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Emissions
Test Report

EUT Name: Highpower USB Wifi Module

Model No.: MaxR 950

CFR 47 Part 90Y

Prepared for:

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Report/Issue Date: Aug 26, 2012
Report Number: 31250954.002

Statement of Compliance

Manufacturer:	Arada Systems, Inc. 4633 Old Ironsides Drive, Suite 415 Santa Clara, CA 95054
Requester / Applicant:	Praveen Singh
Name of Equipment:	Highpower USB Wifi Module
Model No.	MaxR 950
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 90Y
Test Dates:	04 April to 22 May, 06 June 2012 and Aug 13, 2012

Guidance Documents:

Emissions: ANSI C63.10-2009 & TIA 603-C

Test Methods:

Emissions: ANSI C63.10-2009 & TIA 603-C

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This report contains data that are not covered by NVLAP accreditation. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Suresh Kondapalli	Aug 26, 2012	Conan Boyle	Aug 26, 2012
Test Engineer	Date	NVLAP Signatory	Date

Testing Cert#1331.02 **US5254** **2932M-1**

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 90Y based on the results of testing performed on April 4 to May 22 and June 6, 2012 on the Highpower USB Wifi Module Model MaxR 950 manufactured by *Arada Systems* . This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Transmitter Modulation, output power and other parameters

Test	FCC Rule part	Measured value/ Comments	Limit/Requirement	Result
Frequency Ranges	2.1033(C) (5) 90.1215	4945 - 4985 MHz	4940 - 4990 MHz	**Complied**
Conducted Power	2.1033(C) (6) 2.1033(C) (7) 2.1046 90.1215(a)	26.62 dBm 27.24 dBm 30.94 dBm	27 dBm (5 MHz Bw) 30 dBm (10 MHz Bw) 33 dBm (20 MHz Bw)	**Complied**
Emission Mask	2.1033(C) (4) 2.1047 90.210	See spectral masks –See test data pages	Mask M	**Complied**
Channel Bandwidth	2.1049 90.1213	4.35 MHz 8.95 MHz 19.98 MHz	5 MHz 10 MHz 20 MHz	**Complied**

Transmitter spurious emissions

Test	FCC Rule Part	Measured value/ Comments	Limit/Requirement	Result
Transmitter Spurious				
At Antenna Terminal	2.1051 2.1057 90.210	-35.59 dBm	-25 dBm	**Complied**
Receiver Spurious				
Field Strength	15.109	43.33 dBuV	60 dBuV	**Complied**

Other parameters

Test	FCC Rule Part	Measured value/ Comments	Limit/Requirement	Result
Frequency Stability	2.1055 90.213(a)	0.0048 PPM	Information only	**Complied**
RF Exposure	1.1307 (b) 2.1093	**Complies: Separate Exhibit is generated for MPE calculation**		
DC voltage and current for final amplifier stage	15.109	Digitally Tuned Equipment	Information only	-
Antenna Gain	90.1215(a)	2.1 dBi	9 dBi max (Power should be reduced if antenna gain exceeds)	**Complied**

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 is recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (US5254). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / A2LA

TUV Rheinland of North America is accredited by the A2LA Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:1999 and ISO 9002 (Testing Cert#1331.02). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada

TUV Rheinland of North America at the 1279 Quarry Ln, Pleasanton, CA 94566 address is accredited by Industry Canada for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by Industry Canada (File Number 2932M-1). This reference number is the indication to the Industry Canada Certification Officers that the site meets the requirements of RSS 212, Issue 1 (Provisional). The accreditation is updated every 3 years.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration No. A-0031).

2.1.5 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA. The 2305 Mission College, Santa Clara, 95054, USA location is considered a Pleasanton annex.

2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2009, at a test distance of 3 and 5 meters. The site is listed with the FCC and accredited by A2LA (Testing Cert#1331.02). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2009, at a test distance of 3 meter and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 4.8 m x 3.175 mm thick aluminum floor connected to PE ground.

For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors.

For EFT, Surge, PQF, the HCP and VCP are removed.

RF Field Immunity testing is performed in a 7.3m x 4.3m x 4.1m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.8m x 3.7m x 3.175mm thick aluminum ground plane.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.3.2 Measurement Uncertainty

	U_{lab}	U_{cispr}
Radiated Disturbance		
30 MHz – 40,000 MHz	3.2 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	2.4 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.5 dB

Measurement Uncertainty – Immunity Testing

The estimated combined standard uncertainty for ESD immunity measurements is ± 4.1%.
The estimated combined standard uncertainty for radiated immunity measurements is ± 2.7 dB.
The estimated combined standard uncertainty for conducted immunity measurements is ± 1.4 dB.
The estimated combined standard uncertainty for damped oscillatory wave immunity measurements is ± 8.8%.
The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 0.45%.

Measurement Uncertainty – Radio Testing

The estimated combined standard uncertainty for frequency error measurements is ± 3.88 Hz
The estimated combined standard uncertainty for carrier power measurements is ± 1.59 dB.
The estimated combined standard uncertainty for adjacent channel power measurements is ± 1.47 dB.
The estimated combined standard uncertainty for modulation frequency response measurements is ± 0.46 dB.
The estimated combined standard uncertainty for transmitter conducted emission measurements is ± 4.01 dB

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

3 Product Information

3.1 Product Description

The MaxR 950 is a Highpower USB wifi Module complies with the IEEE 802.11g and HT20 specification to communicate with other 802.11 wireless devices in the 2.4 GHz and 4.9 GHz band, and up to 65 Mbps. The EUT is normally placed inside host device and powered by host system.

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.4 ***Duty Cycle:*** *None*

3.5 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply
with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.5.1 Results

The Highpower USB Wifi Module has two external antennas with reverse polarity SMA connector. Antenans are connected to Transmitter module through 70mm long pigtail cable with MMCX connector at PCB end and reverse ploraity SMA connector at Antenna side.

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4 Emission Requirements – 4940 to 4990 MHz Band

Testing was performed in accordance with CFR 47 Part 90 & FCC part 15. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

4.1 Output Power Requirements

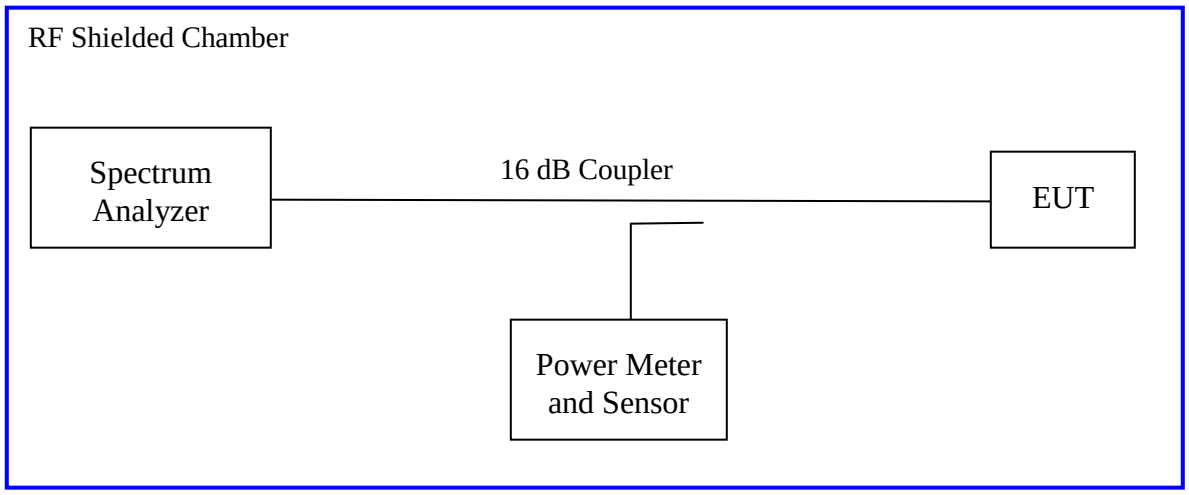
The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

The maximum output power shall not exceed CFR47 Part 90.1215(a) (1)

Test Method

The conducted method was used to measure the channel power output according to TIA603-C. The measurement was performed with modulation. This test was conducted on 3 channels in each operating range. The worst mode result are indicated below.

Test Setup:



4.1.1 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 2: RF Output Power at the Antenna Port – Test Results

Test Conditions: Conducted Measurement						
Antenna Type: External Monopole +2.1 dBi						
Signal State: Modulated @ 99%						
Ambient Temp.: 21 °C				**Relative Humidity:** 39%		
Operating Frequency MHz	**Modulation/ Data rate**	**Power Setting**	**Channel Power Measured at Antenna port**	**Avg Power measured with power meter**	**Limit**	**Result**
			dBm	**dBm**	**dBm**	
4947.5	5 MHz BW	23	26.62	23.60	27.0	Compliant
4967.5		23	26.62	23.60		
4987.5		23	26.65	23.40		
4945	10 MHz BW	22	26.45	22.80	30.0	
4965		22	26.92	22.50		
4985		22	27.24	22.35		
4950	20 MHz BW	24	30.91	24.65	33.0	
4960		24	30.00	24.45		
4980		24	29.88	24.00		
Note: Highest power measured was at 6 Mbits for 5 MHz , 24 Mbps for 10 and 20 MHz bandwidths						

Note: Only worst-case/ limited number of plots are placed in the report.

