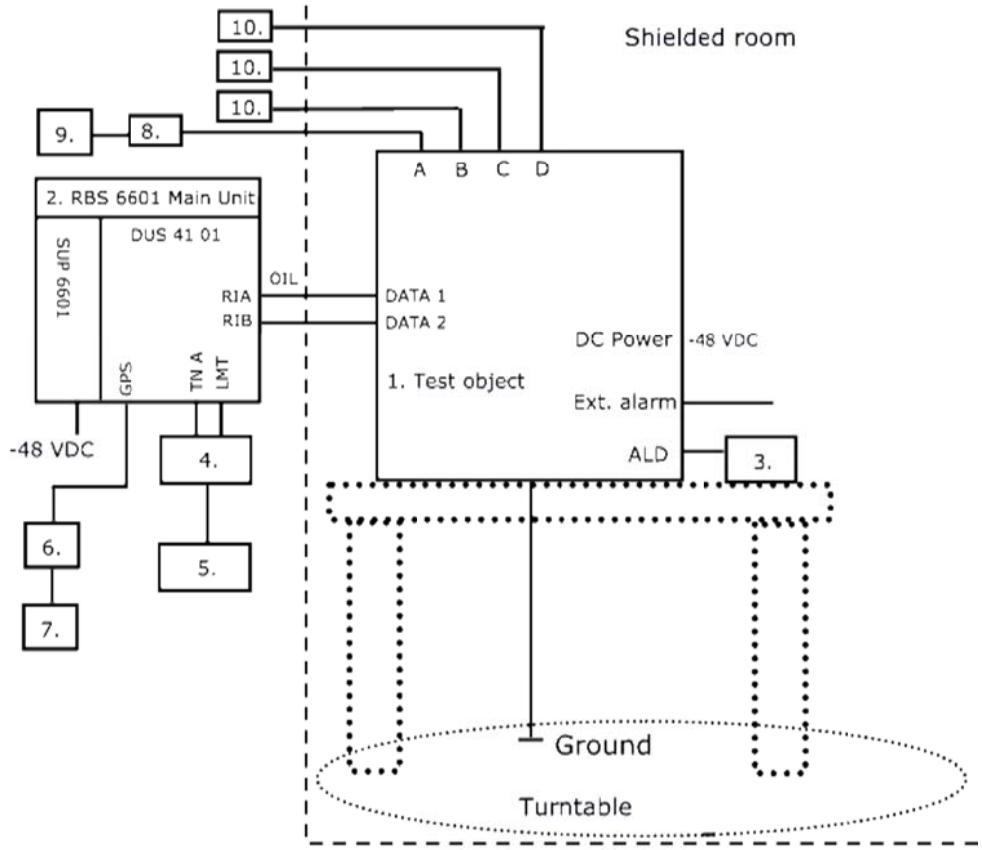
1.	RRUS 72 B41, KRC 161 410/1, rev R1B, s/n: C828660306 software CXP 901 7316/5, rev R59DH, with FCC ID: TA8AKRC161410-1

Functional test equipment:

2.	Main Unit: DUS 41 01 KDU 137 624/1 R5A/A, s/n: D18F285445, hosted in RBS 6201 BAMS-1000778792
3.	Switch Netgear GSM 7224, BAMS-1001356268
4	HP Elitbook 8540w, BAMS – 1001052060
5.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K474887
6.	GPS Active Antenna, KRE 101 2082/1
7.	SP Test Instrumentation according to measurement equipment list or Terminators, 50 ohm
8.	SP Test Instrumentation according to measurement equipment list

Appendix 1

Test setup radiated measurements



Test object:

1.	RRUS 72 B41, KRC 161 410/1, rev. R1B, s/n: C829660311 Software: CXP 901 7316/5, rev. R59DH, with FCC ID: TA8AKRC161410-1

Functional test equipment:

2.	RBS 6601 Main Unit: SUP 6601, 1/ BFL 901 009/4, rev: R1E, s/n: BR88236818 DUS 41 01, KDU 137 624/1, rev: R5A/A, s/n: D16H558958
3.	RET, KRY 121 67/2, rev: R1G, BAMS – 1000601140
4.	Switch Neatgear GSM 7224, BAMS – 1000906285
5.	EliteBook 8540w, BAMS – 1001052044
6.	GPS 02 01, NCD 901 41/1, rev: R1D, s/n: TU8KH75515
7.	GPS Active Antenna, KRE 101 2082/1
8.	Attenuator
9.	R&S FSIQ 40, SP number: 503 738, for supervision purpose only
10.	Attenuator/ Terminator

Interfaces:

Power: -48 VDC	DC Power
Antenna port (A), 7/16 connector, combined TX/RX	Antenna
Antenna port (B), 7/16 connector, combined TX/RX	Antenna
Antenna port (C), 7/16 connector, combined TX/RX	Antenna
Antenna port (D), 7/16 connector, combined TX/RX	Antenna
1, Optical Interface Link, single mode opto fibre	Signal
2, Optical Interface Link, single mode opto fibre	Signal
EXT Alarm, shielded multi-wire	Signal
ALD Ctrl, shielded multi-wire	Signal
Ground wire	Ground

RBS software:

Product number	Revision
CXP 102 051/22	R44GC

RF power output measurements according to CFR 47 §27.50, conducted

Date	Temperature	Humidity
2014-12-05	23 °C ± 3 °C	27 % ± 5 %
2014-12-08	23 °C ± 3 °C	25 % ± 5 %
2014-12-09	23 °C ± 3 °C	29 % ± 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 80 MHz was used acc. to 971168 D01 Power Meas License Digital Systems v02r02, chapter 5.2.3.

Measurement equipment	SP number
R&S FSW 43	902 073
RF attenuator	902 282
Directional coupler	901 496
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

MIMO mode, single carrier

Rated output power level at RF connector 1x 46 dBm.

Tested configuration	[RMS dBm/ PAR dB]				
BW and frequency	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
5 MHz, B	46.32/ 7.28	46.39/ 7.28	46.30/ 7.28	46.46/ 7.28	52.39
5 MHz, M	46.28/ 7.28	46.43/ 7.28	46.41/ 7.28	46.38/ 7.28	52.40
5 MHz, T	46.33/ 7.28	46.45/ 7.28	46.34/ 7.28	46.40/ 7.28	52.40
10 MHz, T	46.43/ 7.30	46.53/ 7.30	46.31/ 7.30	46.49/ 7.30	52.46
15 MHz, T	46.35/ 7.38	46.53/ 7.38	46.30/ 7.38	46.46/ 7.38	52.43
20 MHz, T	46.30/ 7.38	46.52/ 7.38	46.28/ 7.38	46.50/ 7.38	52.42

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

MIMO mode, multi carrier

Rated output power level at RF connector 2x 43 dBm.

Tested configuration	[RMS dBm/ PAR dB]				
BW and frequency	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
5 MHz, T2im	46.32/ 7.40	46.51/ 7.40	46.30/ 7.40	46.45/ 7.40	52.42
20 MHz, T2	46.38/ 7.48	46.42/ 7.48	46.33/ 7.48	46.40/ 7.48	52.40
5MHz, B2im	46.20/ 7.40	46.50/7.40	46.32/ 7.42	46.34/ 7.40	52.36

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

Rated output power level at RF connector 3x 41.3 dBm.

Tested configuration	[RMS dBm/ PAR dB]				
BW and frequency	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
5 MHz, T3im	46.33/ 6.98	46.53/ 6.98	46.36/ 6.98	46.38/ 6.98	52.42
20 MHz, T3	46.23/ 7.22	46.58/ 7.22	46.44/ 7.20	46.51/ 7.22	52.46
20 MHz, M3 20	46.30/ 6.80	46.35/ 6.80	46.30/ 6.80	46.33/ 6.78	52.34

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

Remark

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 antenna gain used in combination with above power settings to prevent the radiated output power to exceed the limits.

Limits

CFR 47 §27.50 (h):

Main, booster and base stations. The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition.

Limit EIRP in Watt Channel BW [X]	LBS: 2496-2572 UBS: 2614-2690 Y=5.5 Limit EIRP [W]	MBS: 2572-2614 Y=6 Limit EIRP [W]
4.48	1625	1490
8.96	3250	2980
13.49	4894	4486
17.86	6479	5939

Complies?	Yes

Occupied bandwidth measurements according to CFR 47 2.1049

Date	Temperature	Humidity
2014-12-05	23 °C ± 3 °C	27 % ± 5 %
2014-12-08	23 °C ± 3 °C	25 % ± 5 %

Test set-up and procedure

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

Measurement equipment	SP number
R&S FSW 43	902 073
RF attenuator	902 282
Directional coupler	901 496
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	5 MHz	B	RF B	4.48
2	5 MHz	M	RF B	4.48
3	5 MHz	T	RF B	4.50
4	5MHz	T	RF A	4.50
5	5 MHz	T	RF C	4.50
6	5 MHz	T	RF D	4.50
7	10 MHz	T	RF A	8.96
8	10 MHz	T	RF B	8.96
9	10 MHz	T	RF C	8.96
10	10 MHz	T	RF D	8.96
11	15 MHz	T	RF A	13.53
12	15 MHz	T	RF B	13.49
13	15 MHz	T	RF C	13.53
14	15 MHz	T	RF D	13.53
15	20 MHz	T	RF A	17.86
16	20 MHz	T	RF B	17.86
17	20 MHz	T	RF C	17.86
18	20 MHz	T	RF D	17.86

Appendix 3

Diagram 1:

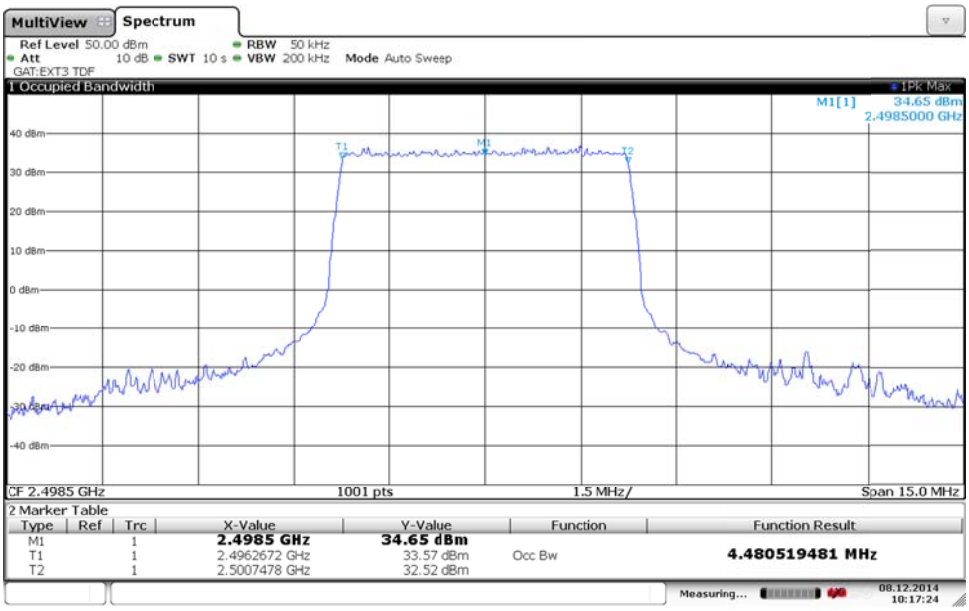


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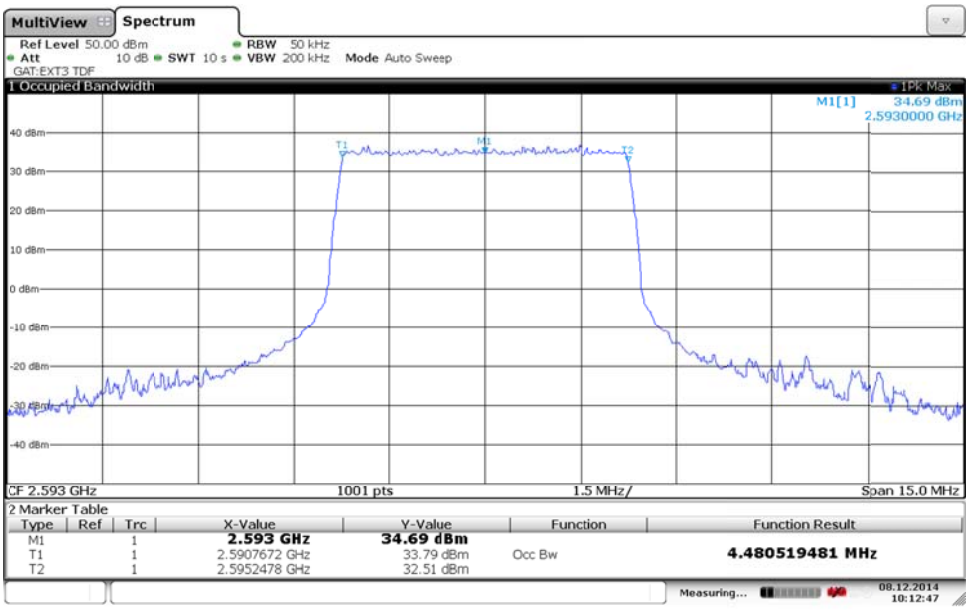
Diagram 2:



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Appendix 3

Diagram 3:

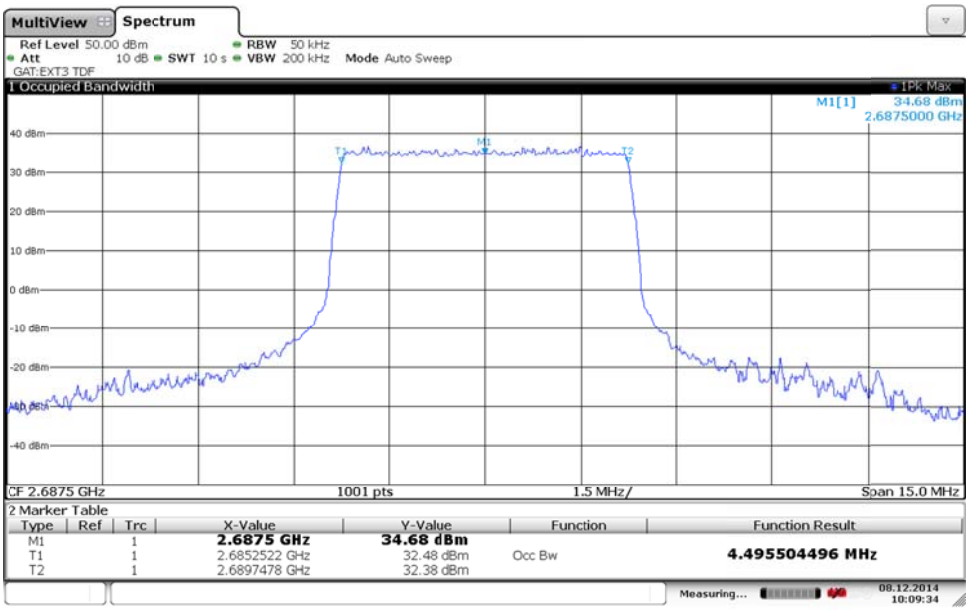

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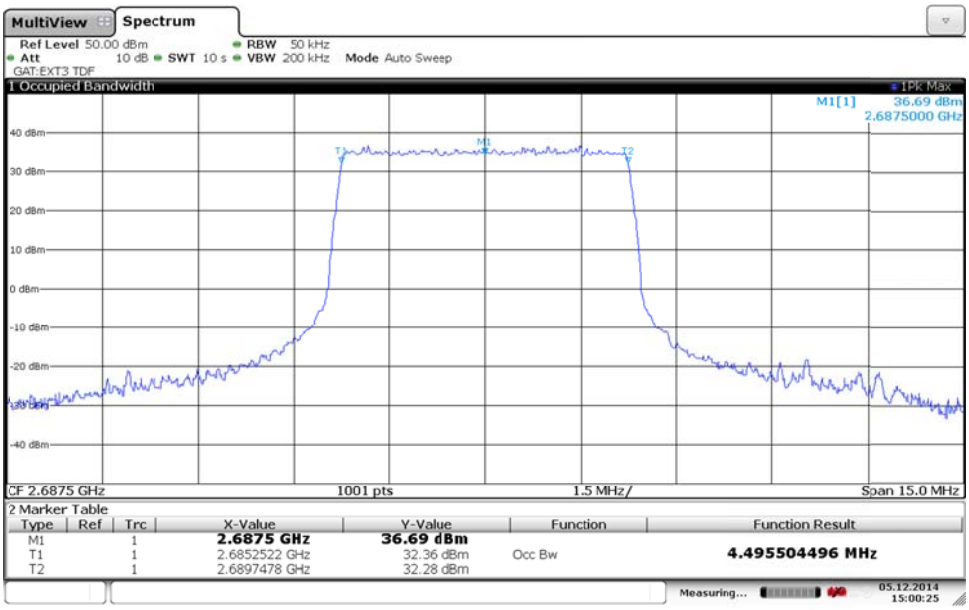
Diagram 4:



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Appendix 3

Diagram 5:

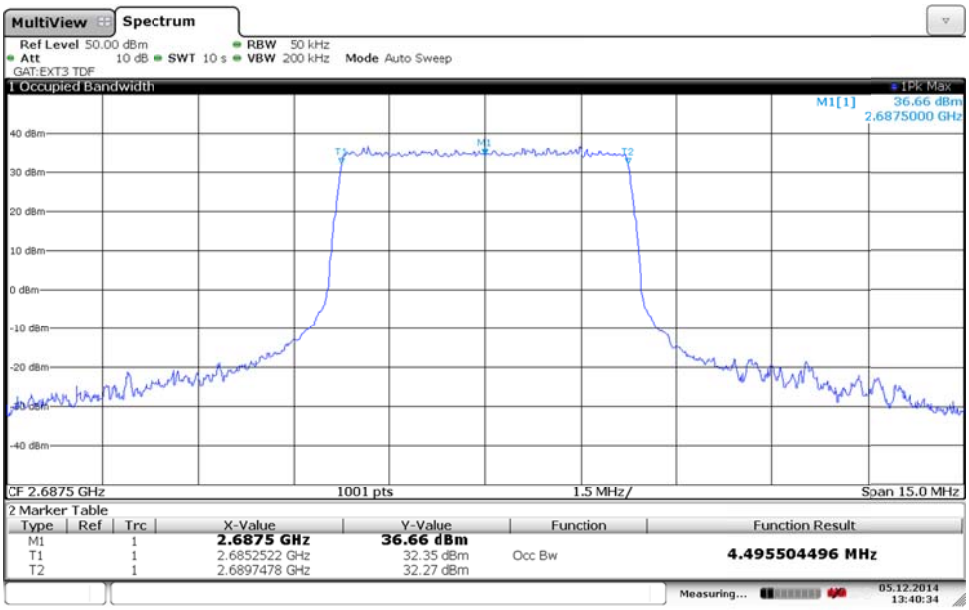

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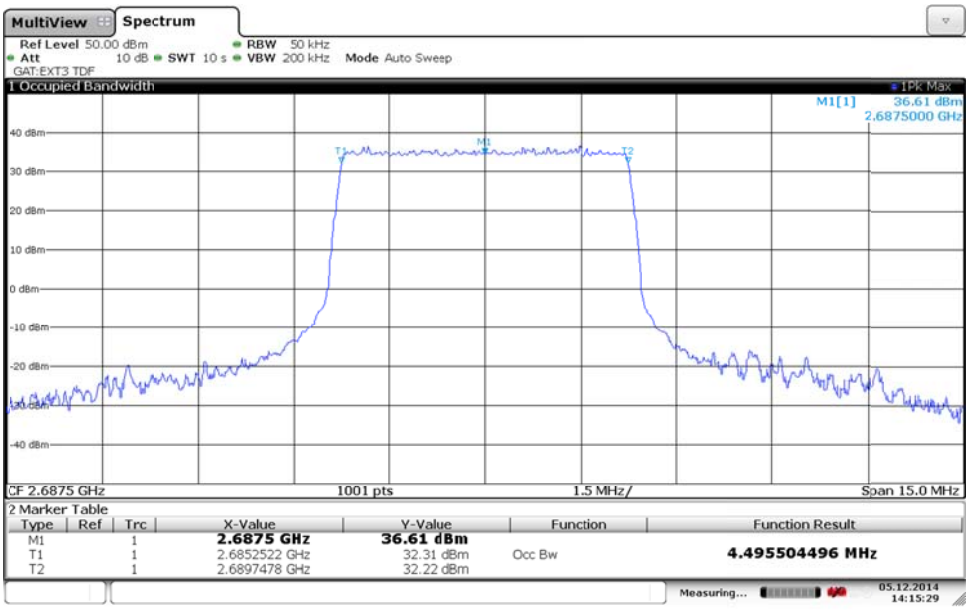
Diagram 6:



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Appendix 3

Diagram 7:

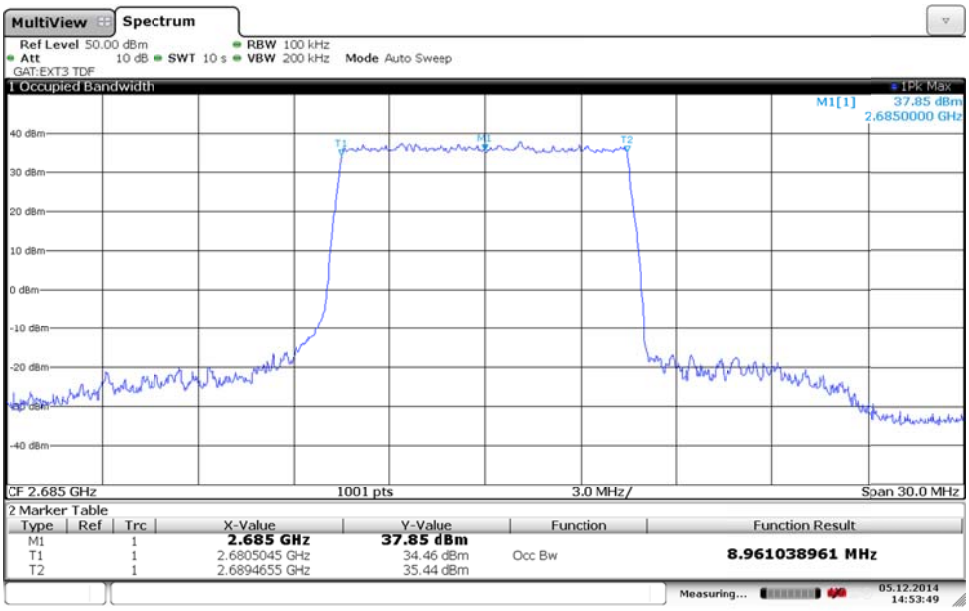

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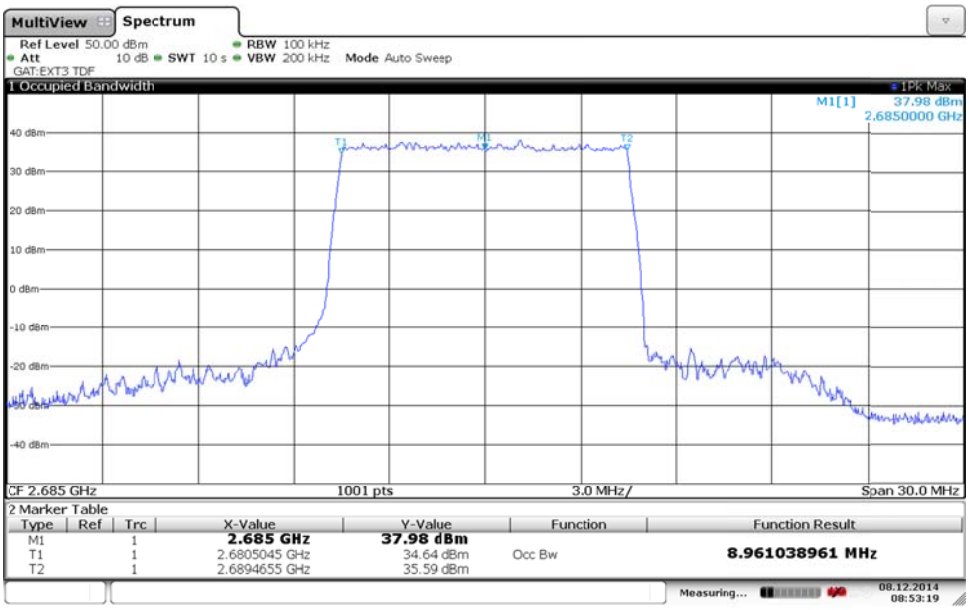
Diagram 8:



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Appendix 3

Diagram 9:

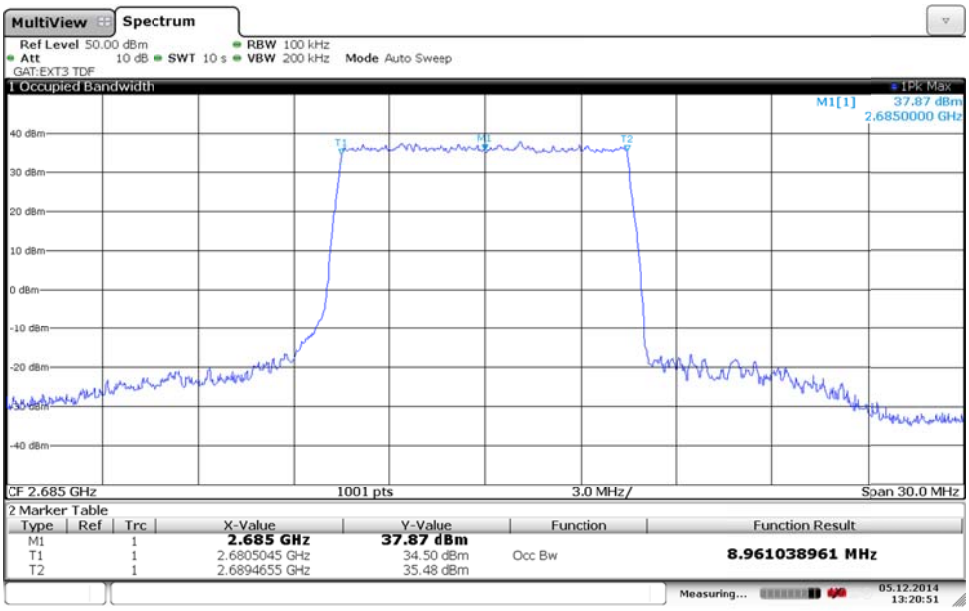

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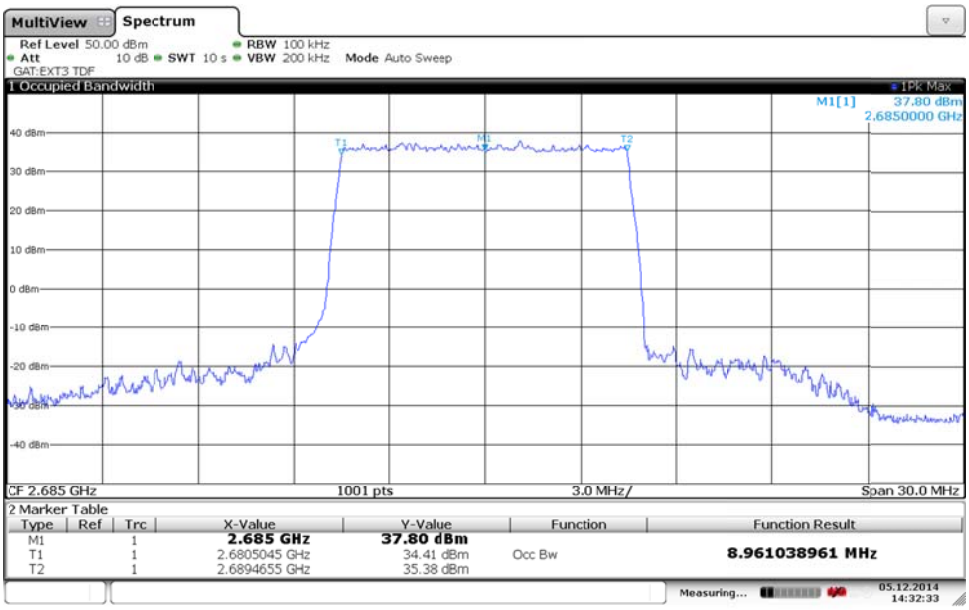
Diagram 10:



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Appendix 3

Diagram 11:

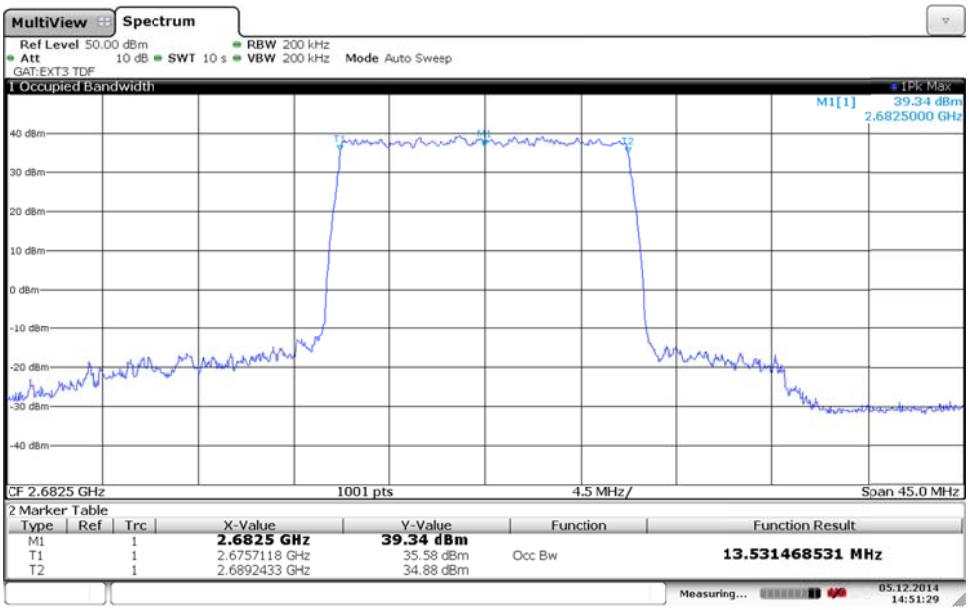

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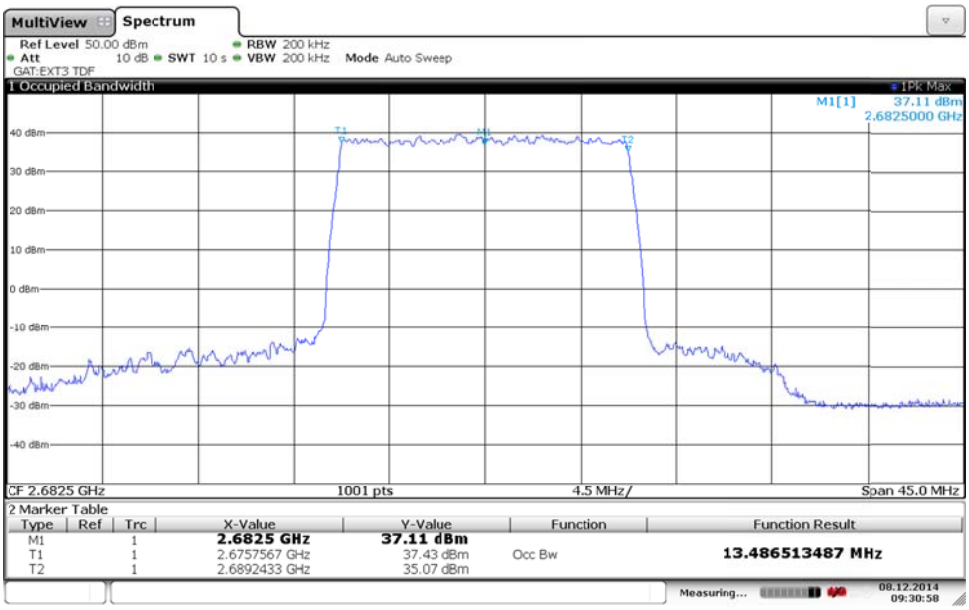
Diagram 12:



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Appendix 3

Diagram 13:

