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Radio measurements on RRUS32 B66A 1700/2100 MHz radio equipment with FCC ID: TA8AKRC161583-1 and IC: 287AB-AS1615831

(8 appendices)

Test object

Product name: RRUS32 B66A.
Product number: KRC 161 583/1.

Summary

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

Standard		Compliant	Appendix
FCC CFR 47 part 2 and 27 / IC RSS-139 Issue 3			
2.1046 / RSS-139 6.5	RF power output conducted	Yes	2
2.1049 / RSS-Gen 6.6	Occupied bandwidth	Yes	3
2.1051 / RSS-139 6.6	Band edge	Yes	4
2.1051 / RSS-139 6.6	Spurious emission at antenna terminals	Yes	5
2.1053 / RSS-139 6.6	Field strength of spurious radiation	Yes	6
2.1055 / RSS-139 6.4	Frequency stability	Yes	7

SP Technical Research Institute of Sweden
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Performed by

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Anders Nordlöf

Table of contents

Appendix 1

Description of the test object

Equipment:	Product name: RRUS 32 B66A Product number: KRC 161 583/1
FCC ID:	TA8AKRC161583-1
IC ID:	287AB-AS1615831
HVIN:	AS1615831
Hardware revision state:	R1A
FVIN:	CXP 901 7316/5 rev. R62AM
Tested configuration:	WCDMA FDD single RAT
Frequency bands:	TX: 2110 – 2155 MHz RX: 1710 – 1755 MHz
IBW:	45 MHz, Valid for all power classes in both contiguous and non-contiguous operation.
Antenna ports:	4 TX/RX ports
RF configuration:	Single carrier, multi carrier, 2-way diversity, 2x2 MIMO
RF power tolerance	+ 0.6 / - 2.0 dB
Nominal output power per antenna port:	Single carrier: 1x 46 dBm (40W) Multi carrier: 2 x 43 dBm (40W)
Frequency stability tolerance:	±0.05 PPM
Antenna:	No dedicated antenna, handled during licensing
Channel bandwidths:	4.2 to 5 MHz (configurable in steps of 100/200 kHz)
Channel spacing:	4.4 to 5 MHz (configurable in steps of 100/200 kHz)
Emission Designators:	5M00F9W
Modulations:	QPSK, 16QAM and 64QAM
Nominal supply voltage:	-48VDC

Operation mode during measurements

Measurements were performed with the test object transmitting test models as defined in 3GPP TS 25.141. Test model 1 (TM1) was used to represent QPSK. Test model 5 (TM5) to represent 16QAM modulation and Test model 6 (TM6) to represent 64QAM modulation.

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
TM1: 64 DPCH:s at 30 ksps (SF=128)

MIMO mode multi carrier, 2 carriers
TM1: 32 DPCH:s at 30 ksps (SF=128)

Channel bandwidth 5 MHz

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 the RF port representing worst case for each measurement.

Radiated measurements

The test object was supplied with -48 VDC by an external power supply. Additional connections are documented in the test setup drawings.

Purpose of test

The purpose of the tests is to verify compliance to the performance characteristics specified in applicable items of FCC CFR 47 part 2 and 27, IC RSS-139 and IC RSS-Gen.

References

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

ANSI 63.4-2009
ANSI/TIA/EIA-603-C-2004
3GPP TS 25.141, version 13.0.0
CFR 47 part 2, October 1st , 2014
CFR 47 part 27, October 1st, 2014
RSS-Gen Issue 4
RSS-139 Issue 3
KDB 662911 Multiple transmitter output v02r01
KDB 971168 D01 Power Meas Licens, v02r02

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 2015-10-07.

Manufacturer’s representative

Lars Wallin, Ericsson AB.

Test engineers

Andreas Johnson, Tomas Lennhager, Tomas Isbring, Jörgen Wassholm, Patric Augustsson and Senad Pasalic, SP.

Test participant

None.

Measurement equipment

	Calibration Due	SP number
Test site Tesla	2017-01	503 881
R&S ESU 40	2016-07	901 385
R&S FSW 43	2016-07	902 073
R&S ESI 26	2016-07	503 292
R&S FSQ 40	2016-07	504 143
Control computer with R&S software EMC32 version 9.15.0	-	503 899
High pass filter	2016-07	504 200
RF attenuator	2016-10	902 282
Directional coupler	2016-10	901 496
Chase Bilog Antenna CBL 6111A	2017-10	503 182
EMCO Horn Antenna 3115	2016-09	502 175
µComp Nordic, Low Noise Amplifier	2016-01	901 545
Flann STD Gain Horn Antenna 20240-20	-	503 674
Flann STD Gain Horn Antenna 22240-20		503 674
Miteq, Low Noise Amplifier	2016-08	503 278
Schwarzbeck preamplifier BBV 9742	2015-12	504 085
Temperature and humidity meter, Testo 635	2016-04	504 203
Temperature Chamber	-	503 360
Multimeter Fluke 87	2016-08	502 190

Appendix 1

Test frequencies during conducted measurements

UARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
1537	2112.4	B	Single carrier TX bottom frequency
1537 1562	2112.4 2117.4	B2	2 carrier TX band bottom constellation
1638	2132.6	M	Single carrier TX band mid frequency
1638 1663	2132.6 2137.6	M2	2 carrier TX band mid constellation
1597 1679	2124.4 2140.8	M2 IM	2 carrier TX band constellation
1738	2152.6	T	Single carrier TX top frequency
1713 1738	2147.6 2152.6	T2	2 carrier TX band top constellation

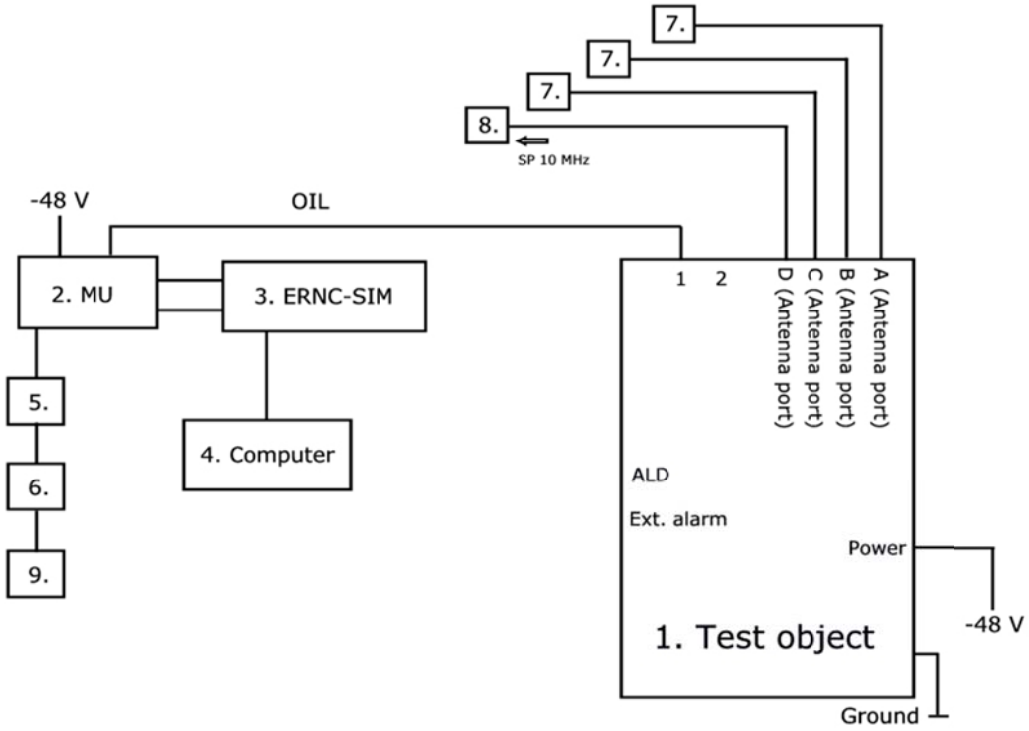
Test frequencies during radiated measurements

UARFCN Downlink	Frequency [MHz]	Symbolic name	Comment
1537 1562	2112.4 2117.4	B-Rspr	Single carrier TX bottom frequency at TX A and B Single carrier TX bottom frequency at TX C and D
1638 1663	2132.6 2137.6	M-Rspr	Single carrier TX bottom frequency at TX A and B Single carrier TX bottom frequency at TX C and D
1738 1713	2152.6 2147.6	T-Rspr	Single carrier TX bottom frequency at TX A and B Single carrier TX bottom frequency at TX C and D
1537 1562 1713 1738	2112.4 2117.4 2147.6 2152.6	B2-Rspr	Multi carrier TX bottom frequency at TX A and B Multi carrier TX bottom frequency at TX C and D Multi carrier TX bottom frequency at TX A and B Multi carrier TX bottom frequency at TX C and D

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

Appendix 1

Test set-up conducted measurements



Test object:

1.	RRUS32 B66A, KRC 161 583/1, rev. R1A, S/N: D16Q869113 with radio software CXP 901 7316/5, rev. R62AM FCC ID TA8AKRC161583-1 and IC 287AB-AS1615831

Associated equipment:

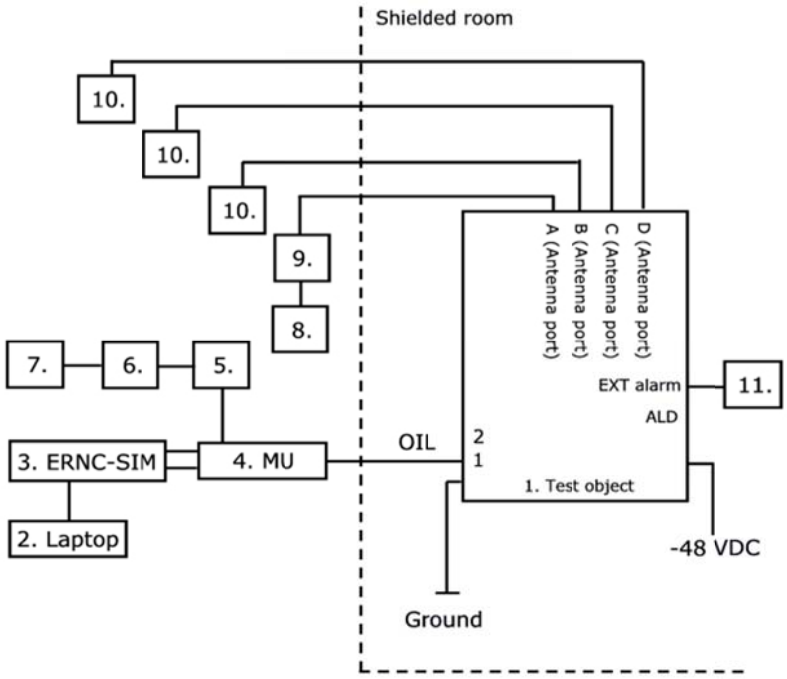
2.	RBS 6601 Main Unit: SUP 6601, 1/BFL 901 009/4, rev. R1E, s/n: BR82691785 DUW 30 01, KDU 127 161/3, rev. R4C, s/n: C825194264 SW: CXP 102 051/24, rev. R13BT
5.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K474887
9.	GPS Active Antenna, KRE 101 2082/1

Functional test equipment

3.	ERNC-SIM 130, BAMS – 1000660991 Netgear Switch FS726T
4.	Laptop HP Elitebook 8540w, BAMS – 1001052061
6.	1x4 GPS SPLITTER, KRY 101 1946/1, s/n: FG1017916
7.	Attenuator/ terminator 50 ohm
8.	SP Test Instrumentation according to measurement equipment list The signal analyzer was connected to an external 10 MHz reference standard during the measurements

Appendix 1

Test set-up radiated measurements



Test object:

1.	RRUS32 B66A, KRC 161 583/1, rev. R1A, S/N: D16Q917977 With radio software CXP 901 7316/5, rev. R62AM FCC ID TA8AKRC161583-1 and IC 287AB-AS1615831

Associated equipment:

4.	RBS 6601 Main Unit: SUP 6601, 1/BFL 901 009/4, rev. R1E, s/n: BR82691785 DUW 30 01, KDU 127 161/3, rev. R4C, s/n: C825194264 SW: CXP 102 051/24, rev. R13BT
5.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8KH75515
7.	GPS Active Antenna, KRE 101 2082/1
11.	Remote Control Unit, s/n: CS61547222

Functional test equipment

2.	Laptop HP Elitebook 8560w, BAMS – 1001236856
3.	ERNC-SIM 130, BAMS – 1000660990 Netgear Switch FS726T
6.	1x4 GPS SPLITTER, KRY 101 1946/1
7.	Attenuator/ terminator 50 ohm
8.	R&S ESI 26 SP 503 292, for supervision only
9.	Attenuator
10.	Attenuator/ terminator 50 ohm

Appendix 1

Interfaces:	**Type of port:**
Power: -48 VDC	DC Power
RF port A, 7/16 connector, combined TX/RX	Antenna
RF port B, 7/16 connector, combined TX/RX	Antenna
RF port C, 7/16 connector, combined TX/RX	Antenna
RF port D, 7/16 connector, combined TX/RX	Antenna
1, optical interface	Signal
2, optical interface, not used in this configuration	Signal
Remote Control Unit	Signal
EXT. alarm	Signal
Ground wire	Ground

Appendix 3

RF power output measurements according to CFR 47 §27.50 / IC RSS-139 6.5

Date	Temperature	Humidity
2015-10-14	23 °C ± 3 °C	21 % ± 5 %
2015-10-15	23 °C ± 3 °C	21 % ± 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.

Measurement equipment	SP number
R&S FSW 43	902 073
R&S FSQ 40	504 143
RF attenuator	902 282
Directional coupler	901 496
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

MIMO, single carrier
Rated output power level at each RF port 1x 46 dBm.

	Output power CCDF [RMS dBm/ PAR dB]				
BW configuration [MHz] symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
5, B	46.1/ 7.3	46.2/ 7.3	46.2/ 7.3	46.2/ 7.3	52.19
5, M	46.0/ 7.3	46.0/ 7.3	46.1/ 7.3	46.1/ 7.3	52.07
5, T	46.1/ 7.3	46.2/ 7.2	46.1/ 7.3	46.1/ 7.3	52.14

[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.

	Output power CCDF [RMS dBm/ PAR dB]				
symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
B2 5	46.1/ 7.4	46.2/ 7.4	46.0/ 7.5	46.2/ 7.5	52.12
M2 5	46.1/ 7.4	46.2/ 7.4	46.1/ 7.5	46.1/ 7.4	52.12
T2 5	46.0/ 7.2	46.1/ 7.2	46.0/ 7.5	46.2/ 7.6	52.09

[1)]: Summed output power according to FCC KDB662911 D01 Multiple transmitter output v02

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

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

	Output power per 1 MHz [RMS dBm]	
BW configuration [MHz] symbolic name	Port RF C	Total power[1)]
5, B	40.5	46.5
5, M	40.8	46.8
5, T	40.5	46.5

Limits

§27.50 (d)

The power of each base station transmitting in the 2110-2180 MHz band and located in any county with population density of 100 or fewer persons per square mile is limited to an EIRP of 3280 W/MHz, when transmitting with an emission bandwidth greater than 1 MHz.
The power of each base station transmitting in the 2110-2180 MHz band and situated in any geographic location other than that described above is limited to an EIRP of 1640 W/MHz, when transmitting with an emission bandwidth greater than 1 MHz.
A licensee operating a base station in the 2110-2180 MHz band utilizing a power greater than 1640 watts/MHz EIRP must coordinate such operations in advance with all parties addressed in the rules.
In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

RSS-139 6.5:

There is no power limit specified for base station equipment in the RSS-139.
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 ERP/EIRP limits specified in SRSP-513
When the transmitter power is measured in terms of average value, the peak-to-average ratio of the power shall not exceed 13 dB.