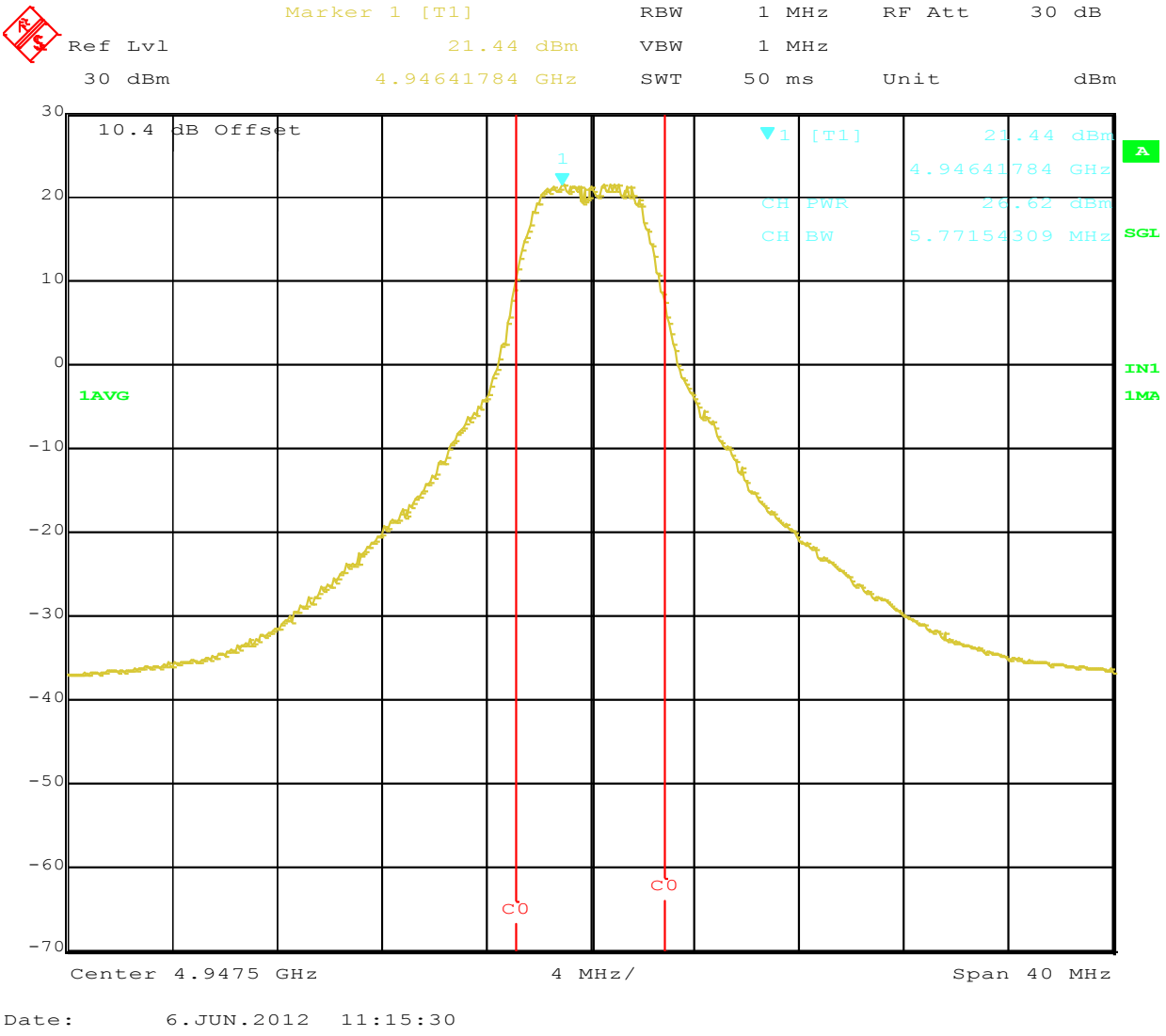


Figure 1: Channel Power, 4947.5 MHz 6 Mbps,

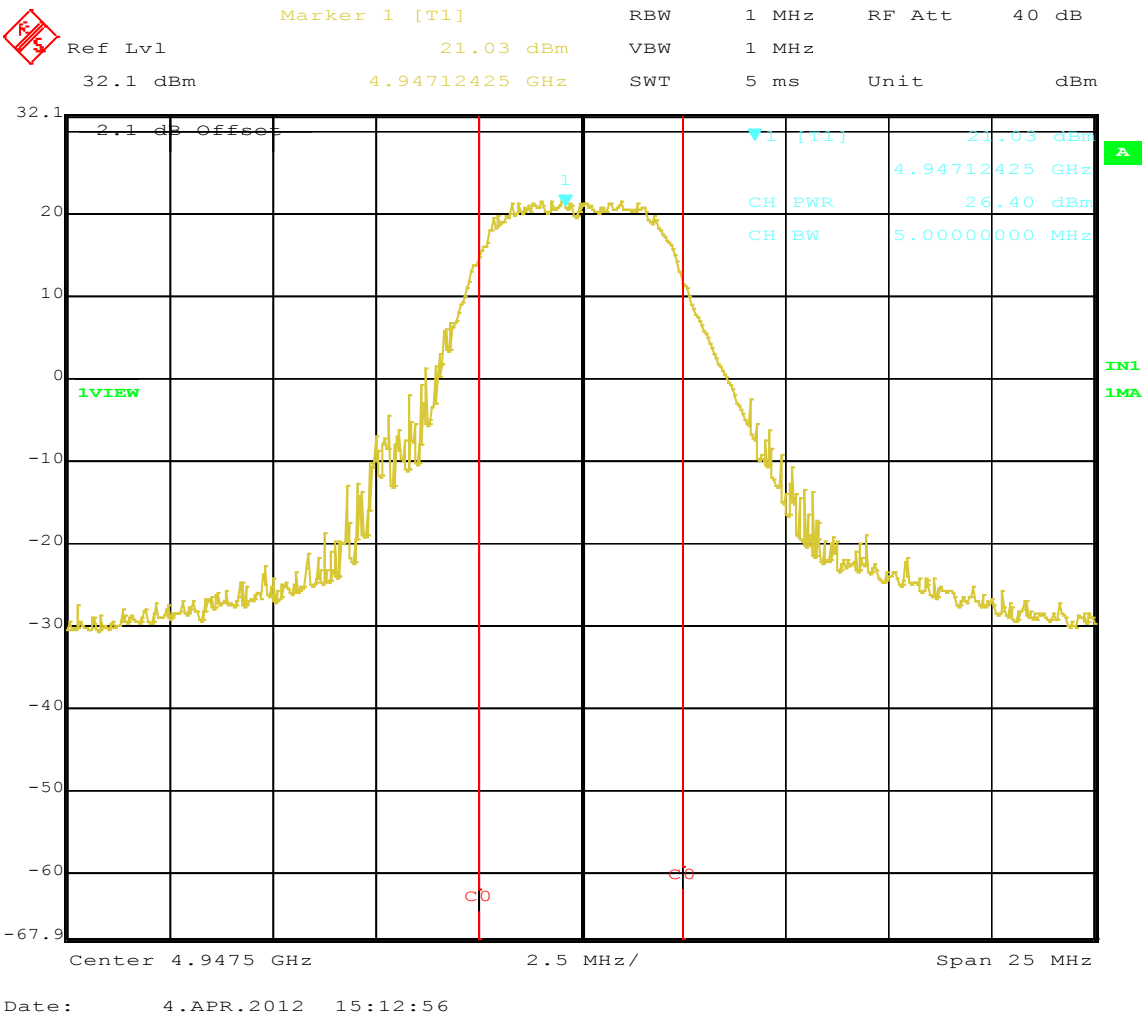


Figure 2: Channel Power, 4947.5 MHz 24 Mbps

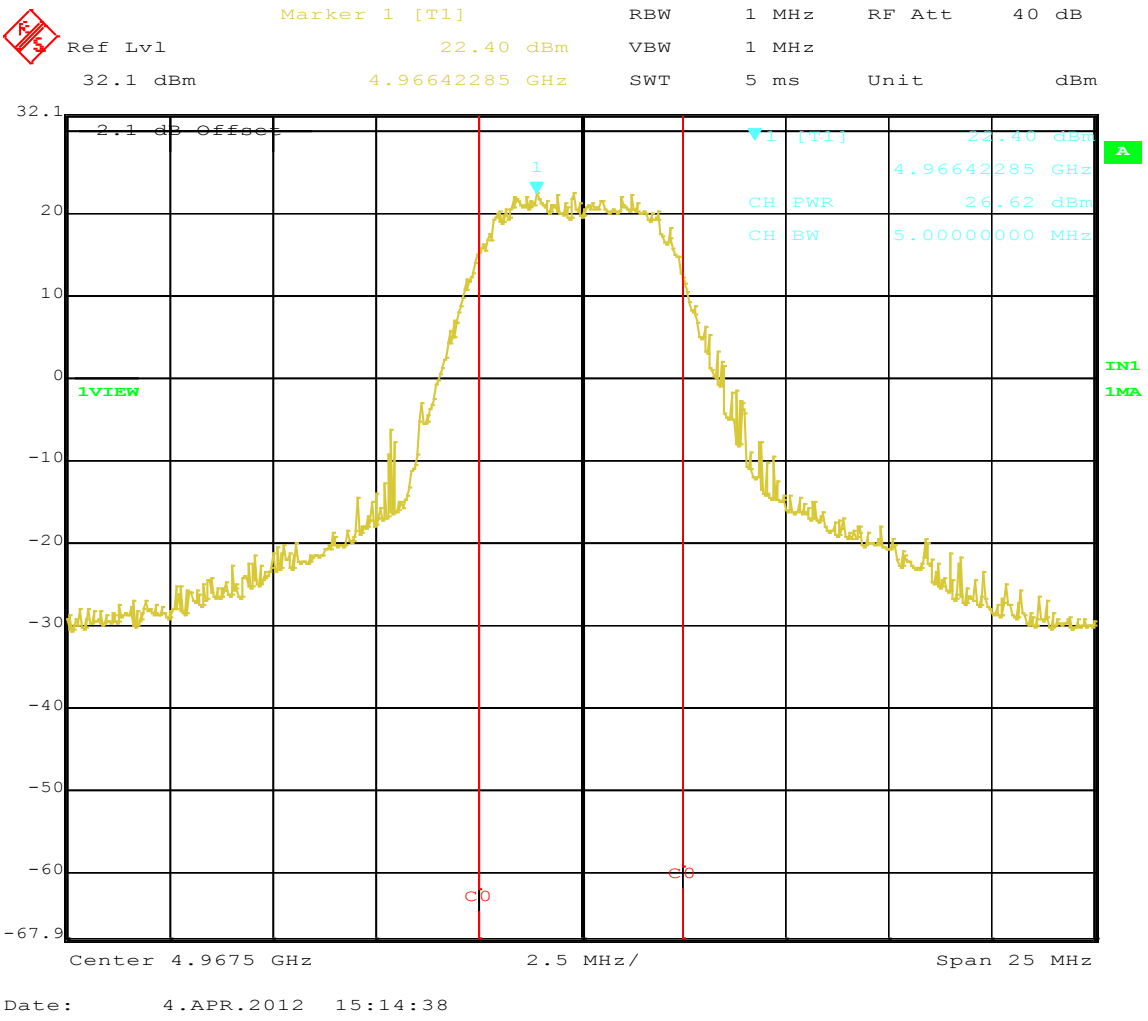


Figure 3: Channel Power, 4967.5 – 5 Mb – 6 Mbps

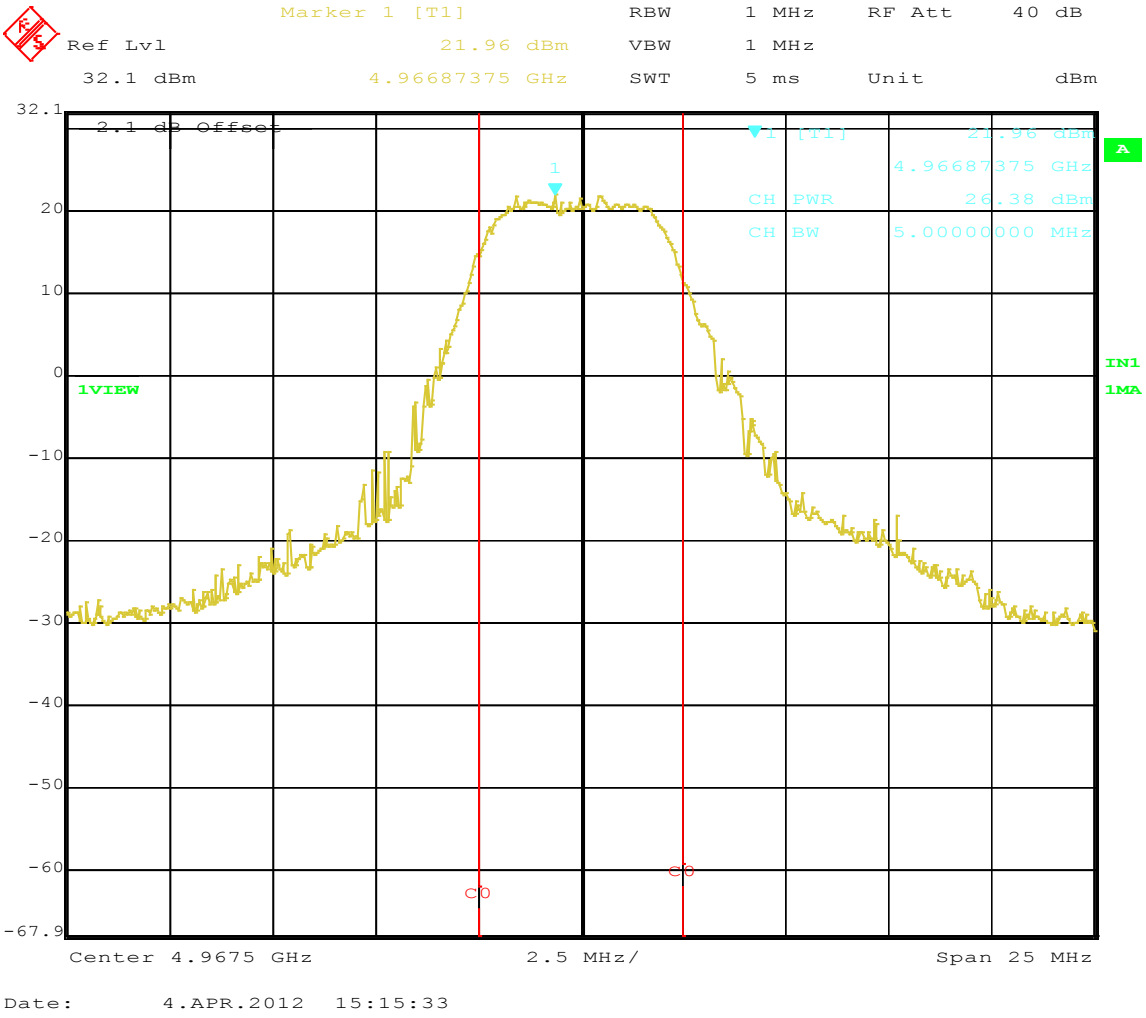


Figure 4: Channel Power, 4967.5 – 5 MHz – 24 Mbps

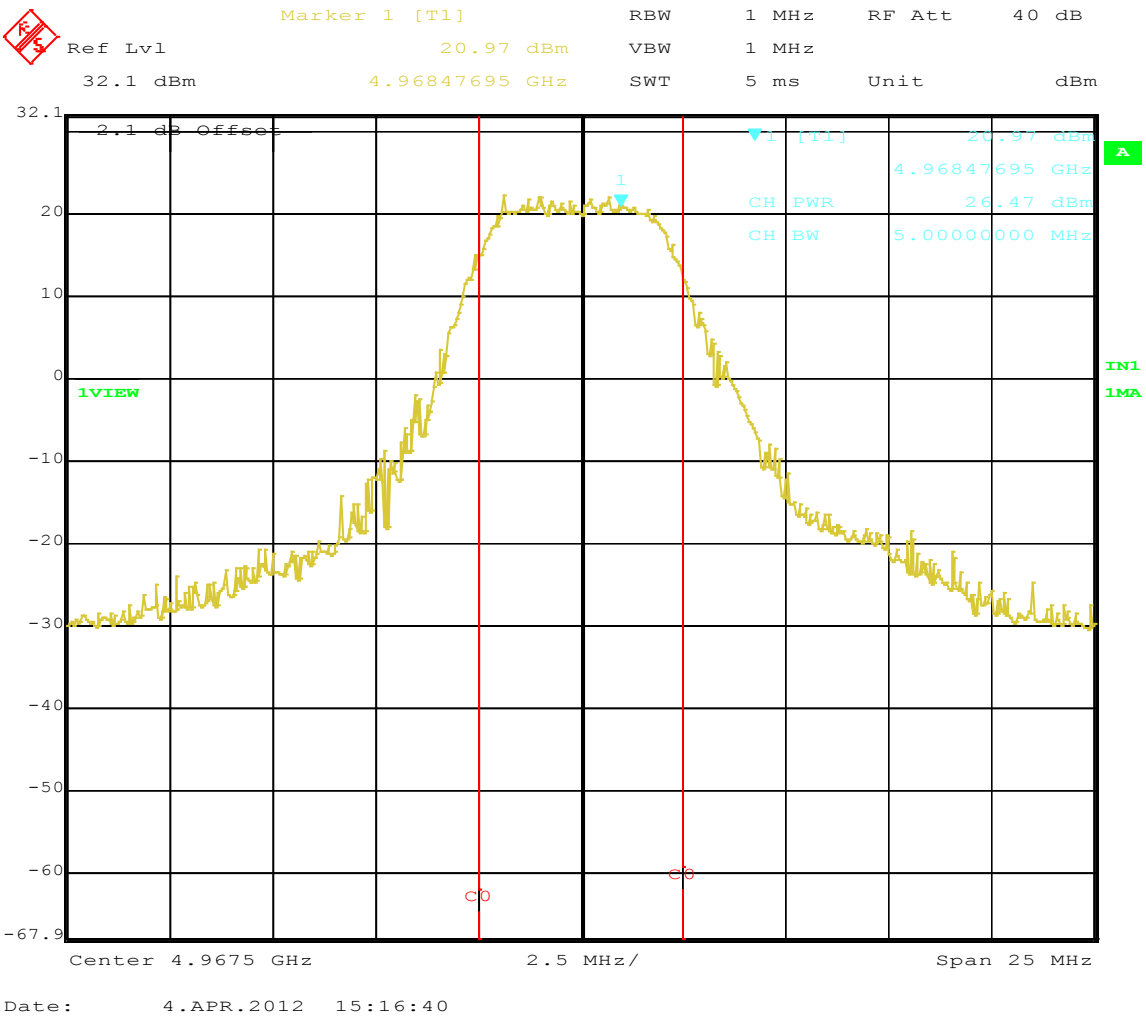


Figure 5: Channel Power, 4967.5 – 5 MHz – 54 Mbps

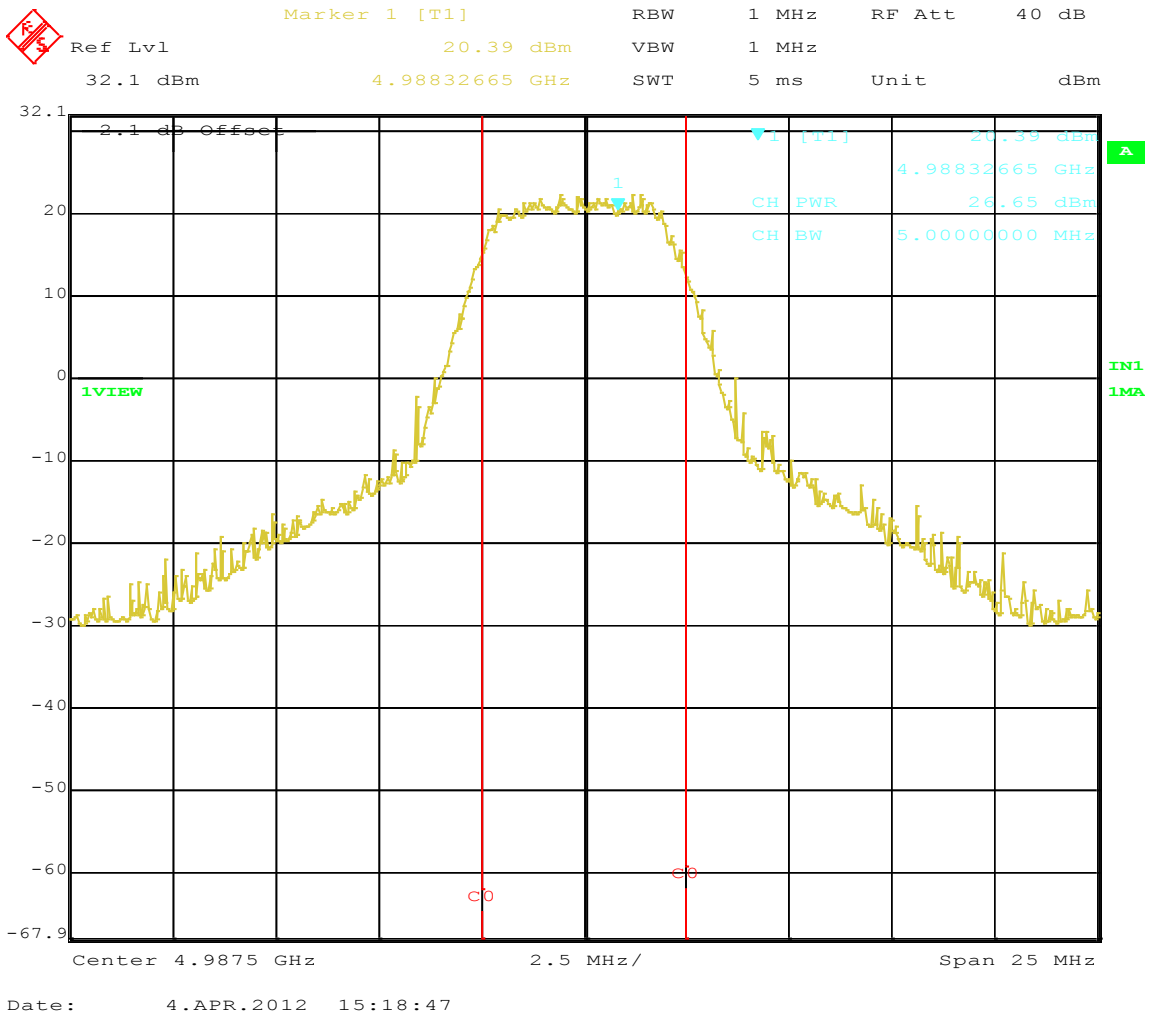


Figure 6: Channel Power, 4987.5 – 5 MHz – 6 Mbps

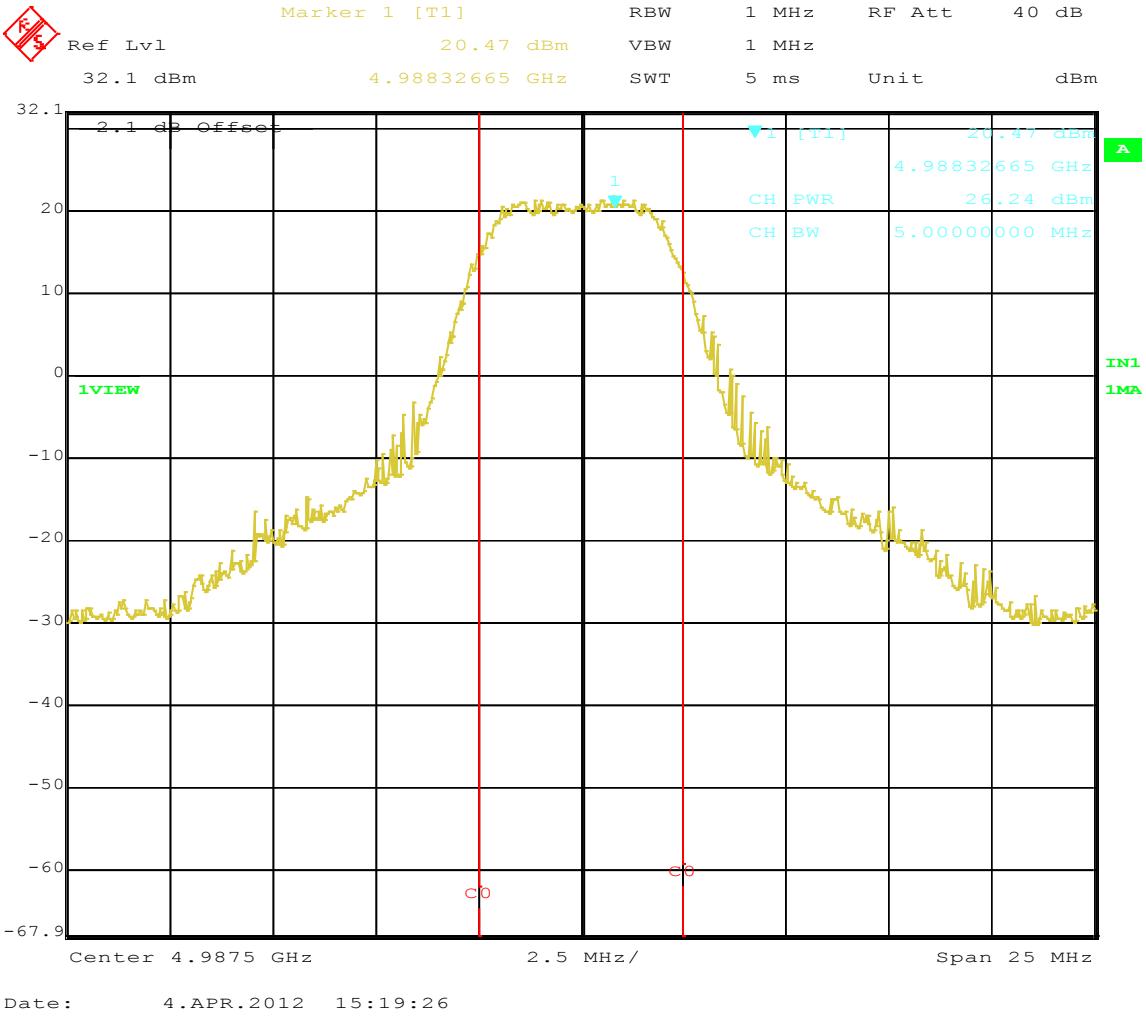


Figure 7: Channel Power, 4987.5 – 5 MHz – 24 Mbps

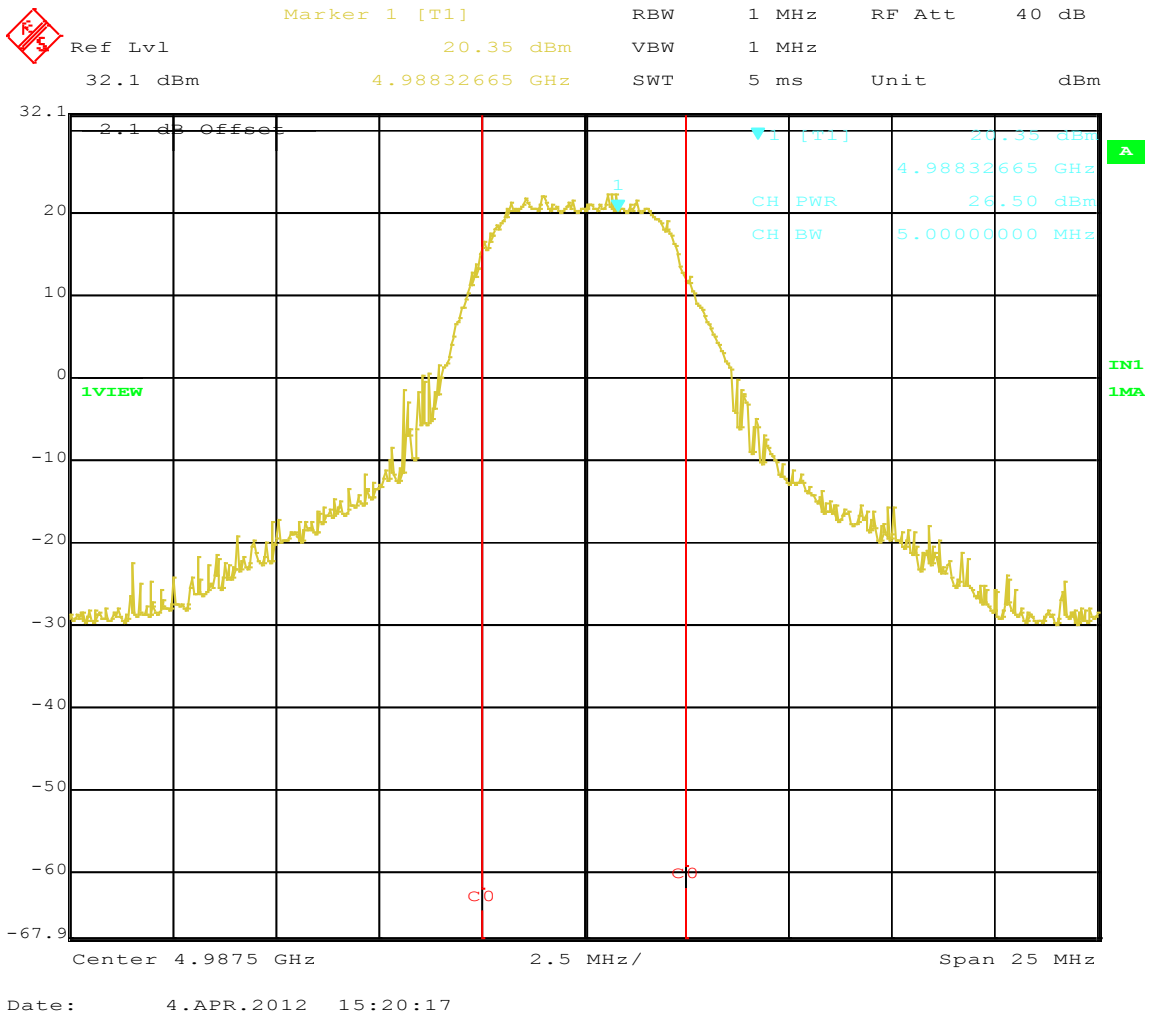


Figure 8: Channel Power, 4987.5 – 5 MHz – 54 Mbps

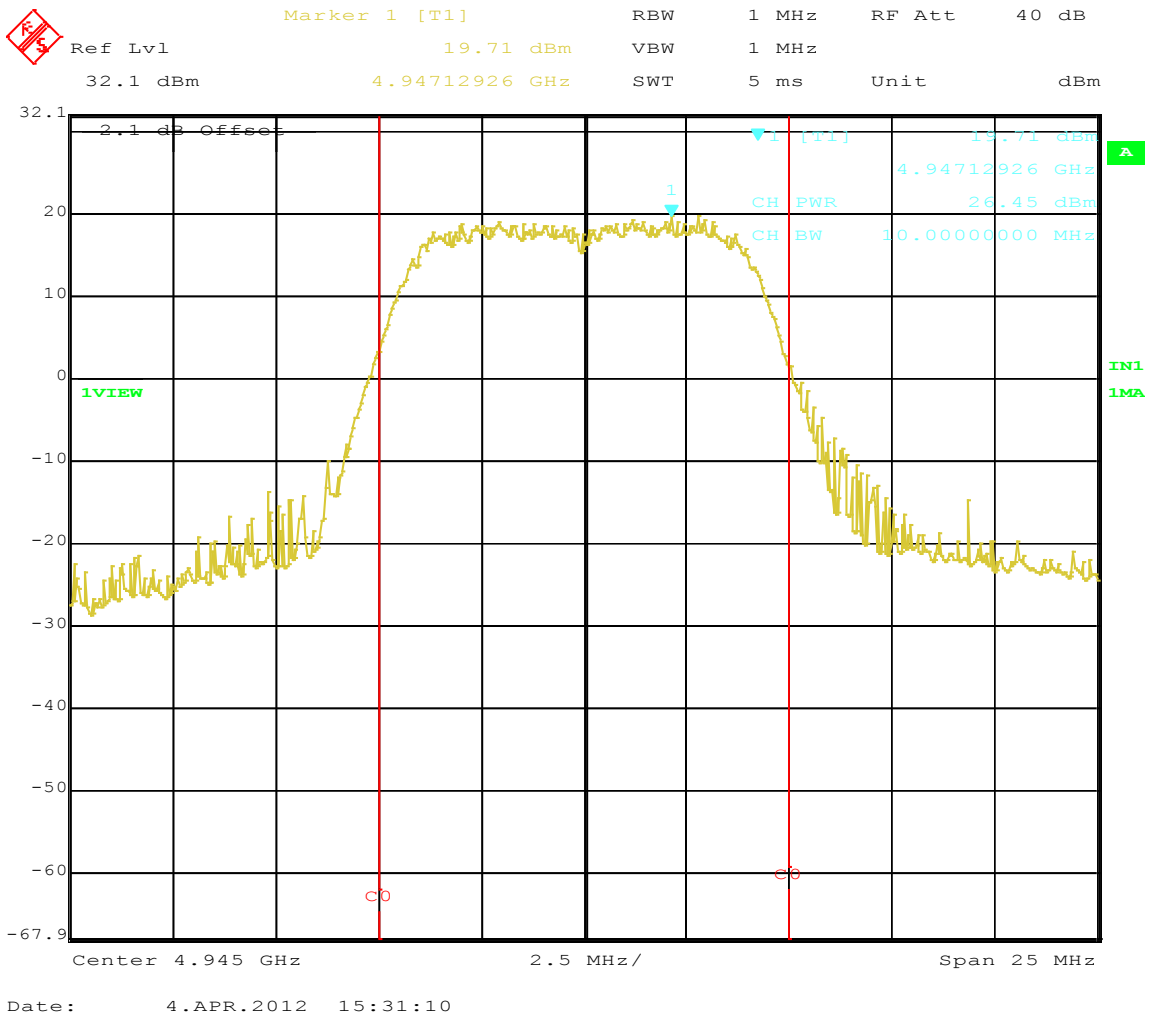


Figure 9: Channel Power, 4945 -10 MHz – 6 Mbps

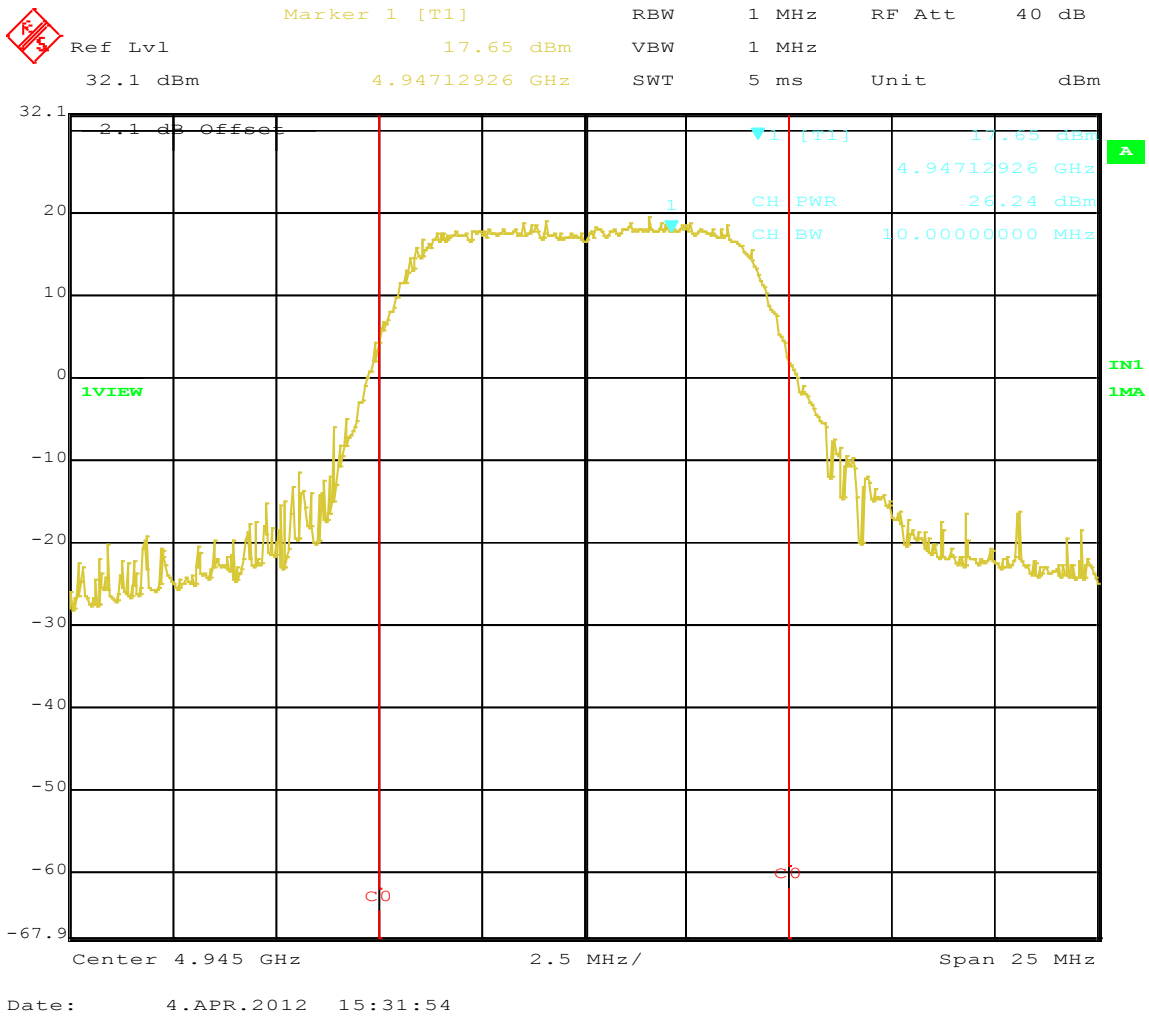


Figure 10: Channel Power, 4945 - 10 MHz – 24 Mbps

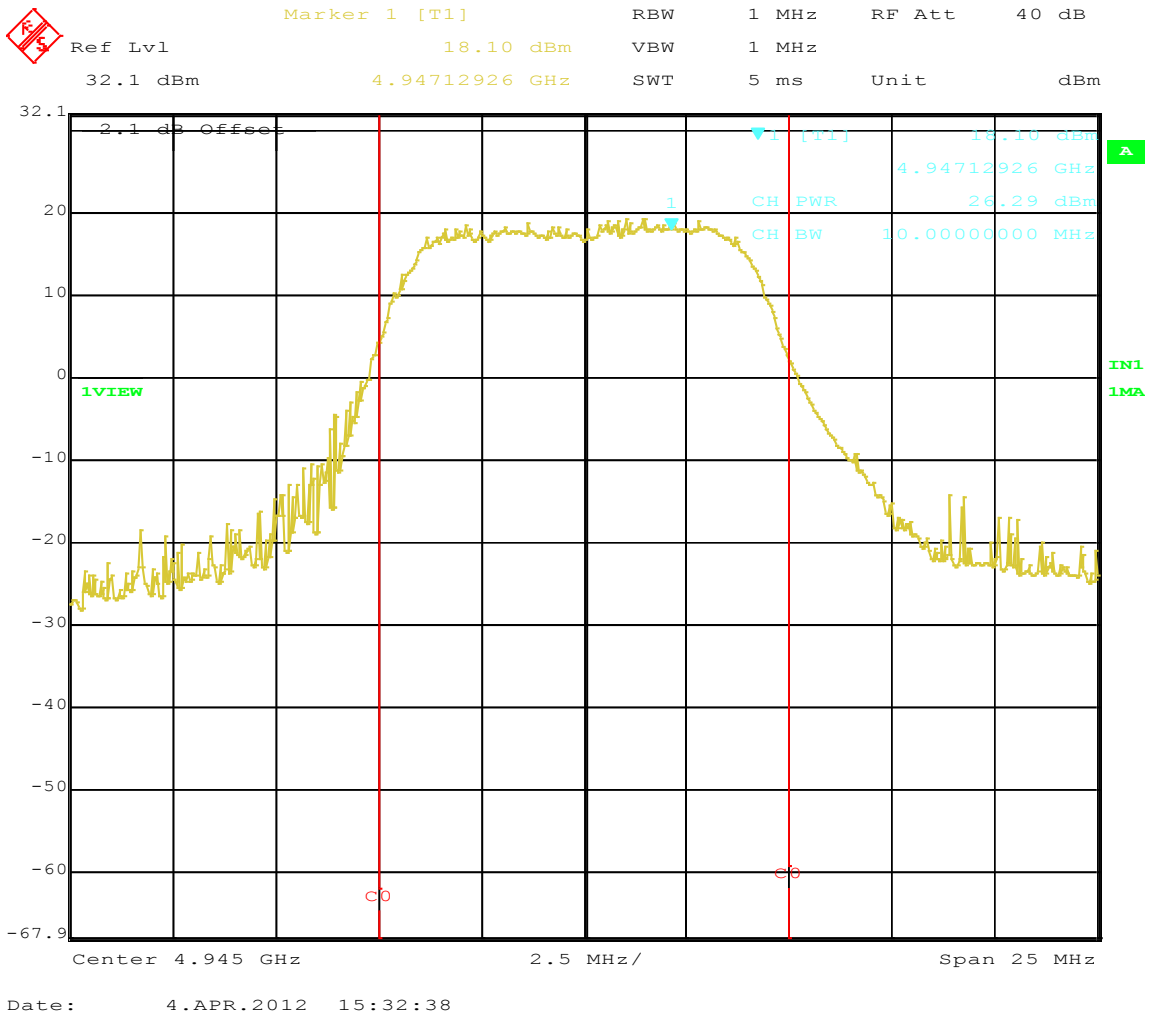


Figure 11: Channel Power, 4945 - 10 MHz – 54 Mbps

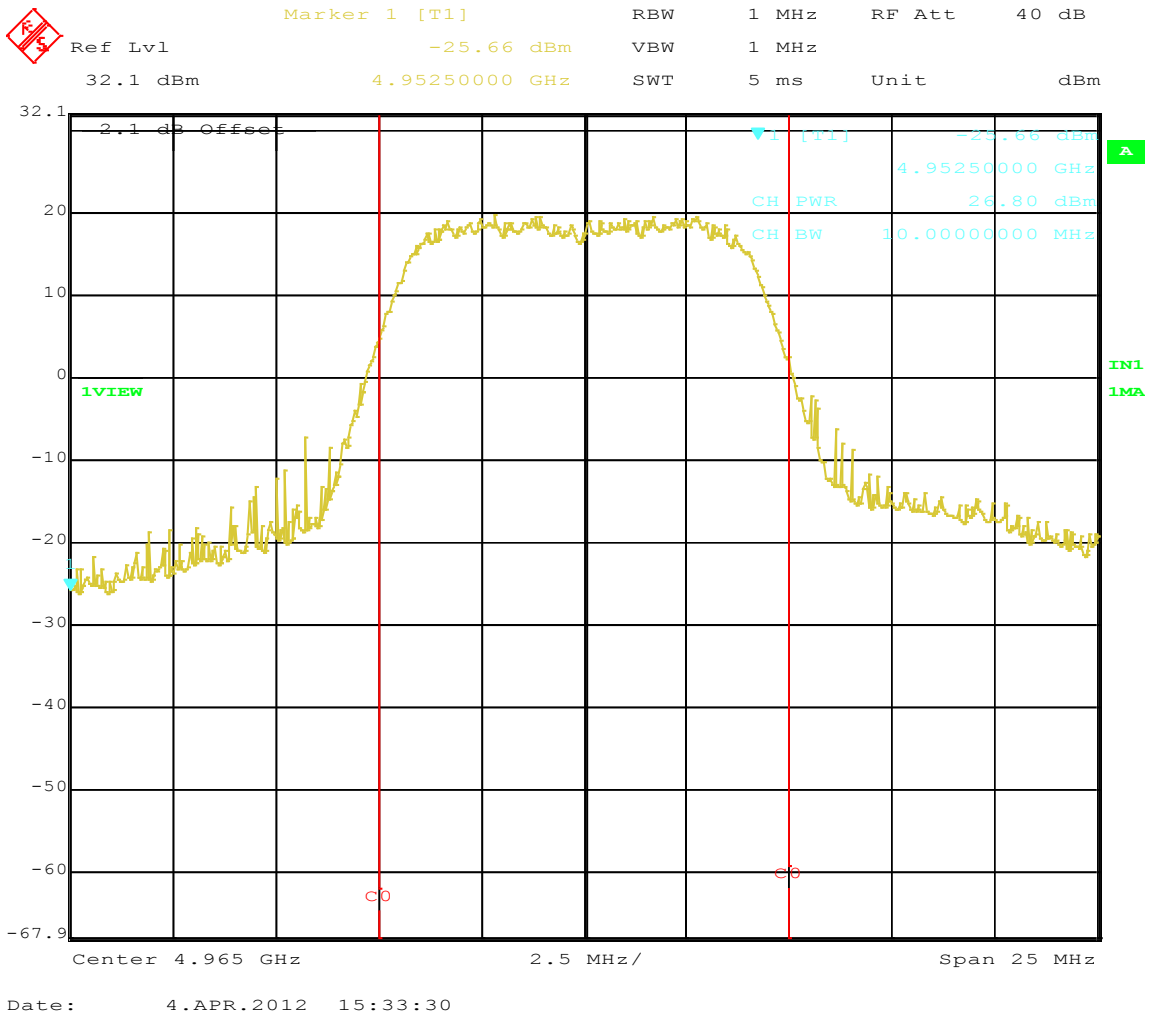


Figure 12: Channel Power, 4965 – 10 MHz – 6 Mbps

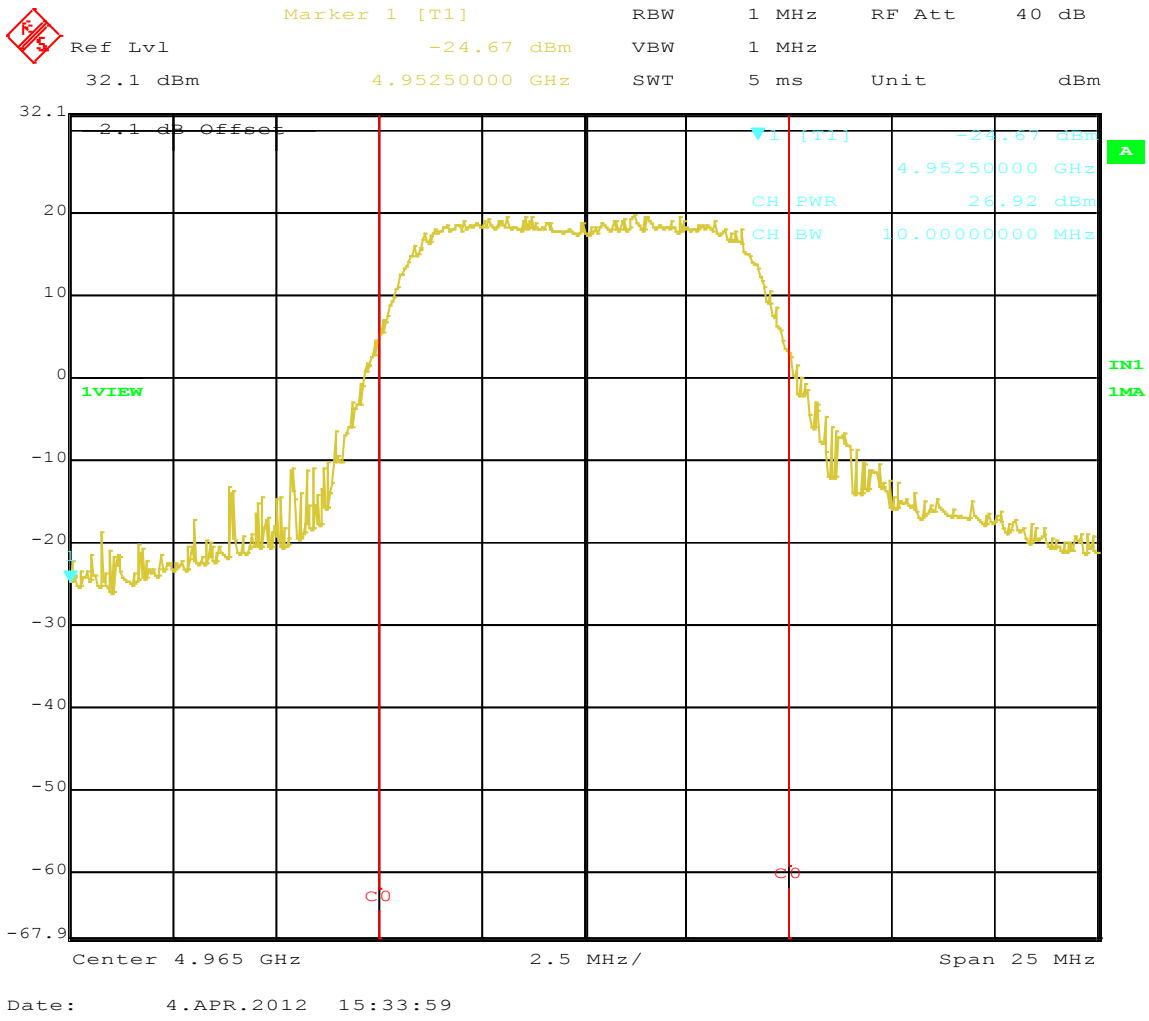


Figure 13: Channel Power, 4965 – 10 MHz – 24 Mbps

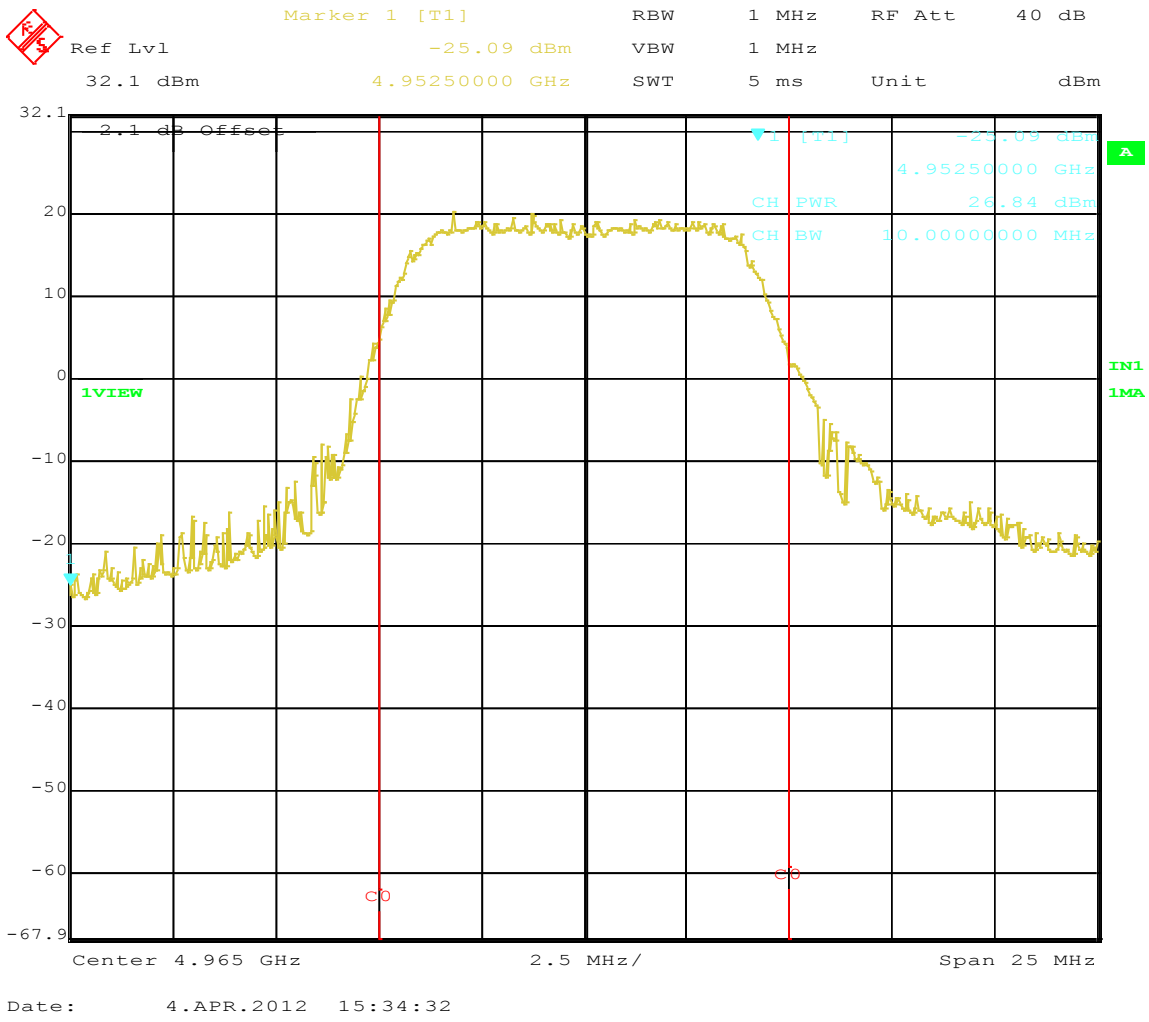


Figure 14: Channel Power, 4965 – 10 MHz – 54 Mbps

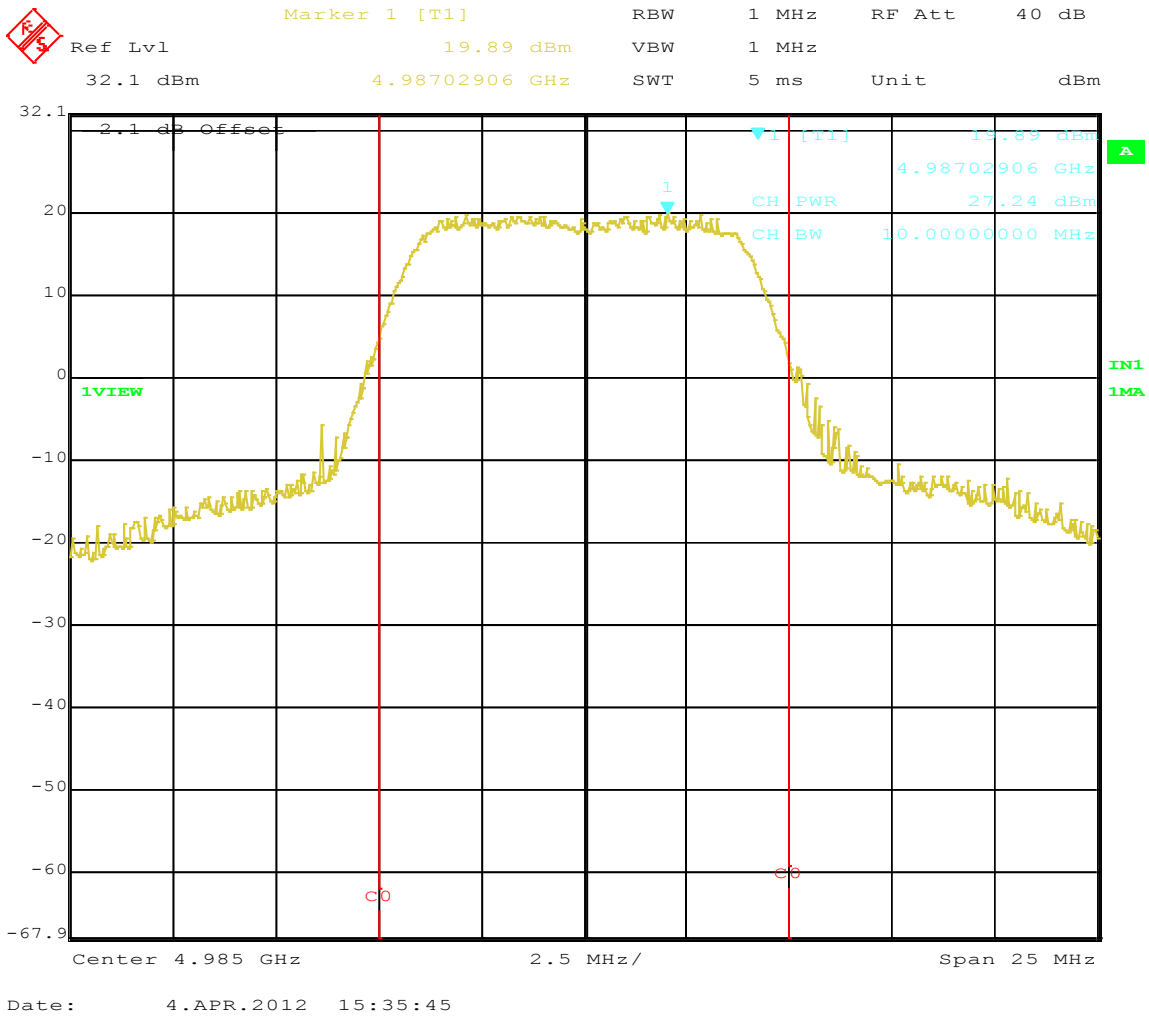


Figure 15: Channel Power, 4985 – 10 MHz – 6 Mbps

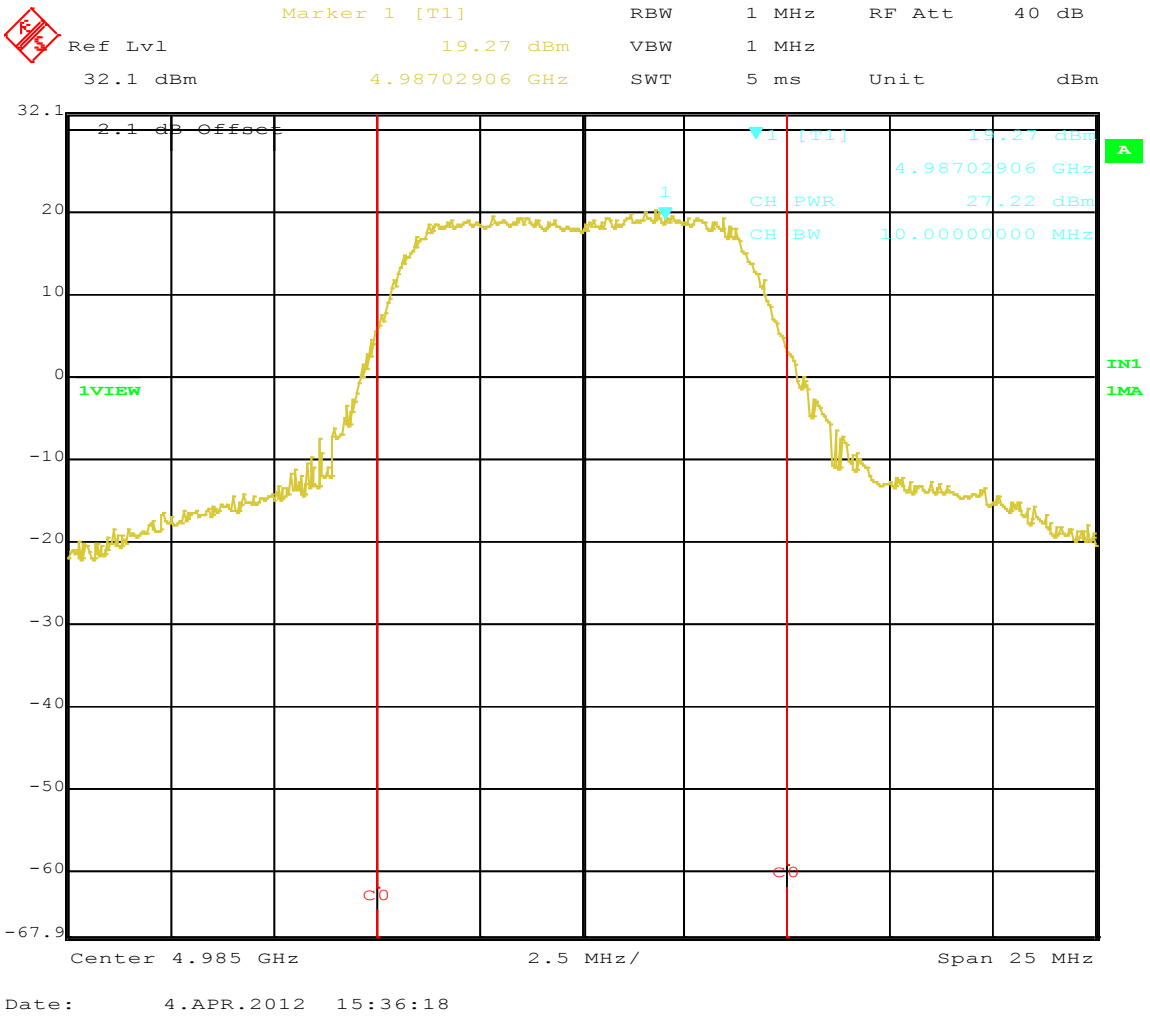


Figure 16: Channel Power, 4985 – 10 MHz – 24 Mbps

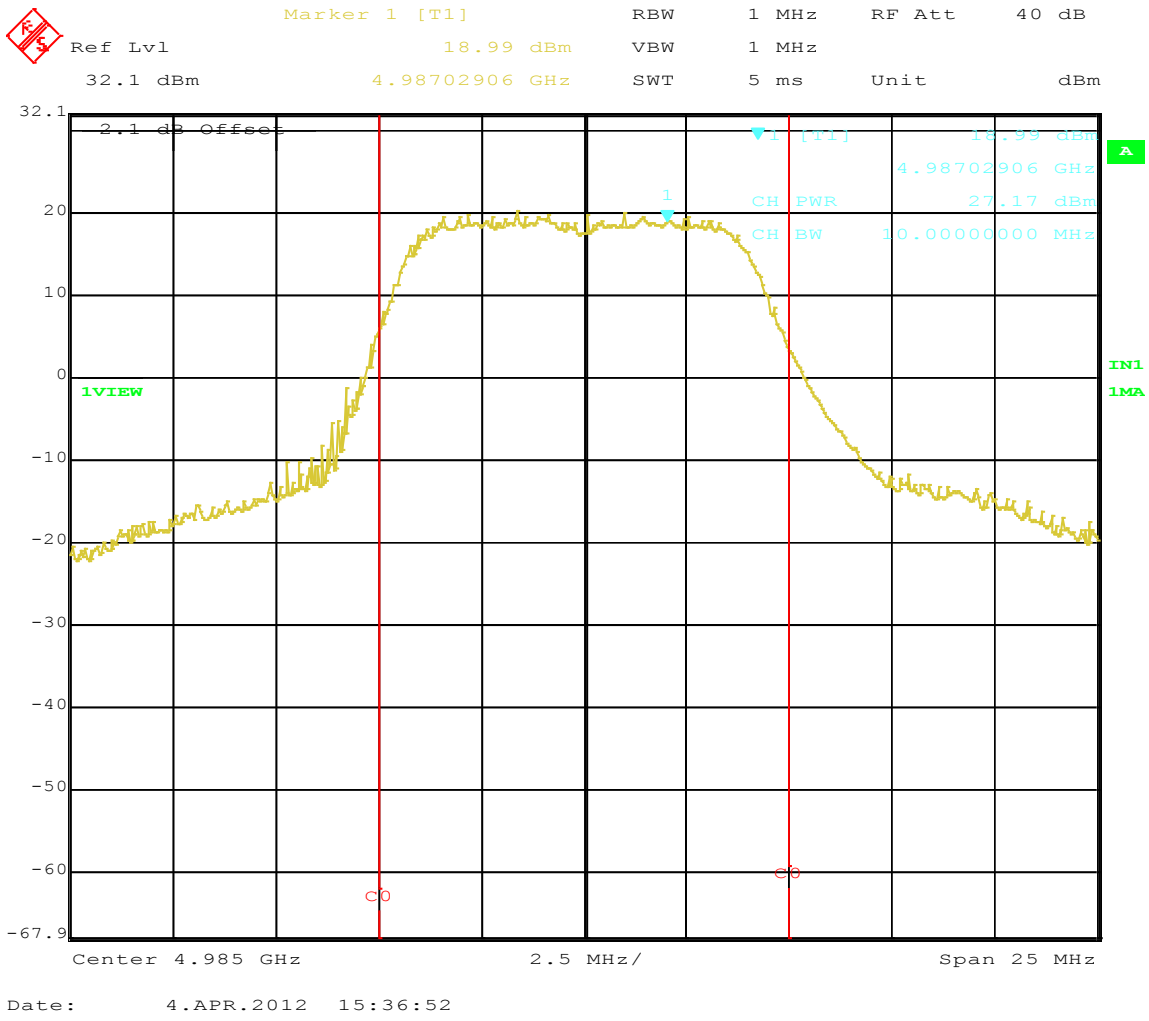


Figure 17: Channel Power, 4985 – 10 MHz – 54 Mbps

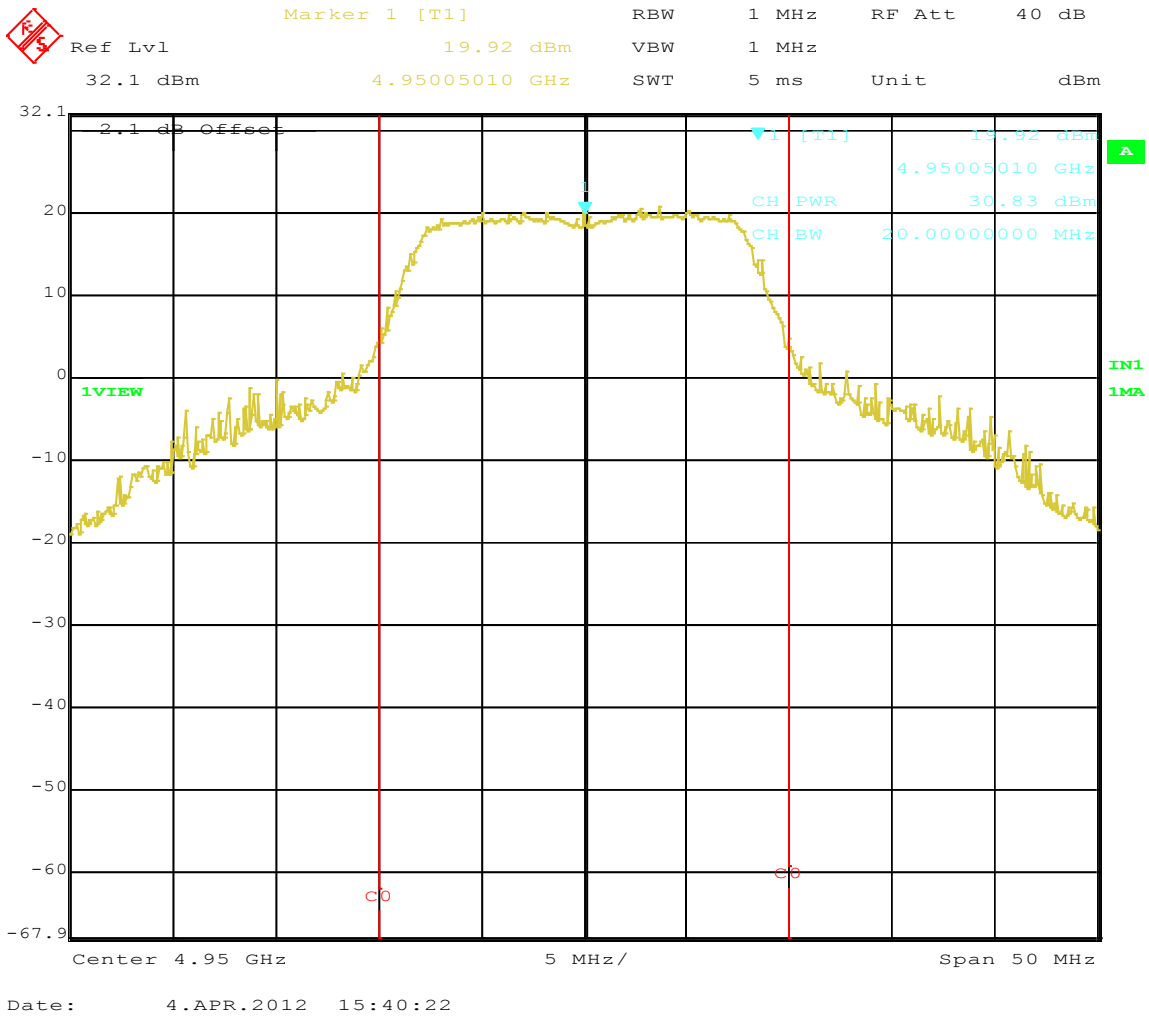


Figure 18: Channel power 4950 -20 MHz – 6 Mbps

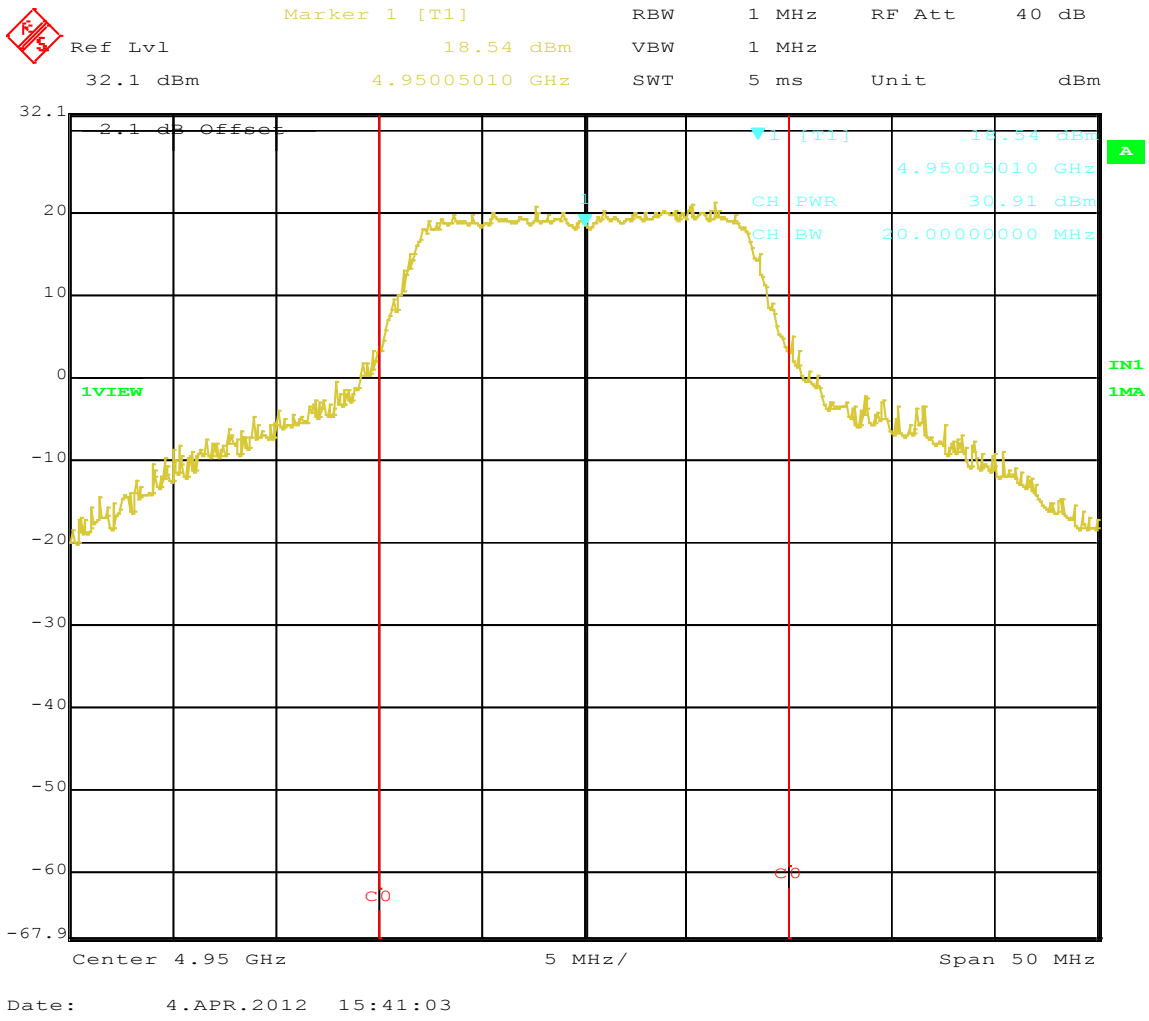


Figure 19: Channel Power 4950 - 20 MHz – 24 Mbps

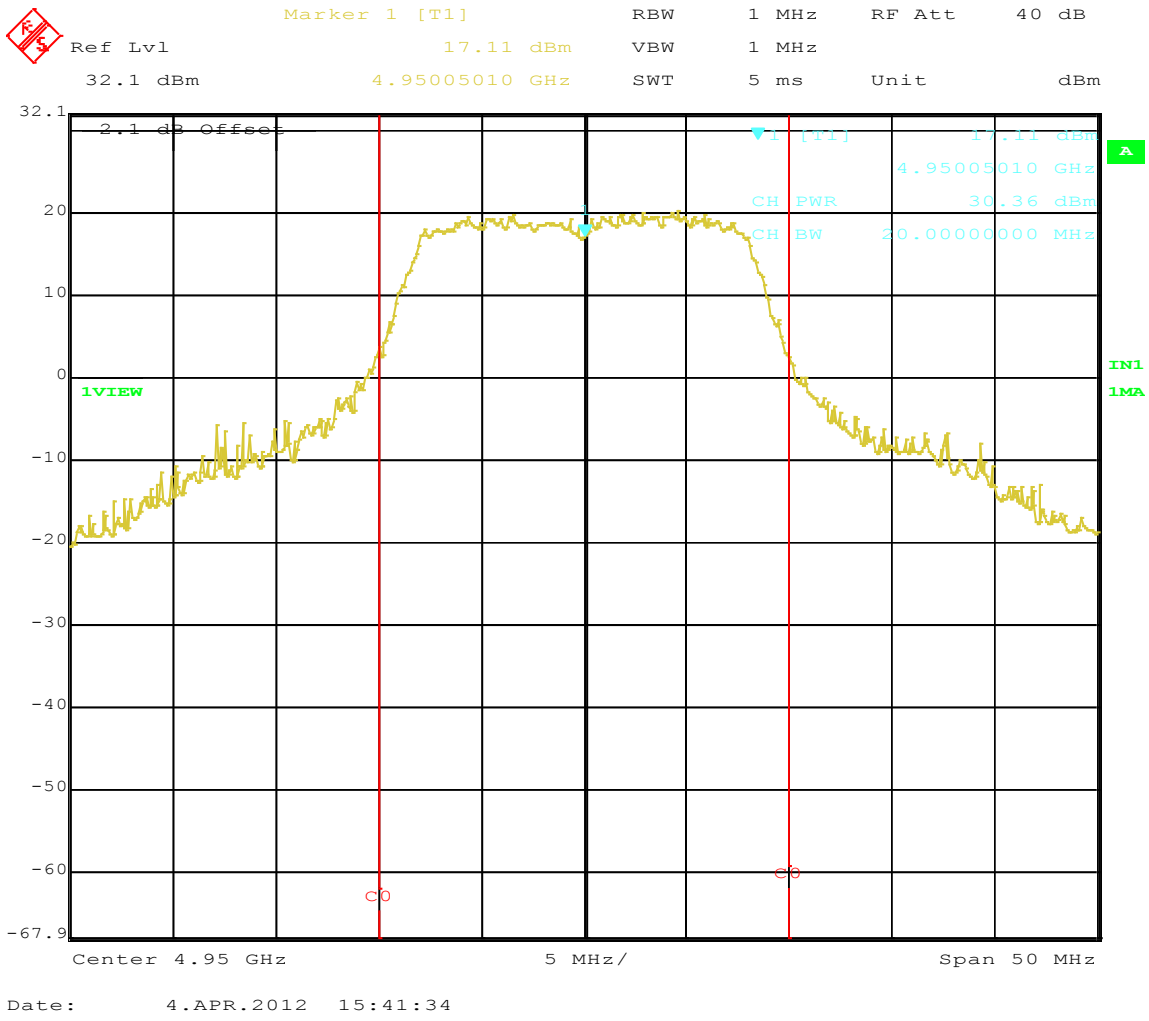


Figure 20: Channel Power 4950 - 20 MHz – 54 Mbps

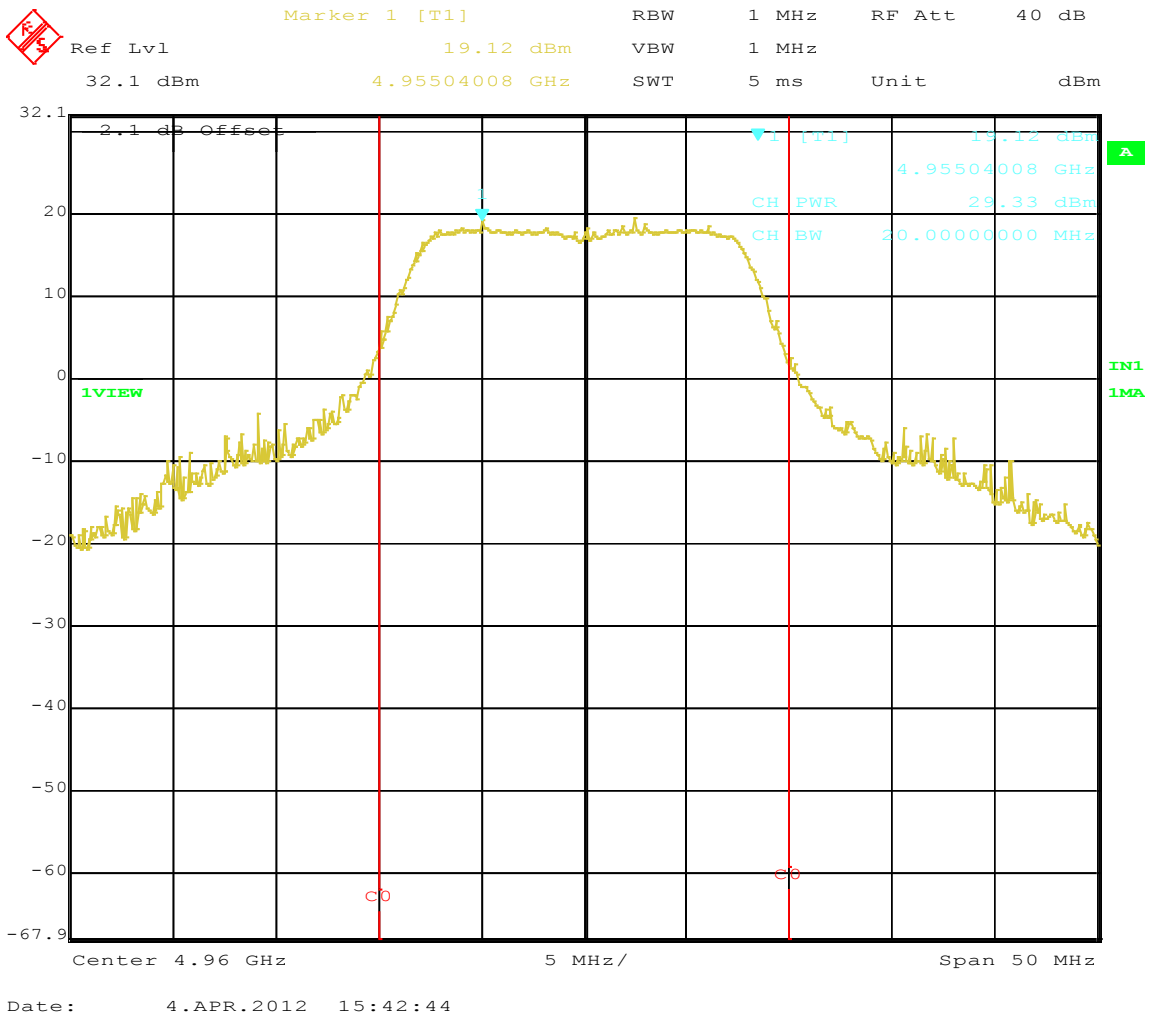


Figure 21: Channel Power 4960 – 20 MHz – 6 Mbps

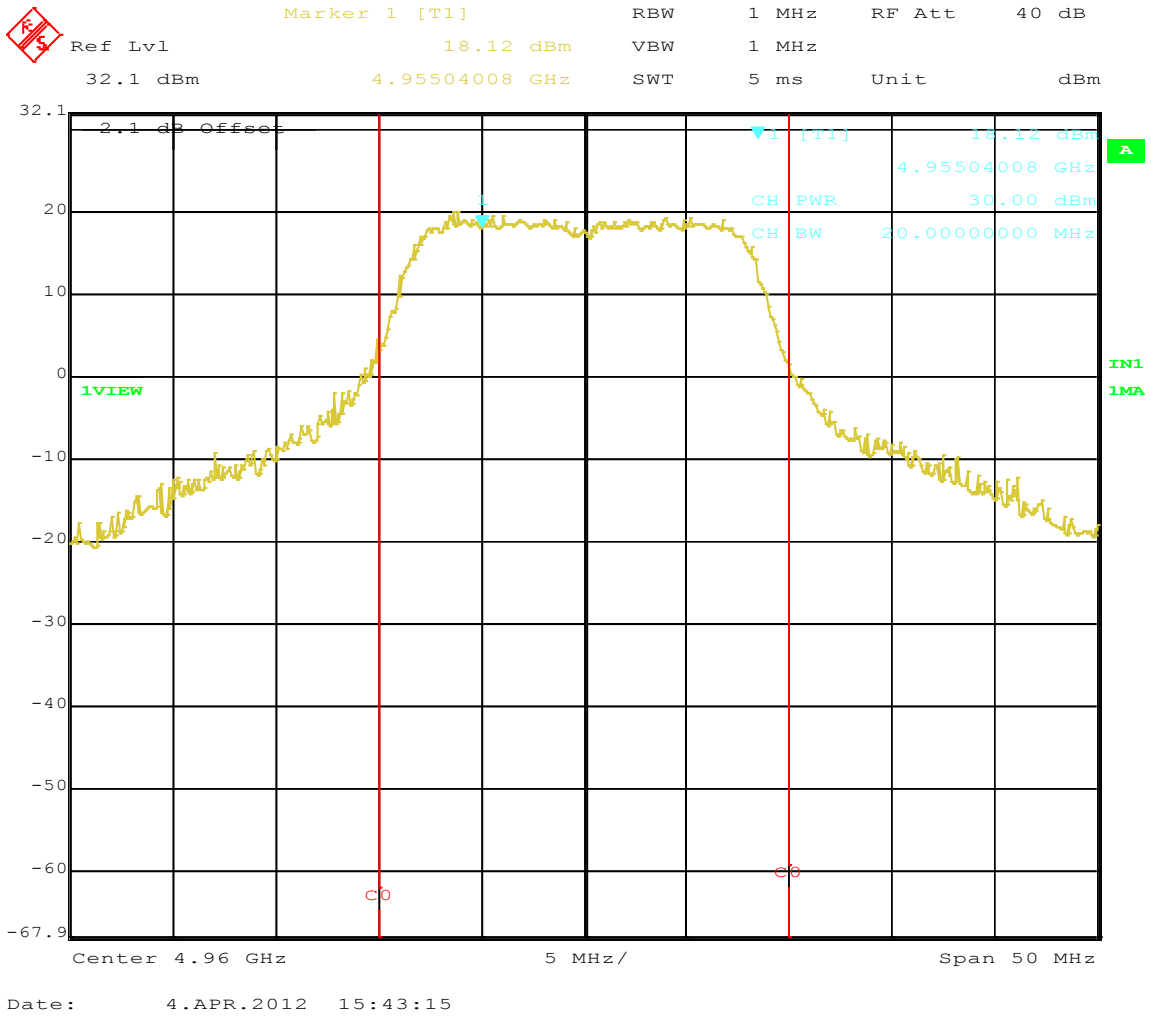


Figure 22: Channel Power 4960 – 20 MHz – 24 Mbps

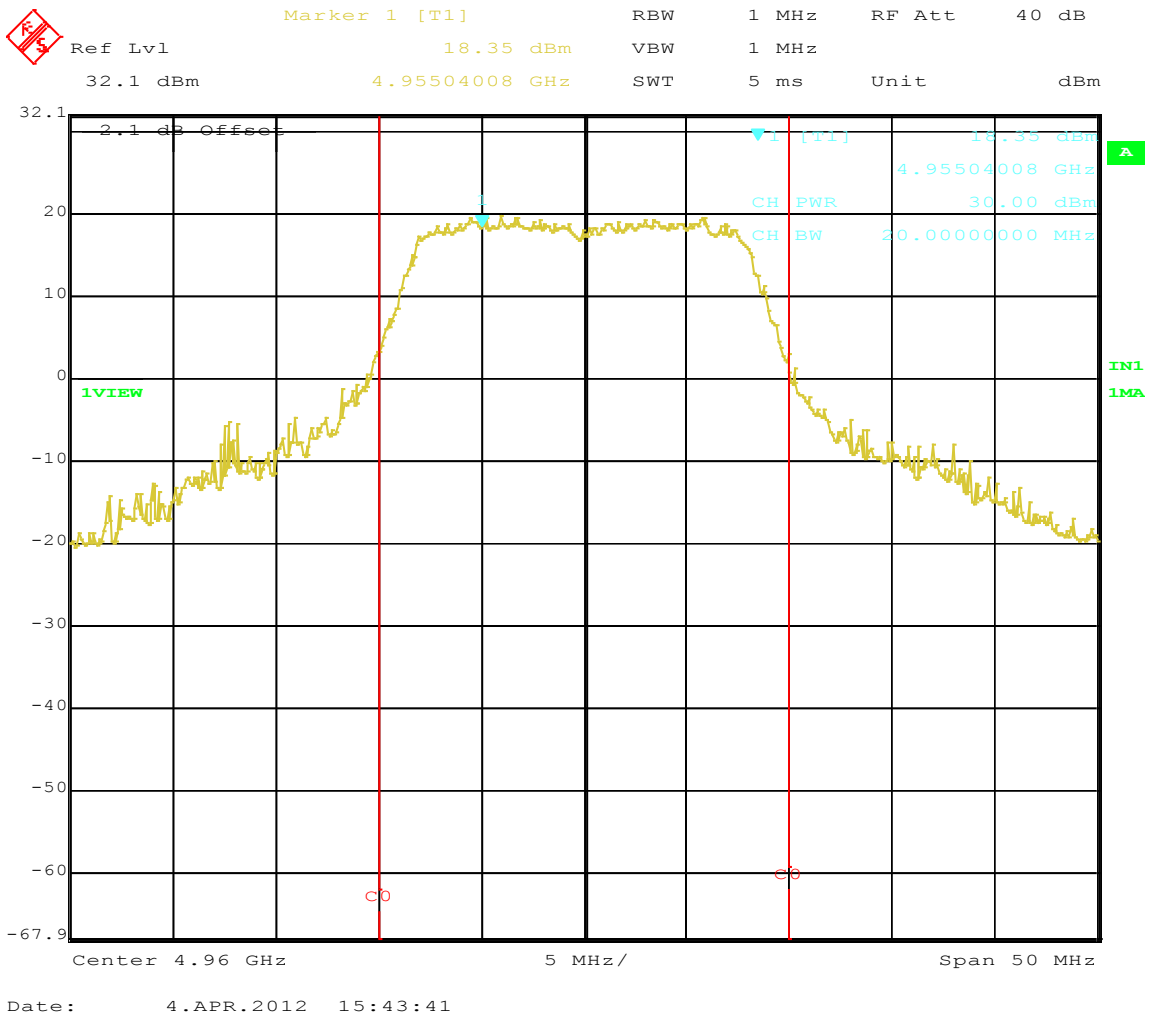


Figure 23: Channel Power 4960 MHz – 20 MHz – 54 Mbps

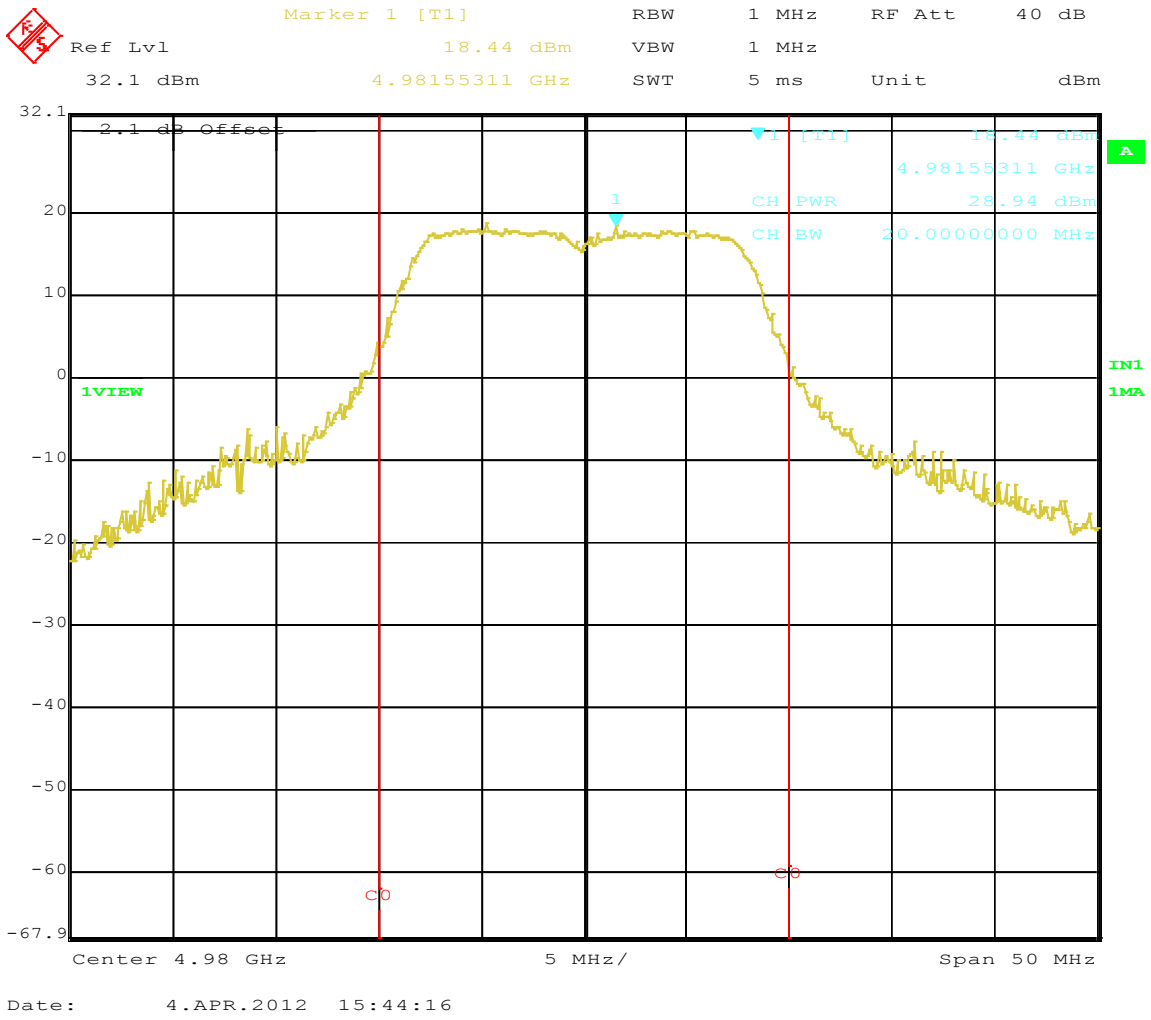


Figure 24: Channel Power 4980 MHz – 20 MHz – 6 Mbps

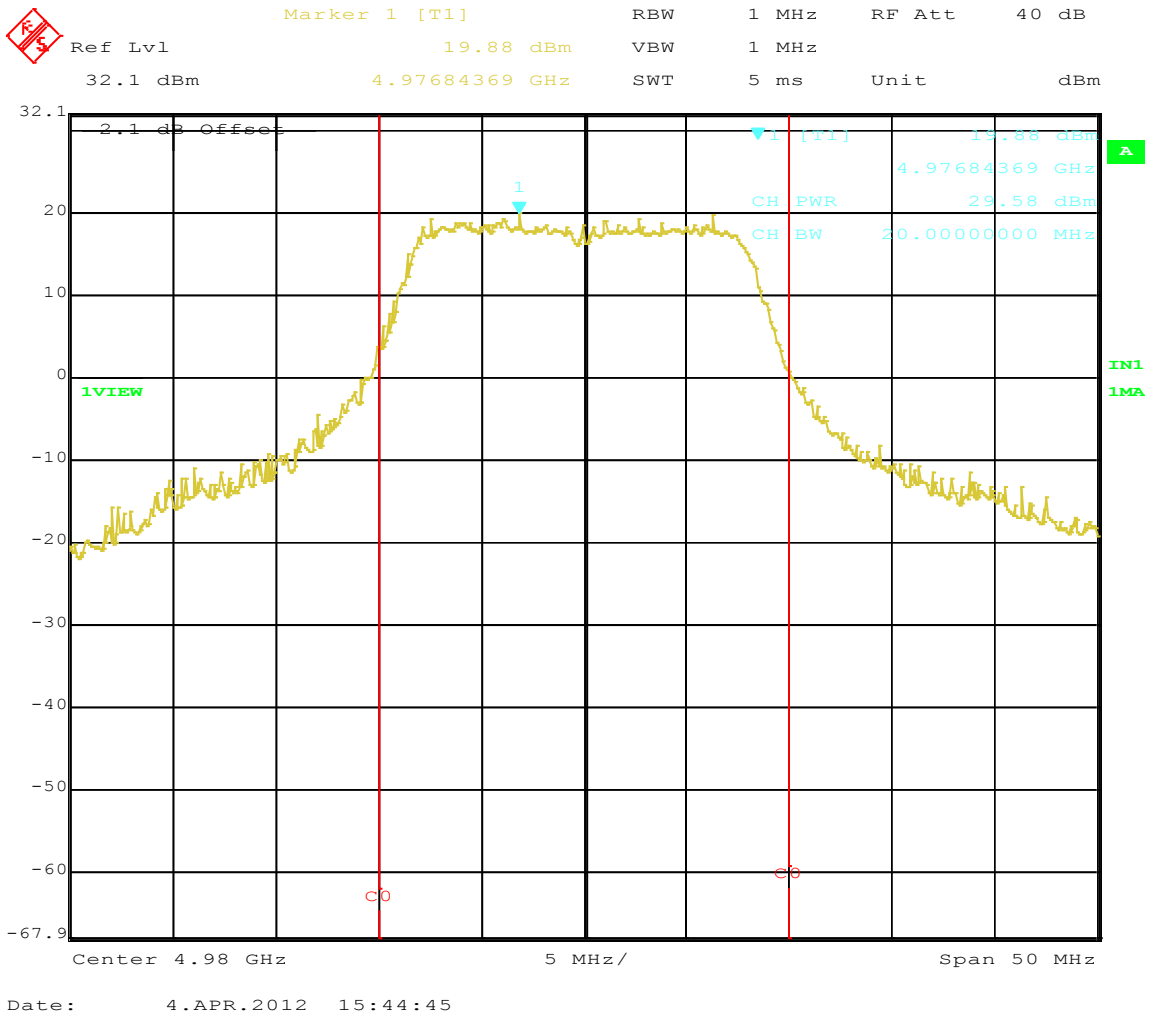


Figure 25: Channel Power 4980 MHz – 20 MHz – 24 Mbps

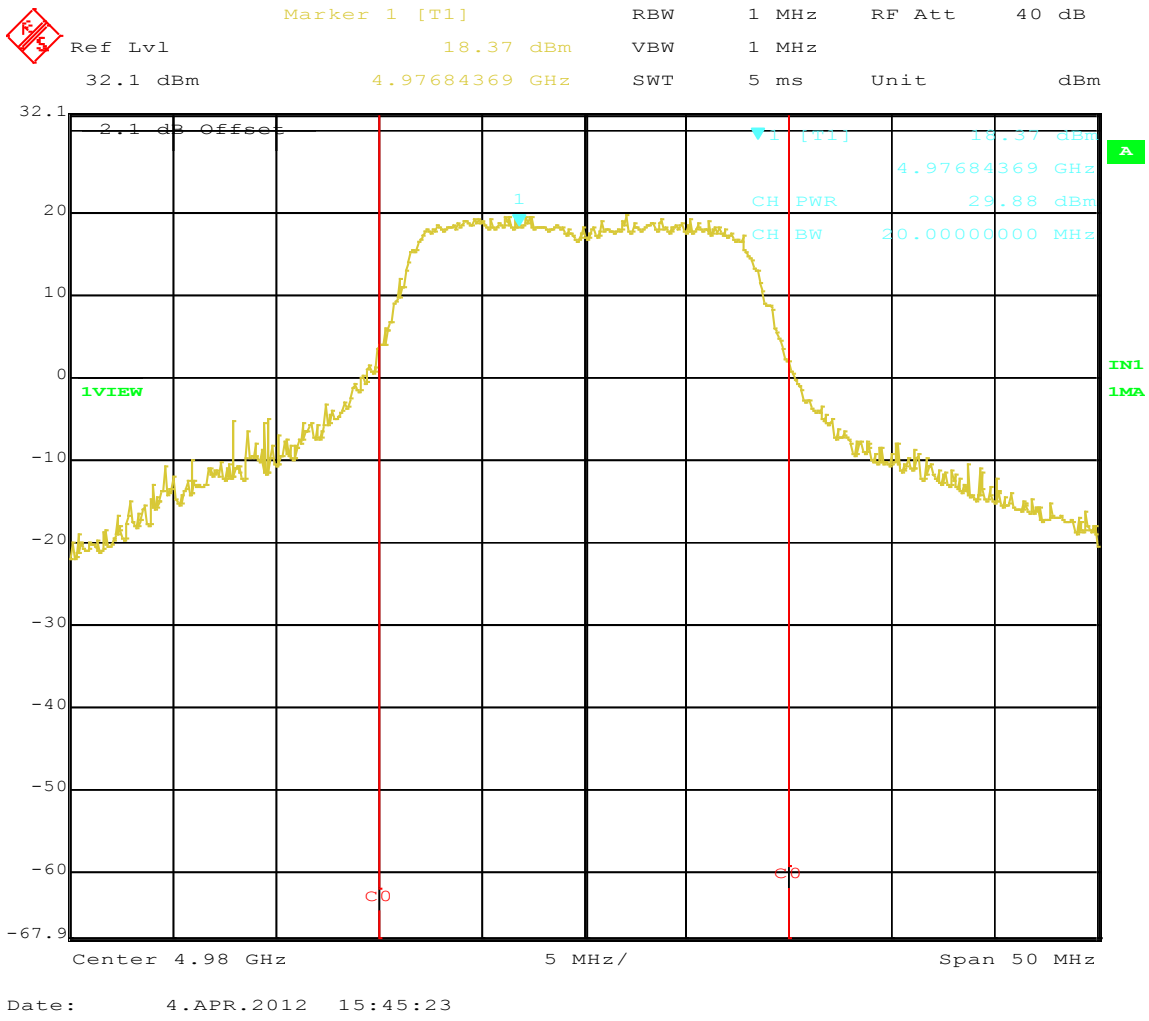


Figure 26: Channel Power 4980 MHz– 20 MHz – 54 Mbps

4.2 Channel Bandwidth

The channel center frequencies are permitted to be aggregated for channels bandwidths of 5, 10 and 20 MHz Channels numbers 1 through 5and 15 through 18 are 1MHz channels and channels number 6 the 14 are 5 MHz Channels.

The channel plan is listed part 90.1213 Emission Bandwidth must be eual to less than nominal Bandwidth

4.2.1 Test Method

The channel plan meets the requirements of FCC part 90.1213. Arada systems use 3 channels Bandwidths 5, 10 and 20 MHz. The Transmitter output was connected Spectrun analyzer RBW is set to 1 to 3% of measured BW. VBW is set to 3 times or higher than RBW. Sweeptime set to auto and Spectrum Analyzer internal function was used to measure Occupied BW.

Table 3: BW requirements

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only				
Antenna Type: External Monopole			**Power Setting:** See test plan	
Max. Antenna Gain: +2.1 dBi			**Signal State:** Modulated @99%	
Ambient Temp.: 21 °C			**Relative Humidity:**39%	
Occupied BW				
Operating Freq. MHz	**Mode**	**Limit (MHz)**	**Measured Value (MHz)**	**Result**
4947.5	Low	5	4.31	Pass
4967.5	Mid	5	4.22	Pass
4987.0	High	5	4.26	Pass
4945.0	Low	10	8.95	Pass
4965.0	Mid	10	8.42	Pass
4985.0	High	10	8.32	Pass
4950.0	Low	20	17.84	Pass
4960.0	Mid	20	19.09	Pass
4980.0	High	20	19.98	Pass

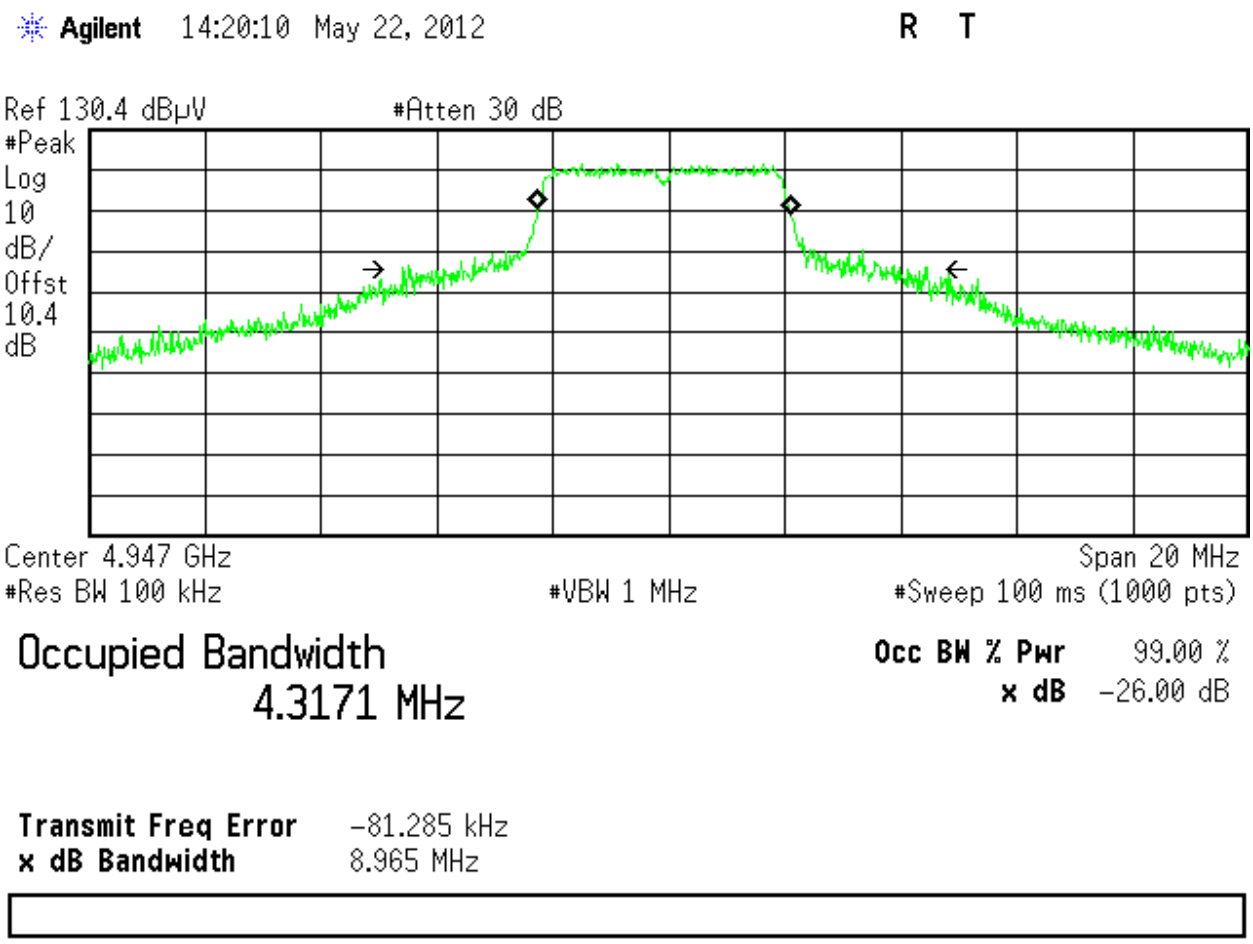


Figure 27: Occupied BW Low Channel

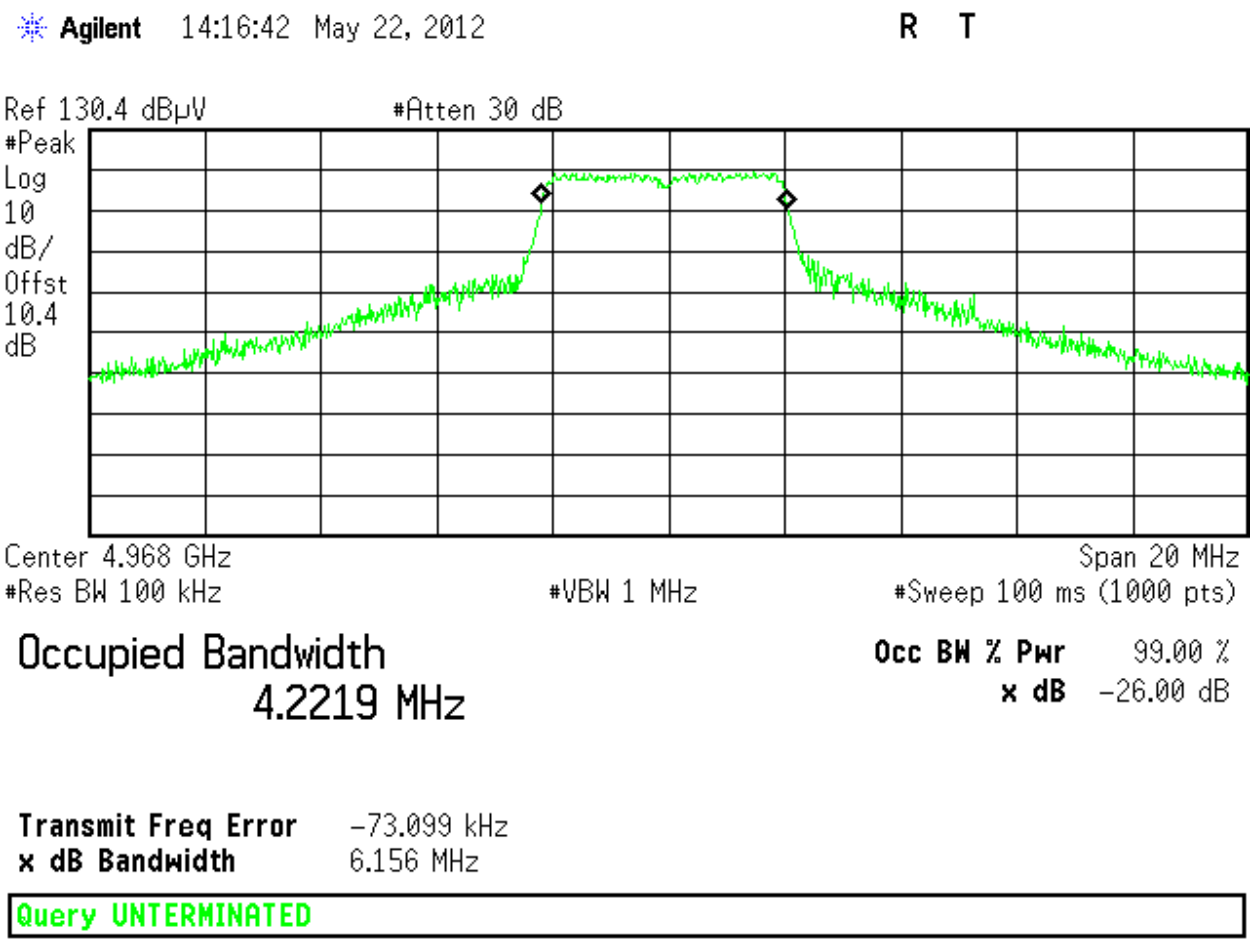


Figure 28: Occupied BW Mid Channel

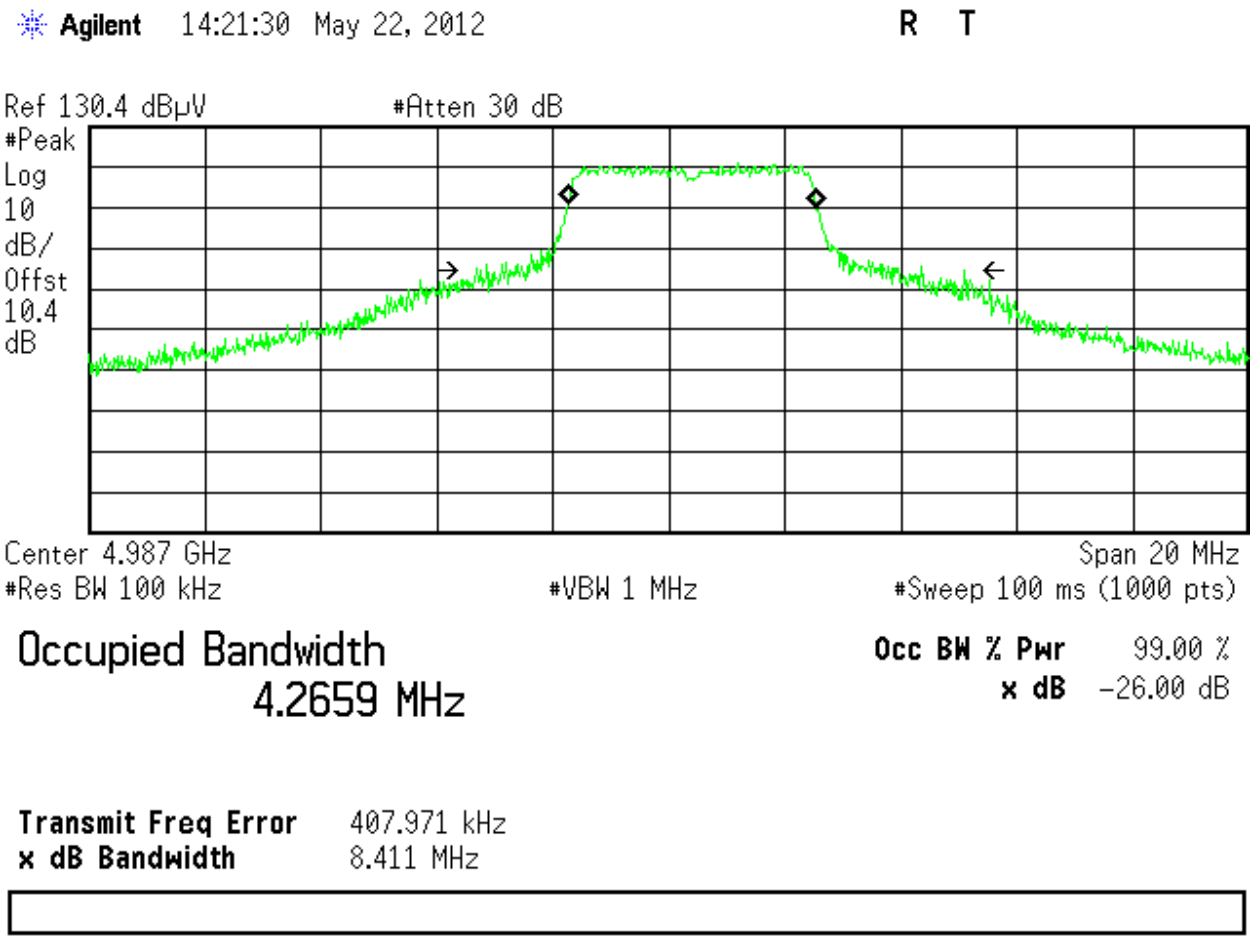


Figure 29: Occupied BW High Channel

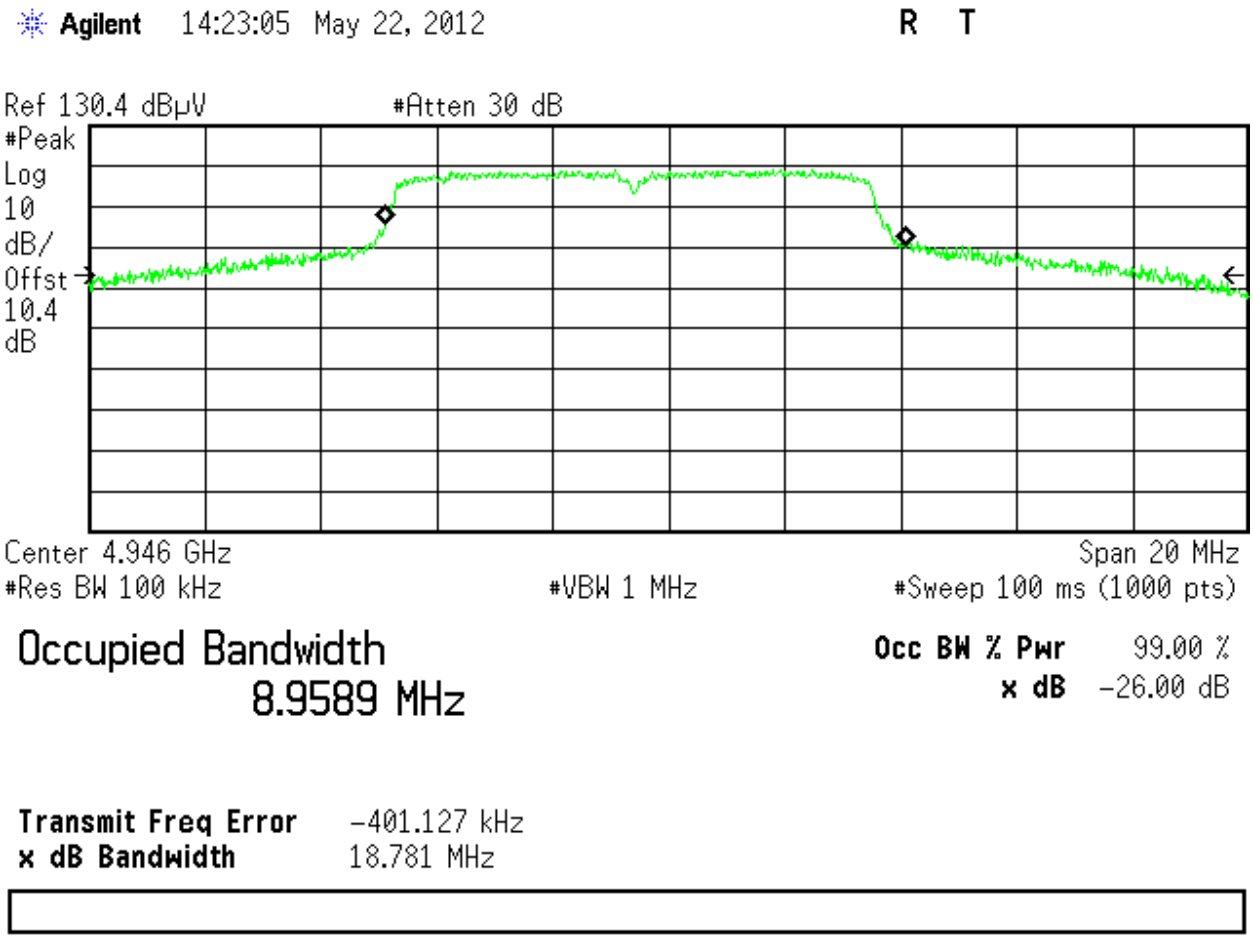


Figure 30: Occupied BW Low Channel

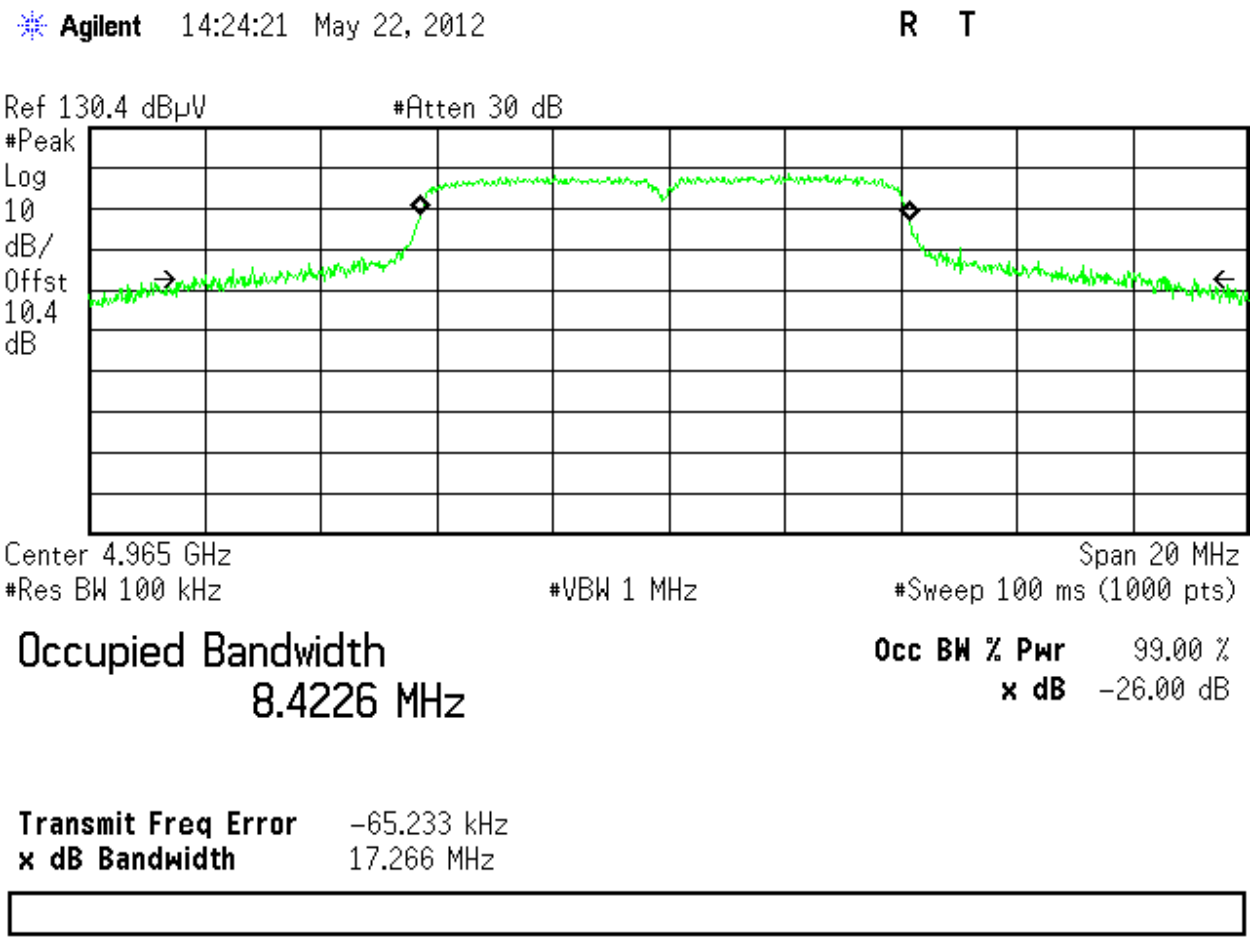


Figure 31: Occupied BW Mid Channel

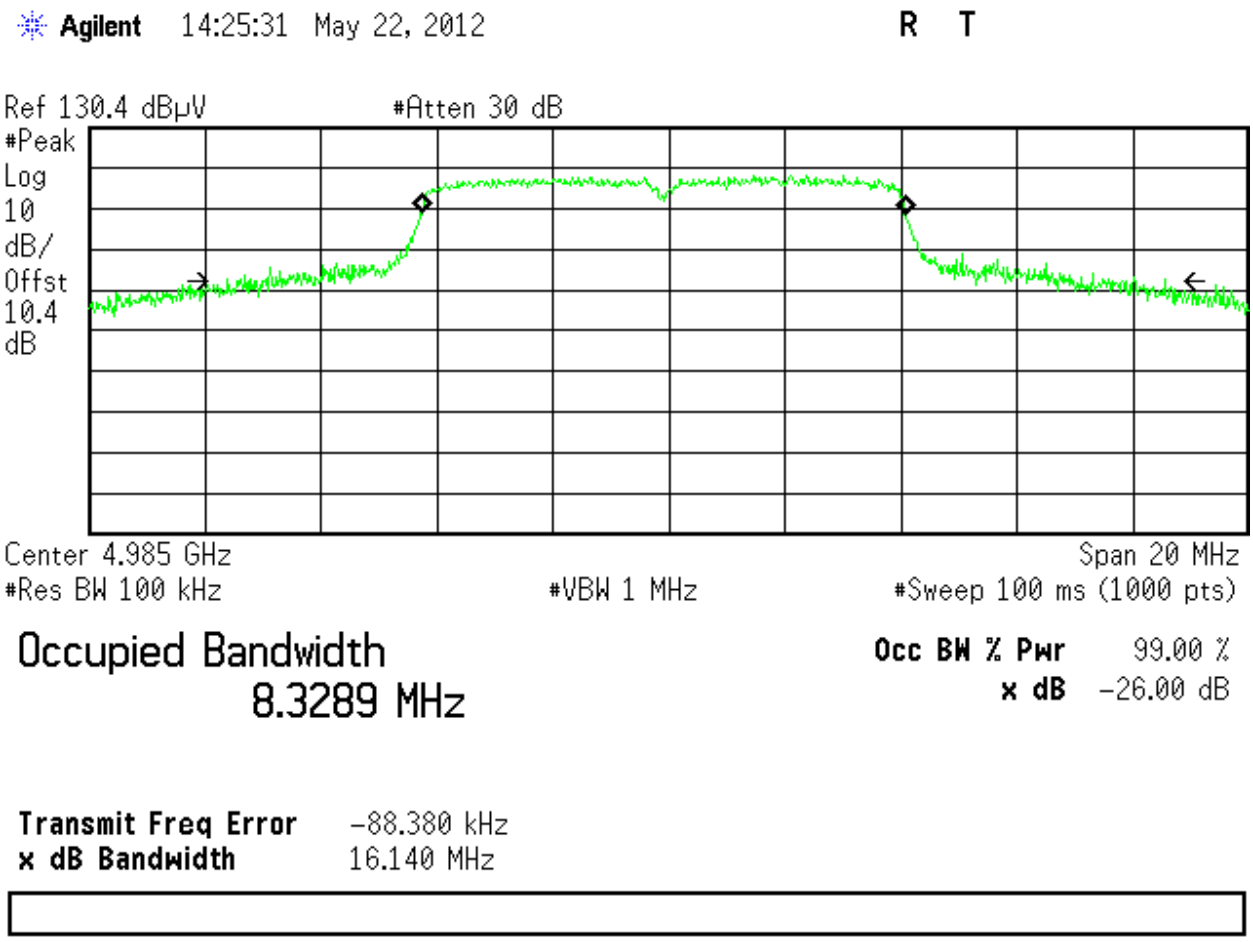


Figure 32: Occupied BW High Channel

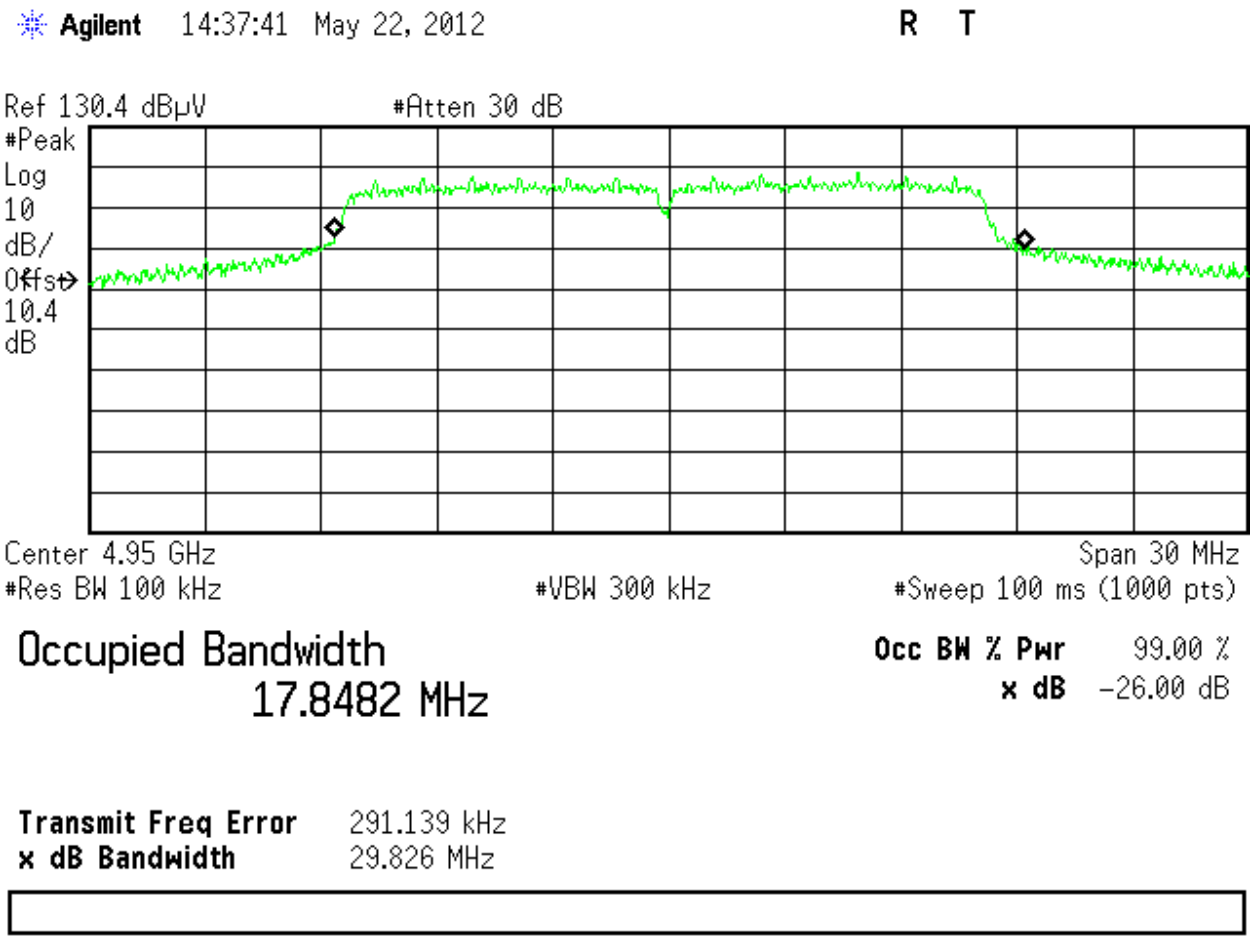


Figure 33: Occupied BW Low Channel

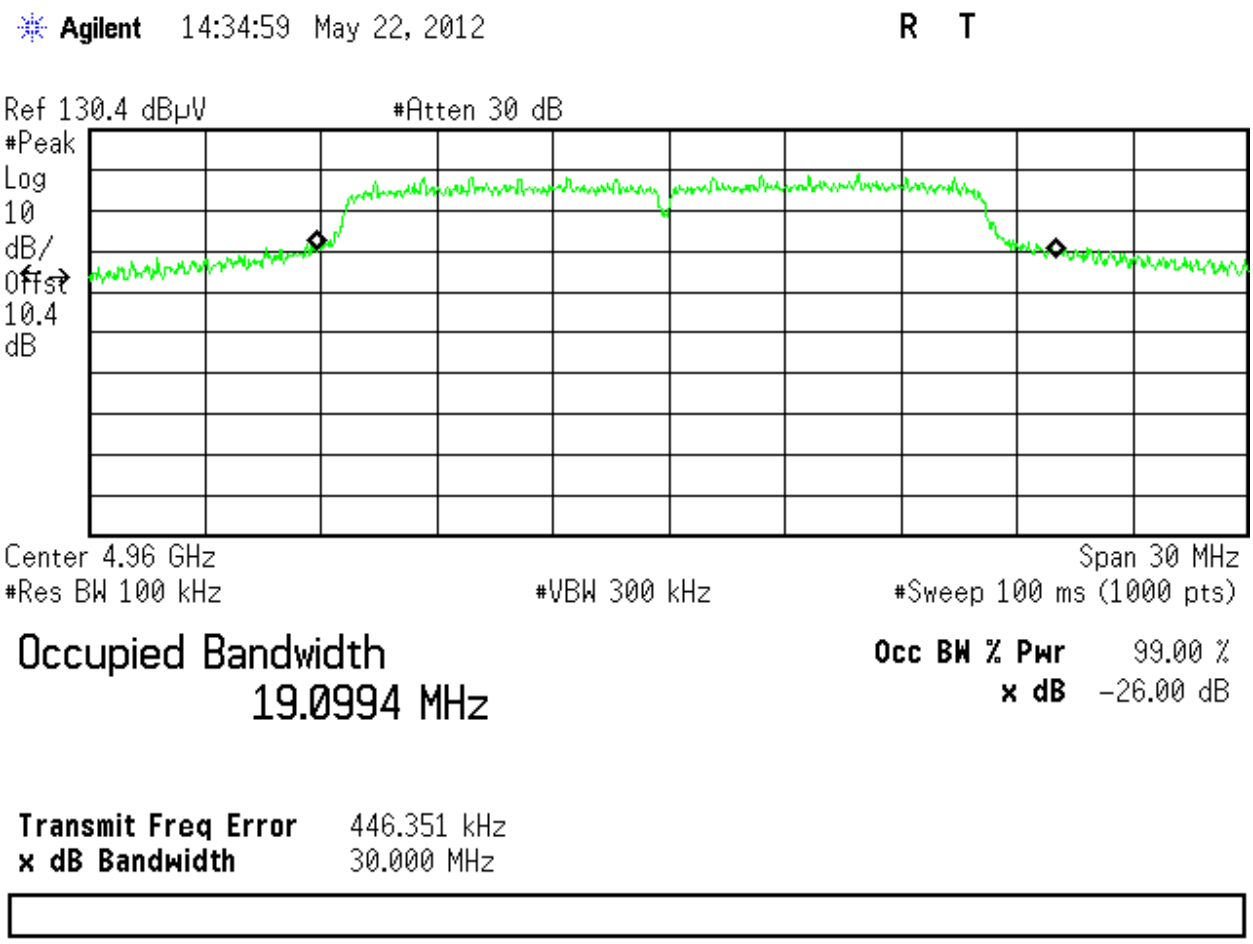


Figure 34: Occupied BW Mid Channel

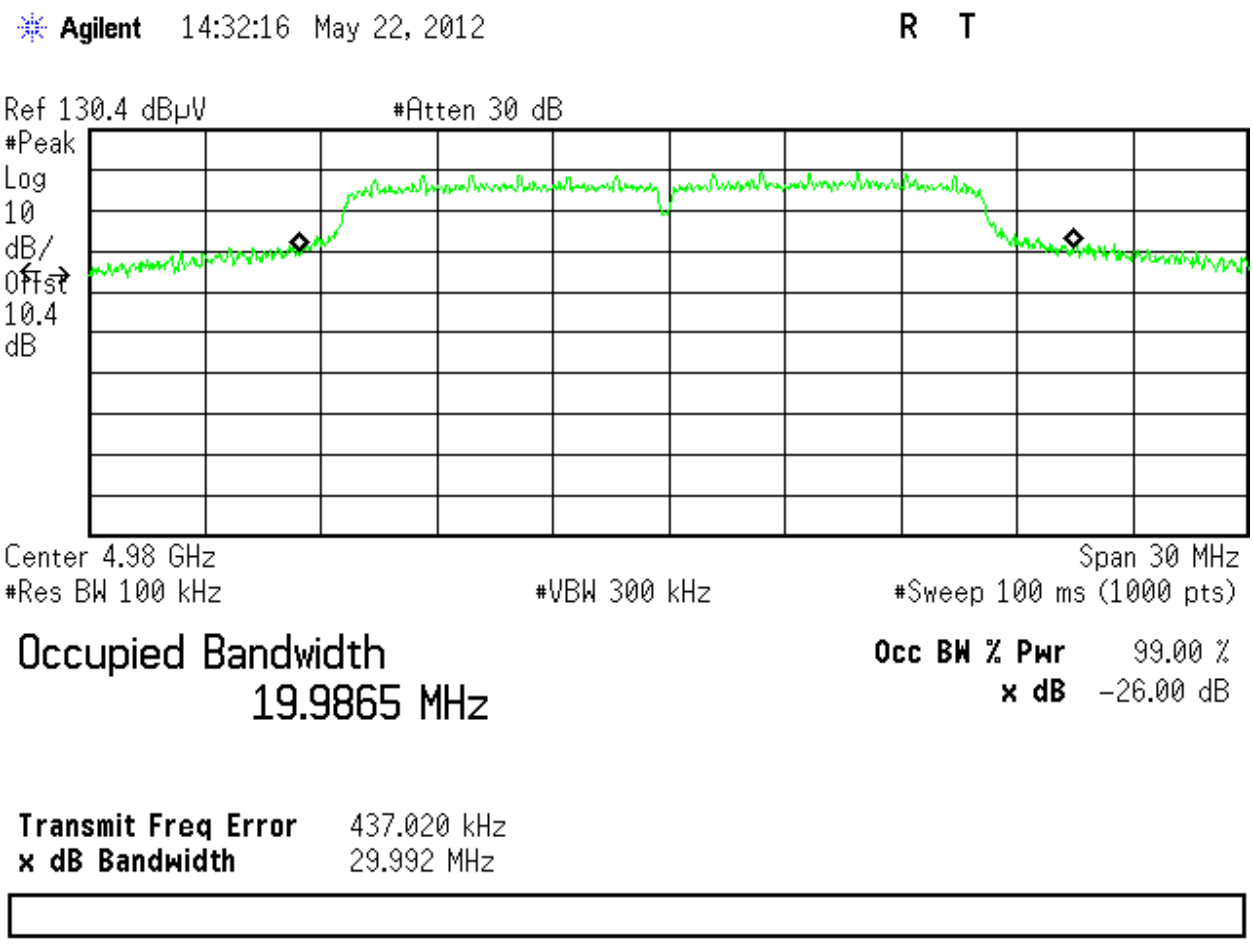


Figure 35: Occupied BW High Channel

4.3 Spectral Mask requirements

§ 90.210 Emission Masks.

The transmitters used in the radio service governed by this part of radio service must comply with Emission Mask M.

(m) *Emission Mask M.* For high power transmitters (greater that 20 dBm) operating in the 4940–4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0–45% of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45–50% of the authorized bandwidth: 568 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50–55% of the authorized bandwidth: 26 + 145 log (% of BW/50) dB.

(4) On any frequency removed from the assigned frequency between 55–100% of the authorized bandwidth: 32 + 31 log (% of (BW)/55) dB.

(5) On any frequency removed from the assigned frequency between 100–150% of the authorized bandwidth: 40 + 57 log (% of (BW)/100) dB.

(6) On any frequency removed from the assigned frequency between above 150% of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is the lesser attenuation.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Spectral Mask Requirements – Test Results

Test Conditions: Conducted Measurement,				
Antenna Type: External Monopole +2.1 dBi			**Power Setting:** See test plan	
Max. Antenna Gain: +2.1 dBi				
Ambient Temp.: 21 °C		**Relative Humidity:** 35%		
Emission Mask M				
Operating Freq. MHz	**Mode**	**Limit (dBm)**	**Measured Value (dBm)**	**Result**
4967.5	6 Mbps 5 MHz	Mask M	See plots #36 & 37	pass
4967.5	24 Mbps 5 MHz	Mask M	See plots #38 & 39	pass
4967.5	54 Mbps 5 MHz	Mask M	See plots #40 & 41	pass
4965	6 Mbps 10 MHz	Mask M	See plot #42	pass
4965	24 Mbps 10 MHz	Mask M	See plot #43	pass
4965	54 mbps 10 MHz	Mask M	See plot #44	pass
4960	6 Mbps 20 MHz	Mask M	See plot #45	pass
4960	24 Mbps 20 MHz	Mask M	See plot #46	pass
4960	54 mbps 20 MHz	Mask M	See plot #47	pass

Note: Only worst-case/ limited number of plots are placed in the report.

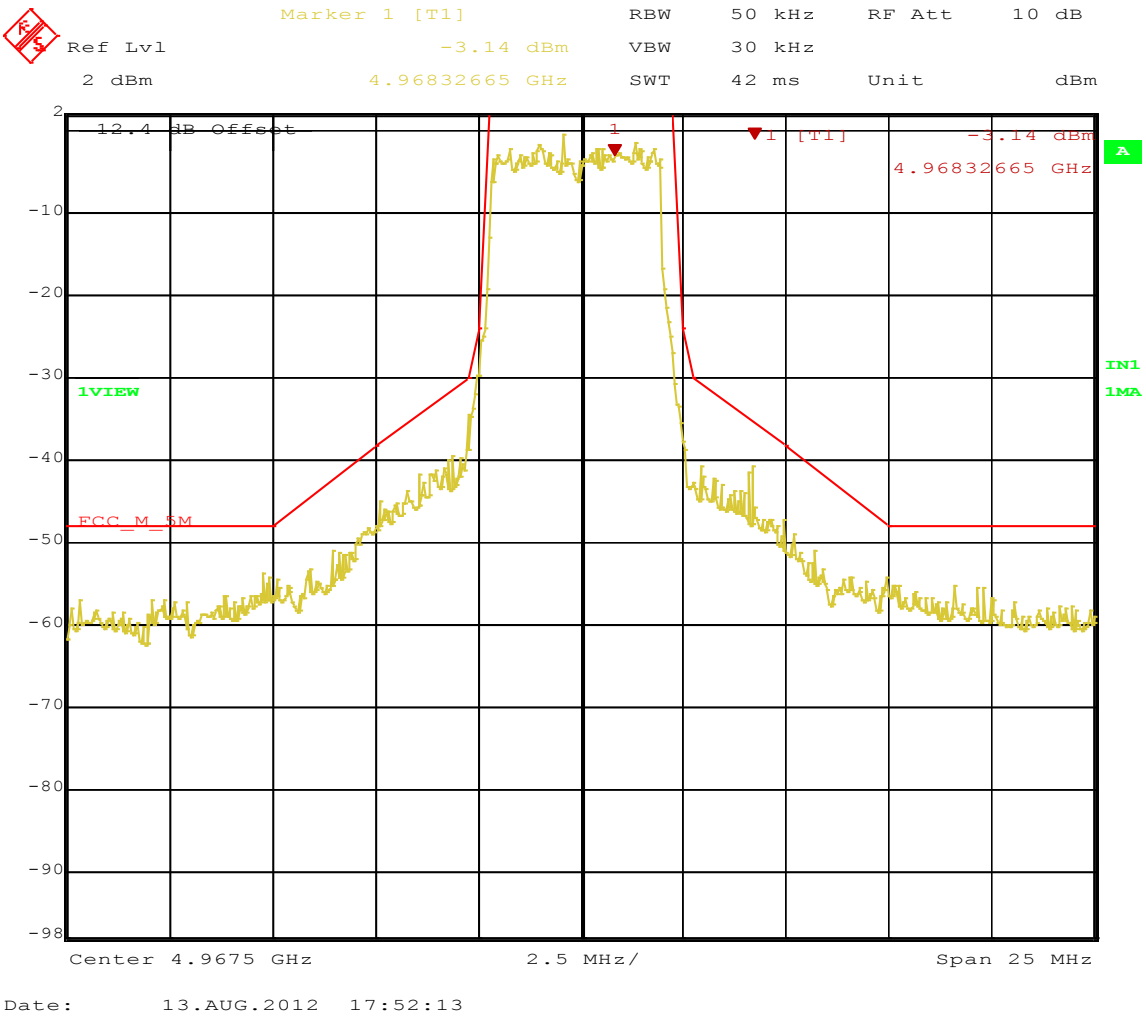


Figure 36: Emission Mask M requirement at Operating Channel 4967.5 MHz 6 Mbps

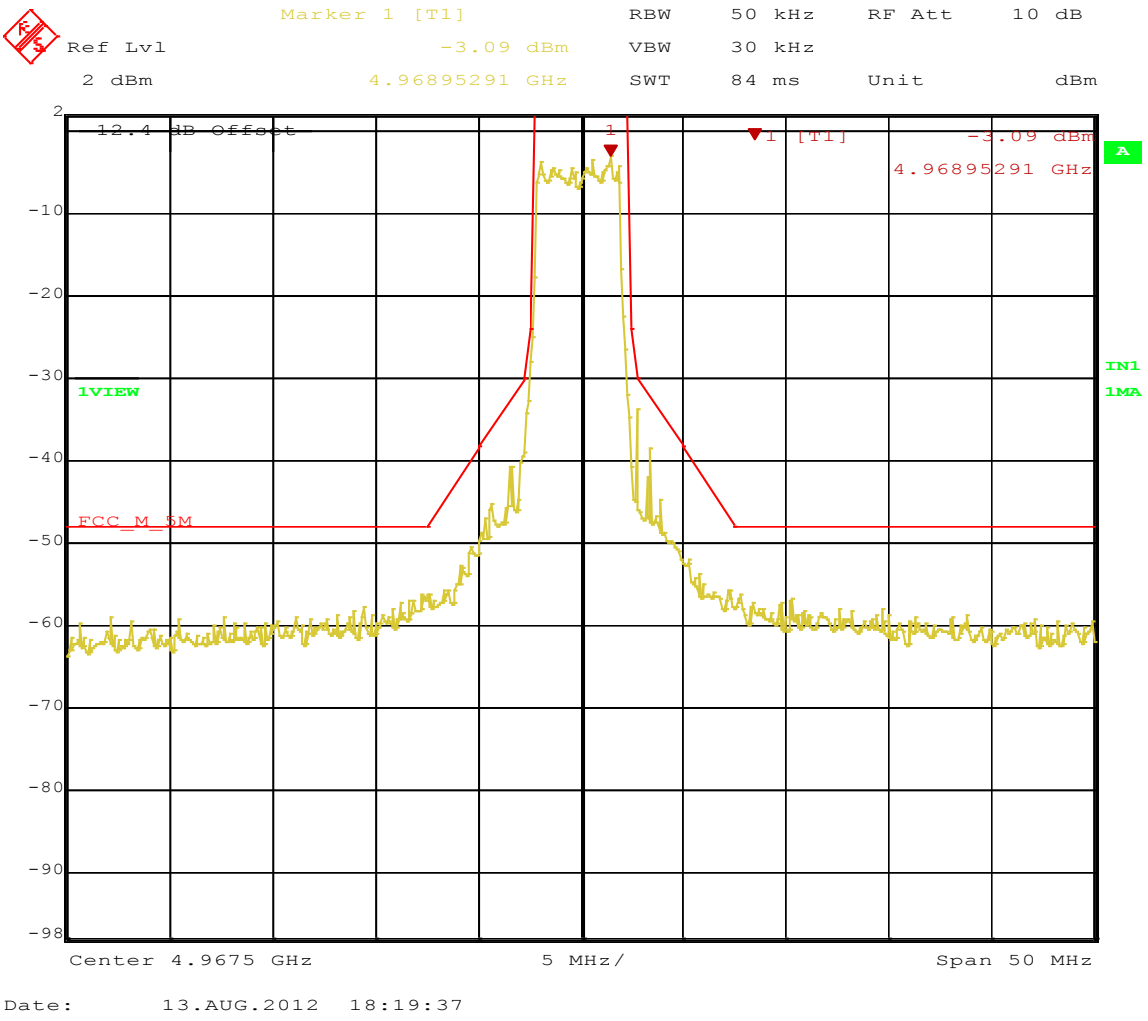


Figure 37: Emission Mask M requirement at Operating Channel 4967.5 MHz 6 Mbps

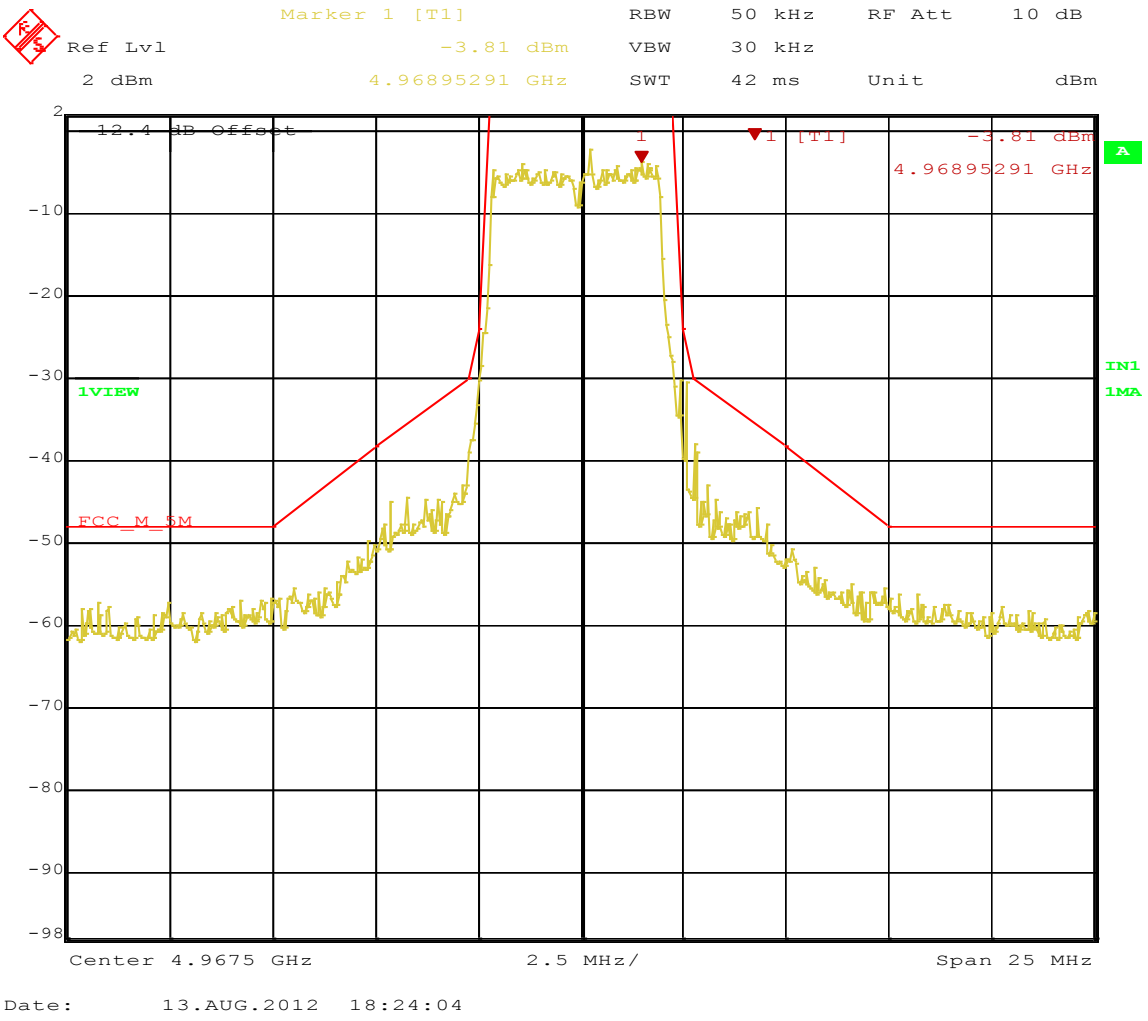


Figure 38: Emission Mask M requirement at Operating Channel 4967.5 MHz 24 Mbps

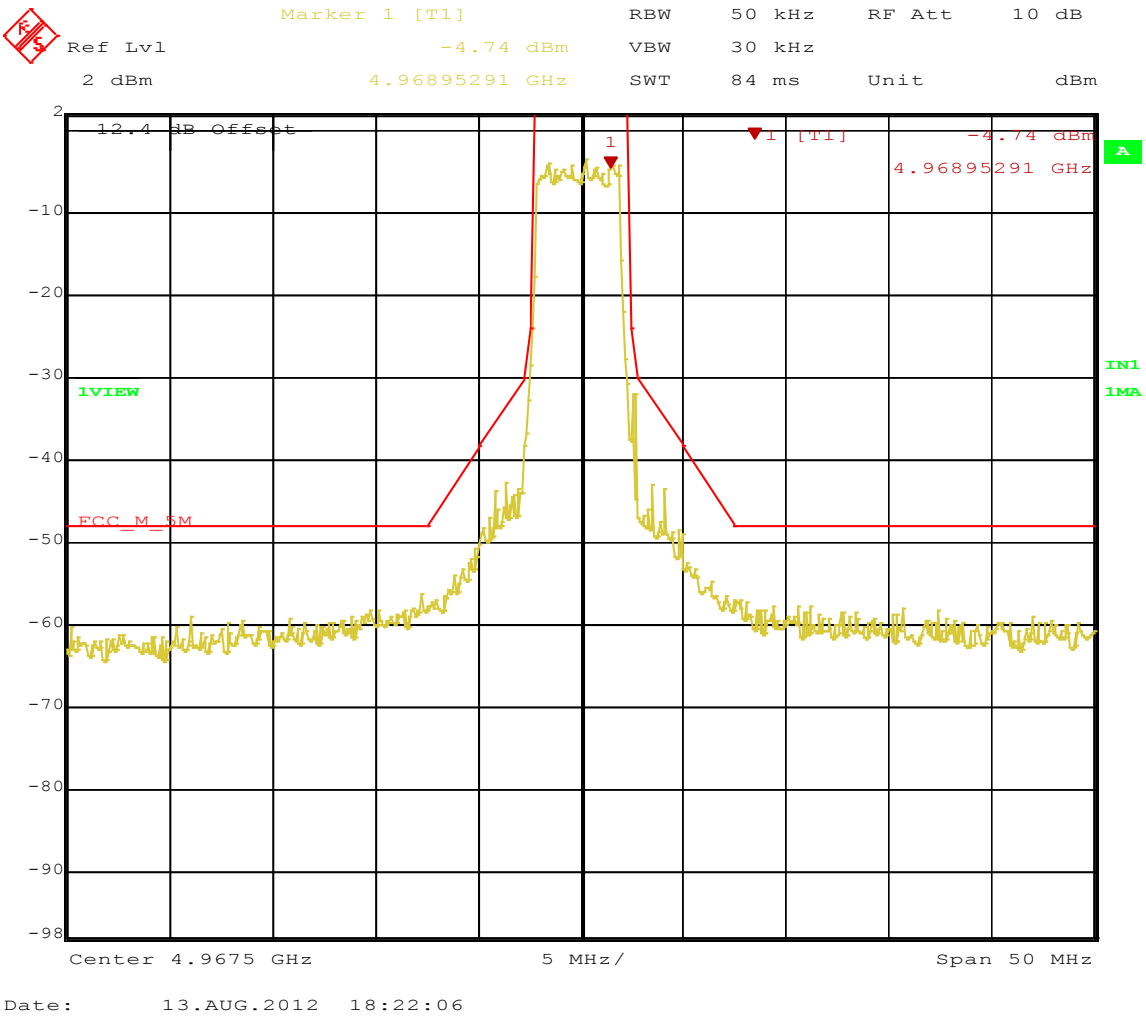


Figure 39: Emission Mask M requirement at Operating Channel 4967.5 MHz 24 Mbps

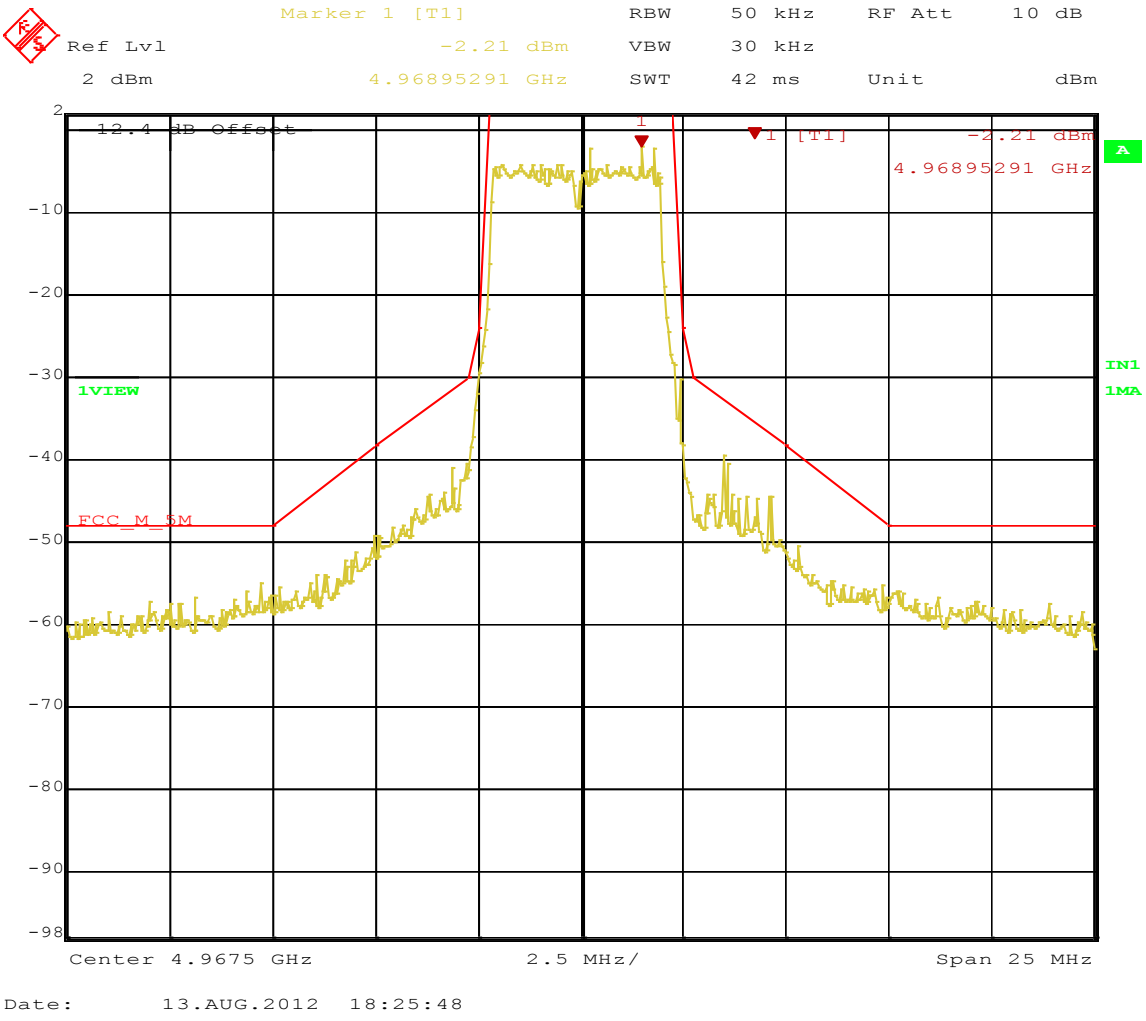


Figure 40: Emission Mask M requirement at Operating Channel 4967.5 MHz 54 Mbps

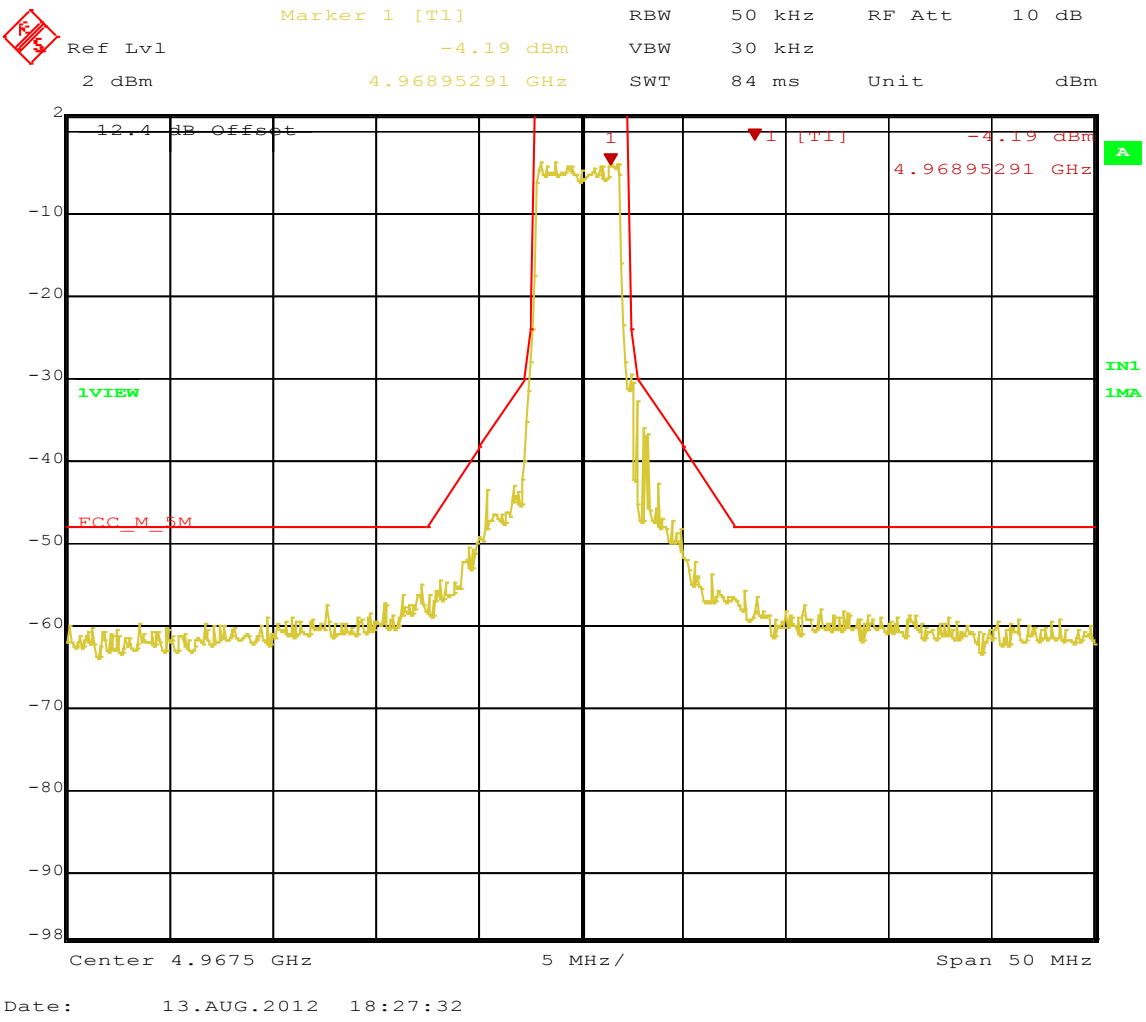


Figure 41: Emission Mask M requirement at Operating Channel 4967.5 MHz 54 Mbps

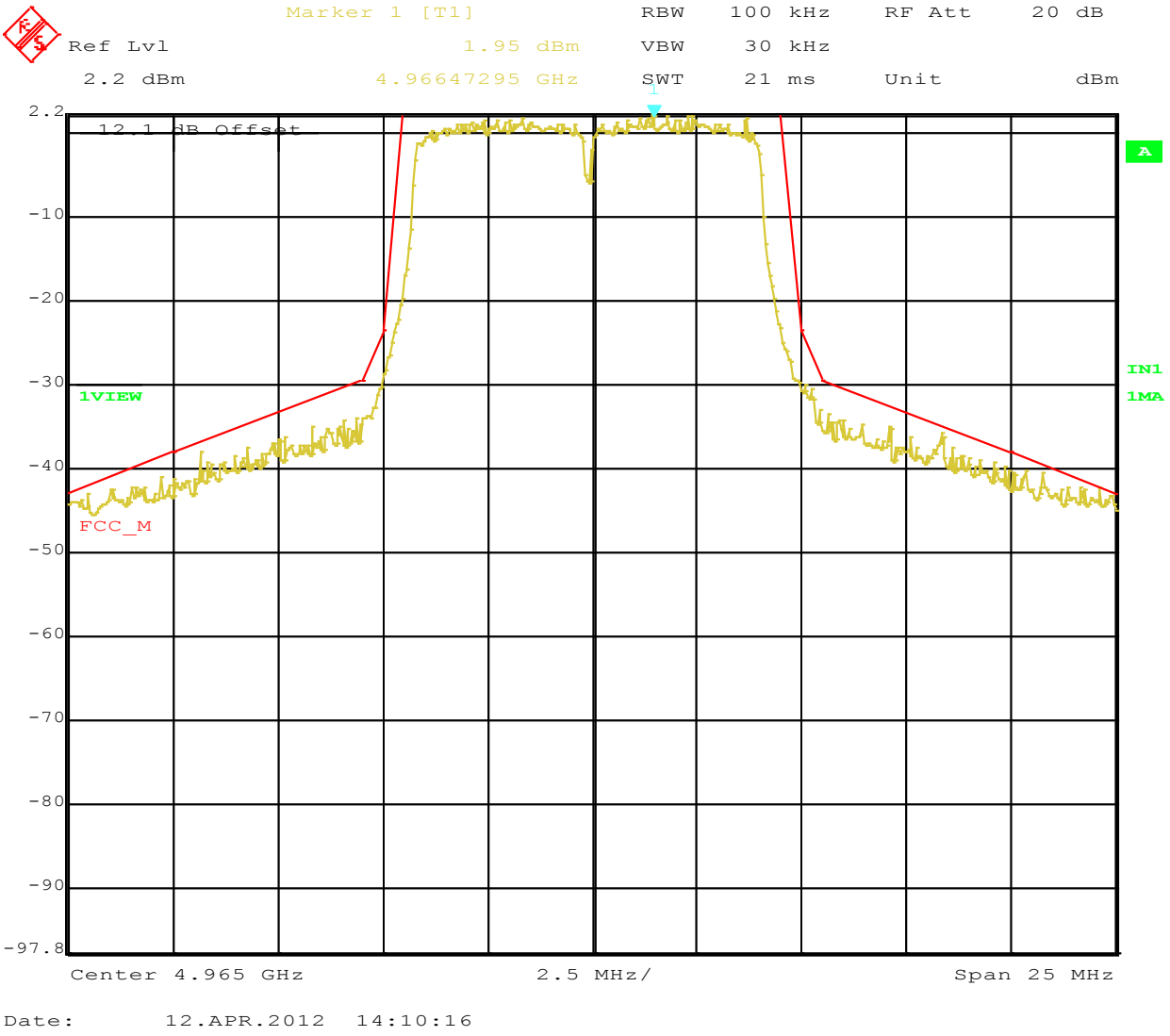


Figure 42: Emission Mask M requirement at Operating Channel 4965 MHz 6 Mbps Bw 10MHz

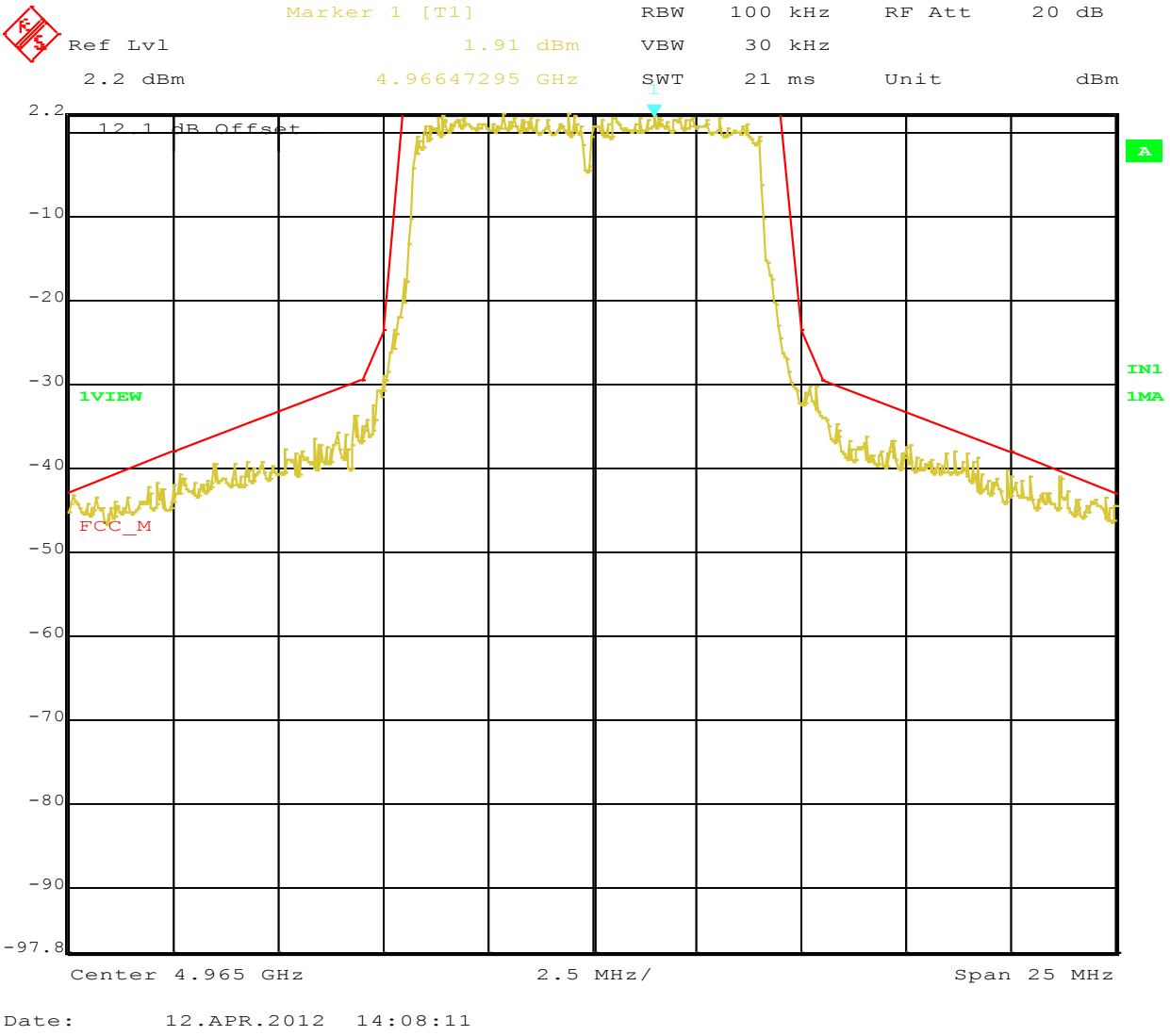


Figure 43: Emission Mask M Requirement at Operating Channel 4965 MHz, data rate 24 Mbps BW 10MHz

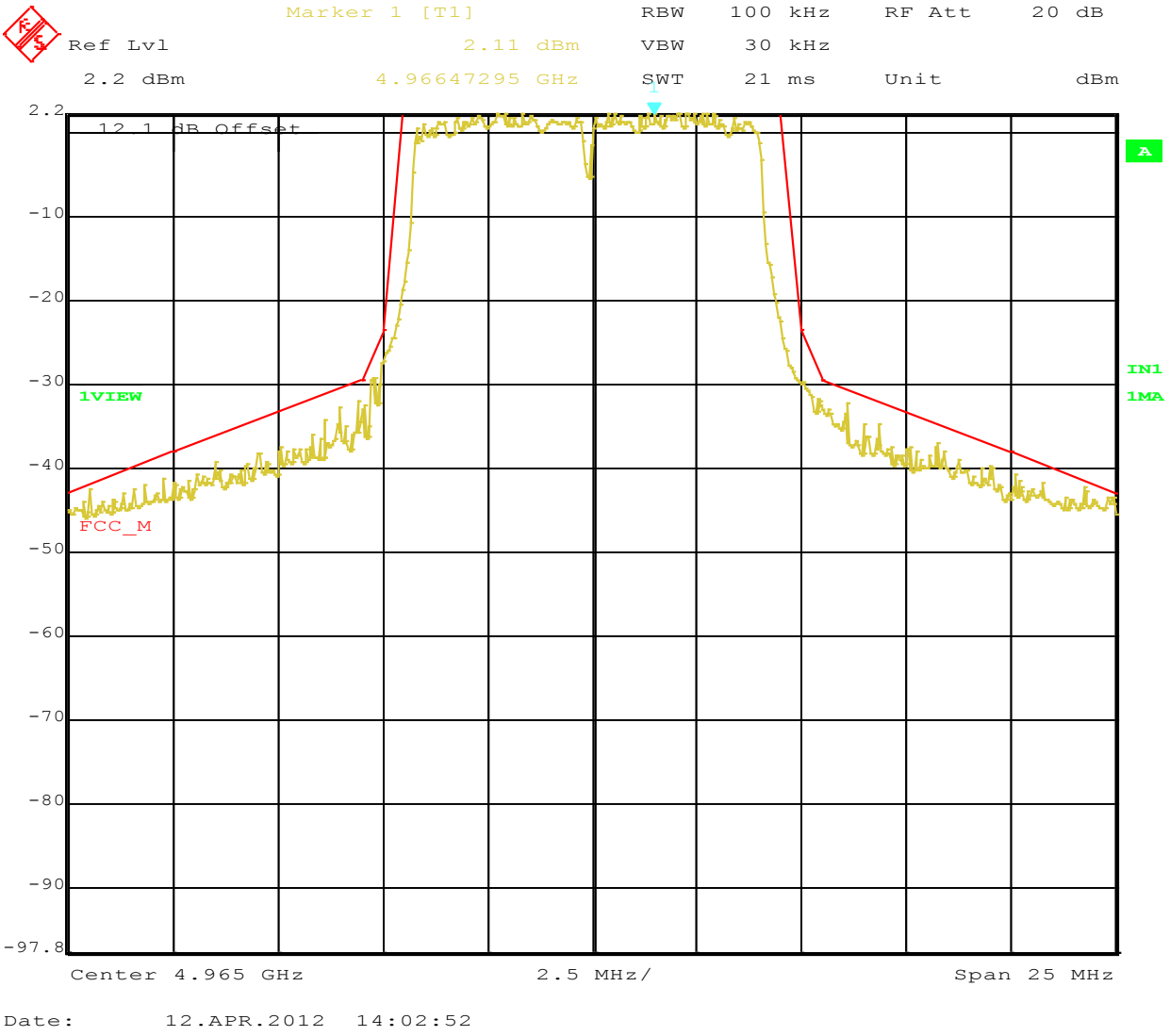


Figure 44: Emission Mask M Requirement at Operating Channel 4965 MHz, data rate 54 Mbps Bw 10MHz

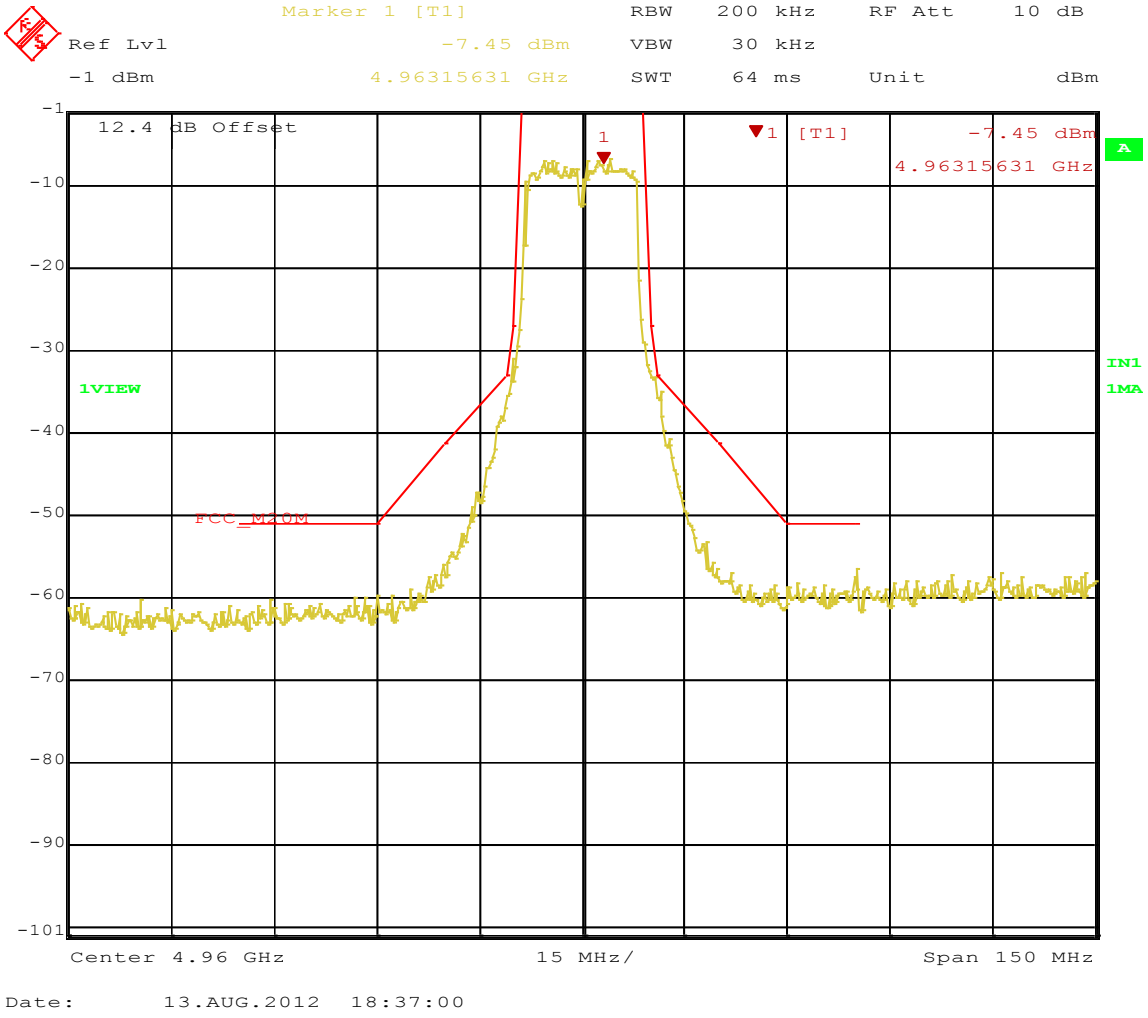


Figure 45: Emission Mask M requirement at Operating Channel 4960 MHz 6 Mbps BW 20MHz

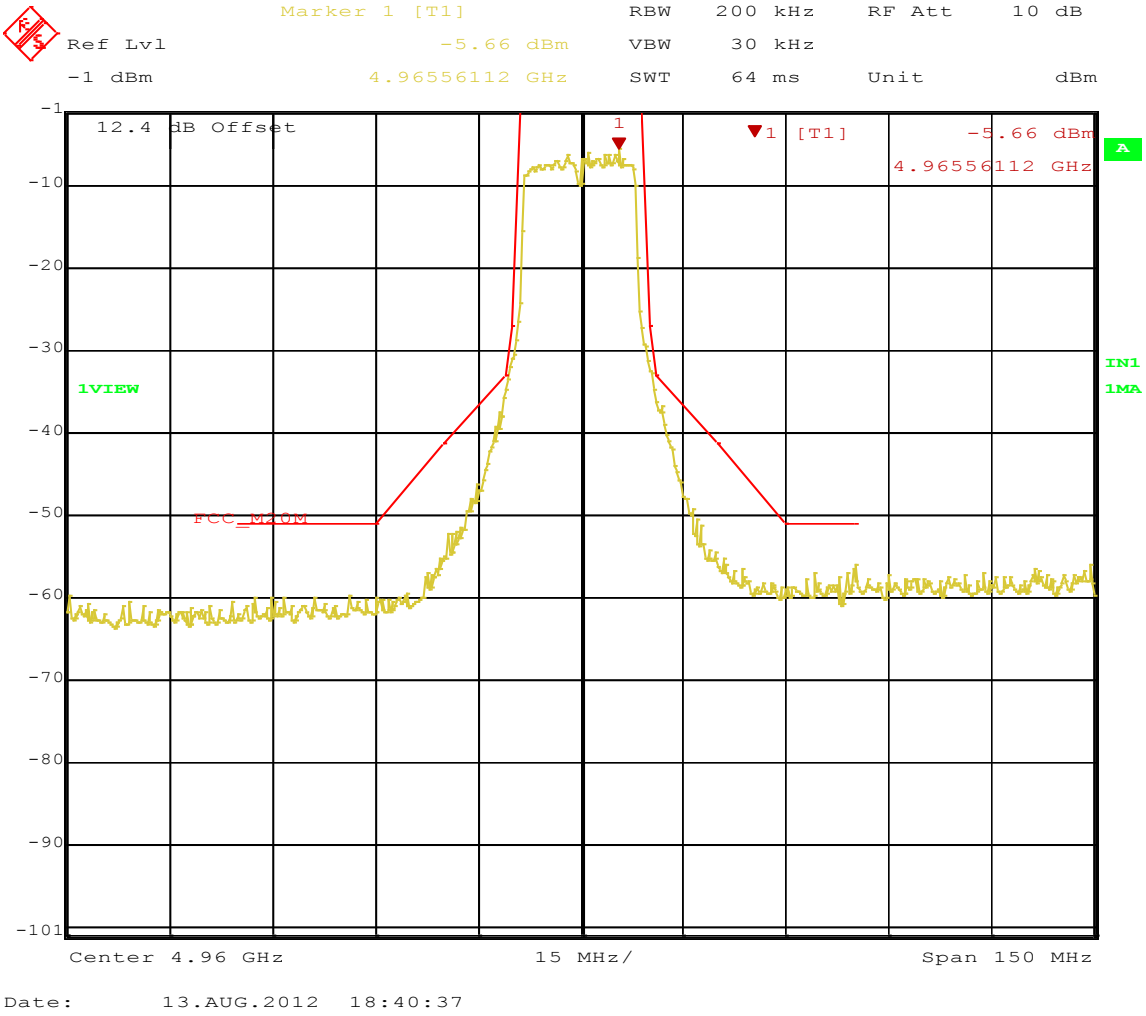


Figure 46: Emission Mask M requirement at Operating Channel 4960 MHz 24 Mbps

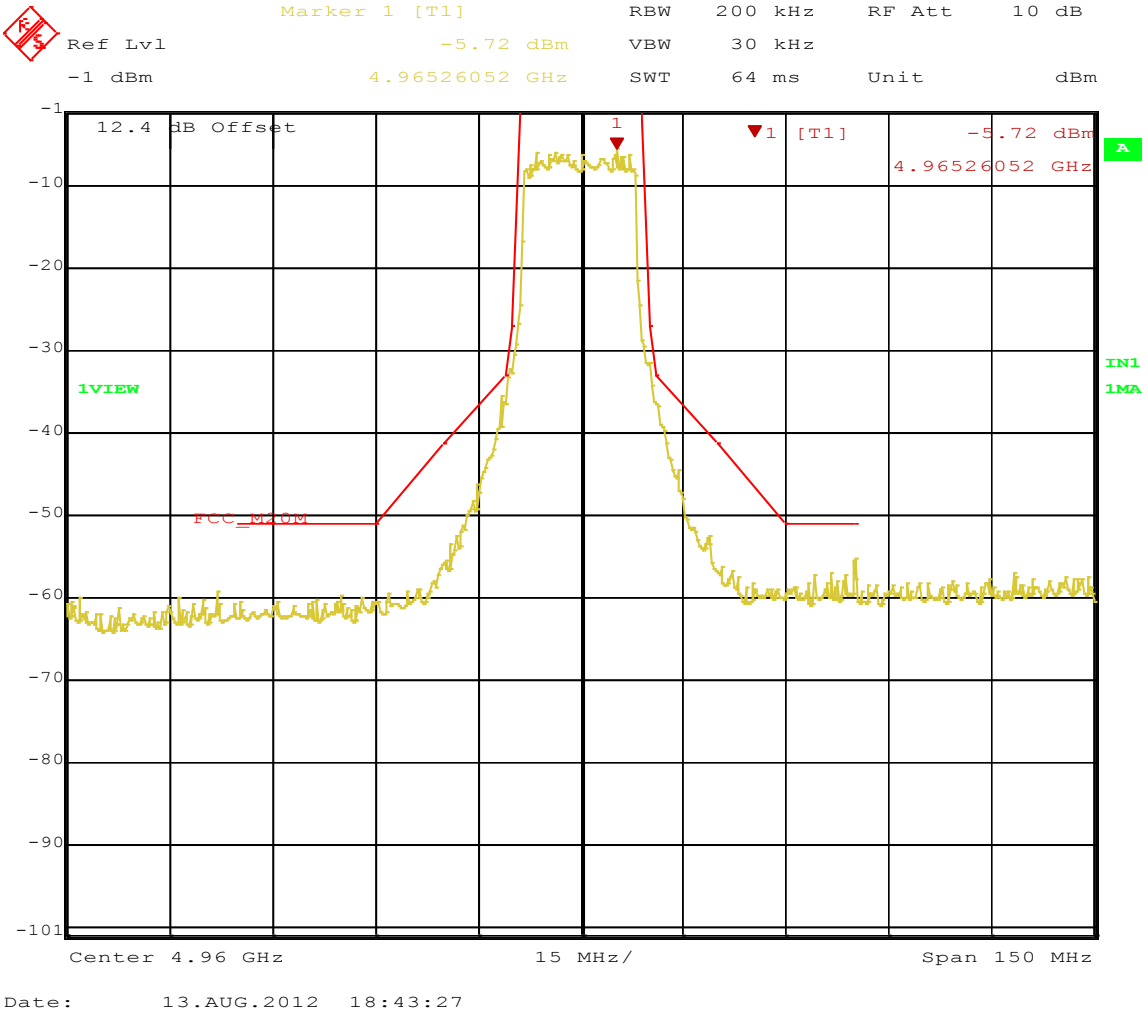


Figure 47: Emission Mask M requirement at Operating Channel 4960 MHz 54 Mbps

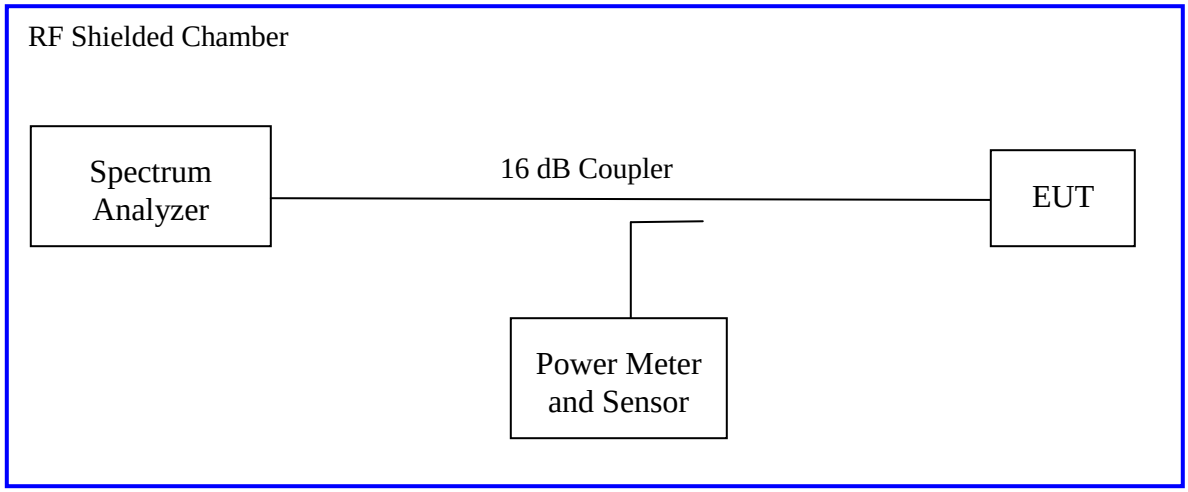
4.4 Conducted Spurious Emissions

Requirements same as Emission Mask M as para 4.3 of this report. Any frequency outside the band of 4940 MHz to 4990 MHz, the power output level must be below –25 dBm

4.4.1 Test Method

The conducted method was used to measure the out of band of emisions. The measrements were performed 30 MHz to 40 GHz. Preliminary measurements indicated worst-case emissions

Test Setup:



4.4.2 Results

Table 5: Out of band Conducted Emission – Test Results

Test Conditions: Conducted Measurement,				
Antenna Type: External Monopole				
Max. Antenna Gain: +2.1 dBi			**Signal State:** Modulated@99%	
Ambient Temp.: 21 °C			**Relative Humidity:**39%	
Emission Mask M				
Operating Freq. MHz	**Mode**	**Limit (dBm)**	**Measured Value (dBm)**	**Result**
4967.5	6 Mbps	-25 dBm	See plot #48 & 49	Pass
4965	24 Mbps	-25 dBm	See plot #50 & 51	Pass
4960	54 mbps	-25 dBm	See plot #52 & 53	Pass

Note: Outband emissions measurements were performed all modes and data rates, only worst-case/ limited number of plots are placed in the report.

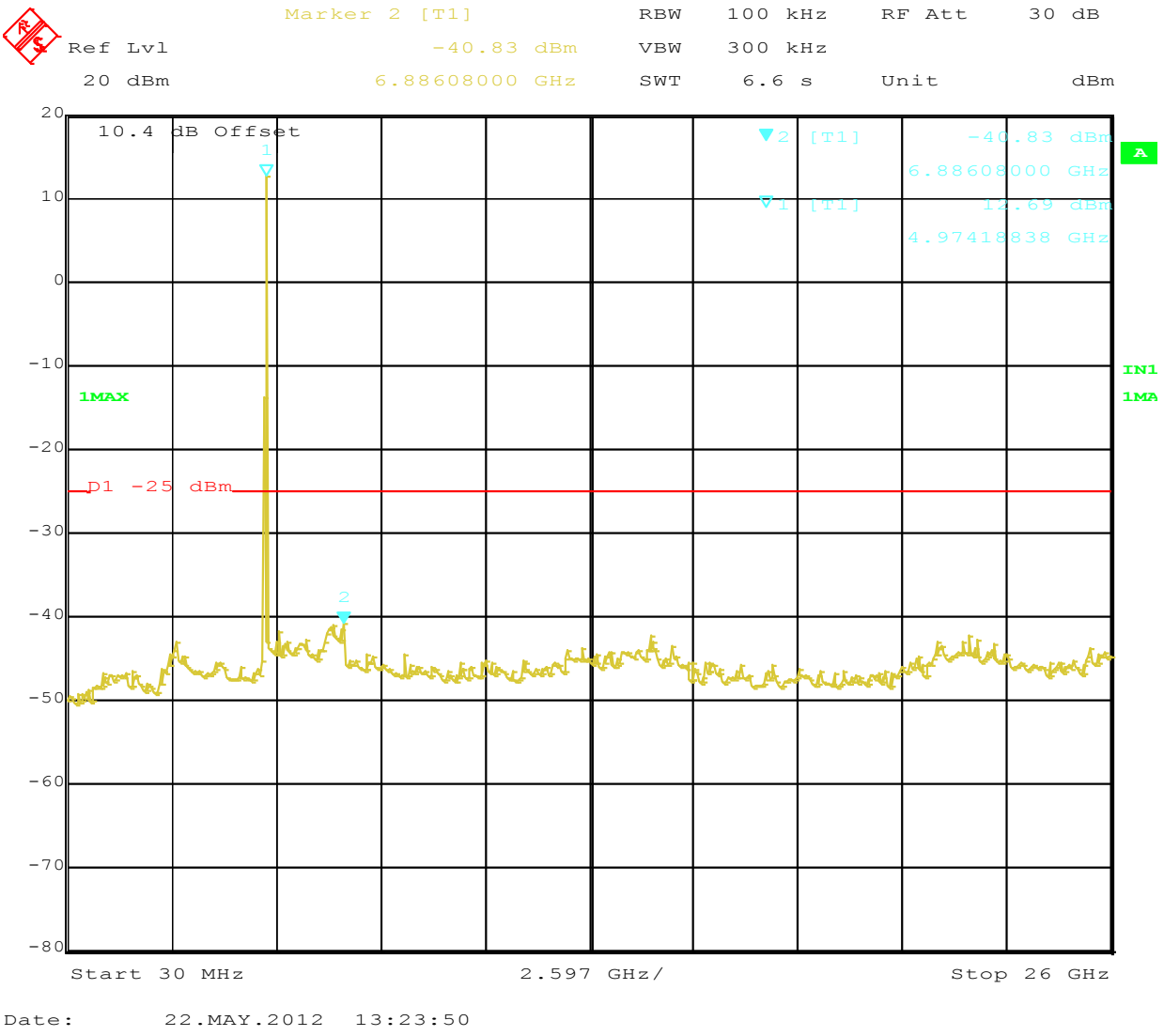


Figure 48: Out of Band Emissions Operating Mid Channel 4967.5 MHz, Plot 1

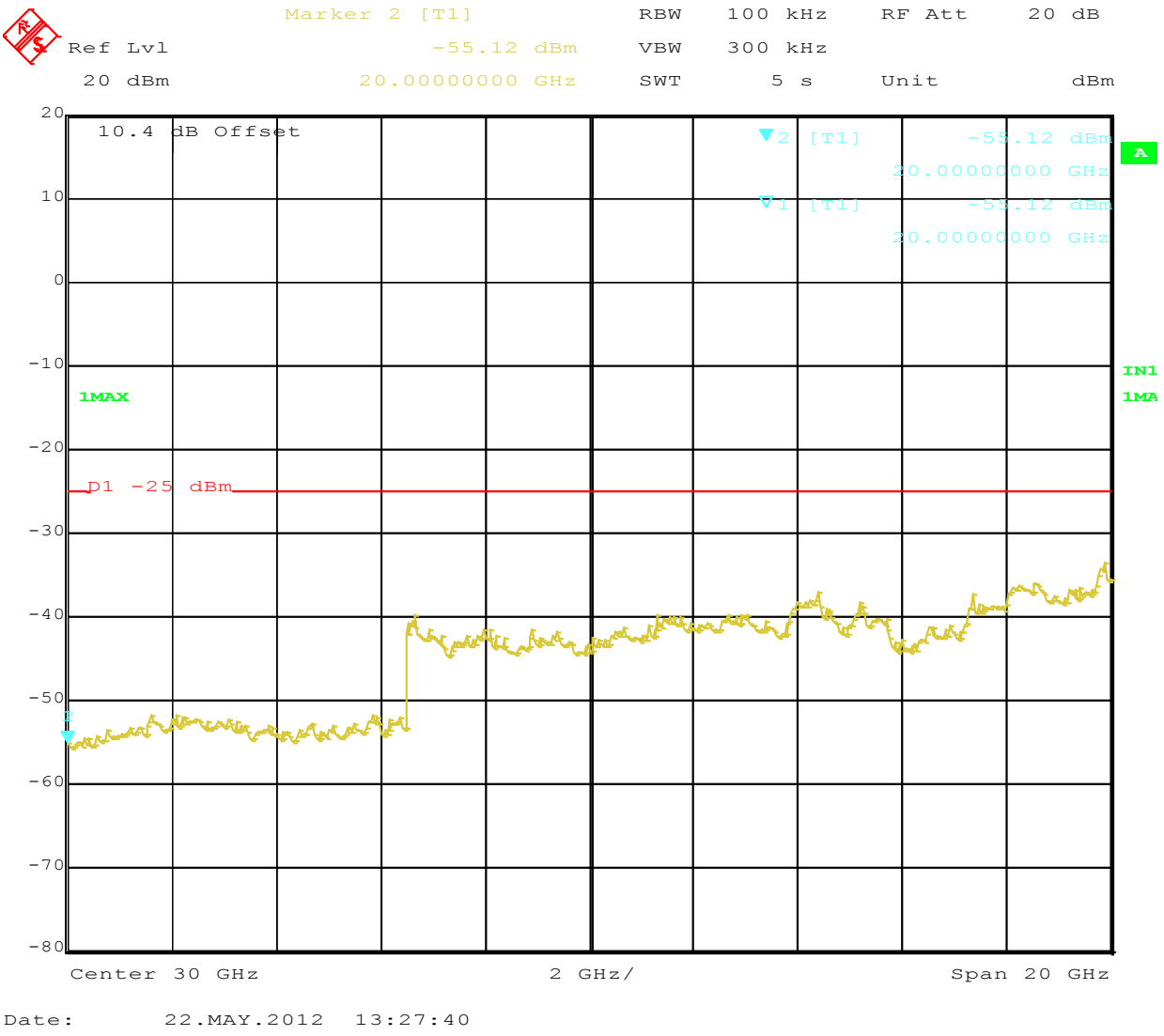


Figure 49: Out of Band Emissions Operating on Low Channel, Plot 2

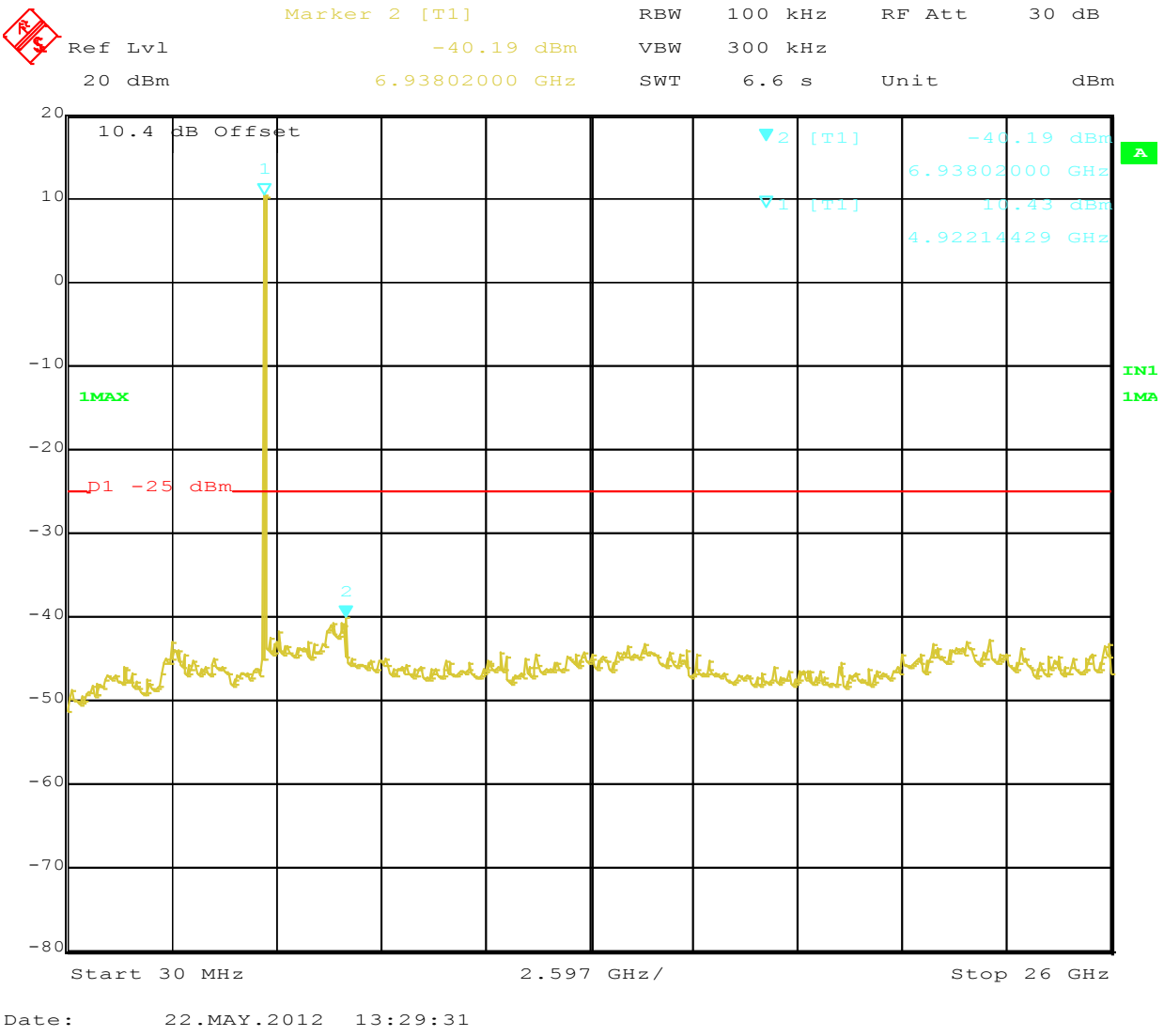


Figure 50: Out of Band Emissions Operating Mid Channel 4965 MHz, Plot 1

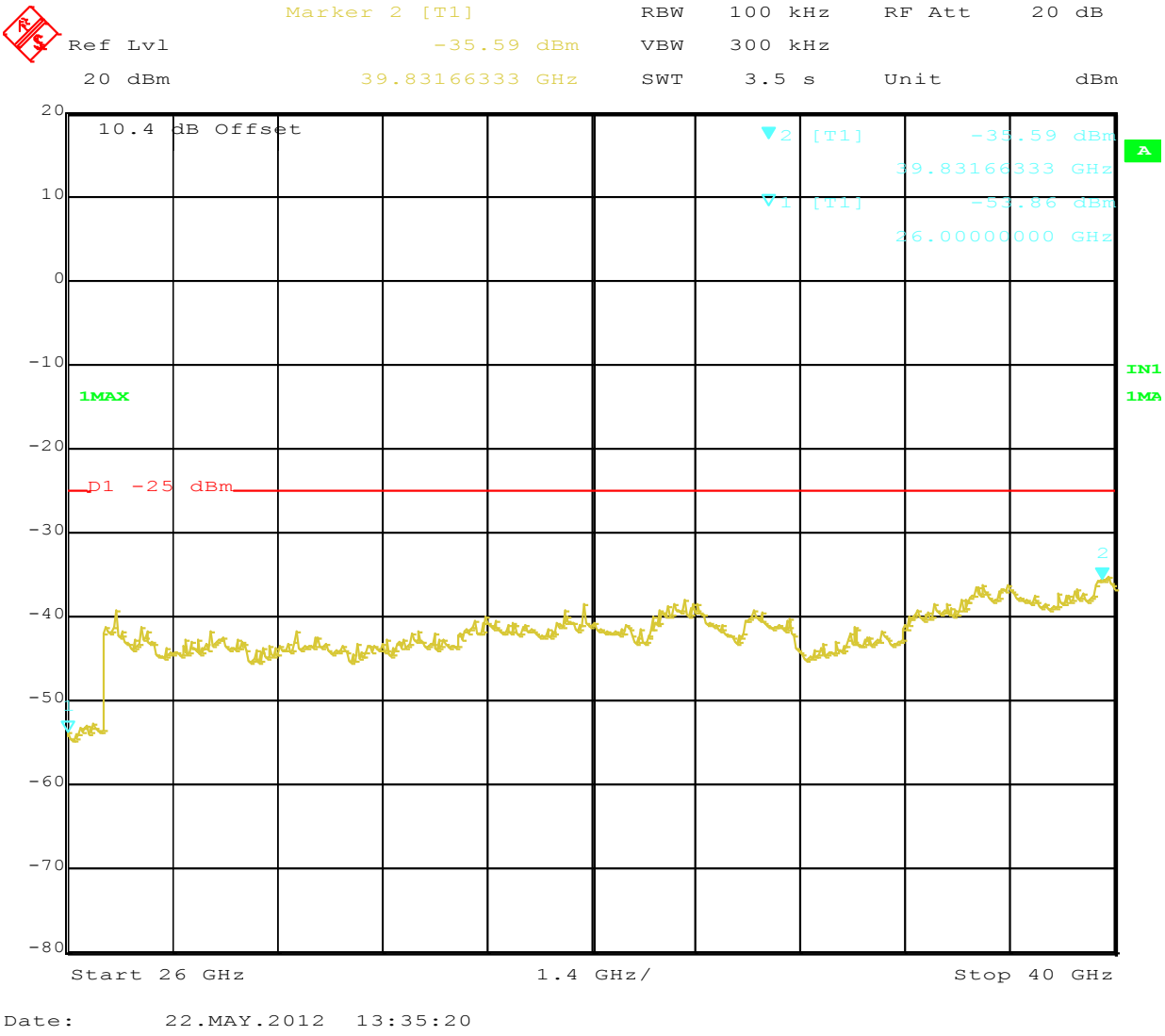


Figure 51: Out of Band Emissions Operating Channel 4965 MHz, Plot 2

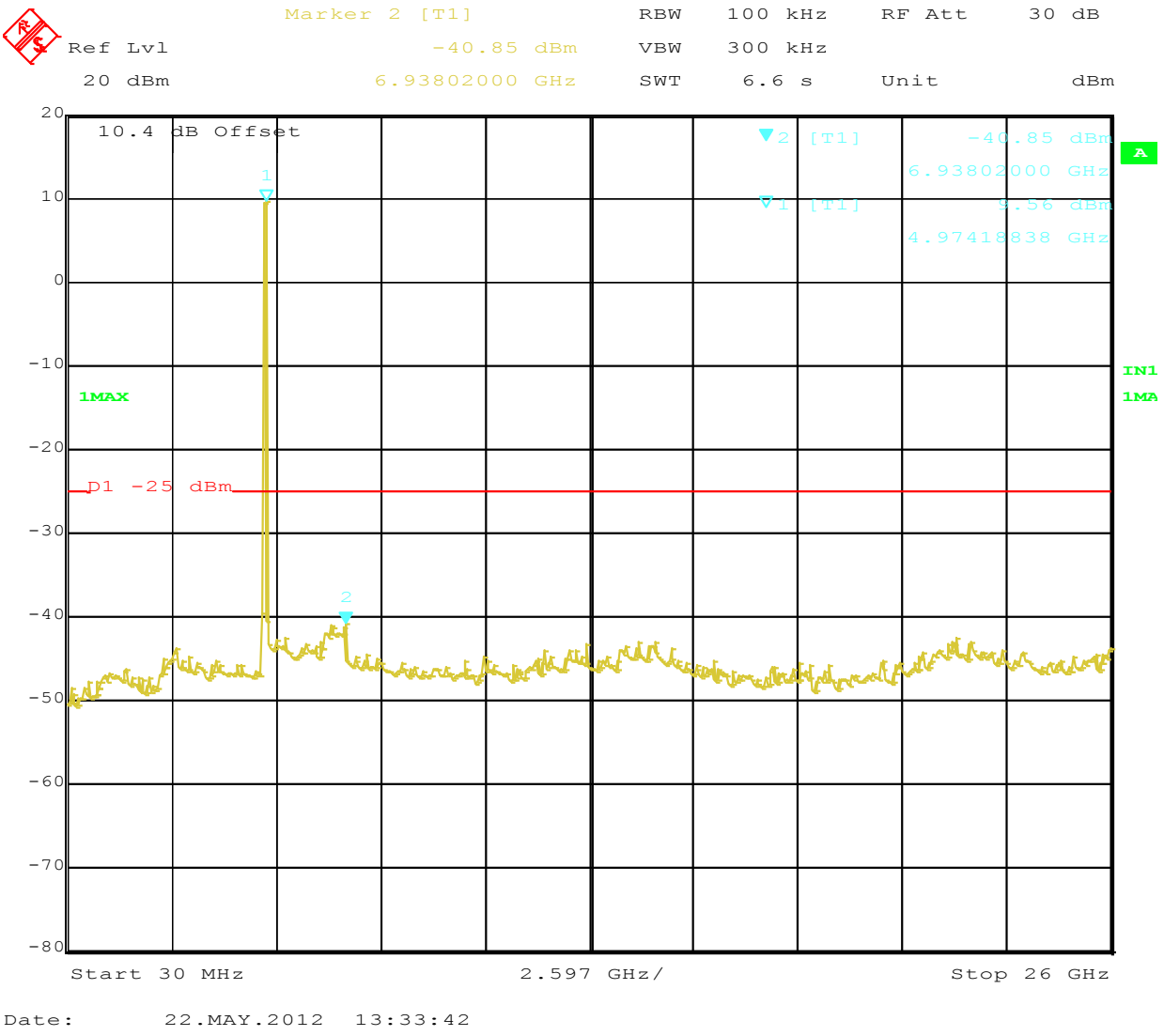


Figure 52: Out of Band Emissions Operating 4960 MHz, Plot 1

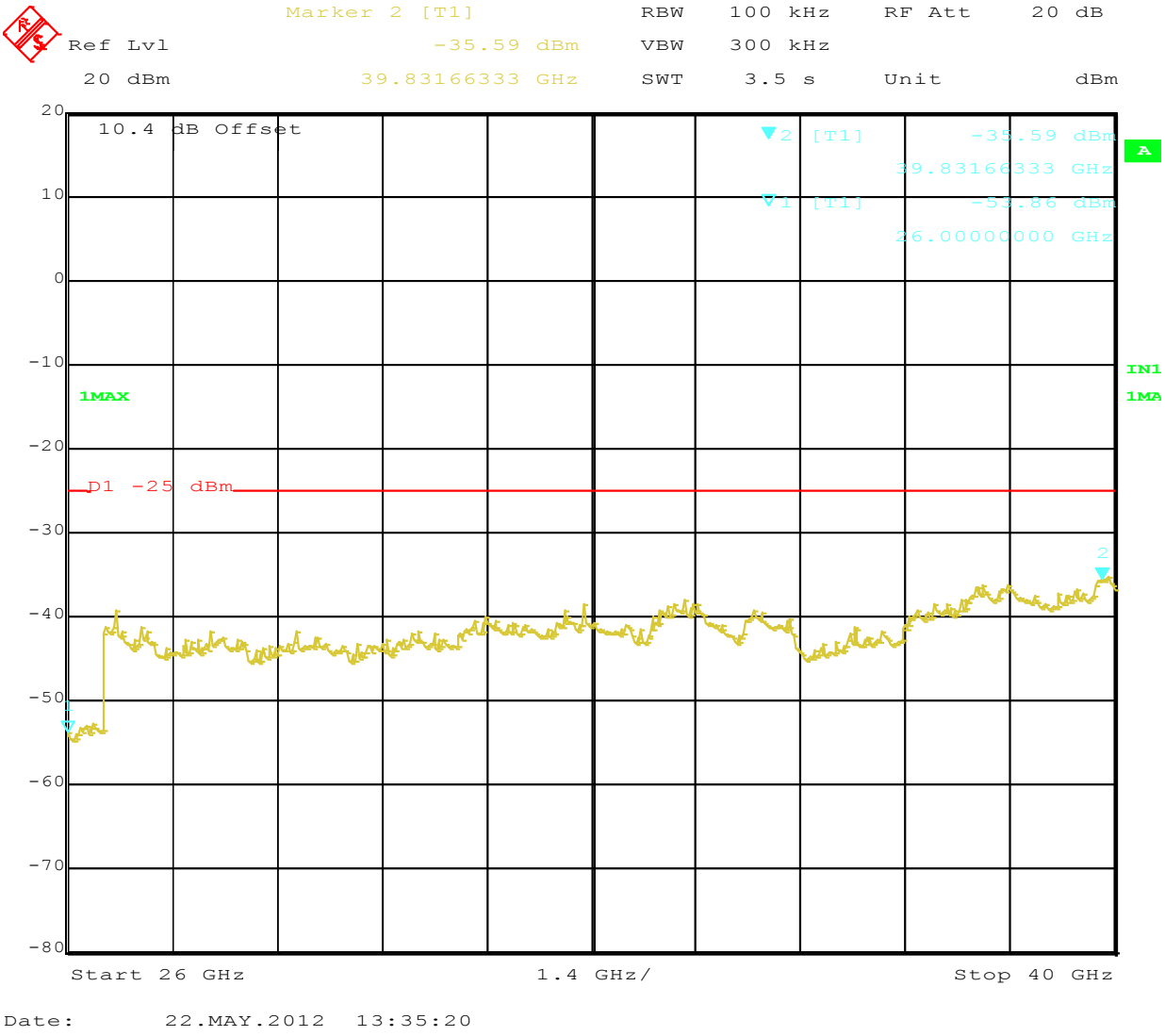


Figure 53: Out of Band Emissions Operating Channel 4960 MHz, Plot 2

4.5 Peak Power Spectral Density and Peak Excursion

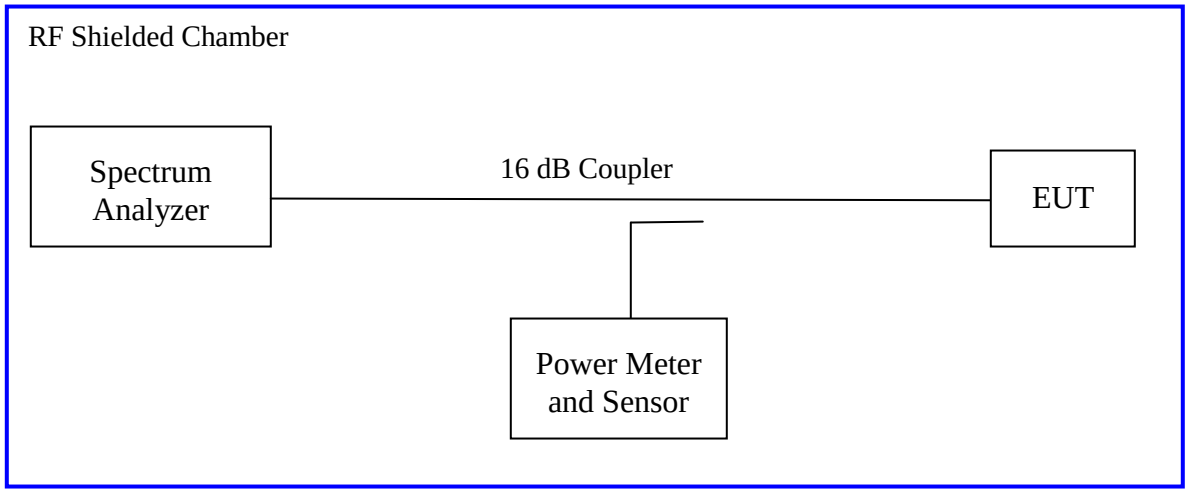
According to the CFR47 Part 90. 1215(a)

(2) High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the maximum conducted output power or spectral density. Corresponding reduction in the maximum conducted output power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

(e) The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

4.5.1 Test Method

Test Setup:



4.5.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 6: Peak Power Spectral Density – Test Results

Test Conditions: Conducted Measurement,					
Antenna Type: External Monopole			**Power Setting:** see test plan		
Max. Antenna Gain: +2.1 dBi					
Ambient Temp.: 21 °C			**Relative Humidity:**35%		
Peak Power Spectral Density Test Results					
Operating Channel	**BW**	**Mode**	**PPSD [dBm]**	**Limit [dBm]**	**Margin [dB]**
4967.5 MHz	5 MHz	6 Mbps	19.65	21	-1.35
4965 MHz	10 MHz	24 Mbps	20.97	21	-0.03
4960.0 MHz	20 MHz	24 Mbps	18.53	21	-1.47
Note: Preliminary tests were performed in all modes only worst case results are placed in the report					

Table 7: Peak Excursion – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only					
Antenna Type: External Monoploe			**Power Setting:** see test plan		
Max. Antenna Gain: +2.1 dBi					
Ambient Temp.: 21 °C			**Relative Humidity:**35%		
Peak Excursion Test Results					
Operating Channel	**BW**	**Mode**	**[dBm]**	**Limit [dBm]**	**Margin [dB]**
4967.5 MHz	5 MHz	6 Mbps	9.80	13	-3.20
4965 MHz	10 MHz	24 Mbps	8.75	13	-4.25
4960 MHz	20 MHz	24 Mbps	8.73	13	-4.27
Note: Preliminary tests were performed in all modes only worst case results are placed in the report					

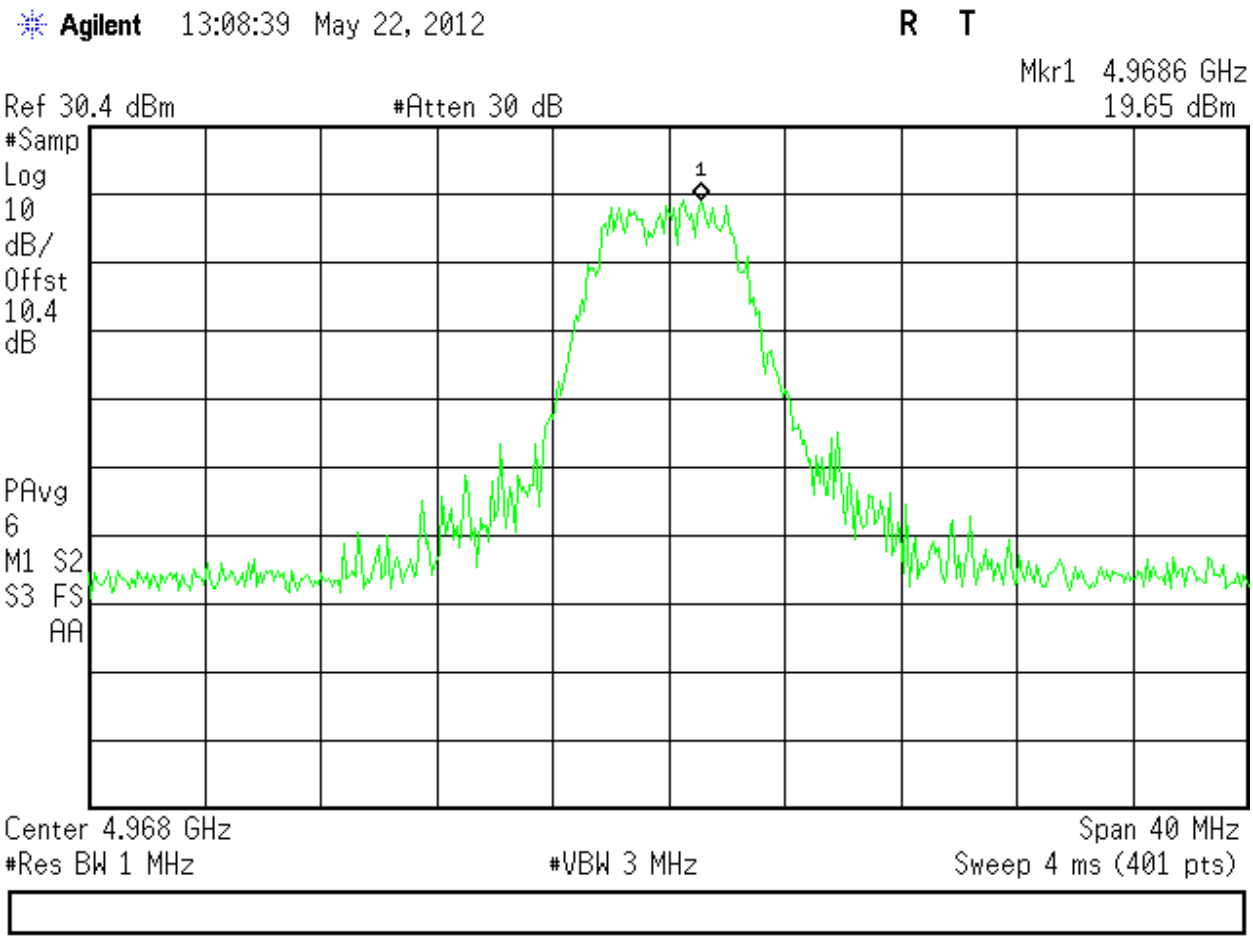


Figure 54: Peak power spectral density with 5 MHz Bandwidth

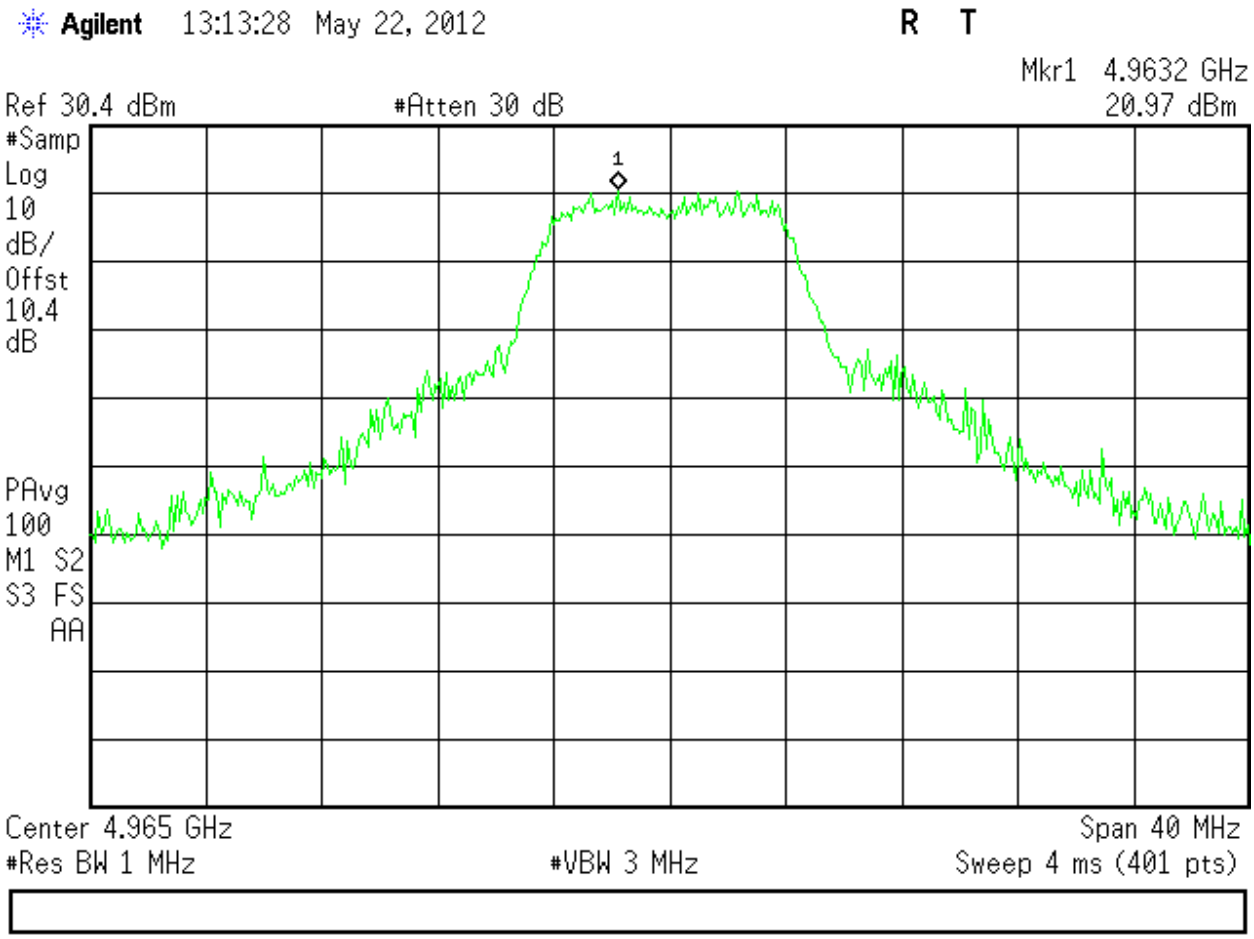


Figure 55: Peak power spectral density with 10 MHz Bandwidth

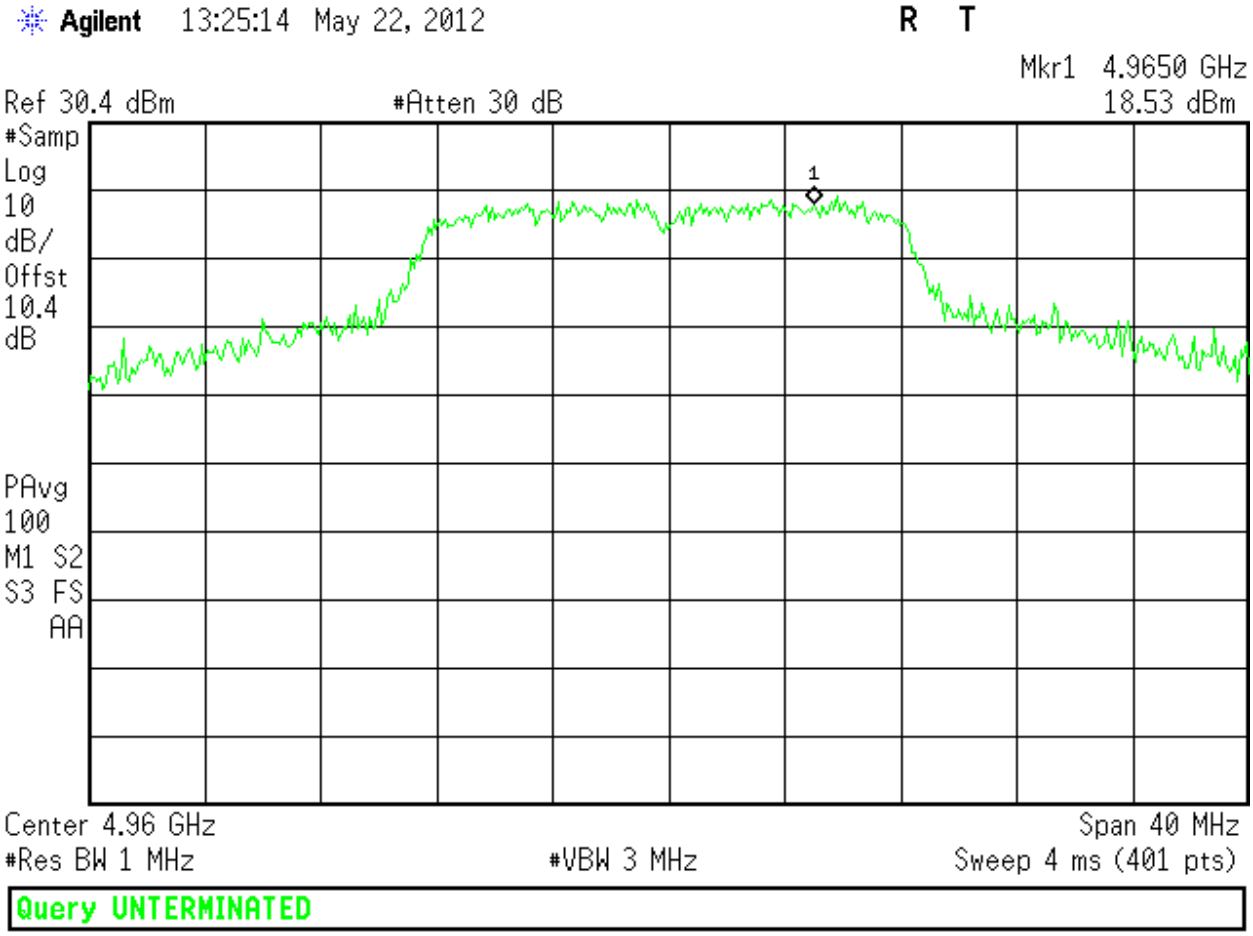


Figure 56: Peak power spectral density with 20 MHz Bandwidth

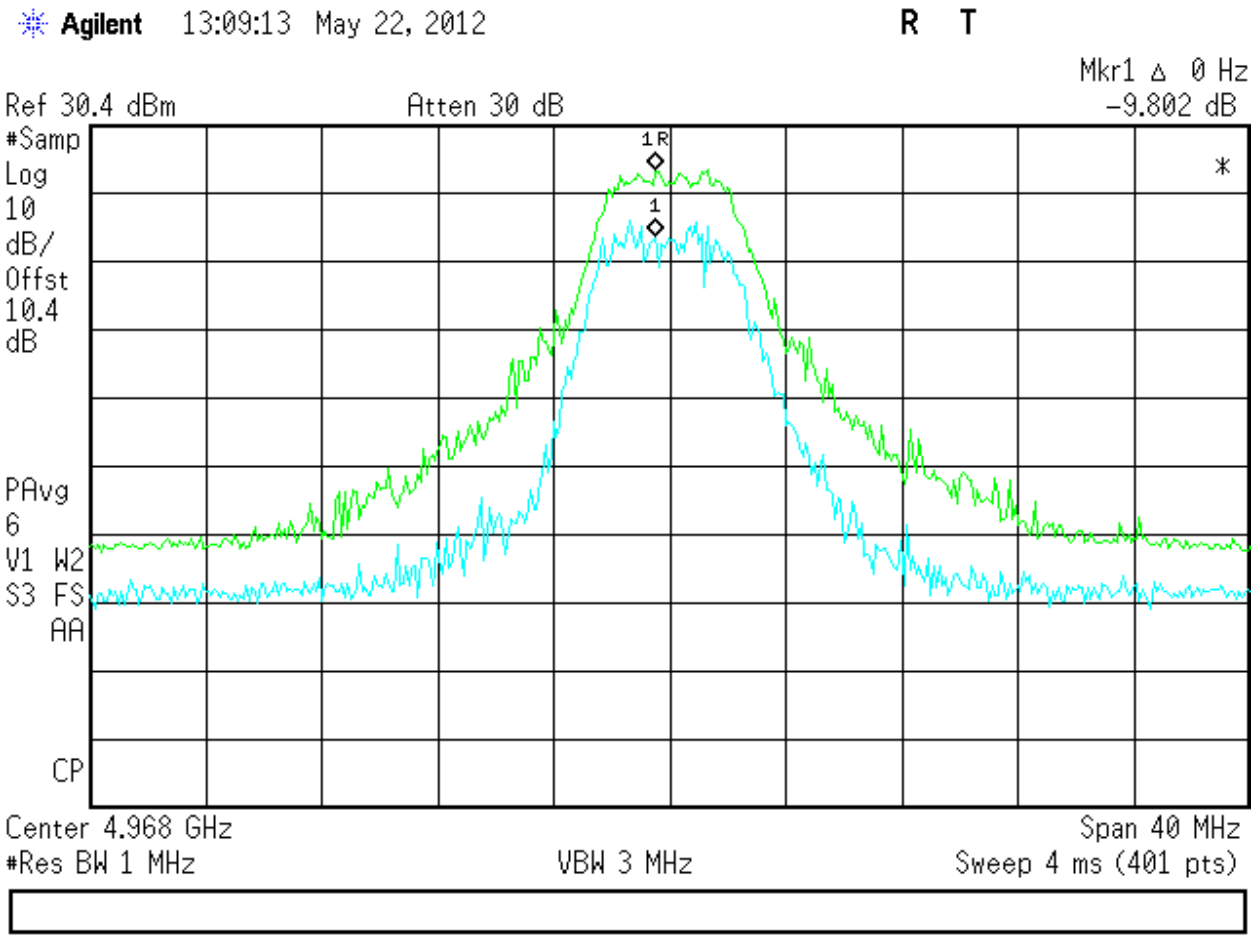


Figure 57: Peak Excusrion with 5 MHz Bandwidth

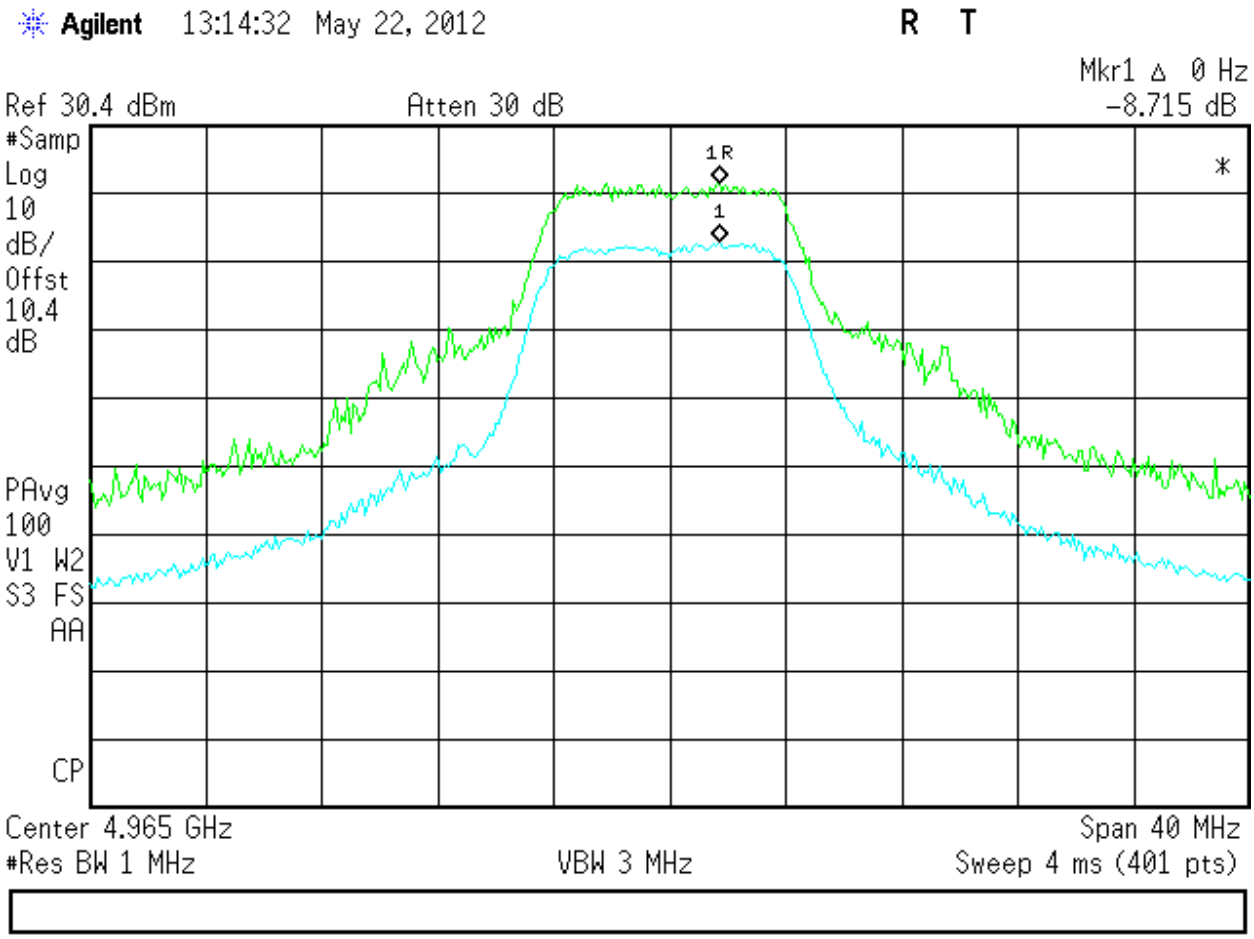


Figure 58: Peak Excusrion with 10 MHz Bandwidth

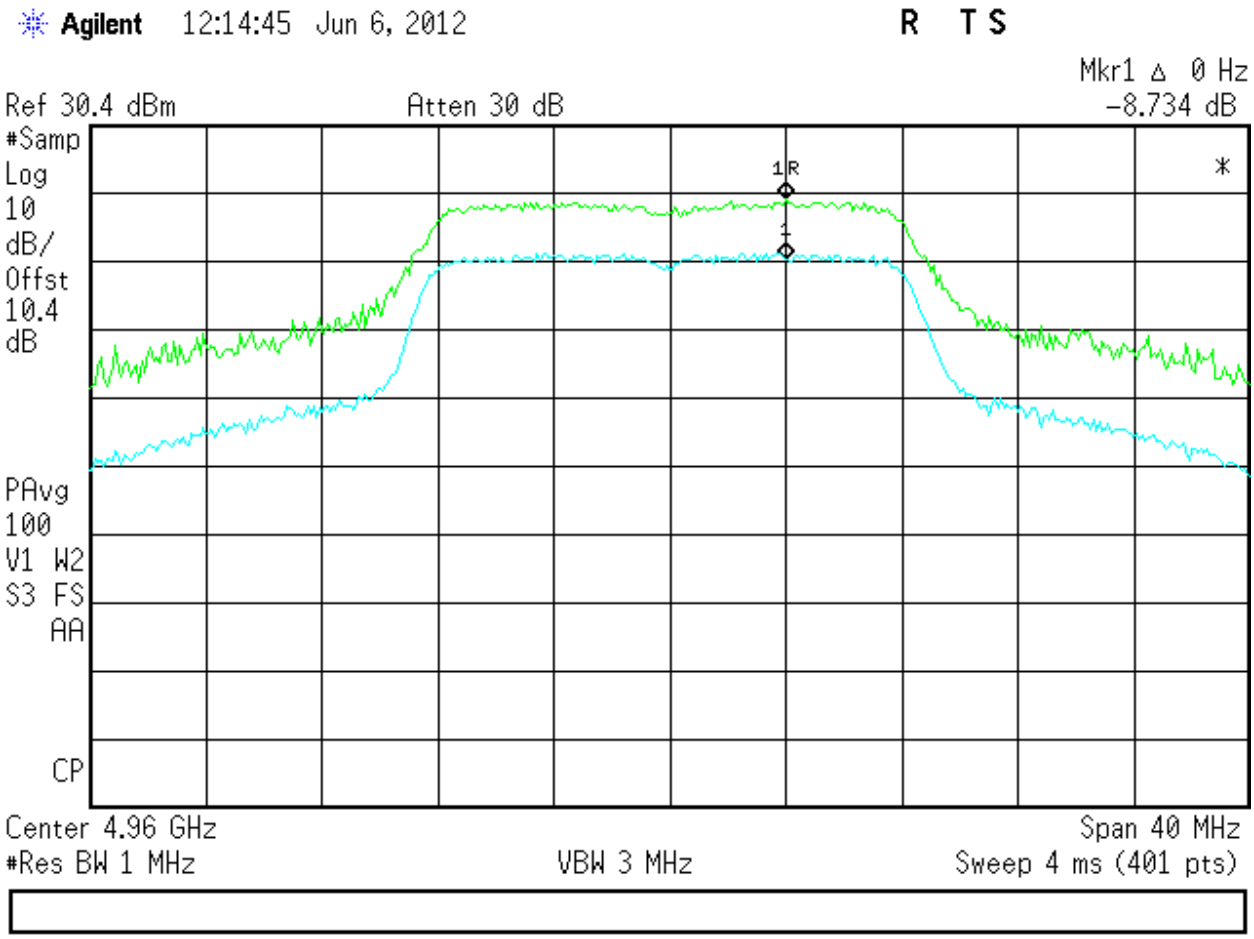


Figure 59: Peak Excusrion with 20 MHz Bandwidth

4.6 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 part 90.210

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.6.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

The final scans performed on the worst axis, Y-Axis, for three operating channels;

4.6.1.3 Deviations

None.

4.6.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 90

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F(kHz)	300
0.490-1.705.....	24000/F(kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

All harmonics and spurious emission which are outside of the restricted band shall be 20 dB below the in-band emission.

4.6.3 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and Test Plan.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

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EUT Name	USB Wifi Module	**Date**	June 06, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 39%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	TX ON	**Line AC / Freq**	5 Vdc
Standard	CFR47 Part 90	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m / EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Emission Freq	Efield Pk	Efield Ave	E-Field Ave	Spec Limit	Spec Margin	Table Pos	ANT Pos	ANT Pola	Type
Transmitted Data at 5 MHz all channels combined									
1200.05	45.40	36.20	36.20	54	-25.80	74	105	V	Spurious
1680.06	44.22	33.73	33.73	54	-26.05	-67	94	V	Spurious
1920.03	41.10	25.82	25.82	54	-32.88	183	131	V	Spurious
6596.64	39.57	32.26	36.20	54	-25.80	139	112	V	Spurious
9895.27	62.14	47.91	47.91	54	-6.09	44	103	V	Harmonic
9935.02	61.01	47.89	47.89	54	-6.11	157	105	V	Harmonic
14842.2	58.16	43.84	43.84	54	-10.16	420	103	V	Harmonic
14902.5	57.09	41.59	41.59	54	-12.41	83	145	V	Harmonic
9974.82	44.70	47.70	47.70	54	-6.30	106	267	V	Harmonic
14962.1	34.39	34.39	34.39	54	-19.61	110	16	V	Harmonic
19870.00	67.41	52.04	52.04	64	-11.94	21	92	H	Harmonic
24837.70	55.07	42.04	42.04	64	-21.94	61	91	H	Harmonic

Spec Margin = E-Field Avg - Limit, E-Field Avg = FIM Avg+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Limit for outband spurious emissions is -25.0 dBm. Unit has passed lower restricted band limit. Restricted band limit was used.
Worst case was observed with antennas Vertical. Preliminary scans determined worst-case orientation.
The output radio was transmitted at +26.65 dBm. (tp23)

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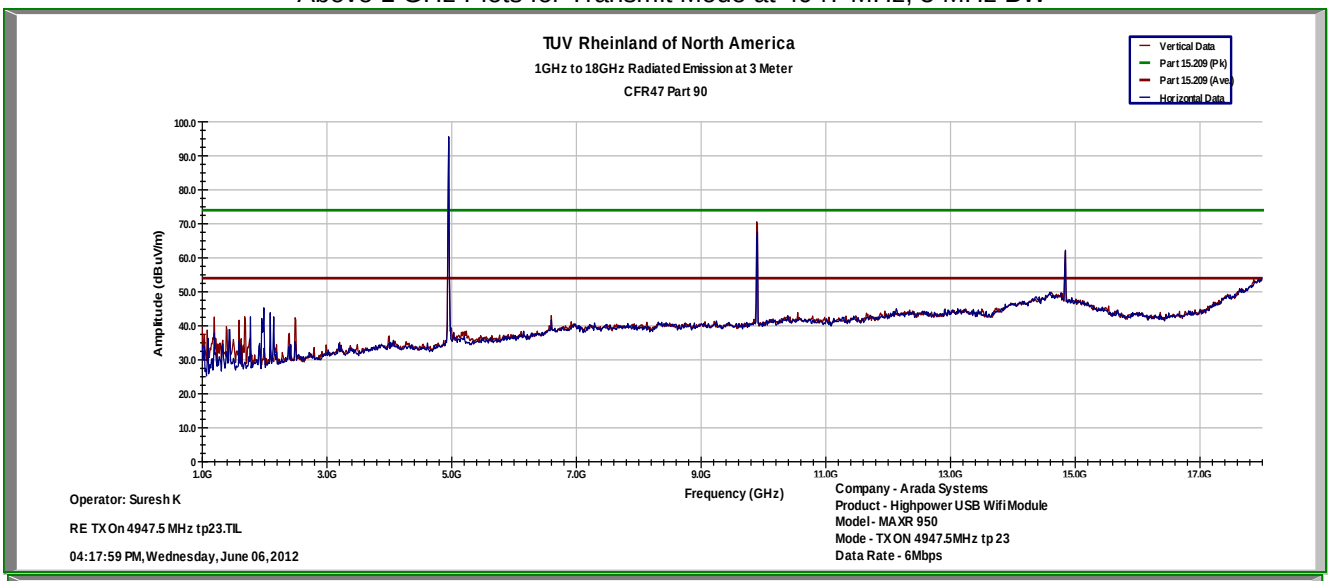
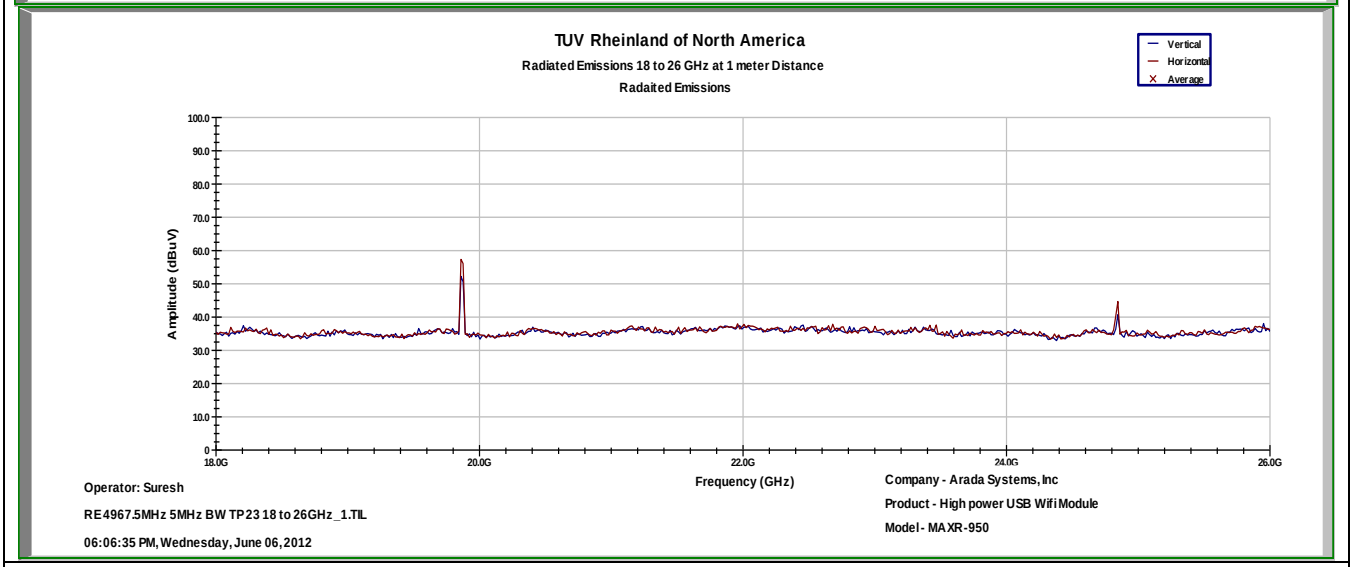
EUT Name	USB Wifi Module	**Date**	June 06, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 39%rh
EUT Serial	Proto type	**Temp / Hum out**	N/A
EUT Config.	TX ON	**Line AC**	5 Vdc
Standard	CFR47 Part 90	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Above 1 GHz Plots for Transmit Mode at 4947 MHz, 5 MHz BW





Notes: Limit was extrapolated to 1m distance for 18GHz – 26 GHz range.
1 GHz – 26 GHz Setting: RBW = 1MHz/ VBW = 3MHz All emissions were atleast 20 dB below the limit for 26 to 40 GHz

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EUT Name	USB Wifi Module	**Date**	April 09, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 39%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	TX ON	**Line AC / Freq**	5 Vdc
Standard	CFR47 Part 90	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m / EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Emission Freq	Efield Pk	Efield Ave	E-Field Ave	Spec Limit	Spec Margin	Table Pos	ANT Pos	ANT	Type
Transmitted Data at 10 MHz BW All Channels combined Low, mid and High									
9929.89	64.66	50.48	50.48	54.0	-3.52	331	100	V	Harmonic
14897.10	57.13	43.48	43.48	54.0	-10.52	60	110	V	Harmonic
9901.85	50.22	33.73	33.73	54.0	-20.27	459	195	V	Harmonic
9960.93	55.5	38.58	38.58	54.0	-15.42	127	116	V	Harmonic
14835.00	39.85	38.58	38.58	54.0	-15.42	325	100	V	Harmonic
14925.00	39.28	38.30	38.30	54.0	-15.70	-53	116	V	Harmonic

Spec Margin = E-Field Avg - Limit, E-Field Avg = FIM Avg+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Limit for outband spurious emissions is -25.0 dBm. Unit has passed lower restricted band limit. Restricted band limit was used.
Worst case was observed on, 6 Mbps with antennas in Vertical orientation.
The output radio was transmitted at +27.24dBm. (tp22)

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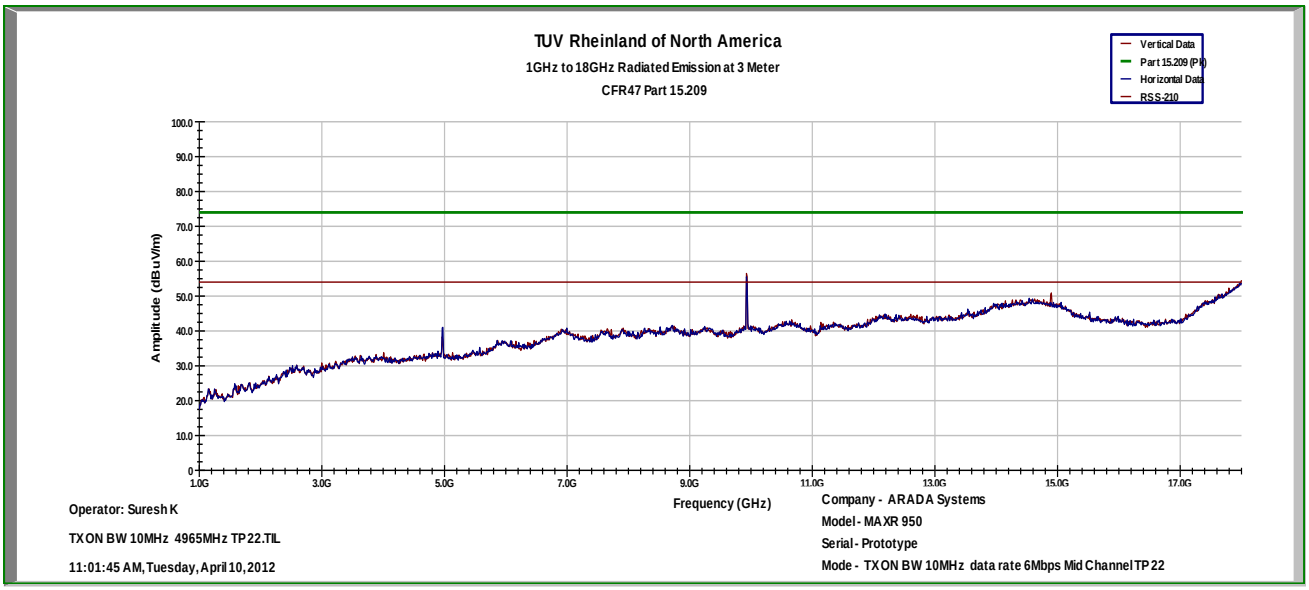
EUT Name	Highpower USB Wifi Module	**Date**	April 10, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 39%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	TX ON	**Line AC**	5 Vdc
Standard	CFR47 Part 90	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Above 1 GHz Plots for Transmit on 4965 MHz 10 MHz BW



Notes: Limit was extrapolated to 1m distance for 18GHz – 25 GHz range.
1 GHz – 25 GHz Setting: RBW = 1MHz/ VBW = 3MHz
No emissions were observed above 18GHz

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EUT Name	USB Wifi Module	**Date**	April 10, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 39%rh
EUT Serial	Proto type	**Temp / Hum out**	N/A
EUT Config.	TX ON	**Line AC / Freq**	5 Vdc
Standard	CFR47 Part 90	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m / EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Emission Freq MHz	EField Pk dBuV/m	Efield Ave dBuV/m	E-Field Ave dBuV/m	Spec Limit dBuV/m	Spec Margin dB	Table Pos	ANT Pos	ANT Pola	Type
Transmitted Data 20 MHzBW all channels combined									
9901.85	50.22	33.73	33.73	54.00	-20.27	459	195	V	Harmonic
14835.00	39.85	38.58	38.58	54.00	-15.42	326	100	V	Harmonic
9960.93	55.5	38.58	38.58	54.00	-15.42	127	116	V	Harmonic
14925.00	39.28	38.30	38.30	54.00	-15.70	53	116	V	Harmonic
9919.50	51.02	36.12	36.12	54.00	-17.88	59	124	V	Harmonic
14963.10	40.1	38.36	38.36	54.00	-15.64	170	123	V	Harmonic
19896.80	47.66	33.31	33.31	63.98	-30.67	30	100	V	Harmonic
24927.00	46.34	33.54	33.54	63.98	-30.44	85	100	V	Harmonic

Spec Margin = E-Field Avg - Limit, E-Field Avg = FIM Avg+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: The output radio was transmitted at 24 dBm. Emission measurements 18 to 40 GHz were performed at 1meter. All emissions 26 to 40 GHz were atleast 20 dB below the limit.
The output radio was transmitted at ++30.91 (tp24)

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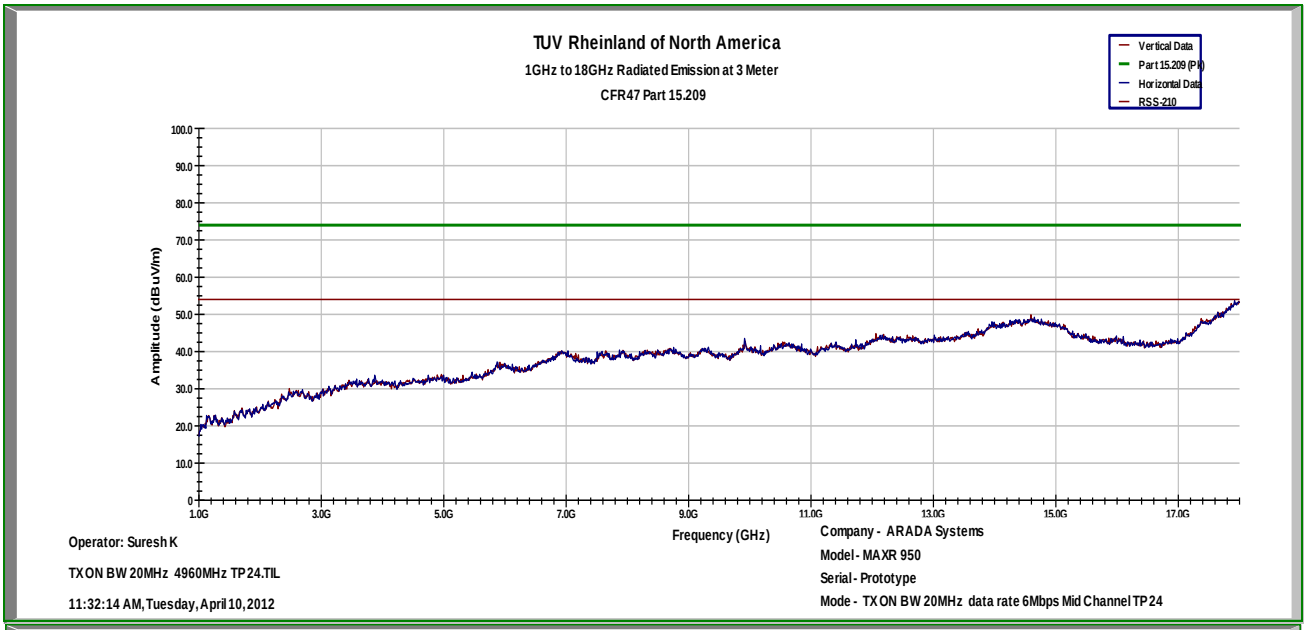
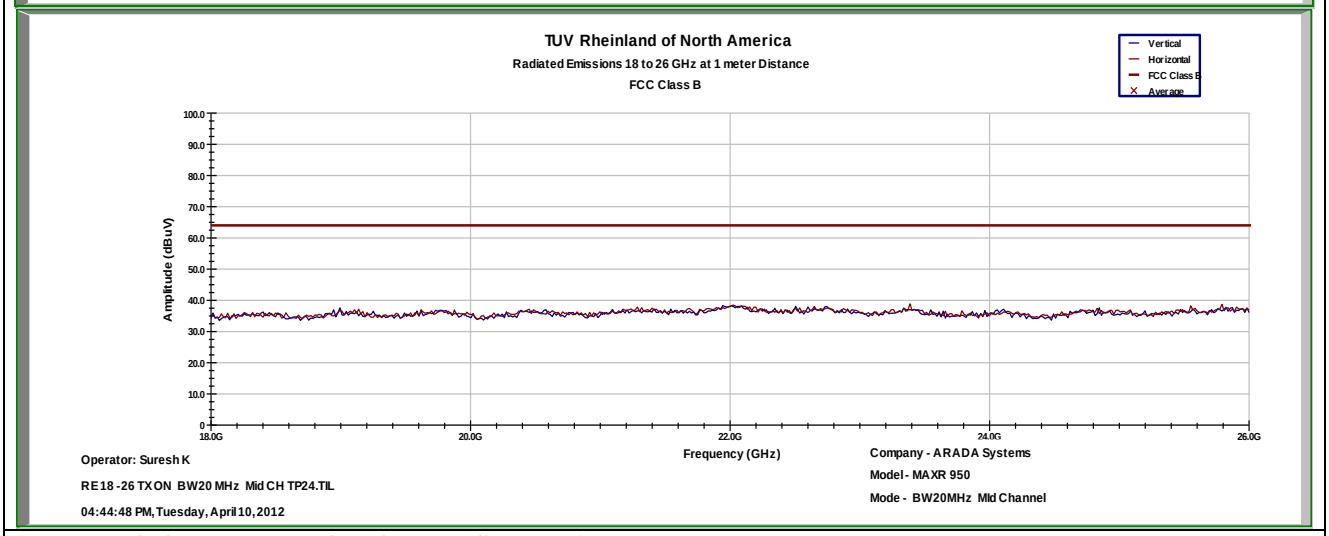
EUT Name	Highpower USB Wifi Module	**Date**	**April 10, 2012**
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 40%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	TX ON	**Line AC**	**5 Vdc**
Standard	CFR47 Part 90	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Above 1 GHz Plots for Transmit Mode at 4960 MHz





Notes: Limit was extrapolated to 1m distance for 18GHz – 26 GHz range.
1 GHz – 26 GHz Setting: RBW = 1MHz/ VBW = 3MHz

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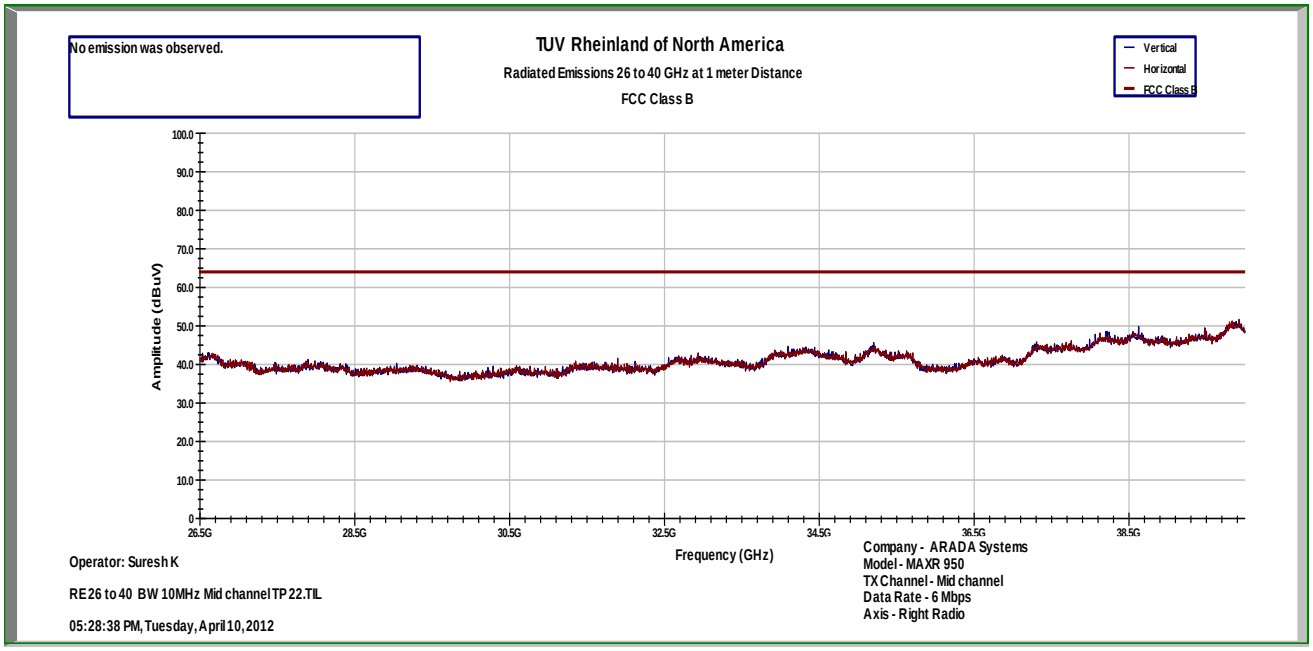
EUT Name	Highpower USB Wifi Module	**Date**	April 10, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 40%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	TX ON	**Line AC**	**5 Vdc**
Standard	CFR47 Part 90	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Above 1 GHz Plots for Transmit Mode at 4960 MHz



Notes: Limit was extrapolated to 1m distance for 18GHz – 40 GHz range.
1 GHz – 40 GHz Setting: RBW = 1MHz/ VBW = 3MHz

4.6.4 Sample Calculation

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = FIM - AMP + CBL + ACF

Where: FIM = Field Intensity Meter (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

4.7 Receiver Spurious Emissions

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

The spurious emissions of the receiver shall not exceed the values in CFR47 Part 15.109 Test Methodology

4.7.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.7.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

4.7.1.3 Deviations

None.

4.7.2 Receiver Spurious Emission Limit

The spurious emissions of the receiver shall not exceed the values in CFR47 Part 15.109: 2009

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F(kHz)	300
0.490-1.705.....	24000/F(kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

4.7.3 Test Results

The final measurement data indicates the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

4.7.3.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and without any modifications or special accessories implemented as the manufacturer intends.

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EUT Name	Highpower USB Wifi Module	**Date**	April 09, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 39%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	Receive Mode	**Line AC / Freq**	5 Vdc
Standard	CFR47 Part 15.109	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m / EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Emission Freq	FIM Pk	FIM Ave	Total CF	E-Field Ave	Spec Limit	Spec Margin	Table Pos	ANT Pos	ANT Pola	Type
1128.56	40.69	27.81	-8.55	19.26	53.98	-34.72	173	136	H	Spurious
1225.20	44.97	28.61	-7.95	20.66	53.98	-33.32	154	100	V	Spurious
1956.71	40.14	25.76	-4.73	21.03	53.98	-32.95	124	150	H	Spurious
4874.03	45.63	40.81	2.52	43.33	53.98	-10.65	280	121	H	Spurious

Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Worst case was observed on Y-axis, 1Mbps. All other emissions atleast 20db below the limit.
Notes: RBW=120 kHz,VBW=300 kHz 1 GHz – 25 GHz: RBW=1MHz, VBW=3MHz

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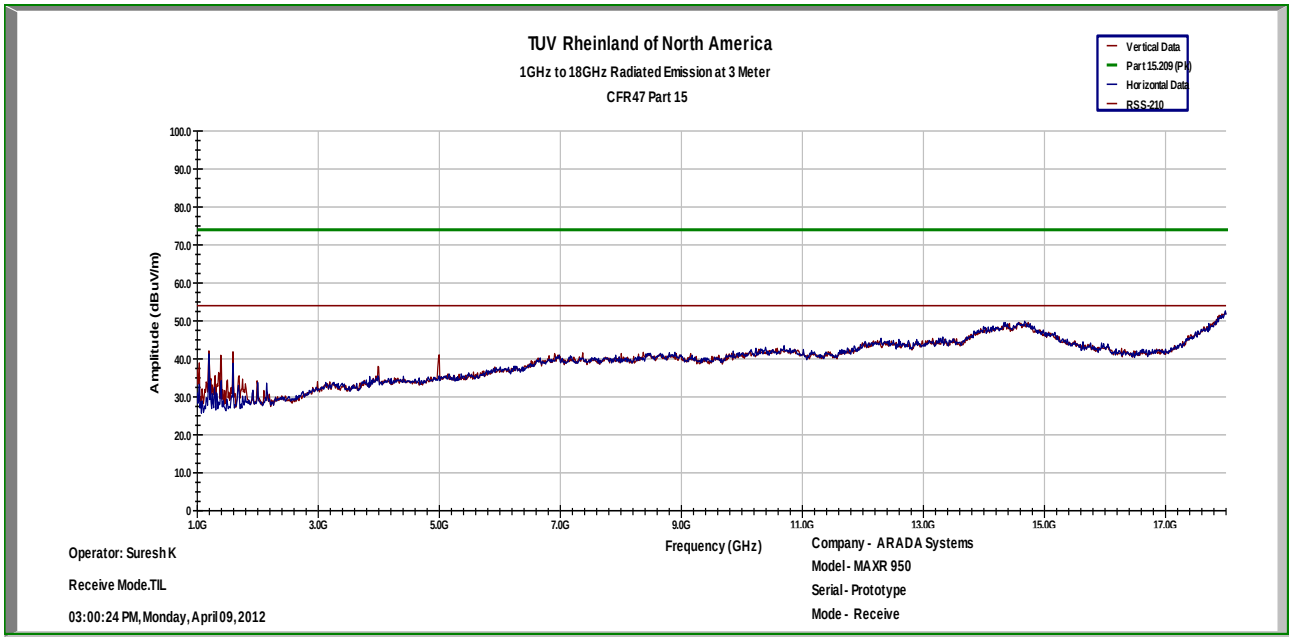
EUT Name	**Highpower USB** Wifi Module	**Date**	April 09, 2012
EUT Model	MaxR 950	**Temp / Hum in**	22°C / 40%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	Normal orentation	**Line AC**	**5 Vdc**
Standard	CFR47 Part 15.109,	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m / JB3	**Performed by**	Suresh Kondapali

Above 1 GHz Plot for Receive Mode



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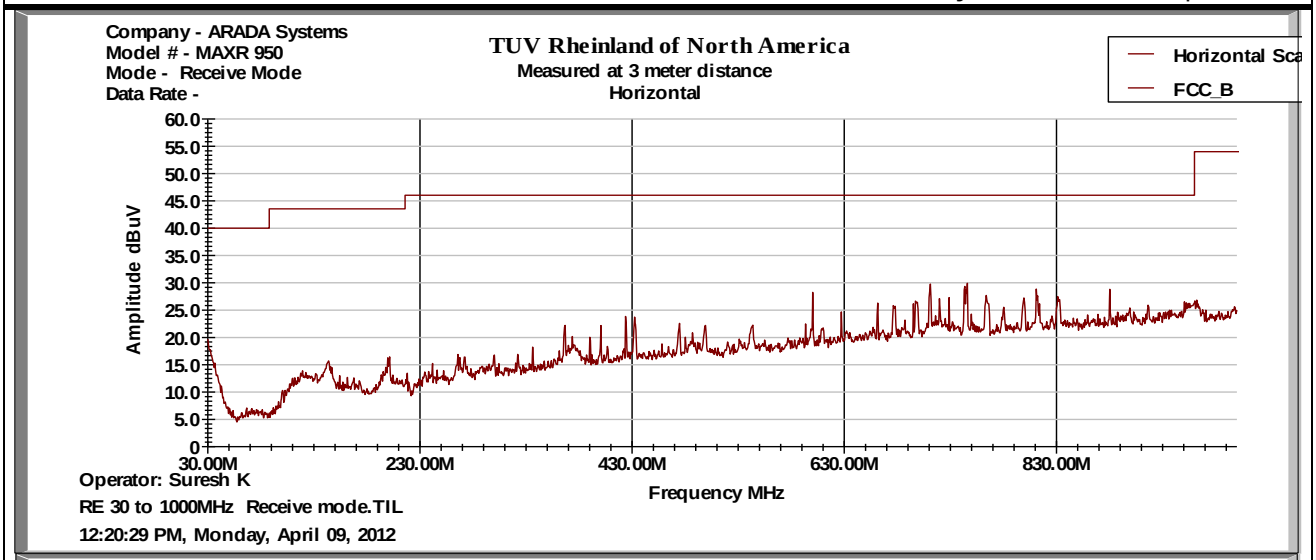
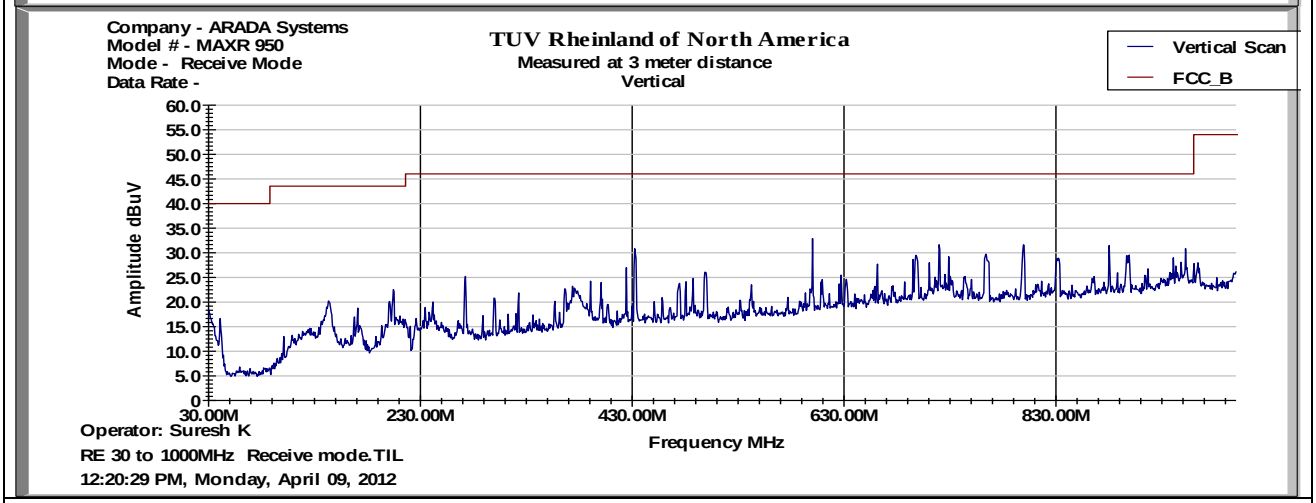
EUT Name	**Highpower USB** Wifi Module	**Date**	April 09, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 40%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	Normal operation	**Line AC**	**5 Vdc**
Standard	CFR47 Part 15.109, Class A	**RBW / VBW**	120KHz/300KHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Suresh Kondapalli





Notes: None.

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EUT Name	Highpower USB Wifi Module	**Date**	April 09, 2012
EUT Model	MaxR 950	**Temp / Hum in**	23°C / 39%rh
EUT Serial	Prototype	**Temp / Hum out**	N/A
EUT Config.	Normal operation	**Line AC / Freq**	5 Vdc
Standard	CFR47 Part 15 part 15 Class A	**RBW / VBW**	120KHz/300KHz
Dist/Ant Used	3m / EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Emission Freq	Raw Pk	Raw QP	Total CF	E-Field QP	Spec Limit	Spec Margin	Table Pos	ANT Pos	ANT Pola	Type
97.2988	40.18	39.75	-22.68	17.07	40	-22.93	H	296	90	
117.846	38.76	34.73	-18.13	16.6	40	-23.40	H	291	76	
270.318	45.19	37.97	-17.39	20.58	47	-26.42	V	119	215	
599.985	45.89	45.59	-12.33	33.26	47	-13.74	V	111	140	
798.372	37.14	33.65	-8.42	25.23	47	-21.77	H	171	305	
798.504	43.68	40.76	-8.92	31.84	47	-15.16	V	156	13	

Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Emissions from digital parts . EUT is Class A device
Notes: 30 MHz – 1 GHz: RBW=120 kHz,VBW=300 kHz

4.7.4 Sample Calculation

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = FIM - AMP + CBL + ACF

Where: FIM = Field Intensity Meter (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

4.8 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4-2009. These test methods are listed under the laboratory's NVLAP Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2009 and RSS 210: 2010.

4.8.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50μH / 50Ω LISNs.

Testing is either performed in Lab 5. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.8.1.1 Deviations

There were no deviations from this test methodology.

4.8.2 Test Results

Test Not applicable EUT is DC powered. The host is DC powered

4.9 Frequency Stability

In accordance with 47 CFR Part 90.213(a) the transmitters used in the services governed by this part must have a minimum frequency stability specified below

§ 90.213 Frequency stability.

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have minimum frequency stability as specified in the following table.

Minimum Frequency Stability

[Parts per million (ppm)]

Above 2450[10]

[10]Except for DSRCS equipment in the 5850 – 5925 MHz band, frequency stability is to be specified in the station authorization.

4.9.1 Test Methodology

FCC 2.1055

EUT was placed inside temperature chamber and its power supply was connected to varable DC power supply. Anteena port was connected to spectrum Analyzer placed outside the chamber. The frequency stability was measured at the antenna port with a spectrum analyzer using a peak detector with a resolution bandwidth of 3Hz and a video bandwidth of 1 kHz.

Measurements were performed at nominal power supply voltage (DC 5V) with variation of ambient temperature from -30 to +50°C with 10°C steps and at nominal temperature (20°C) with variation of power supply voltage from 85% to 115% of the nominal value. For each test condition, after stable temperature was reached, the EUT was turned on and the operating frequency was measured at startup and at 2, 5 and 10 minutes after the EUT was energized. The EUT was transmitting an unmodulated carrier for this test.

4.9.2 Test results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 8: Frequency Stability – Test Results

Test conditions		MHz	Measured Deviation MHz	Measured Deviation PPM	Comments
Temp. °C	DC Input Volts				
0	5	4968.555745	None	None	Pass
-10	5	4968.315745	-0.240	-48.3	Pass
-20	5	4968.315745	-0.240	-48.3	Pass
10	5	4968.555745	None	None	Pass
20.3	**5**	**4968.555745**	**REF**	**REF**	Pass
30	5	4968.195745	-0.36	-72.0	Pass
40	5	4968.195745	-0.36	-72.0	Pass
50	5	4968.195745	-0.36	-72.0	Pass
20.3	4.25	4968.555745	None	None	Pass
20.3	5.75	4968.555745	None	None	Pass

Frequency evaluation was made at the start time, 2 min, 5 min and 10 min from start of time with worst-case values are reported here.

4.9.3 Test Setup Photos

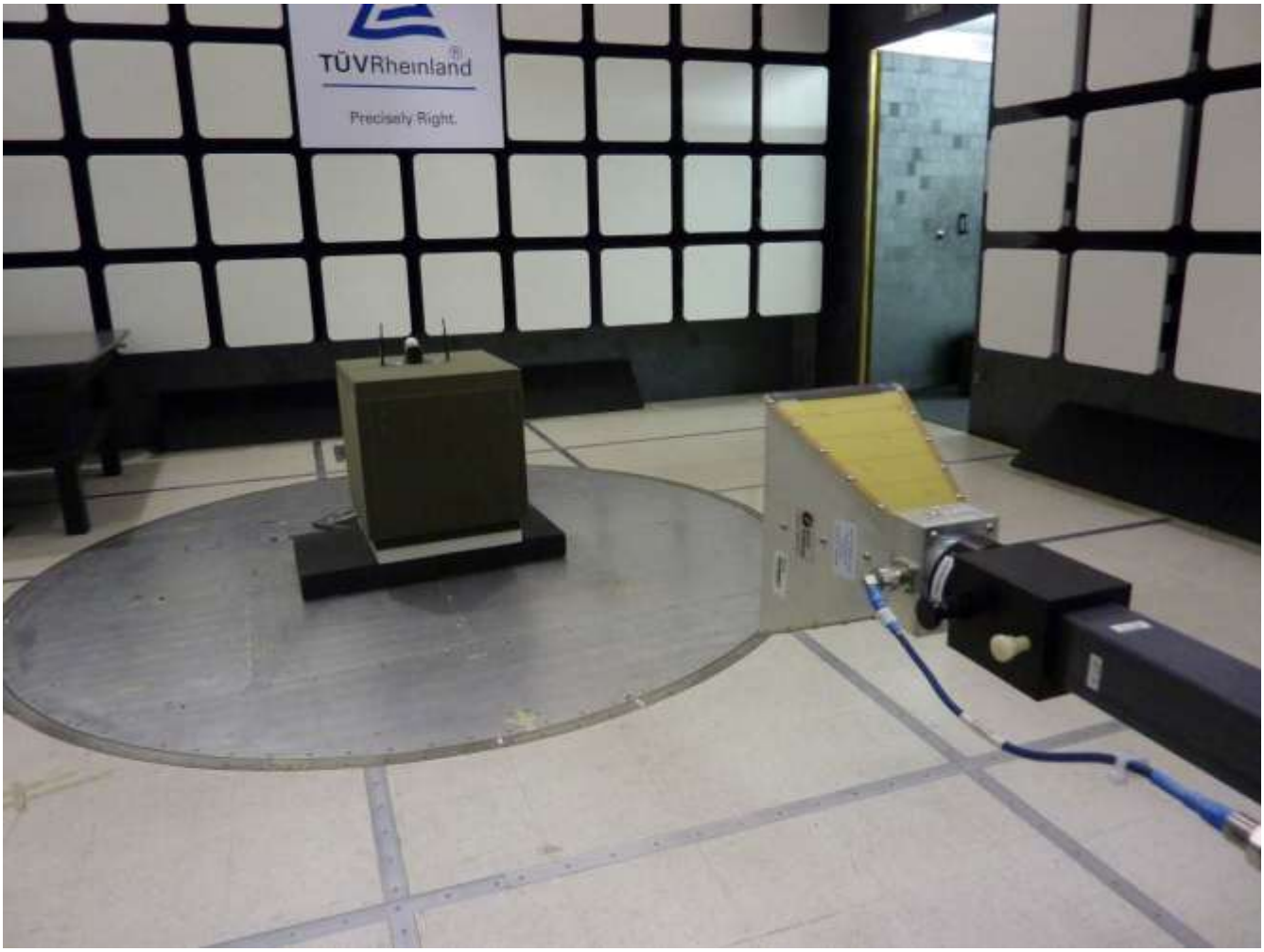

Figure 60: Test Setup Photo Radiated Emissions Front side

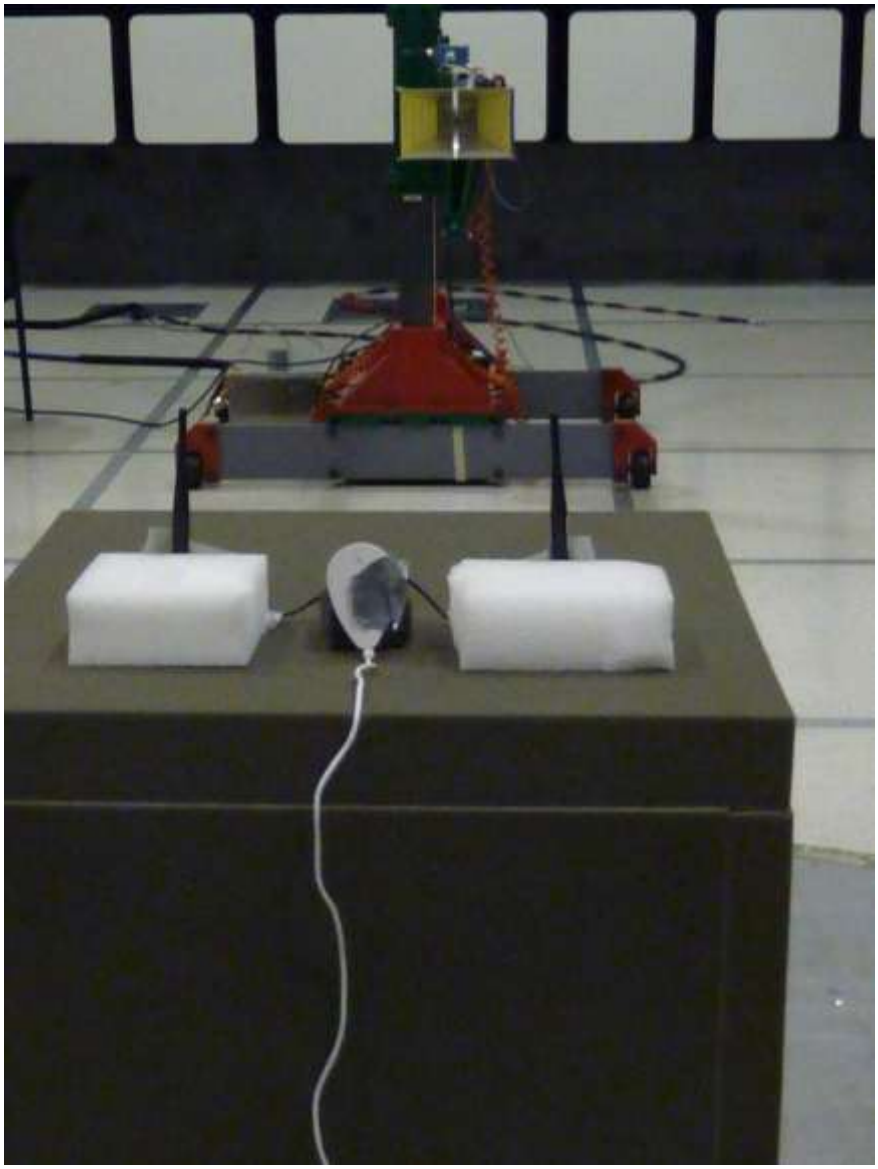

Figure 61: Test Setup Photo Radiated Emissions Back side

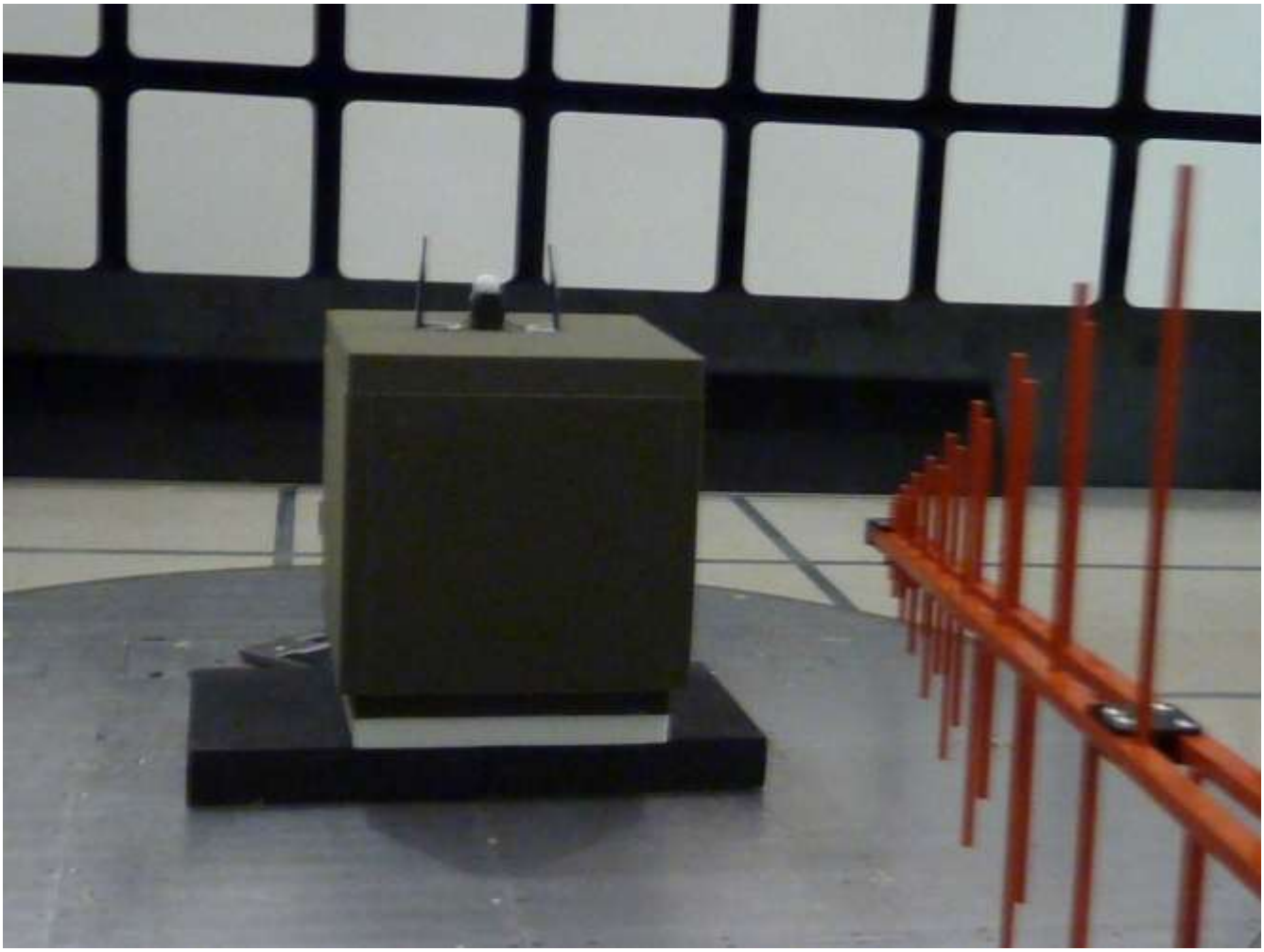

Figure 62: Test Setup Photo Radiated Emissions 30 MHz to 1 GHz

5 Test Equipment Use List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Bilog Antenna	Sunol Science	JB3	A102606	5/15/2012	5/15/2014
Horn Antenna	Sunol Scienece	DRH-118	A040806	9/29/2010	9/29/2012
Antenna (18-26GHz)	CMT	RA42-K-F-4B-C	020131-004	1/17/2012	1/17/2013
Antenna (26-40 GHz)	CMT	RA28-K-F-4B-C	011469R-003	1/17/2012	1/17/2013
EMI Receiver	Hewlett Packard	8546A	3807A00445	1/17/2012	1/17/2013
Preselector	Hewlett Packard	85460A	3704A00407	1/17/2012	1/17/2013
Amplifier	Hewlett Packard	8447D	2944A07996	1/16/2012	1/16/2013
Spectrum Analyzer	Rhode&Schwarz	ESIB	832427/002	1/17/2012	1/17/2013
Amplifier	Rhode&Schwarz	TS-PR18	3545.7008.03	9/29/2010	9/29/2012
Amplifier	Rhode&Schwarz	TS-PR26	100011	1/16/2012	1/16/2013
Amplifier	Rhode&Schwarz	TS-PR40	100012	1/16/2012	1/16/2013
Signal Generator	Anritsu	MG3694A	42803	1/17/2012	1/17/2013
Notch Filter	Micro-Tronics	BRM50702	37	1/17/2012	1/17/2013
Notch Filter	Micro-Tronics	BRC50705	9	1/17/2012	1/17/2013
High Pass Filter (3.5 GHz)	Hewlett Packard	84300-80038	820004	1/17/2012	1/17/2013
High Pass Filter (8.5 GHz)	Micro-Tronics	HPM50107	4	1/17/2012	1/17/2013
Power Supplier	Kikosui	PCR8000W	CM000912	1/19/2012	1/19/2013
Digital Multimeter	Fluke	177	92780314	1/18/2012	1/18/2013
Power Meter	Agilent	E4418B	MY45103902	1/19/2012	1/19/2013
Power Sensor	Hewlett Packard	8482A	55-5131	1/19/2012	1/19/2013
Spectrum Analyzer	Agilent	E4407B	SG43330468	10/05/2011	10/05/2012
Themal Chamber	Tenny	T30RS	10.785.19	03/12/2012	03/12/2013
Thermometer	Fluke	52 II	E-121	07/26/2012	07/26/2013

* Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.

6 EMC Test Plan

6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

6.2 Customer

Table 9: Customer Information

Company Name	Arada Systems, Inc
Address	4633 Old Ironsides Drive, Suite 415
City, State, Zip	Santa Clara, CA 95054
Country	USA
Phone	408-773-9298
Fax	408-716-3238

Table 10: Technical Contact Information

Name	Praven Singh
E-mail	psingh@aradasystems.com
Phone	408-773-9298
Fax	408-716-3238

6.3 Equipment Under Test (EUT)

Table 11: EUT Specifications

EUT Specification	
Dimensions	72mm x 42mm x 7mm
AC Adapter (For charging only)	Input Voltage: 5 Vdc Input Current: 200 mA
Environment	Limited Modular approval EUT mounted inside a host
Operating Temperature Range:	-20 to +70 degrees C
Multiple Feeds:	☐ Yes and how many ☒ No
Hardware Version	None
Part Number	None
RF Software Version	None
Radio Module	
Operating Mode	Part 90 sub part Y
Transmitter Frequency Band	4940 - 4990 MHz
Max. Rated Power Output	See Channel Planning Table.
Power Setting @ Operating Channel	See Channel Planning Table.
Antenna Type	External Monopole Antenna 2.1 dBi
Modulation Type	☐ AM ☐ FM ☐ DSSS ☒ OFDM ☒ Other describe:
Data Rate	6, 24 & 54 Mbps; @ 5MHz the data rate is divided by 4; @10MHz the data rate is divided by 2; @20MHz rate is the same
TX/RX Chain (s)	1
Directional Gain Type	☒ Uncorrelated ☒ No Beam-Forming ☐ Other describe:
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other *Limited Modular approval EUT mounted inside a host System*

Table 12: EUT Channel Power Specifications

No.	Frequency (MHz)	Band width	Power Setting (TP)	Data rate	Avg Measured power by power meter
		MHz	TP	Mbps	dBm
1	4945.5	5 MHz	23	6	23.60
2	4967.5	5 MHz	23	6	23.40
3	4987.5	5 MHz	23	6	23.40
4	4945	10 MHz	22	24	22.80
5	4965	10 MHz	22	24	22.50
6	4985	10 MHz	22	24	22.35
7	4950	20 MHz	24	24	24.65
8	4960	20 MHz	24	24	24.45
9	4980	20 MHz	24	24	24.00

Notes:
1. The adjusted power target values are updated at the evaluated frequencies. Data rates 6 Mbps, 24 Mbps and 54 Mbps were evaluated. Power levels measured at other data rates were equal or lower than the listed above.

2. This report is only documented for frequency ranges, 4940 - 4990 MHz

Table 13: Interface Specifications: USB Connector: Power from host device

Table 14: Supported Equipment : None

Table 15: Description of Sample used for Testing

Device	Serial	RF Connection	CFR47 Part 90
Highpower USB Wifi Module Model: MaxR 950	Prototype	Two External Antennas	TX Emission, RX Emission
	Prototype	SMA connector (Coax cable with MMCX Connector on EUT side and SMA connector on SA side)	RF Power Output, Out of Band Emission, Peak Power Spectral Density, Occupied Bandwidth, Emission Mask

Table 16: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (Normal opertion)
Highpower USB wifi Module Model: MAXR 950	External	* Transmit * Receive	
EUT was tested in normal operational orientation in host device			

6.4 Test Specifications

Testing requirements

Table 17: Test Specifications

Emissions and Immunity	
Standard	Requirement
CFR 47 Part 90	All

END OF REPORT