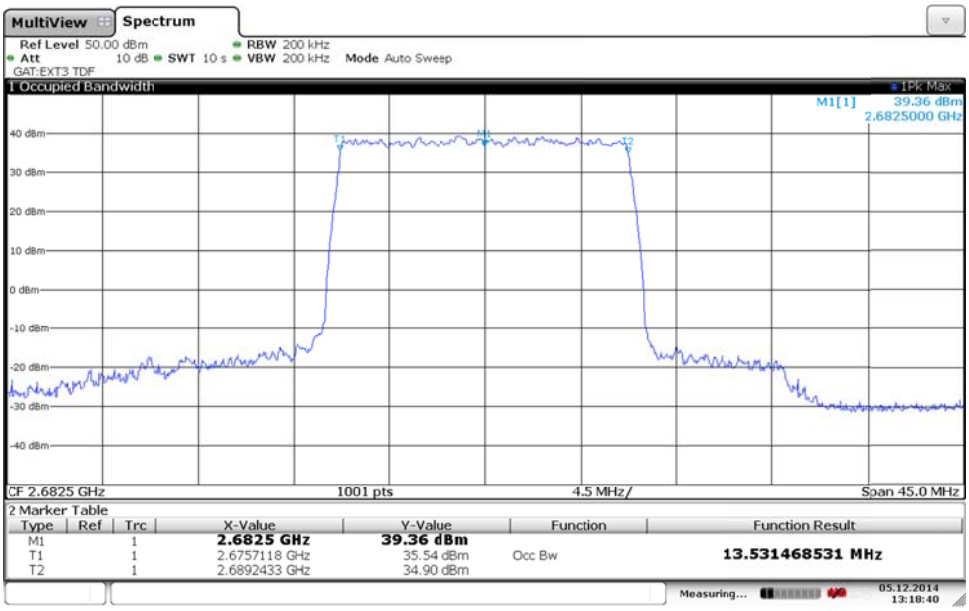

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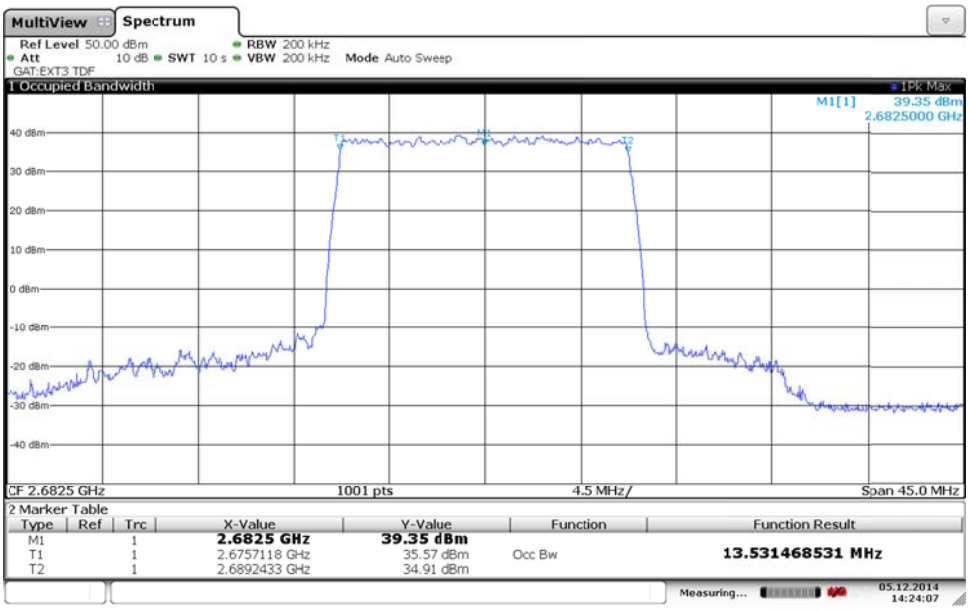
Diagram 14:



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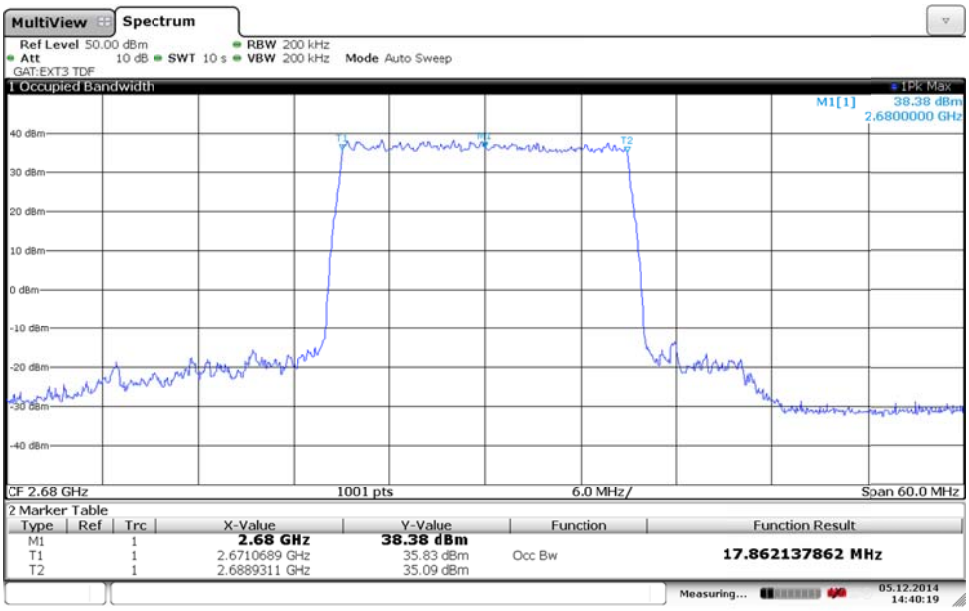
Appendix 3

Diagram 15:



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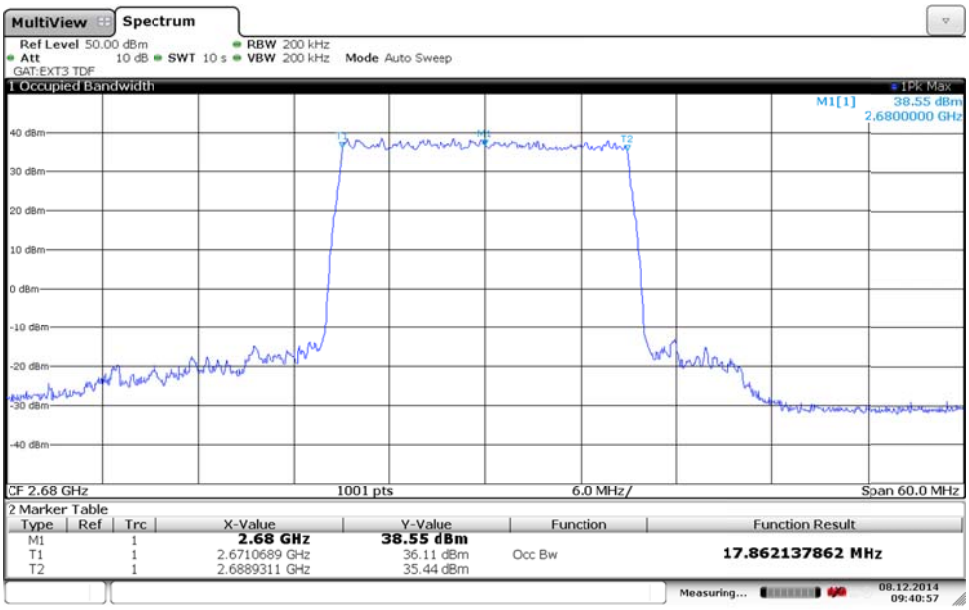

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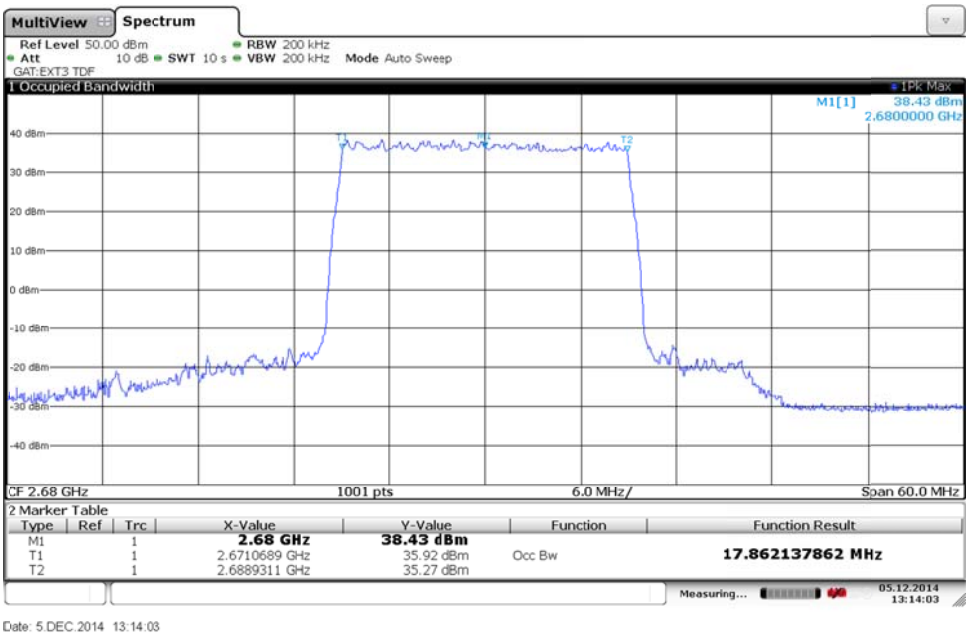
Appendix 3

Diagram 17:



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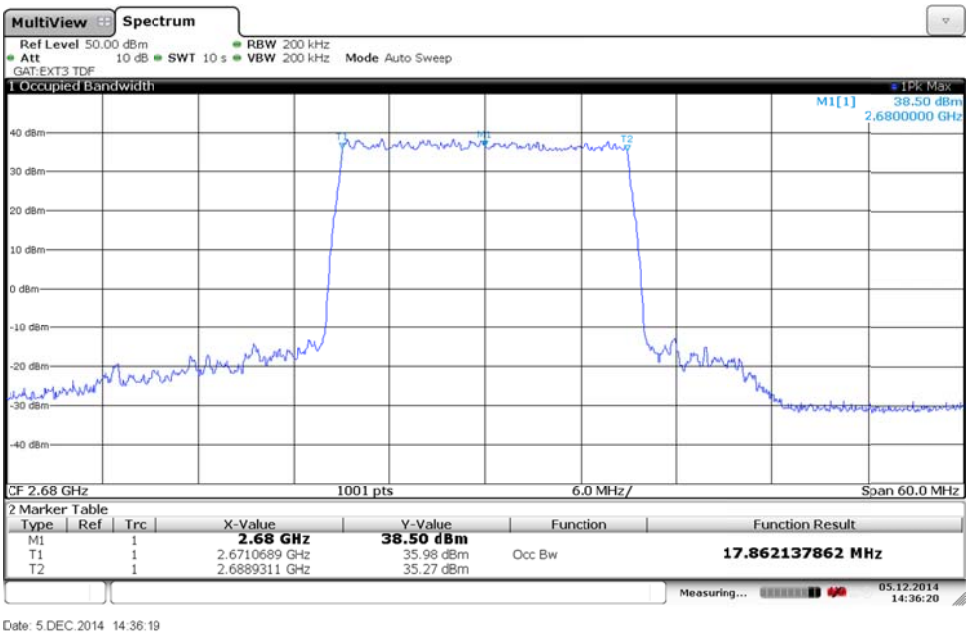

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Band edge measurements according to CFR 47 §27.53(m)

Date	Temperature	Humidity
2014-12-08	23°C ± 3°C	25 % ± 5 %
2014-12-09	23°C ± 3°C	29 % ± 5 %

Test set-up and procedure

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

The transmitter unwanted emissions shall be measured with a resolution bandwidth of 1 MHz. However, in the 1 MHz bands immediately adjacent to the edges of the frequency range(s) in which the equipment is allowed to operate, a resolution bandwidth of as close as possible to, without being less than 1% of the emission bandwidth.
A smaller resolution bandwidth is permitted provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz. 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].

Before comparing the results to the limit, 6 dB [10 log (4)] should be added according to method 2 “measure and add 10 log(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output v02r01

Measurement equipment	SP number
R&S FSW 43	902 073
RF attenuator	902 282
Directional coupler	901 496
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

MIMO mode

Diagram	BW configuration	Tested frequency	Tested Port
1 a-c	5 MHz	B	RF B
2 a-c	10 MHz	B	RF B
3 a-c	15 MHz	B	RF B
4 a-c	20 MHz	B	RF B
5 a-c	5 MHz	T	RF B
6 a-c	10 MHz	T	RF B
7 a-c	15 MHz	T	RF B
8 a-c	20 MHz	T	RF B
9 a-c	5 MHz	B2 5	RF B
10 a-c	5 MHz	T2 5	RF B

Limits

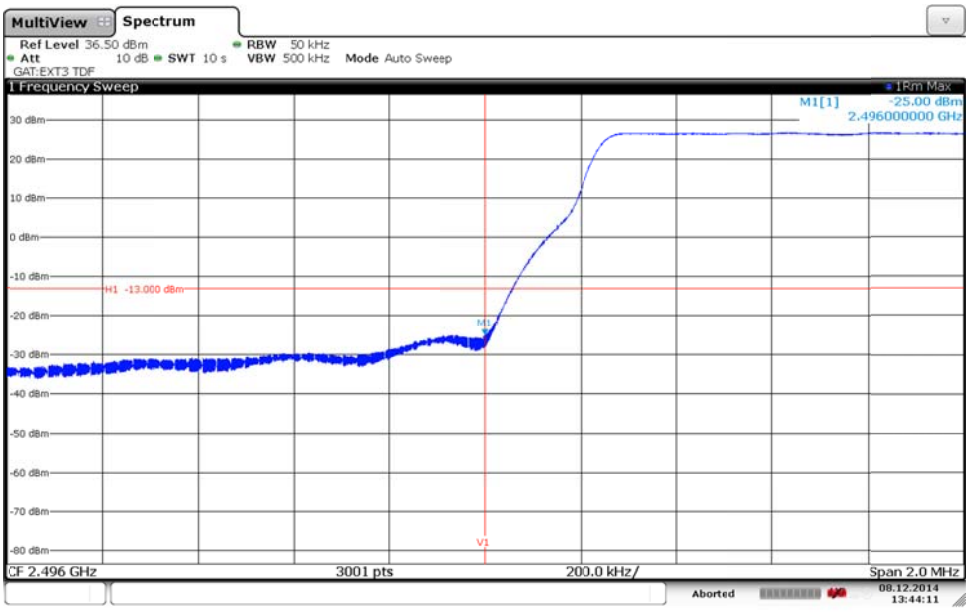
CFR 47 §27.53(m)

For digital base stations, the attenuation shall be not less than 43 + 10 log (P) dB.

Complies?	Yes

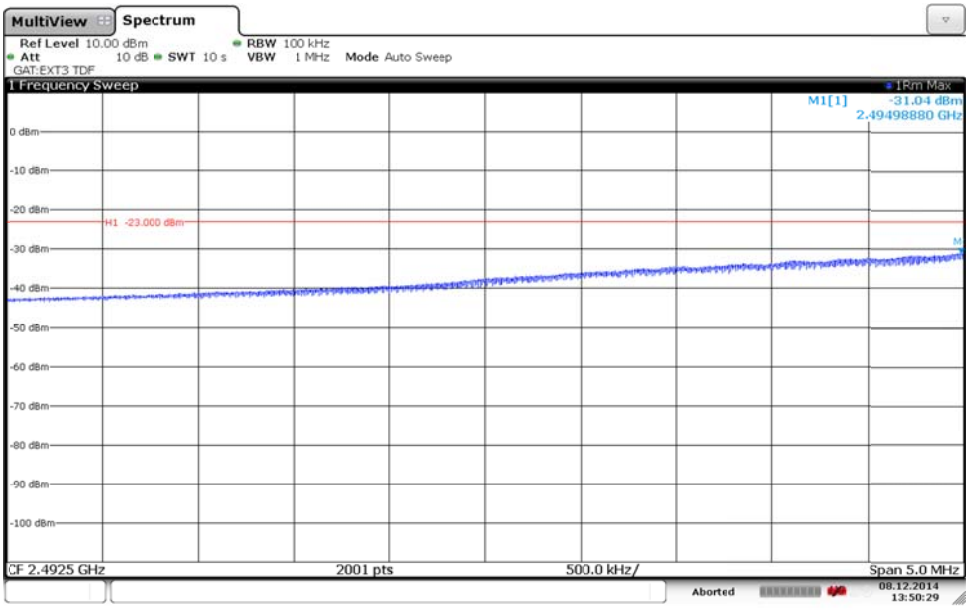
Appendix 4

Diagram 1a:



Date: 8.DEC.2014 13:44:10

Diagram 1b:



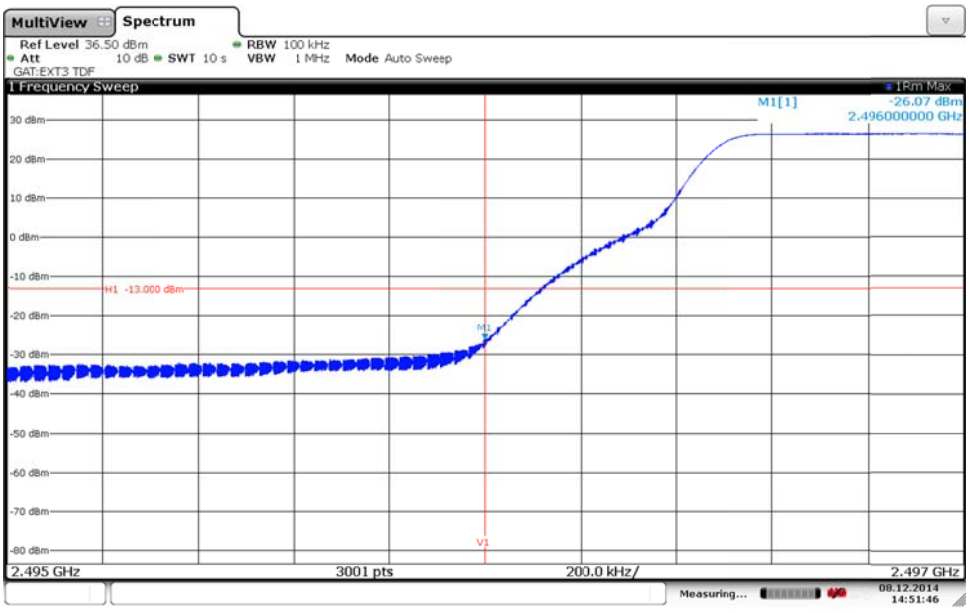
Date: 8.DEC.2014 13:50:29

Appendix 4

Diagram 1c:

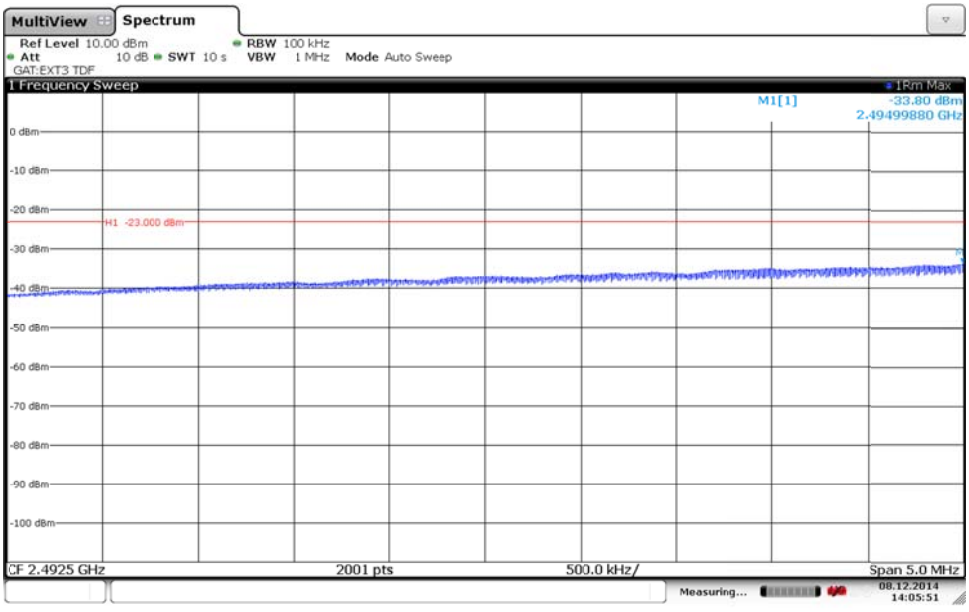
Appendix 4

Diagram 2a:



Date: 8.DEC.2014 14:51:48

Diagram 2b:



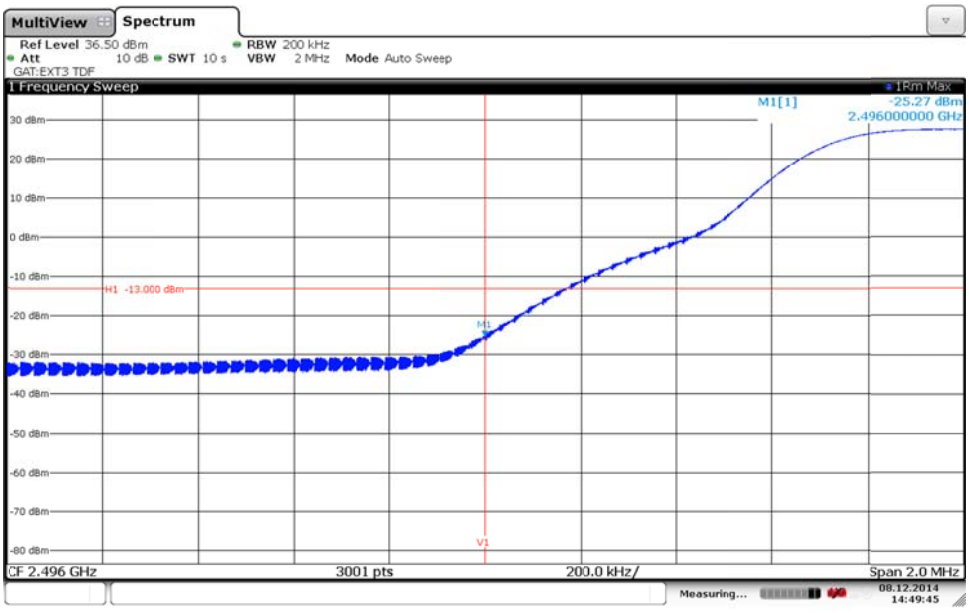
Date: 8.DEC.2014 14:05:50

Appendix 4

Diagram 2c:

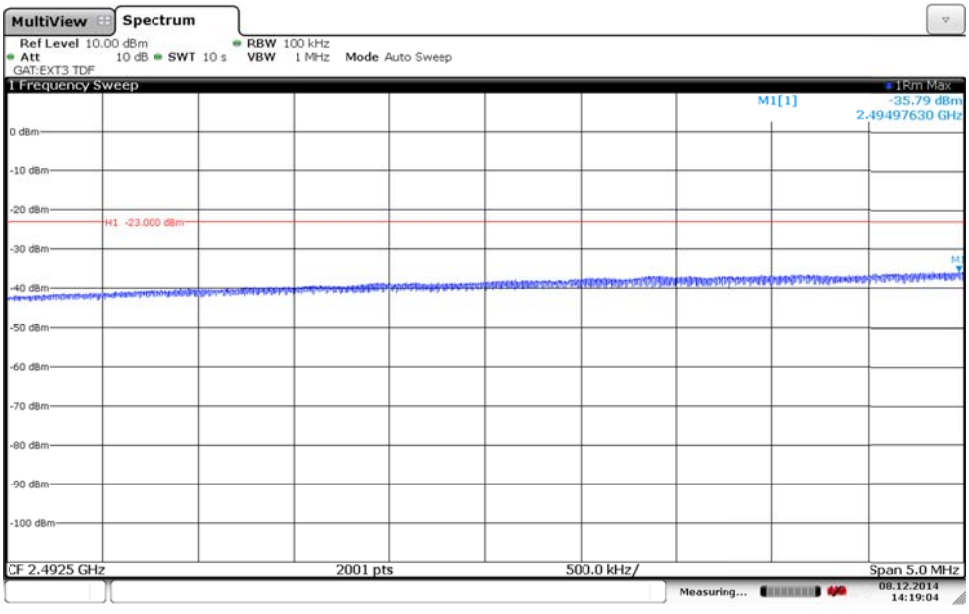
Appendix 4

Diagram 3a:



Date: 8.DEC.2014 14:49:45

Diagram 3b:



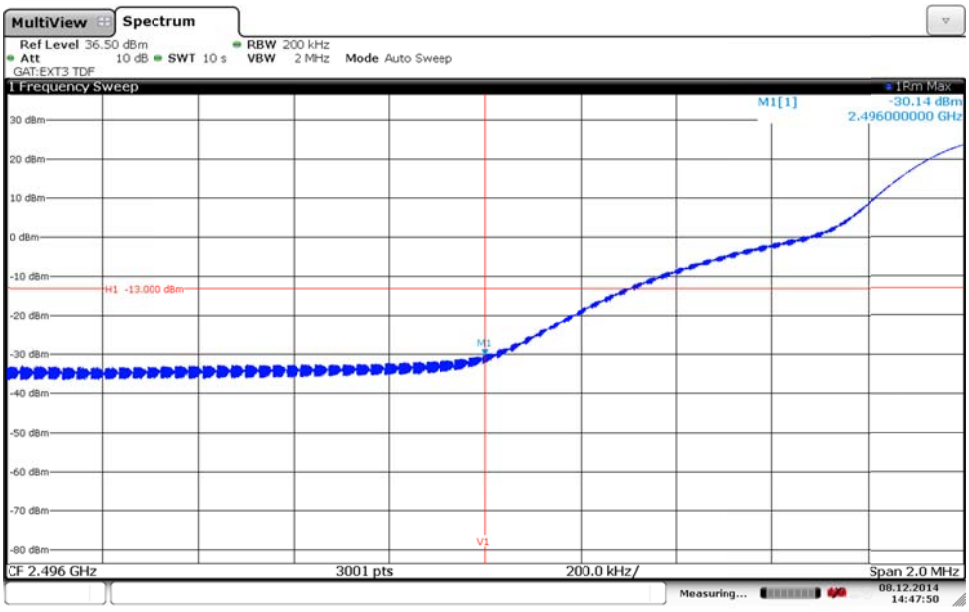
Date: 8.DEC.2014 14:19:03

Appendix 4

Diagram 3c:

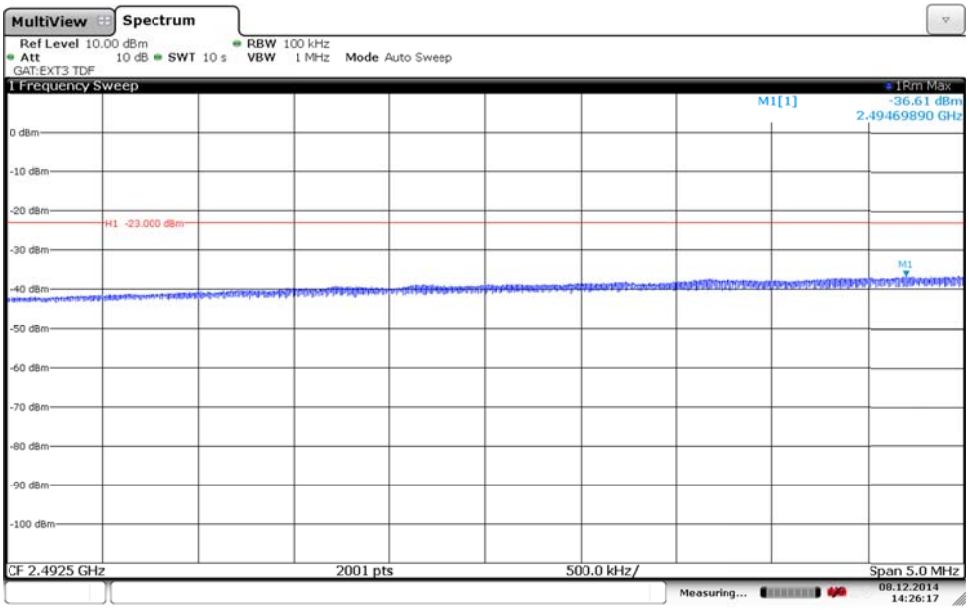
Appendix 4

Diagram 4a:



Date: 8.DEC.2014 14:47:50

Diagram 4b:



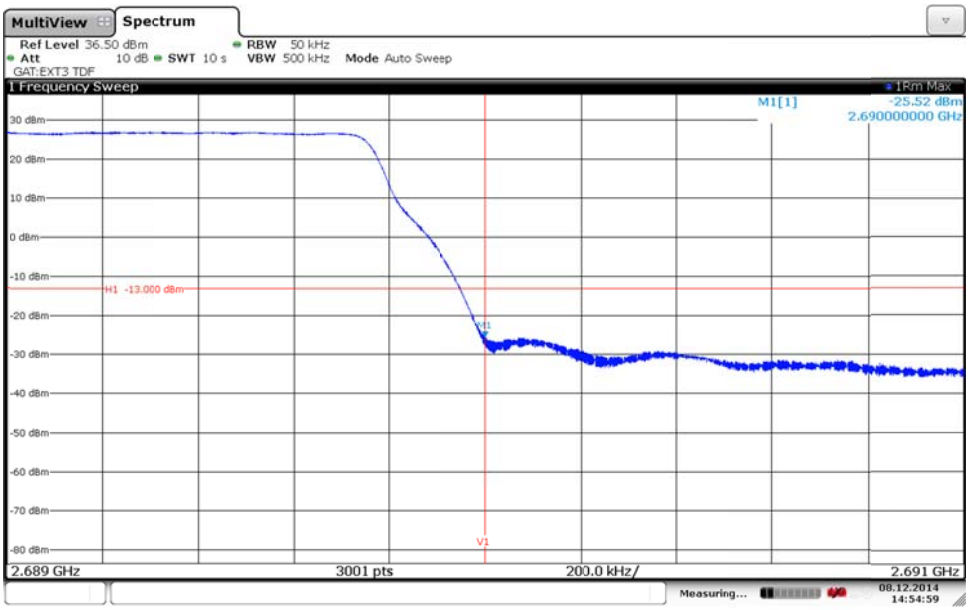
Date: 8.DEC.2014 14:26:18

Appendix 4

Diagram 4c:

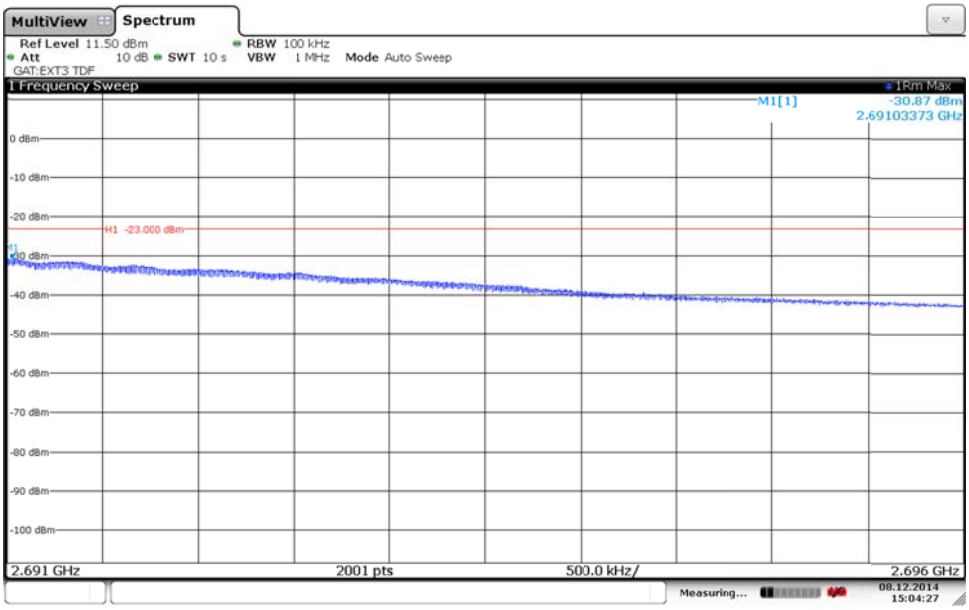
Appendix 4

Diagram 5a:



Date: 8.DEC.2014 14:54:59

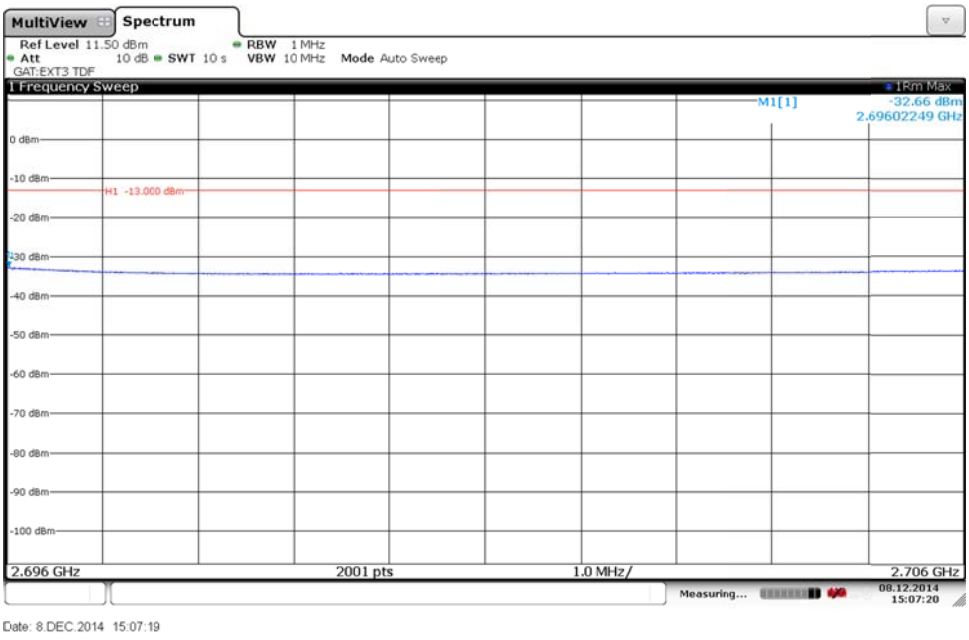
Diagram 5b:



Date: 8.DEC.2014 15:04:27

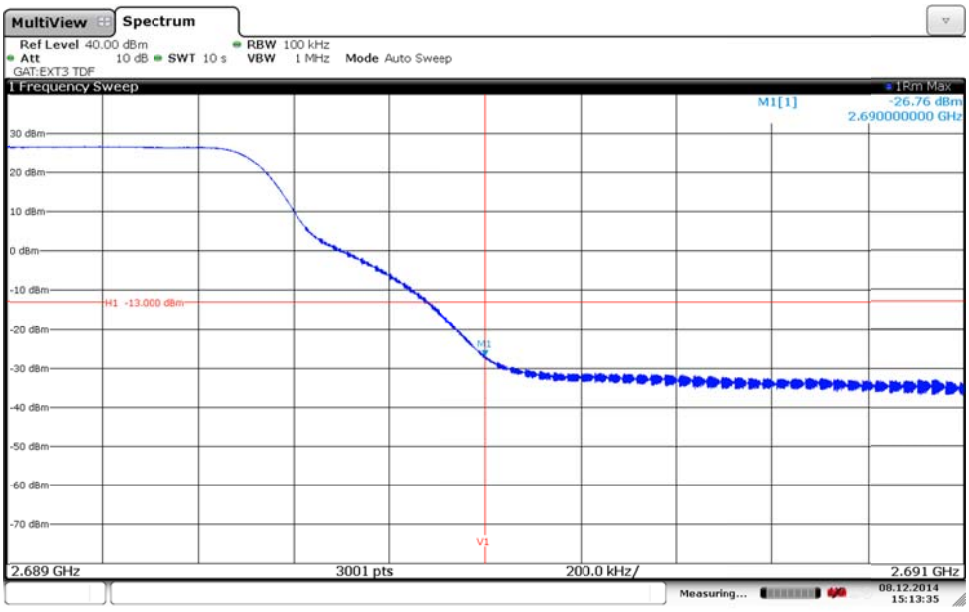
Appendix 4

Diagram 5c:



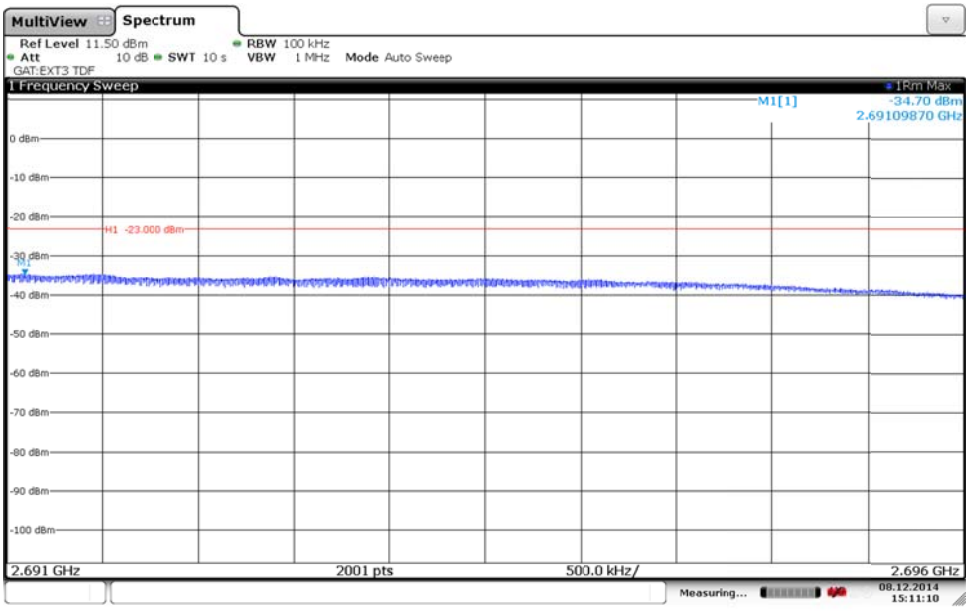
Appendix 4

Diagram 6a:



Date: 8.DEC.2014 15:13:34

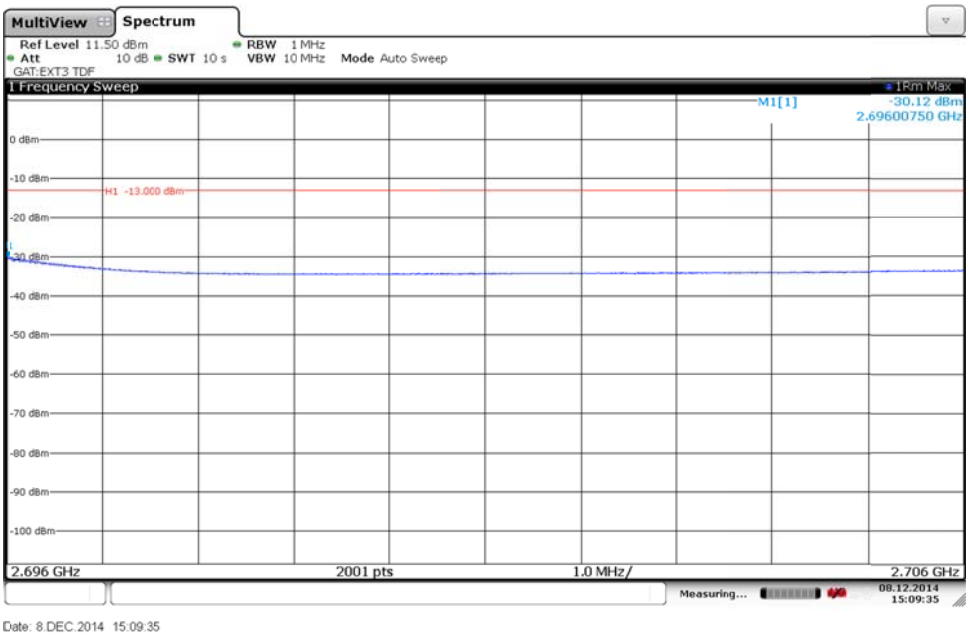
Diagram 6b:



Date: 8.DEC.2014 15:11:10

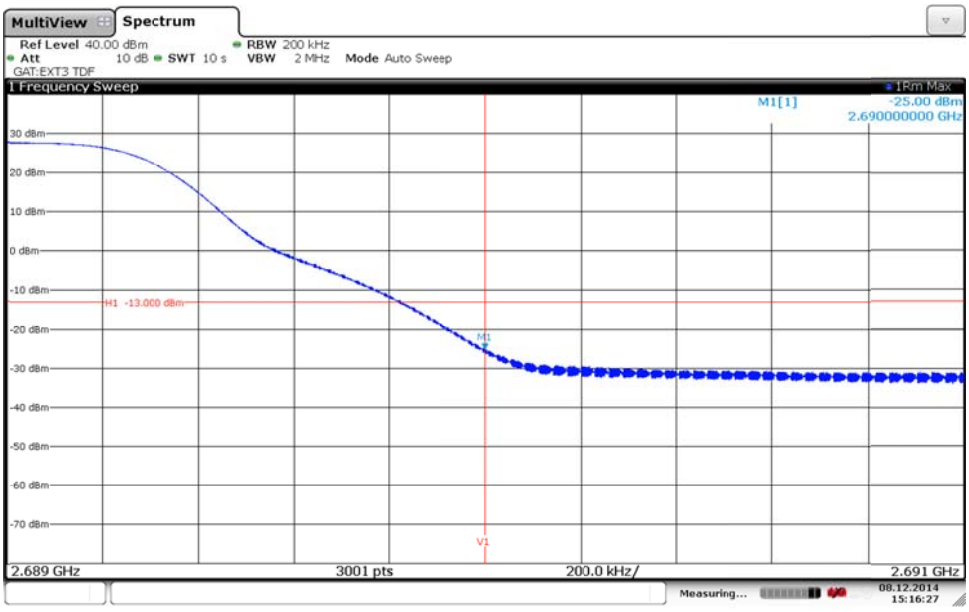
Appendix 4

Diagram 6c:



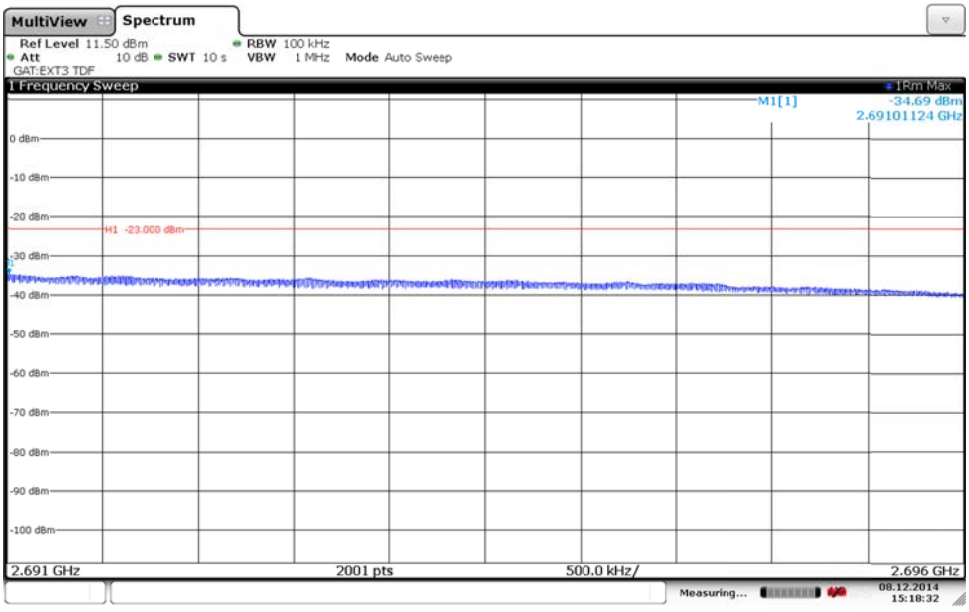
Appendix 4

Diagram 7a:



Date: 8.DEC.2014 15:16:27

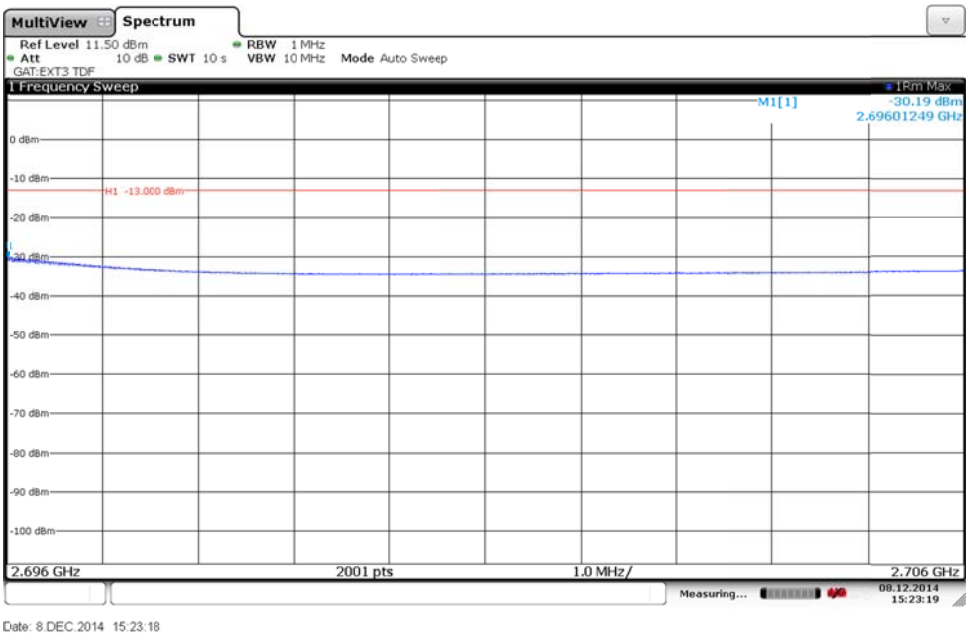
Diagram 7b:



Date: 8.DEC.2014 15:18:32

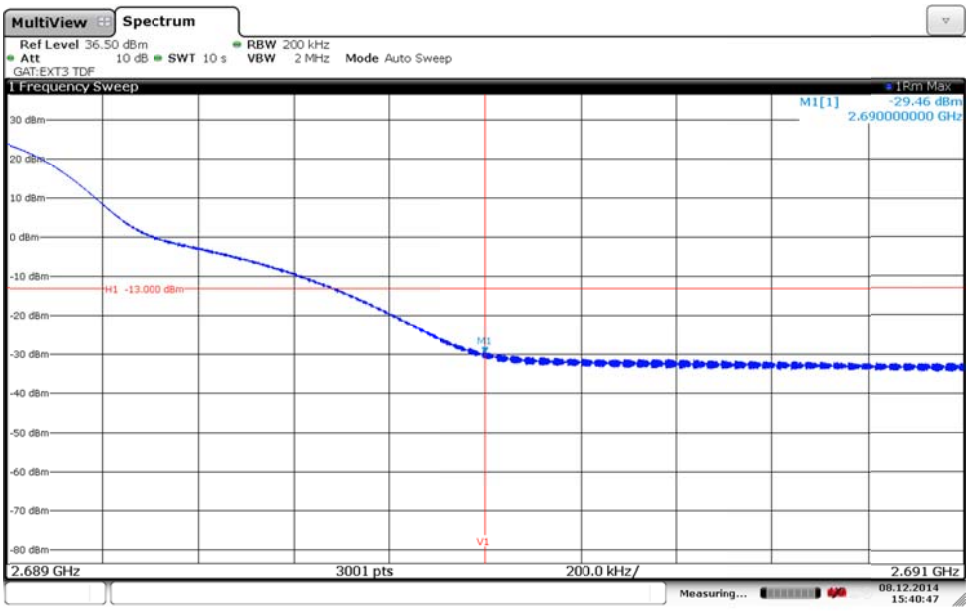
Appendix 4

Diagram 7c:



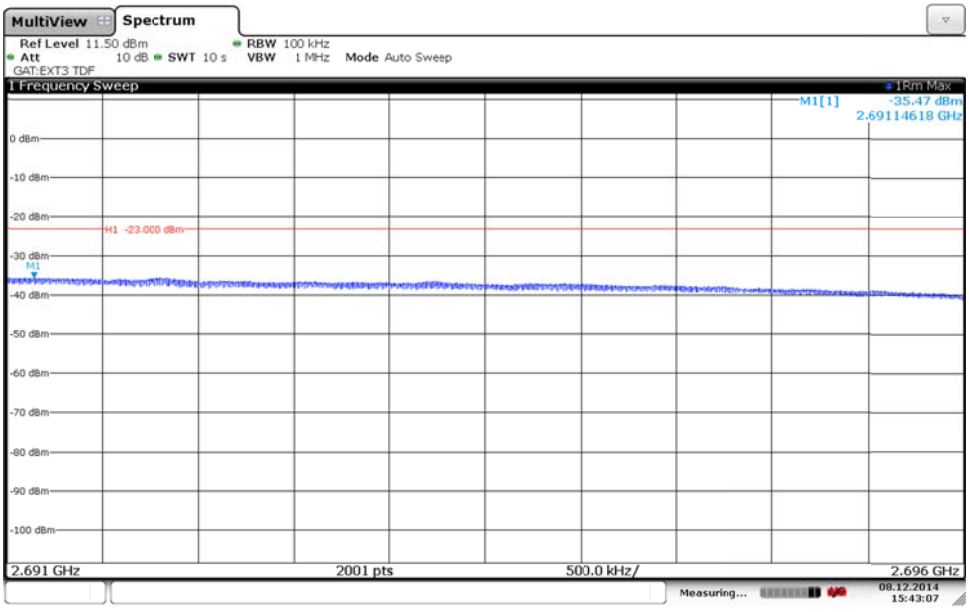
Appendix 4

Diagram 8a:



Date: 8.DEC.2014 15:40:47

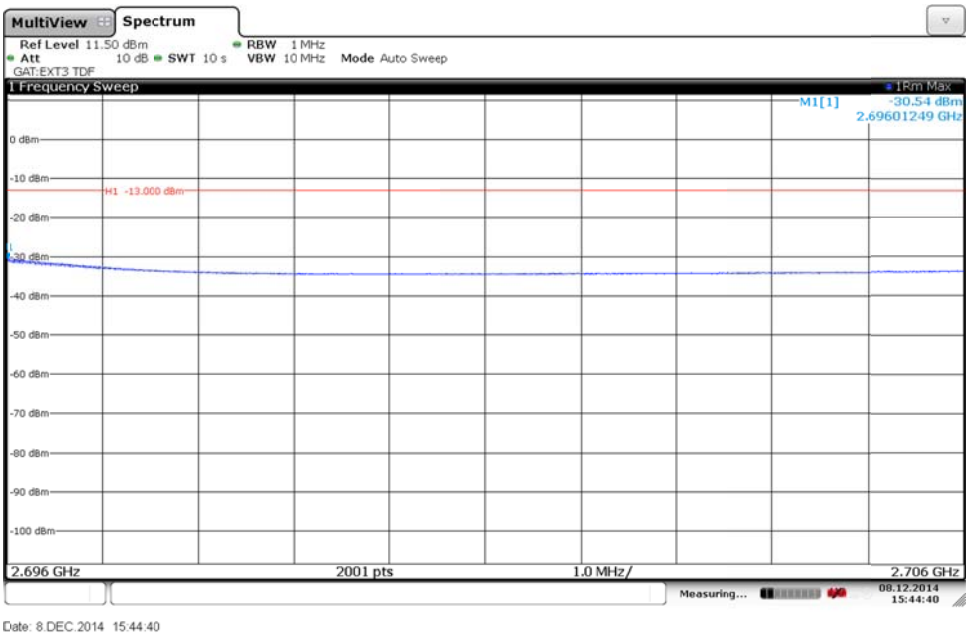
Diagram 8b:



Date: 8.DEC.2014 15:43:07

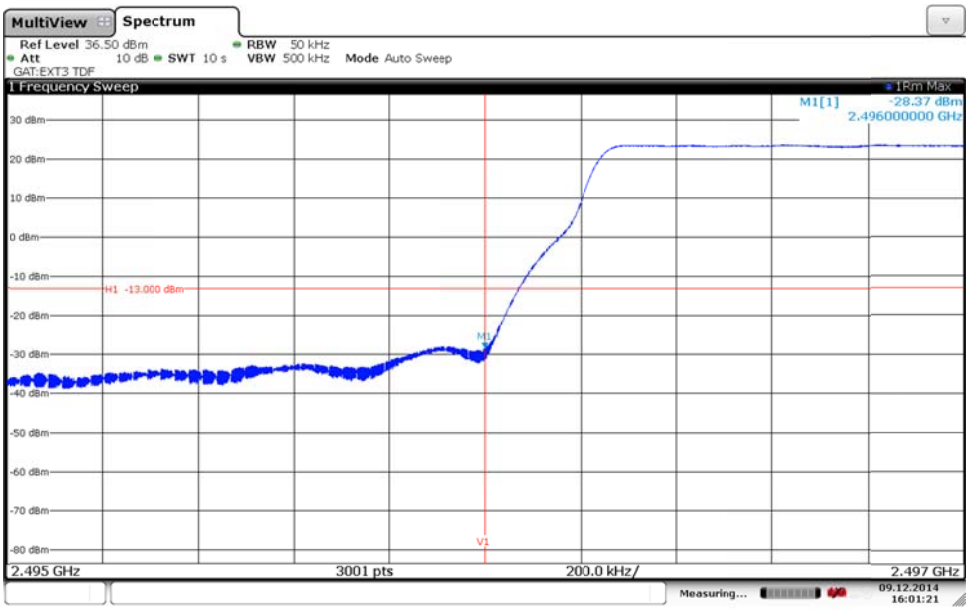
Appendix 4

Diagram 8c:



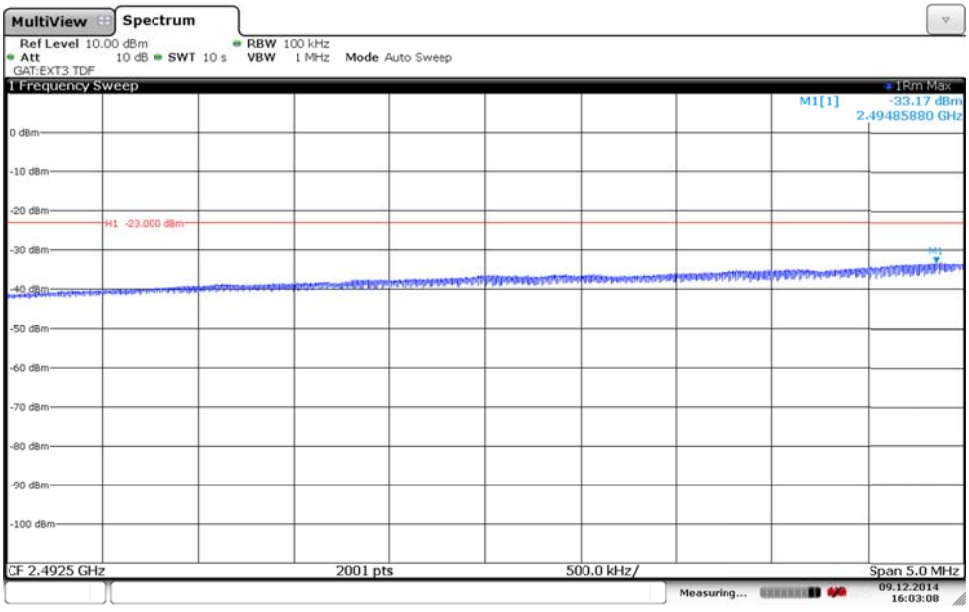
Appendix 4

Diagram 9a:



Date: 9.DEC.2014 16:01:20

Diagram 9b:

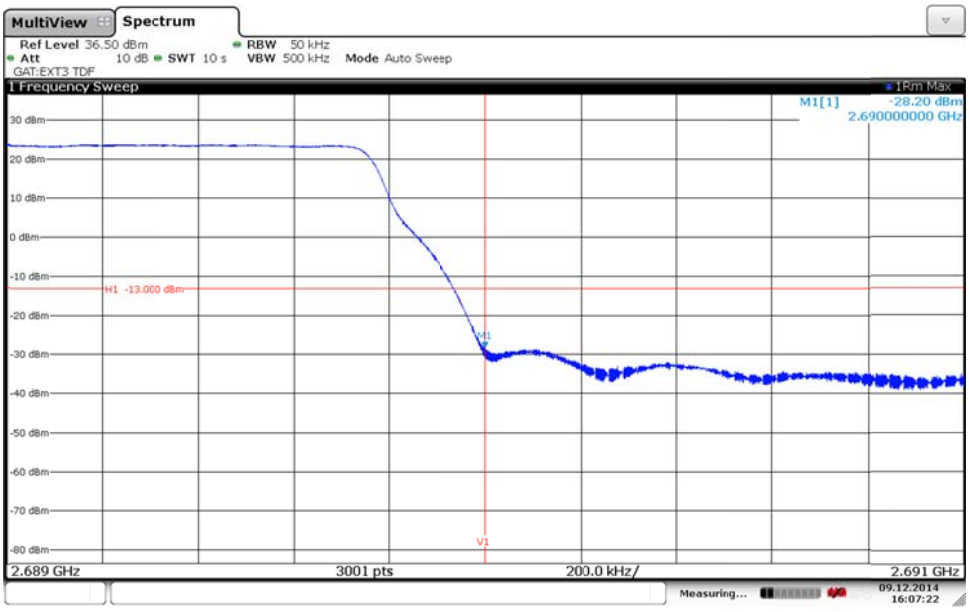


Date: 9.DEC.2014 16:03:08

Appendix 4

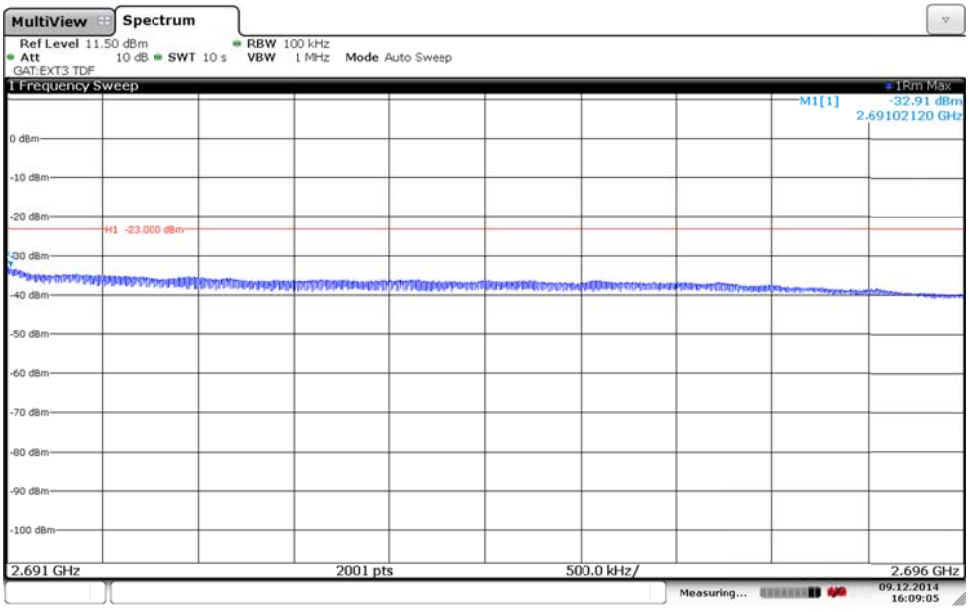
Diagram 9c:

Diagram 10a:



Date: 9.DEC.2014 16:07:21

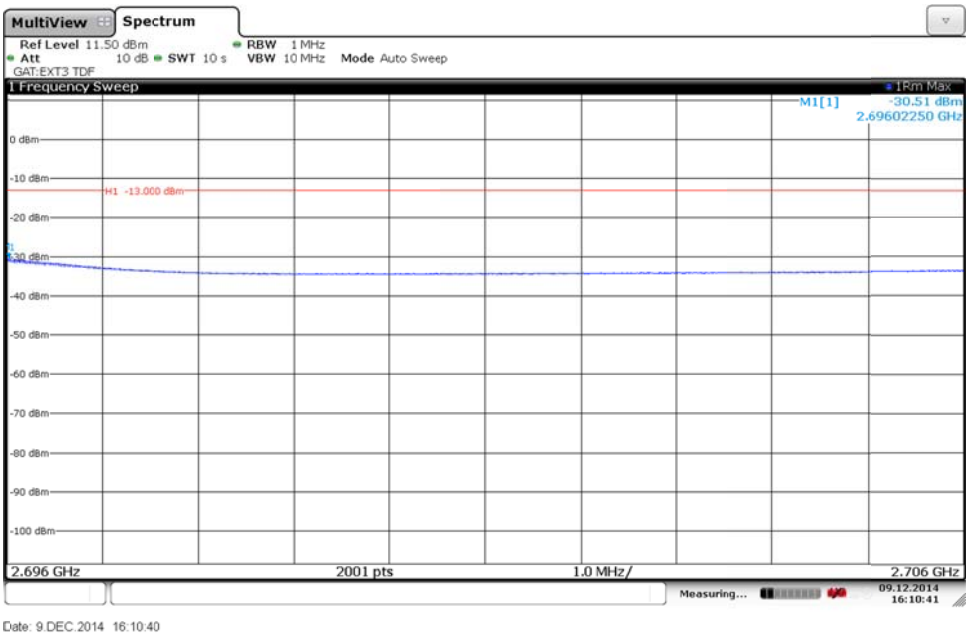
Diagram 10b:



Date: 9.DEC.2014 16:09:05

Appendix 4

Diagram 10c:



Conducted spurious emission measurements according to CFR 47 §27.53(m)

Date	Temperature	Humidity
2014-12-05	23 °C ± 3 °C	27 % ± 5 %
2014-12-08	23 °C ± 3 °C	25 % ± 5 %
2014-12-09	23 °C ± 3 °C	29 % ± 5 %
2014-12-16	23 °C ± 3 °C	32 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53(m). The output was connected to a spectrum analyzer with a RBW setting of 1 MHz and RMS detector activated. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

Before comparing the results to the limit, 6 dB [10 log (4)] should be added according to method 2 “measure and add 10 log(N_{ANT})” of FCC KDB662911 D01 Multiple Transmitter Output v02r01

Measurement equipment	SP number
R&S FSW 43	902 073
RF attenuator	902 282
Directional coupler	901 496
HP filter	901 501
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

MIMO mode, Single and multi carrier

Diagram	BW configuration / [MHz]	Tested frequency	Tested Port
1 a-e	5 MHz	B	RF B
2 a-e	5 MHz	M	RF B
3 a-e	5 MHz	T	RF B
4 a-e	10 MHz	T	RF B
5 a-e	15 MHz	T	RF B
6 a-e	20 MHz	T	RF B
7 a-e	5 MHz	T	RF A
8 a-e	5 MHz	T	RF C
9 a-e	5 MHz	T	RF D
10 a-f	5 MHz	B2im	RF B
11 a-f	5 MHz	T2im	RF B
12 a-f	5 MHz	B3im	RF B
13 a-f	5 MHz	T3im	RF B
14 a-f	20 MHZ	T3M	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 2690 MHz. The measurements were made up to 27 GHz (10x2690 MHz = 26 900 MHz).