Complies?	Yes

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

Date	Temperature	Humidity
2015-10-14	23 °C ± 3 °C	21 % ± 5 %
2015-10-15	23 °C ± 3 °C	21 % ± 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 in max hold.

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

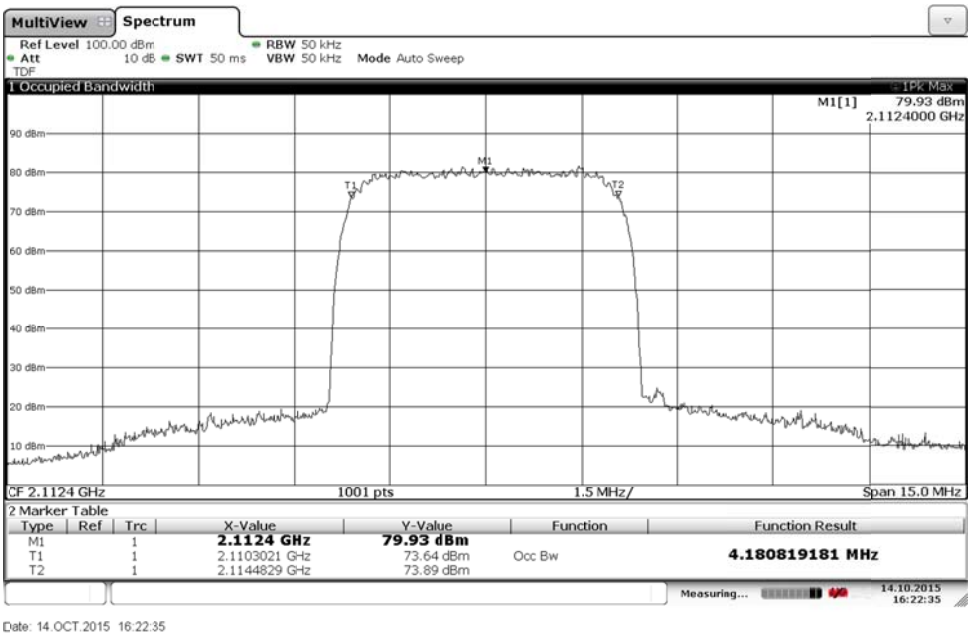
Measurement uncertainty: 3.7 dB

Results

Diagram	BW configuration	Symbolic name	Tested Port	Occupied BW (99%) [MHz]
1	5 MHz	B	RF C	4.18
2	5 MHz	M	RF A	4.15
3	5 MHz	M	RF B	4.17
4	5 MHz	M	RF C	4.20
5	5 MHz	M	RF D	4.18
6	5 MHz	T	RF C	4.18

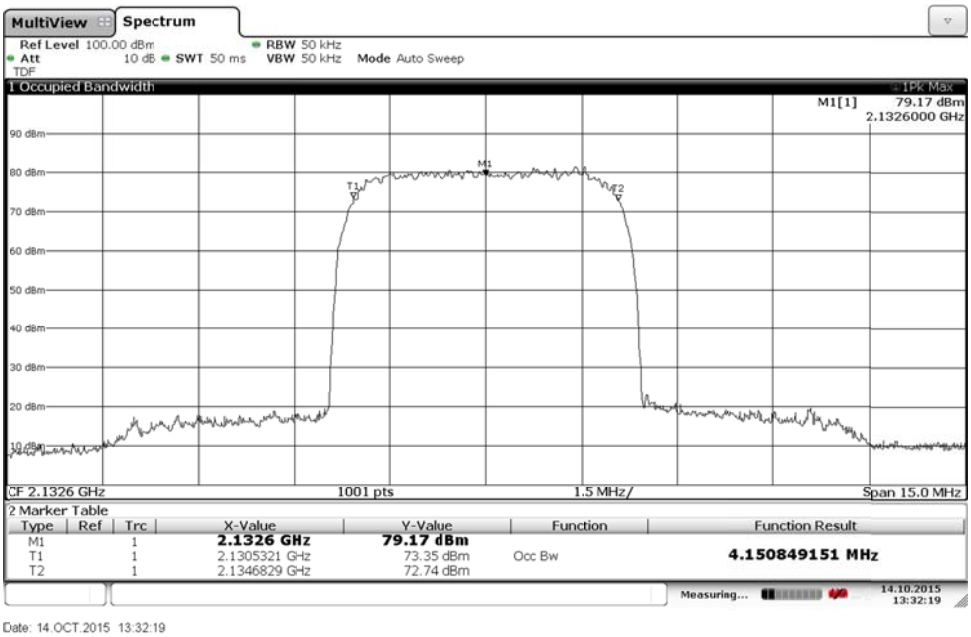
Appendix 4

Diagram 1:



Date: 14.OCT.2015 16:22:35

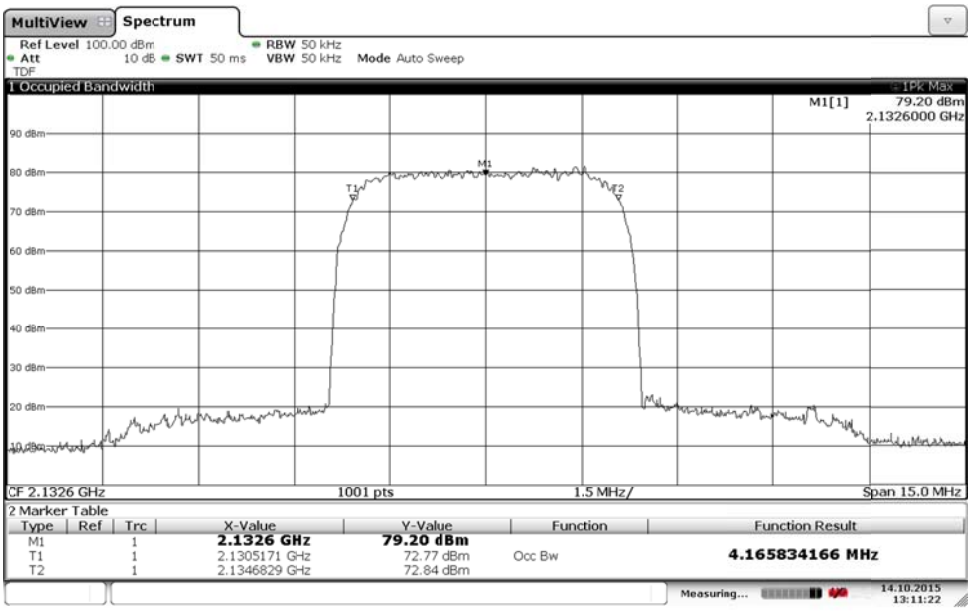
Diagram 2:



Date: 14.OCT.2015 13:32:19

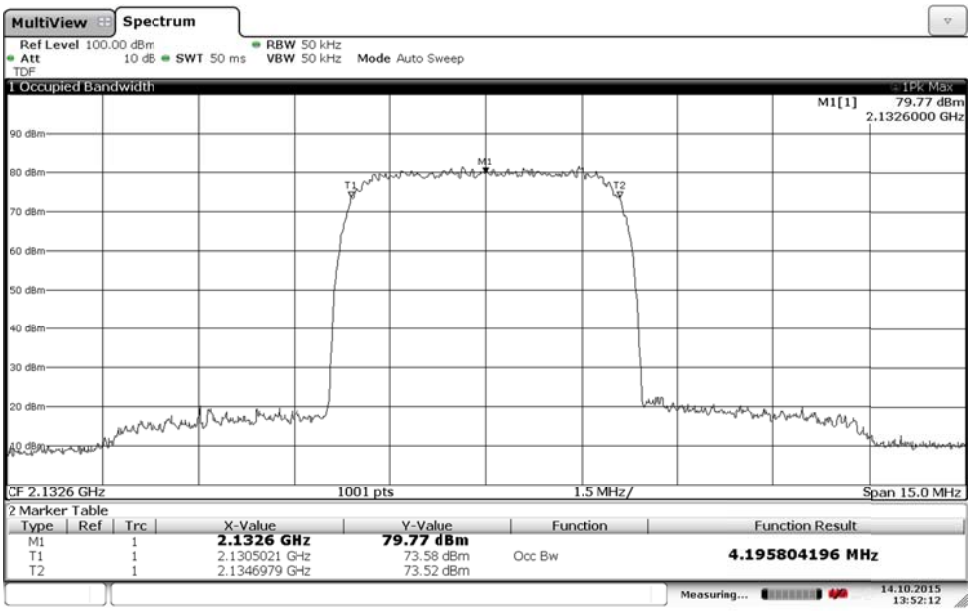
Appendix 4

Diagram 3:



Date: 14.OCT.2015 13:11:22

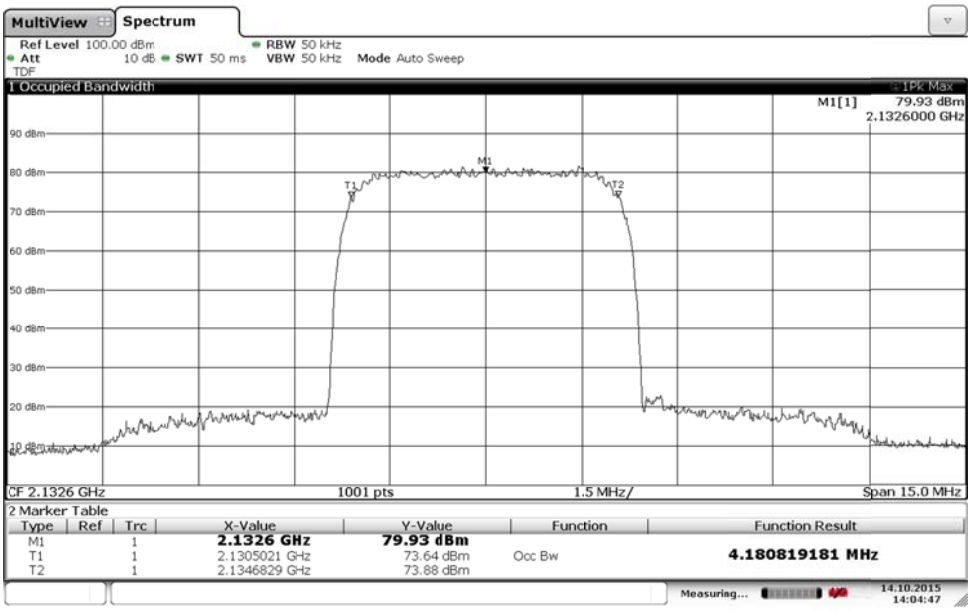
Diagram 4:



Date: 14.OCT.2015 13:52:11

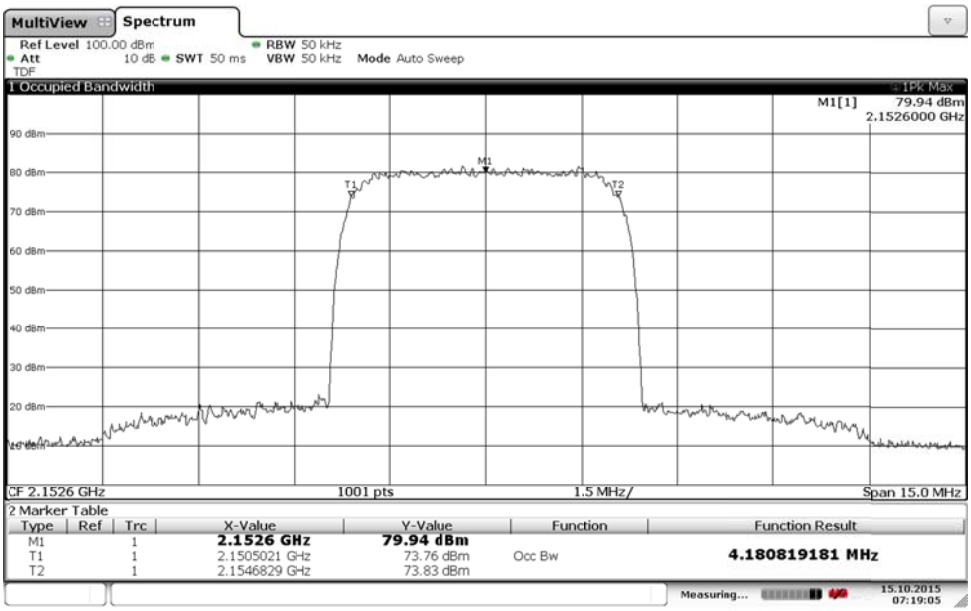
Appendix 4

Diagram 5:



Date: 14.OCT.2015 14:04:47

Diagram 6:



Date: 15.OCT.2015 07:19:06

Appendix 5

Band edge measurements according to CFR 47 §27.53(h) / IC RSS-139 6.6

Date	Temperature	Humidity
2015-10-14	23 °C ± 3 °C	21 % ± 5 %
2015-10-15	23 °C ± 3 °C	21 % ± 5 %
2015-10-16	23 °C ± 3 °C	26 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53(h) and IC RSS-139 6.6. The test object was connected to a spectrum analyzer with the RMS detector activated.

The specified measurement bandwidth for out of band emission measurement is 1 MHz. However, In the 1 MHz band immediately outside and adjacent to the band edges, the unwanted emission power may be measured with a resolution bandwidth of at least 1% of the emission bandwidth. A narrower resolution bandwidth is allowed to be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz or 1% of the emission bandwidth, as applicable. Where a smaller RBW was used the limit in the plot is adjusted by 10 log ($RBW_{used}/RBW_{specified}$) [dB].

A resolution bandwidth of 200 kHz was used 1 MHz to 6 MHz away from the band edges, to compensate for the reduced measurement bandwidth the limit was adjusted by 7 dB to -20 dBm (10 log (200 kHz/ 1 MHz)).

In the 1 MHz band immediately outside and adjacent to the band edges a resolution bandwidth of 20 kHz was used. To compensate for the reduced measurement bandwidth the limit was adjusted by 3.67 dB to -16.67 dBm (10 log (20 kHz/ 46.5 kHz)).

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 v01r02

Note:
In this case this is a very conservative approach as the same carrier frequency can only be allocated to two ports at a time. The remaining ports must be allocated to different frequency.

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

single carrier

Diagram	Tested frequency	EBW (MHz) [-26 dB point]	Tested port
1 a-c	B		RF C
2 a-c	T		RF C
-	M	4.65	RF C

multi carrier

Diagram	Tested frequency	Tested port
3 a-c	B2	RF B
4 a-c	T2	RF B

Limits

CFR 47 §27.53(h) and RSS-139 6.6

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 1a:

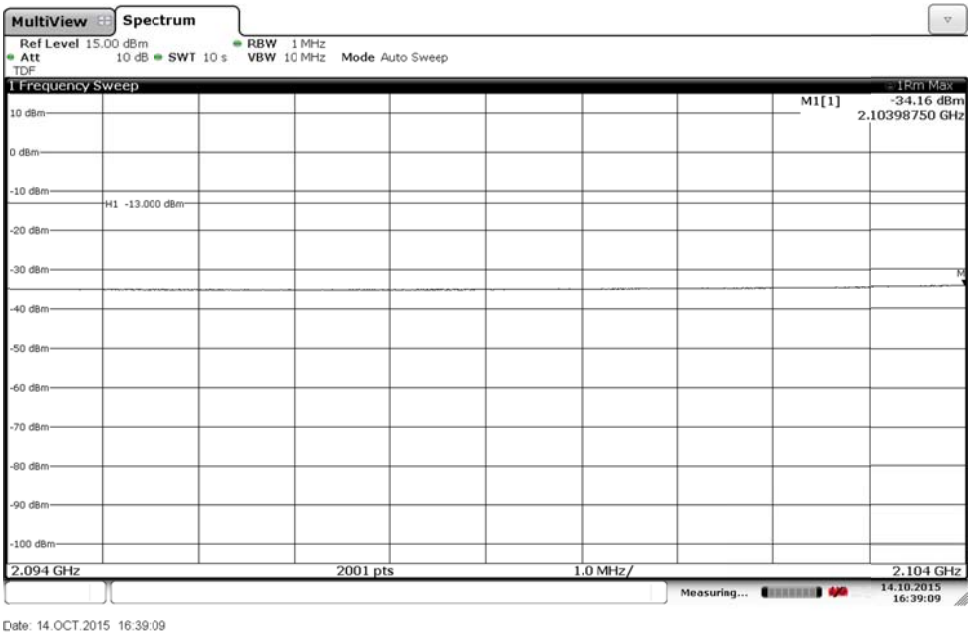
Date: 14.OCT.2015 16:32:18

Diagram 1b:

Date: 14.OCT.2015 16:37:02

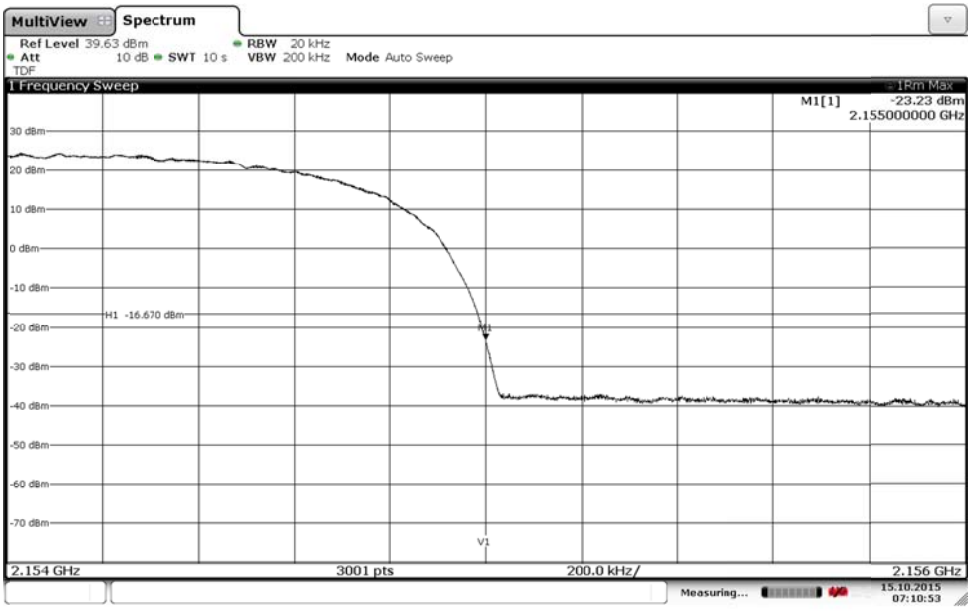
Appendix 5

Diagram 1c



Appendix 5

Diagram 2a:



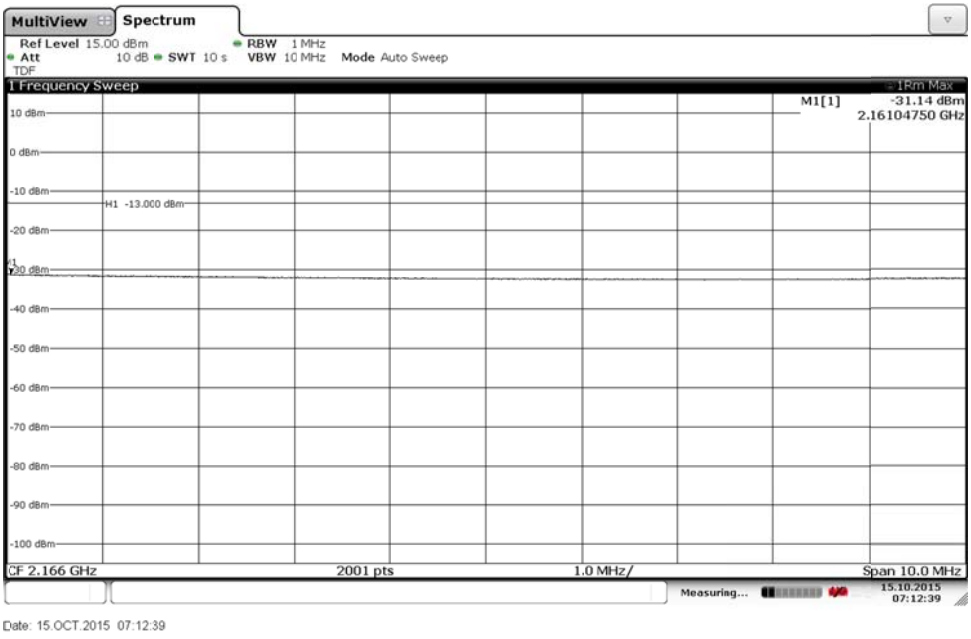
Date: 15.OCT.2015 07:10:53

Diagram 2b:

Date: 15.OCT.2015 07:11:46

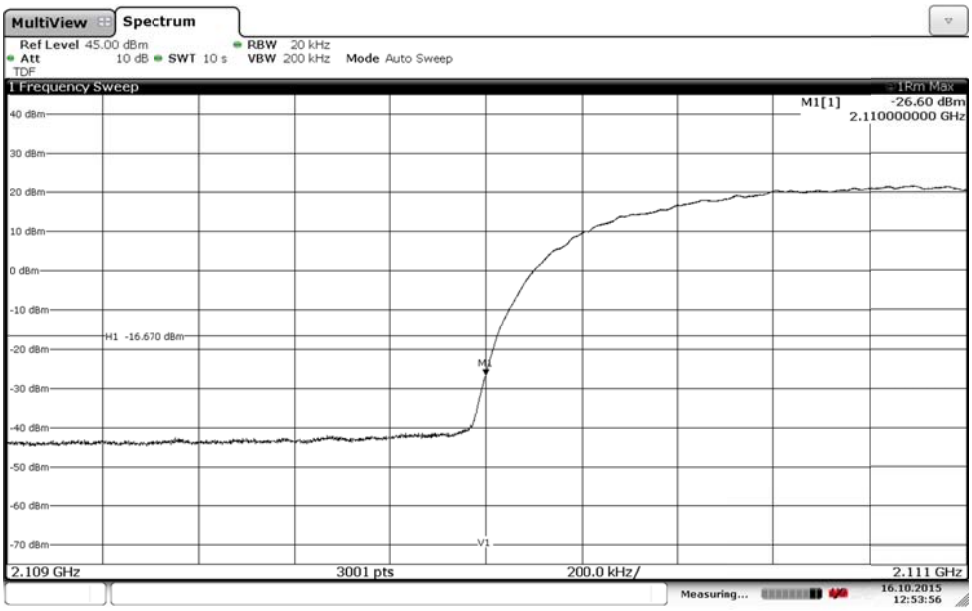
Appendix 5

Diagram 2c:



Appendix 5

Diagram 3a:



Date: 16.OCT.2015 12:53:56

Diagram 3b:

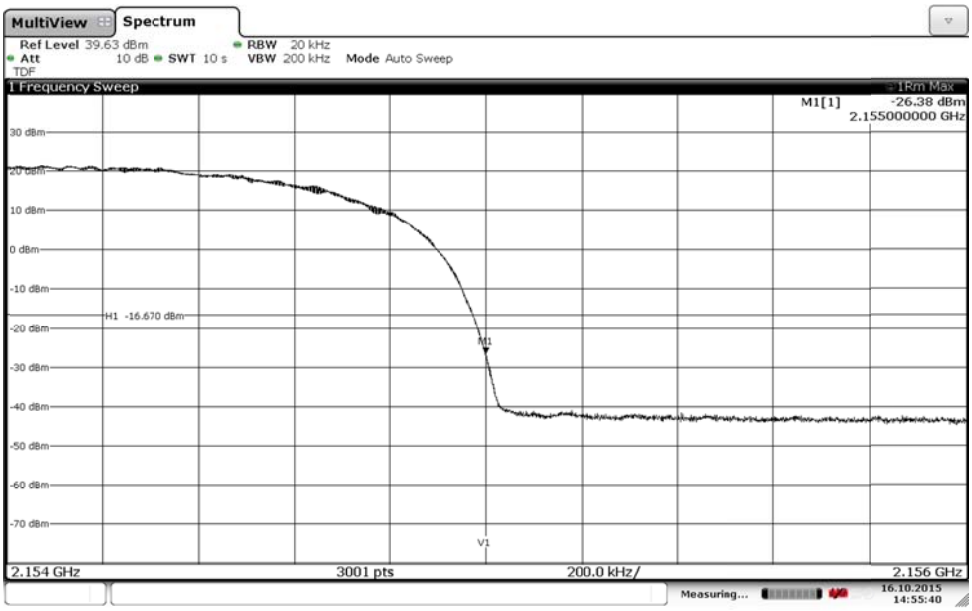
Date: 16.OCT.2015 12:55:16

Appendix 5

Diagram 3c:

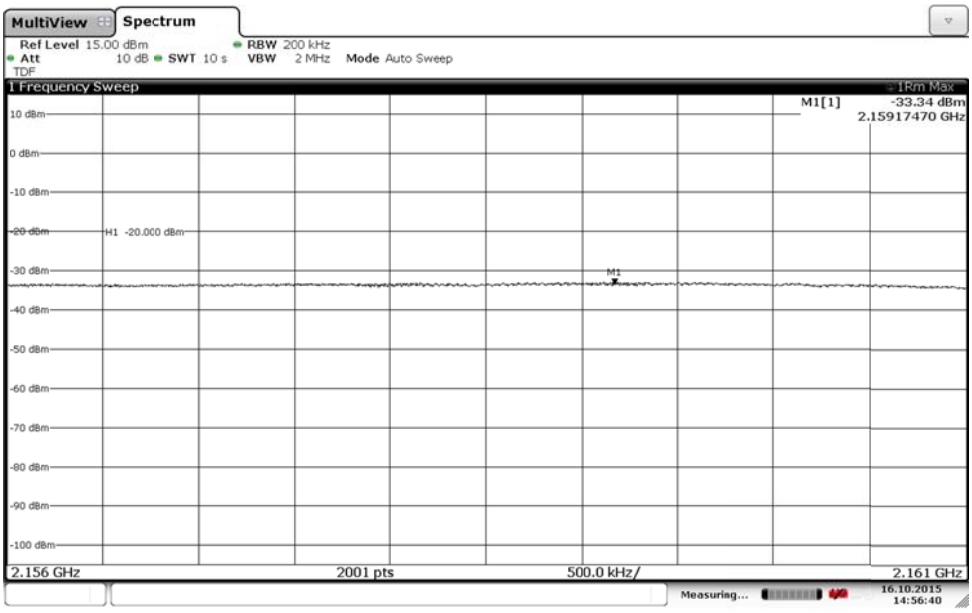
Appendix 5

Diagram 4a:



Date: 16.OCT.2015 14:55:40

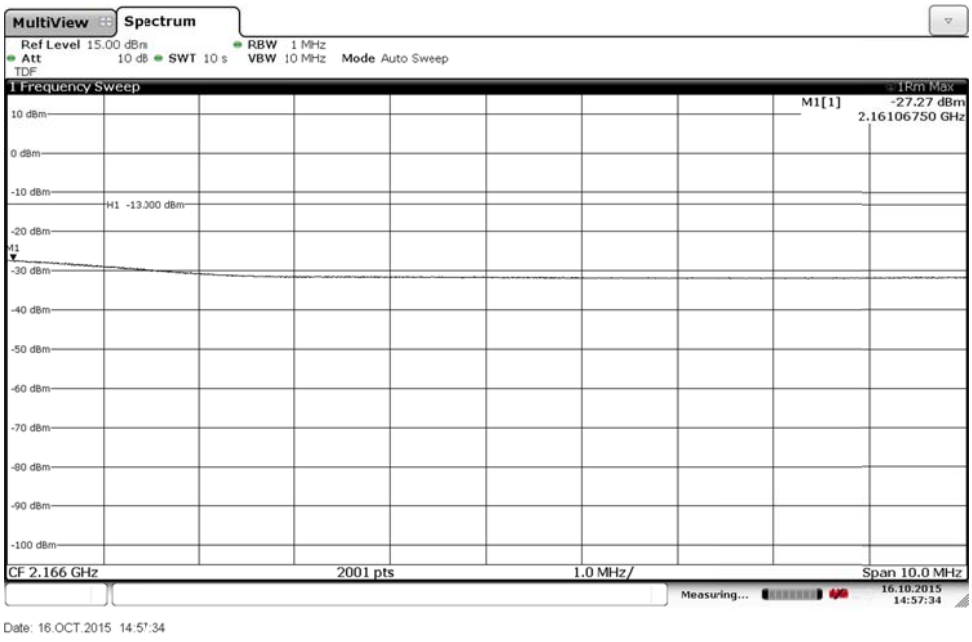
Diagram 4b:



Date: 16.OCT.2015 14:56:40

Appendix 5

Diagram 4c:



Appendix 6

Conducted spurious emission measurements according to CFR 47 §27.53(h)/ IC RSS-139 6.6

Date	Temperature	Humidity
2015-10-14	23 °C ± 3 °C	21 % ± 5 %
2015-10-15	23 °C ± 3 °C	21 % ± 5 %
2015-10-16	23 °C ± 3 °C	22 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53(h) and IC RSS-139.6.6. The output was connected to a spectrum analyzer with a RBW setting of 1 MHz and RMS detector activated.

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	901 502
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

Single carrier

Diagram	BW configuration	Symbolic name	Tested Port
1 a+b+c+d	5 MHz	B	RF A
2 a+b+c+d	5 MHz	M	RF A
3 a+b+c+d	5 MHz	M	RF B
4 a+b+c+d	5 MHz	M	RF C
5 a+b+c+d	5 MHz	M	RF D
6 a+b+c+d	5 MHz	T	RF D

Multi carrier

Diagram	BW configuration	Symbolic name	Tested Port
7 a+b+c+d+e	5 MHz	M2 IM	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 2.155 GHz. The measurements were made up to 22 GHz (10x2.155 GHz = 21.55 GHz).

Limits

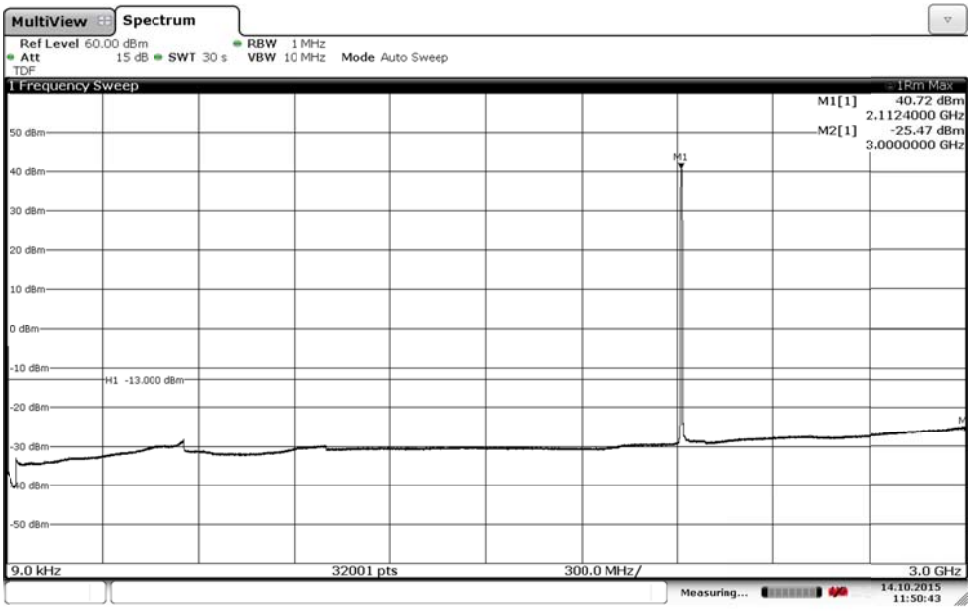
§27.53(h) and RSS-139 6.6

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

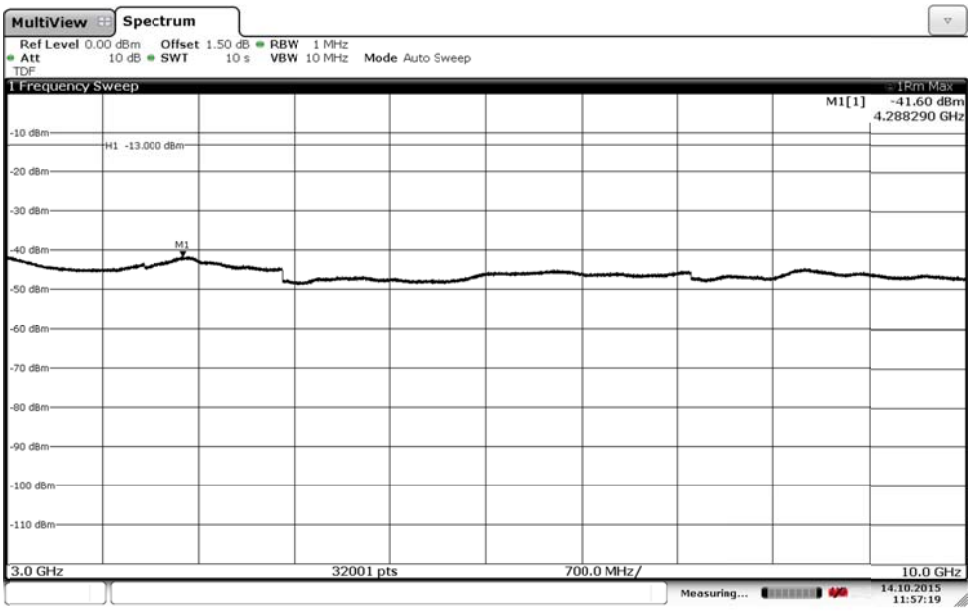
Appendix 6

Diagram 1a:



Date: 14.OCT.2015 11:50:42

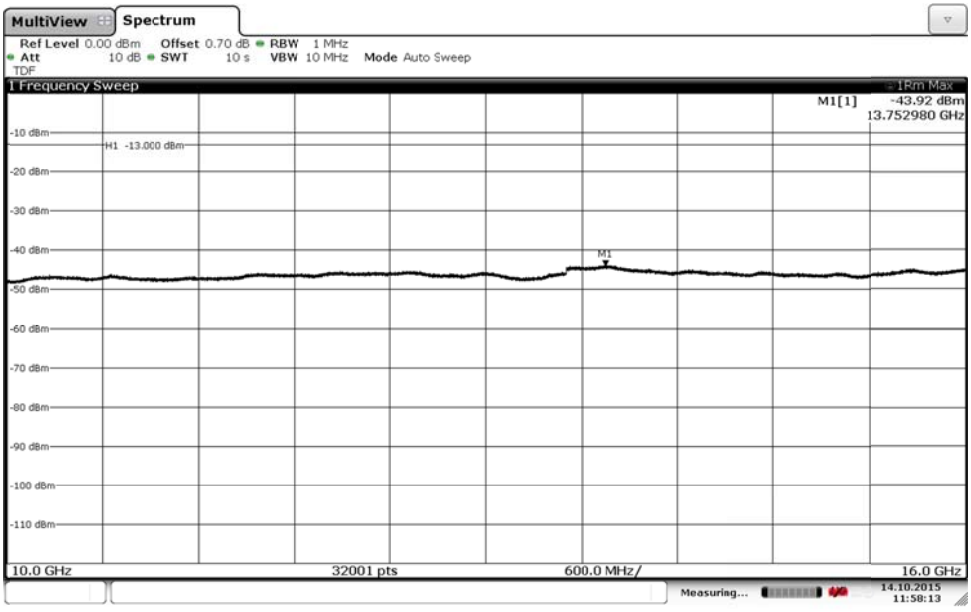
Diagram 1b:



Date: 14.OCT.2015 11:57:19

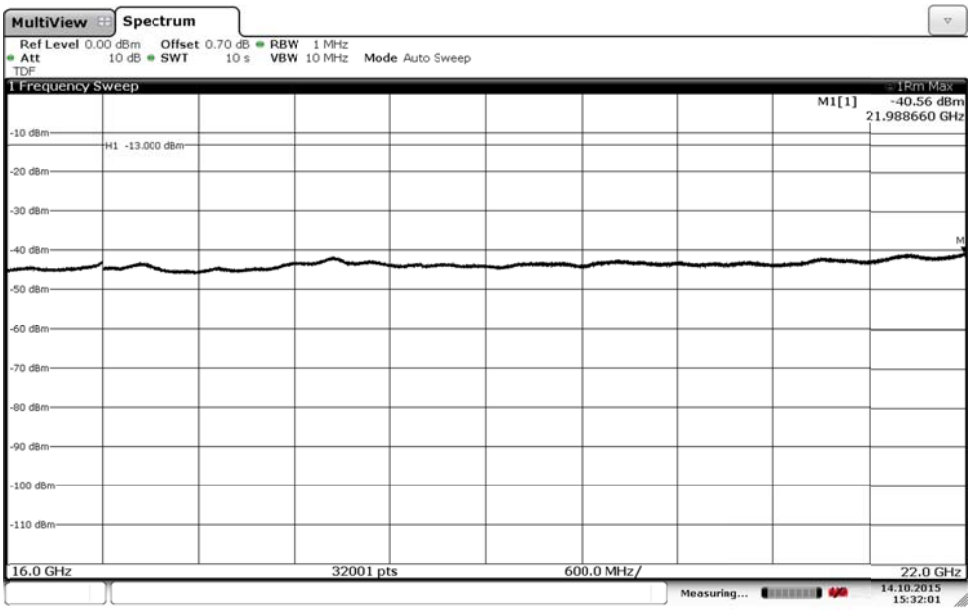
Appendix 6

Diagram 1c:



Date: 14.OCT.2015 11:58:13

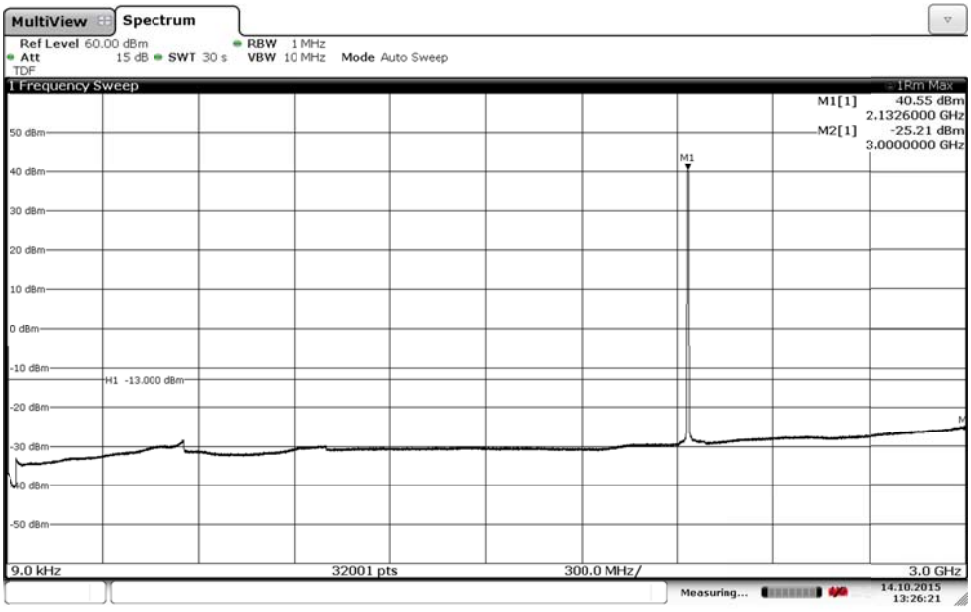
Diagram 1d:



Date: 14.OCT.2015 15:32:00

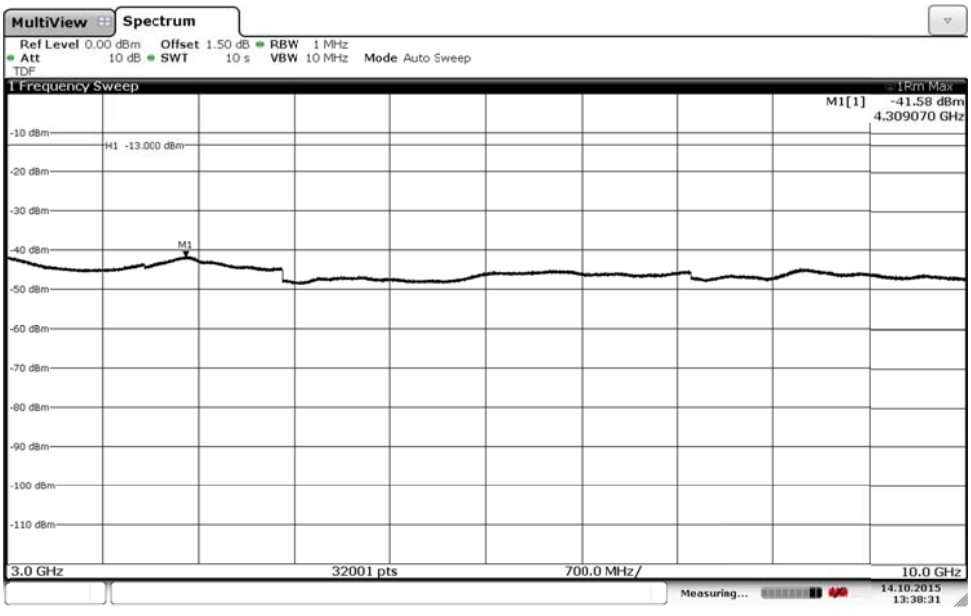
Appendix 6

Diagram 2a:



Date: 14.OCT.2015 13:26:21

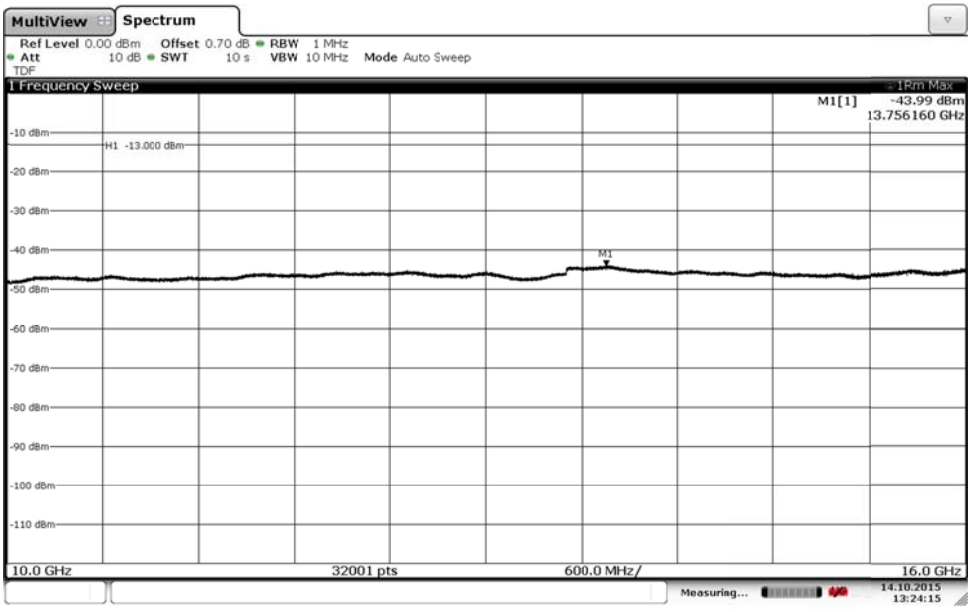
Diagram 2b:



Date: 14.OCT.2015 13:38:31

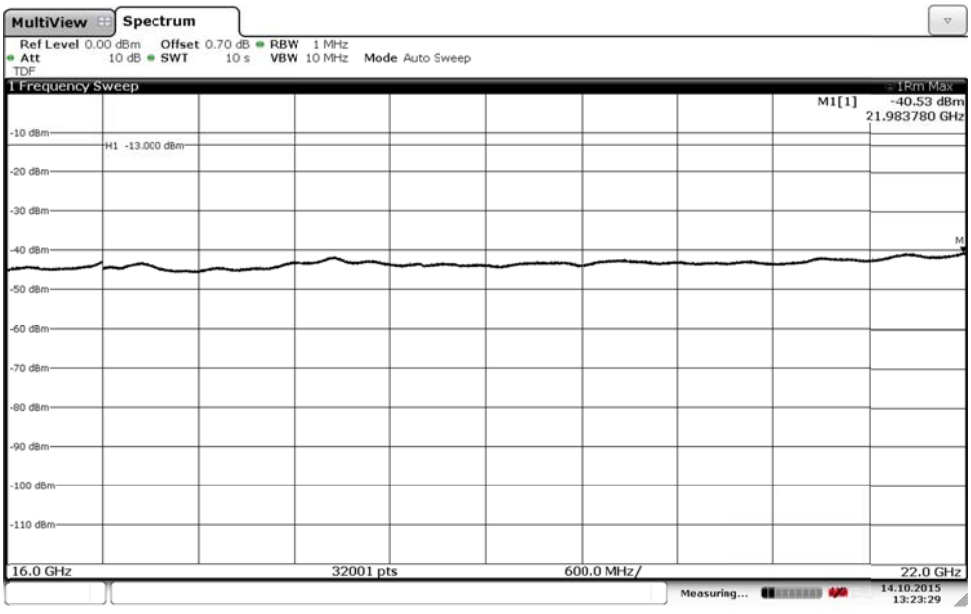
Appendix 6

Diagram 2c:



Date: 14.OCT.2015 13:24:14

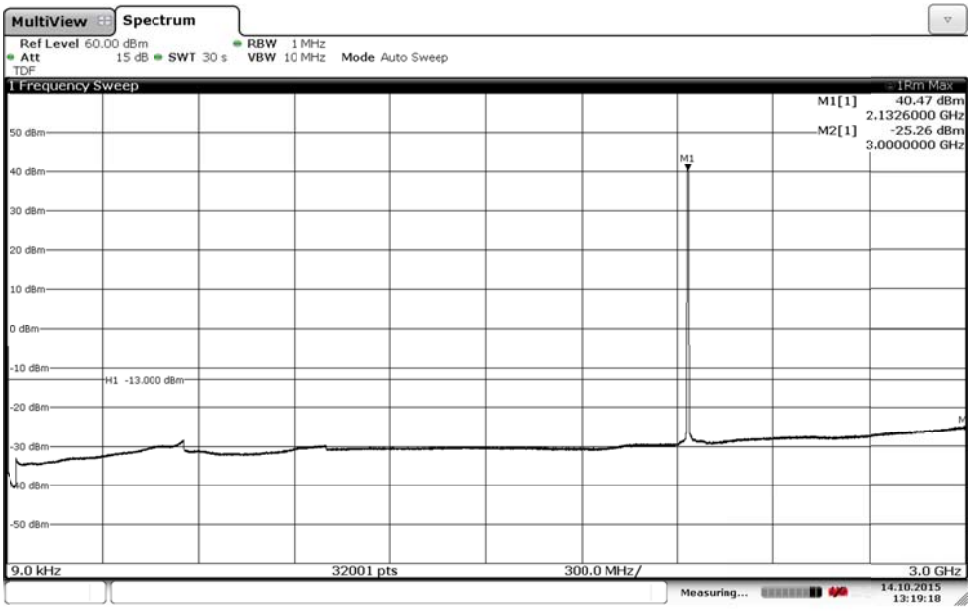
Diagram 2d:



Date: 14.OCT.2015 13:23:28

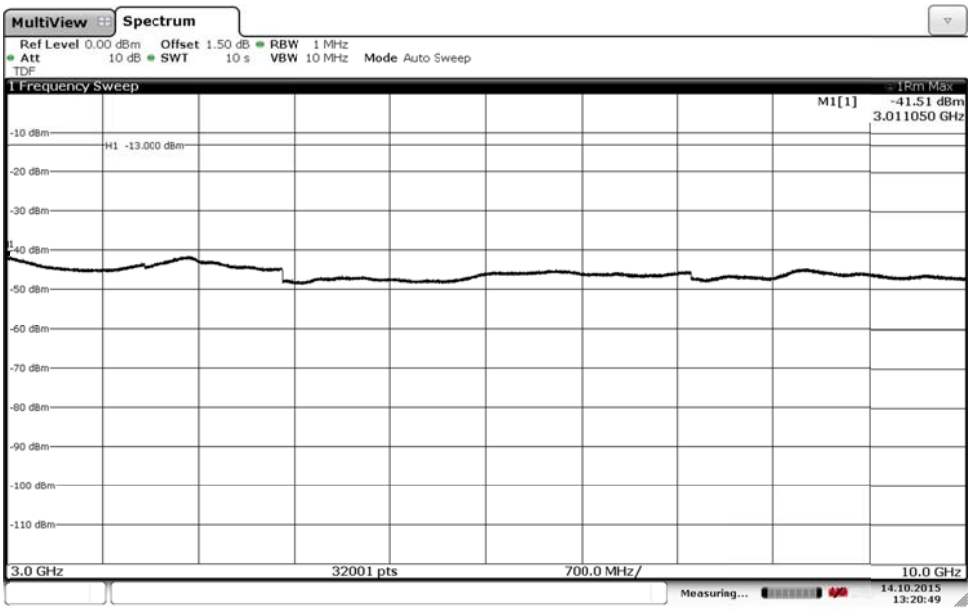
Appendix 6

Diagram 3a:



Date: 14.OCT.2015 13:19:18

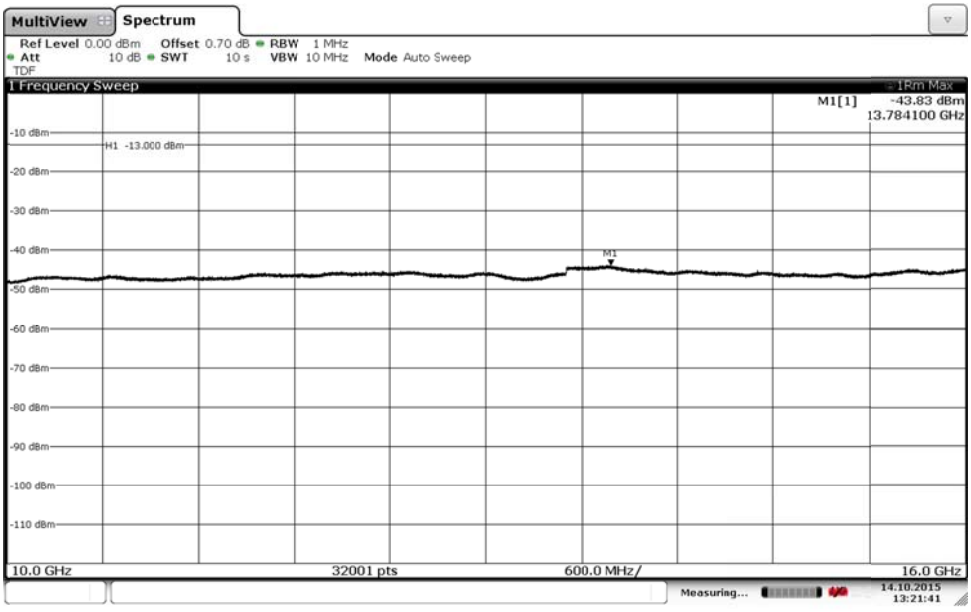
Diagram 3b:



Date: 14.OCT.2015 13:20:49

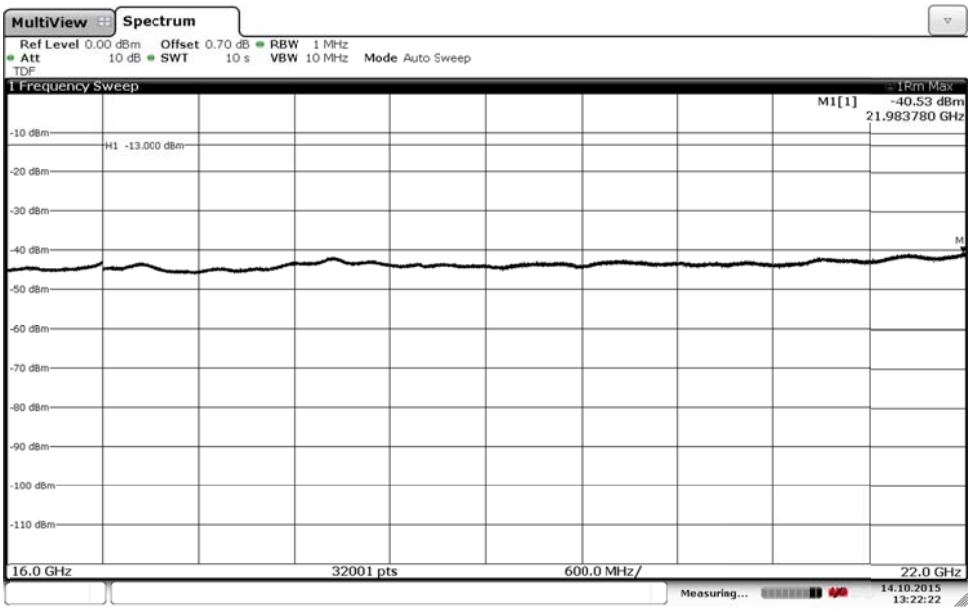
Appendix 6

Diagram 3c:



Date: 14.OCT.2015 13:21:41

Diagram 3d:



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Appendix 6

Diagram 4a:

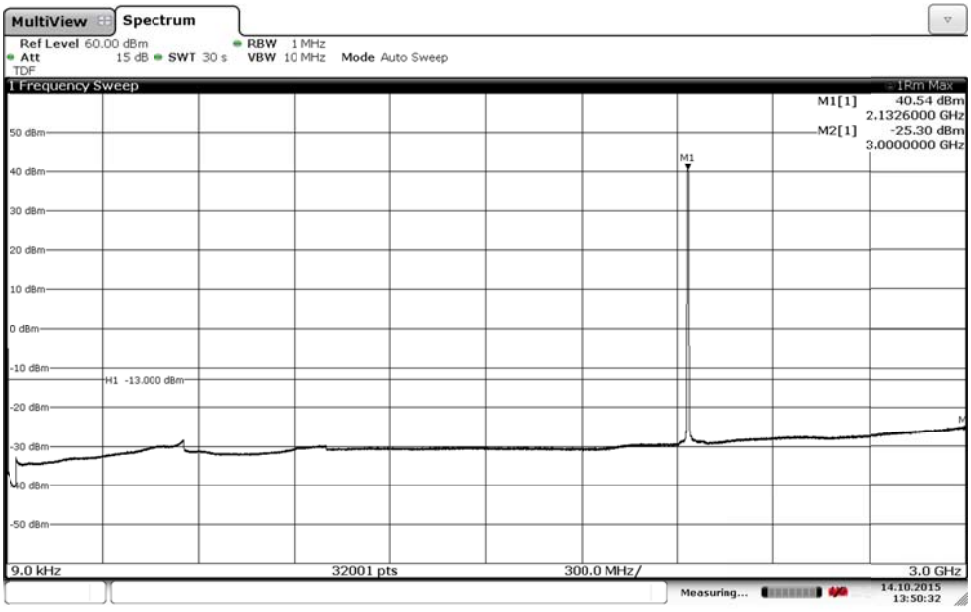

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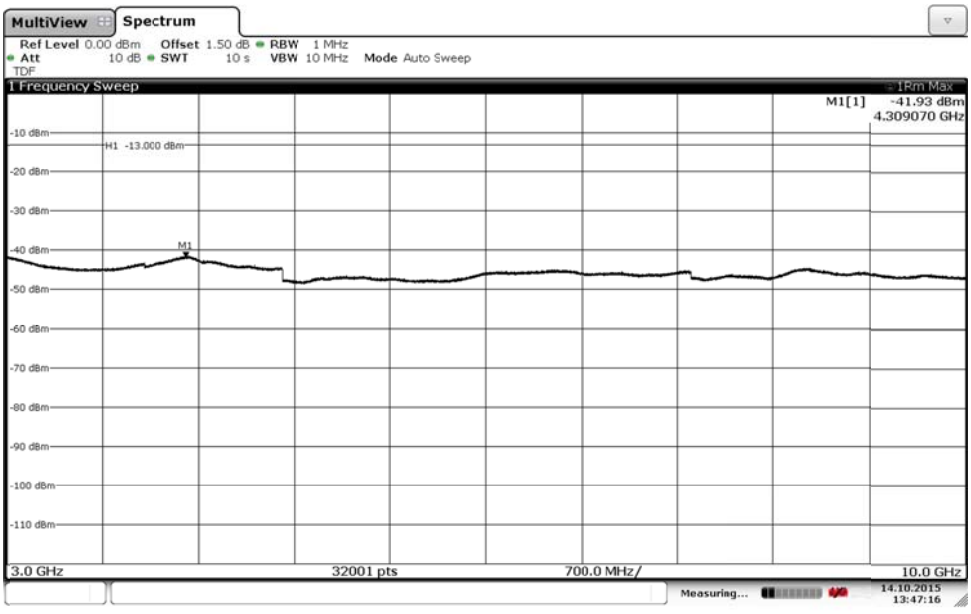
Diagram 4b:



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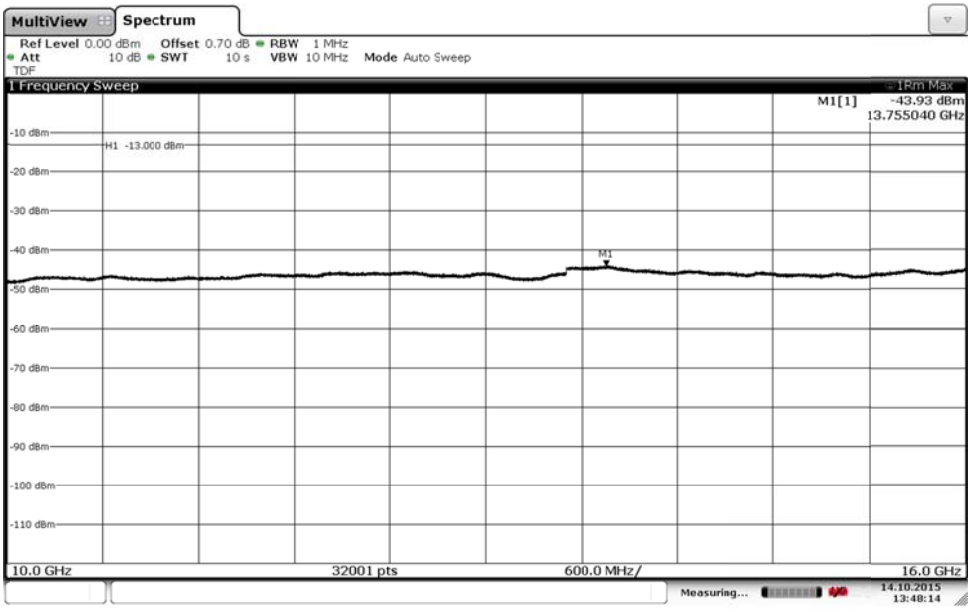
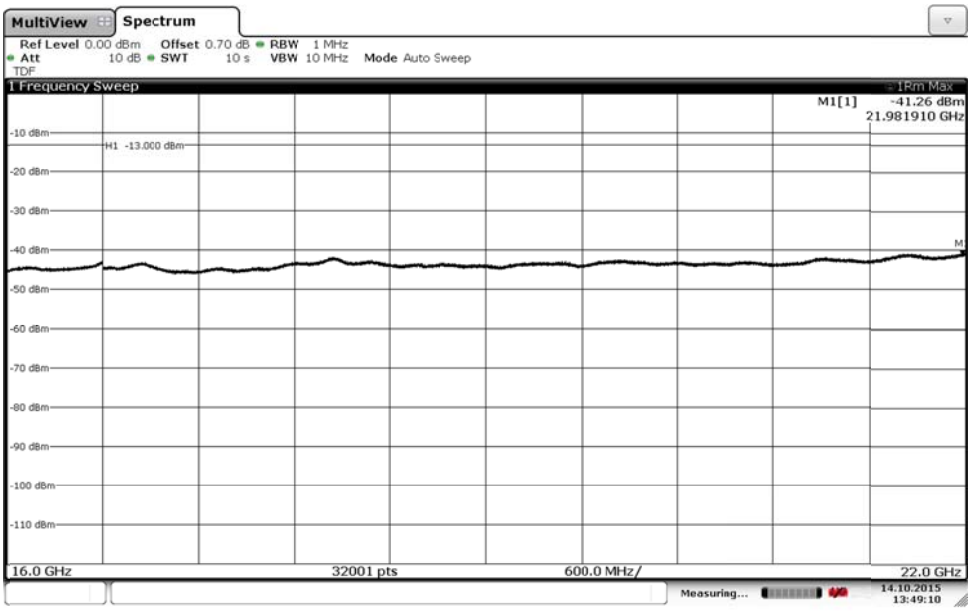
Appendix 6

Diagram 4c:



Date: 14.OCT.2015 13:48:14

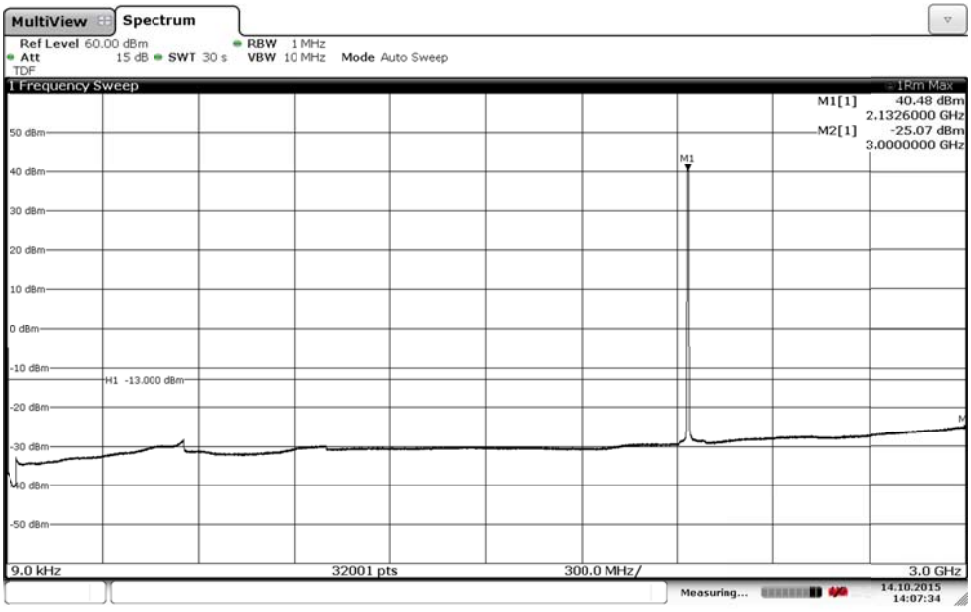
Diagram 4d:



Date: 14.OCT.2015 13:49:10

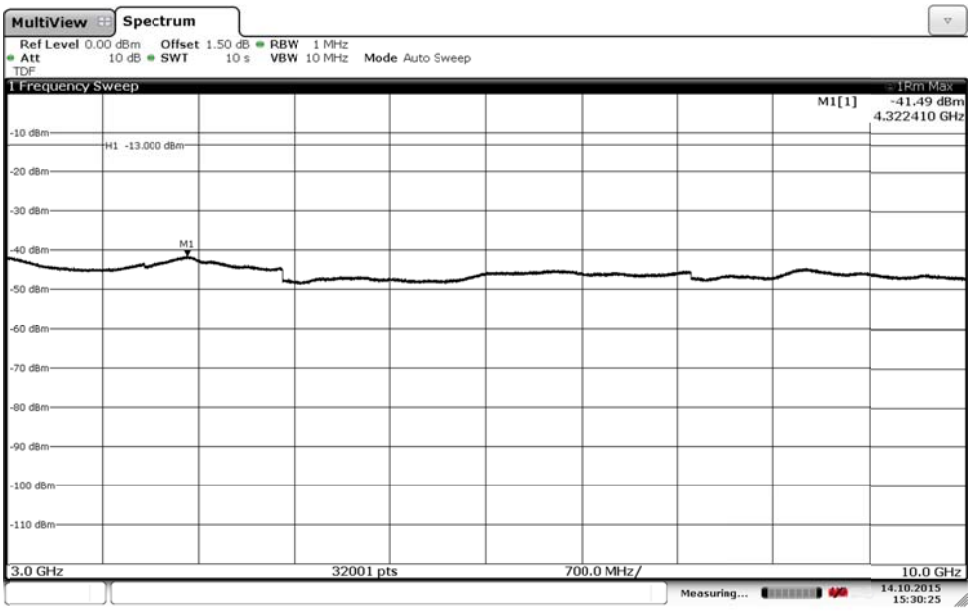
Appendix 6

Diagram 5a:



Date: 14.OCT.2015 14:07:34

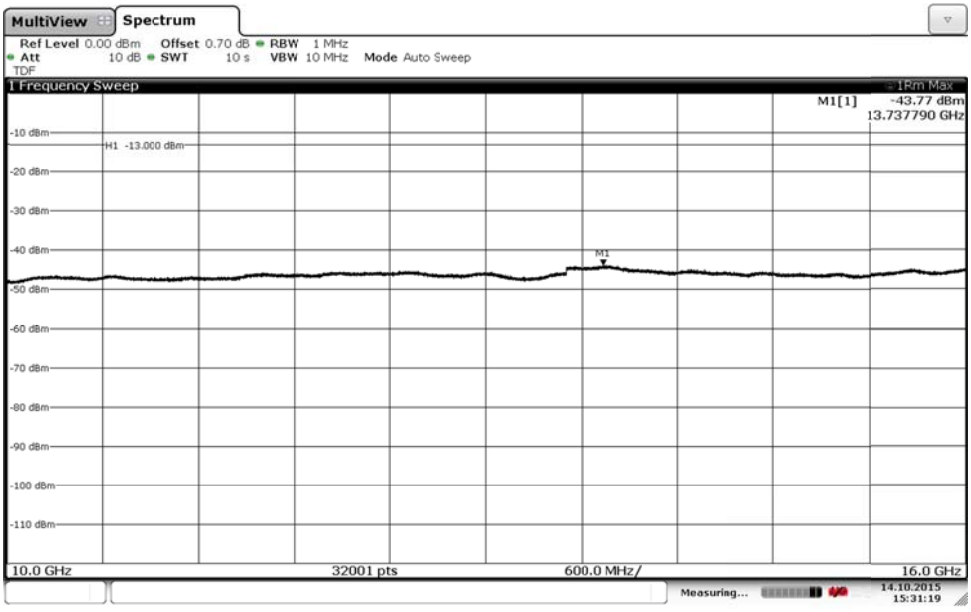
Diagram 5b:



Date: 14.OCT.2015 15:30:25

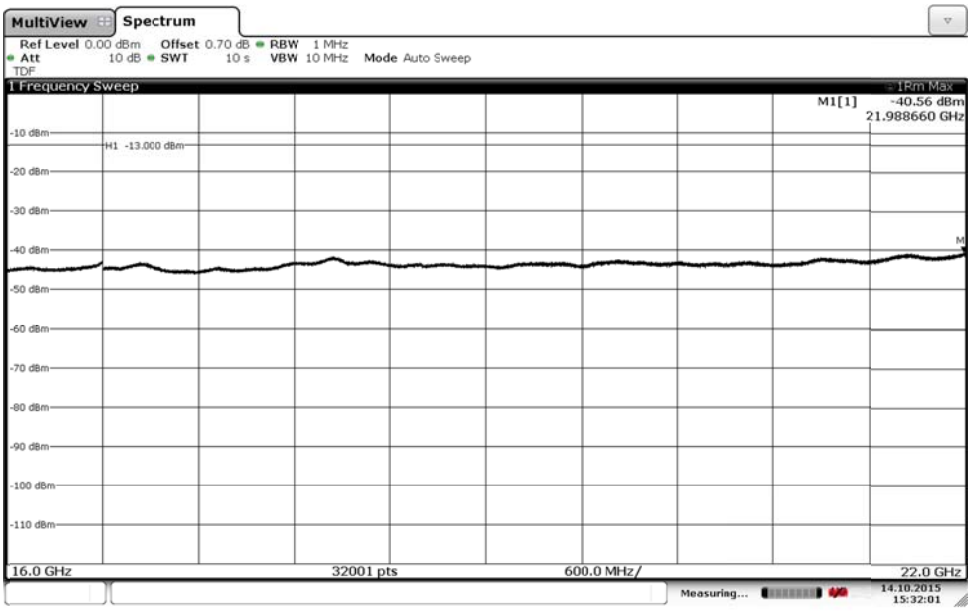
Appendix 6

Diagram 5c:



Date: 14.OCT.2015 15:31:18

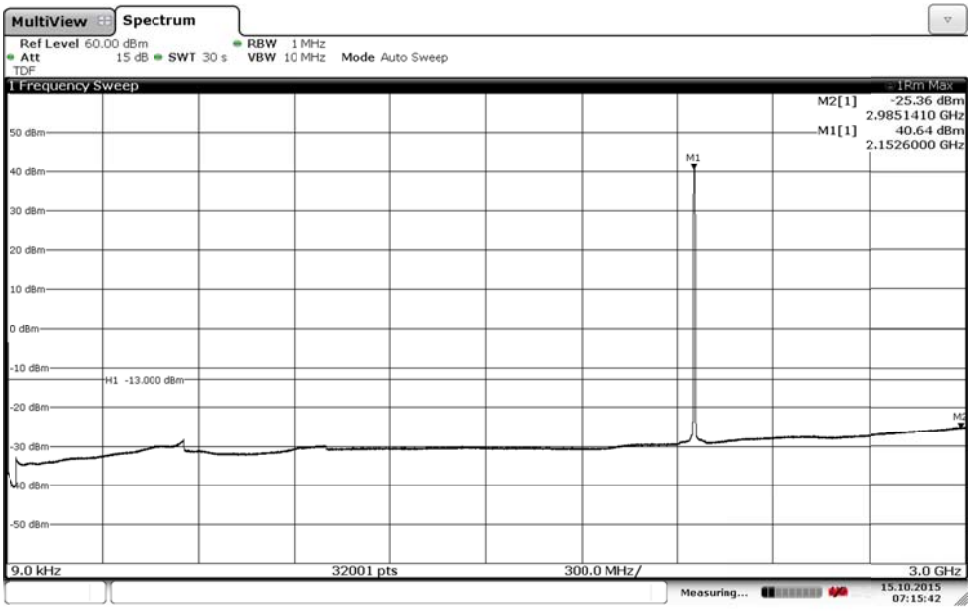
Diagram 5d:



Date: 14.OCT.2015 15:32:00

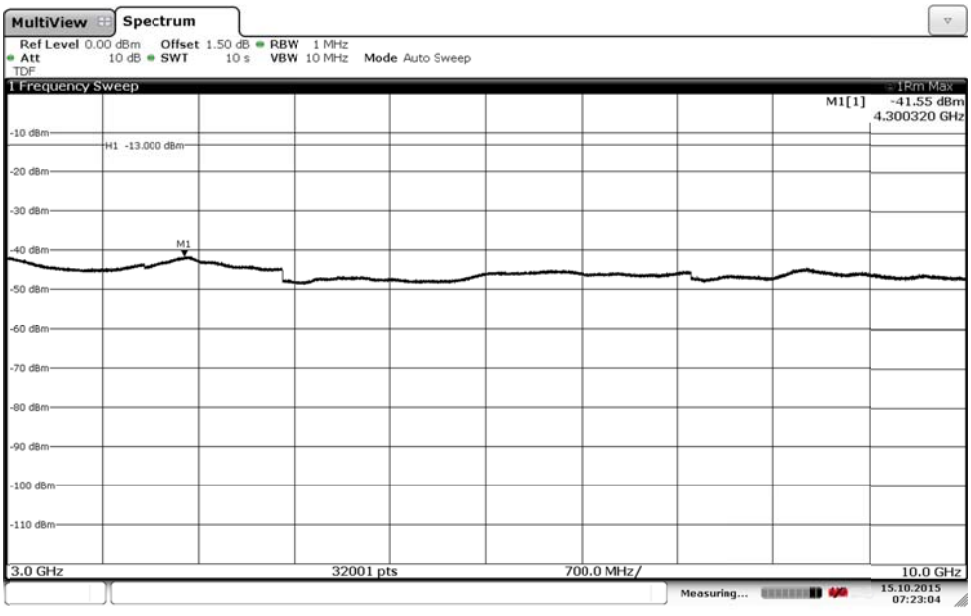
Appendix 6

Diagram 6a:



Date: 15.OCT.2015 07:15:41

Diagram 6b:



Date: 15.OCT.2015 07:23:04

Appendix 6

Diagram 6c:

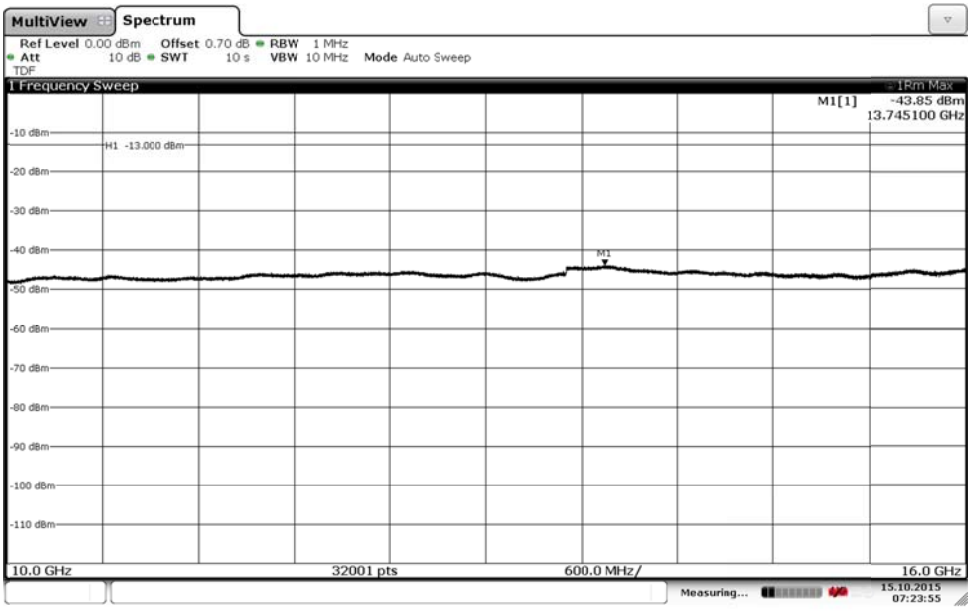


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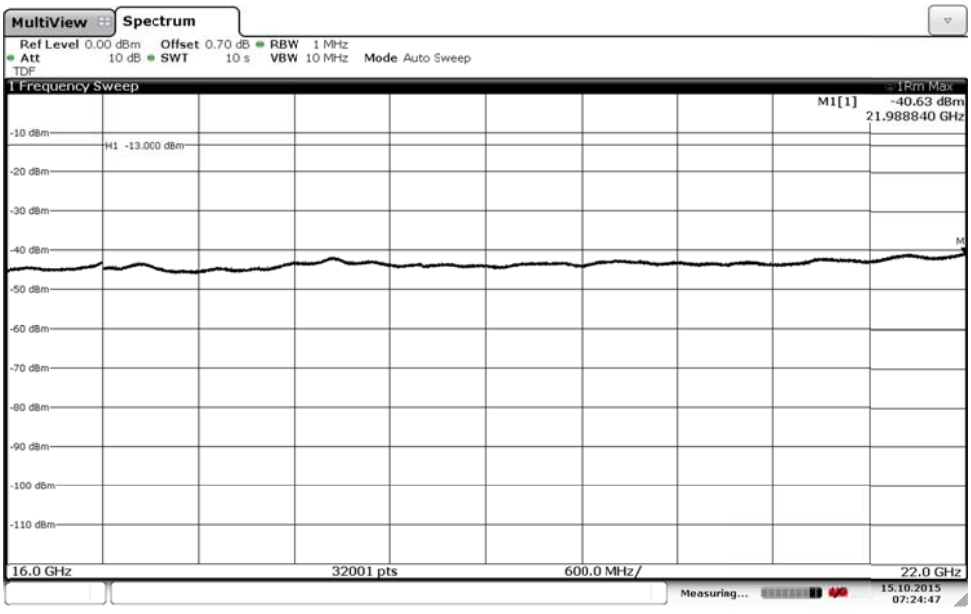
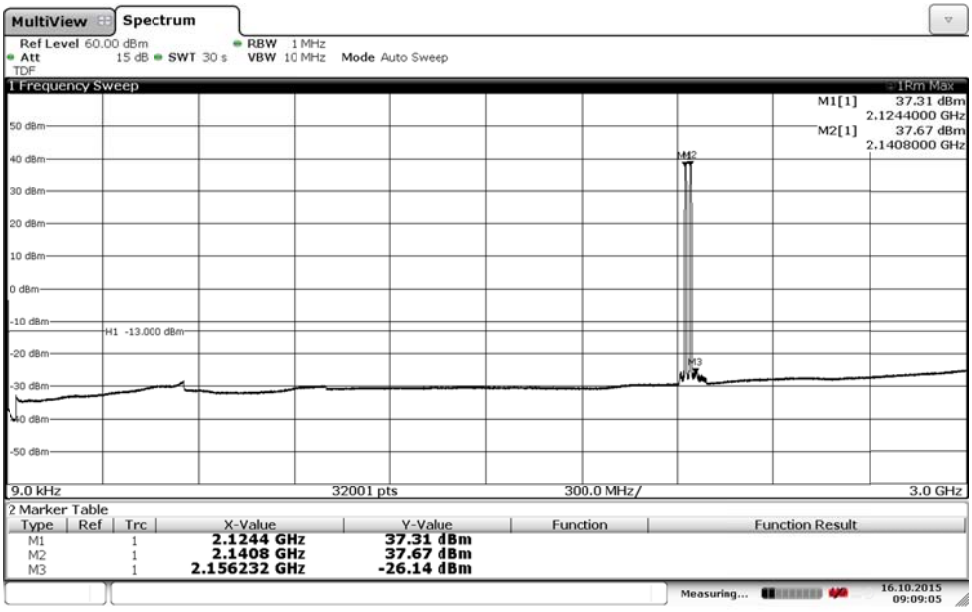
Diagram 6d:



Date: 15.OCT.2015 07:24:47

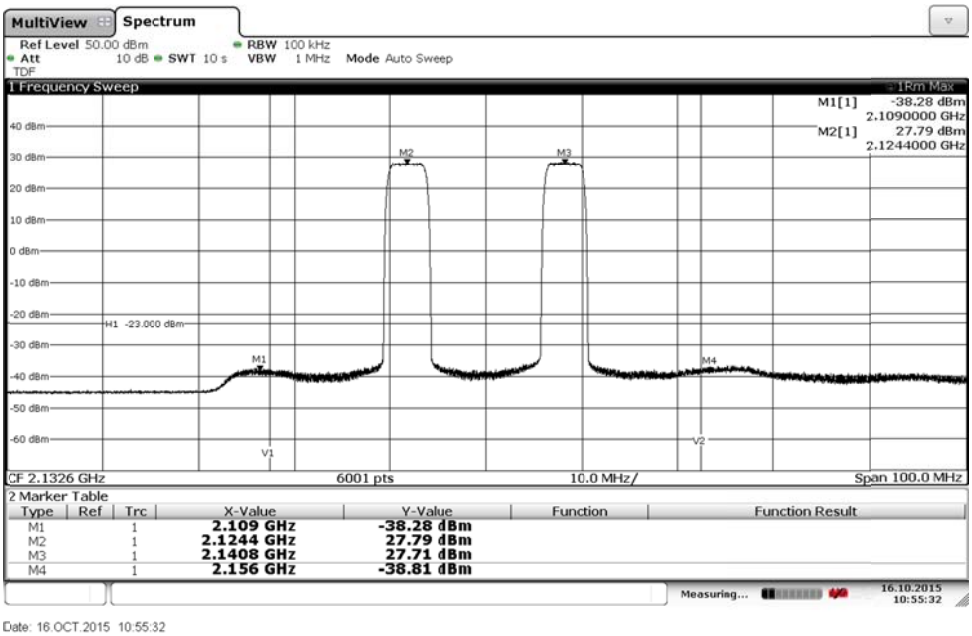
Appendix 6

Diagram 7a:



Date: 16.OCT.2015 09:09:05

Diagram 7b:



Date: 16.OCT.2015 10:55:32

Appendix 6

Diagram 7c:

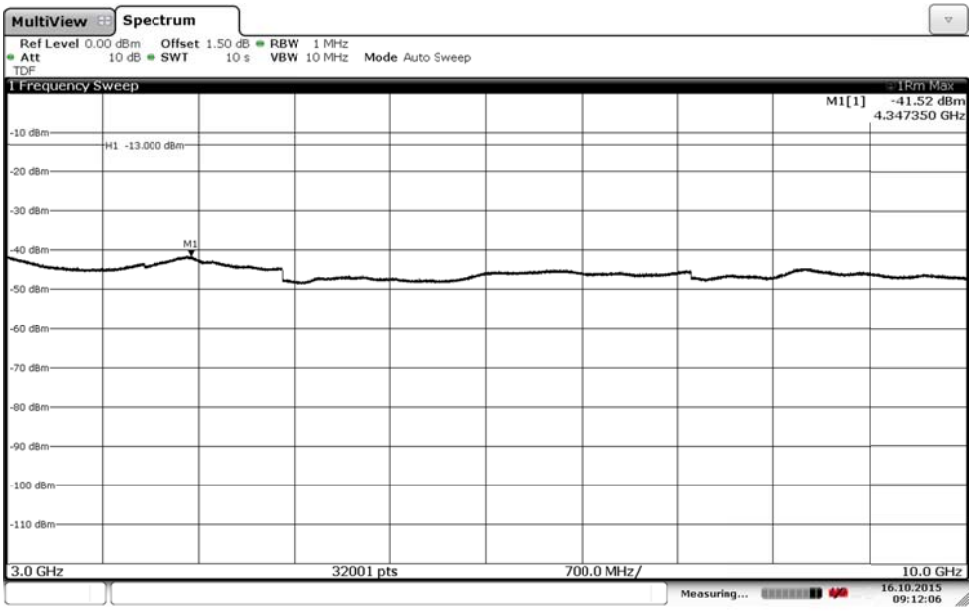


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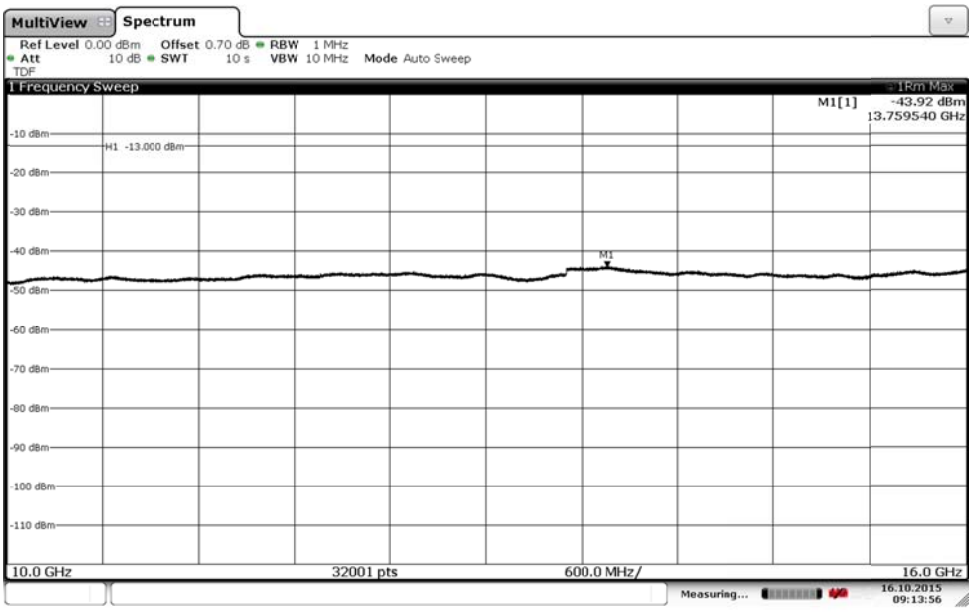
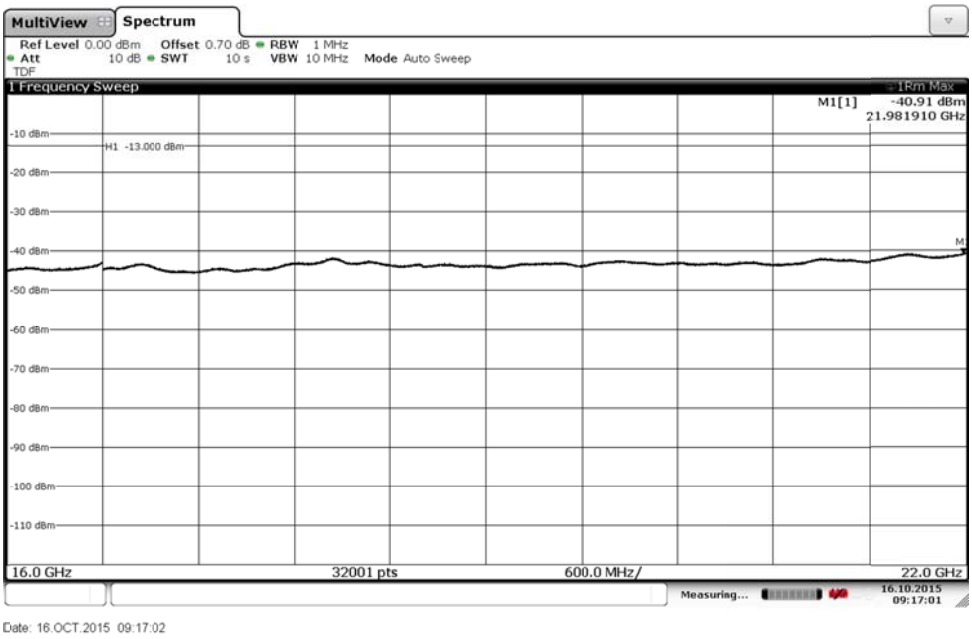
Diagram 7d:



Date: 16.OCT.2015 09:13:56

Appendix 6

Diagram 7e:



Field strength of spurious radiation measurements according to 47 CFR 27.53 (h) / IC RSS-139 6.6

Date	Temperature	Humidity
2015-10-09	23°C ± 3°C	31 % ± 5 %
2013-10-10	23°C ± 3°C	35 % ± 5 %

Test set-up and procedure

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

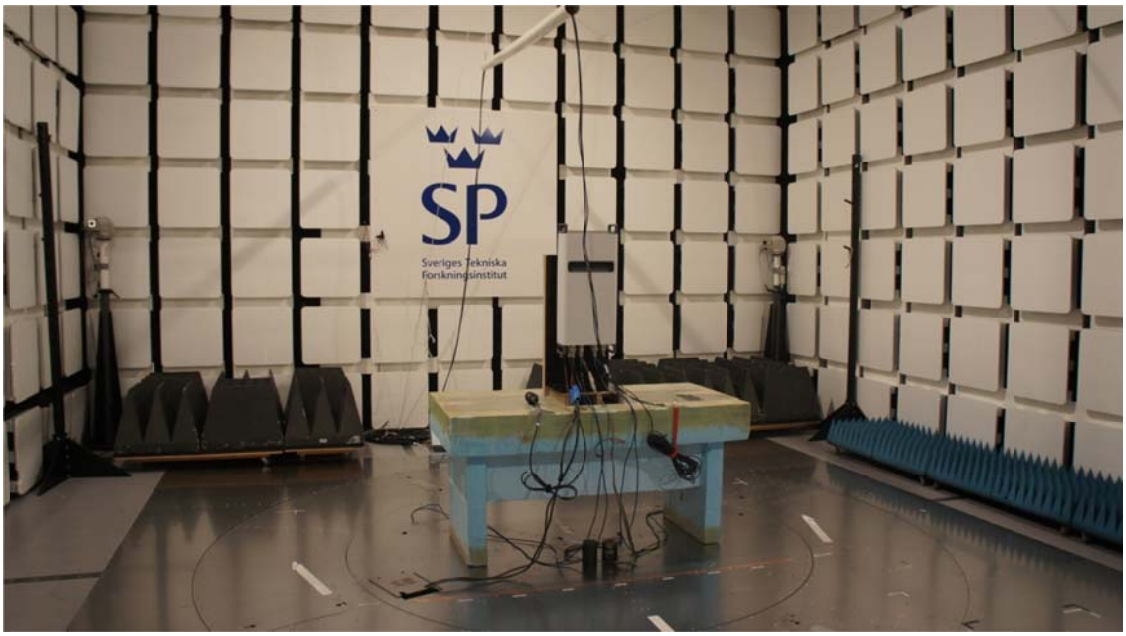
The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz – 18 GHz and 1m in the frequency range 18 - 22 GHz.

In the frequency range 30 MHz – 22 GHz the measurement was performed in power with a RBW of 1 MHz. A propagation loss in free space was calculated. The used formula was $\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

The measurement procedure was as the following:

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

The test 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 ESU40	901 385
EMC 32 ver. 9.15.0	503 745
Chase Bilog Antenna CBL 6111A	503 182
EMCO Horn Antenna 3115	902 212
Flann STD Gain Horn Antenna 20240-20	503 674
Flann STD Gain Horn Antenna 22240-20	503 674
High pass filter	504 200
Miteq, Low Noise Amplifier	503 278
Schwarzbeck BBV9742, Low Noise Amplifier	504 085
µComp Nordic, Low Noise Amplifier	901 545
Testo 635 temperature and humidity meter	504 203

Tested configurations:

Symbolic name
B-Rspr
M-Rspr
T-Rspr
B2-Rspr

Results, representing worst case

B2-Rspr, Diagram 1 a-c

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-22 000	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty:

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

Limits

§27.53(h) and RSS-139 6.6

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

Diagram 1a:

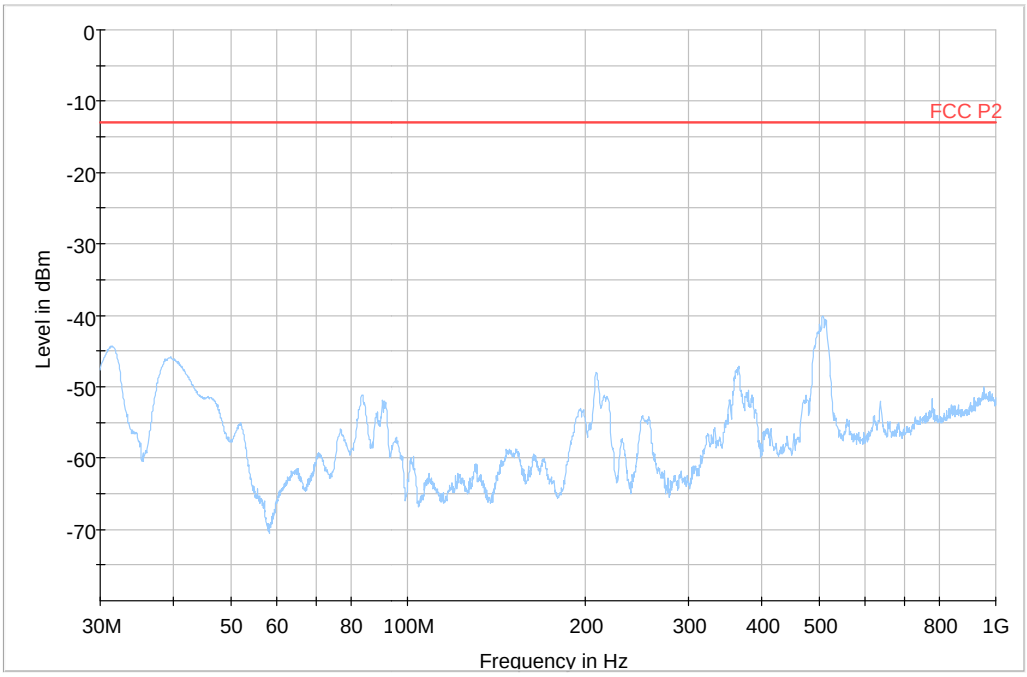
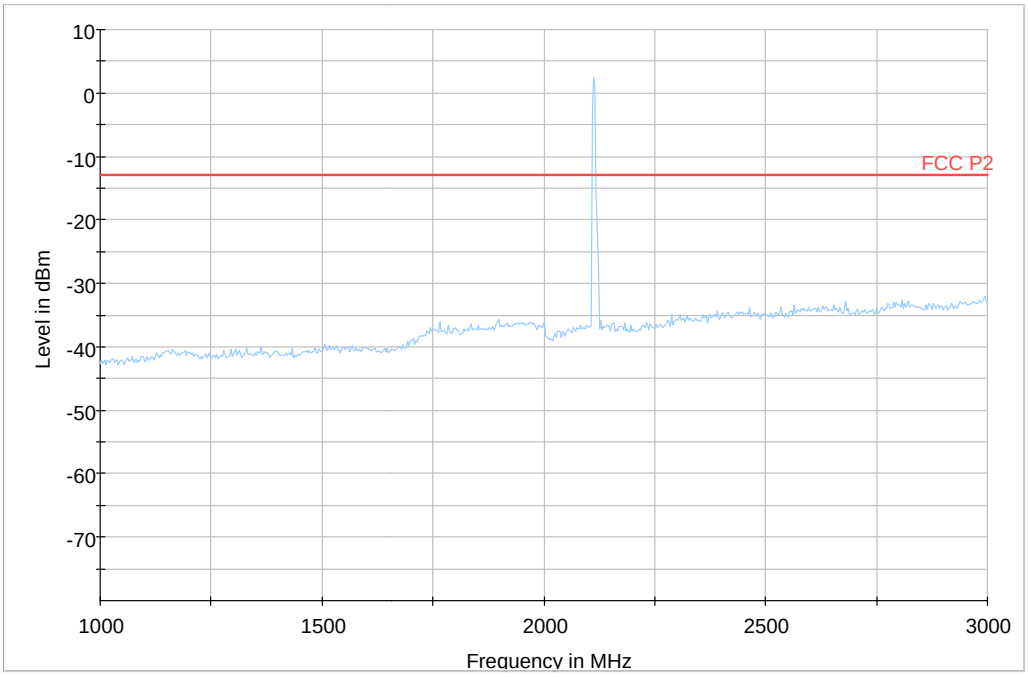


Diagram 1b:



Note: The emission at 2112.4 MHz is the carrier frequency and shall be ignored in the context.

Diagram 1c:

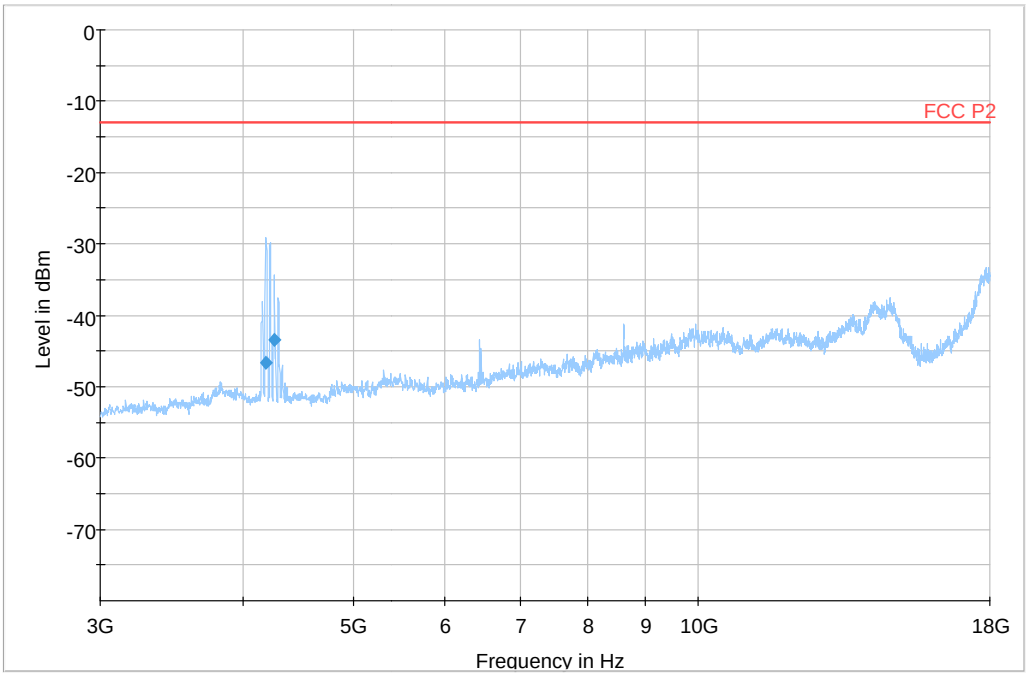
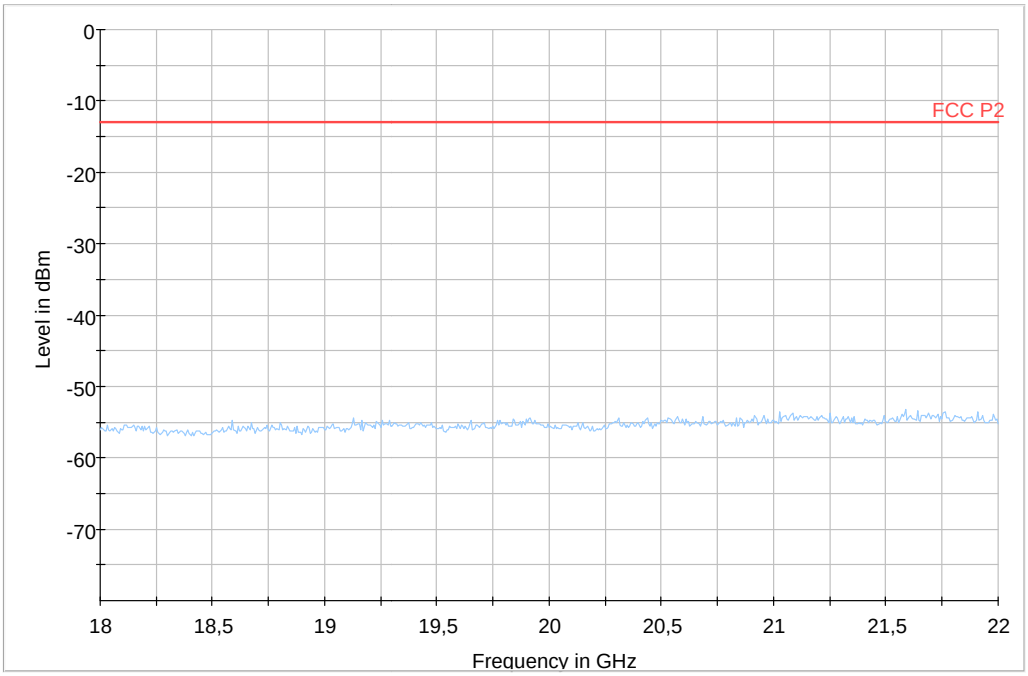


Diagram 1d:



Appendix 8

Frequency stability measurements according to CFR 47 §27.54/ IC RSS-139 6.4

Date	Temperature (test equipment)	Humidity (test equipment)
2015-10-15 to 2015-10-17	22-23 °C ± 3 °C	23-26 % ± 5 %

Test set-up and procedure

The measurement was made per 3GPP TS 25.141. The output was connected to a spectrum analyser. The spectrum analyser 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) (for MIMO -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
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 2132.6 MHz (M) with a bandwidth of 5 MHz. Rated output power level at connector RF A (maximum): 46 dBm.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
-48.0	+20	+6
-55.2	+20	+7
-40.8	+20	+7
-48.0	+30	-8
-48.0	+40	+10
-48.0	+50	+11
-48.0	+10	+8
-48.0	0	+11
-48.0	-10	+8
-48.0	-20	+8
-48.0	-30	-9
Maximum freq. error (Hz)		11
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Test conditions			Frequency margin to band edge at -19dBm (-22.67 with 20kHz)			
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 (2110 MHz) [kHz]	fH [MHz]	Offset to upper band edge (2155 MHz) [kHz]
-48.0	+20	5	2110.012	12.0	2154.998	2.0

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

Limits

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

RSS-139 6.4 Frequency:
The frequency stability shall be sufficient to ensure that the emission bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen

Complies?	Yes

Appendix 8

External photos

Front side

Appendix 8

Rear side

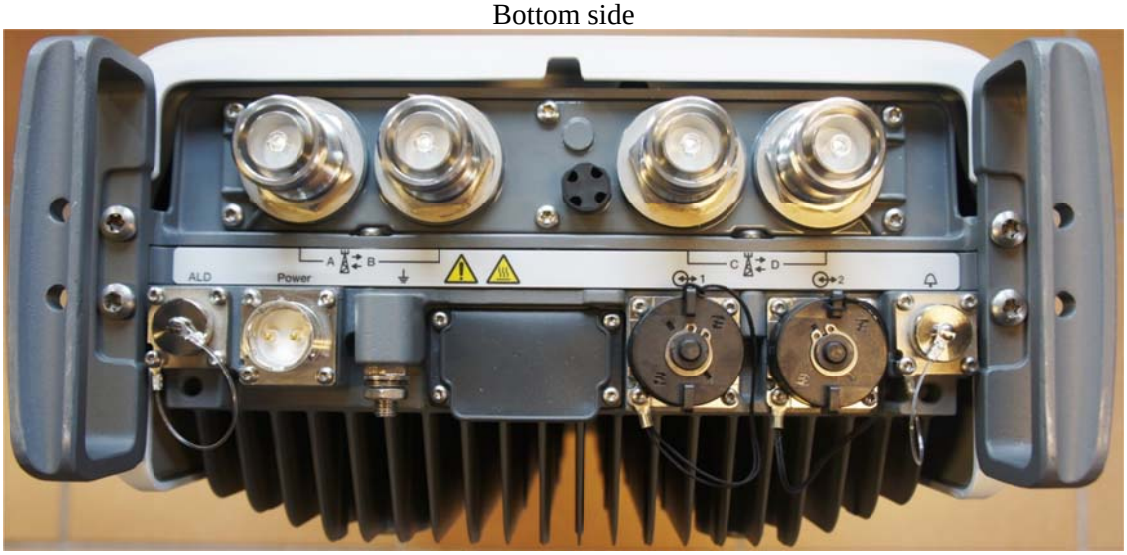
Appendix 8

Left side

Right side

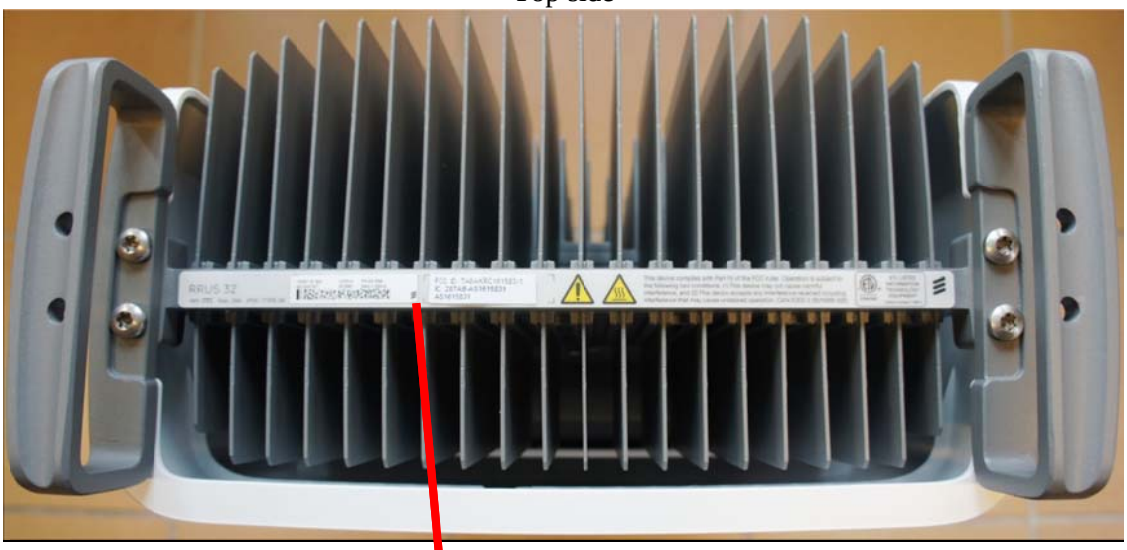
Appendix 8

Bottom side



Appendix 8

Top side



Product label

FCC and IC label