

FCC REPORT

Applicant: Spotwave Wireless Limited

Address of Applicant: 500 Van Buren St., Box 550, Kemptville, Ontario Canada
K0G1J0

Equipment Under Test (EUT)

Product Name: Cellular Signal Booster

Model No.: SpotCell2104Xf, SpotCell3104Xf

Trade mark: Spotwave

FCC ID: P3YSPOTCELL0201

Applicable standards: FCC CFR Title 47 Part 27
FCC CFR Title 47 Part 2

Date of sample receipt: 16 Jul., 2014

Date of Test: 17 Jul., to 06 Aug., 2014

Date of report issued: 25 Sep., 2014

Test Result: PASS*

* In the configuration tested, the EUT complied with the standards specified above

Authorized Signature:

A blue circular stamp with the text "SHENZHEN ZHONGJIAN NANFANG TESTING CO., LTD." around the perimeter and "CCIS" in the center. A handwritten signature in black ink is written over the stamp.

Bruce Zhang
Laboratory Manager

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the CCIS product certification mark. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

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2 Version

Version No.	Date	Description
00	25 Sep., 2014	Original

Prepared By:

Sera Xiang

Date:

25 Sep., 2014

Report Clerk

Check By:

Abimb Yang

Date:

25 Sep., 2014

Project Engineer

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4 Test Summary

Test Item	Section	Result
Maximum Permissible exposure(MPE)	§1.1307(b)(1), §2.1091	PASS* (Please refer to MPE Report)
RF Output Power	§2.1046(a), §27.50,	PASS
Occupied Bandwidth	§2.1049	PASS
Spurious Emissions at Antenna Terminals and inter modulation	§2.1051, §27.53	PASS
Inter-modulation	§2.1051, §27.53	PASS
Field Strength of Spurious Radiation	§2.1053, §27.53	PASS
Out of band emission, Band Edge	§27.53	PASS
Frequency stability vs. temperature Frequency stability vs. voltage	§ 2.1055, § 27.54	N/A*

Remark:

N/A*: Not application for booster.

5 General Information

5.1 Client Information

Applicant:	Spotwave Wireless Limited
Address of Applicant:	500 Van Buren St., Box 550, Kemptville, Ontario Canada K0G1J0
Manufacturer:	Spotwave Wireless Limited
Address of Manufacturer :	500 Van Buren St., Box 550, Kemptville, Ontario Canada K0G1J0

5.2 General Description of E.U.T.

Product Name:		Cellular Signal Booster	
Model No.:		SpotCell2104Xf, SpotCell3104Xf	
Power supply:		Model No.: GS160A12 Input: 100V-240V AC, 50/60Hz ,2.0A Output: 12V DC MAX 11.5A	
Operating Temperature:		Remote Unit: -25℃ to + 55℃	
Operating Humidity:		5%~95%	
Technical Parameter:			
Frequency Range	AWS1700	Downlink	2112.4 MHz~2152.6 MHz
		Uplink	1712.4 MHz~1752.6 MHz
Maximum Output Power		Downlink≥ 24dBm, Uplink≥ 18dBm	
Max Gain		Downlink≥ 80dB ,Uplink≥ 80dB	
Modulation and Designator		WCDMA/F9W	
Antenna Type		External antenna	
Antenna Gain		Downlink :10 dBi, Uplink: 11 dBi	
Remark		The model No. SpotCell2104Xf, SpotCell3104Xf were identical inside, the electrical circuit design, layout, components used and internal wiring, They named differently just due to different output power levels and gains achieved by adjusting the potentiometer, or assembled with different cases. Base on the differences between them, we selected the model SpotCell3104Xf for full Test.	

5.3 Related Submittal(s) / Grant (s)

No related submittal(s)

5.4 Test Methodology

ANSI C63.4: 2003	Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI/TIA-603-C 2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
KDB 935210 D02 v02r01	Signal Boosters Certification

5.5 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **FCC - Registration No.: 817957**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 817957, February 27, 2012.

● **IC - Registration No.: 10106A-1**

The 3m Semi-anechoic chamber of Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

● **CNAS - Registration No.: CNAS L6048**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L6048.

5.6 Laboratory Location

Shenzhen Zhongjian Nanfang Testing Co., Ltd.
Address: No. B-C, 1/F., Building 2, Laodong No.2 Industrial Park, Xixiang Road,
Bao'an District, Shenzhen, Guangdong, China
Tel: +86-755-23118282
Fax: +86-755-23116366

5.7 Test Instruments list

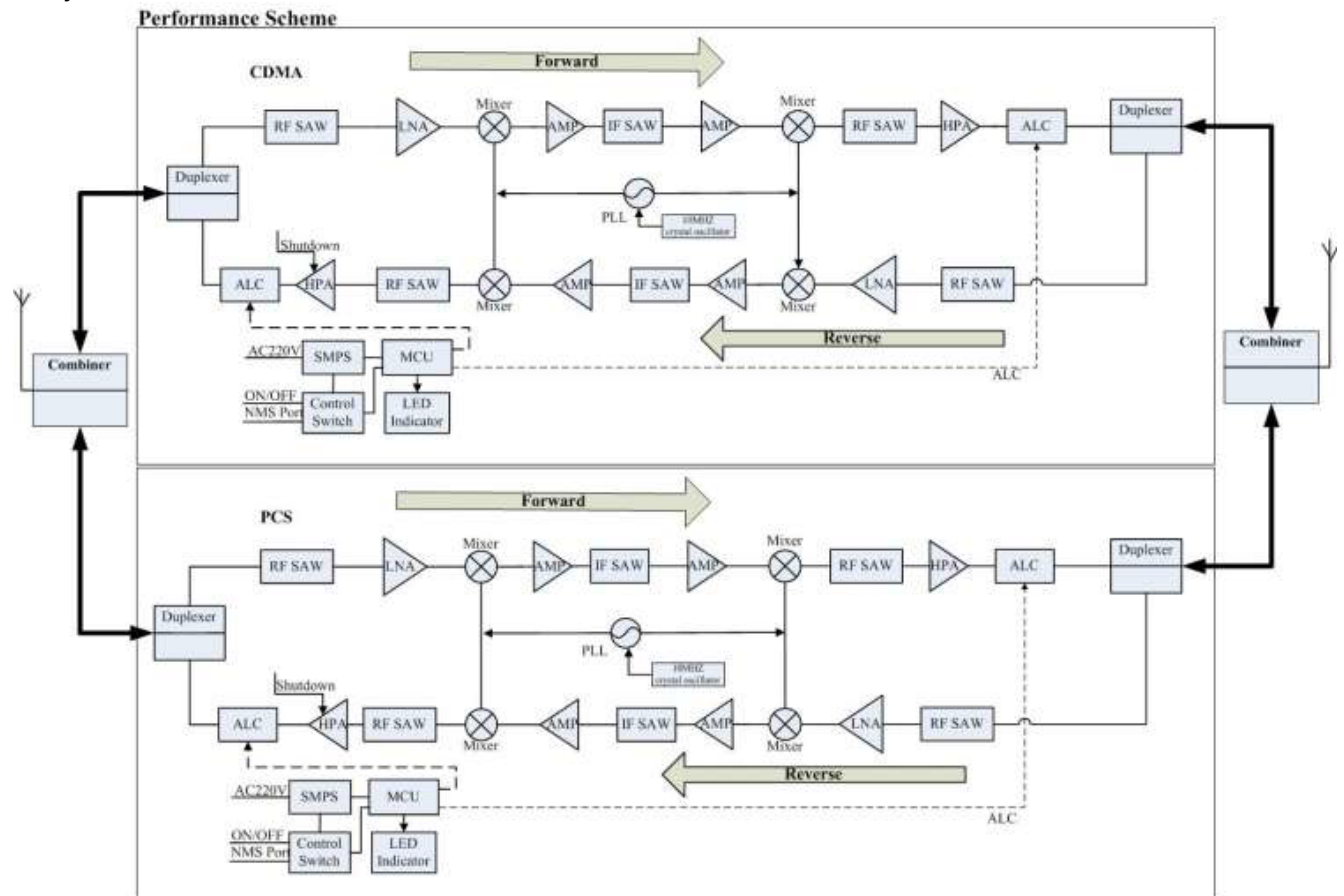
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	SAEMC	9(L)*6(W)* 6(H)	CCIS0001	June 09 2014	June 08 2015
2	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	CCIS0005	June 04 2014	June 03 2015
3	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	CCIS0006	May 28 2014	May 27 2015
4	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
5	Amplifier (10kHz-1.3GHz)	HP	8447D	CCIS0003	Apr. 01 2014	Mar. 31 2015
6	Amplifier (1GHz-18GHz)	Compliance Direction Systems Inc.	PAP-1G18	CCIS0011	June. 09 2014	June. 08 2015
7	Positioning Controller	UC	UC3000	CCIS0015	N/A	N/A
8	Power Meter	Agilent	E4418B	GB42421076	Apr. 15 2014	Apr. 14 2015
9	Power Sensor	HP	8481A	US37293152	Apr. 15 2014	Apr. 14 2015
10	Signal Generator	Aero flex	IFR3413	341006/286	Apr. 15 2014	Apr. 14 2015
11	Signal Generator	Aero flex	IFR2026Q	112282/081	May. 10 2014	May. 9 2015
12	Vector Signal Generator	Agilent	E4438C	MY45093111	May. 10 2014	May. 9 2015
13	Network analyzer	HP	8753D	3410A08987	May. 10 2014	May. 9 2015
14	Spectrum Analyzer	Rohde & Schwarz	FSP30	CCIS0023	May.10.2014	May. 9.2015
15	Universal radio communication tester	Rohde & Schwarz	CMU200	CCIS0069	May.10.2014	May.9.2015

6 TEST CONFIGURATION AND CONDITIONS

6.1 EUT Configuration

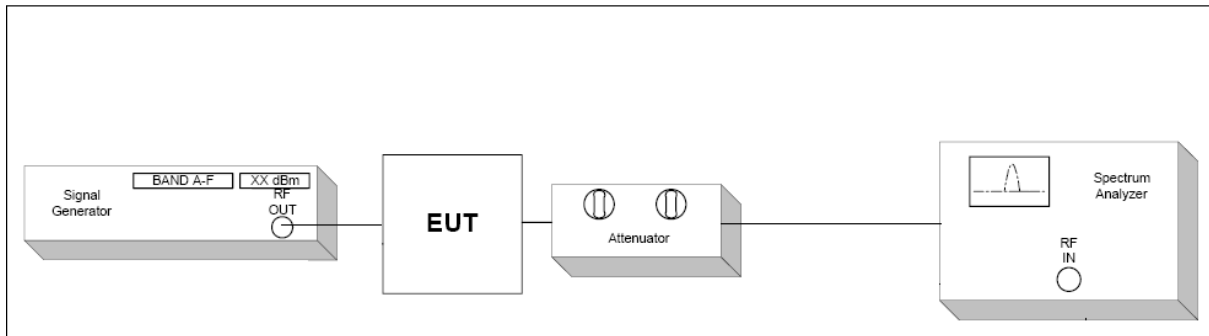
SpotCell2104Xf is basically a bi-directional booster, the downlink signals are received by the booster from BTS by the donor antenna, filtered by its combiner, internal duplexers and FC unit, amplified by low noise amplifier (LNA) and downlink PA unit, and then sent via the server antenna to the coverage area. The bandwidth is wide band frequency.

The uplink signal of mobile terminal from the coverage area is input via the server antenna, then filtered by combiner, duplexers and FC unit, amplified by the uplink low noise amplifier (LNA) and the uplink PA unit and finally sent via the donor antenna to the BTS.

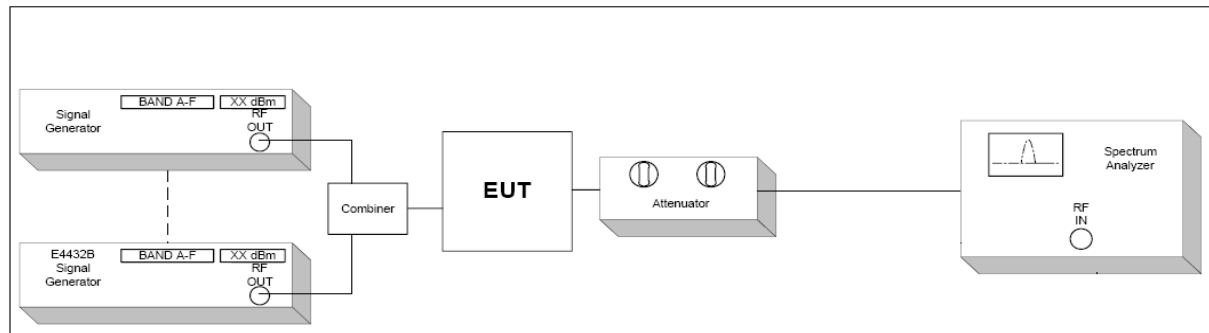


6.2 Configuration of Tested System

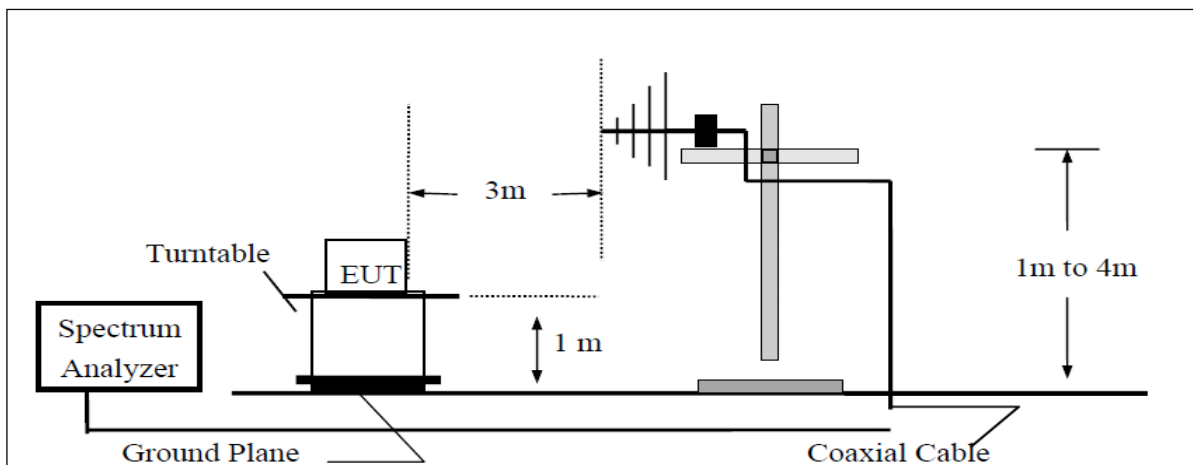
(A) RF Output Power, Occupied Bandwidth, Spurious Emissions at Antenna Terminal, Band Edge, Test Setup



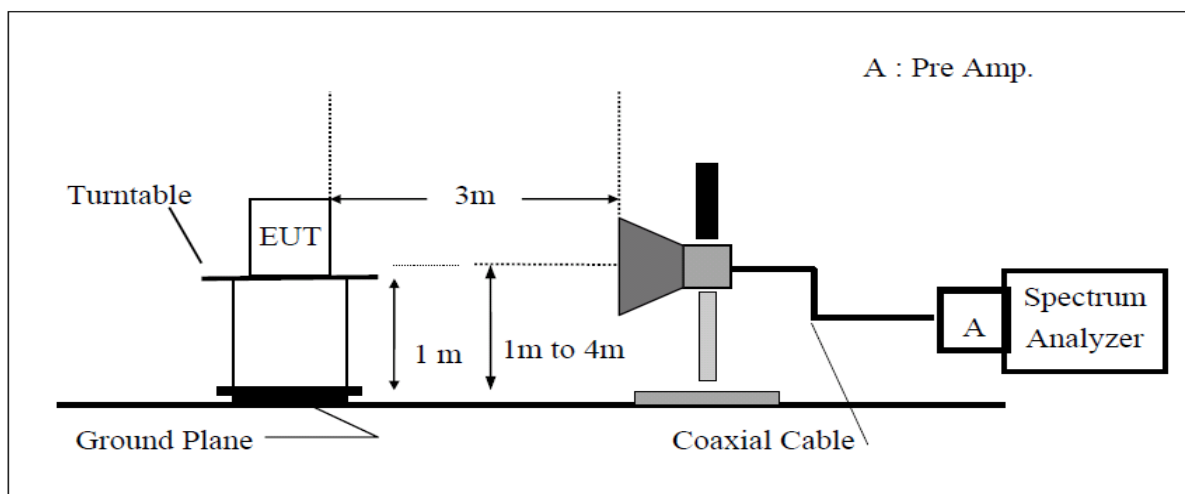
(B) Inter-modulation Test Setup



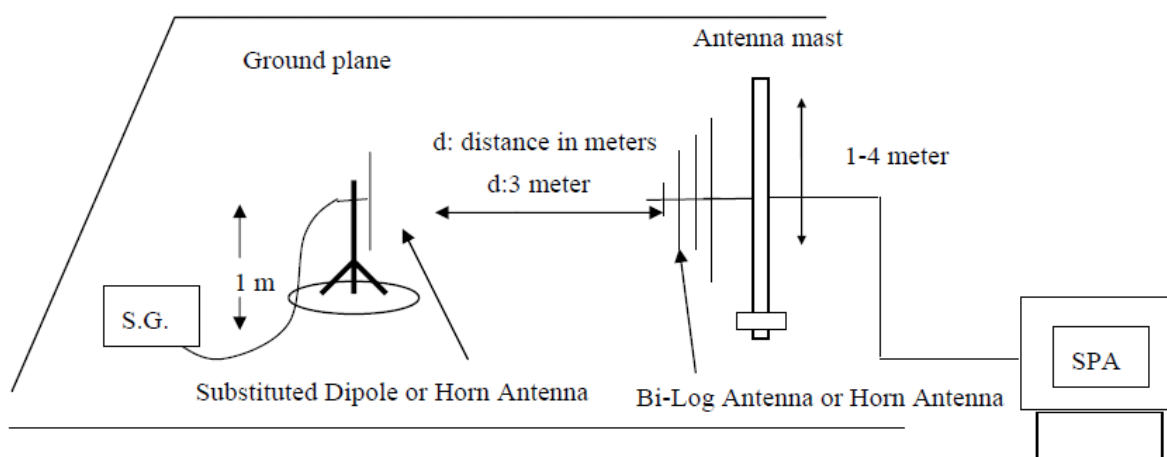
(C) Radiated Emission Test Setup, Frequency below 1000MHz



(D) Radiated Emission Test Setup Frequency over 1 GHz



(E) Substituted Method Test Setup



6.3 Test Environments

Condition	Minimum value	Maximum value
Barometric pressure	86 kPa	106 kPa
Temperature	15°C	30°C
Relative Humidity	25 %	75 %
Power supply range	±5% of rated voltages	
Normal Test Condition	(1). Temperature: +15 °C to +30 °C; (2). Voltage is AC 120V	
Extreme Test Conditions	(1). Temperatures: -25°C to +55°C. (2). Voltages: AC 102V to AC138V.	

6.4 Test Configurations

Operating Mode	Direction	Channels frequency (MHz)		
		Low Ch.	Mid Ch.	High Ch.
AWS1700	Downlink	2112.4	2132.4	2152.6
	Uplink	1712.4	1732.4	1752.6

6.5 Description of test modes

Test mode	Detail description of the test mode
AWS1700 mode	AWS1700 modulation

6.6 Test Conditions

Test case	Test Conditions	
RF Output Power	RF channels	L,M,H
Occupied Bandwidth	RF channels	L,M,H
Spurious emission at antenna terminals	RF channels	L,M,H
Inter-modulation	RF channels	L,H
Band edge	RF channels	L,H
Filed Strength of spurious emissions	RF channels	L,M,H

7 RF Output power

7.1 Standard Applicable

According to §2.1046(a), §27.50.

7.2 Test setup

Please refer the section 6.2 Configuration of Tested System.

7.3 Test Procedure

1. The output from the EUT antenna connector was connected to the signal generator.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached, and ensure the AGC function not activated.
3. When the maximum output power declared by manufacturer is reached, still increased the input signal level until the AGC function activated.
4. The RF output power was measured at low, middle and high channel of each type of modulation and each type of carrier.
5. Repeat step 1 to step 4 for uplink and downlink respectively.

7.4 Test Result

Downlink mode:

Test mode	Channel	Input power (dBm)	Output power (dBm)	Gain(dB)	Result
AWS1700	Low	-54.60	24.85	79.45	Compliant
		Increased 10 dB	25.70	70.30	
	Middle	-54.70	24.87	79.57	Compliant
		Increased 10 dB	25.03	66.73	
	High	-56.44	22.19	78.63	Compliant
		Increased 10 dB	23.12	69.56	

Uplink mode:

Test mode	Channel	Input power (dBm)	Output power (dBm)	Gain(dB)	Result
AWS1700	Low	-61.77	18.30	80.07	Compliant
		Increased 10 dB	19.25	71.02	
	Middle	-61.38	18.20	79.58	Compliant
		Increased 10 dB	19.10	70.48	
	High	-63.15	18.14	81.29	Compliant
		Increased 10 dB	19.23	72.38	

8 Bandwidth

8.1 Standard Applicable

According to §2.1049.

8.2 Test setup

Please refer the section 6.2 Configuration of Tested System.

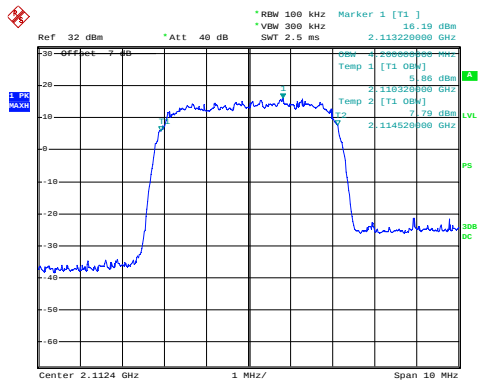
8.3 Test Procedure

1. The EUT RF output port was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. The spectrum analyzer was setup to measure the Occupied Bandwidth (defined as the 99% Power Bandwidth) & 20 dB bandwidth.
4. The pass band gain was tested by spectrum analyzer.

8.4 Test Result

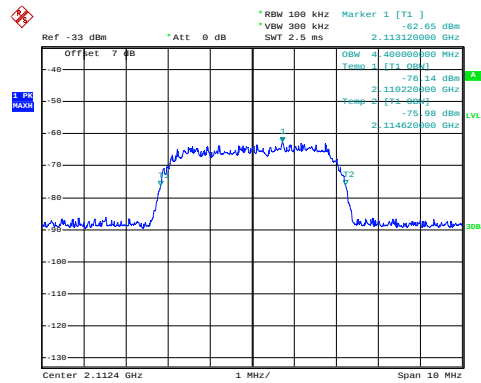
Input/output Bandwidth Comparison for 99% occupied bandwidth Downlink mode

Output



Date: 31.JUL.2014 22:49:04

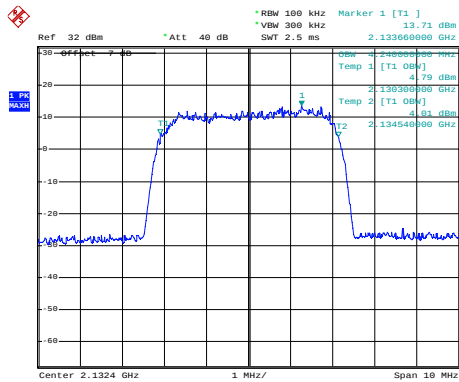
Input



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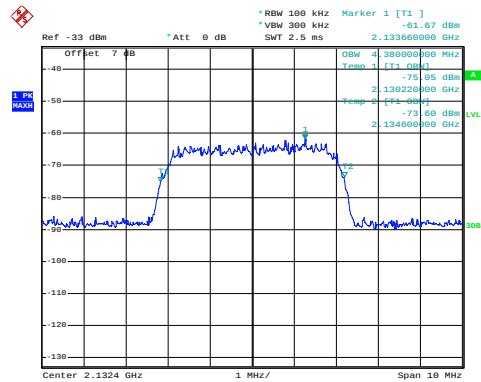
Low Channel

Output



Date: 31.JUL.2014 22:49:52

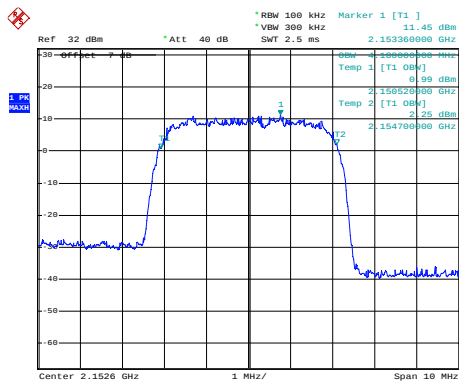
Input



Date: 31.JUL.2014 18:30:49

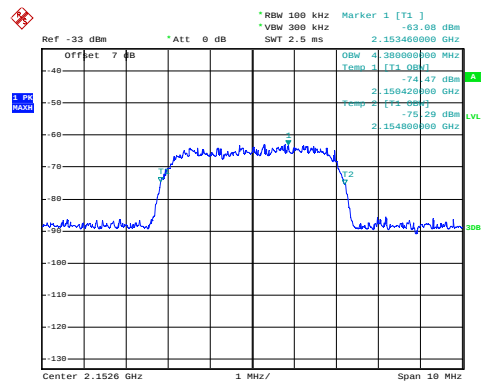
Middle Channel

Output



Date: 31.JUL.2014 22:50:50

Input

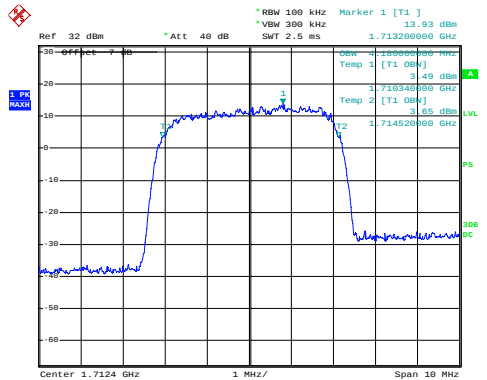


Date: 31.JUL.2014 18:31:25

High Channel

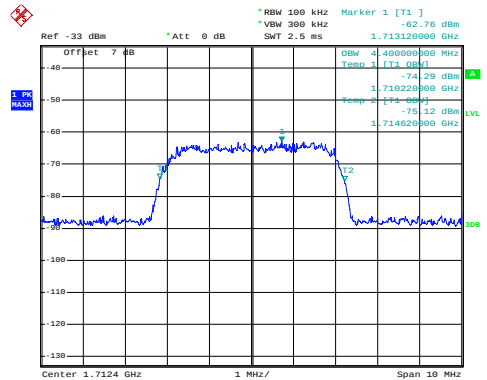
Uplink mode

Output



Date: 31.JUL.2014 23:15:18

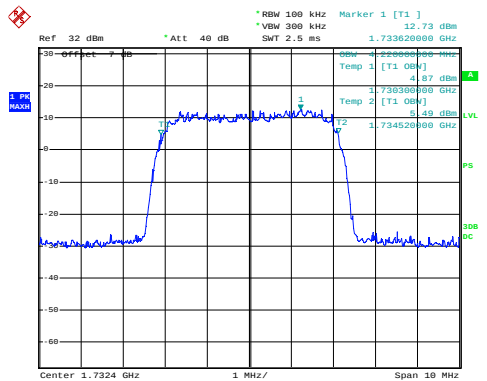
Input



Date: 31.JUL.2014 18:28:26

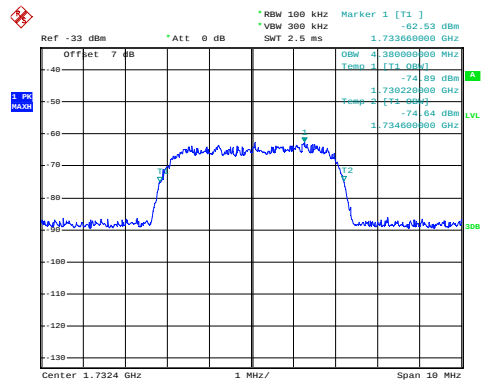
Low Channel

Output



Date: 31.JUL.2014 23:15:57

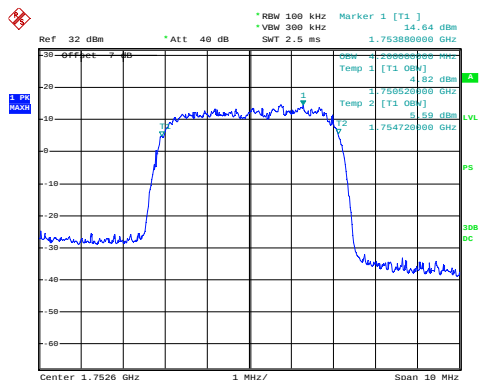
Input



Date: 31.JUL.2014 18:29:03

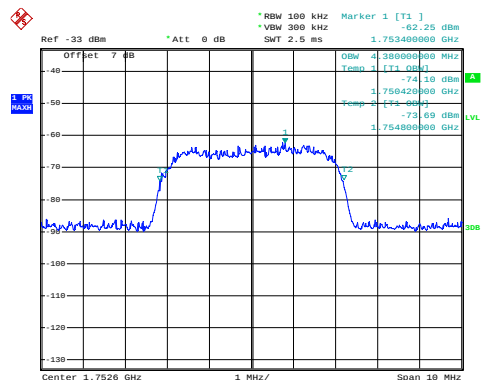
Middle Channel

Output



Date: 31.JUL.2014 23:16:50

Input

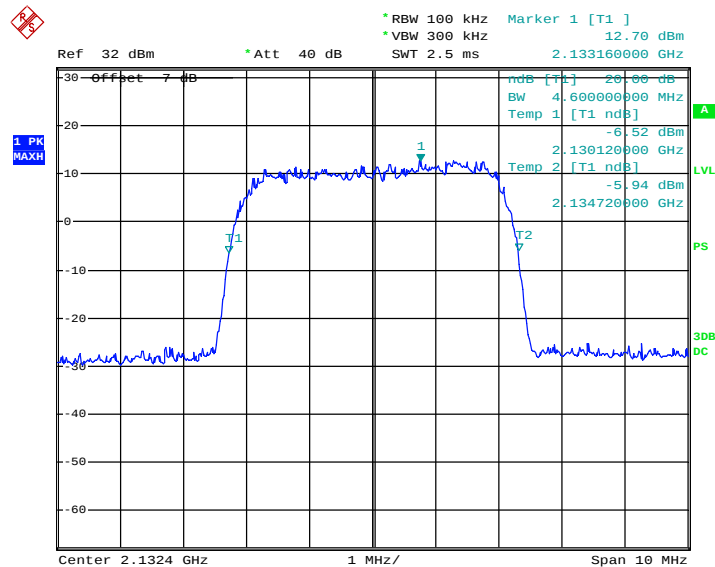


Date: 31.JUL.2014 18:29:36

High Channel

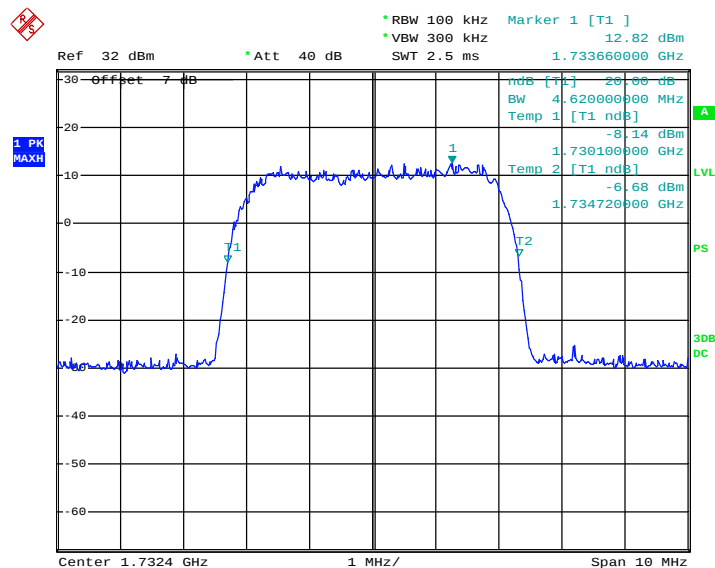
20 dB bandwidth for midband

Downlink mode



Date: 31.JUL.2014 22:52:18

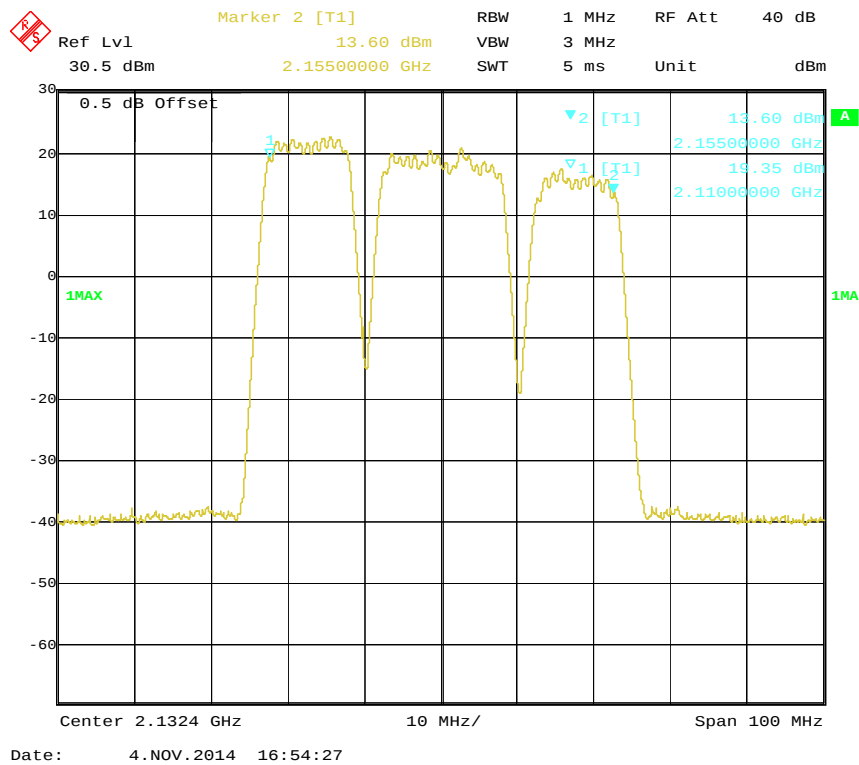
Uplink mode



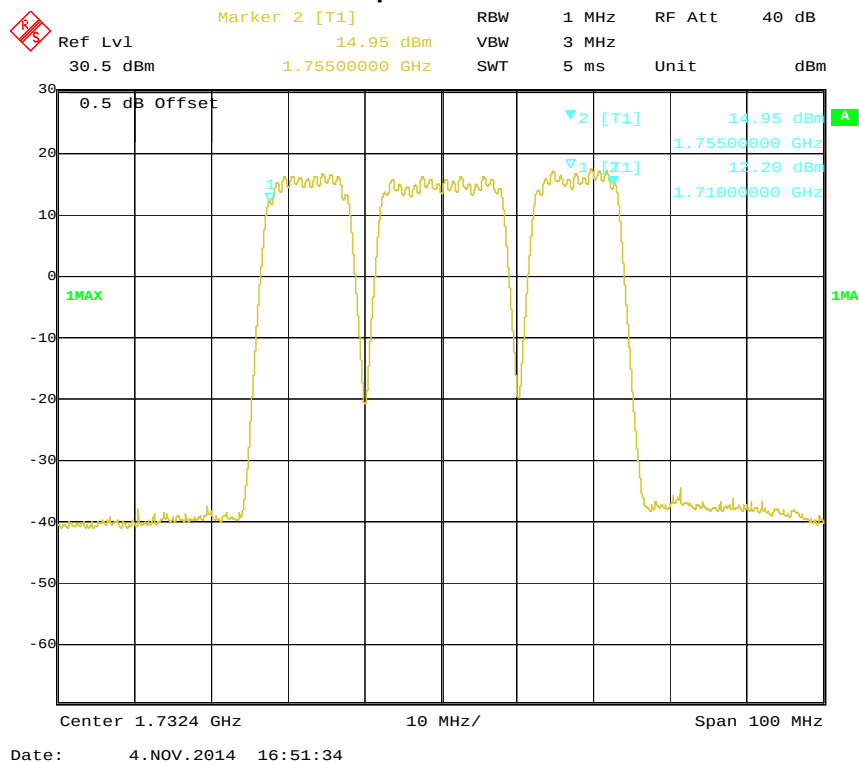
Date: 31.JUL.2014 23:09:35

Out-of-band rejection

Down link mode



Uplink mode



9 Spurious emission at antenna terminals and intermodulation

9.1 Standard Applicable

According to §2.1051, §27.53.

9.2 Test setup

Please refer the section 6.2 Configuration of tested System.

9.3 Test Procedure

For Spurious emissions at antenna terminals test procedure

The spurious emissions were measured directly from the EUT antenna output with a spectrum analyzer from 30 MHz to the 5th harmonic of the highest carrier frequency.

Band edge compliance is also demonstrated using a WCDMA signal at the upper and lower limits of the band.

1. The EUT RF output port was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. The spurious emissions at antenna were measured at the RF output port of the EUT at low, middle, high channels.

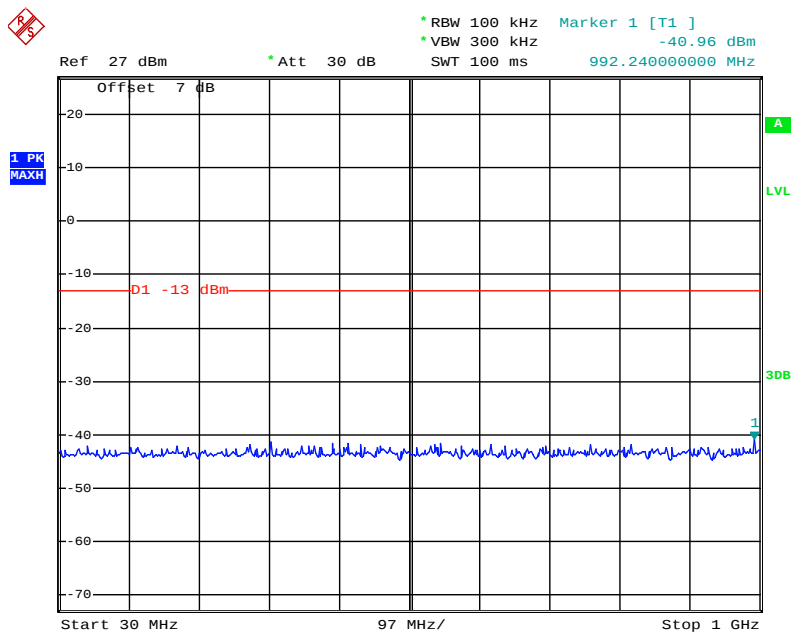
For inter modulation test procedure

1. The EUT RF output port was connected to spectrum analyzer. The EUT shall be set to maximum gain and maximum rated output power per channel.
2. Two continuous sinusoidal RF signals shall be fed to the input antenna port of the booster using a combining device. The two channels near each other should be separated by at least one operating channel width.
3. The spurious emissions at antenna were measured at the RF output port of the EUT.
4. Spectrum analyzer settings:
Detector: Peak.
RBW: 1%-3% of bandwidth

9.4 Test Result

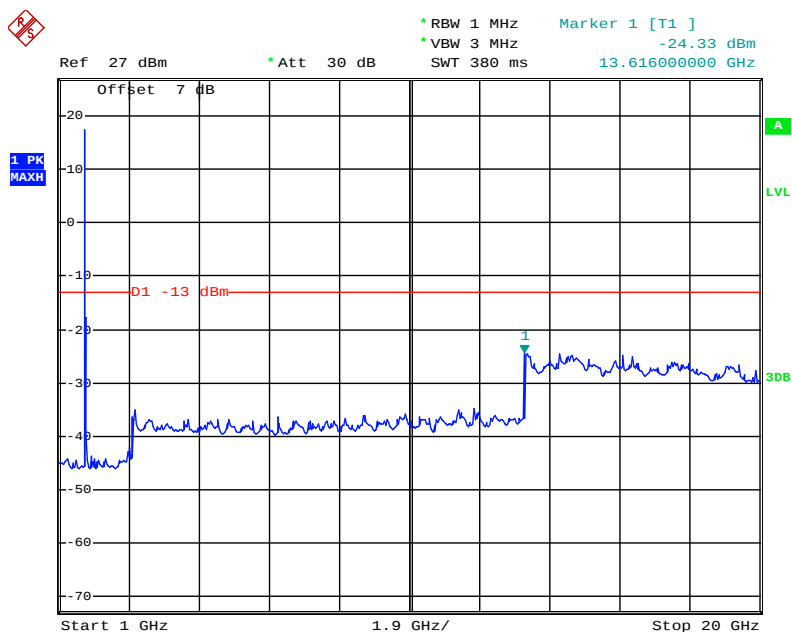
Spurious emission at antenna terminals

Uplink - Low Channel



Date: 1.AUG.2014 19:50:48

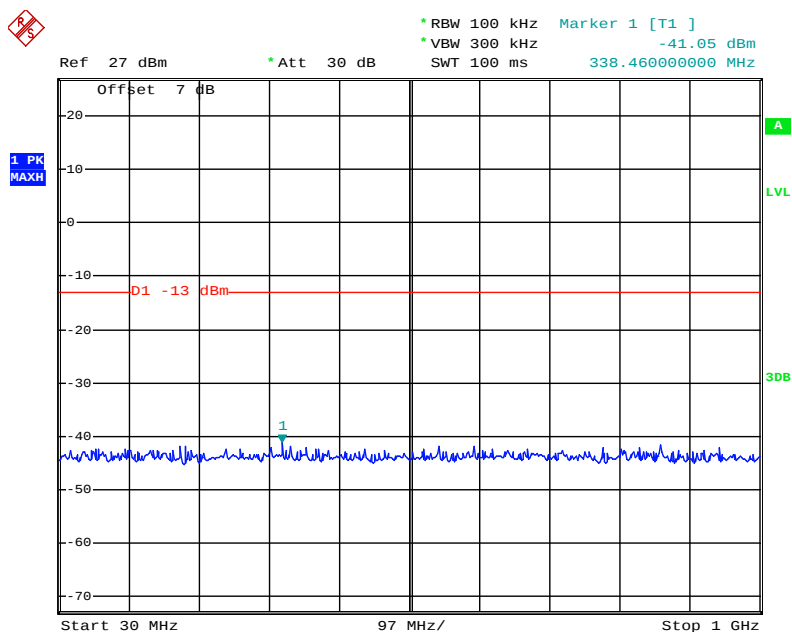
30MHz~1GHz



Date: 1.AUG.2014 19:53:47

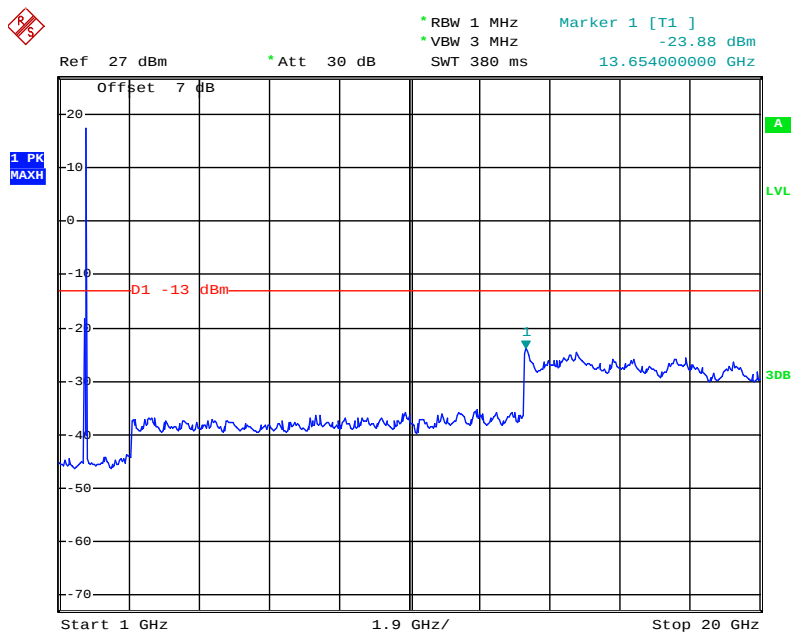
1GHz~20GHz

Uplink - Middle channel



Date: 1.AUG.2014 19:51:16

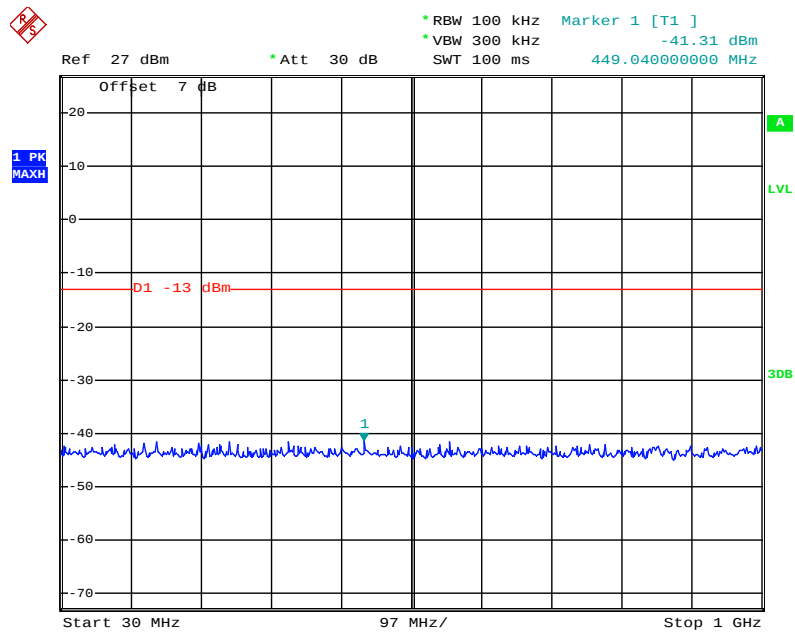
30MHz~1GHz



Date: 1.AUG.2014 19:53:12

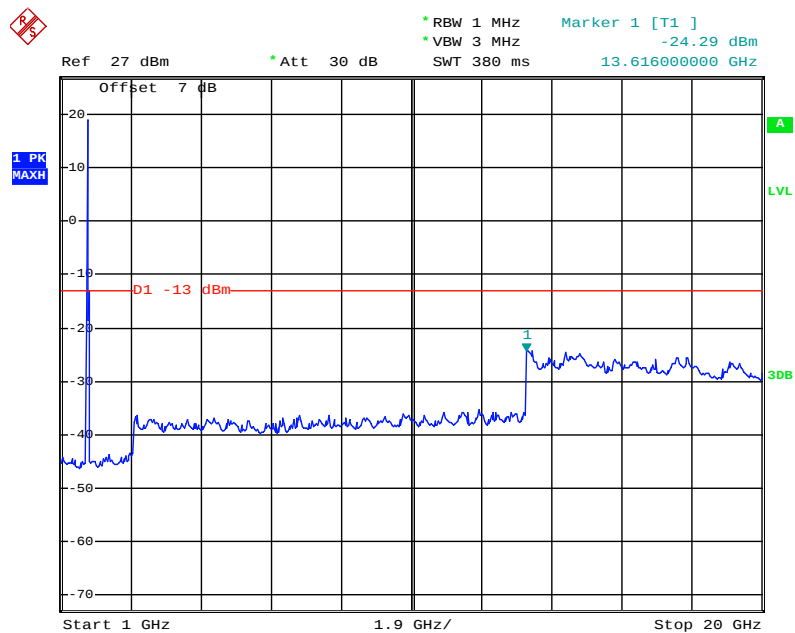
1GHz~20GHz

Uplink - High Channel



Date: 1.AUG.2014 19:51:43

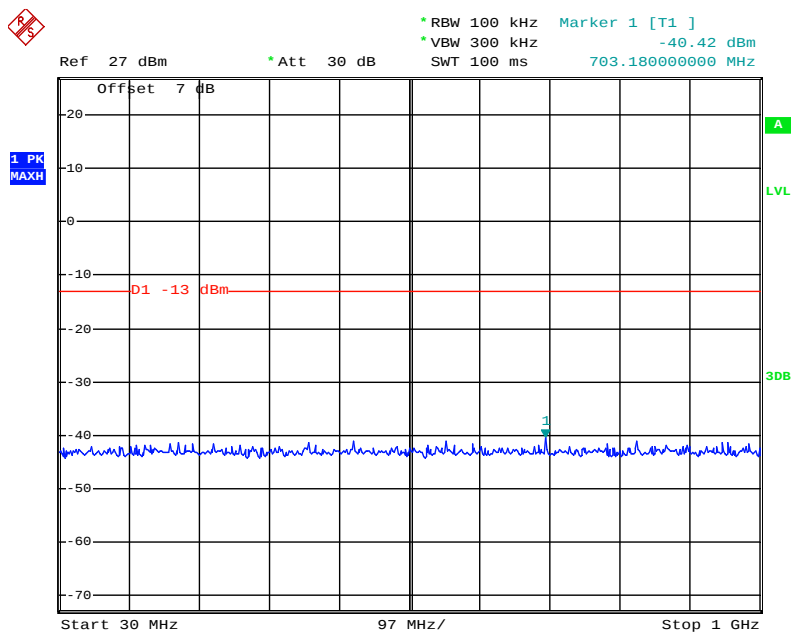
30MHz~1GHz



Date: 1.AUG.2014 19:52:39

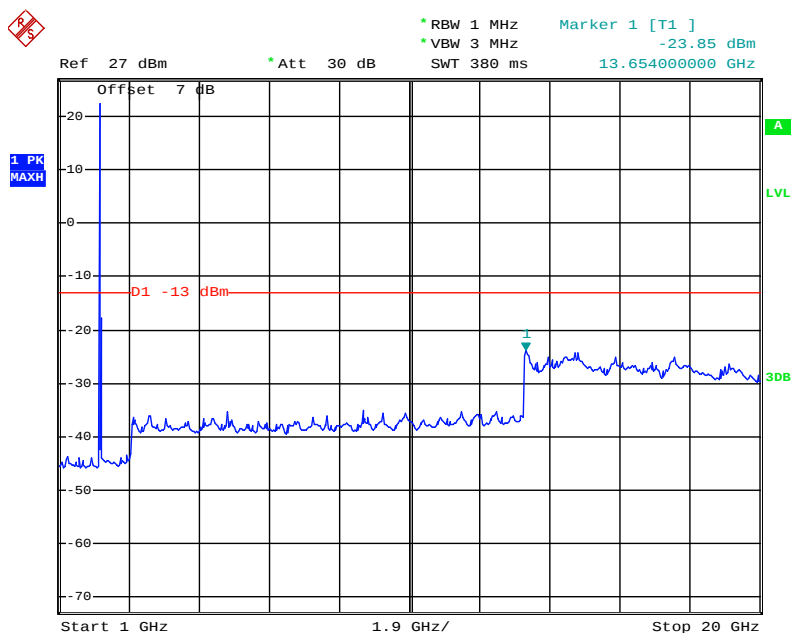
1GHz~20GHz

Downlink - Low Channel



Date: 1.AUG.2014 19:35:48

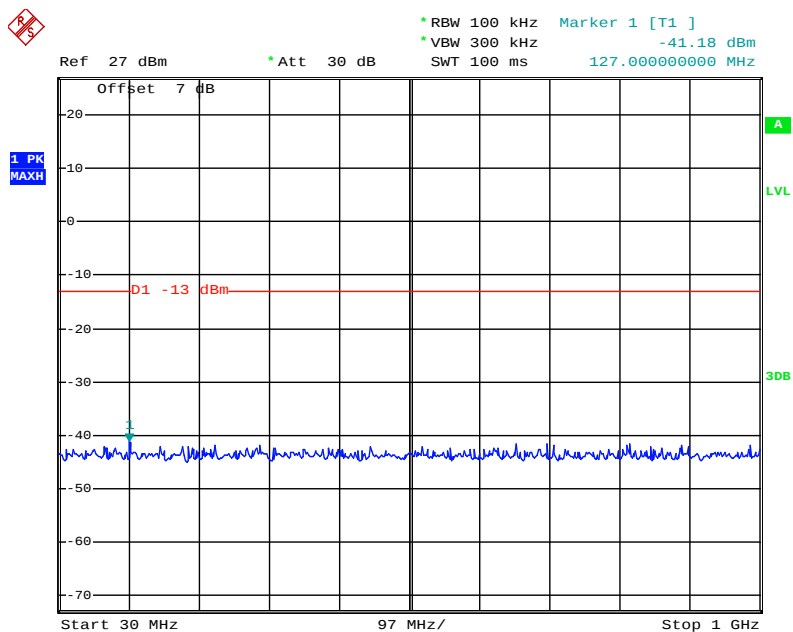
30MHz~1GHz



Date: 1.AUG.2014 19:39:23

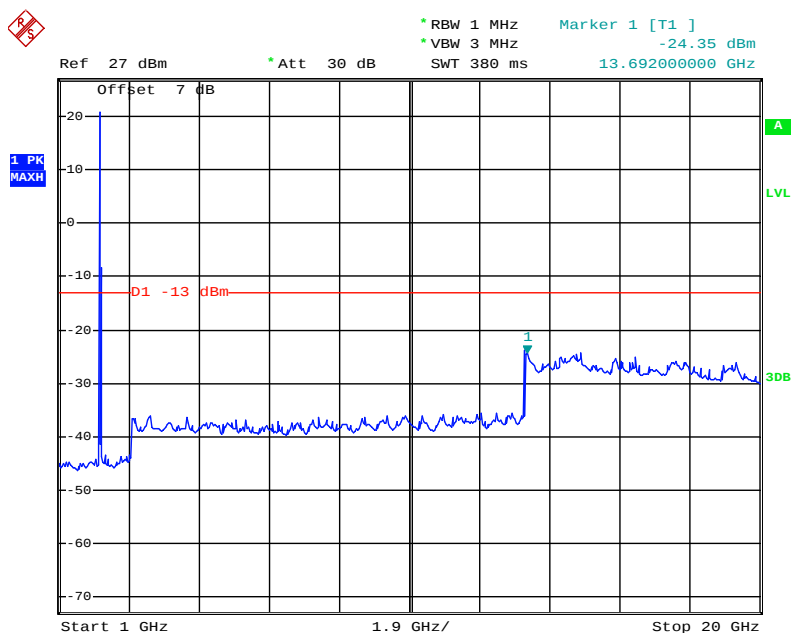
1GHz~20GHz

Downlink - Middle channel



Date: 1.AUG.2014 19:36:25

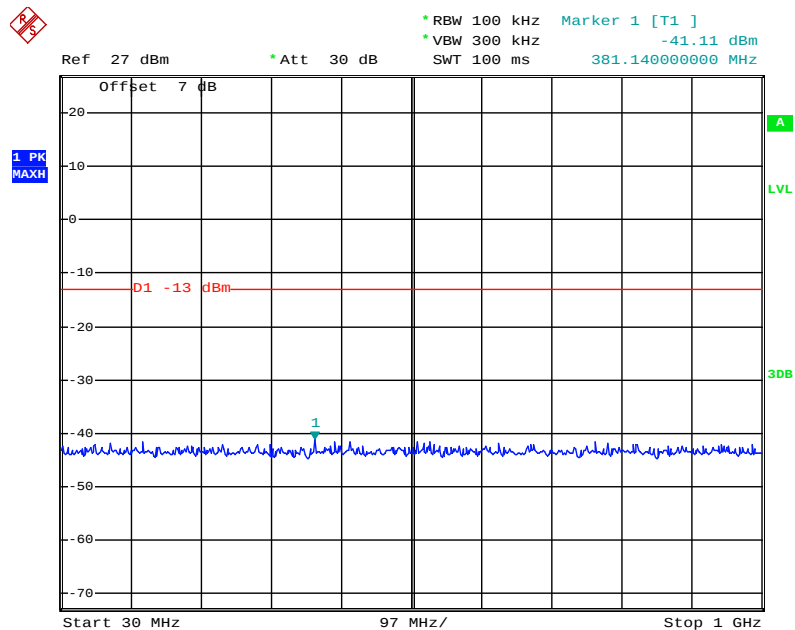
30MHz~1GHz



Date: 1.AUG.2014 19:38:31

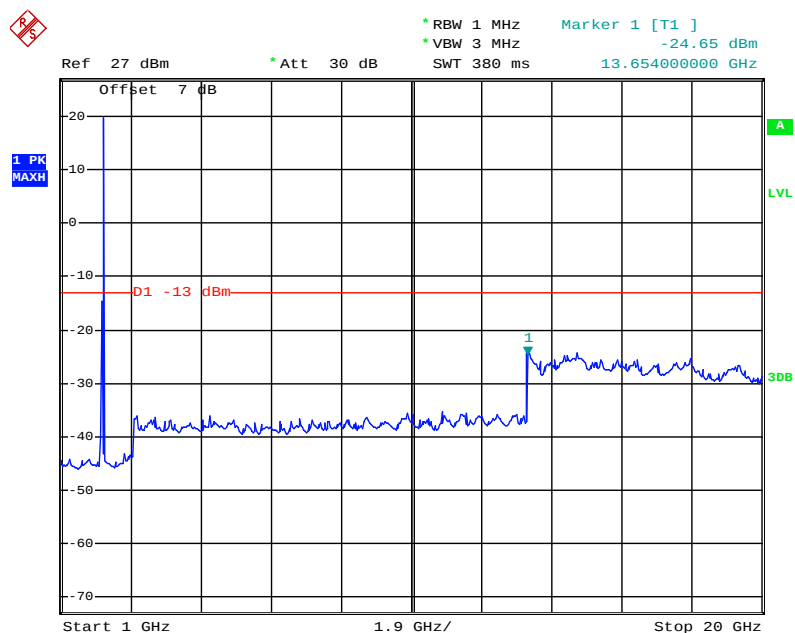
1GHz~20GHz

Downlink - High Channel



Date: 1.AUG.2014 19:37:06

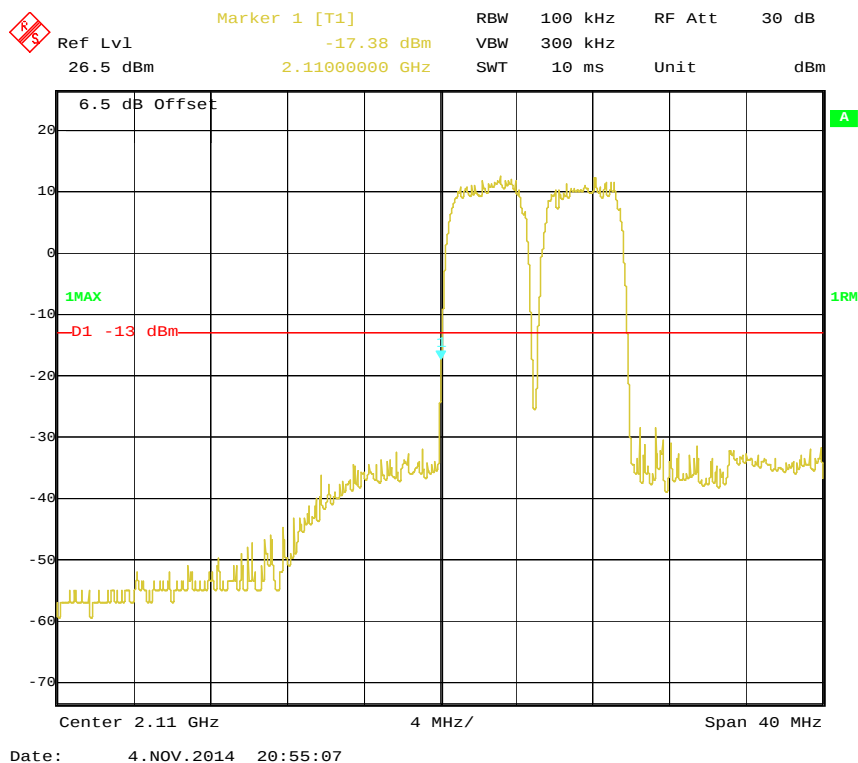
30MHz~1GHz



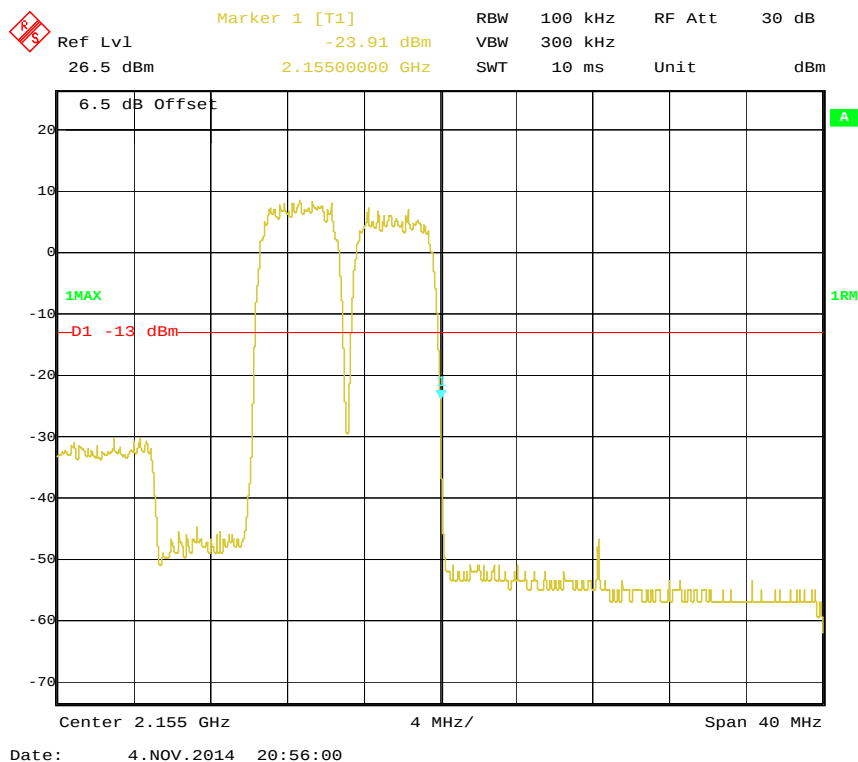
Date: 1.AUG.2014 19:37:49

1GHz~20GHz

Downlink mode Inter-modulation

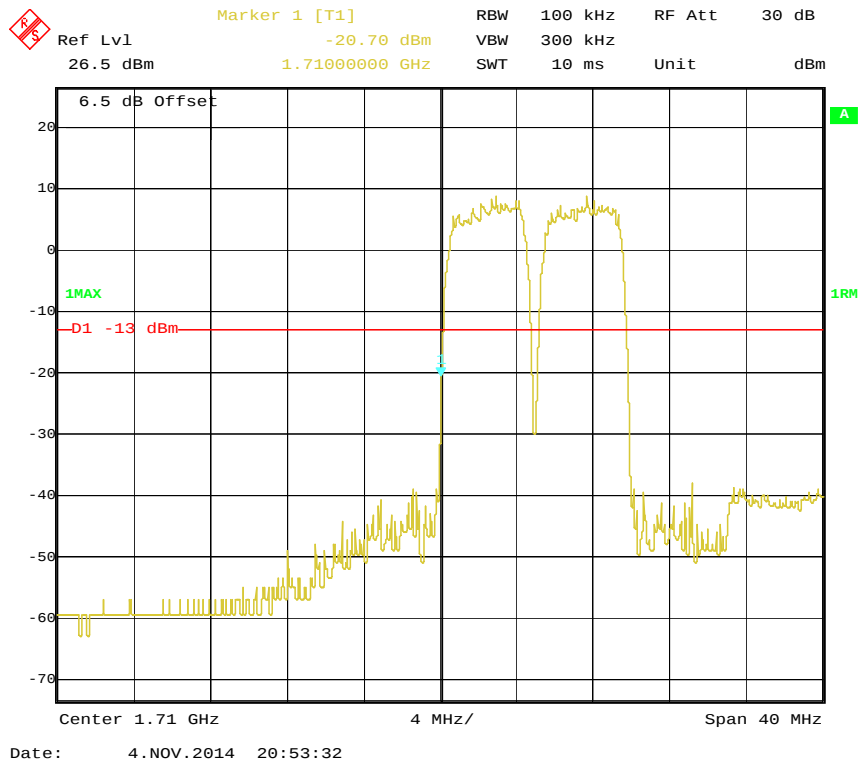


Low channel

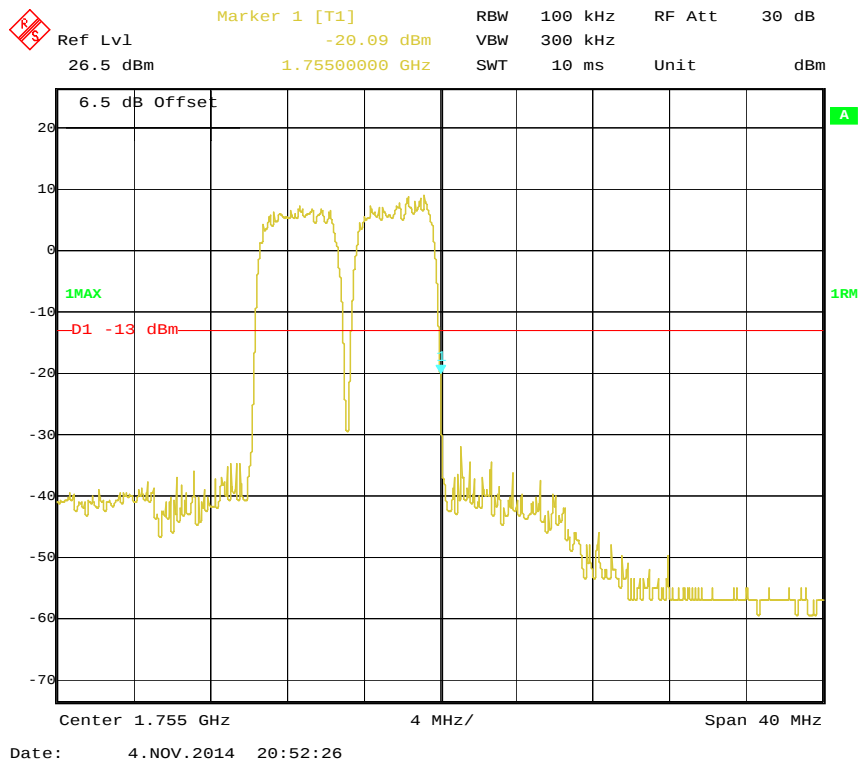


High channel

Uplink mode Inter-modulation



Low channel



High channel

10 Band edge

10.1 Standard Applicable

According to §27.53,.

10.2 Test setup

Please refer the section 6.2 Configuration of tested System.

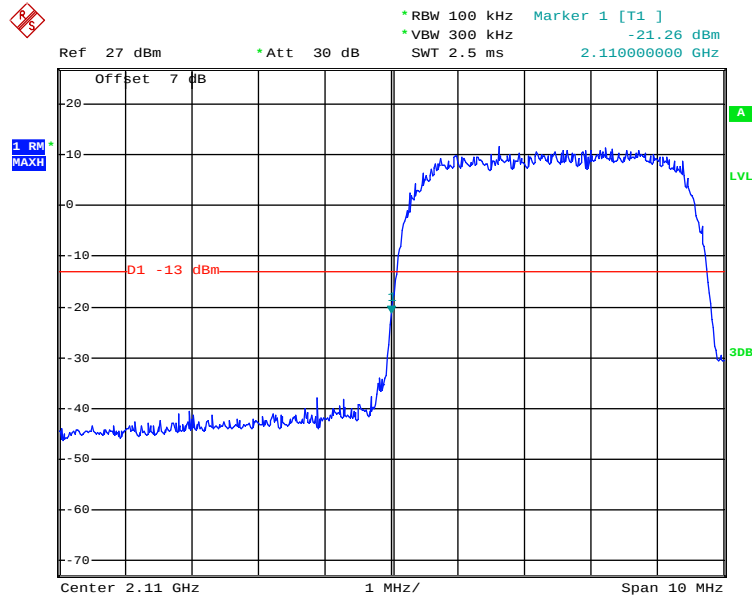
10.3 Test Procedure

1. The EUT RF output port was connected to spectrum analyzer. The EUT shall be set to maximum gain and maximum rated output power per channel.
2. The modulation RF signals shall be fed to the input antenna port of the booster.
3. The band edge was measured at the RF output port of the EUT.
4. Spectrum analyzer settings:
Detector: RMS.
RBW: 1%-3% of bandwidth

10.4 Test Result

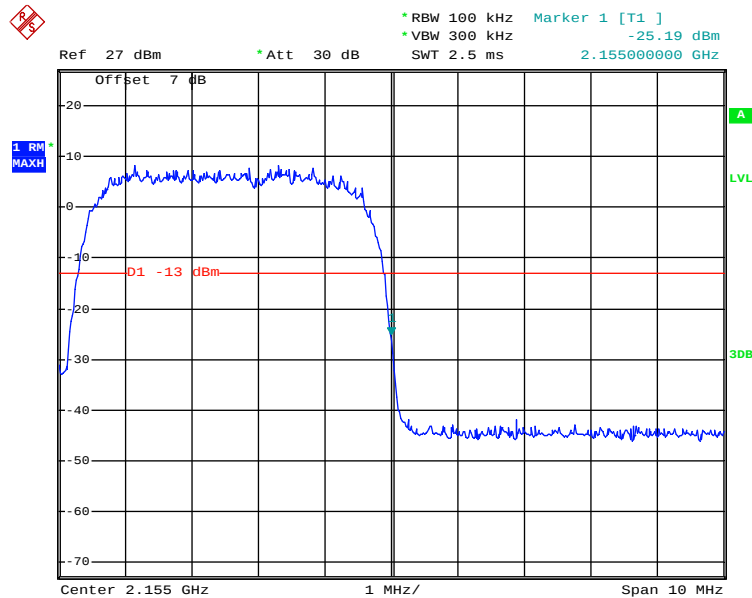
Downlink mode

Band edge



Date: 1.AUG.2014 20:20:10

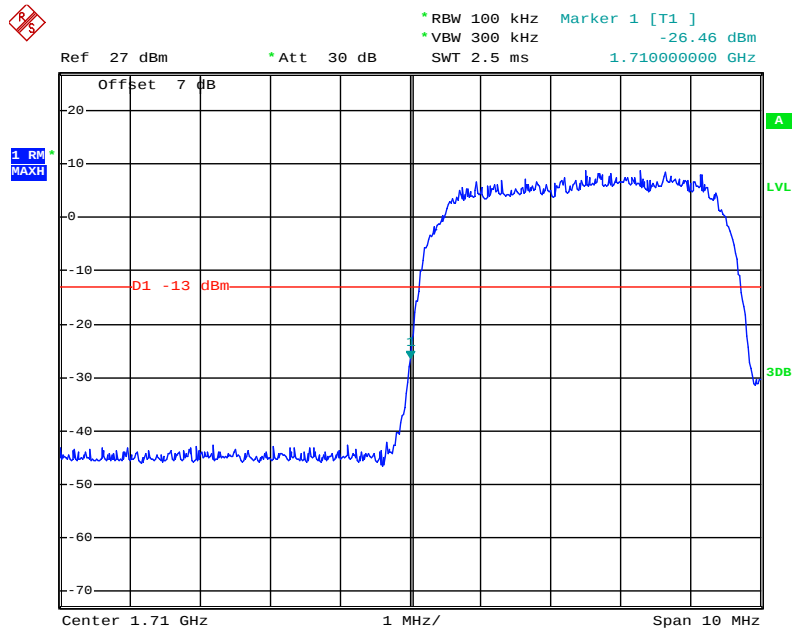
Left edge of band



Date: 1.AUG.2014 20:21:01

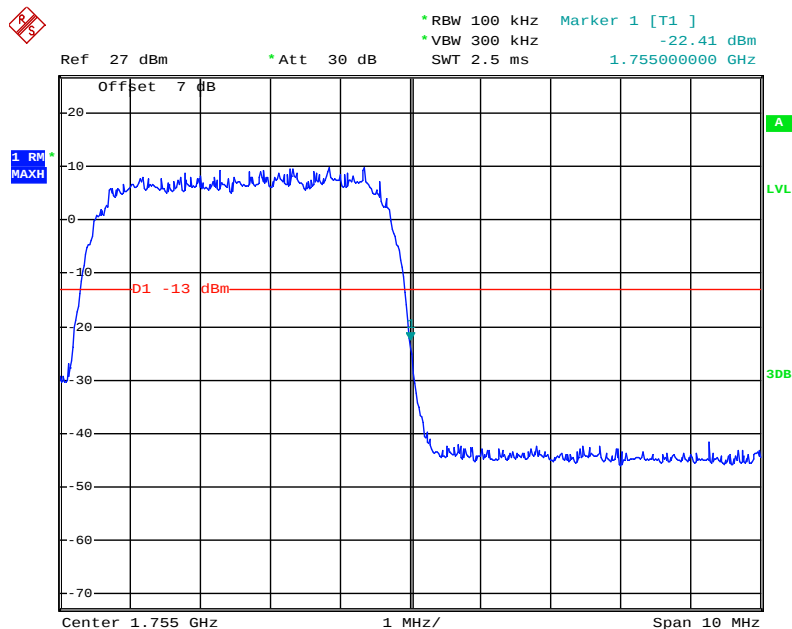
Right edge of band

Uplink mode Band edge



Date: 1.AUG.2014 20:23:06

Left edge of band



Date: 1.AUG.2014 20:23:55

Right edge of band

11 Field strength of spurious radiation measurement

11.1 Standard Applicable

According to § 2.1053, §27.53.

11.2 Test Setup

Please refer the section 6.2 Configuration of Tested System.

11.3 Test Procedure

1. The EUT RF output port was connected to 50 ohm RF load.
2. The EUT input port was connected to signal generator and was setup to transmit maximum power.
3. The measurement antenna was placed at a distance of 3 meters from the EUT.
4. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from EUT.
5. The frequency range up to 5-th harmonic of each of the three fundamental frequencies (low, middle and high channels) was investigated. The worst case of emissions was reported.
6. For spurious emissions attenuation, the substitution method was used.
7. The EUT was substituted by a reference antenna (half-wave dipole - below 1 GHz, or Horn antenna - above 1 GHz), connected to a signal generator.
8. The signal generator output level was adjusted to obtain the same reading as from EUT. The EIRP at the spurious emissions frequency was calculated as follows:
$$\text{ERP} = \text{S.G. output (dBm)} + \text{Antenna Gain (dBd)} - \text{Cable Loss (dB)}$$
$$\text{EIRP} = \text{S.G. output (dBm)} + \text{Antenna Gain (dBi)} - \text{Cable Loss (dB)}$$
9. The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to a dipole. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic dipole
10. Radiated spurs (enclosure) - Use of CW signal is acceptable rather than all modulations.
11. The maximum RFI field strength was determined during the measurement by rotating the turntable (± 180 degrees) and varying the height of the receive antenna ($h = 1 \dots 4$ m) as like defined in ANSI C63.4. A measurement receiver has been used with a RBW 120 kHz up to 1 GHz and 1 MHz above 1 GHz. Steps with during pre measurement was half the RBW.
12. Both, the Fully Anechoic Chamber (FAC) and the Semi Anechoic Chamber (SAC) fulfil the requirements of ANSI C63.4 and CISPR 16-1-4 with regards to NSA and SVSWR.

11.4 Test Result

Test mode:	Uplink		Test channel:	Low
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
30.53	Vertical	-56.22	-13	Pass
45.86	V	-63.25		
3424.8	V	-50.53		
167.24	Horizontal	-56.87		
226.10	H	-55.42		
3424.8	H	-54.63		
Test mode:	Uplink		Test channel:	Middle
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
30.53	Vertical	-57.21	-13	Pass
45.86	V	-64.26		
3464.8	V	-51.53		
167.24	Horizontal	-57.89		
226.10	H	-51.44		
3464.8	H	-54.61		
Test mode:	Uplink		Test channel:	High
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
30.53	Vertical	-57.31	-13	Pass
45.86	V	-64.46		
3505.2	V	-51.73		
167.24	Horizontal	-56.89		
226.10	H	-52.44		
3505.2	H	-54.65		

Test mode:	Downlink		Test channel:	Low
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
30.64	Vertical	-58.03	-13	Pass
111.74	V	-62.56		
4224.8	V	-47.62		
113.32	Horizontal	-53.57		
167.82	H	-52.26		
4224.8	H	-52.03		
4224.8	H	-52.03		
Test mode:	Downlink		Test channel:	Middle
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
30.64	Vertical	-57.01	-13	Pass
111.74	V	-60.53		
4264.8	V	-49.65		
113.32	Horizontal	-57.56		
167.82	H	-56.24		
4264.8	H	-50.05		
4264.8	H	-50.05		
Test mode:	Downlink		Test channel:	High
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
30.64	Vertical	-57.33	-13	Pass
111.74	V	-61.62		
4305.2	V	-43.37		
113.32	Horizontal	-57.52		
167.82	H	-52.47		
4305.2	H	-53.28		
4305.2	H	-53.28		

Remark: The test data blew 30MHz is too lower than the limit, so not show in this report.