Limits

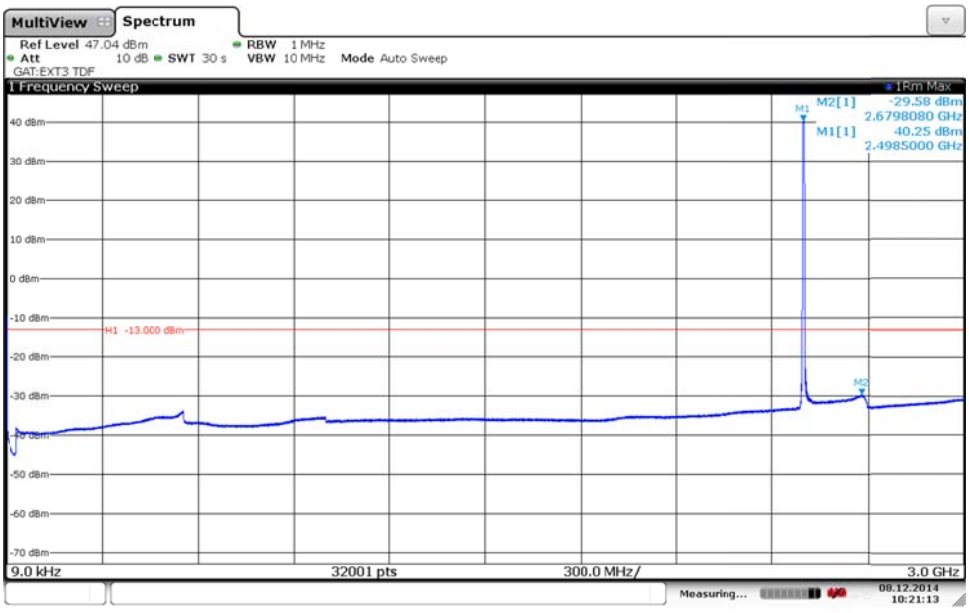
CFR 47 §27.53(m)

For digital base stations, the attenuation shall be not less than 43 + 10 log (P) dB.

Complies?	Yes

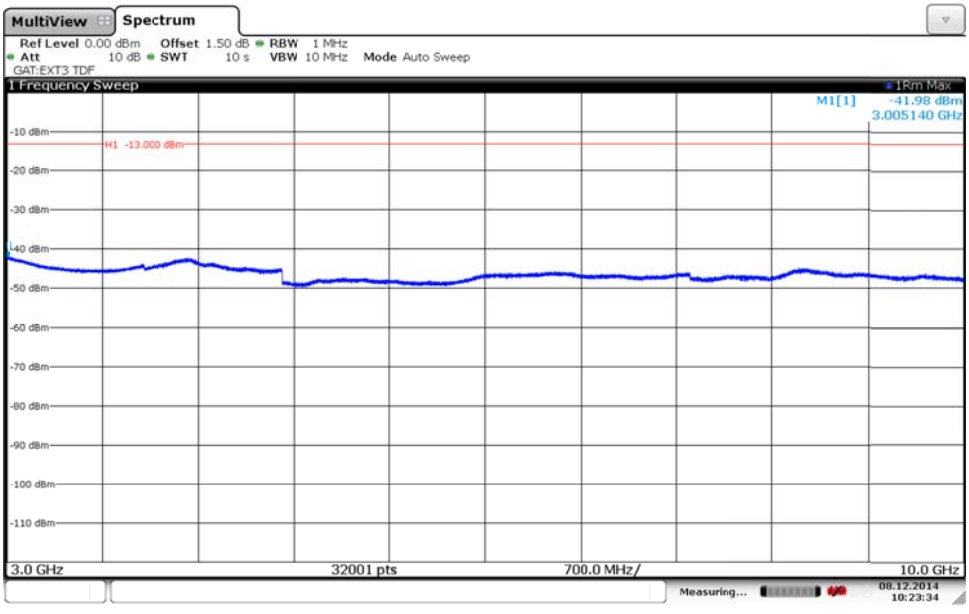
Appendix 5

Diagram 1a:



Date: 8.DEC.2014 10:21:13

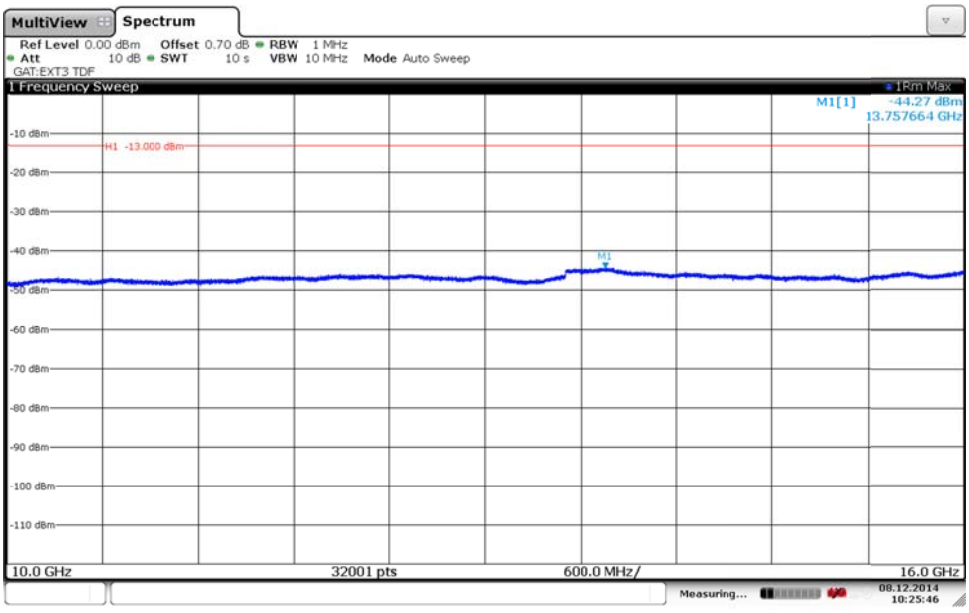
Diagram 1b:



Date: 8.DEC.2014 10:23:35

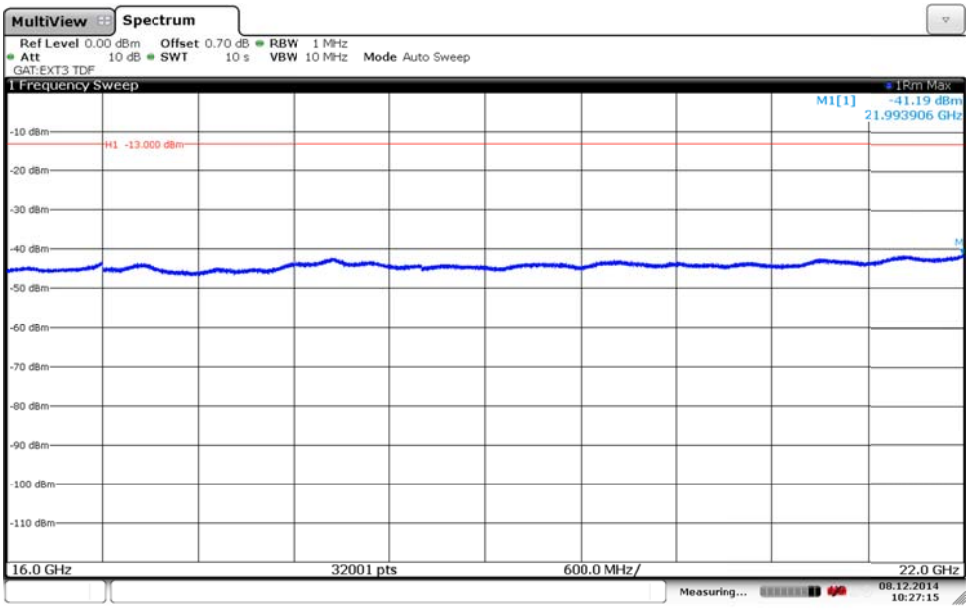
Appendix 5

Diagram 1c:



Date: 8.DEC.2014 10:25:46

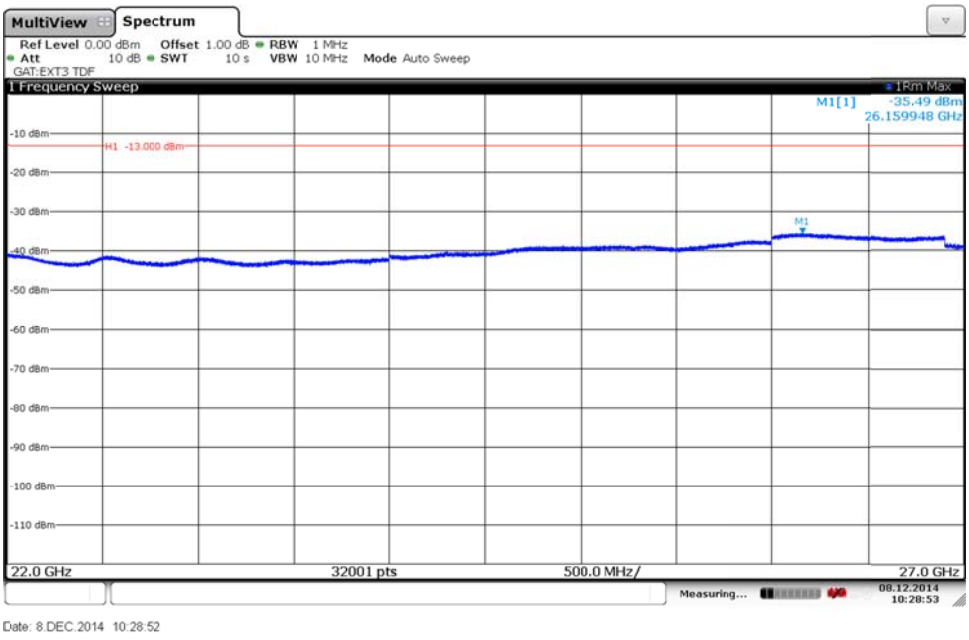
Diagram 1d:



Date: 8.DEC.2014 10:27:16

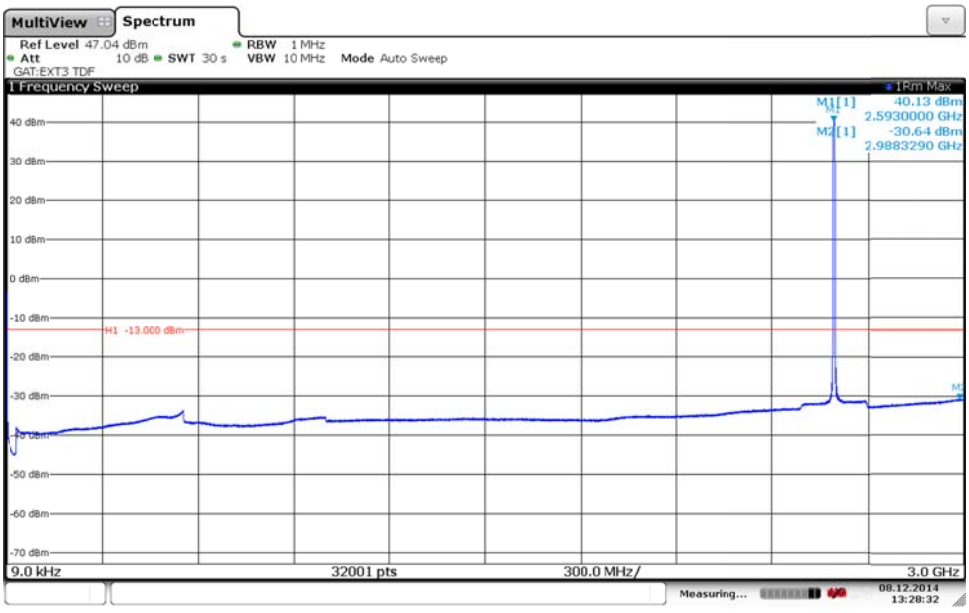
Appendix 5

Diagram 1e:



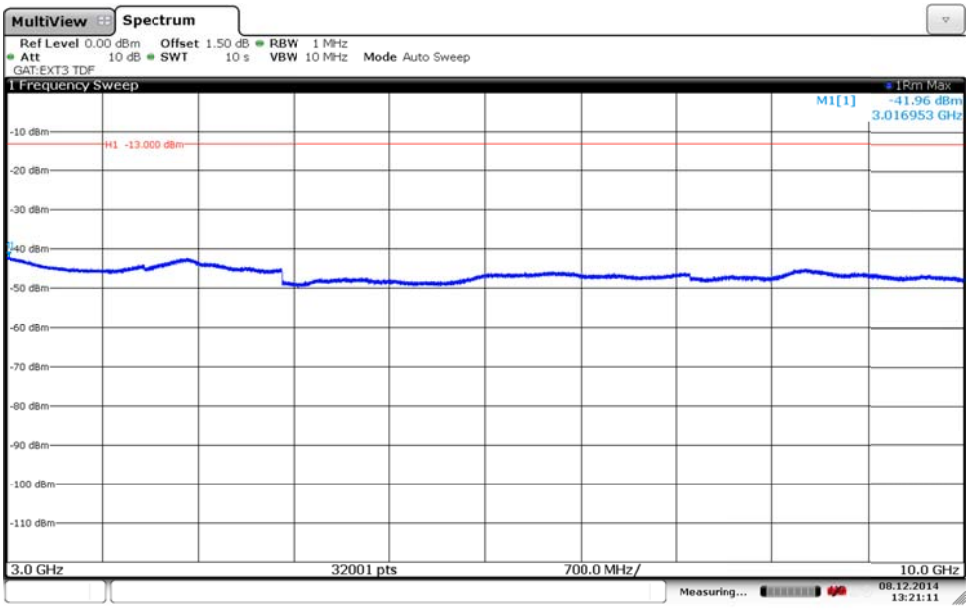
Appendix 5

Diagram 2a:



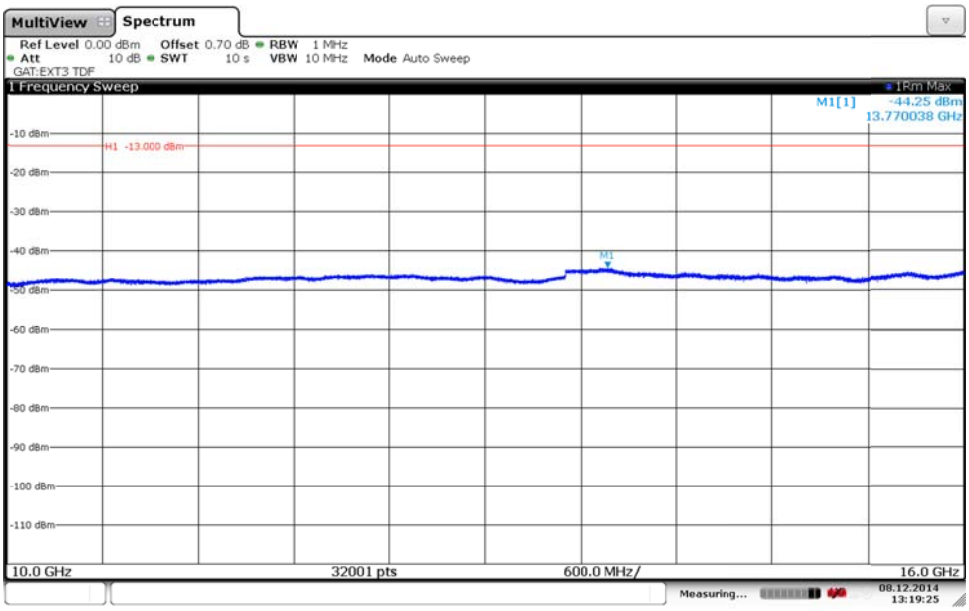
Date: 8.DEC.2014 13:28:31

Diagram 2b:



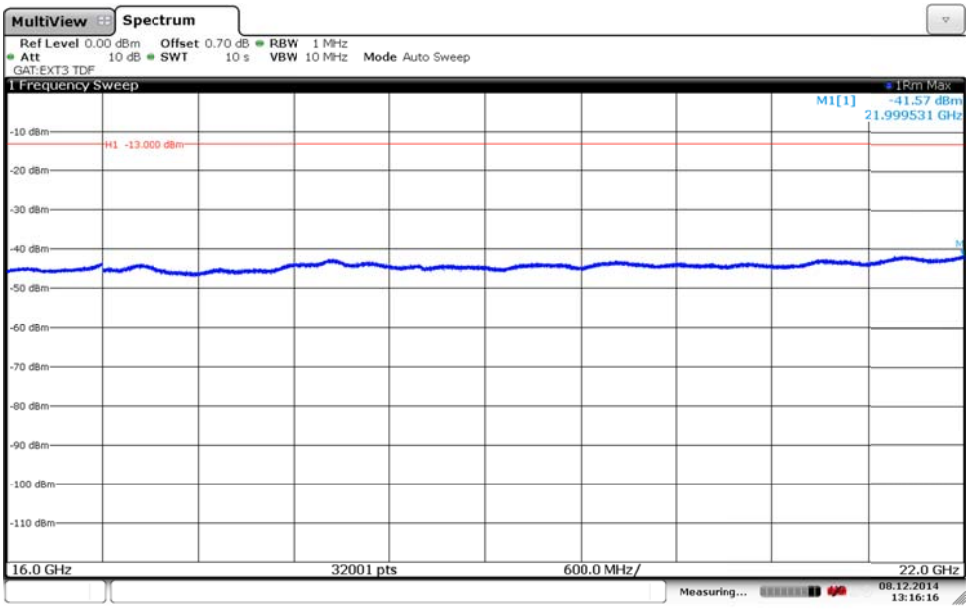
Date: 8.DEC.2014 13:21:10

Diagram 2c:



Date: 8.DEC.2014 13:19:25

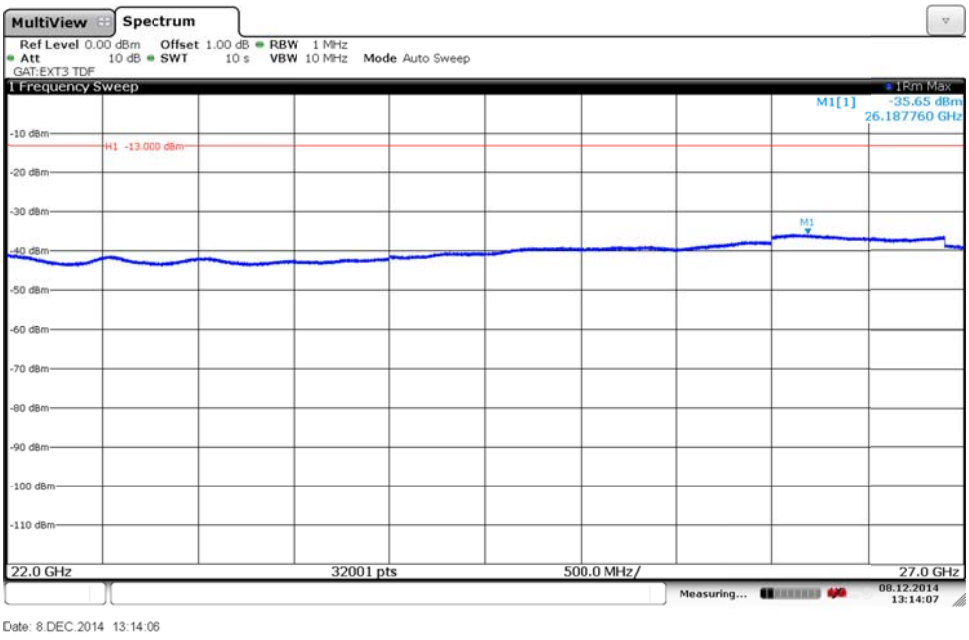
Diagram 2d:



Date: 8.DEC.2014 13:16:16

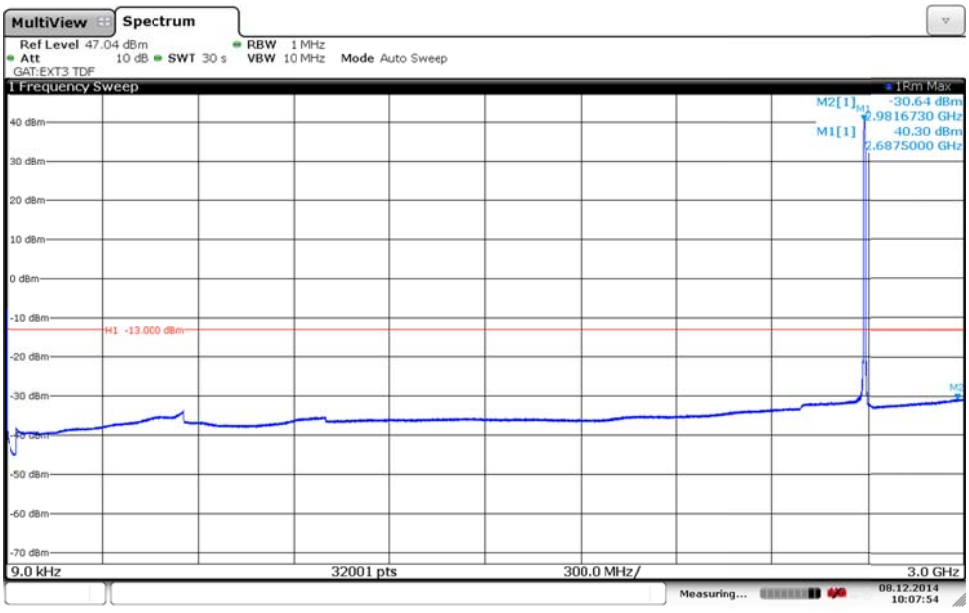
Appendix 5

Diagram 2e:



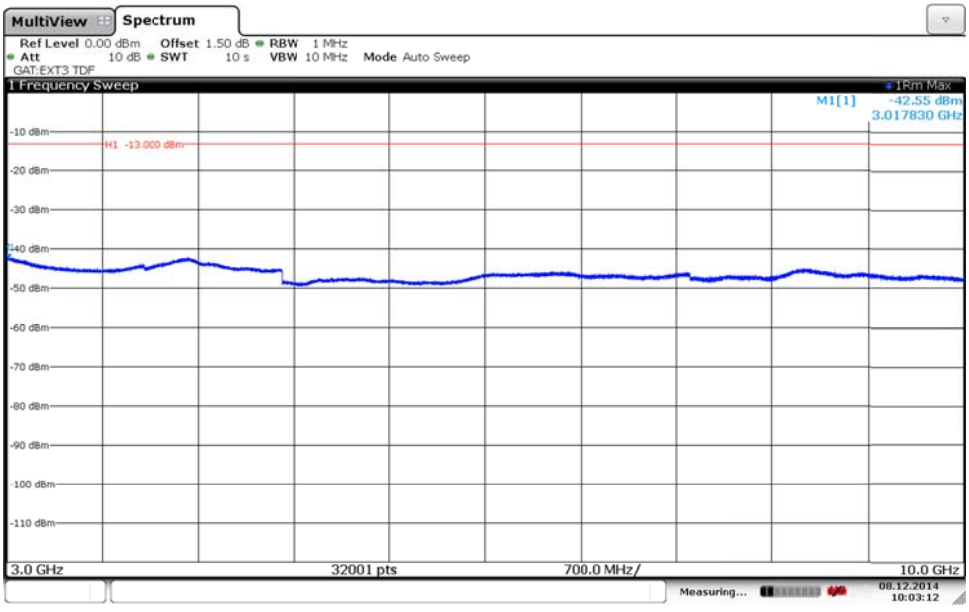
Appendix 5

Diagram 3a:



Date: 8.DEC.2014 10:07:55

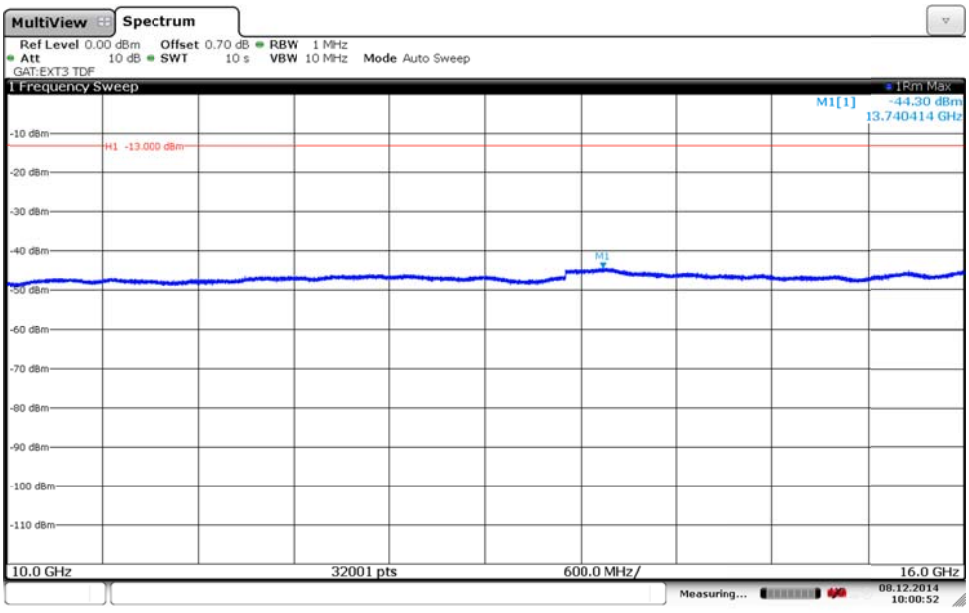
Diagram 3b:



Date: 8.DEC.2014 10:03:12

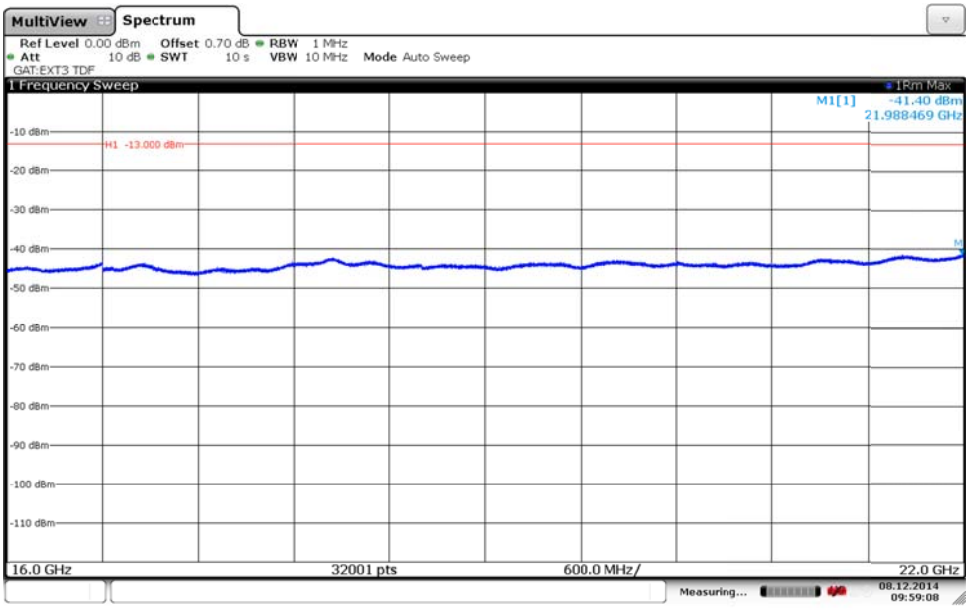
Appendix 5

Diagram 3c:



Date: 8.DEC.2014 10:00:51

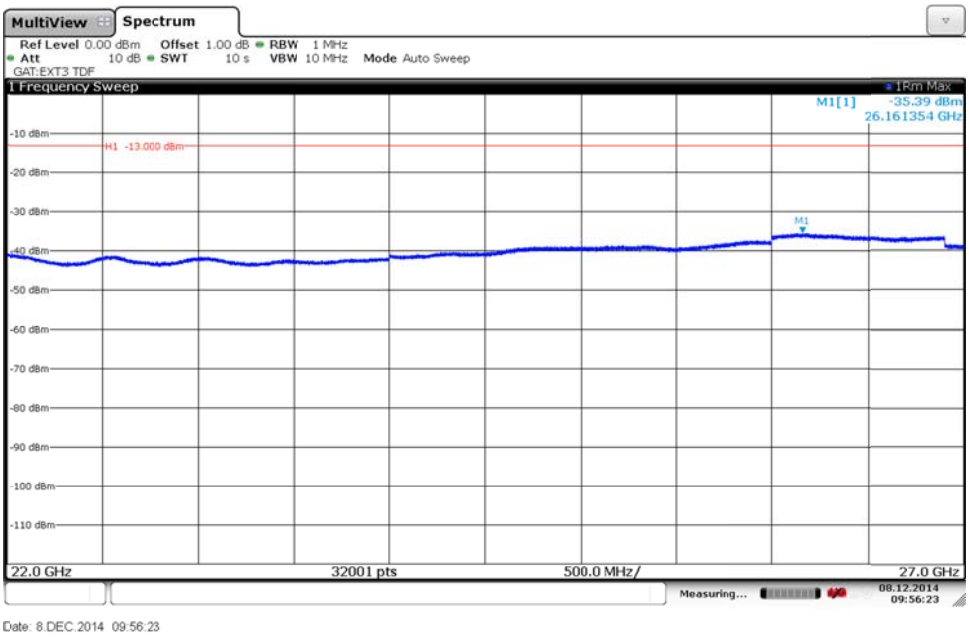
Diagram 3d:



Date: 8.DEC.2014 09:59:08

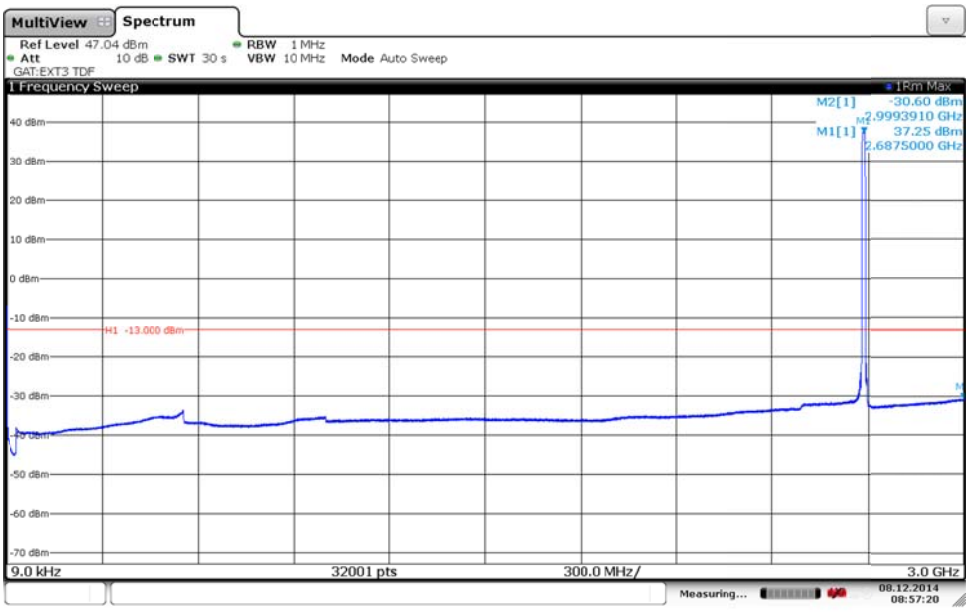
Appendix 5

Diagram 3e:



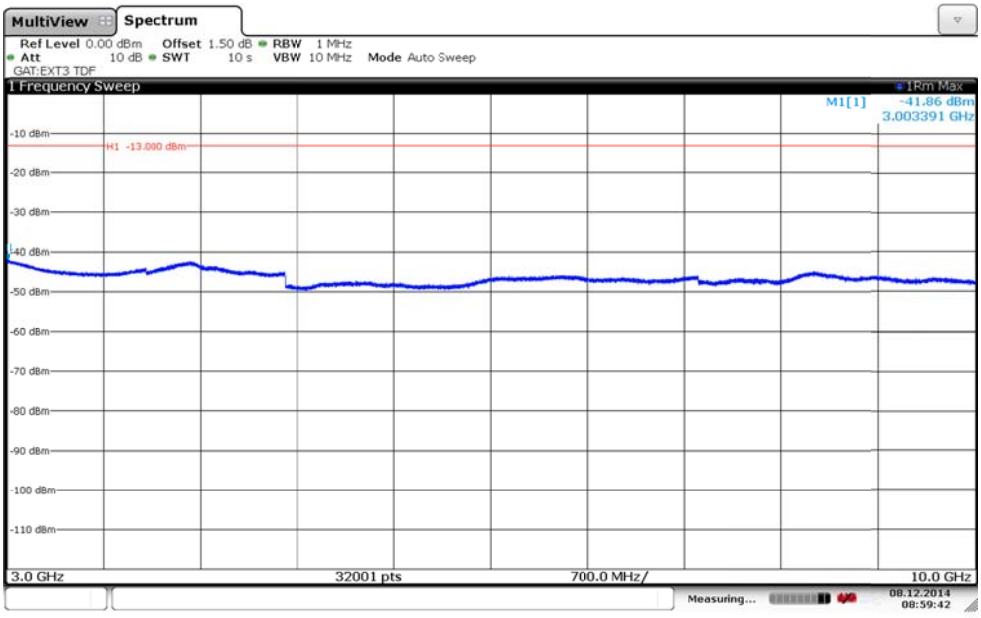
Appendix 5

Diagram 4a:



Date: 8.DEC.2014 08:57:20

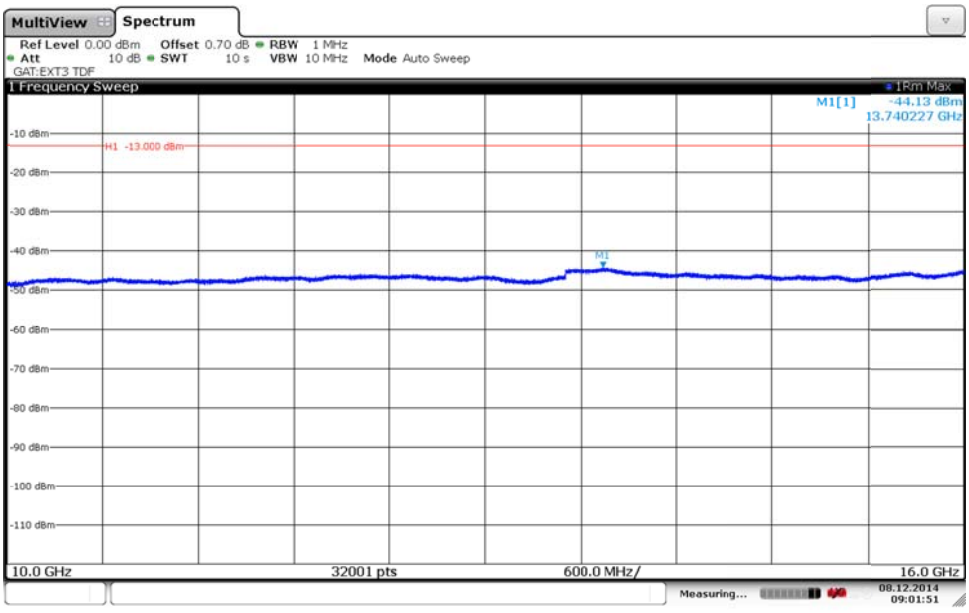
Diagram 4b:



Date: 8.DEC.2014 08:59:41

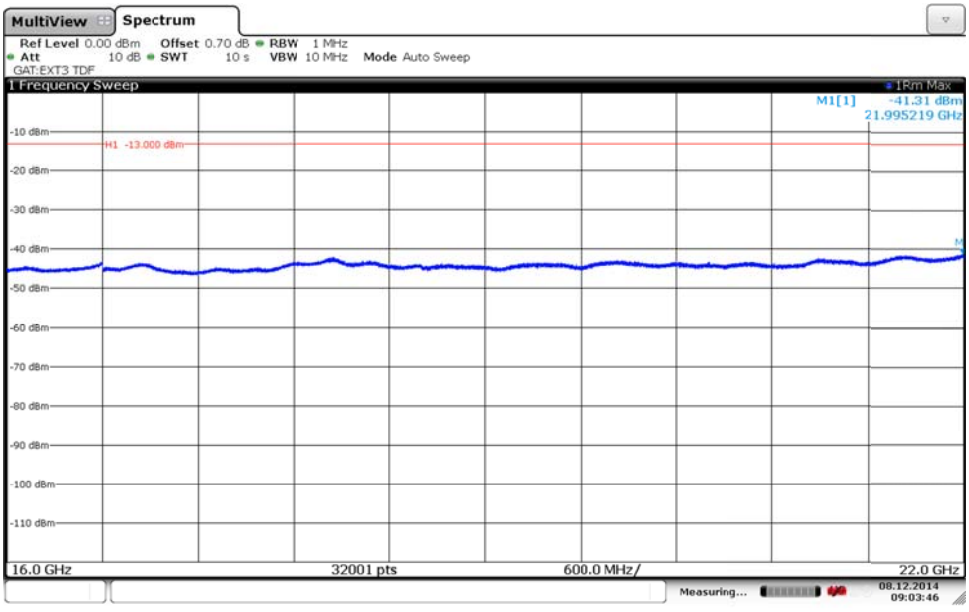
Appendix 5

Diagram 4c:



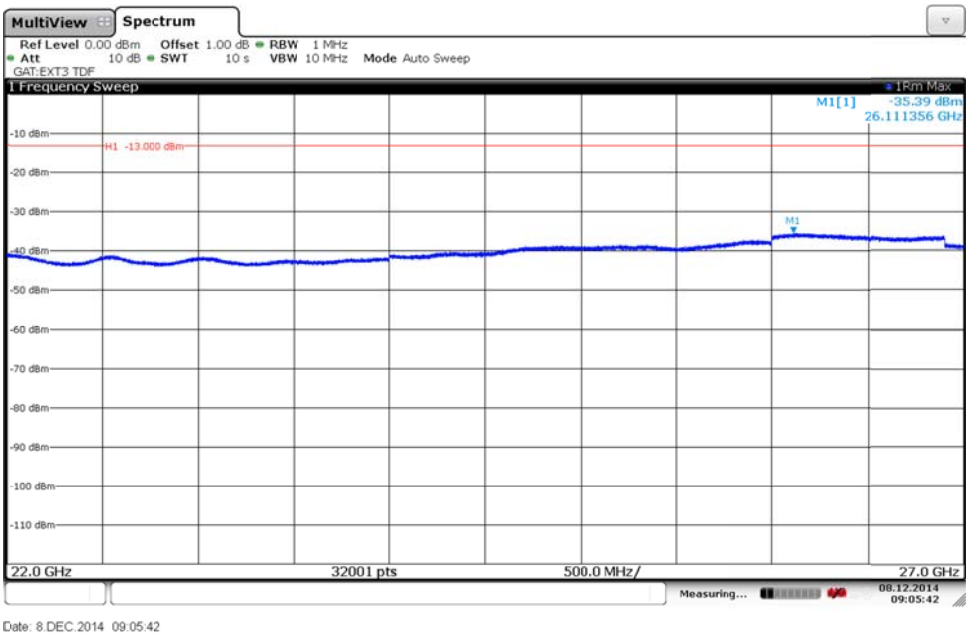
Date: 8.DEC.2014 09:01:51

Diagram 4d:



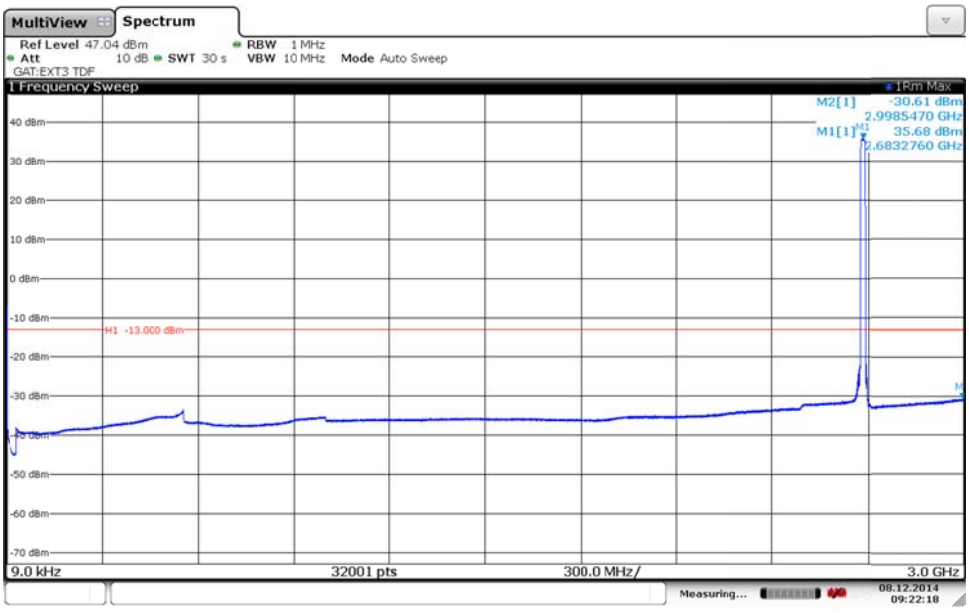
Date: 8.DEC.2014 09:03:46

Diagram 4e:


MultiView
Spectrum
Ref Level 0.00 dBm Offset 1.00 dB RBW 1 MHz
Att 10 dB SWT 10 s VBW 10 MHz Mode Auto Sweep
GAT:EXT3 TDF
1 Frequency Sweep
1Rm Max
M1[1] -35.39 dBm
26.111356 GHz
H1 -13.000 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
-110 dBm
M1
22.0 GHz
32001 pts
500.0 MHz/
27.0 GHz
Measuring...
08.12.2014
09:05:42
Date: 8.DEC.2014 09:05:42

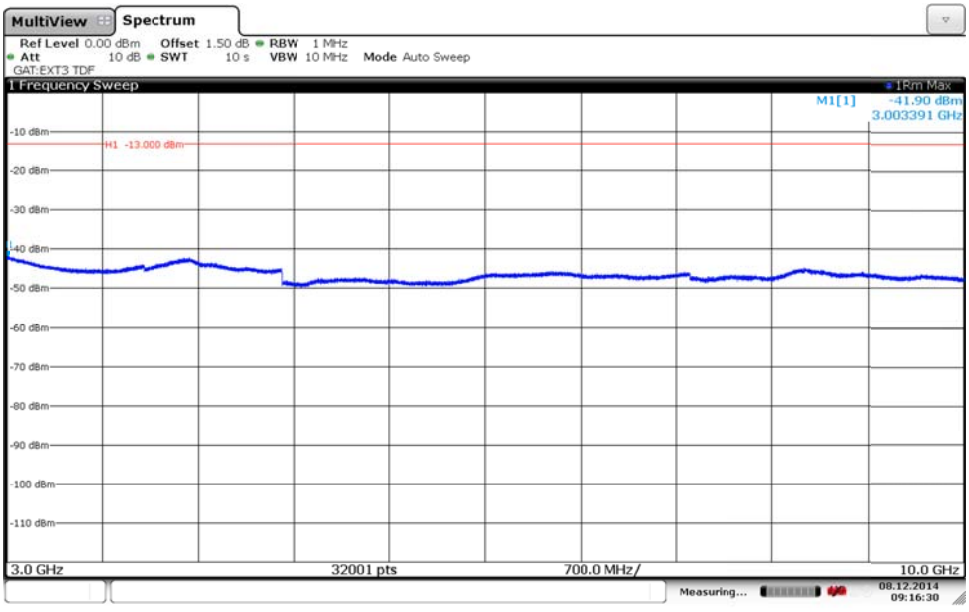
Appendix 5

Diagram 5a:



Date: 8.DEC.2014 09:22:18

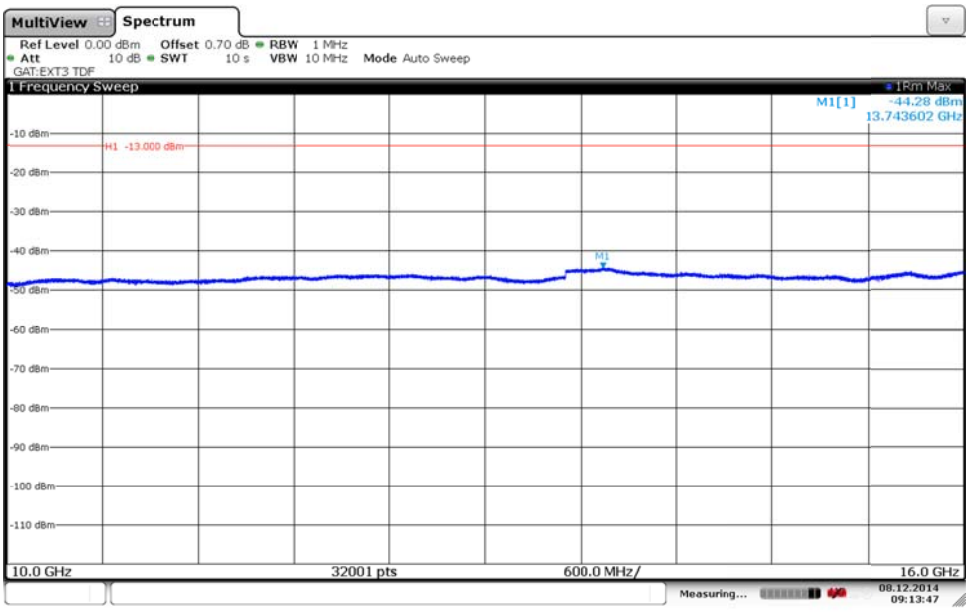
Diagram 5b:



Date: 8.DEC.2014 09:16:30

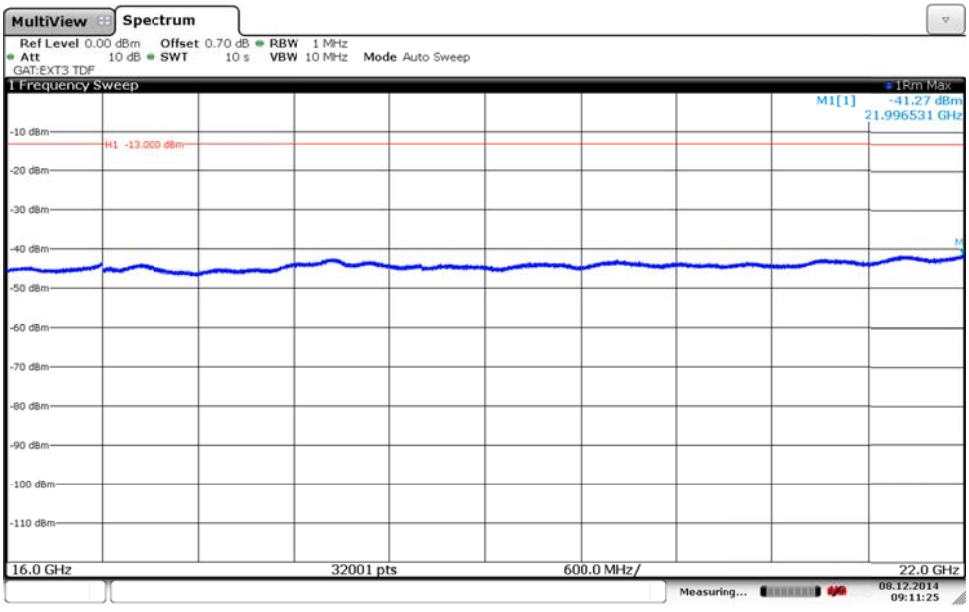
Appendix 5

Diagram 5c:



Date: 8.DEC.2014 09:13:47

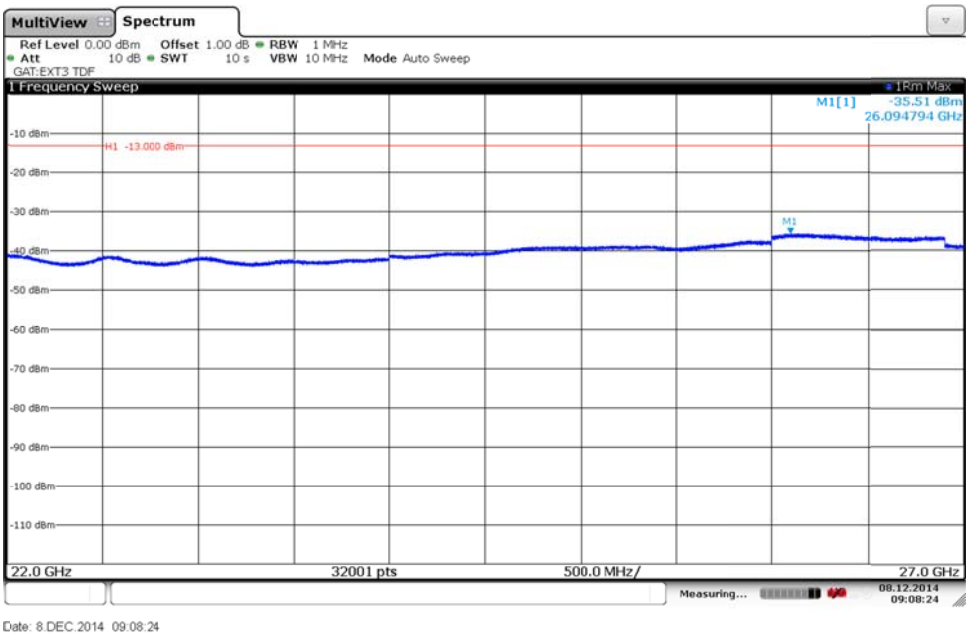
Diagram 5d:



Date: 8.DEC.2014 09:11:24

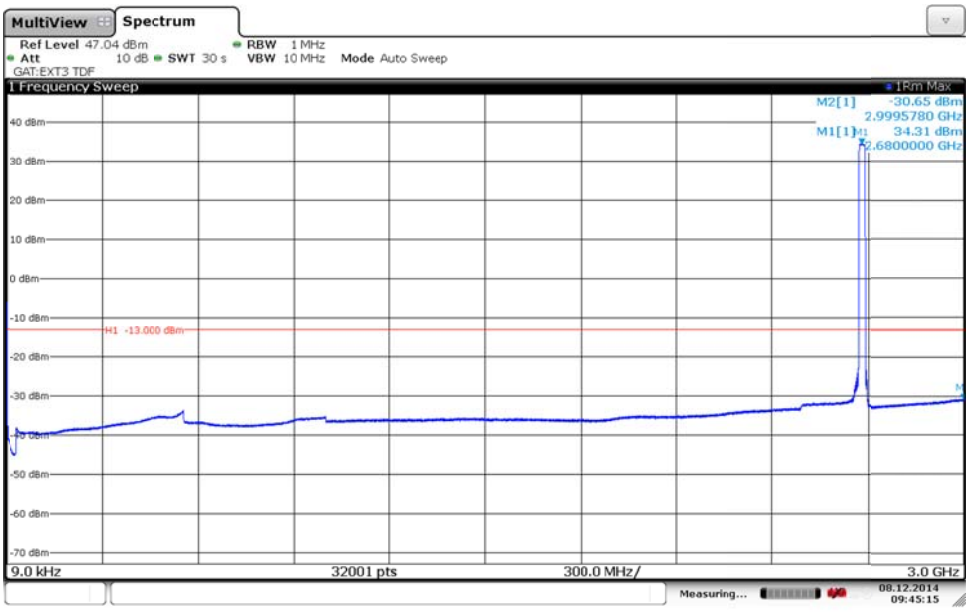
Appendix 5

Diagram 5e:



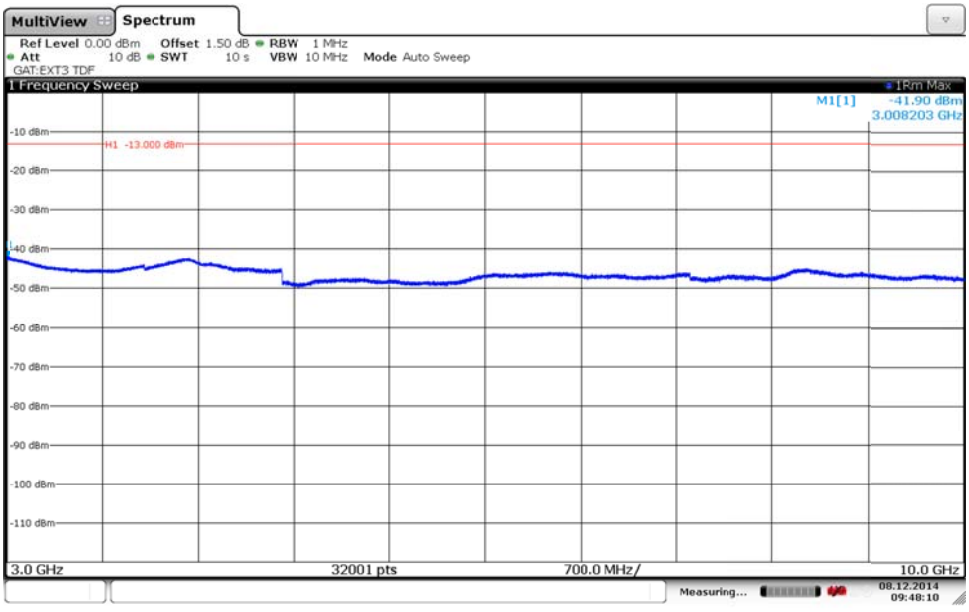
Appendix 5

Diagram 6a:



Date: 8.DEC.2014 09:45:14

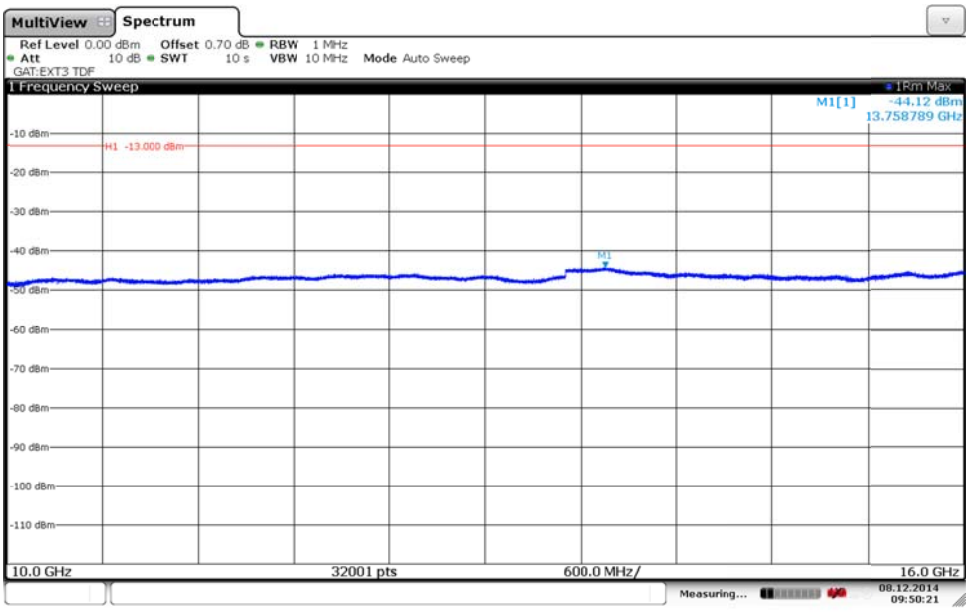
Diagram 6b:



Date: 8.DEC.2014 09:48:10

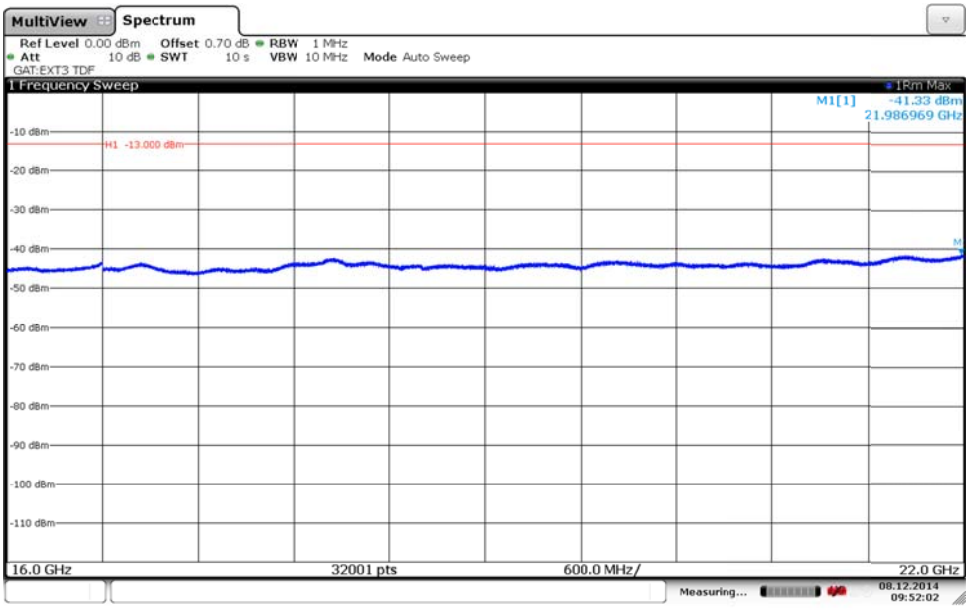
Appendix 5

Diagram 6c:



Date: 8.DEC.2014 09:50:20

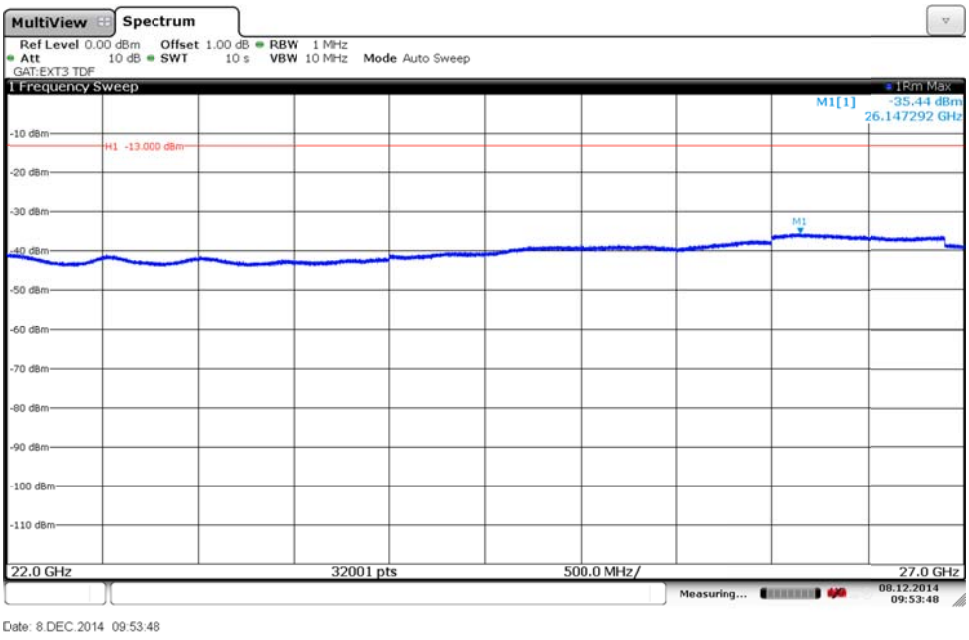
Diagram 6d:



Date: 8.DEC.2014 09:52:03

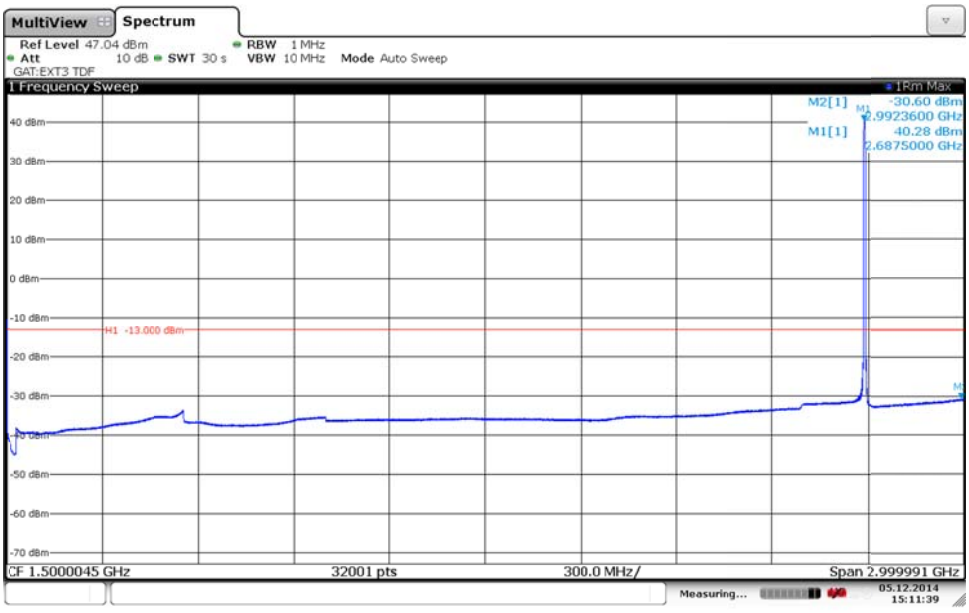
Appendix 5

Diagram 6e:



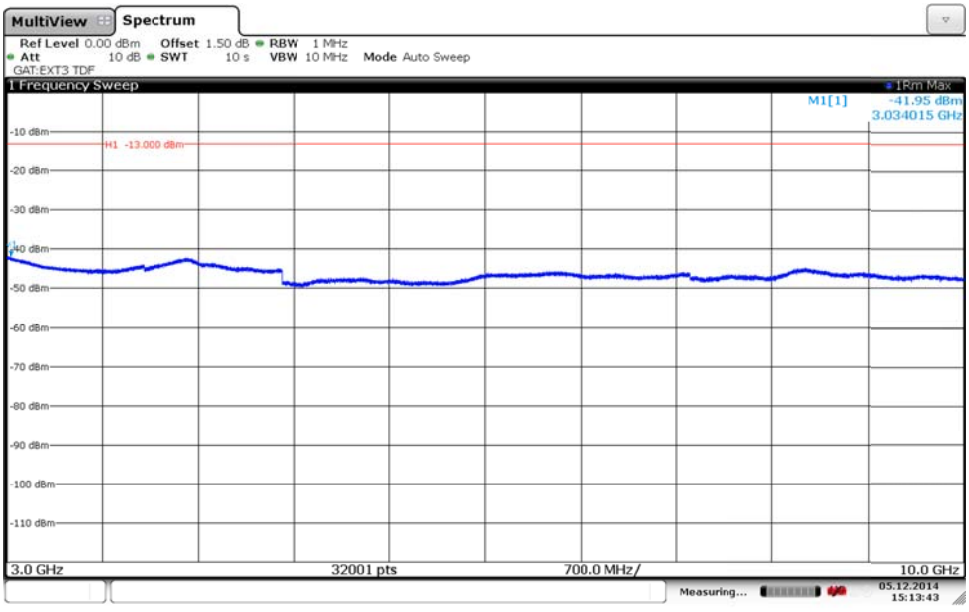
Appendix 5

Diagram 7a:



Date: 5.DEC.2014 15:11:39

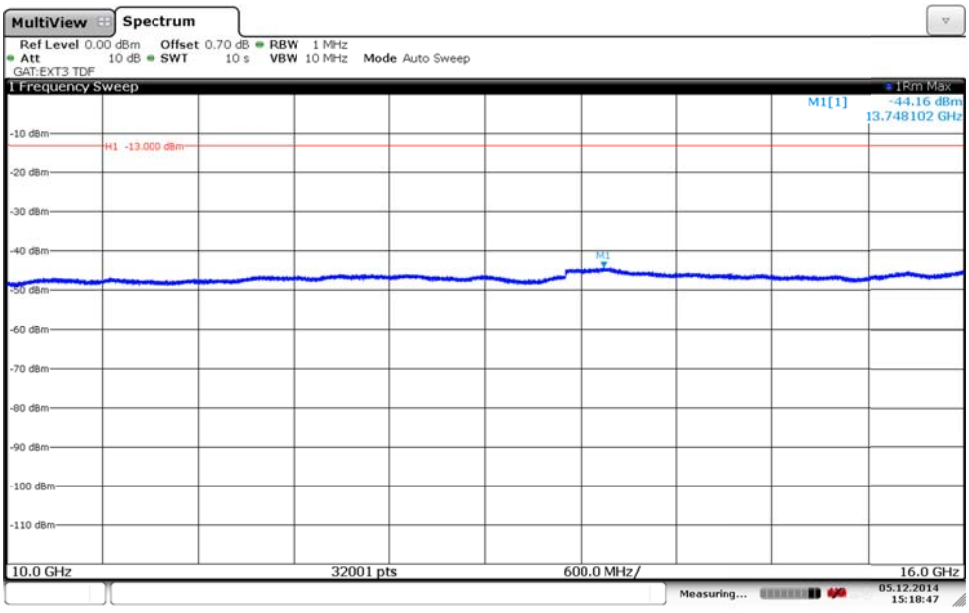
Diagram 7b:



Date: 5.DEC.2014 15:13:43

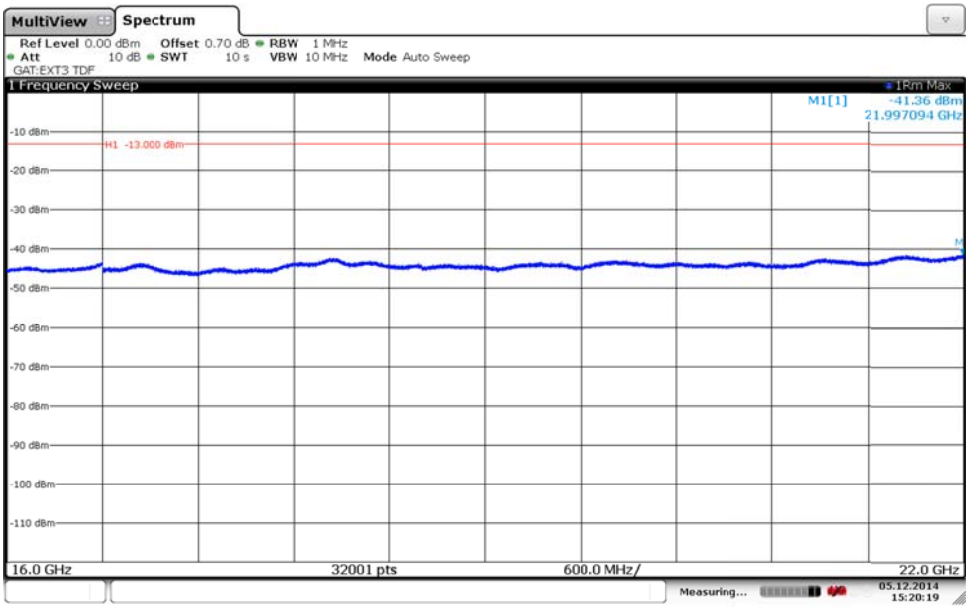
Appendix 5

Diagram 7c:



Date: 5.DEC.2014 15:18:47

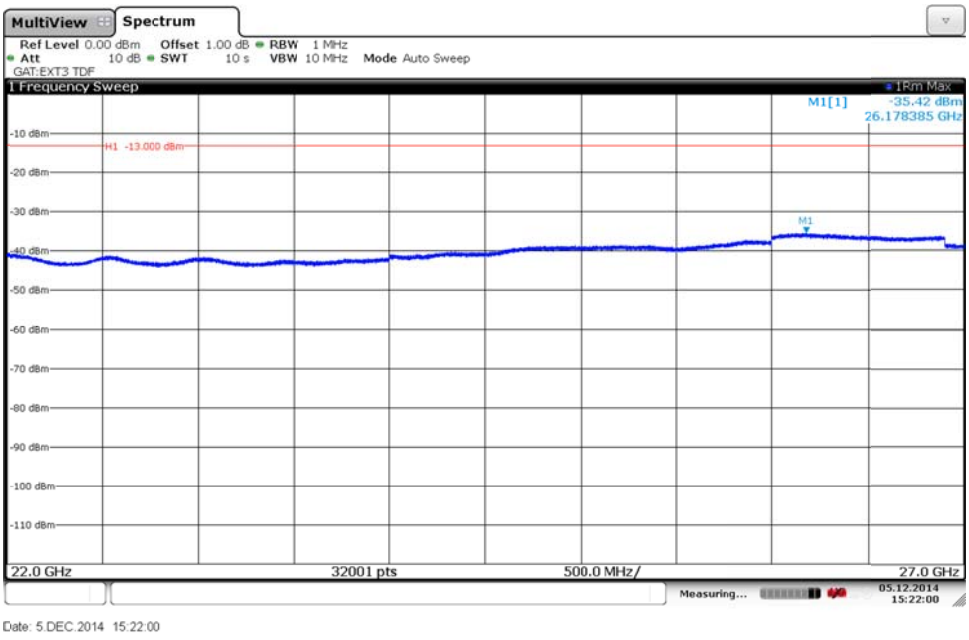
Diagram 7d:



Date: 5.DEC.2014 15:20:18

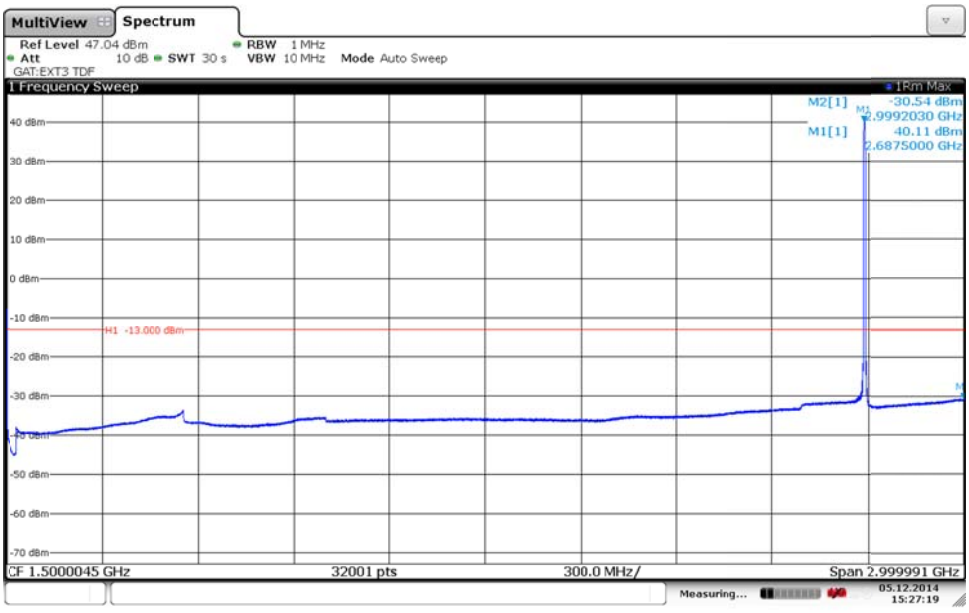
Appendix 5

Diagram 7e:



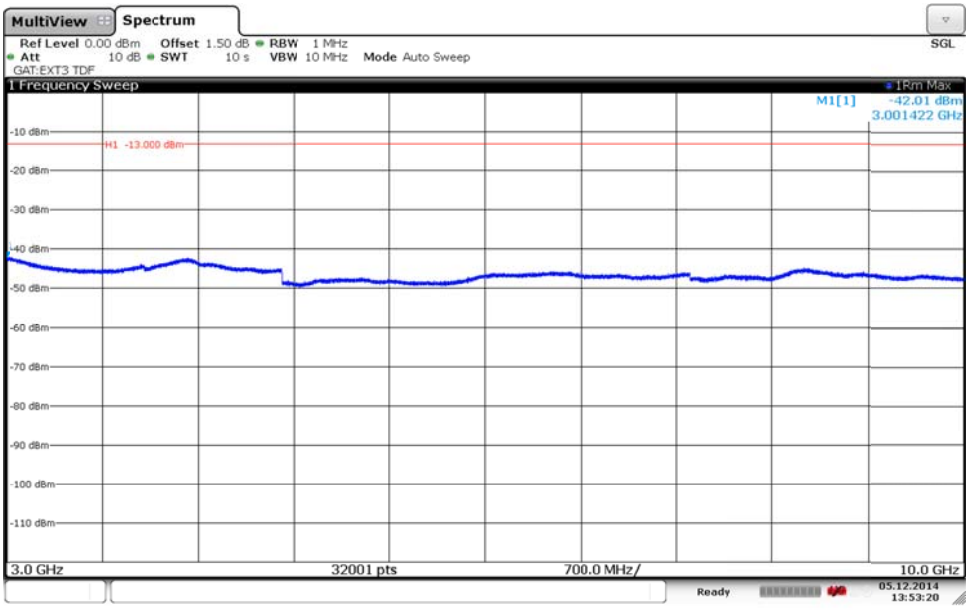
Appendix 5

Diagram 8a:



Date: 5.DEC.2014 15:27:18

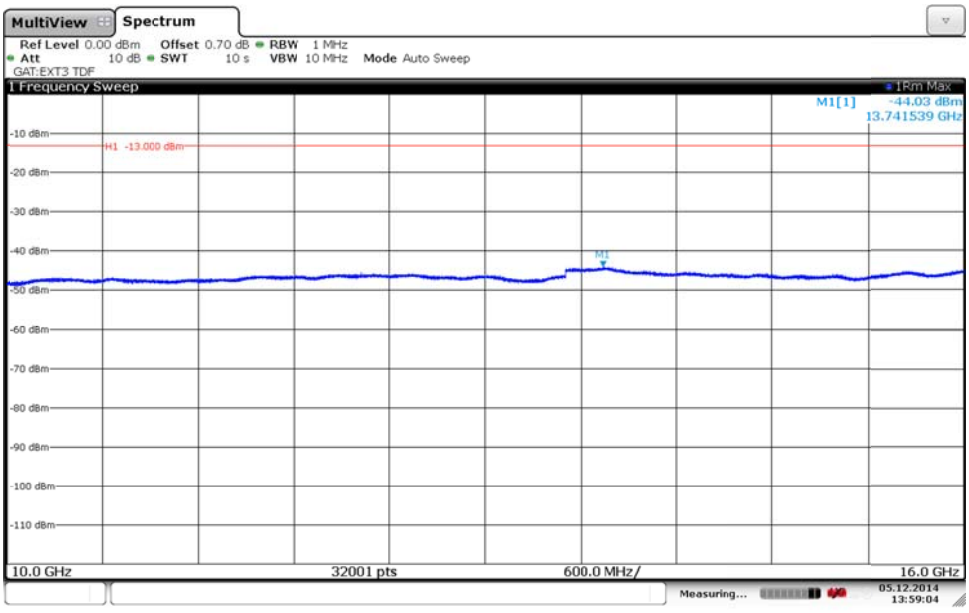
Diagram 8b:



Date: 5.DEC.2014 13:53:20

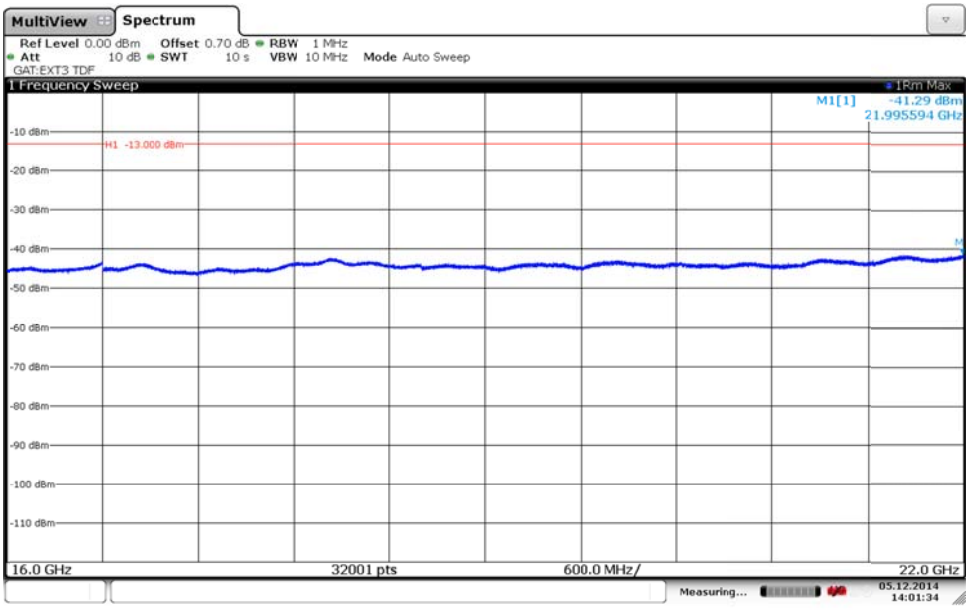
Appendix 5

Diagram 8c:



Date: 5.DEC.2014 13:59:04

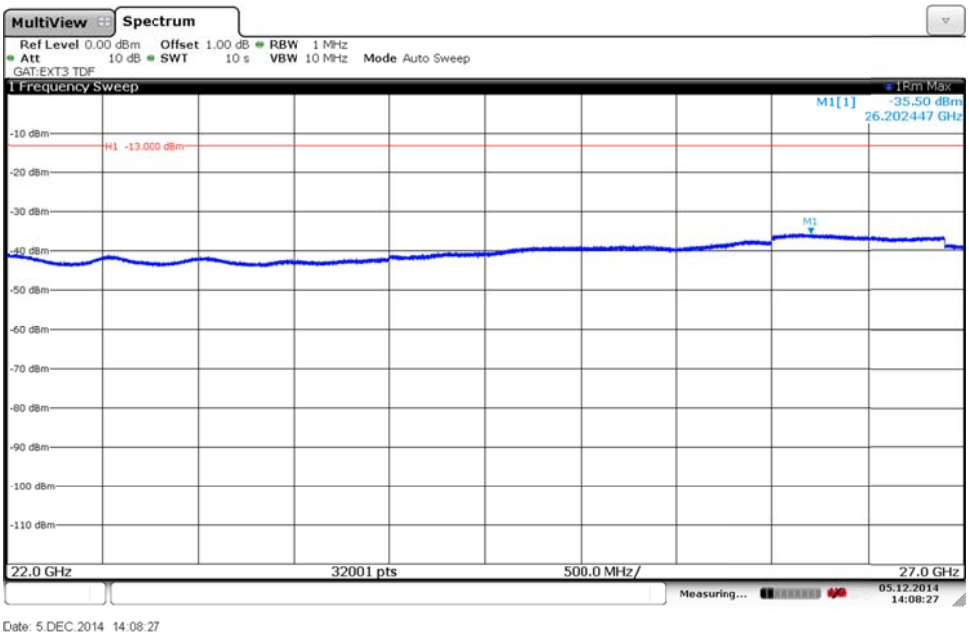
Diagram 8d:



Date: 5.DEC.2014 14:01:33

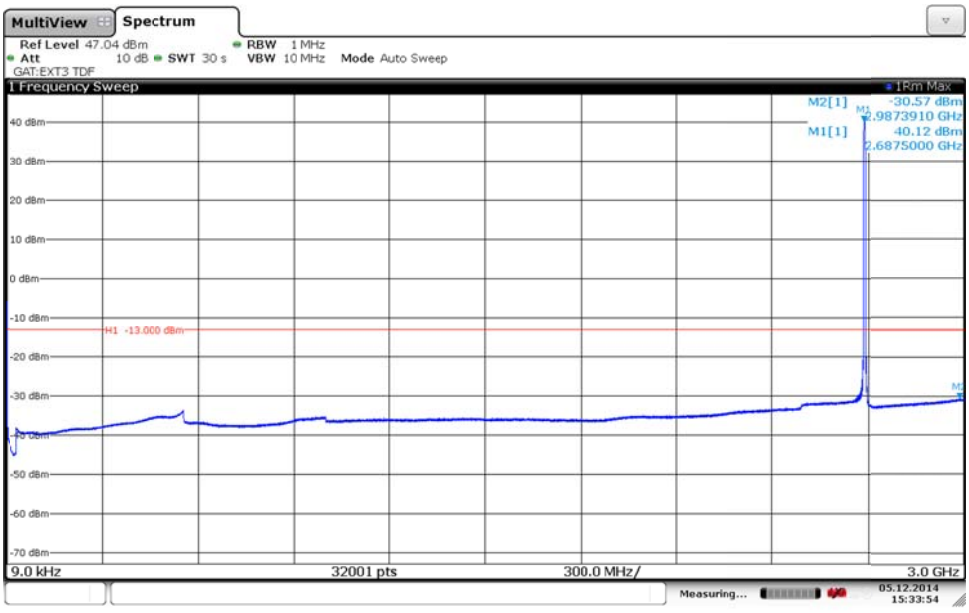
Appendix 5

Diagram 8e:



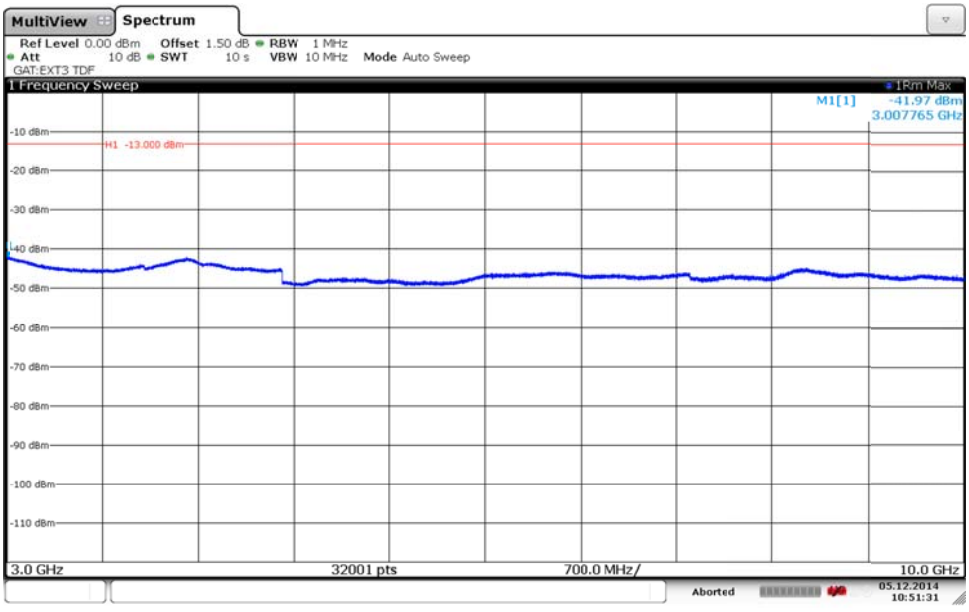
Appendix 5

Diagram 9a:



Date: 5.DEC.2014 15:33:54

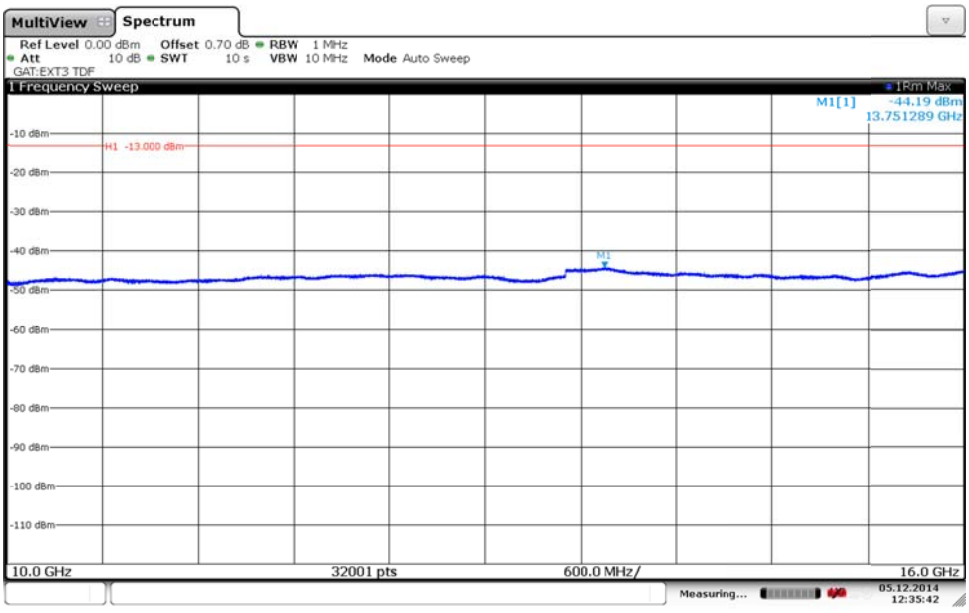
Diagram 9b:



Date: 5.DEC.2014 10:51:31

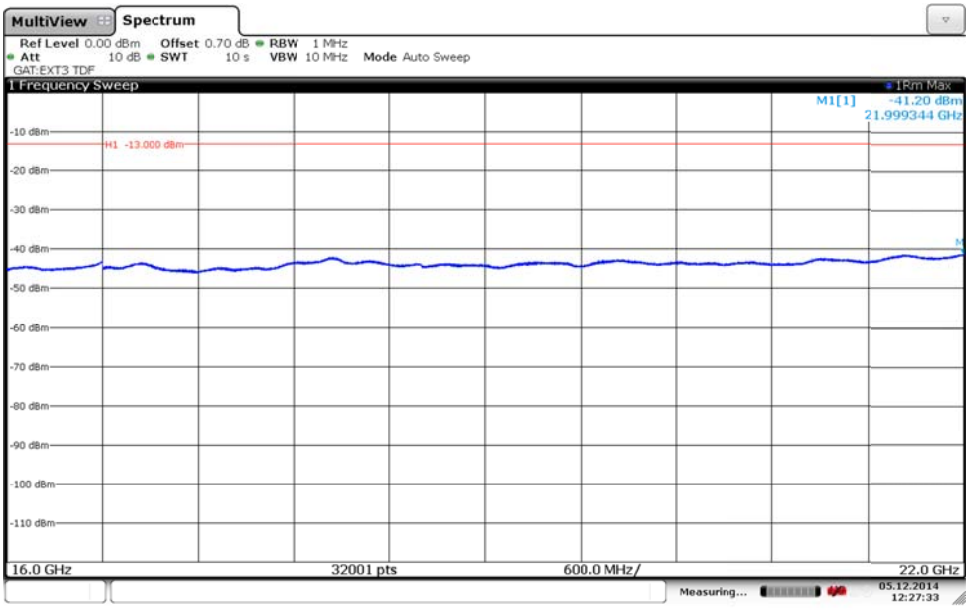
Appendix 5

Diagram 9c:



Date: 5.DEC.2014 12:35:42

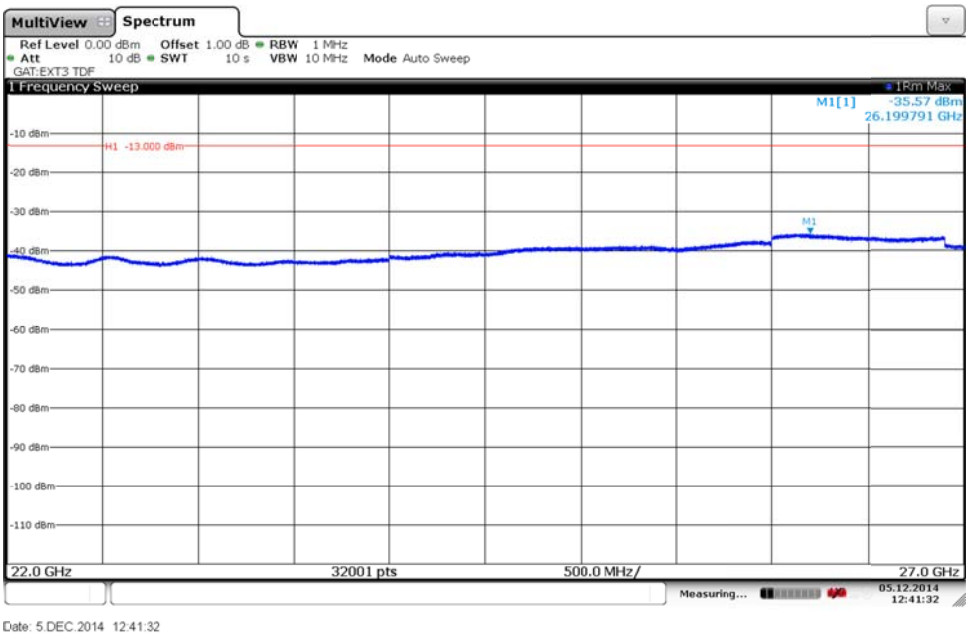
Diagram 9d:



Date: 5.DEC.2014 12:27:33

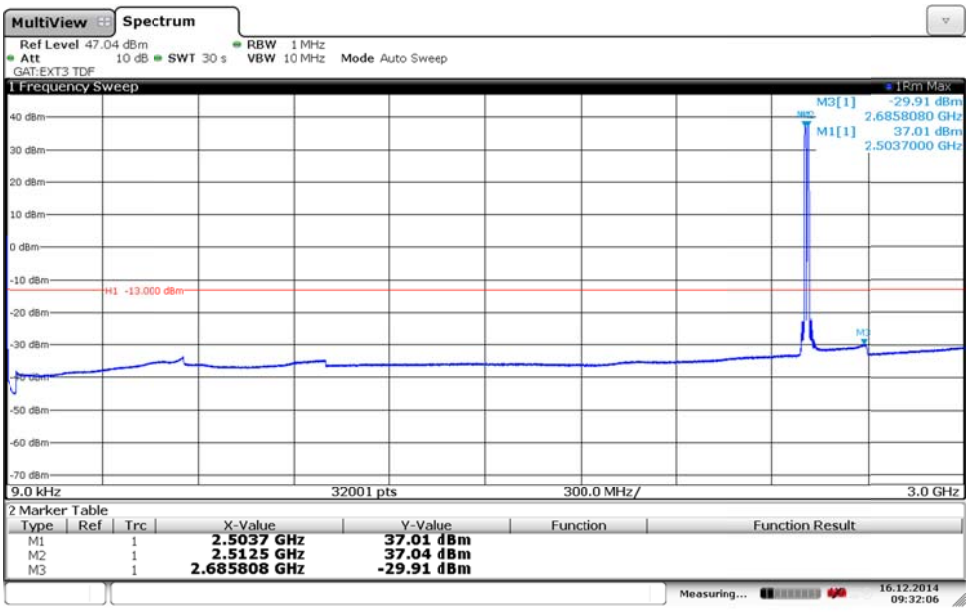
Appendix 5

Diagram 9e:



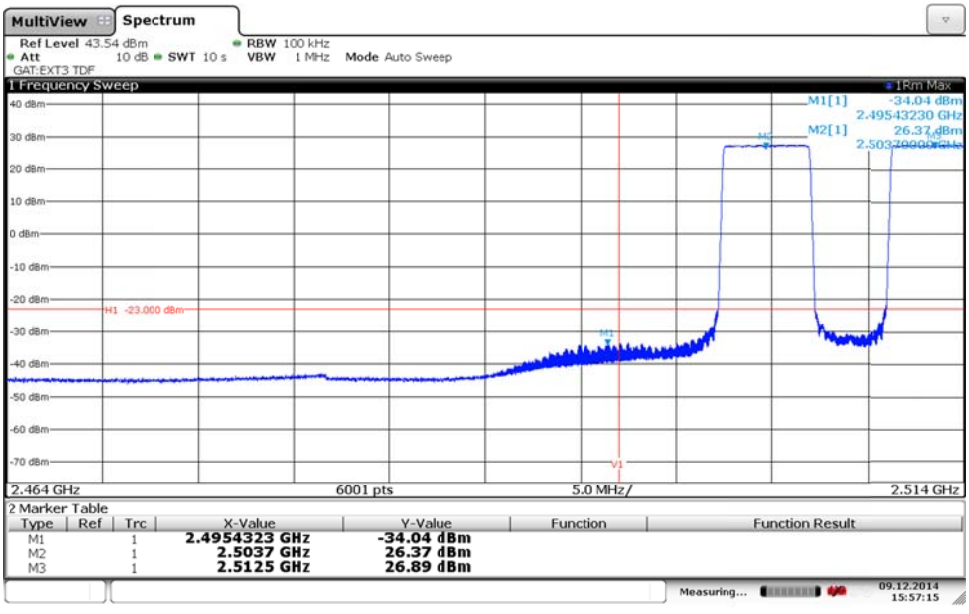
Appendix 5

Diagram 10a:



Date: 16.DEC.2014 09:32:04

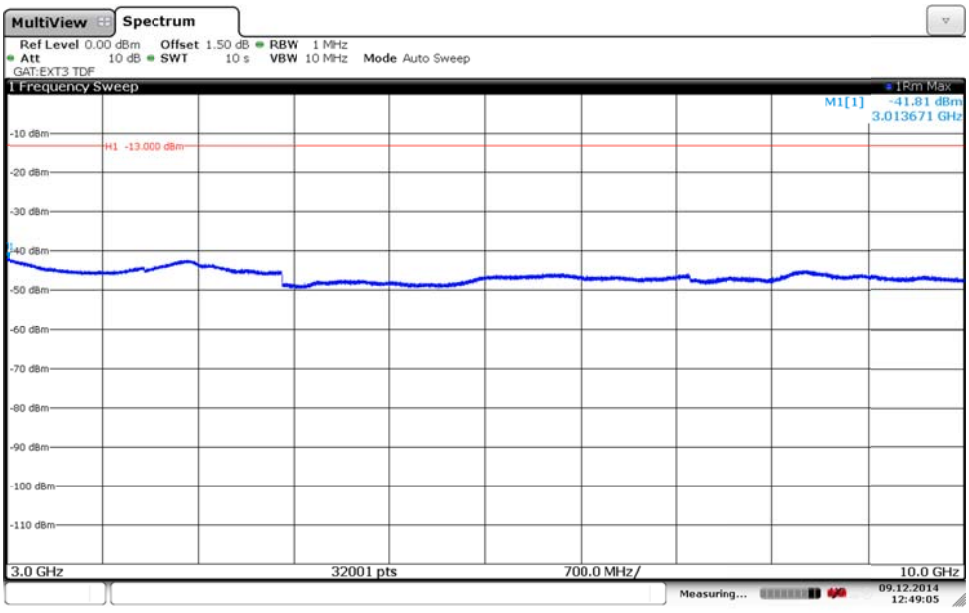
Diagram 10b:



Date: 9.DEC.2014 15:57:15

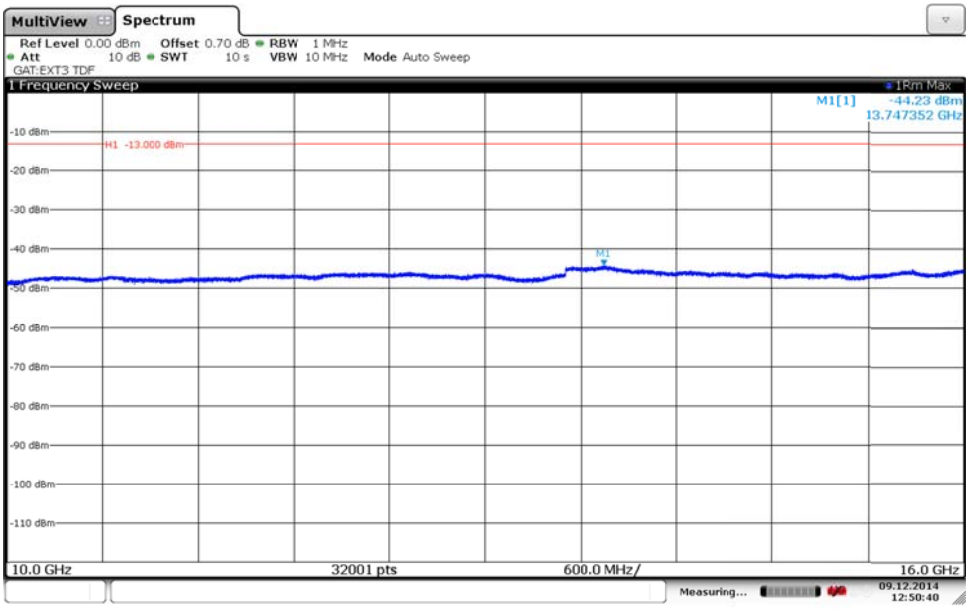
Appendix 5

Diagram 10c:



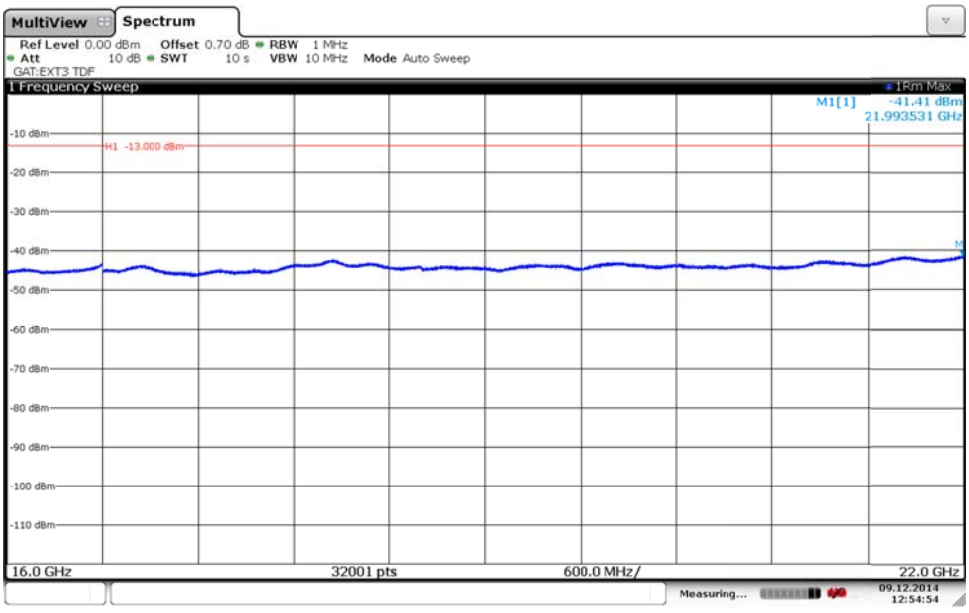
Date: 9.DEC.2014 12:49:05

Diagram 10d:



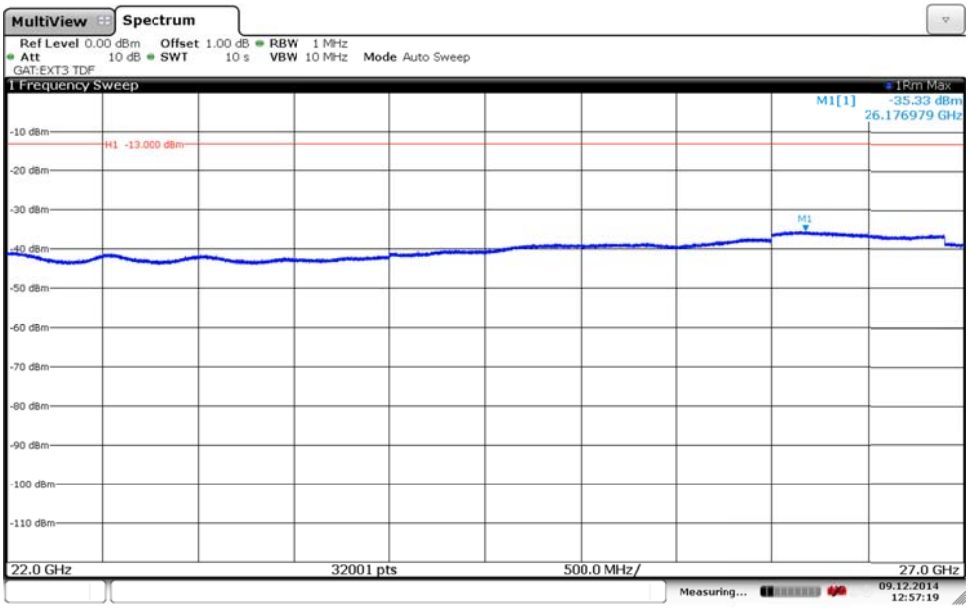
Date: 9.DEC.2014 12:50:39

Diagram 10e:



Date: 9.DEC.2014 12:54:54

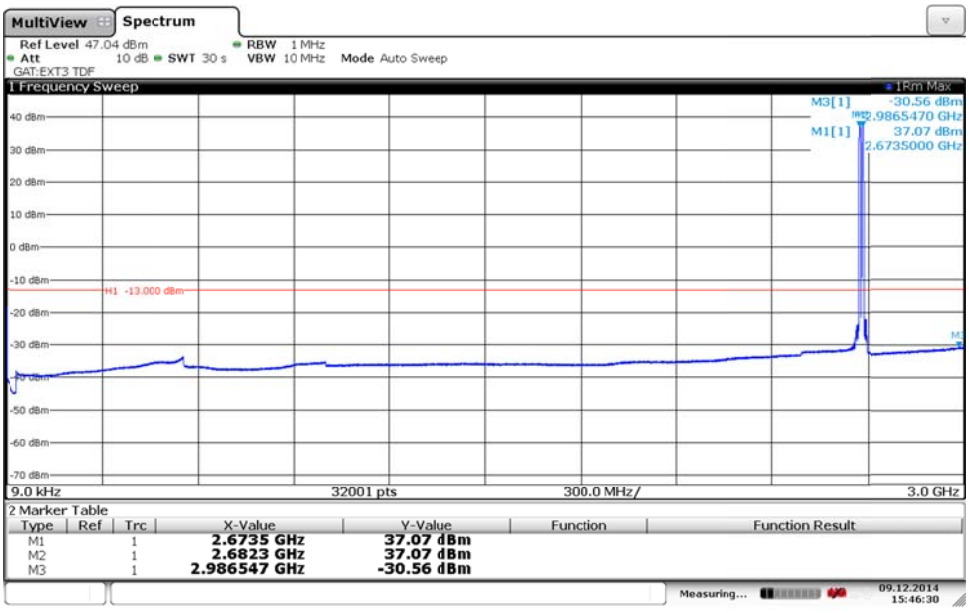
Diagram 10f:



Date: 9.DEC.2014 12:57:19

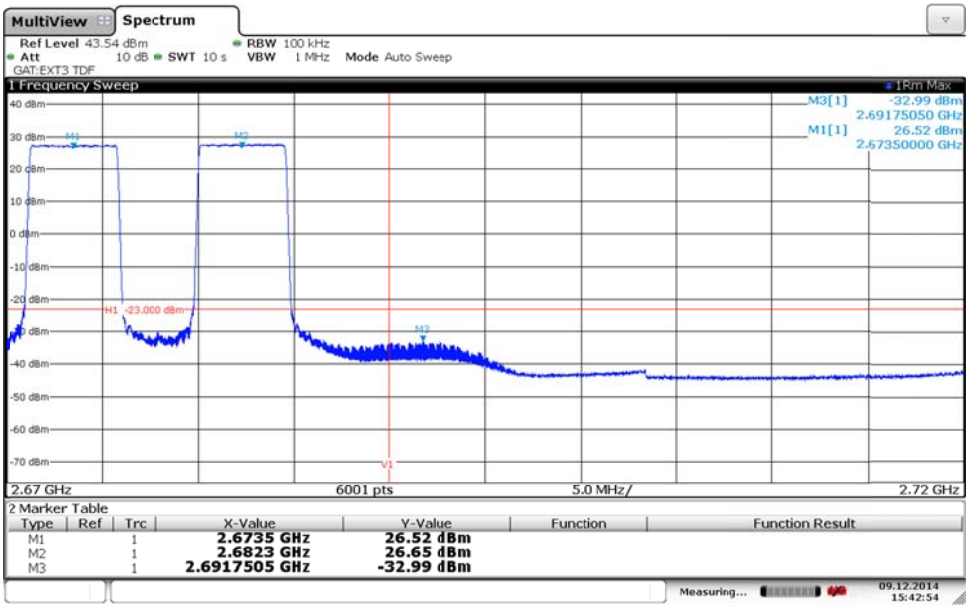
Appendix 5

Diagram 11a:



Date: 9.DEC.2014 15:46:31

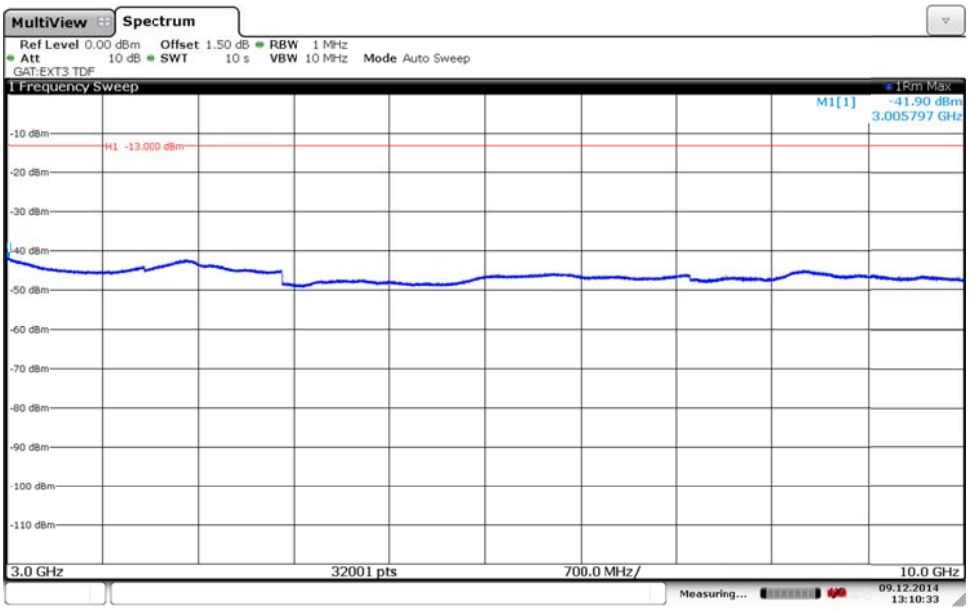
Diagram 11b:



Date: 9.DEC.2014 15:42:54

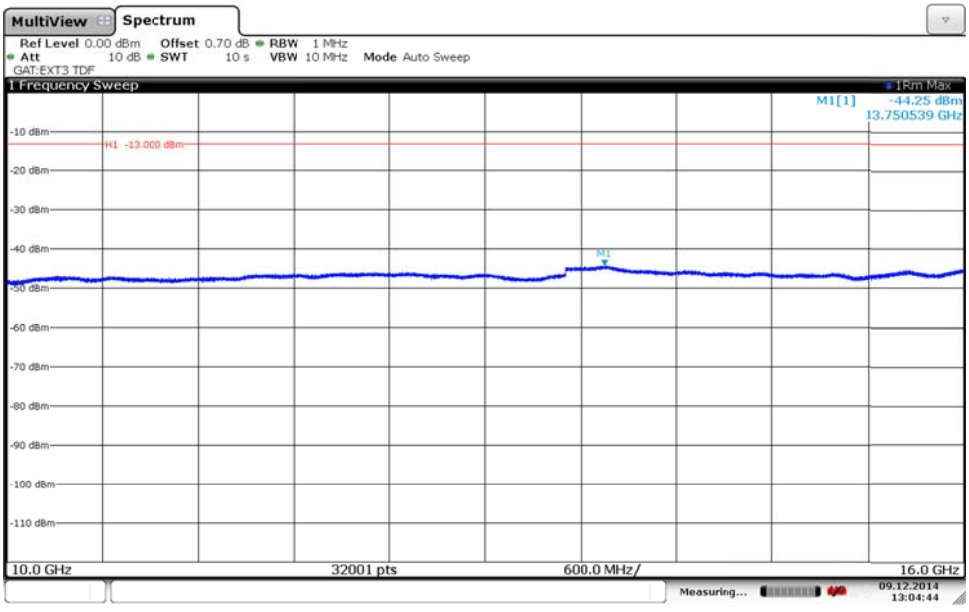
Appendix 5

Diagram 11c:



Date: 9.DEC.2014 13:10:34

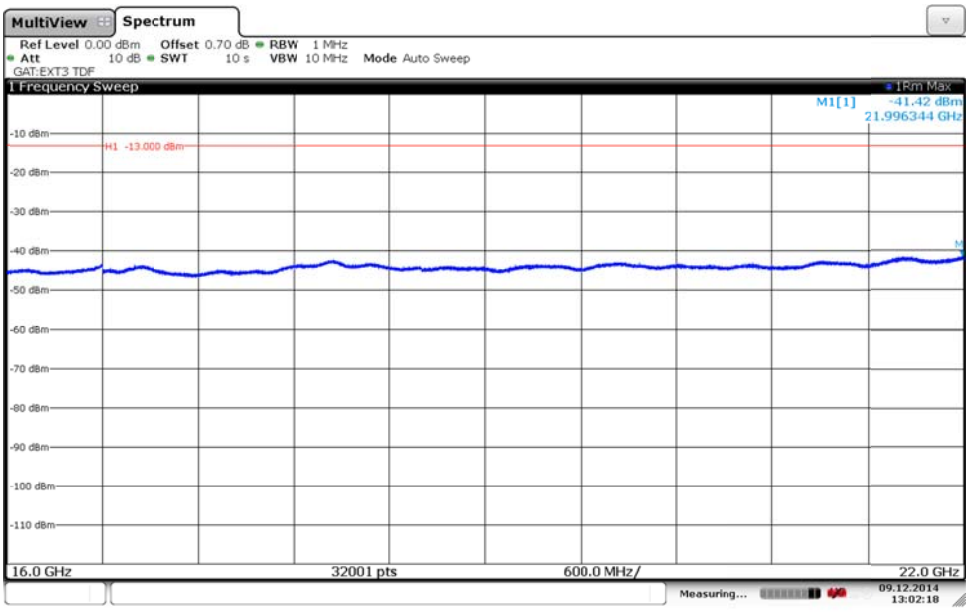
Diagram 11d:



Date: 9.DEC.2014 13:04:43

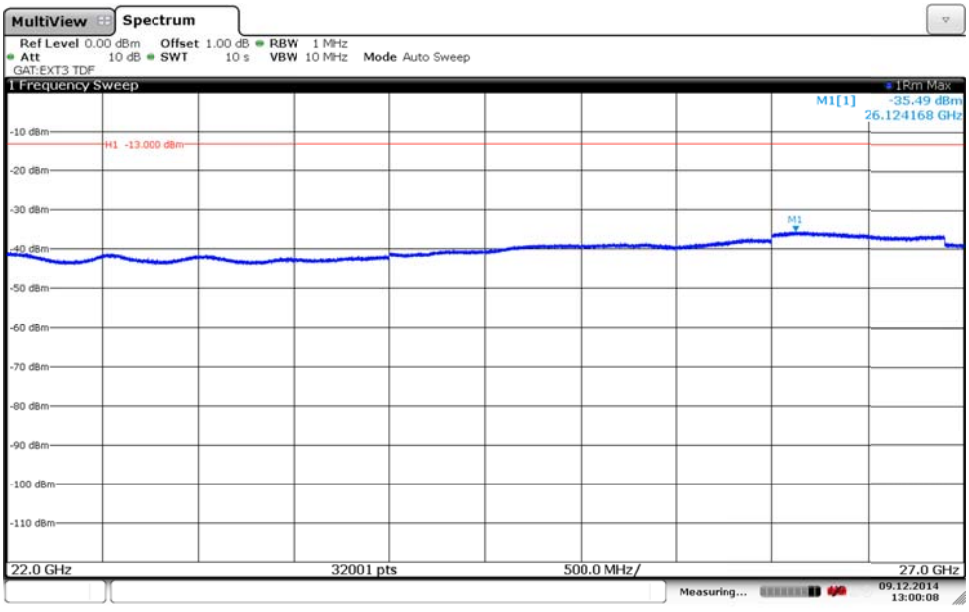
Appendix 5

Diagram 11e:



Date: 9.DEC.2014 13:02:19

Diagram 11f:



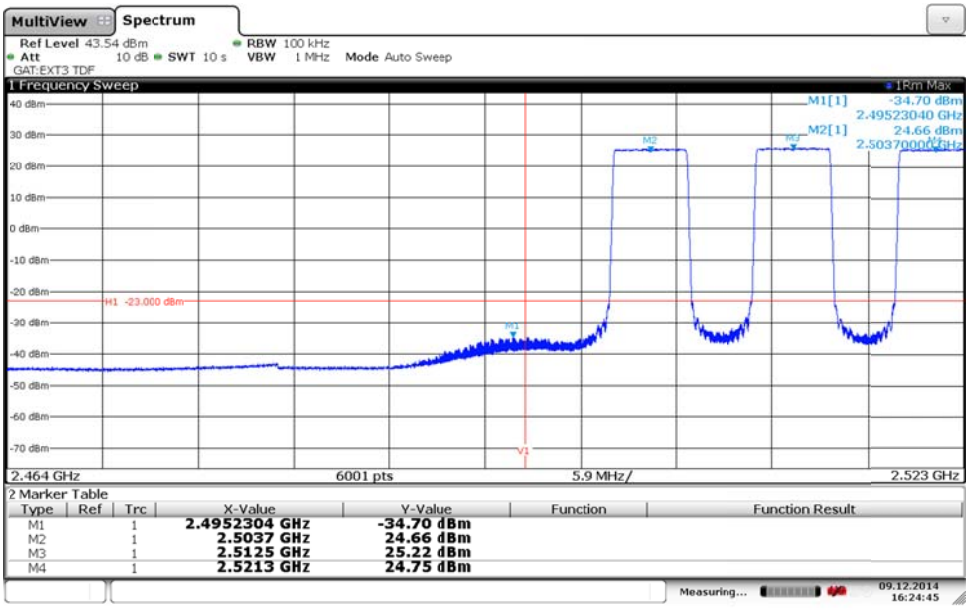
Date: 9.DEC.2014 13:00:07

Appendix 5

Diagram 12a:

Date: 9.DEC.2014 16:31:37

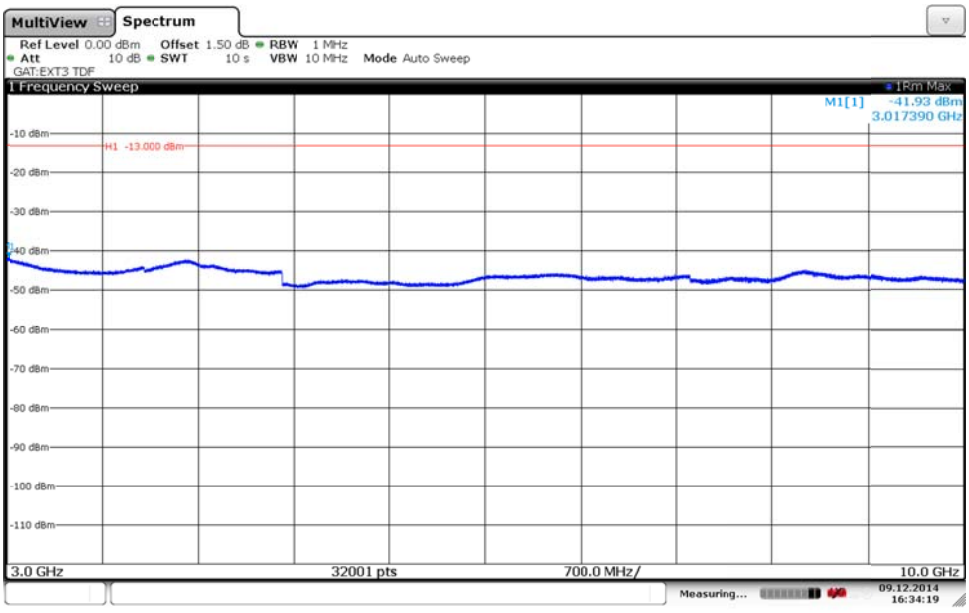
Diagram 12b:



Date: 9.DEC.2014 16:24:45

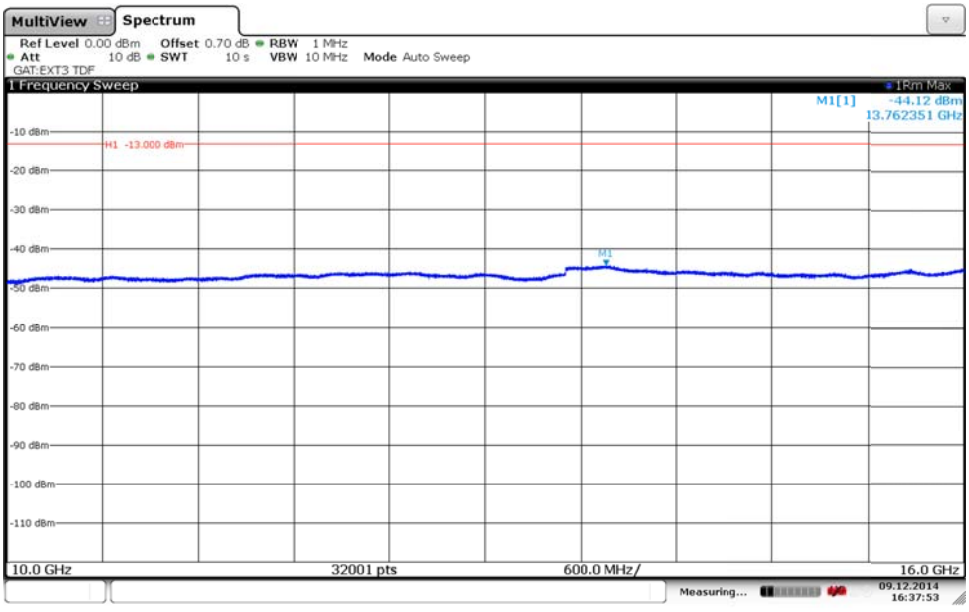
Appendix 5

Diagram 12c:



Date: 9.DEC.2014 16:34:19

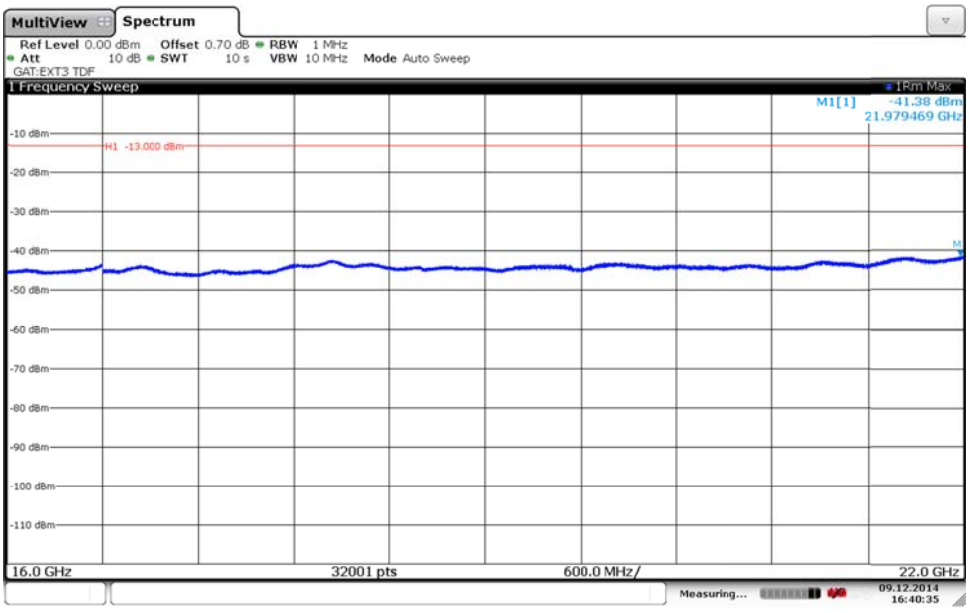
Diagram 12d:



Date: 9.DEC.2014 16:37:52

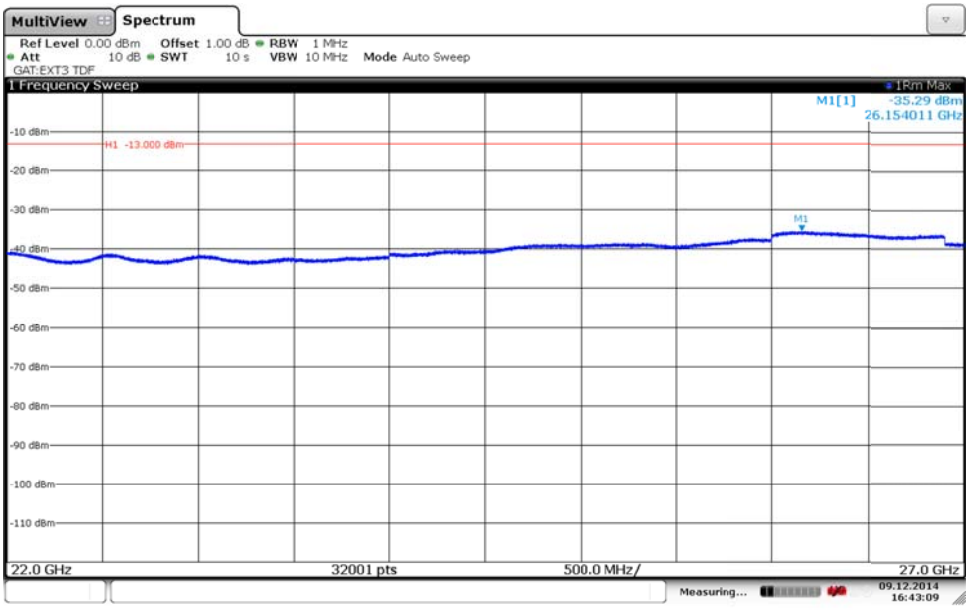
Appendix 5

Diagram 12e:



Date: 9.DEC.2014 16:40:35

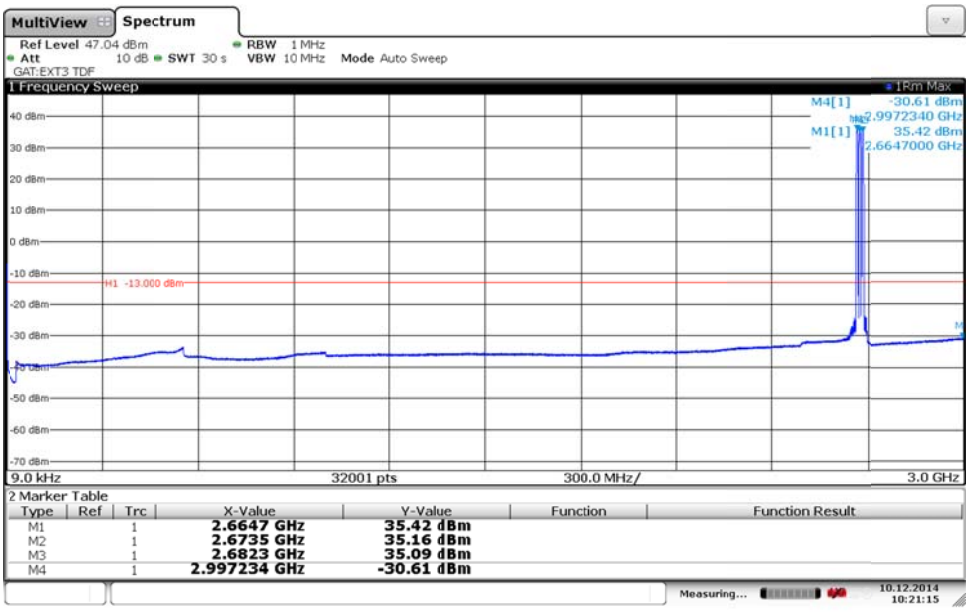
Diagram 12f:



Date: 9.DEC.2014 16:43:09

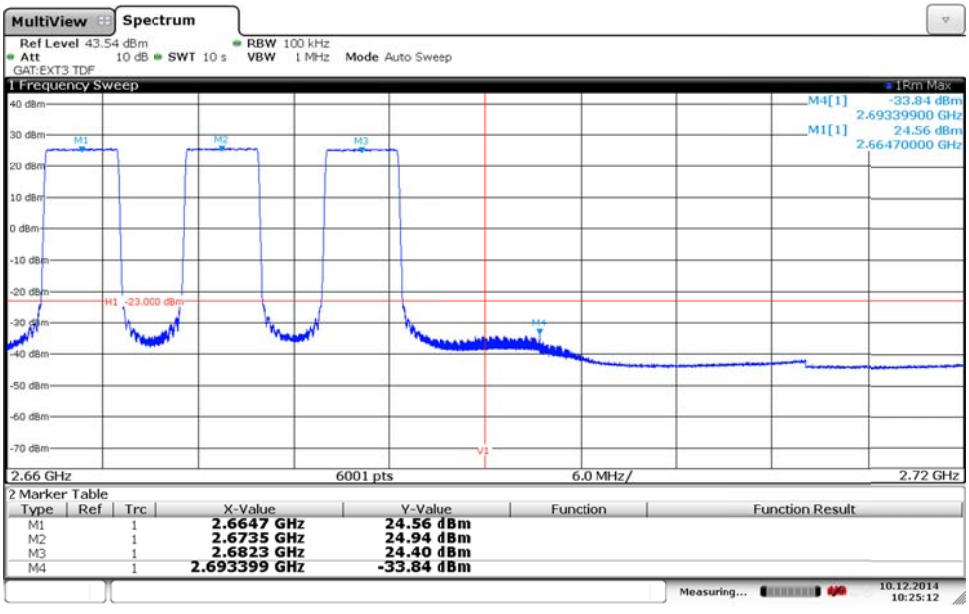
Appendix 5

Diagram 13a:



Date: 10.DEC.2014 10:21:15

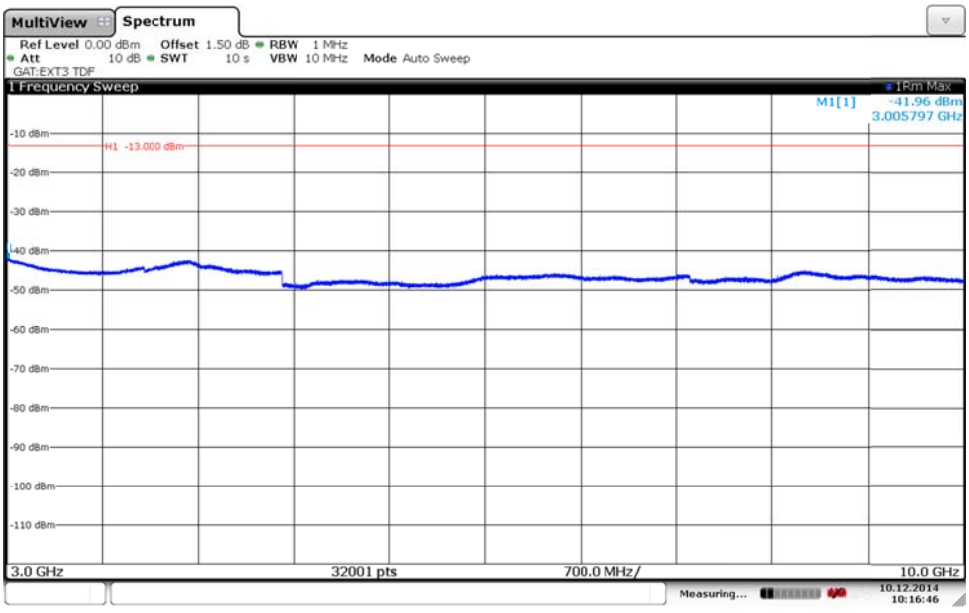
Diagram 13b:



Date: 10.DEC.2014 10:25:12

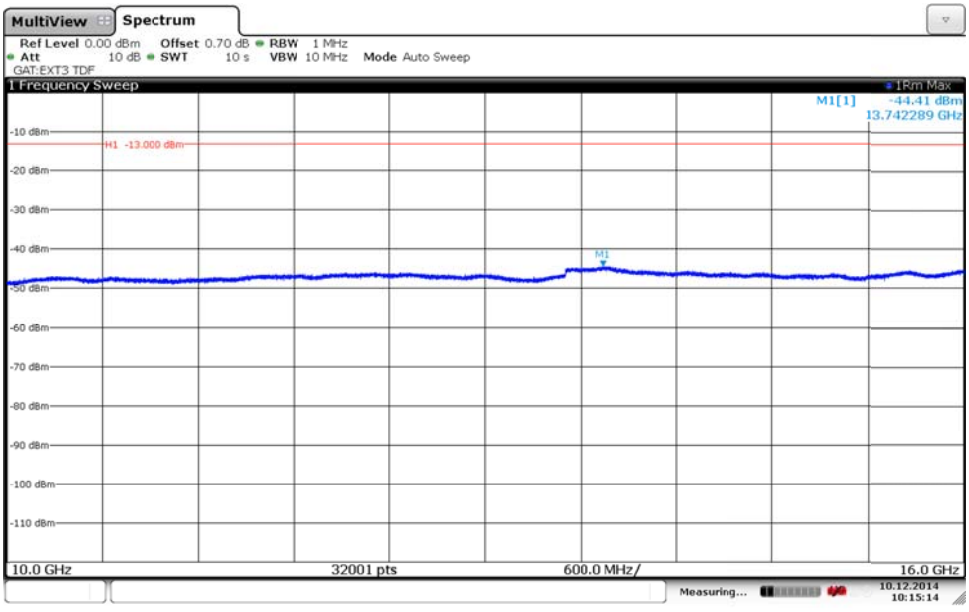
Appendix 5

Diagram 13c:



Date: 10.DEC.2014 10:16:46

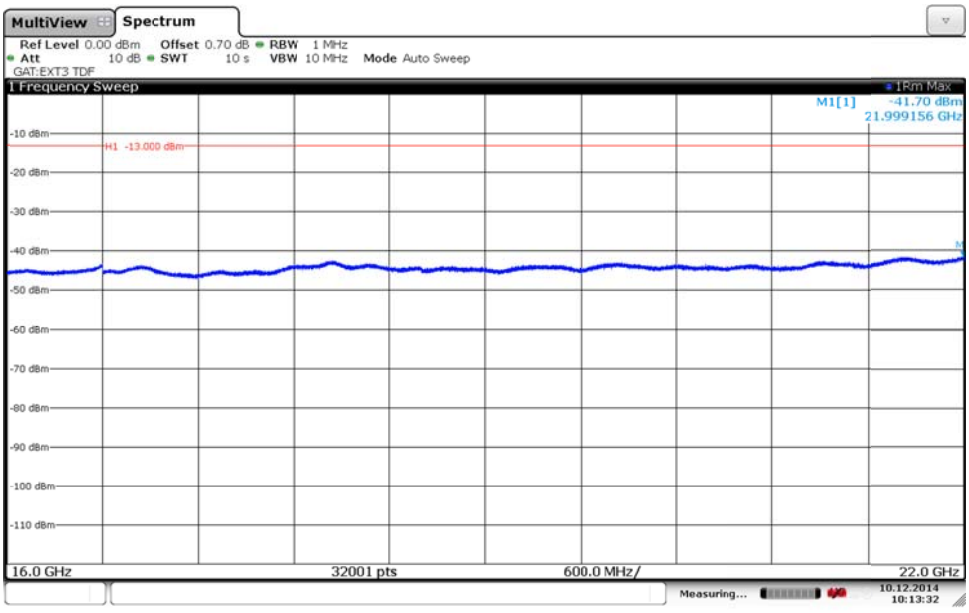
Diagram 13d:



Date: 10.DEC.2014 10:15:14

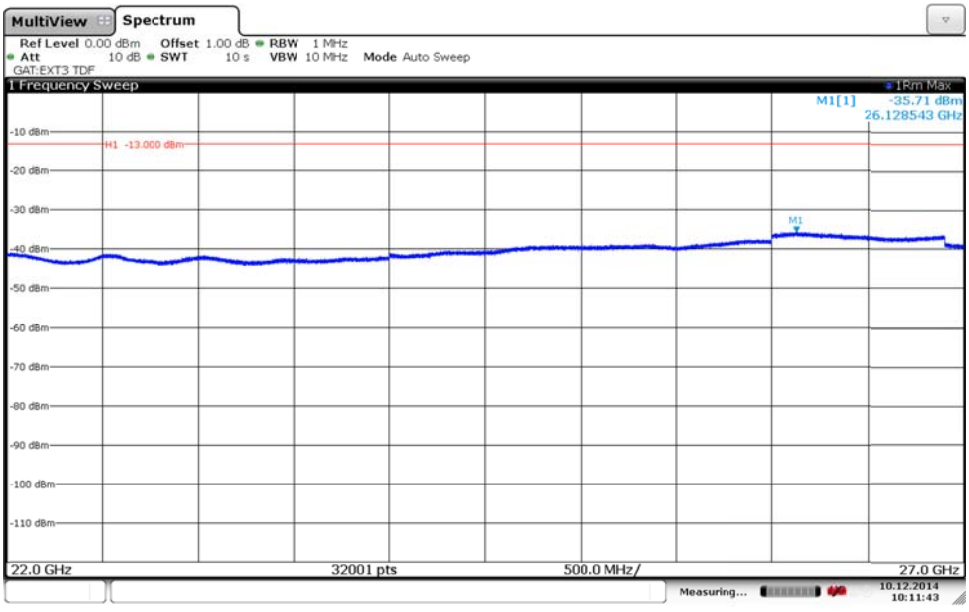
Appendix 5

Diagram 13e:



Date: 10.DEC.2014 10:13:31

Diagram 13f:



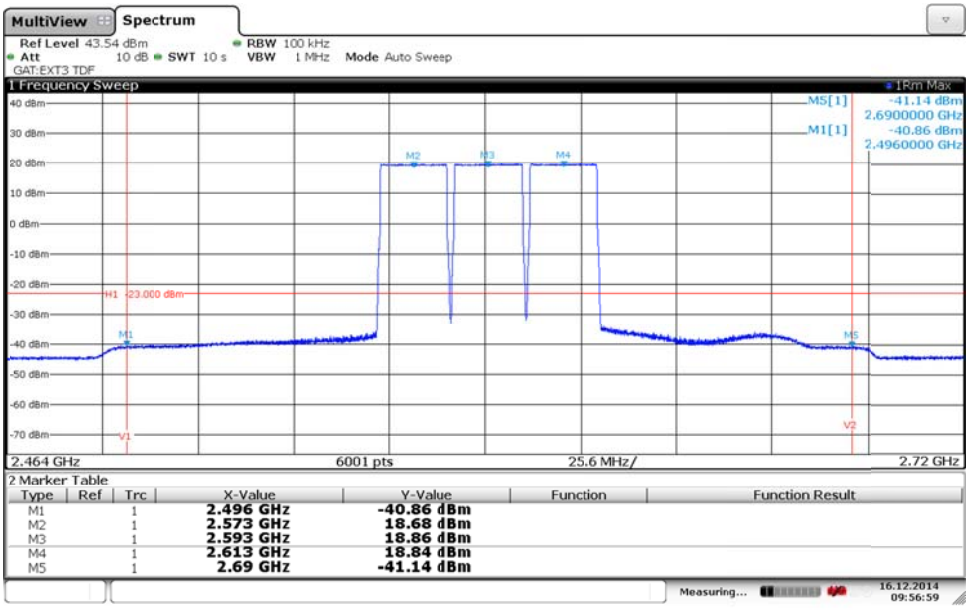
Date: 10.DEC.2014 10:11:43

Appendix 5

Diagram 14a:

Date: 16.DEC.2014 09:54:09

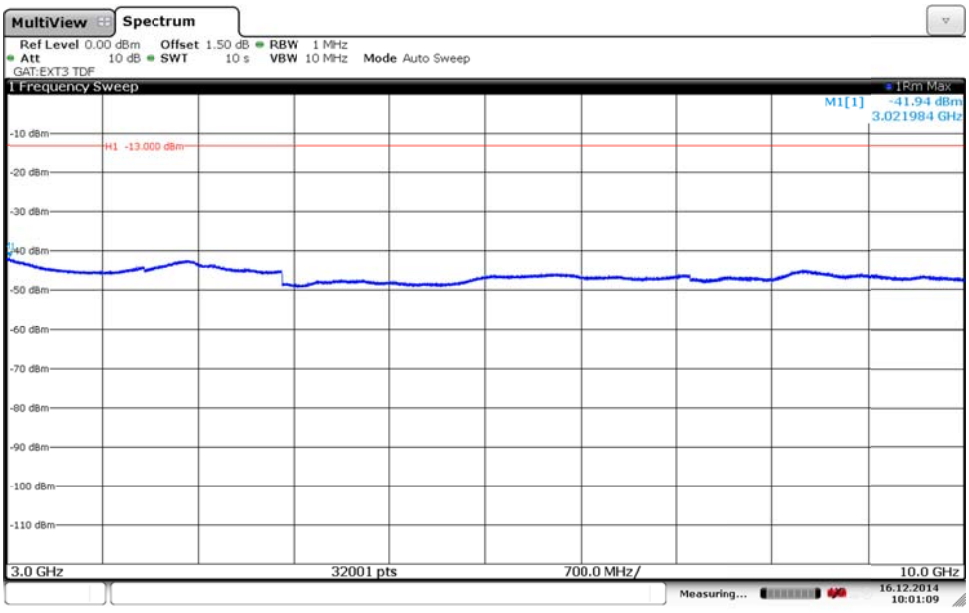
Diagram 14b:



Date: 16.DEC.2014 09:56:59

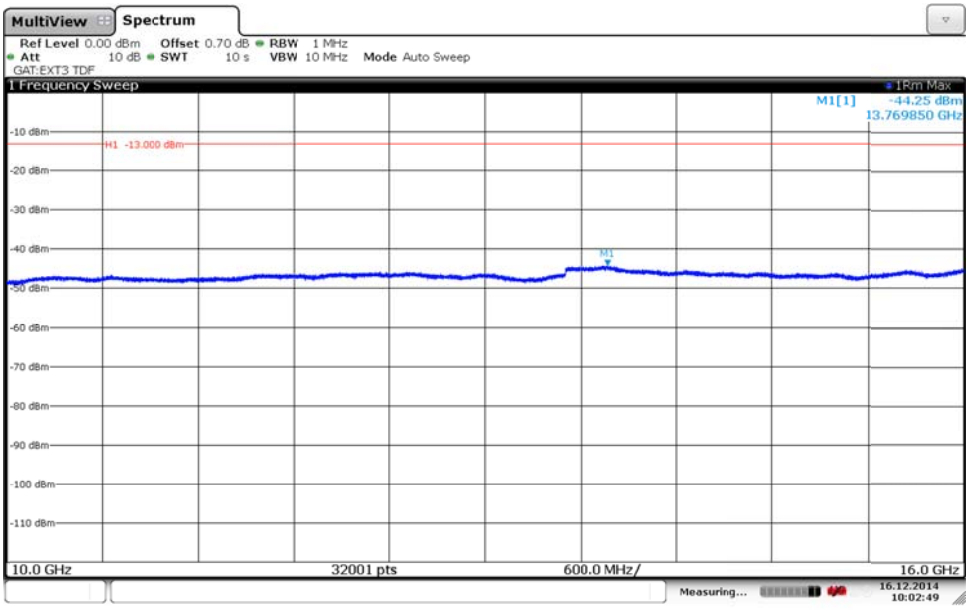
Appendix 5

Diagram 14c:



Date: 16.DEC.2014 10:01:08

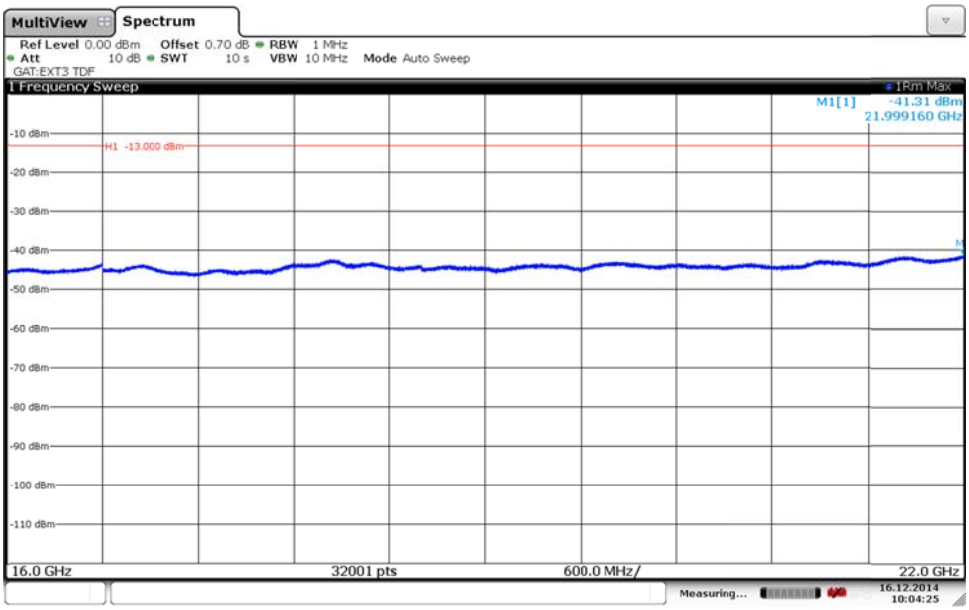
Diagram 14d:



Date: 16.DEC.2014 10:02:49

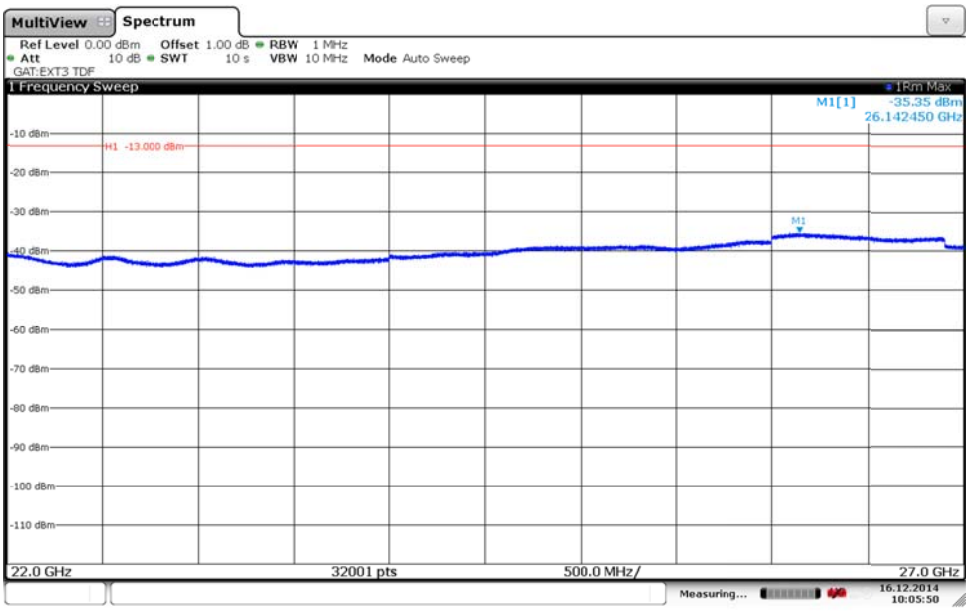
Appendix 5

Diagram 14e:



Date: 16.DEC.2014 10:04:25

Diagram 14f:



Date: 16.DEC.2014 10:05:50

Field strength of spurious radiation measurements according to 47 CFR 27.53 (m)

Date	Temperature	Humidity
2014-12-09	23°C ± 3°C	29 % ± 5 %
2014-12-10	23°C ± 3°C	30 % ± 5 %

Test set-up and procedure

The test sites are listed at FCC, Columbia with registration number: 93866.

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 GHz – 27 GHz.

The measurement was performed with a RBW of 1 MHz.

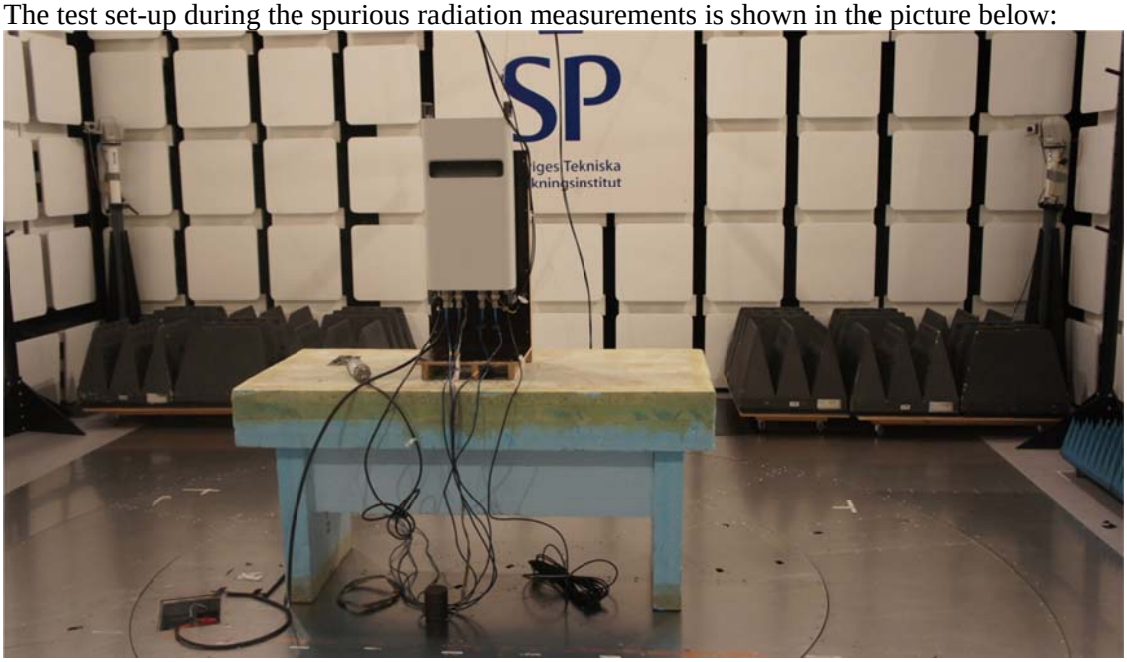
A propagation loss in free space was calculated. The used formula was

$\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

The measurement procedure was as the following:

1. A pre-measurement is performed with peak detector. For measurement < 1 GHz the test object is measured in eight directions with the antenna at three heights, 1.0 m, 1.5 m and 2.0. For measurements > 1 GHz the test object was measured in seventeen directions with the antenna at three heights 1.0 m, 1.5 m and 2.0.
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 ANSI/TIA/-603-C-2004.

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
R&S ESU 40	901 385
EMC 32 ver. 8.52.0	503 899
Chase Bilog Antenna CBL 6111A	503 182
EMCO Horn Antenna 3115	502 175
FLANN Std gain 16240-25	503 939
FLANN Std gain 18240-25	503 900
FLANN Std gain 20240-20	503 674
FLANN Std gain 22240-20	503 674
µComp Nordic, Low Noise Amplifier	901 545
Schwarzbeck preamplifier BBV 9742	504 085
Miteq 18-40 GHz, Low Noise Amplifier	503 278
HP Filter 3-18 GHz	503 739
Temperature and humidity meter, Testo 625	504 188

Tested configurations

B
M
T
T2im
T3im

Results, representing worst case

T3im, BW 5 MHz: Diagram 1 a-e

Measurement uncertainty:

3.1 dB up to 27 GHz

Limits

CFR 47 §27.53(m)

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by $43 + 10 \log_{10}(p)$, measured with 1 MHz RBW.

Complies?	Yes

Appendix 6

Diagram 1a:

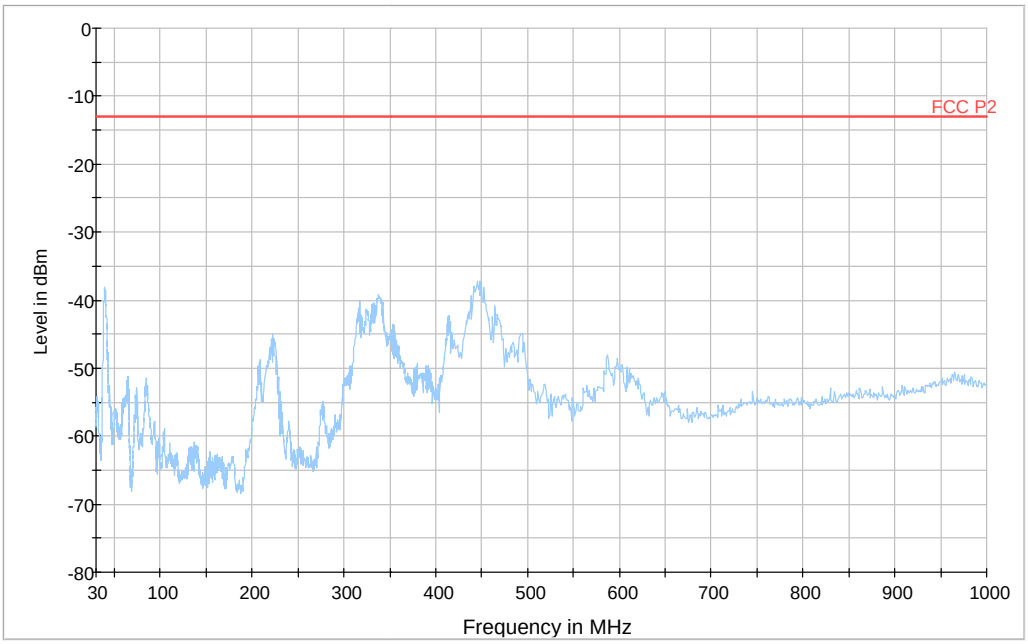
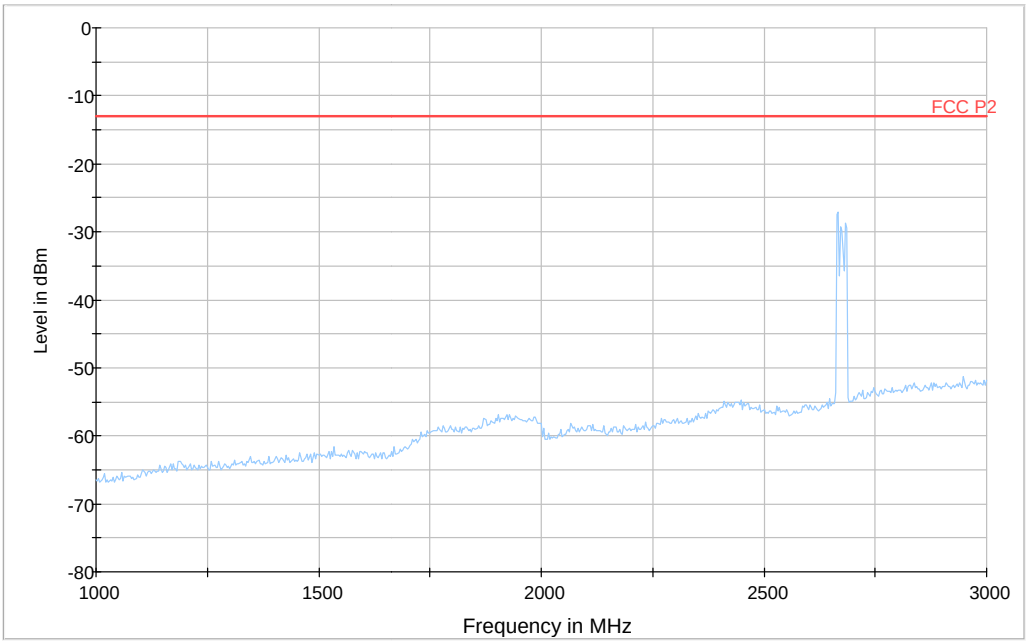
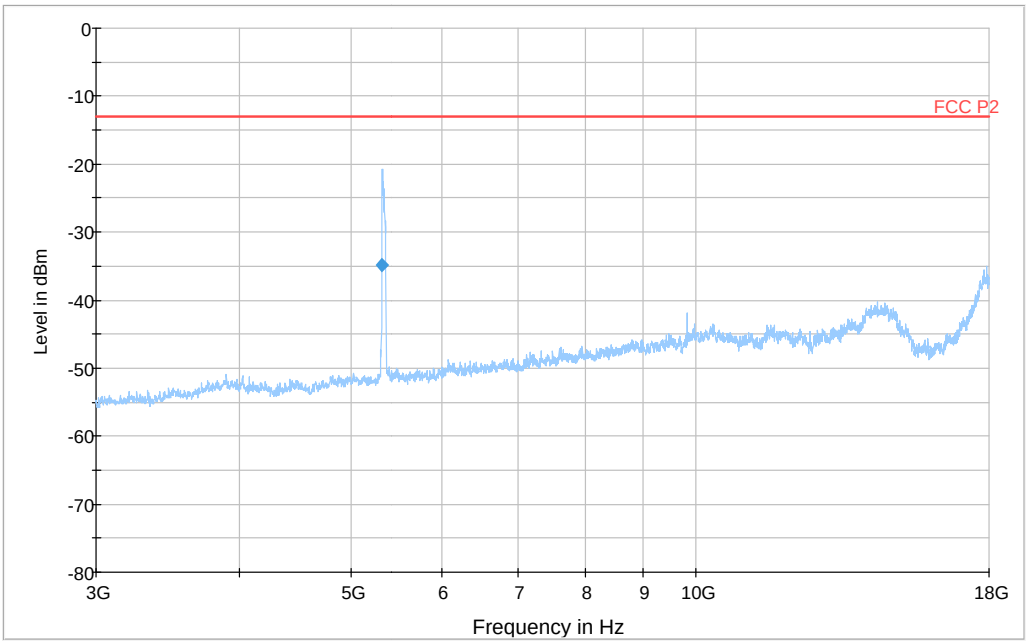


Diagram 1b:



Note: The emission between 2664.7 and 2682.3 MHz is the carrier frequencys and shall be ignored in the context.

Diagram 1c:



Final RMS Result

Frequency (MHz)	RMS (dBm)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)	Comment
5327.223	-34.8	5000.0	1000.000	129.0	H	76.0	-102.8	23.6	-13.0	Note 1

Note 1: This frequency is a product of the TX carrier signals. 1.8 dB has been added to the RMS result with respect to the transmitter duty cycle.

Appendix 6

Diagram 1d:

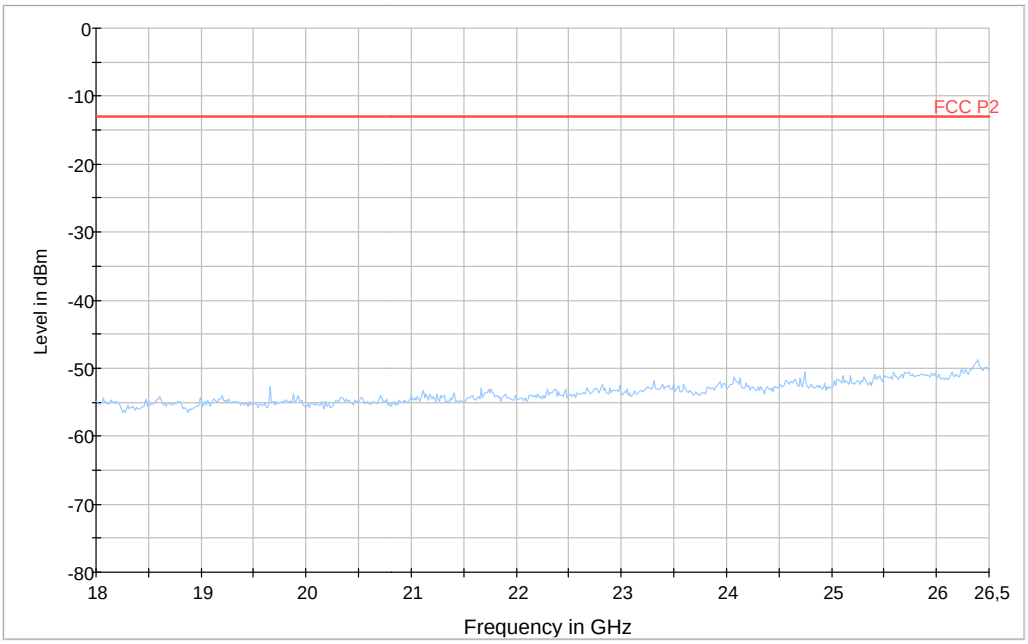
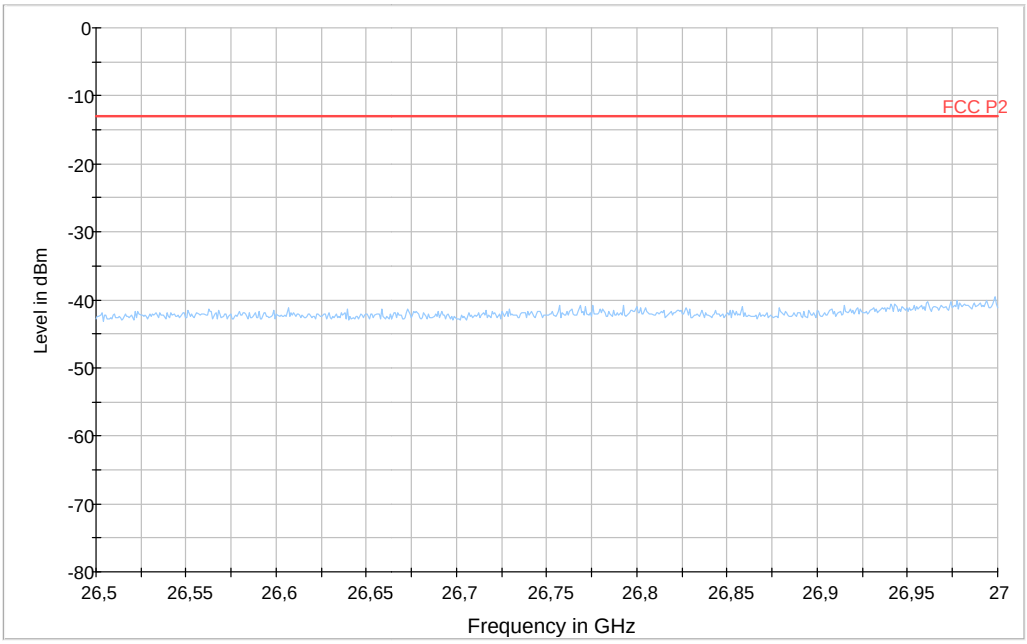


Diagram 1e:



Frequency stability measurements according to CFR 47 §27.54

Date	Temperature	Humidity
2014-12-10	23 °C ± 3 °C	17% ± 5 %
2014-12-11	23 °C ± 3 °C	27 % ± 5 %
2014-12-12	23 °C ± 3 °C	32 % ± 5 %

Test set-up and procedure

The measurement was made per GPP TS 36.141 6.5.1. 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 per IC RSS 130 4.3. Using a resolution bandwidth of 1% of the emission bandwidth (-26 dB points), a reference point at the unwanted emission level which complies with the attenuation of 43 + 10 log10 p (watts) (i.e. -13dBm) (for 4x 4MIMO -19dBm) 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
R&S FSW 43	902 073
RF attenuator	902 282
Temperature Chamber	503 360
Testo 635, temperature and humidity meter	504 203
Multimeter Fluke 87	502 190

Results

Nominal Voltage -48 V DC

Maximum output power at mid channel (M)

Channel Bandwidth 5MHz

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	T (°C)	Test model E-TM1.1
-48.0	+20	-35
-55.2	+20	-29
-40.8	+20	-50
-48.0	+30	-34
-48.0	+40	-35
-48.0	+50	-36
-48.0	+10	-18
-48.0	0	-14
-48.0	-10	-15
-48.0	-20	-15
-48.0	-30	-22
Maximum freq. error (Hz)		50
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

3GPP TS 36.141 6.5.1, limit: ± 0.05 PPM ±12 Hz (±141,65Hz)

Rated output power level at connector RF B (maximum): 46 dBm (40 W)

Test conditions			Frequency margin to band edge at -19dBm			
Supply voltage DC [V]	Temp [°C].	Carrier Bandwidth [MHz]	Test frequency Symbolic name Bottom		Test frequency Symbolic name Top	
			fL [MHz]	Offset to lower band edge (2490 MHz) [kHz]	fH [MHz]	Offset to upper band edge (2690 MHz) [kHz]
-48.0	+20	5	2496.033	33	2689.972	28
-48.0	+20	20	2496.191	191	2689.798	202

Measurements according to IC RSS 130 4.3.

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, channel bandwidth configuration and test model (modulation), as all combinations share a common internal reference to derive the TX frequency from.

Limits

CFR 47 §27.54:
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Complies?	Yes

Appendix 8

External photos

Front side:

Back side:

Left side:

Right side:

Top side:

Bottom side:

Appendix 8

Product Label: