TEST REPORT

Report Number: 100825363MPK-030
Project Number: G100825363
August 22, 2013

Testing performed on the
Qolsys Security Panel
Model: IQPanel-VRZ
FCC ID: 2AAJXQS-9004-VRZ
Contains FCC ID: MIVCNN0301
IC: 11205A-QS9004VRZ
Contains IC: 4160A-CNN0301
to

FCC Part 15 Subpart C (15.247)
Industry Canada RSS-210 Issue 8, Annex 8

for
Qolsys, Inc.

Test Performed by:	Test Authorized by:
Intertek	Qolsys, Inc.
1365 Adams Court	20111 Stevens Creek Blvd., Suite 280
Menlo Park, CA 94025 USA	Cupertino, CA 95014 USA

Prepared by: _____ **Date:** August 22, 2013
Anderson Soungpanya

Reviewed by: _____ **Date:** August 22, 2013
Krishna K Vemuri

Report No. 100825363MPK-030

Equipment Under Test:	Qolsys Security Panel
Trade Name:	Qolsys, Inc..
Model Number:	IQPanel-VRZ
Serial Numbers	QSNA132800177 QSNA132800172
Applicant:	Qolsys, Inc..
Contact:	Mark Skeen
Address:	Qolsys, Inc. 20111 Stevens Creek Blvd., Suite 280 Cupertino, CA 95014
Country	USA
Tel. Number:	408-857-8415
Email:	mark.skeen@qolsys.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-210 Issue 8, Annex 8
Date of Test:	August 16 to August 20, 2013

We attest to the accuracy of this report:

Anderson Soungpanya
Project Engineer

Krishna K Vemuri
EMC Senior Staff Engineer

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1.0 Summary of Tests

Test	Reference FCC	Reference RSS	Result
RF Output Power	15.247(b)(3)	A8.4(4)	Complies
6 dB Bandwidth	15.247(a)(2)	A8.2(a)	Complies
Power Density	15.247(e)	A8.2(b)	Complies
Out of Band Antenna Conducted Emission	15.247(d)	A8.5	Complies
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	A8.5, 2.2	Complies
AC Conducted Emission	15.207	RSS-Gen	Complies
Antenna Requirement	15.203	RSS-Gen	Complies. The EUT uses Integral PCB antenna

EUT receive date: August 16, 2013
EUT receive condition: The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.
Test start date: August 16, 2013
Test completion date: August 20, 2013
The test results in this report pertain only to the item tested.

2.0 General Information

2.1 Product Description

The Equipment Under Test (EUT) is the Qolsys Security Panel, model number IQPanel-VRZ, is a combination wireless home security, life safety, and home automation system. It consists of one Home Security RF receiver, one Zigbee radio, one Zwave radio, one WiFi radio and one CDMA radio.

The CDMA radio is a modular approved CDMA module with FCC ID: MIVCNN0301 and IC: 4160A-CNN0301. This test report covers only the WiFi radio. A separate test report, report # 100825363MPK-029, covers the Zwave radio and a separate test report, report # 100825363MPK-028, covers the Zigbee radio.

The IQ Panel was powered via a 12VDC through an AC/DC power supply which connected to 120VAC/60Hz mains.

Information about the WiFI radio is presented below:

The EUT supports a wide range of data rates in the 2.4GHz band:

IEEE 802.11b: 1, 2, 5.5, 11Mbps
IEEE 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
IEEE 802.11n: MCS0, MCS1, MCS2, MCS3, MCS4, MCS7, MCS8
Note: in 802.11n HT20 an 802.11n HT40 modes, the nominal bandwidth is 20 MHz and 40 MHz respectively.

Applicant	Qolsys, Inc.
Model Number	IQPanel-VRZ
FCC Identifier	2AAJXQS-9004-VRZ Contains FCC ID: MIVCNN0301
IC Identifier	11205A-QS9004VRZ Contains IC: 4160A-CNN0301
Use of Product	Wireless Home Security
Modulation Technique	DSSS (BPSK, QPSK, CCK), OFDM (BPSK, QPSK, 16QAM, 64QAM)
Rated RF Output	15.80 dBm
Frequency Range	2412 – 2462 MHz
Type of modulation	BPSK, QPSK, 16QAM, 64QAM
Number of Channel(s)	11
Antenna(s) & Gain	Internal antenna: PCB antenna, 3dBi peak gain
Manufacturer Name & Address	Qolsys, Inc. 20111 Stevens Creek Blvd., Suite 280 Cupertino, CA 95014 USA

The EUT supports the following configurations:

Channels in 2.4 GHz band					
Number	Frequency, MHz	b/g/n HT20 mode		n HT40 mode	
1	2412	√	X	Not used	Not used
2	2417	√		Not used	Not used
3	2422	√		√	X
4	2427	√		√	
5	2432	√		√	
6	2437	√	X	√	X
7	2442	√		√	
8	2447	√		√	
9	2452	√		√	
10	2457	√		√	
11	2462	√	X	√	X

√ - available
X – to be tested

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Antenna conducted measurements were performed according to the procedure “Measurement of Digital Transmission Systems Operating under Section 15.247”.

Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.4. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **"Data Sheet"** of this Application.

All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

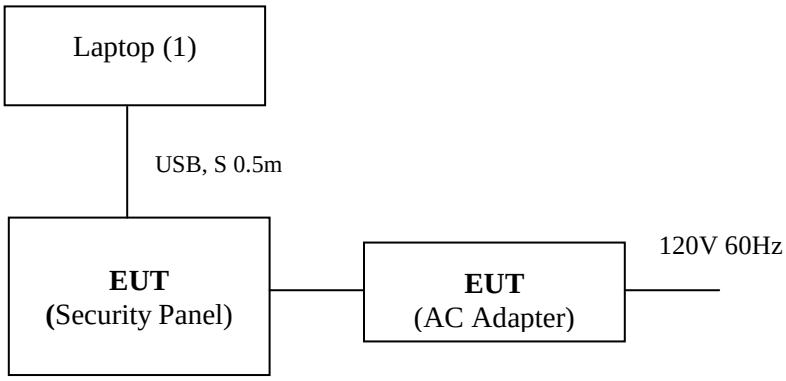
The test site used to collect the radiated data is site 1 (10-m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

3.0 System Test Configuration

3.1 Support Equipment and description

Item #	Description	Model No./ Part No.	Serial No.
1	HP Laptop	6735B	Not Labeled

3.2 Block Diagram of Test Setup



AC Adapter: Model: SW-120200A, Manufacturer: SURE-POWER

S = Shielded **U** = Unshielded	**F** = With Ferrite **M** = Meter

3.3 Justification

Preliminary testing was performed for all modulation/data rate modes. The mode in which the highest power was detected, were selected for final measurements:

CCK 1 Mbps – for 802.11b
OFDM 6 Mbps – for 802.11g
OFDM MCS0 – for 802.11n HT20
OFDM MCS0 – for 802.11n HT40

3.4 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously at maximum RF power on low, middle and high channels.

3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.

4.0 Measurement Results

4.1 6dB DTS Bandwidth, 6dB RSS Bandwidth and 99% Occupied Bandwidth
FCC Rule 15.247(a)(2)

4.1.1 Requirement

The minimum 6-dB bandwidth shall be at least 500 kHz

4.1.2 Procedure

The Procedure described in the FCC Publication 558074 D01 DTS Meas Guidance v03r01 April 9 2013 was used to determine the DTS occupied bandwidth. Section 8.1 Option 1 was used.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

For the 6 dB bandwidth for RSS, the RBW was set to approximately 1% of the EBW without going below 1%.

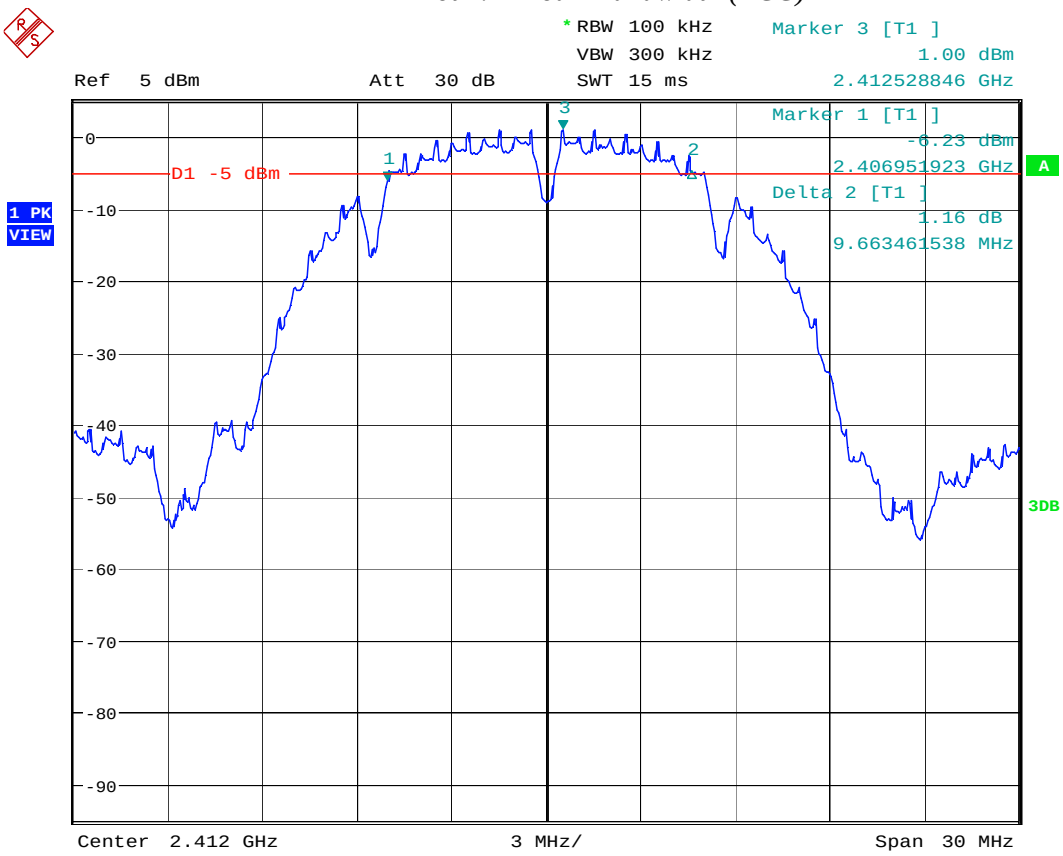
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer.

The antenna port of the EUT was connected to the input of a spectrum analyzer (SA). For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn for 6 dB lower than PEAK level. The 6-dB bandwidth was determined from where the channel output spectrum intersected the display line.

4.1.3 Test Result

Frequency MHz	Channel	Frequency MHz	6 dB FCC Bandwidth, MHz	Plot #	6 dB RSS Bandwidth, MHz	Plot #	99% Bandwidth, MHz	Plot #
802.11b	1	2412	9.66	1.1	9.66	1.13	13.48	1.25
	6	2437	9.94	1.2	9.94	1.14	13.48	1.26
	11	2462	10.00	1.3	10.00	1.15	13.44	1.27
802.11g	1	2412	16.67	1.4	16.53	1.16	17.20	1.28
	6	2437	16.67	1.5	16.59	1.17	17.16	1.29
	11	2462	16.37	1.6	16.58	1.18	17.16	1.30
802.11n HT20	1	2412	17.82	1.7	17.88	1.19	18.08	1.31
	6	2437	17.88	1.8	17.84	1.20	18.08	1.32
	11	2462	17.82	1.9	17.84	1.21	18.08	1.33
802.11n HT40	3	2422	36.60	1.10	36.88	1.22	36.89	1.34
	6	2437	36.60	1.11	36.73	1.23	36.96	1.35
	11	2462	36.58	1.12	36.83	1.24	36.82	1.36

Plot 1. 1 – 6dB Bandwidth (FCC)



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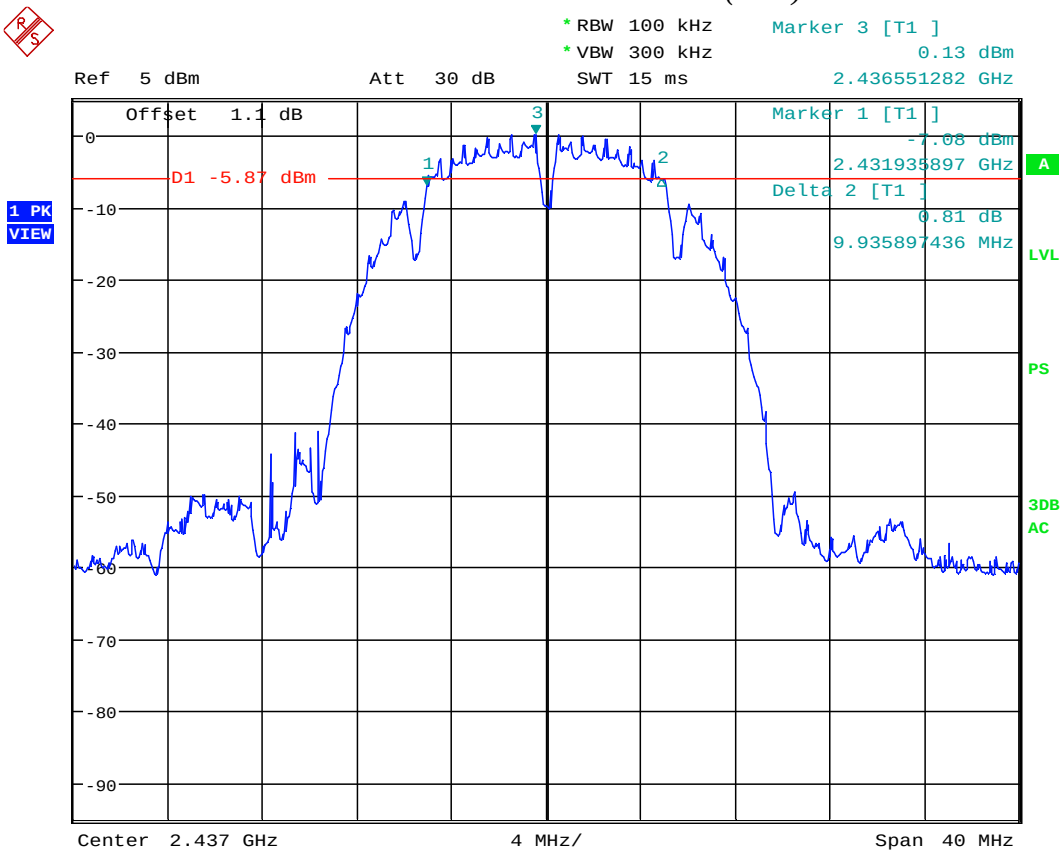
Plot 1. 2– 6dB Bandwidth (FCC)



Occupied Bandwidth

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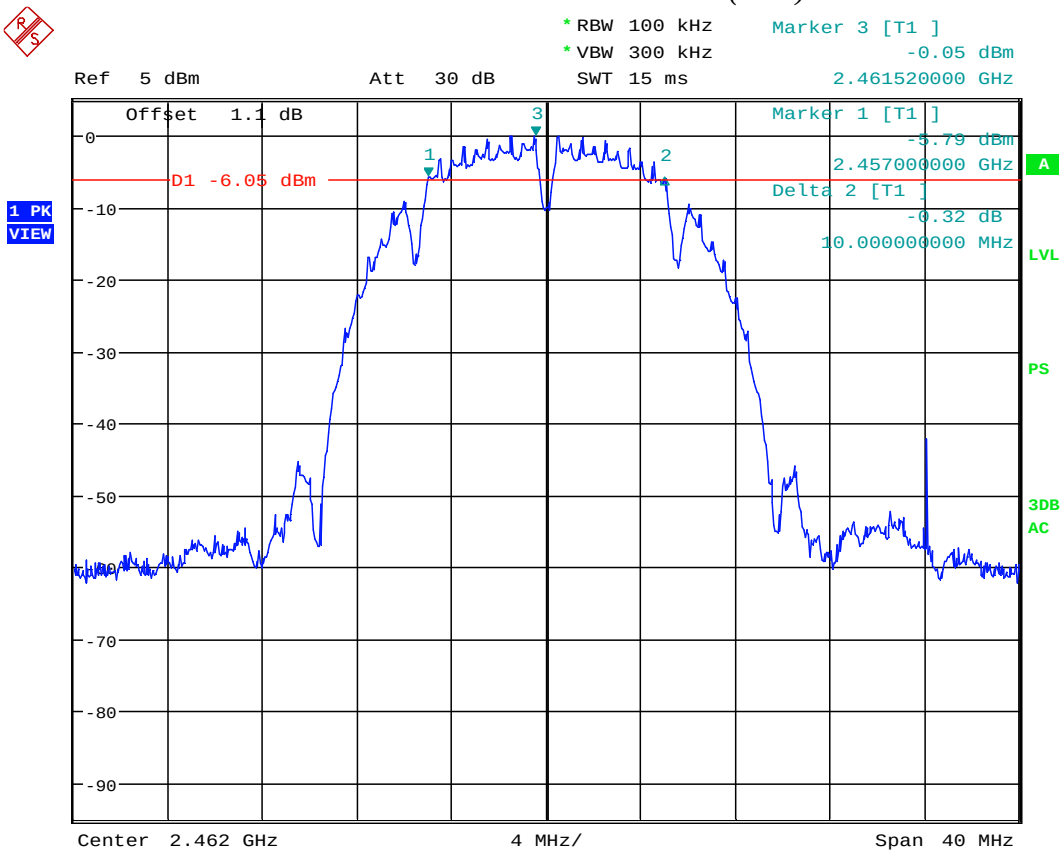
Plot 1. 3 – 6dB Bandwidth (FCC)



Occupied Bandwidth

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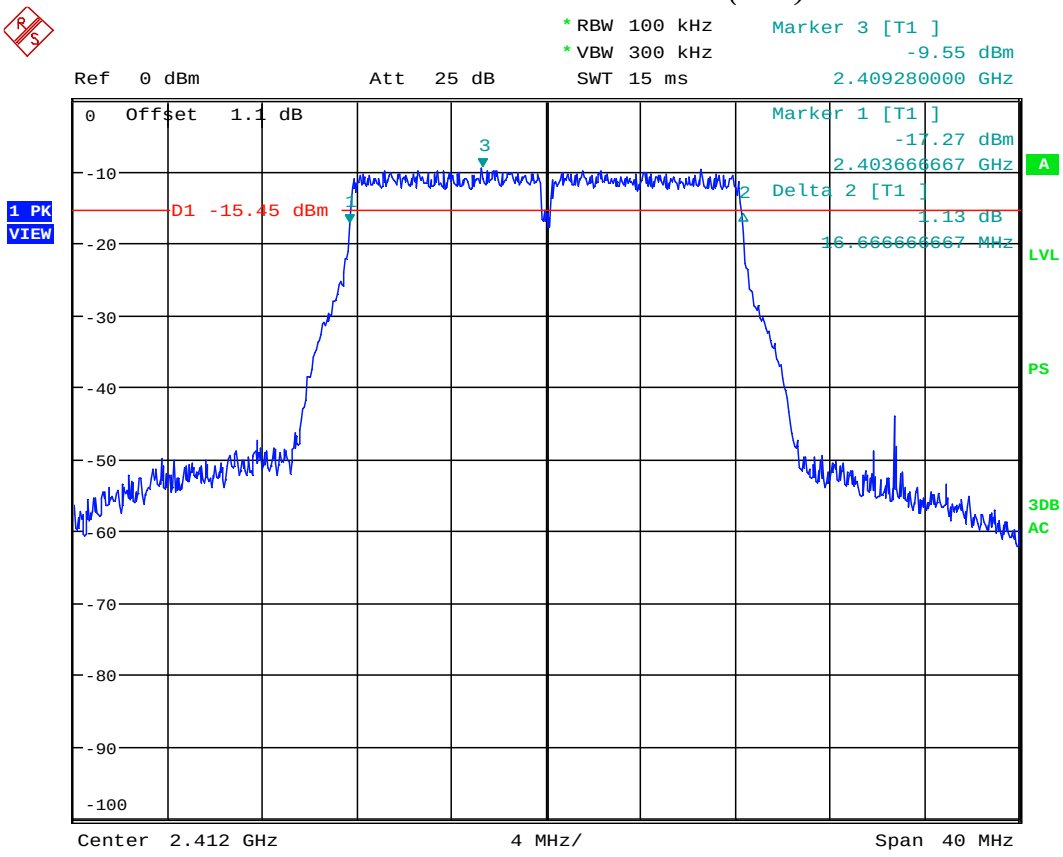
Plot 1. 4 – 6dB Bandwidth (FCC)



Occupied Bandwidth

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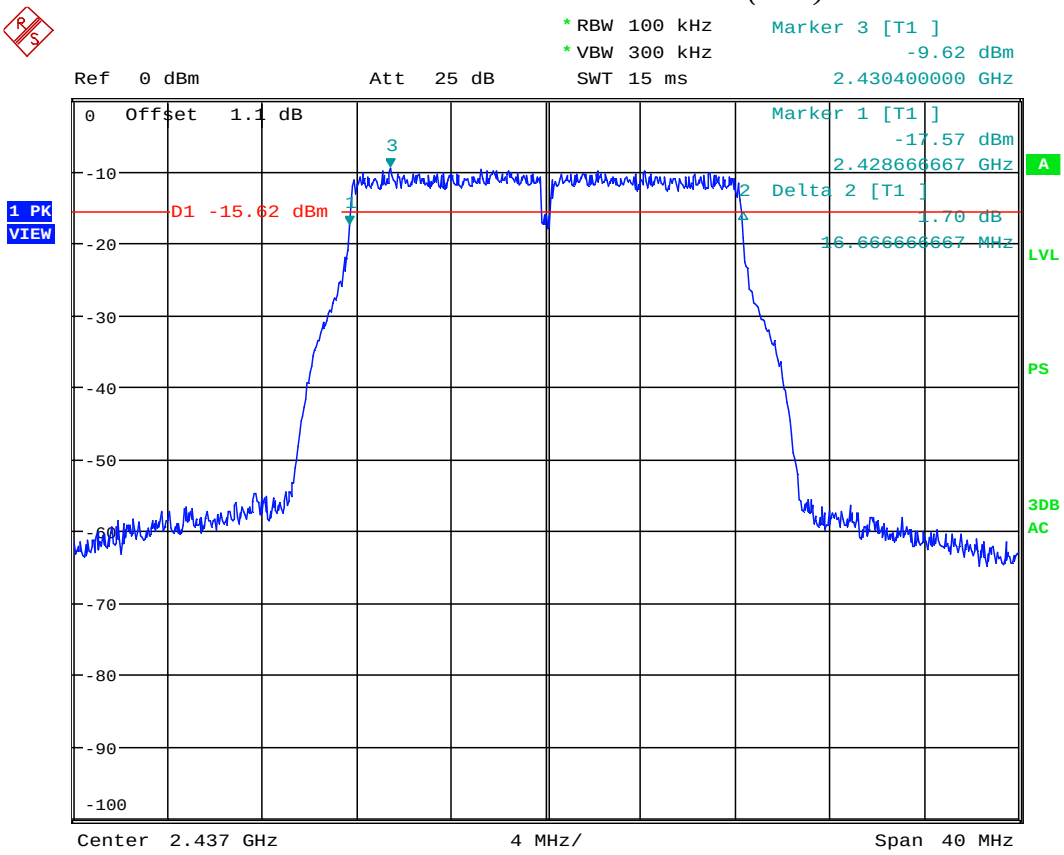
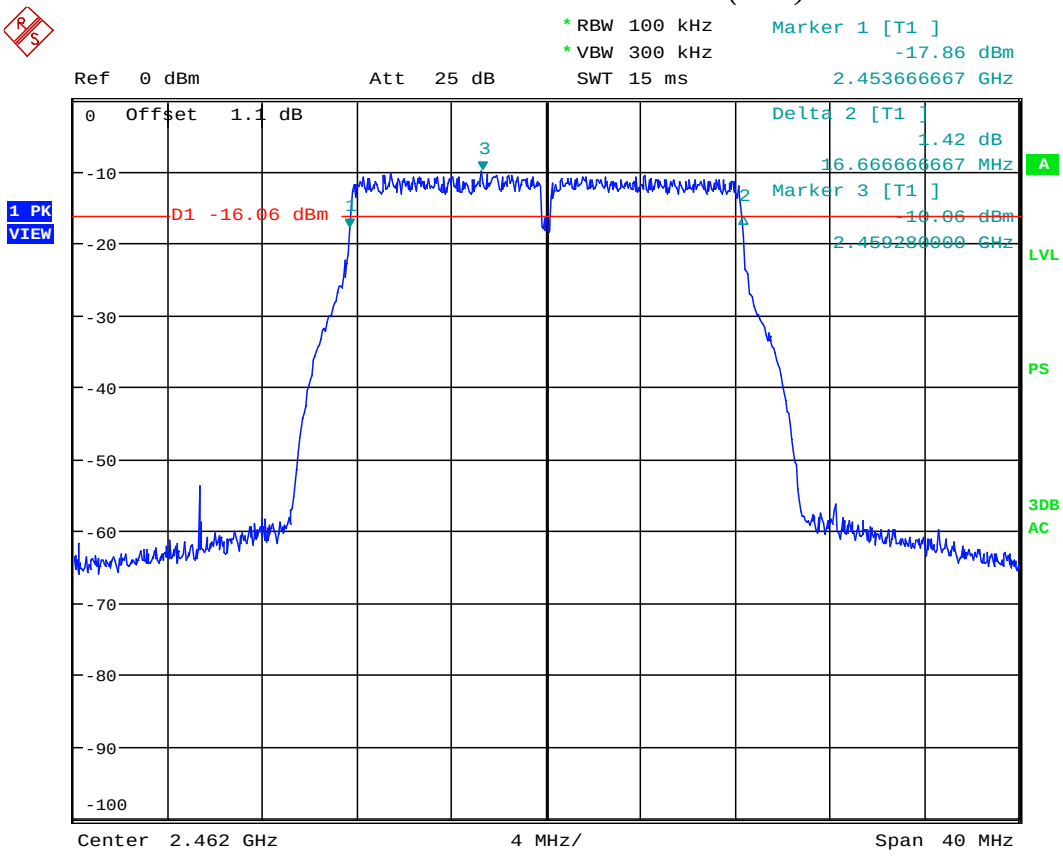
Plot 1. 5 – 6dB Bandwidth (FCC)



Occupied Bandwidth

Date: 15.AUG.2013 14:39:53

Plot 1. 6 – 6dB Bandwidth (FCC)



Occupied Bandwidth

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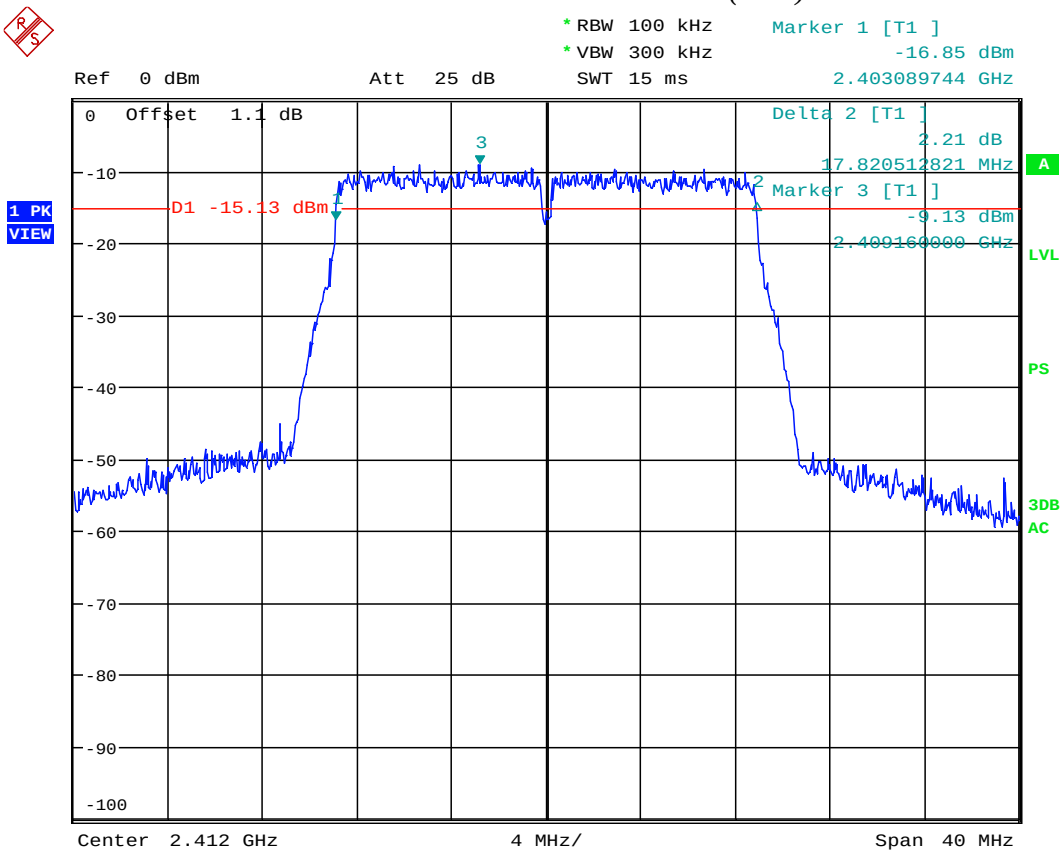
Plot 1. 7 – 6dB Bandwidth (FCC)



Occupied Bandwidth

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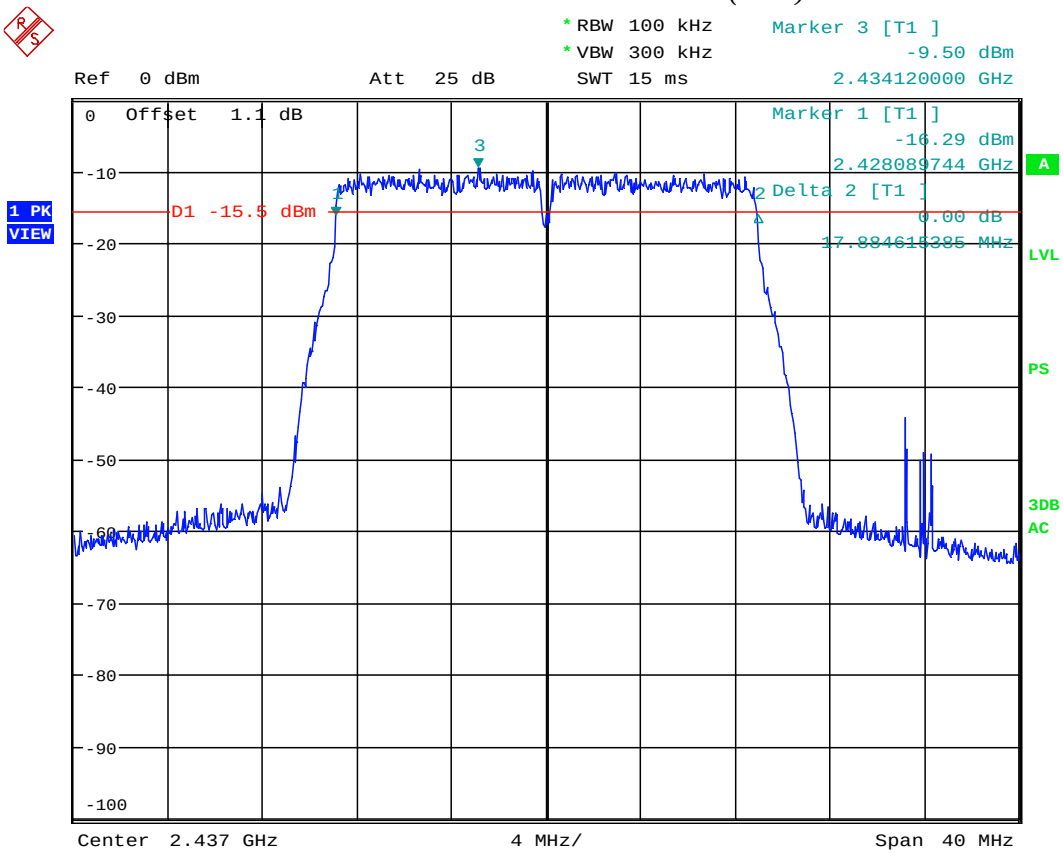
Plot 1. 8 – 6dB Bandwidth (FCC)



Occupied Bandwidth

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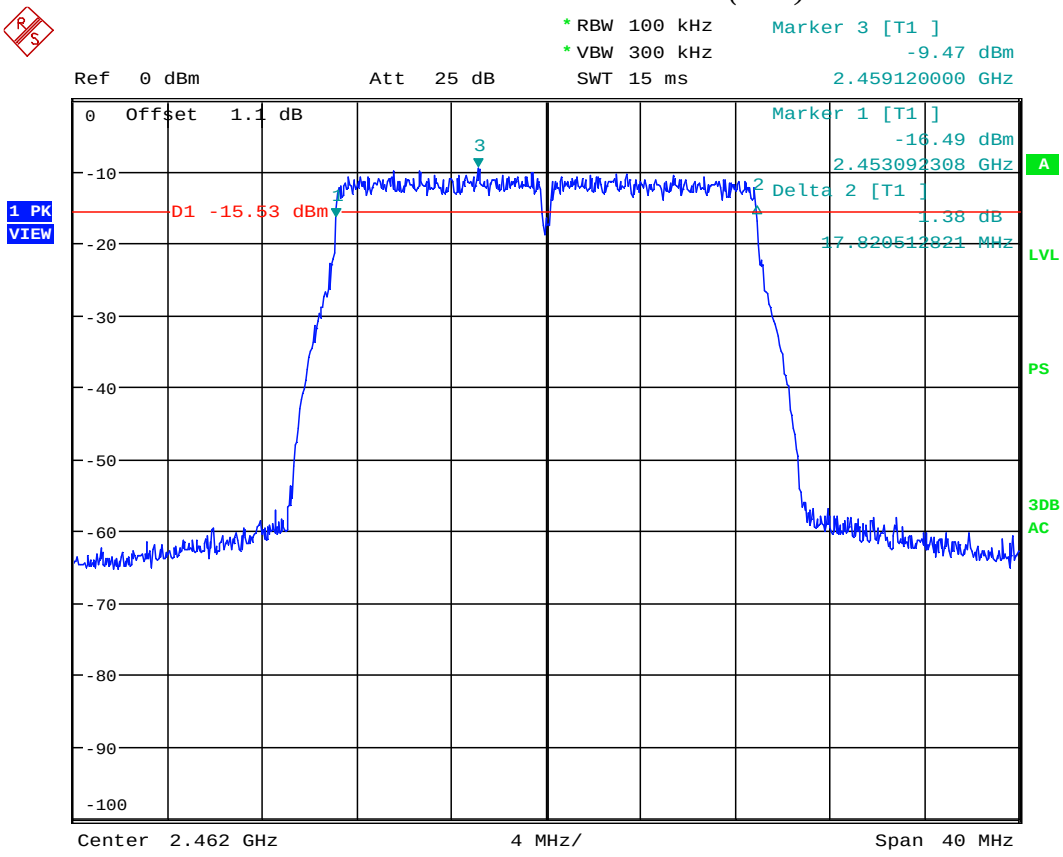
Plot 1. 9 – 6dB Bandwidth (FCC)



Occupied Bandwidth

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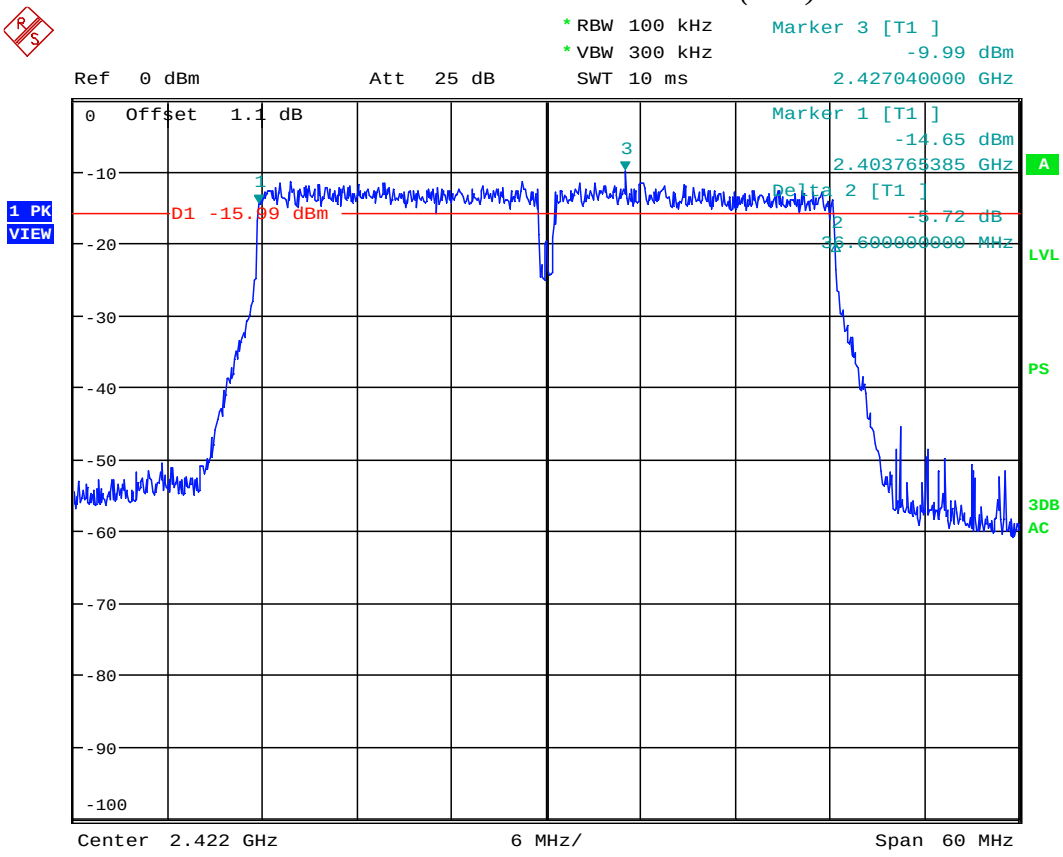
Plot 1. 10 – 6dB Bandwidth (FCC)



Occupied Bandwidth

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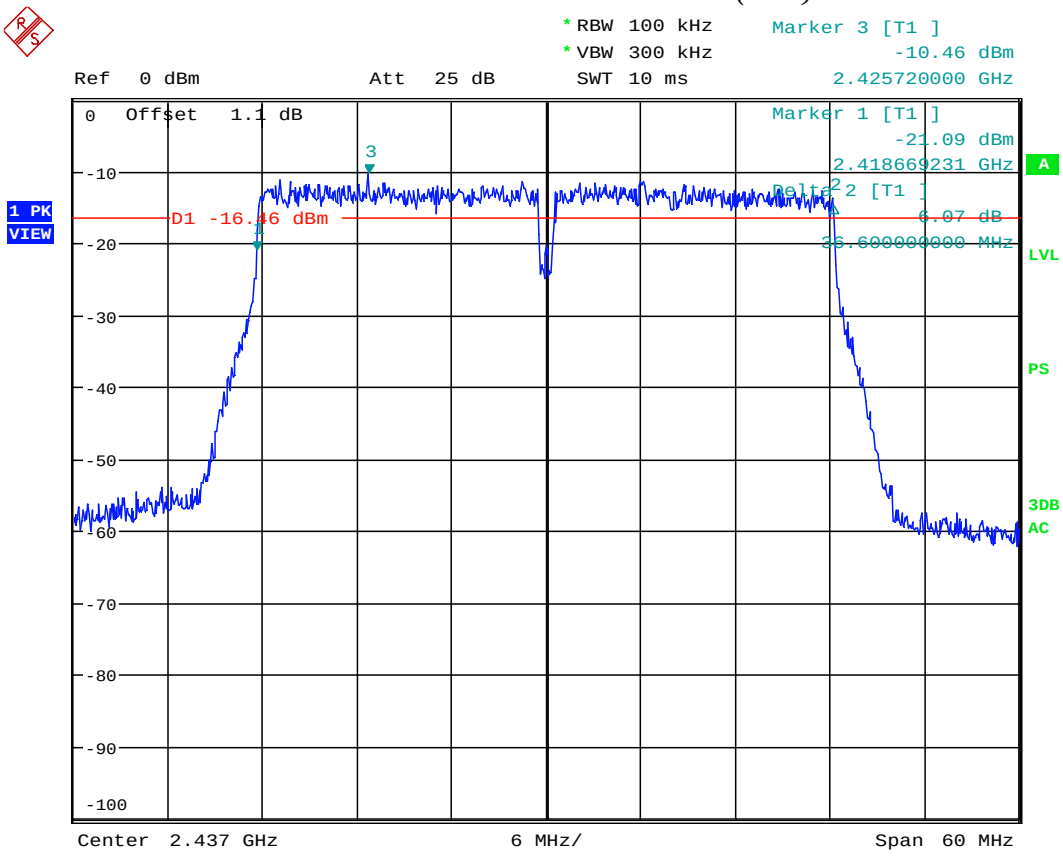
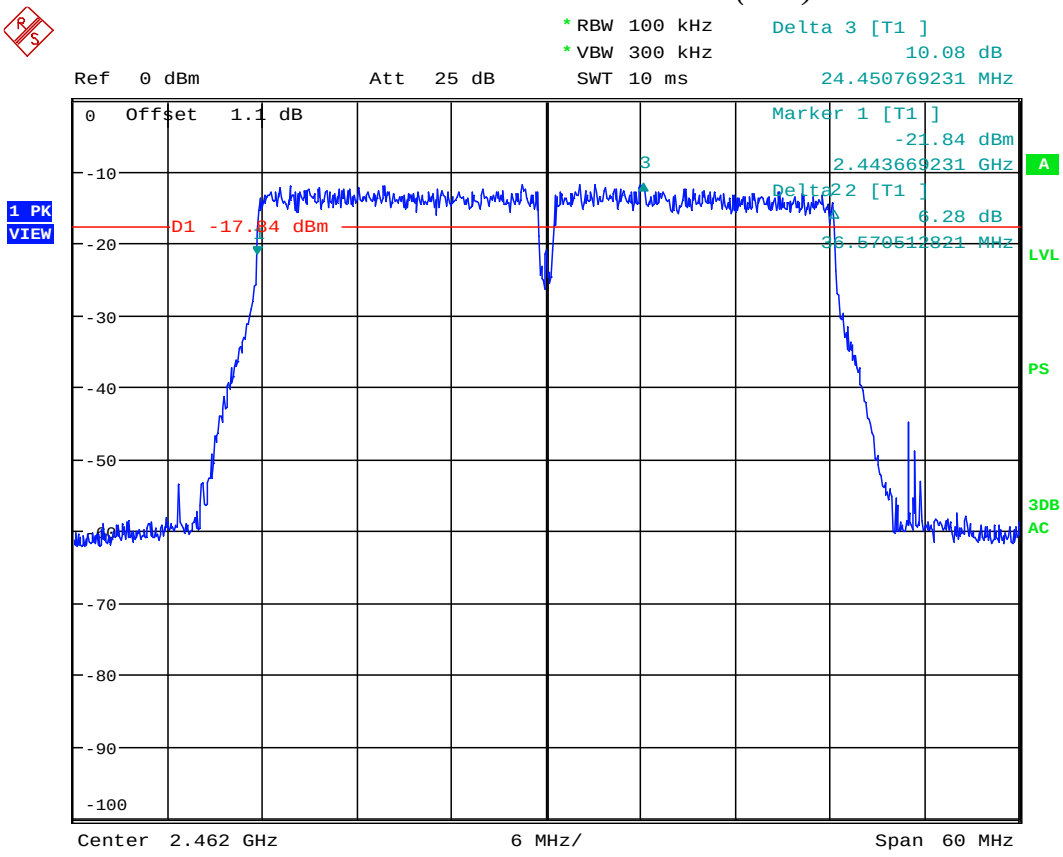
Plot 1. 11 – 6dB Bandwidth (FCC)



Occupied Bandwidth

Date: 15.AUG.2013 14:59:22

Plot 1. 12 – 6dB Bandwidth (FCC)



Occupied Bandwidth

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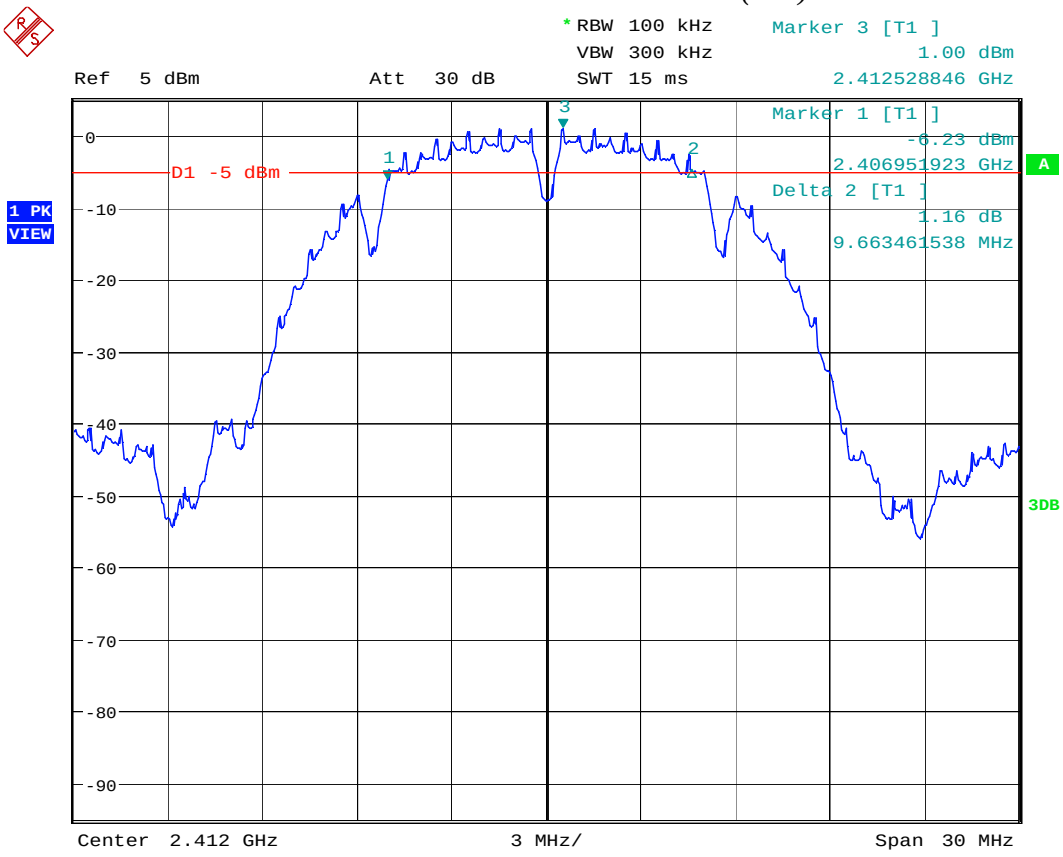
Plot 1. 13 – 6dB Bandwidth (RSS)



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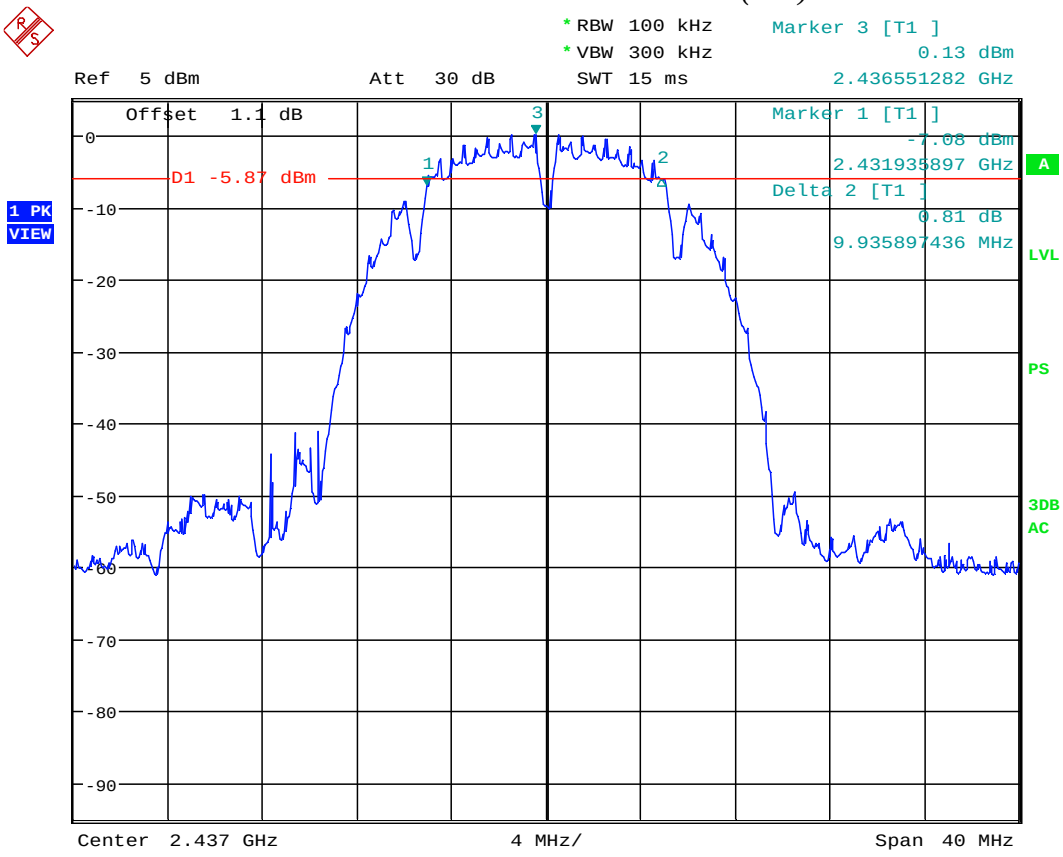
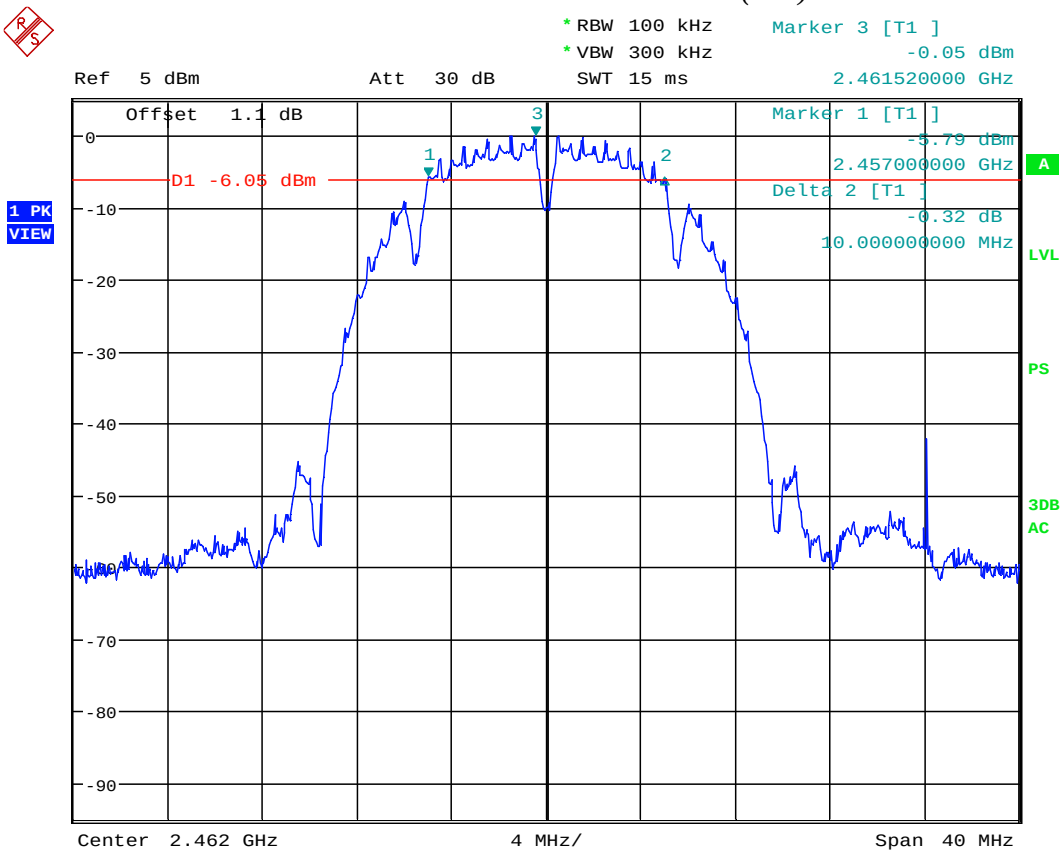
Plot 1. 14 – 6dB Bandwidth (RSS)



Occupied Bandwidth

Date: 15.AUG.2013 14:28:24

Plot 1. 15 – 6dB Bandwidth (RSS)



Occupied Bandwidth

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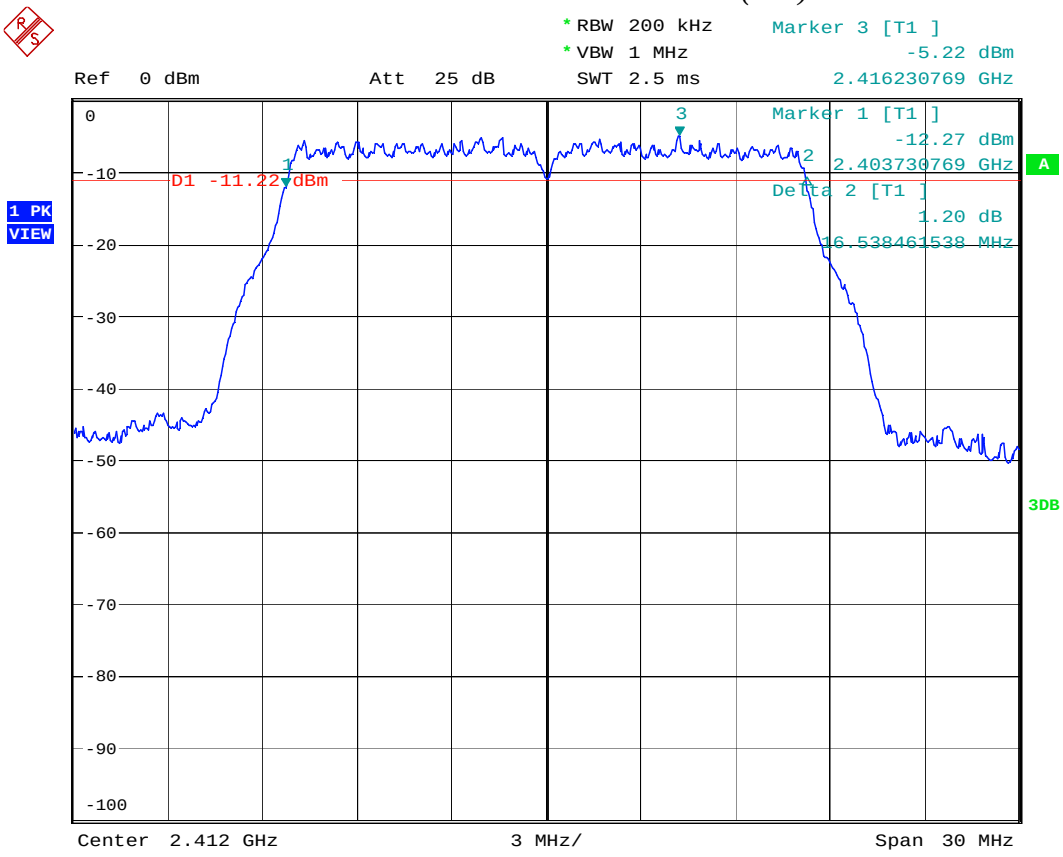
Plot 1. 16 – 6dB Bandwidth (RSS)



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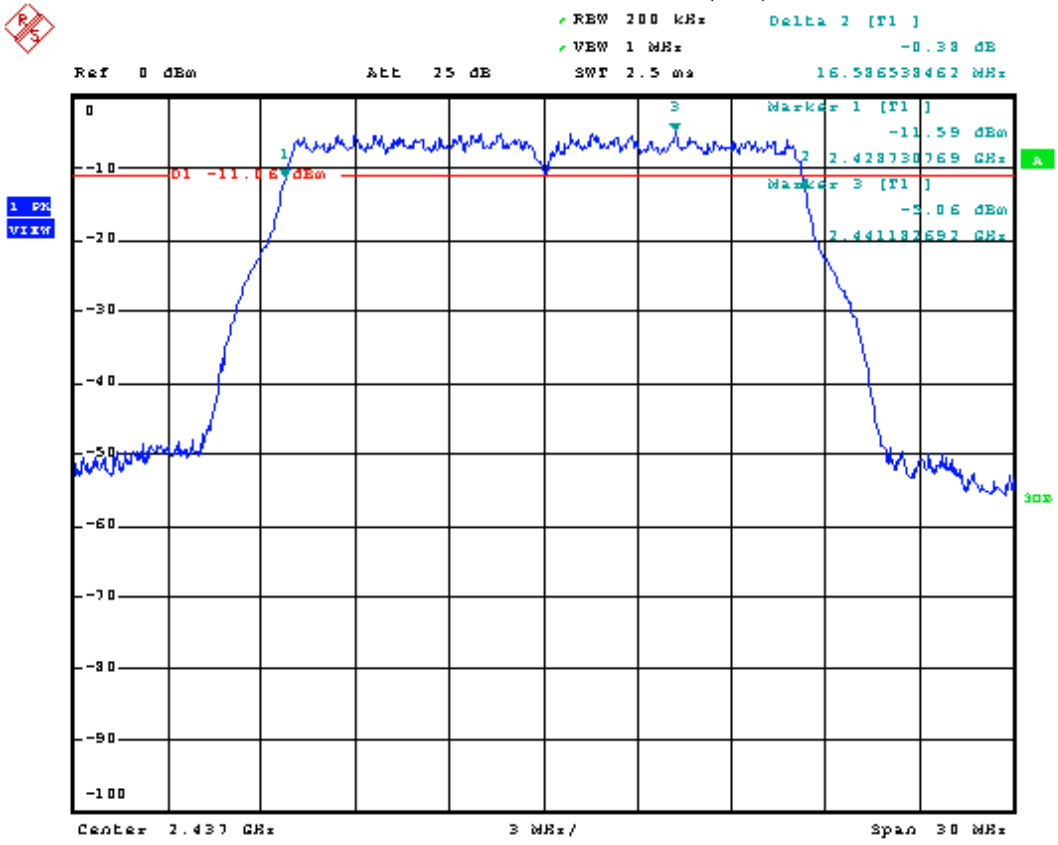
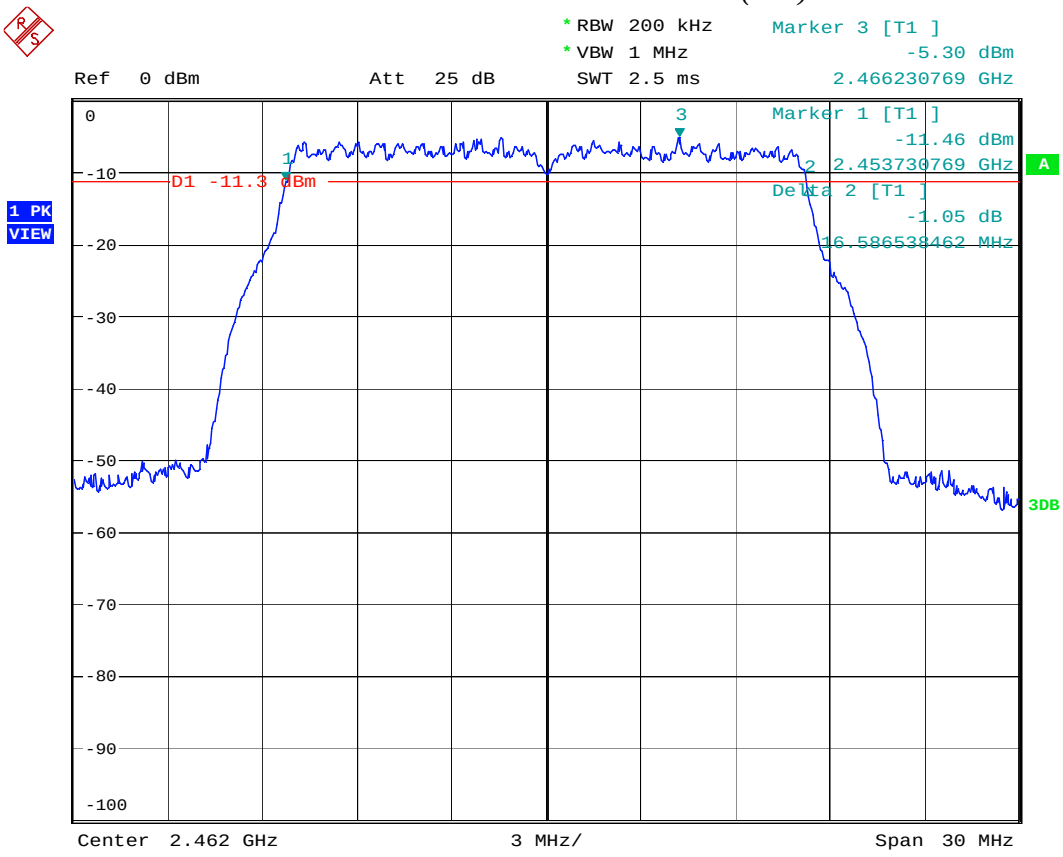
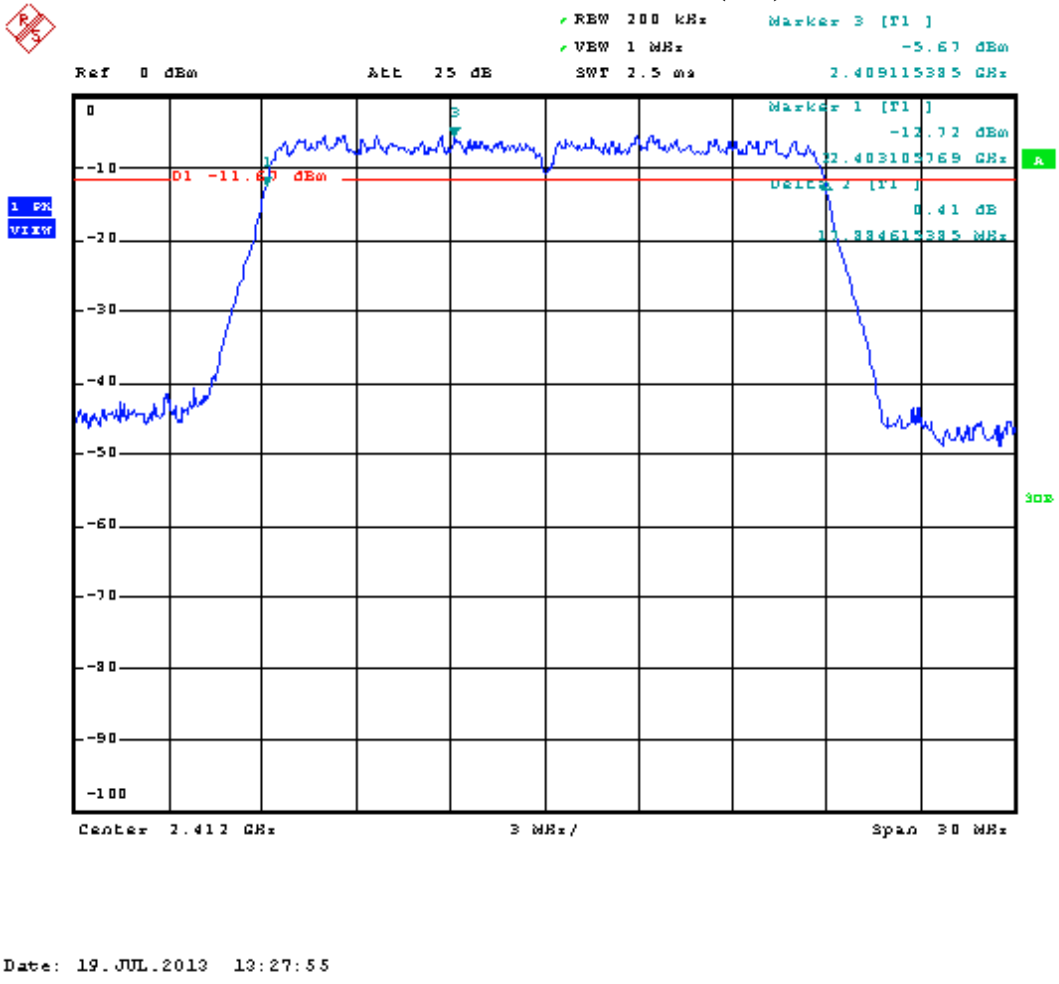
Plot 1. 17 – 6dB Bandwidth (RSS)



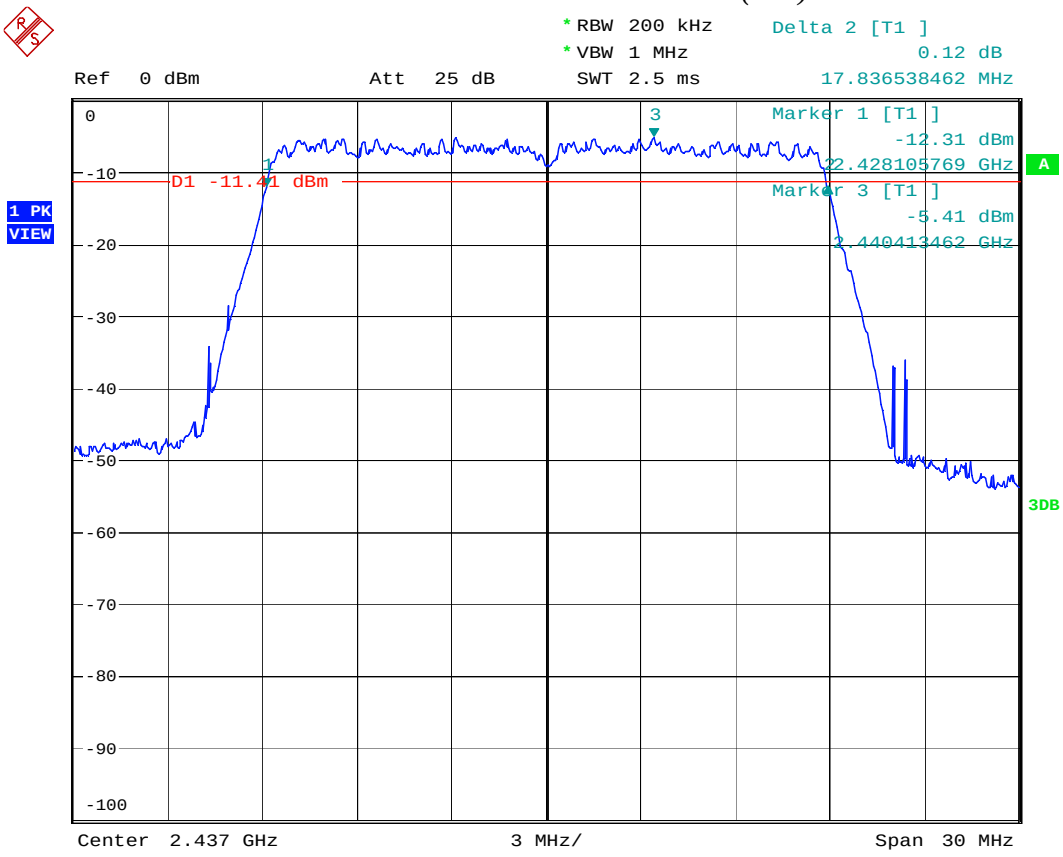
Plot 1. 18 – 6dB Bandwidth (RSS)



Plot 1. 19 – 6dB Bandwidth (RSS)



Plot 1. 20 – 6dB Bandwidth (RSS)



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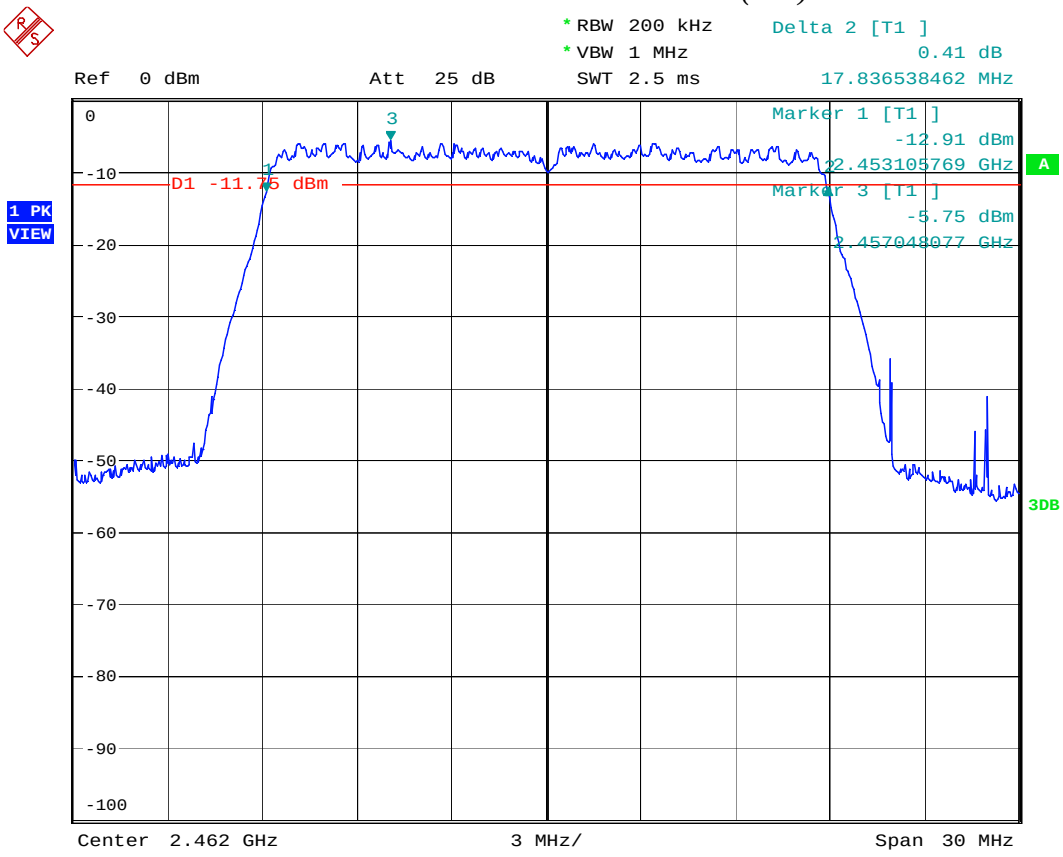
Plot 1. 21 – 6dB Bandwidth (RSS)



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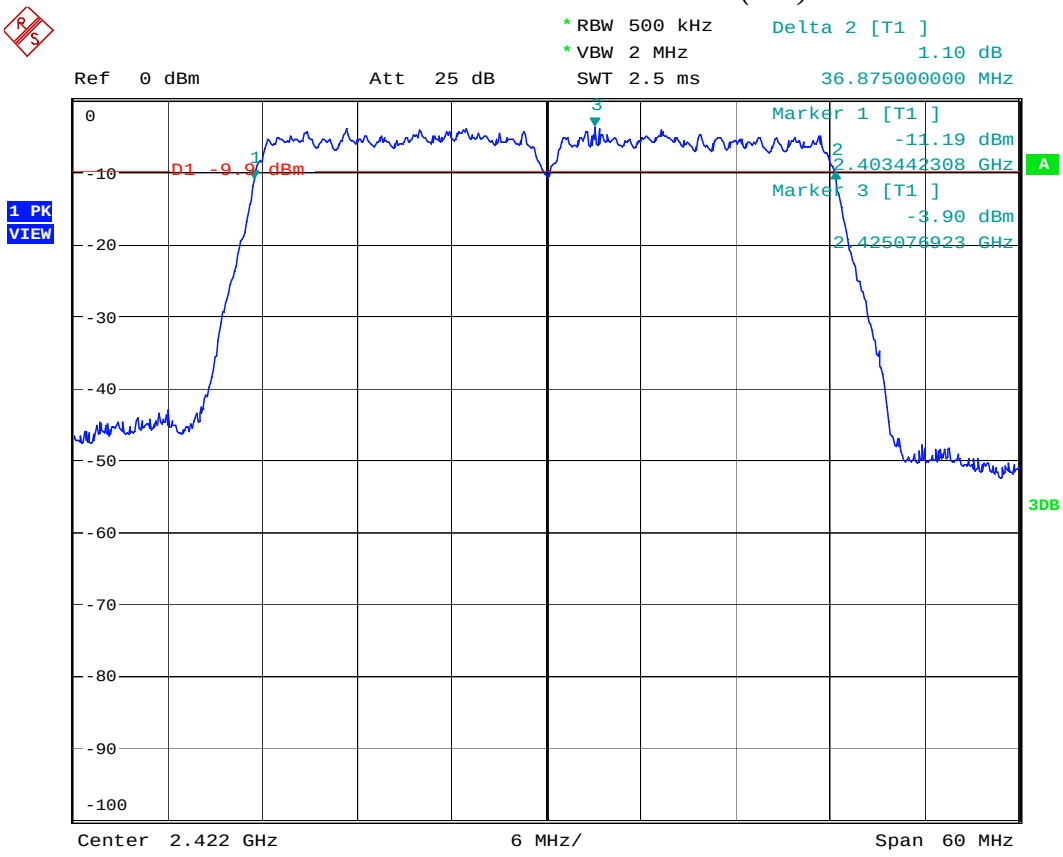
Plot 1. 22 – 6dB Bandwidth (RSS)



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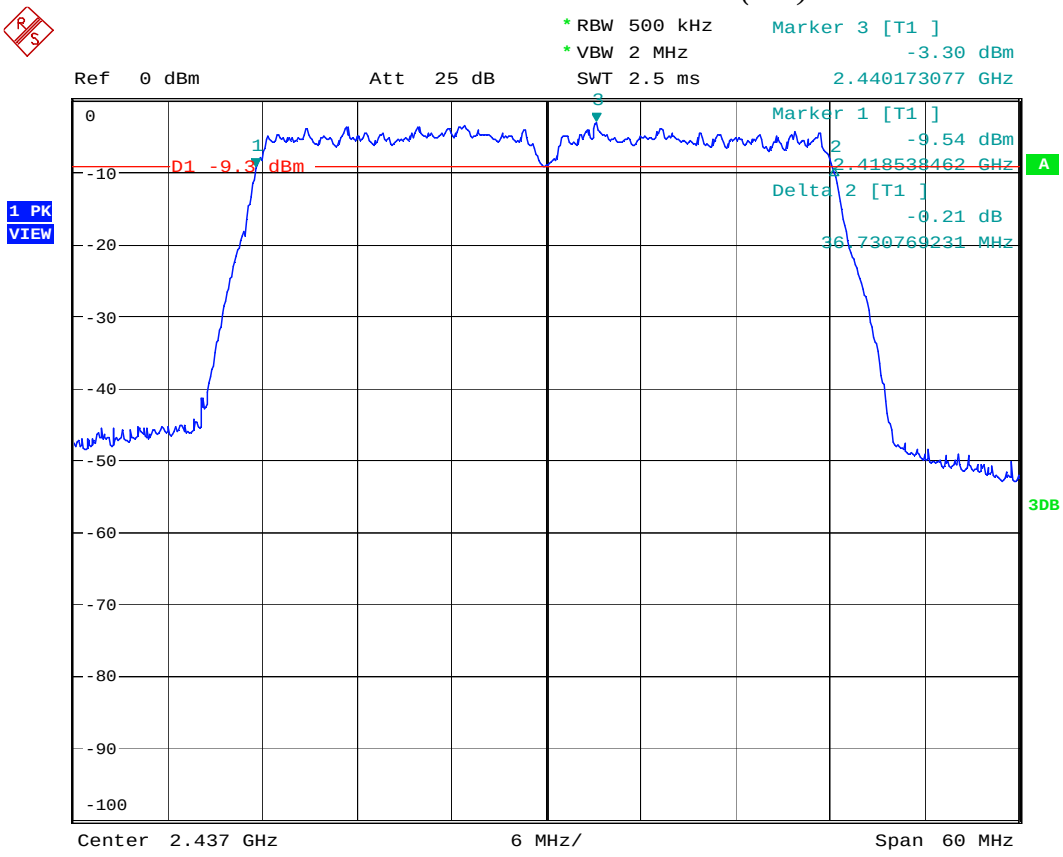
Plot 1. 23 – 6dB Bandwidth (RSS)



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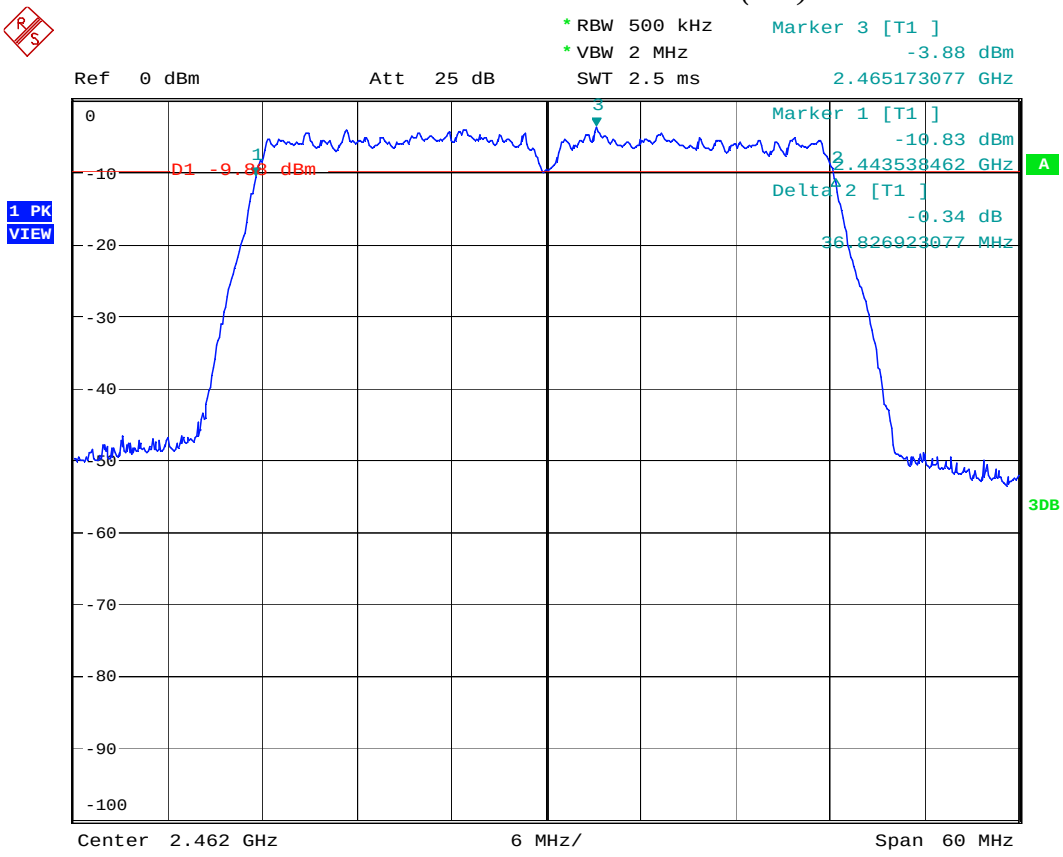
Plot 1. 24 – 6dB Bandwidth (RSS)



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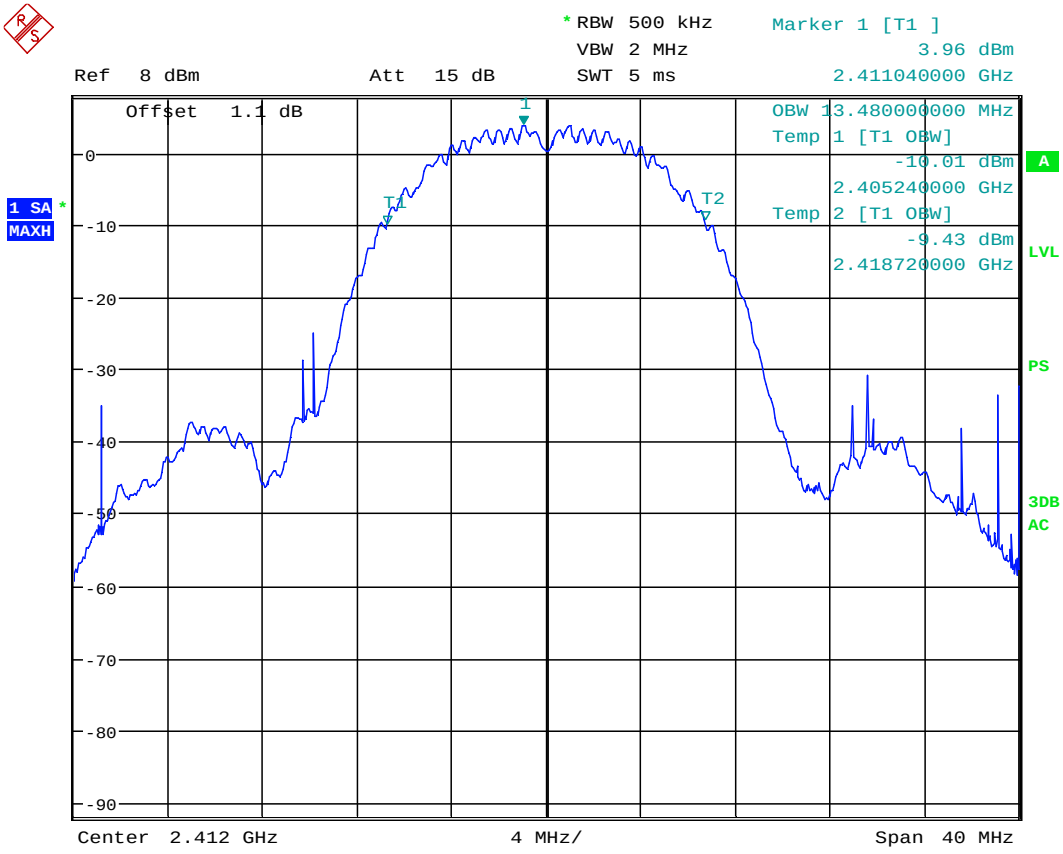
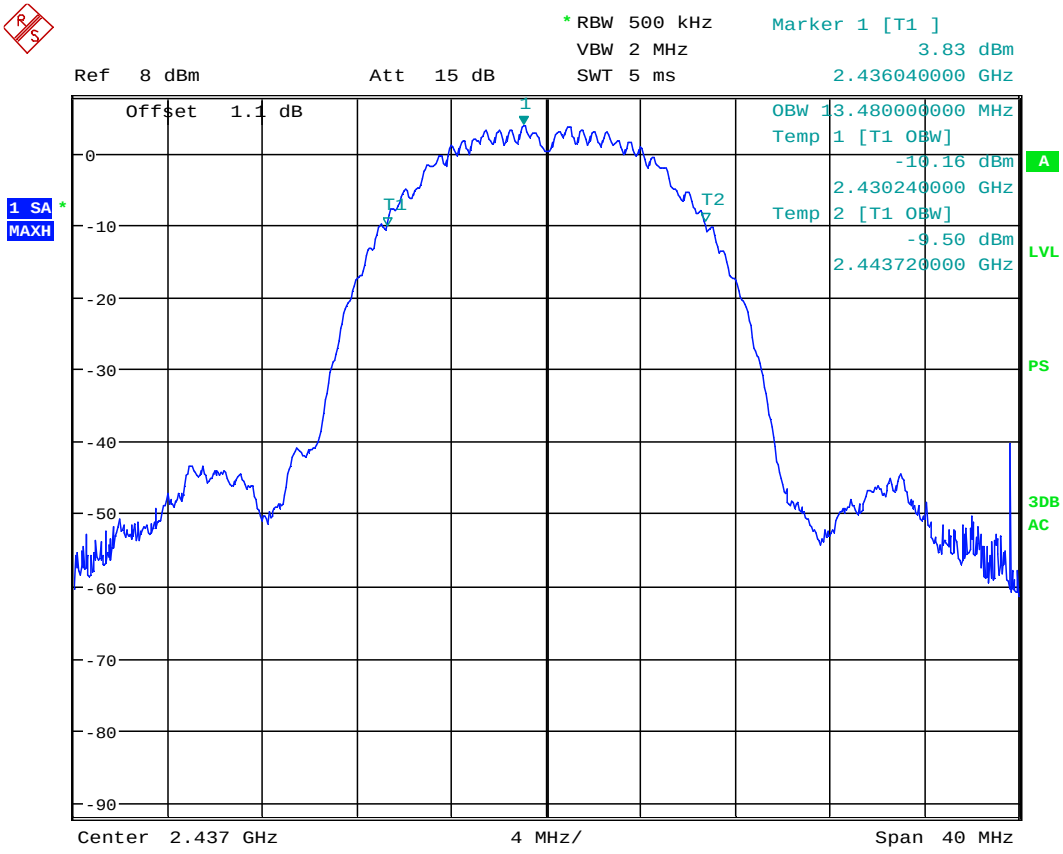
Plot 1. 25 – 99% Bandwidth



Occupied Bandwidth

Date: 15.AUG.2013 15:58:22

Plot 1. 26 – 99% Bandwidth



Occupied Bandwidth

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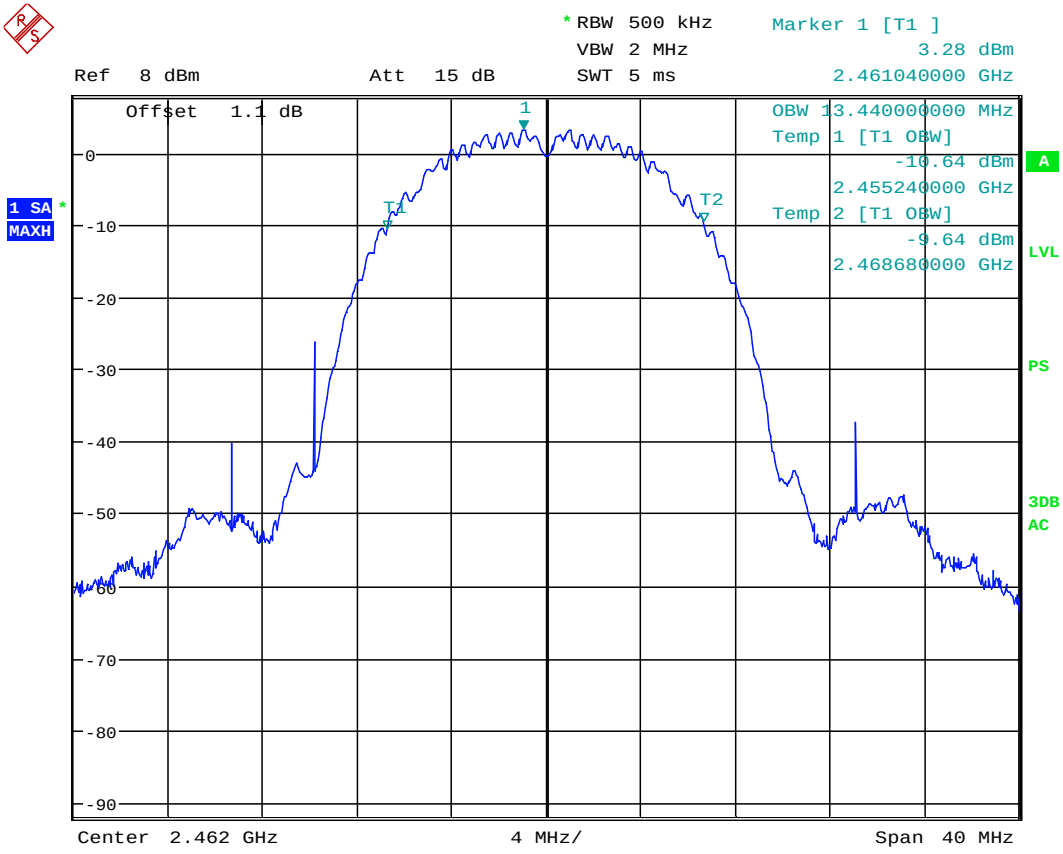
Plot 1. 27 – 99% Bandwidth



Occupied Bandwidth

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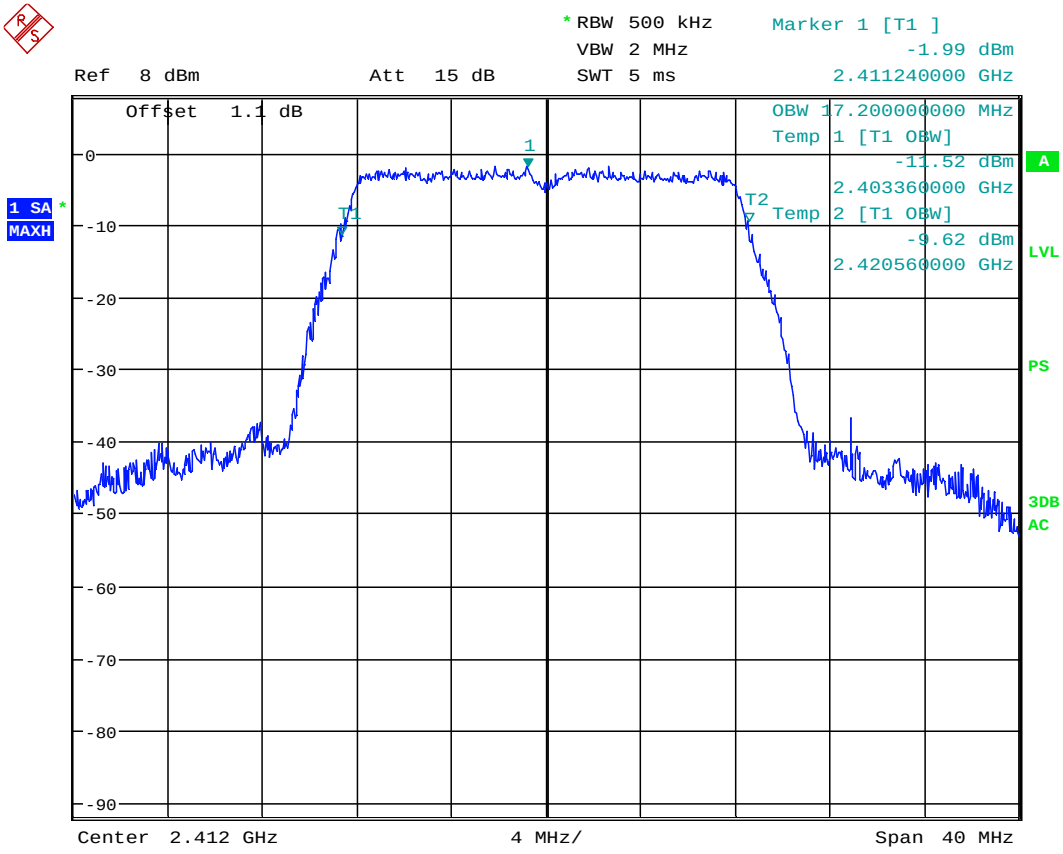
Plot 1. 28 – 99% Bandwidth



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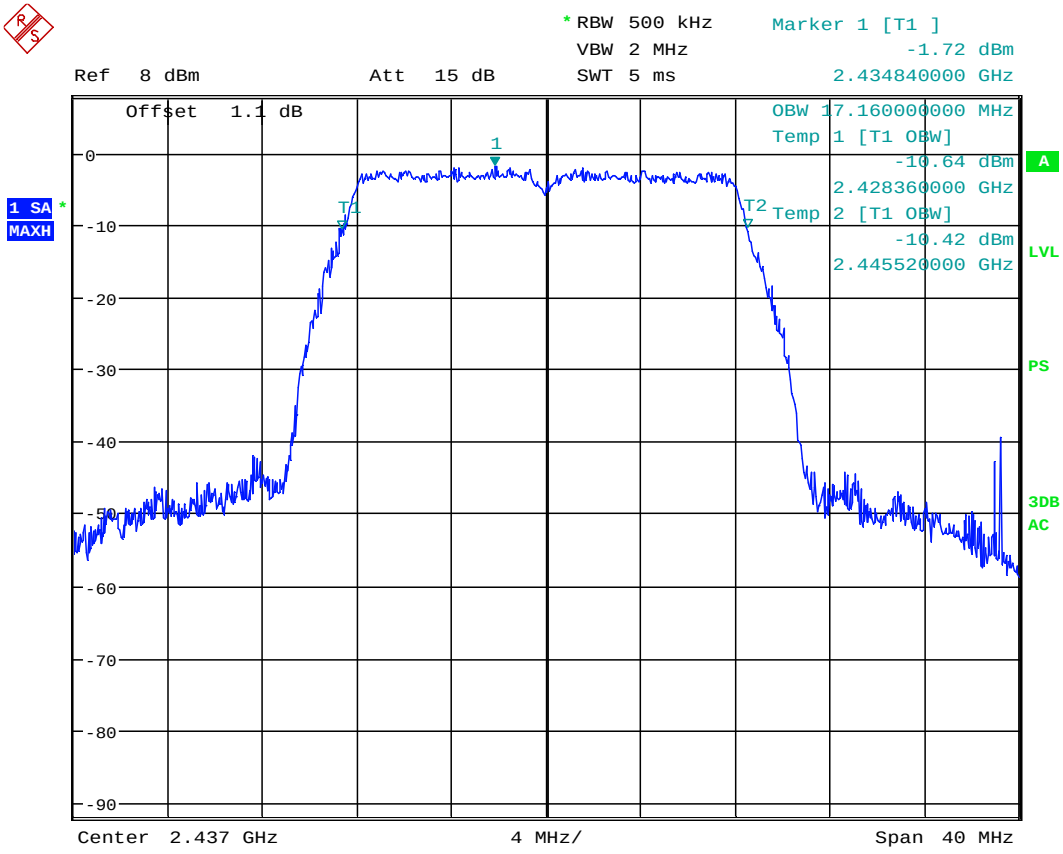
Plot 1. 29 – 99% Bandwidth



Occupied Bandwidth

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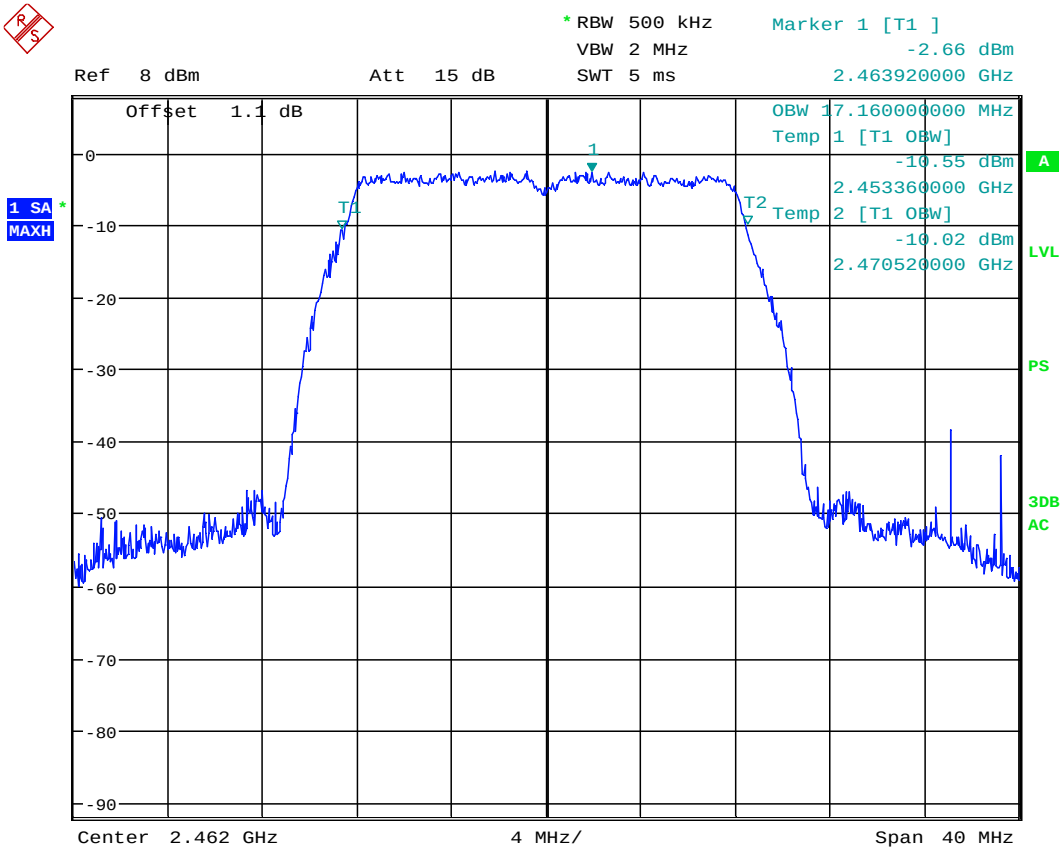
Plot 1. 30 – 99% Bandwidth



Occupied Bandwidth

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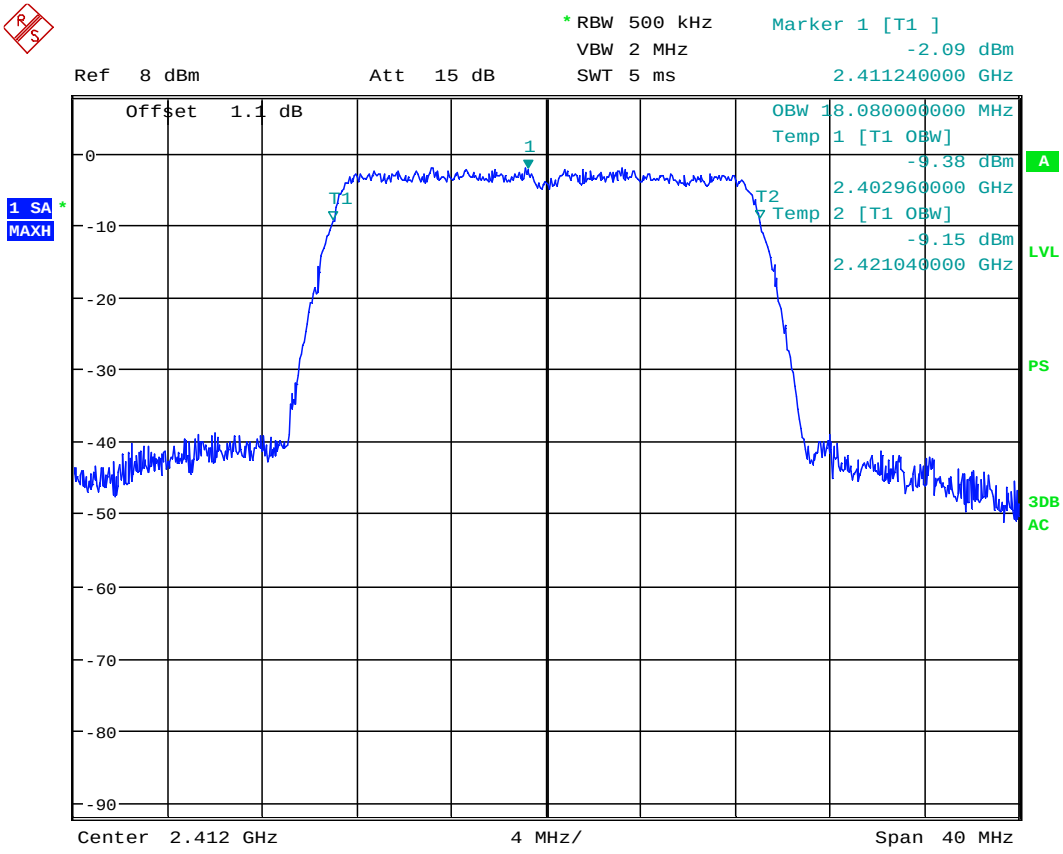
Plot 1. 31 – 99% Bandwidth



Occupied Bandwidth

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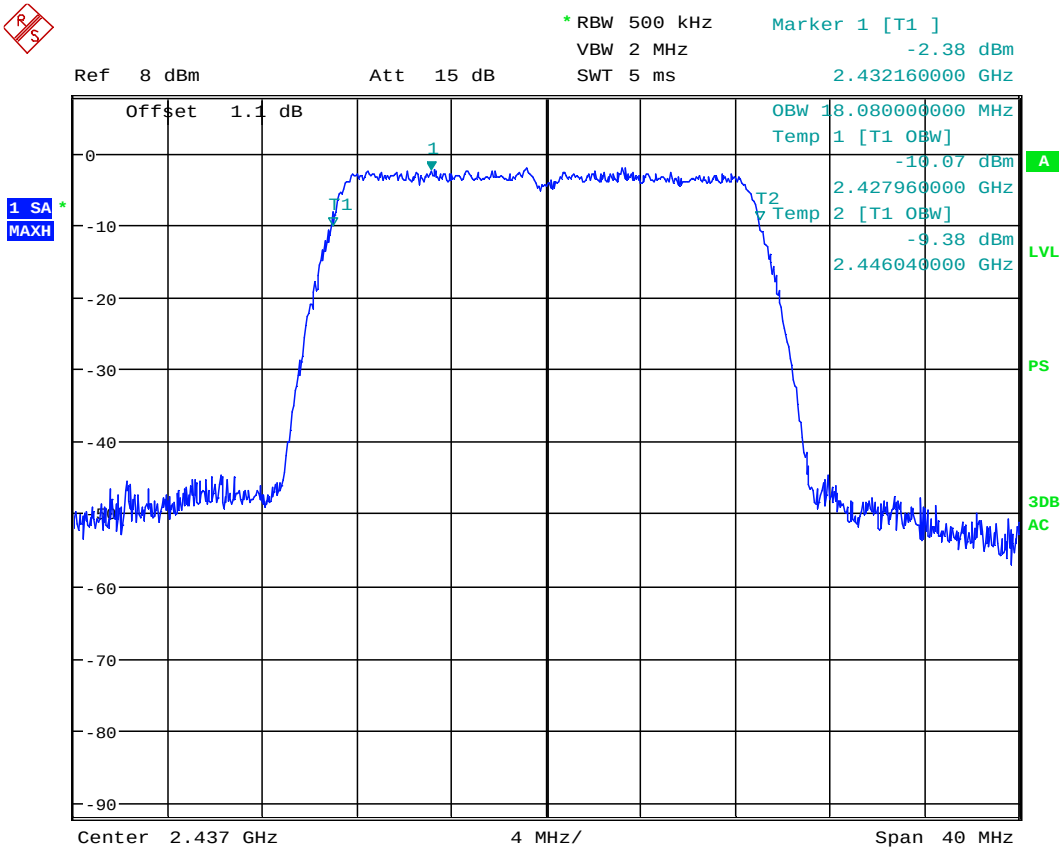
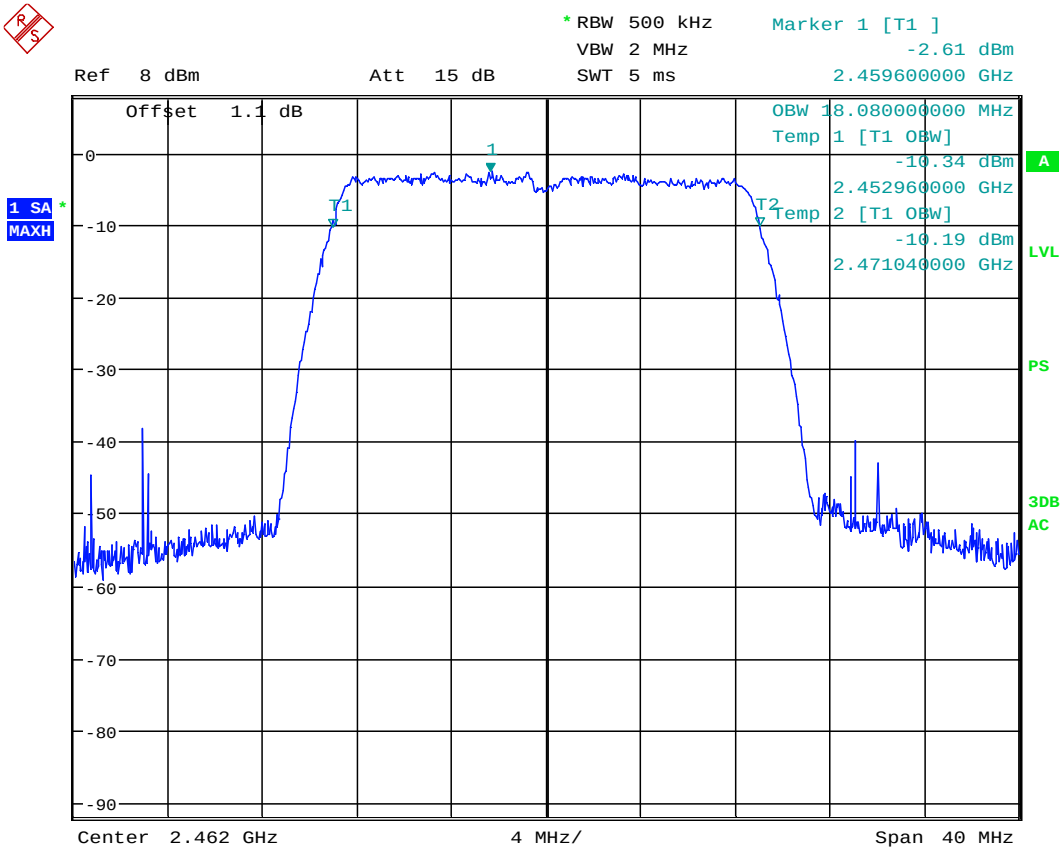
Plot 1. 32 – 99% Bandwidth



Occupied Bandwidth

Date: 15.AUG.2013 15:36:03

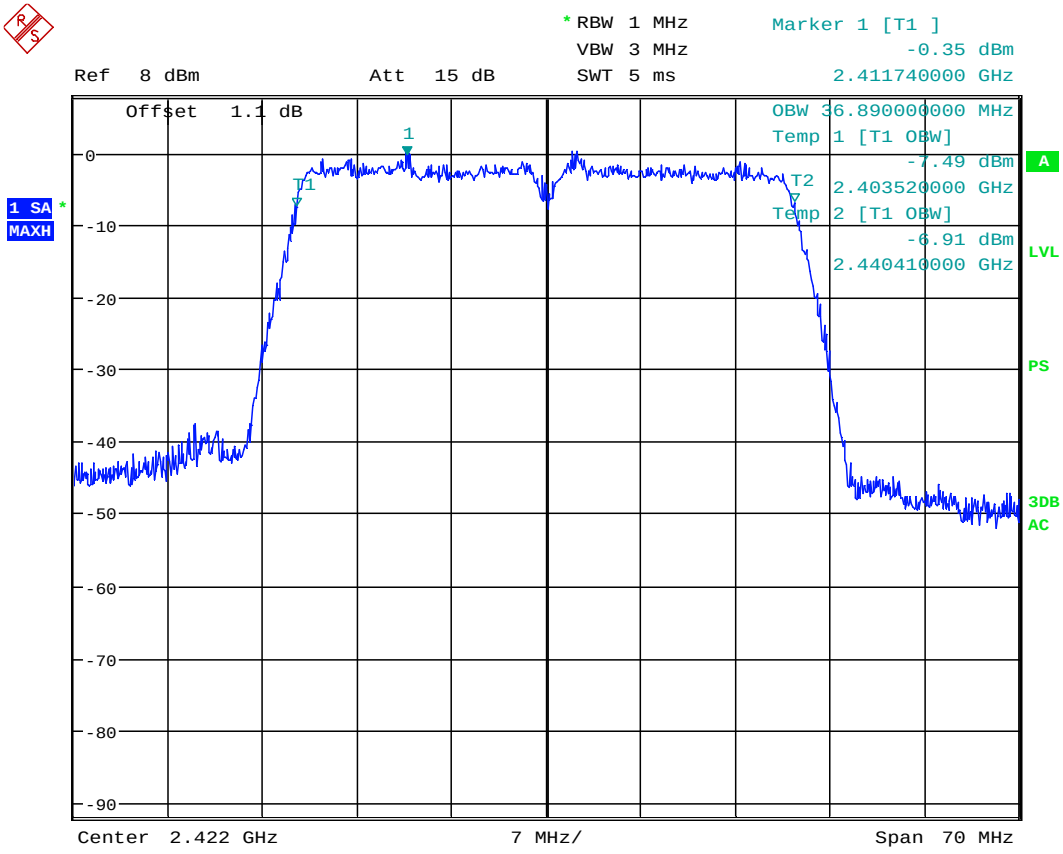
Plot 1. 33 – 99% Bandwidth



Occupied Bandwidth

Date: 15.AUG.2013 15:35:28

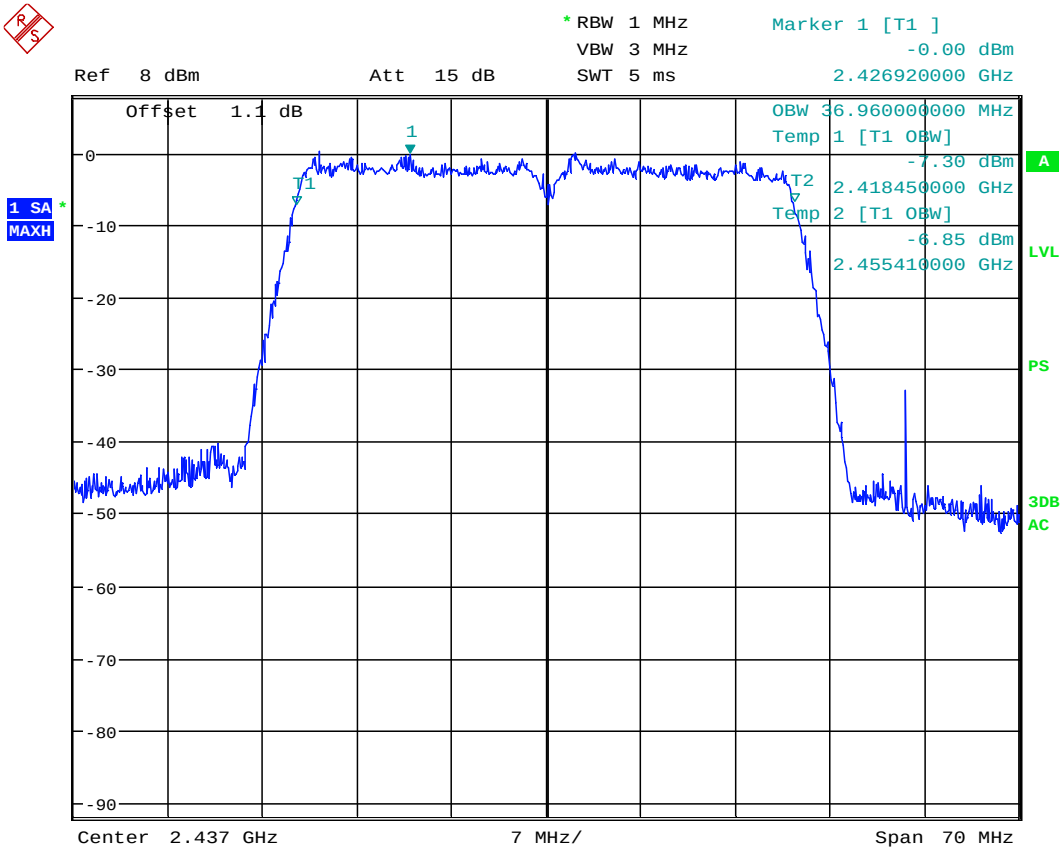
Plot 1. 34 – 99% Bandwidth



Occupied Bandwidth

Date: 15.AUG.2013 15:33:03

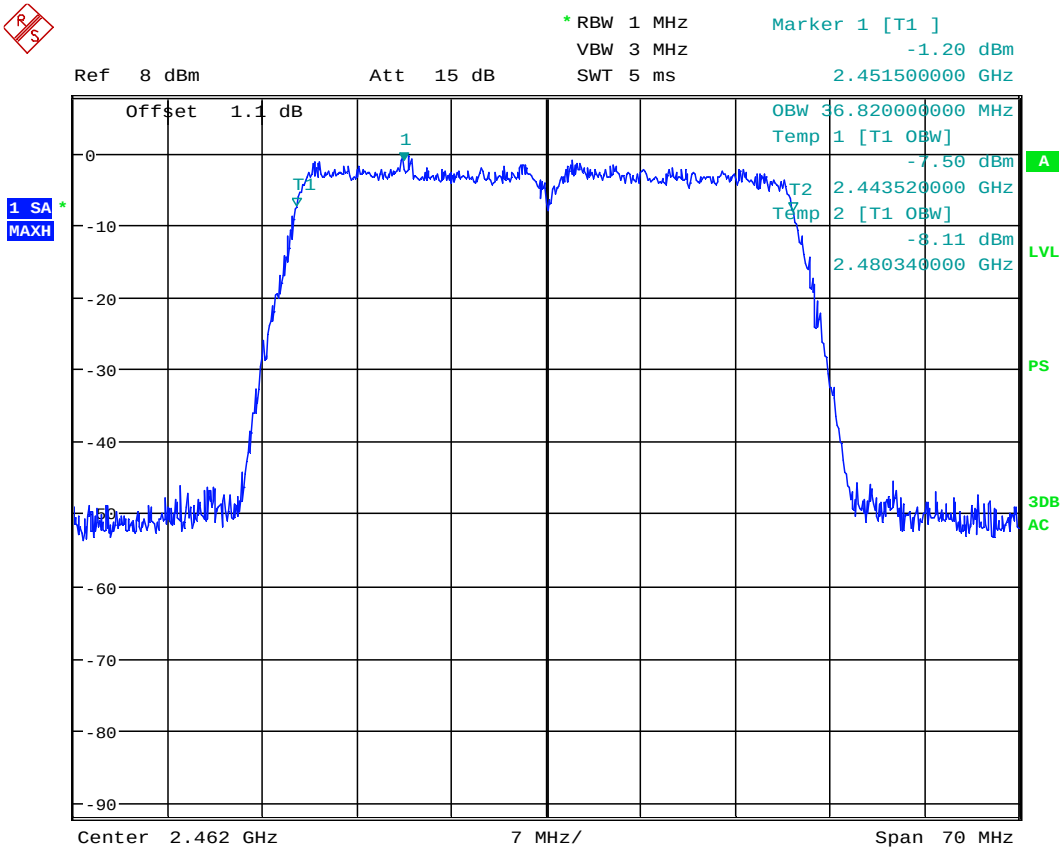
Plot 1. 35 – 99% Bandwidth



Occupied Bandwidth

Date: 15.AUG.2013 15:33:53

Plot 1. 36 – 99% Bandwidth



Occupied Bandwidth

Date: 15.AUG.2013 15:34:21

4.2 Maximum Conducted Output Power at Antenna Terminals
FCC Rule 15.247(b)(3)

4.2.1 Requirement

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm).
For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.2.2 Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer/power meter to measure the Maximum Conducted Transmitter Output Power.

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v03r01 April 9 2013 was used. Specifically, section 9.1.2 Integrated Band Power Method with peak detector using the spectrum analyzer's band/channel power measurement function with band limits set equal to the DTS bandwidth.

1. Set the RBW = 1 MHz.
2. Set the VBW ≥ 3 x RBW
3. Set the span ≥ 1.5 x *DTS bandwidth*.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the instrument's band/channel power measurement function with the band limits set equal to the *DTS bandwidth* edges (for some instruments, this may require a manual override to select peak detector). If the instrument does not have a band power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the *DTS bandwidth*.

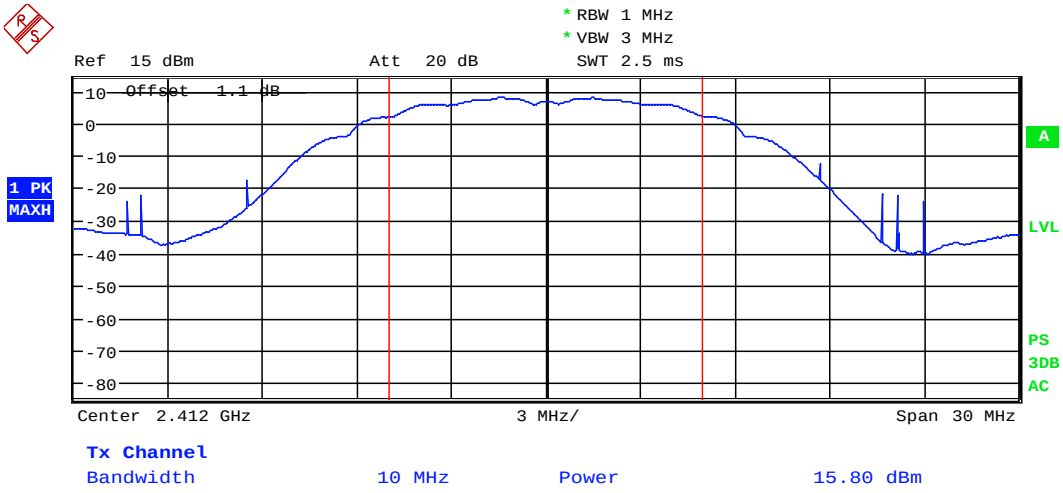
4.3.3 Test Result

Refer to the following plots for the test result:

Standard	Data Rate	Channel	Frequency MHz	Conducted Peak Power dBm	Conducted Peak Power mW	Plot #
802.11b	1 Mbps	1	2412	15.80	38.02	2.1
		6	2437	15.75	37.58	2.2
		11	2462	15.16	32.81	2.3
802.11g	6 Mbps	1	2412	14.26	26.67	2.4
		6	2437	14.21	26.36	2.5
		11	2462	13.61	22.96	2.6
802.11n HT20	MCS 0	1	2412	13.61	22.96	2.7
		6	2437	13.53	22.54	2.7
		11	2462	13.68	23.33	2.9
802.11n HT40	MCS 0	3	2422	13.79	23.93	2.10
		6	2437	13.06	20.23	2.11
		11	2462	13.39	21.83	2.12

Notes:
For all channels in 802.11b mode (1-11Mbps), software power settings = 18
For all channels in 802.11g mode (6-54Mbps), software power settings = 18
For all channels in 802.11n HT20 mode (MCS0-MCS8), software power settings = 16
For all channels in 802.11n HT40 mode (MCS0-MCS8), software power settings = 16

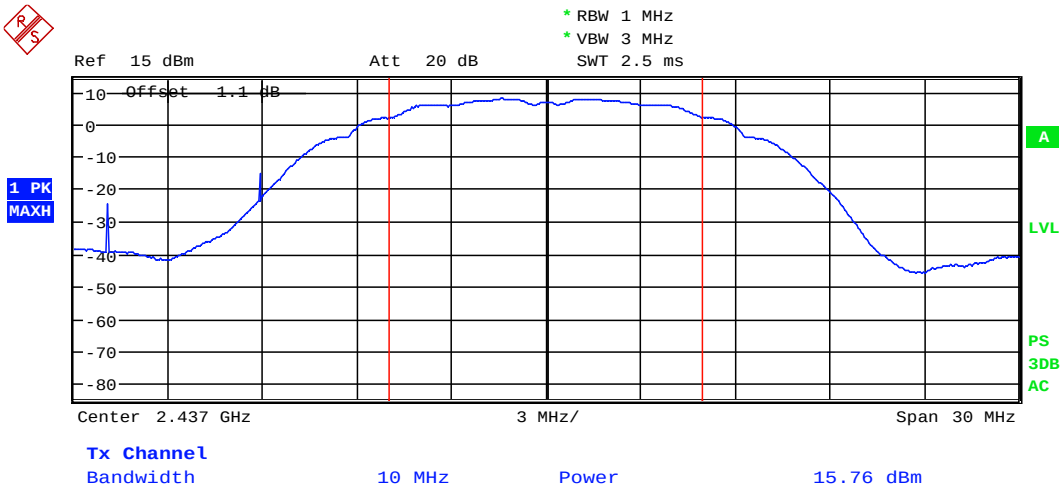
Plot 2. 1



Output Power

Date: 16.AUG.2013 14:43:43

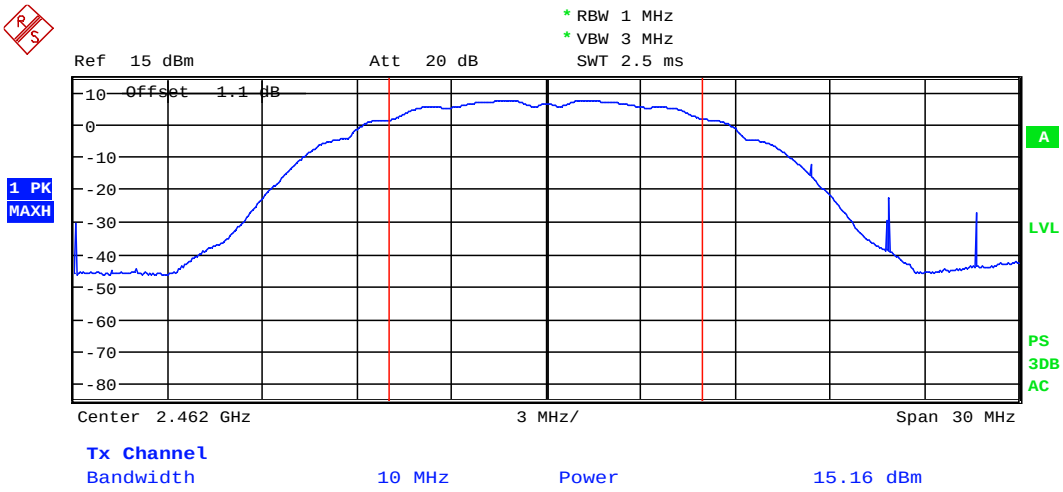
Plot 2. 2



Output Power

Date: 16.AUG.2013 14:44:14

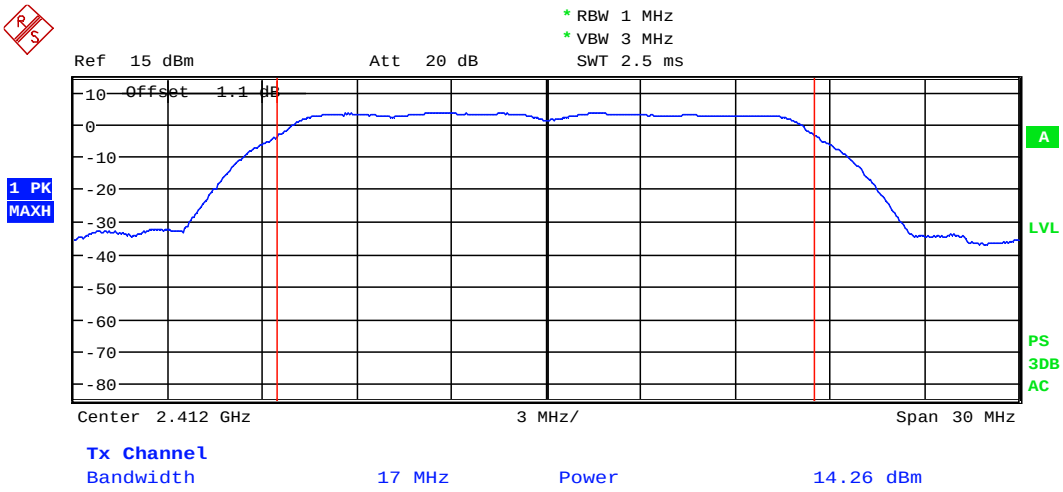
Plot 2. 3



Output Power

Date: 16.AUG.2013 14:44:38

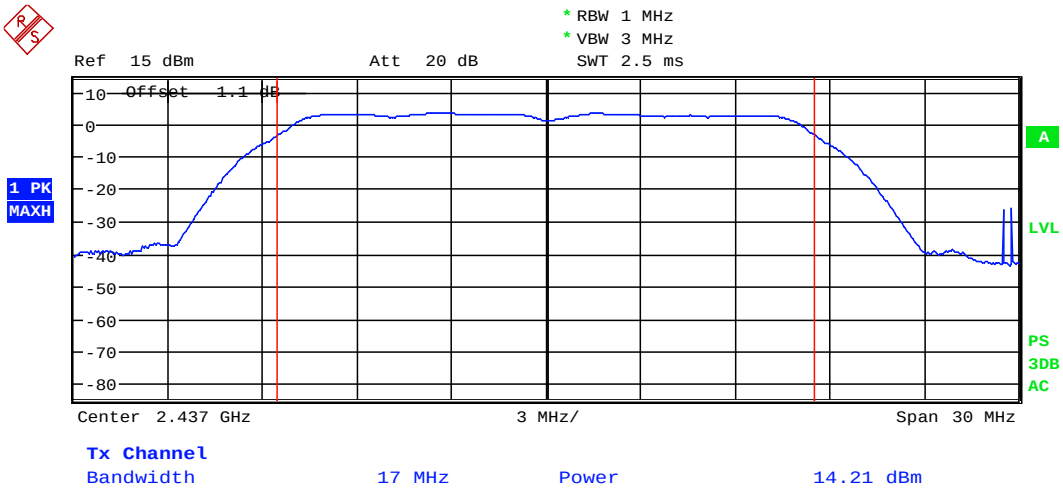
Plot 2. 4



Output Power

Date: 16.AUG.2013 14:49:57

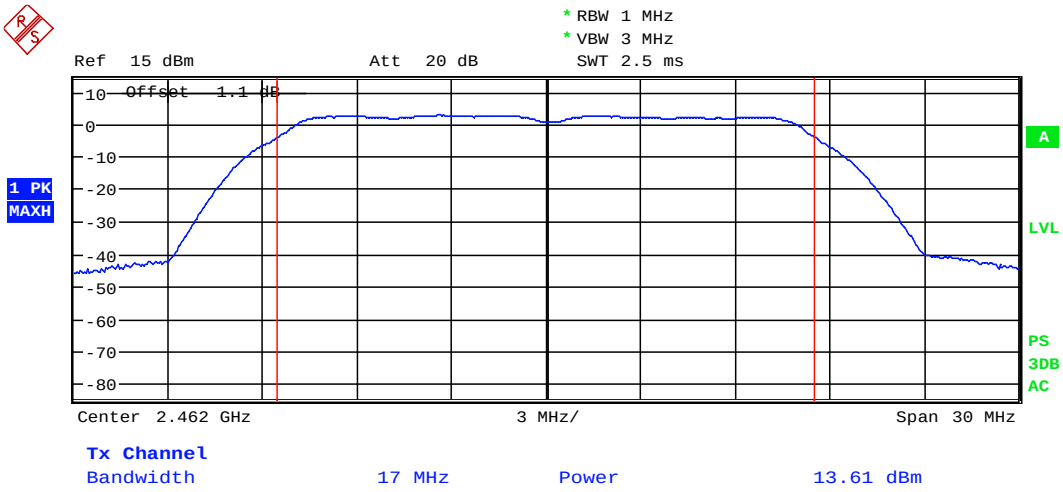
Plot 2. 5



Output Power

Date: 16.AUG.2013 14:49:33

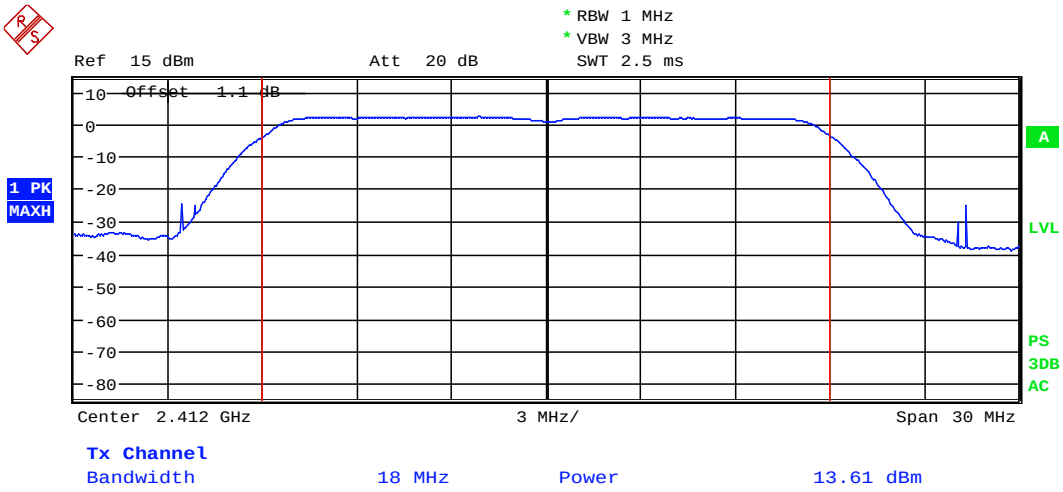
Plot 2. 6



Output Power

Date: 16.AUG.2013 14:49:07

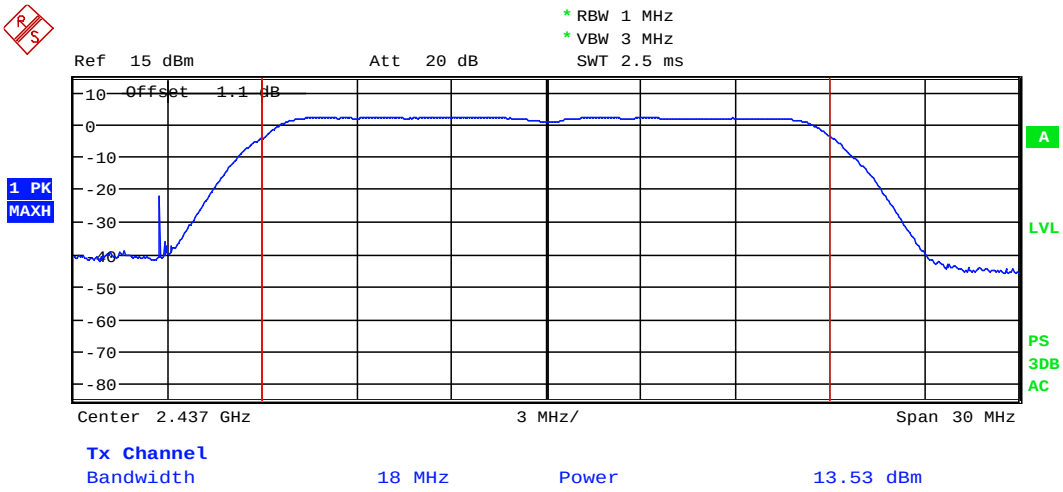
Plot 2. 7



Output Power

Date: 16.AUG.2013 15:01:41

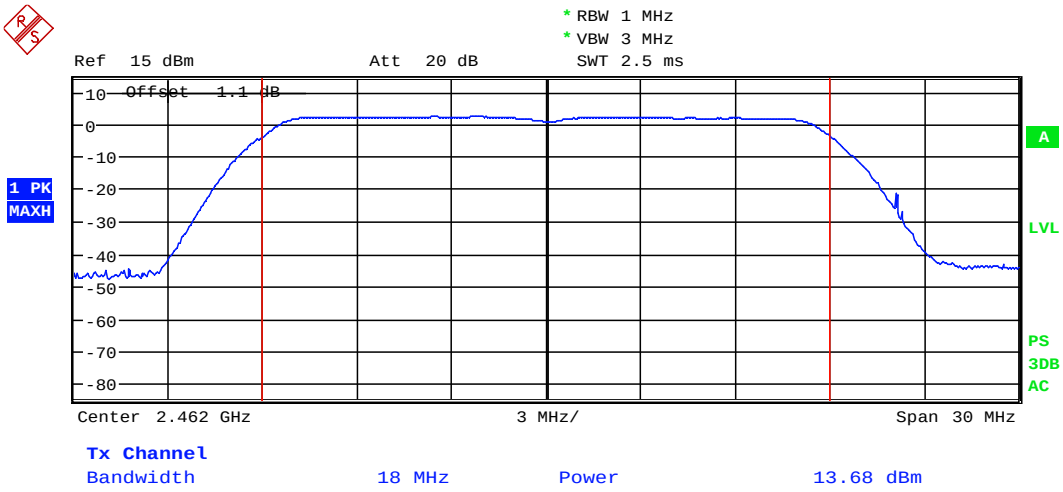
Plot 2. 8



Output Power

Date: 16.AUG.2013 15:06:19

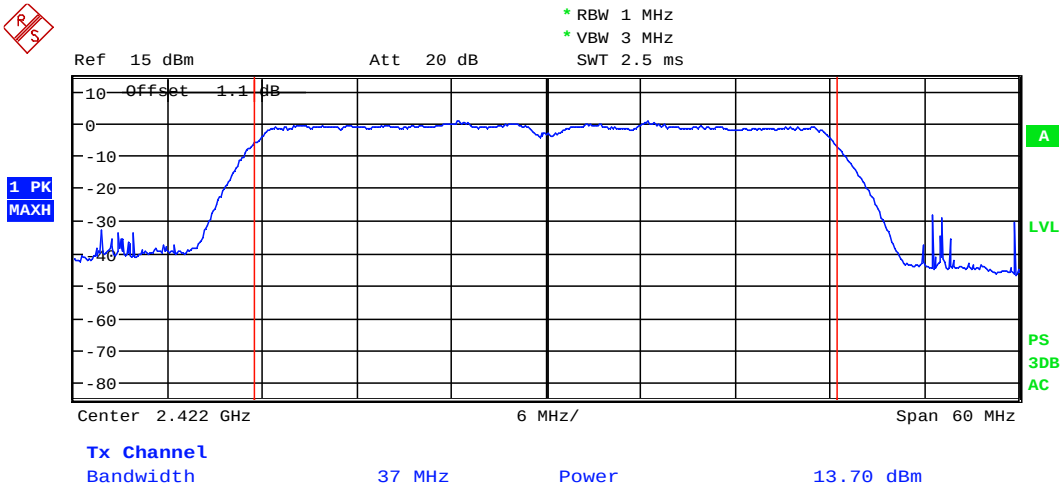
Plot 2. 9



Output Power

Date: 16.AUG.2013 15:10:14

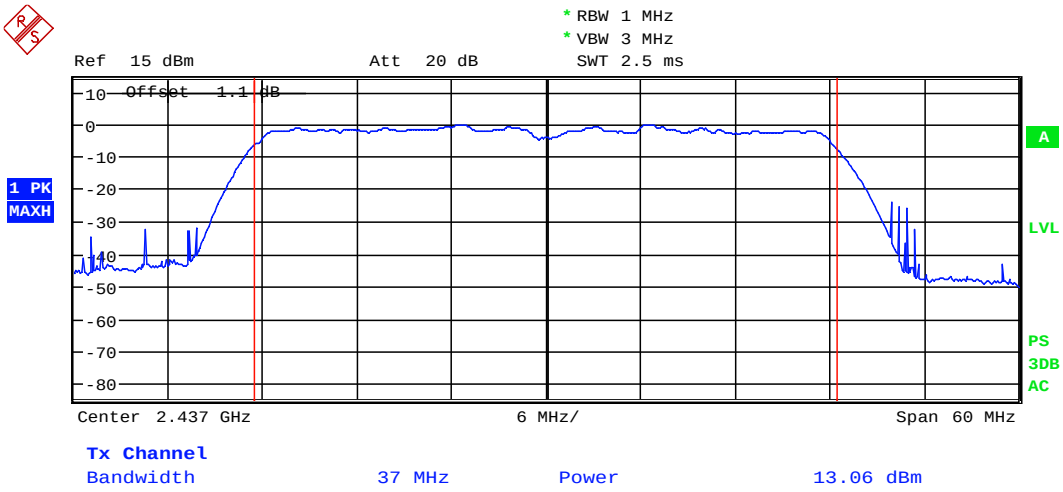
Plot 2. 10



Output Power

Date: 16.AUG.2013 15:09:20

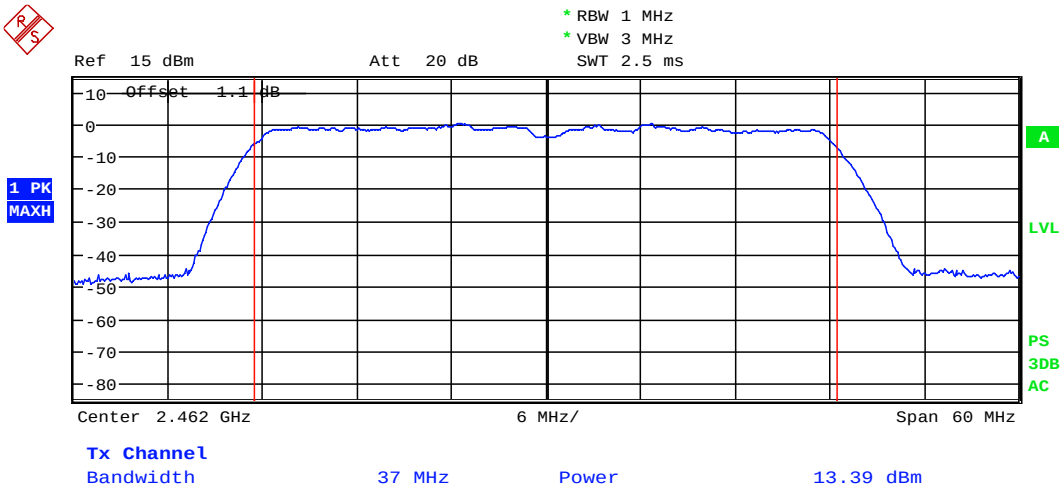
Plot 2. 11



Output Power

Date: 16.AUG.2013 15:08:20

Plot 2. 12



Output Power

Date: 16.AUG.2013 15:07:48

4.3 Power Spectral Density
FCC 15.247 (e)

4.3.1 Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna should not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

4.3.2 Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer to measure the Transmitter Power Density (PSD).

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v03r01 April 9 201, specifically section 10.2 Method PKPSD (peak PSD).

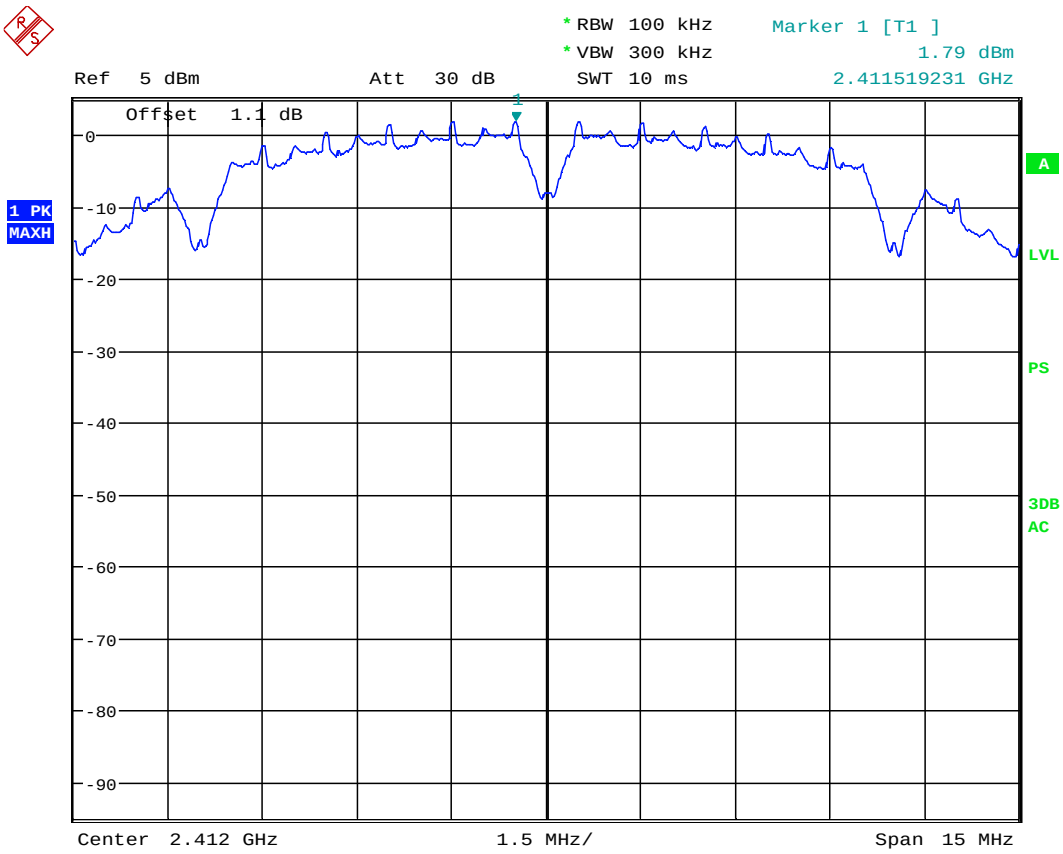
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the *DTS bandwidth*.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

4.3.3 Test Result

Refer to the following plots for the test result:

Standard	Channel	Frequency MHz	PSD (Peak) dBm	Margin to -8dBm Limit dB	Plot #
802.11b	1	2412	1.79	-6.21	3.1
	6	2437	1.70	-6.30	3.2
	11	2462	1.04	-6.96	3.3
802.11g	1	2412	-8.03	-16.03	3.4
	6	2437	-7.98	-15.98	3.5
	11	2462	-8.66	-16.66	3.6
802.11n HT20	1	2412	-7.82	-15.82	3.7
	6	2437	-7.72	-15.72	3.7
	11	2462	-8.64	-16.64	3.9
802.11n HT40	3	2422	-10.01	-18.01	3.10
	6	2437	-9.40	-17.40	3.11
	11	2462	-10.47	-18.47	3.12

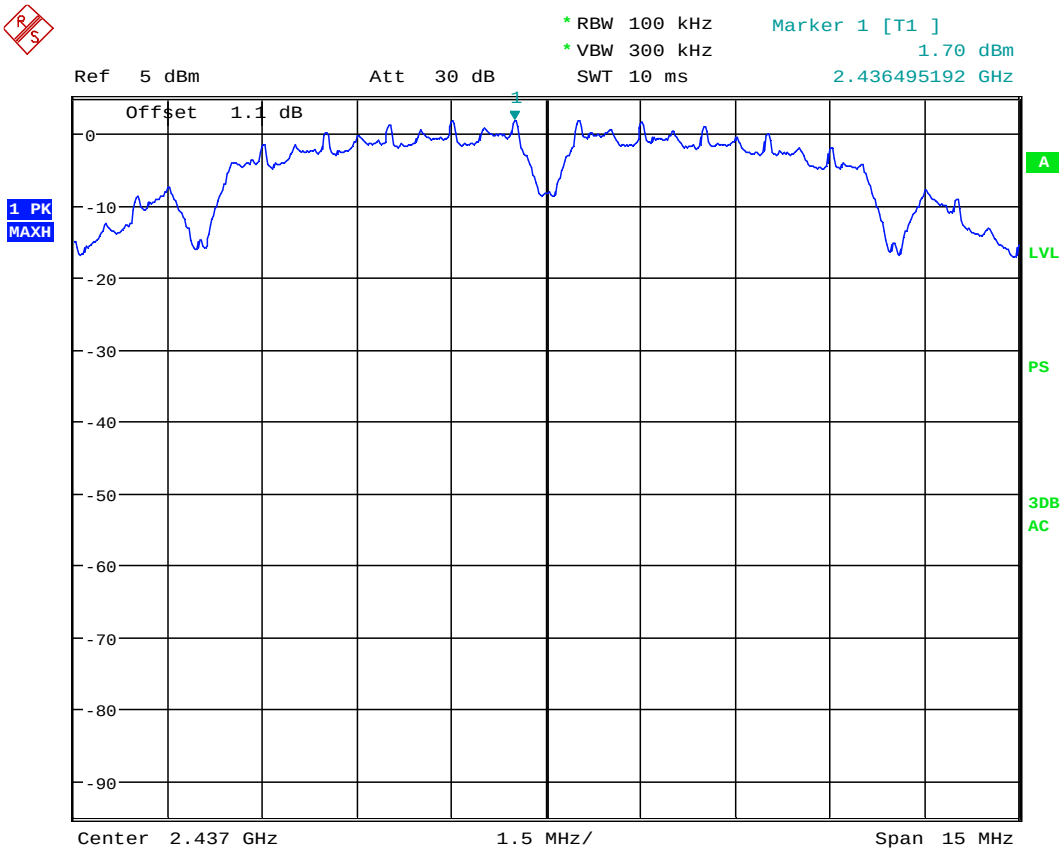
Plot 3. 1



Peak Power Density

Date: 16.AUG.2013 15:23:34

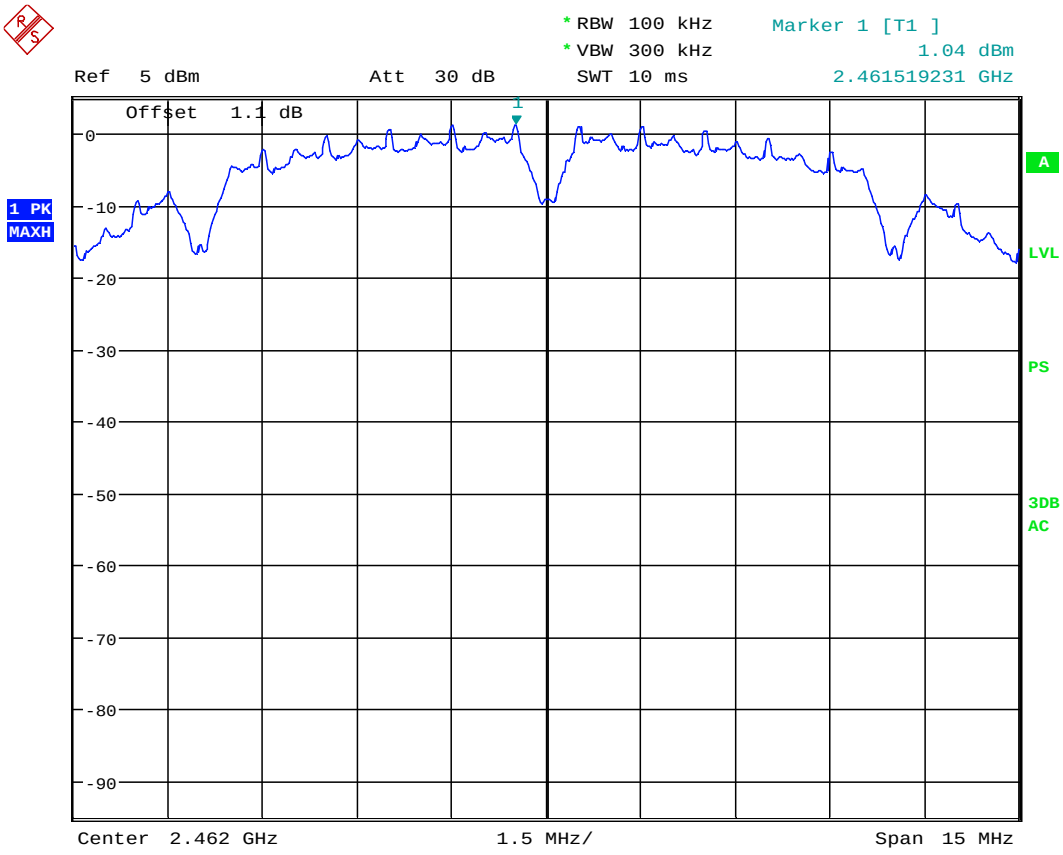
Plot 3. 2



Peak Power Density

Date: 16.AUG.2013 15:23:14

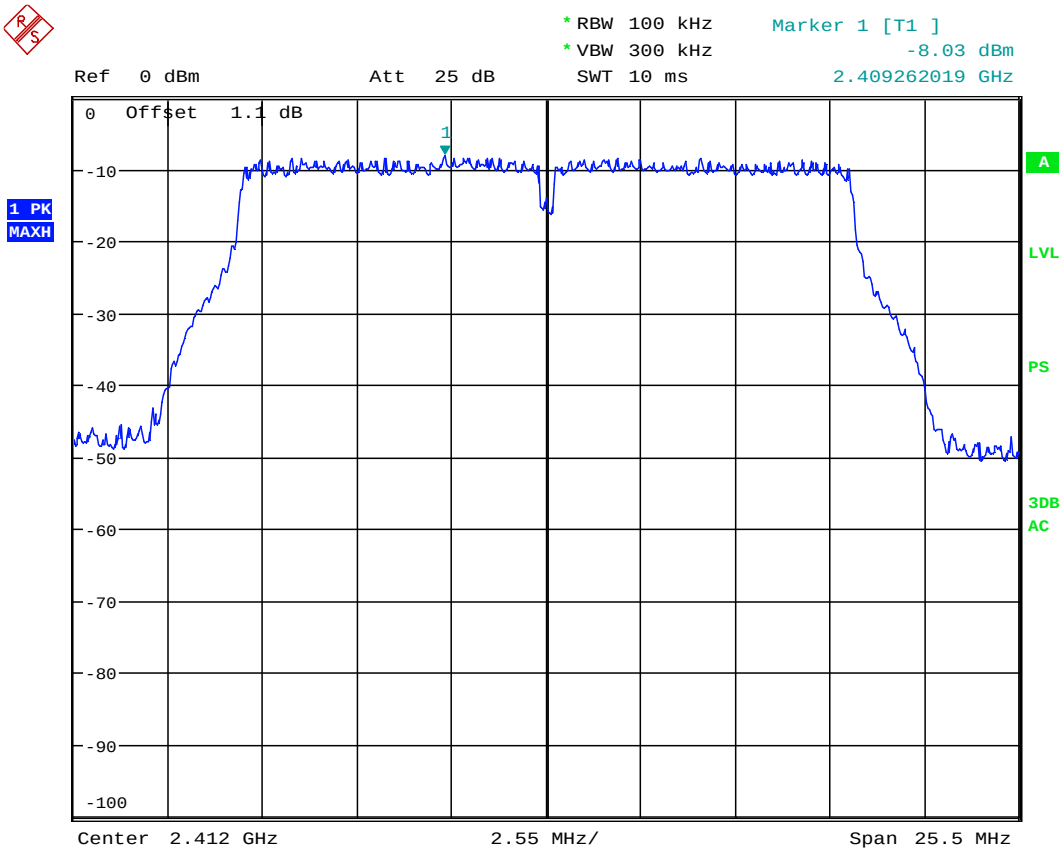
Plot 3. 3



Peak Power Density

Date: 16.AUG.2013 15:22:56

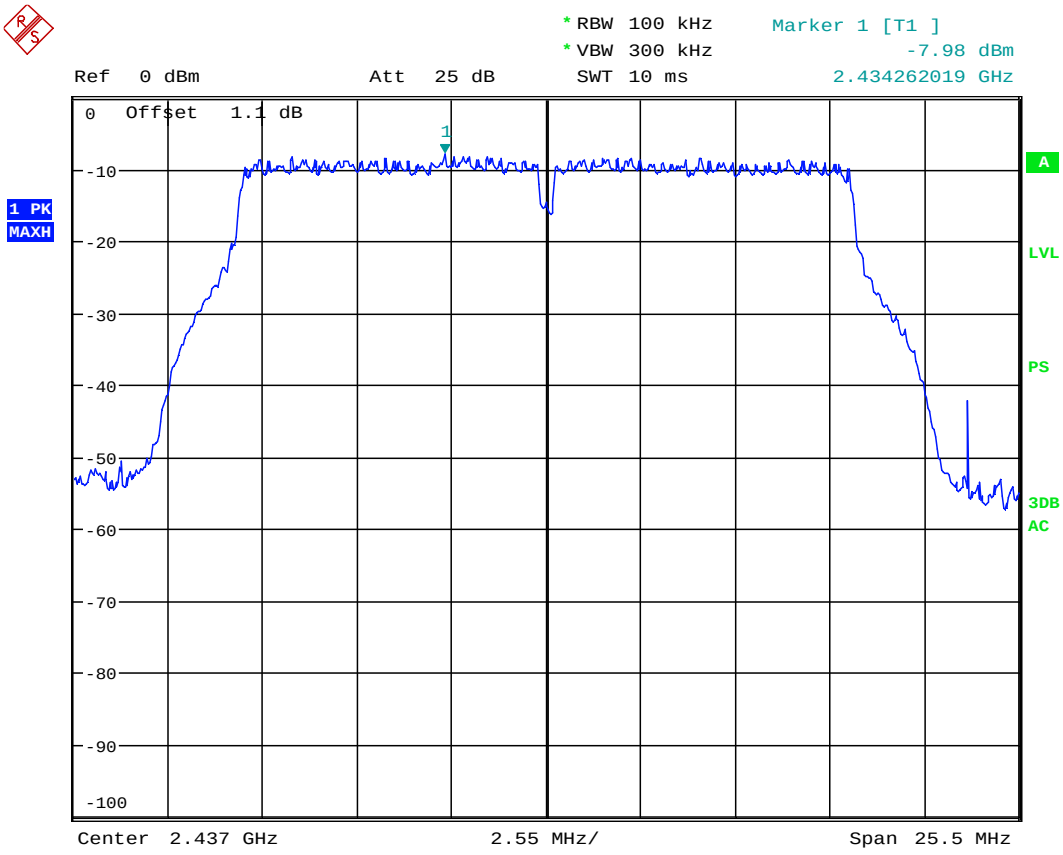
Plot 3. 4



Peak Power Density

Date: 16.AUG.2013 15:17:41

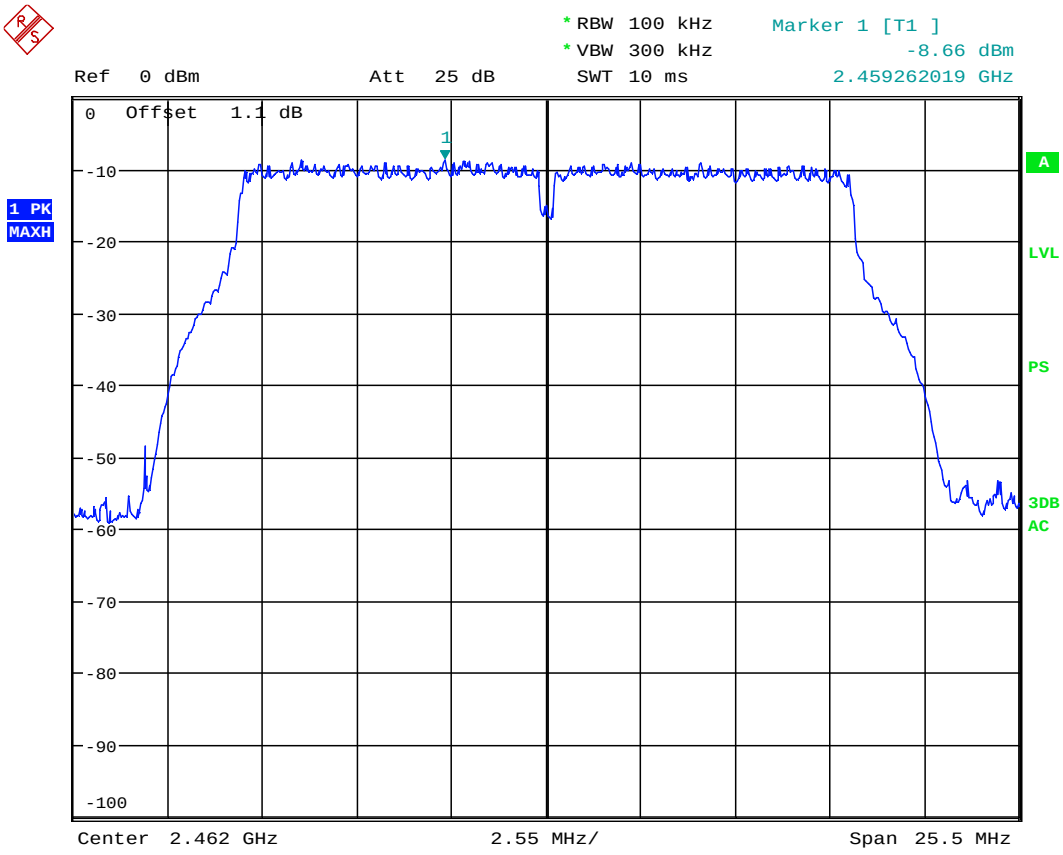
Plot 3. 5



Peak Power Density

Date: 16.AUG.2013 15:17:10

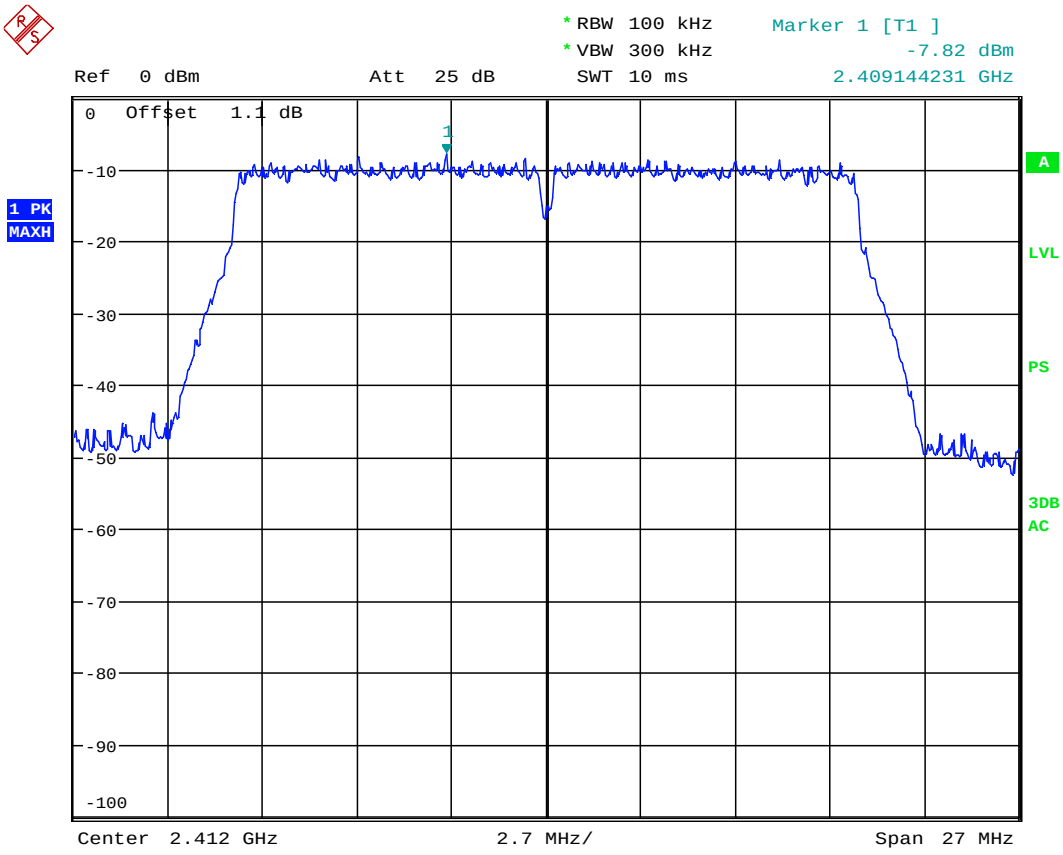
Plot 3. 6



Peak Power Density

Date: 16.AUG.2013 15:16:32

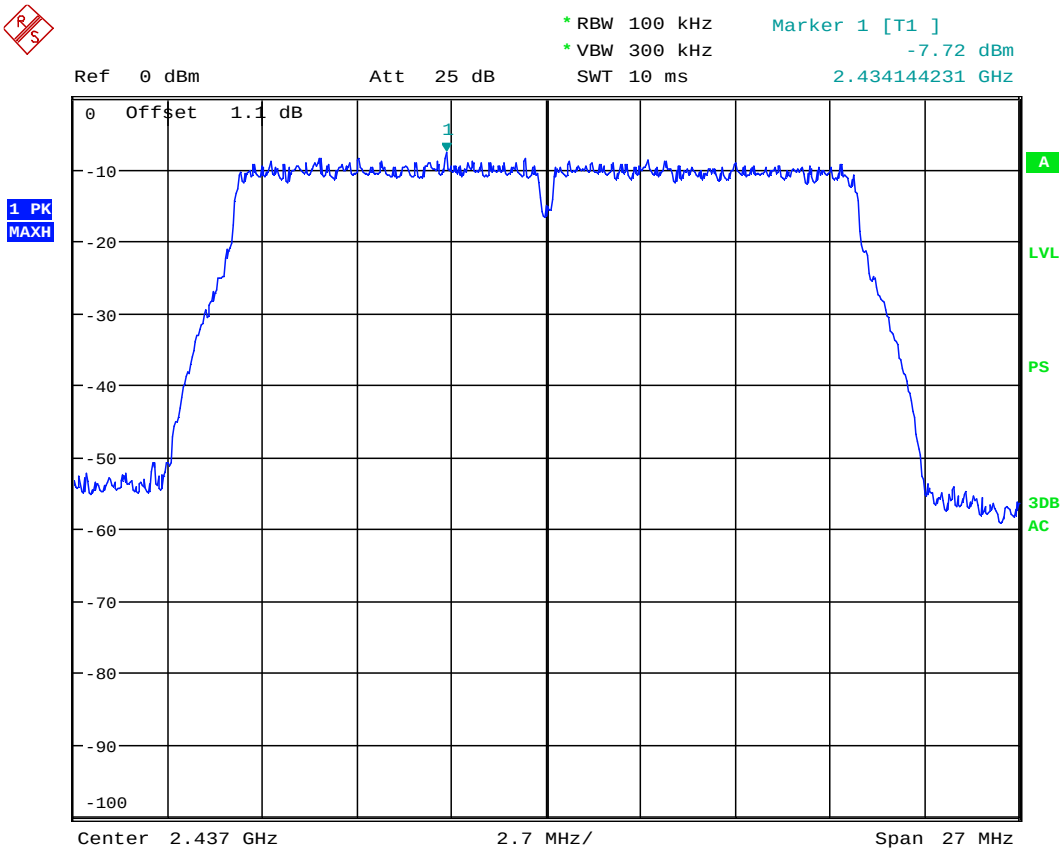
Plot 3. 7



Peak Power Density

Date: 16.AUG.2013 15:21:18

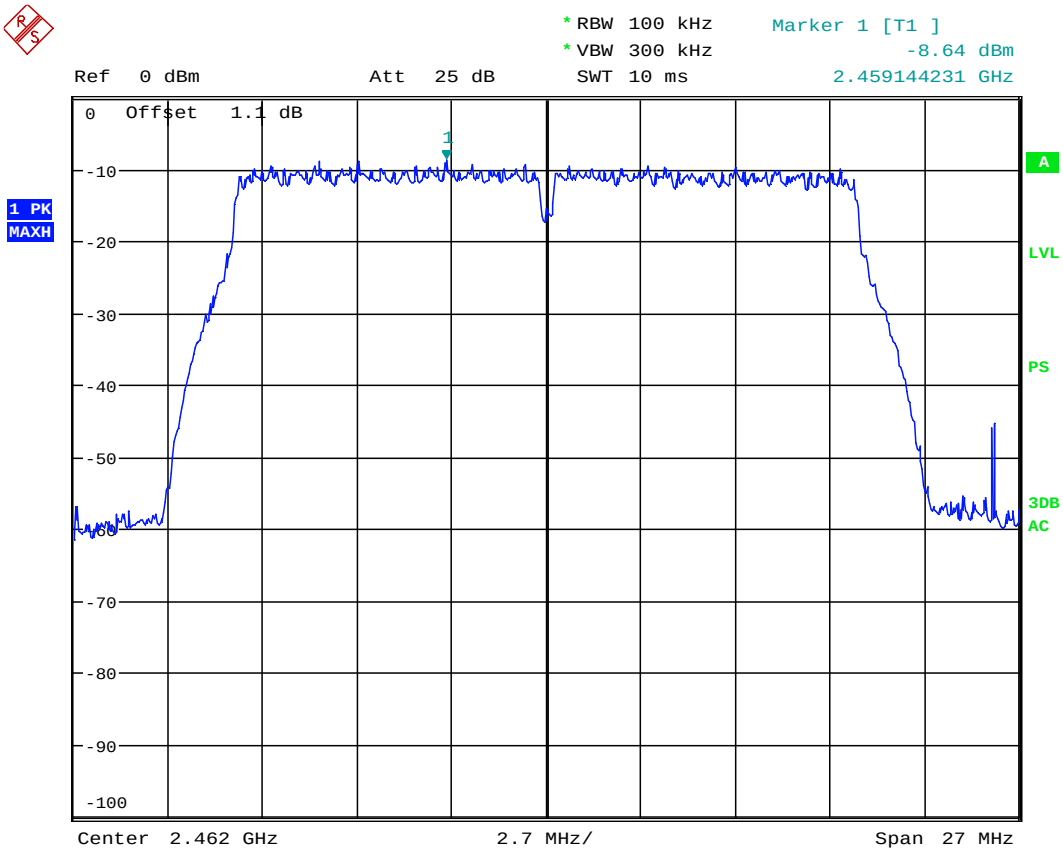
Plot 3. 8



Peak Power Density

Date: 16.AUG.2013 15:21:38

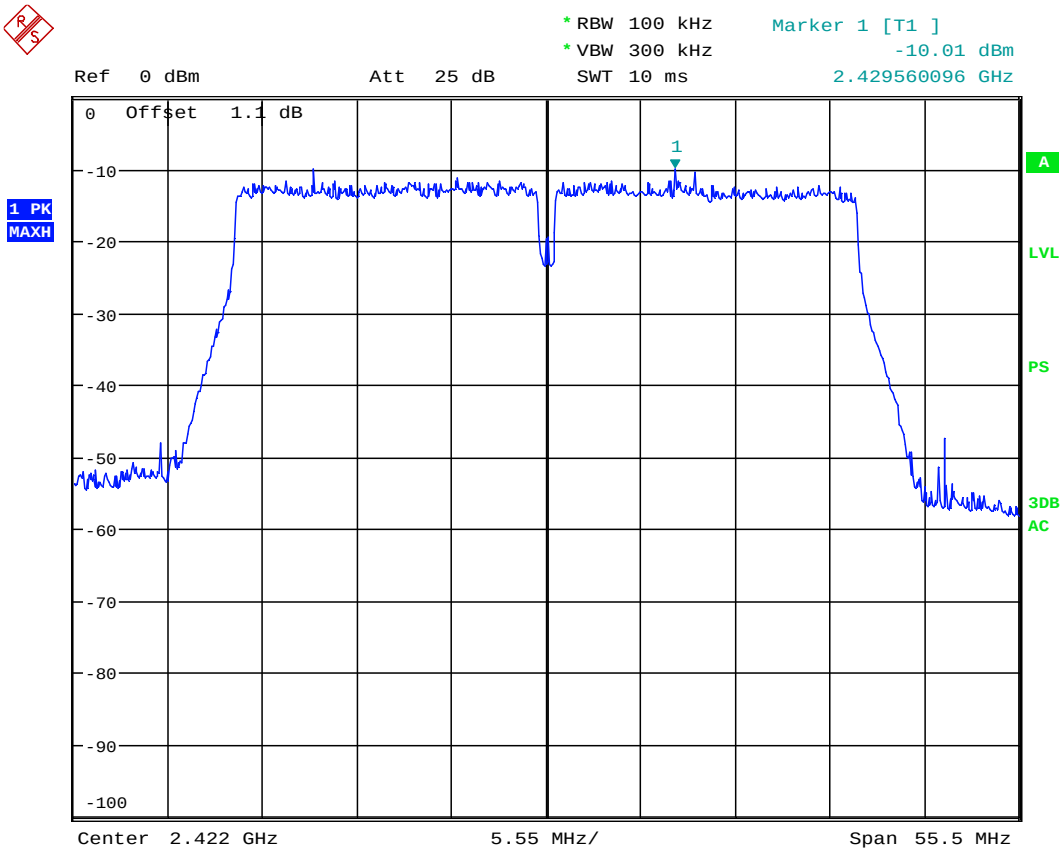
Plot 3. 9



Peak Power Density

Date: 16.AUG.2013 15:22:00

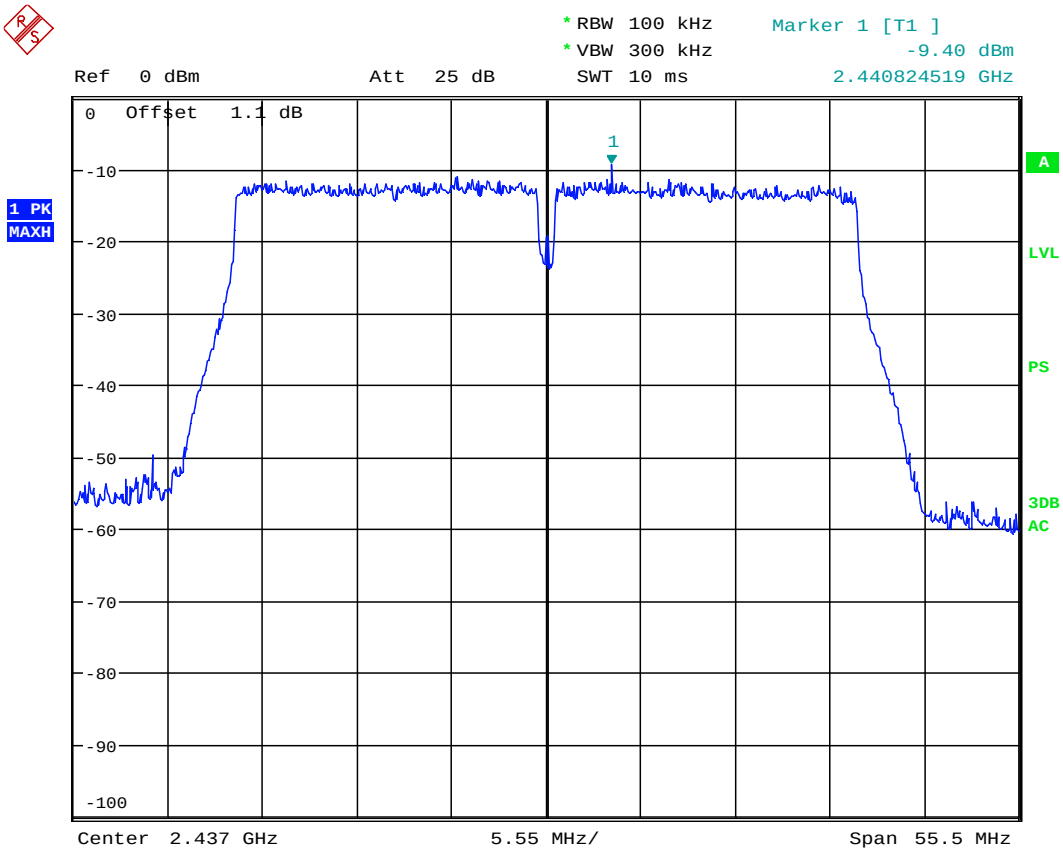
Plot 3. 10



Peak Power Density

Date: 16.AUG.2013 15:24:48

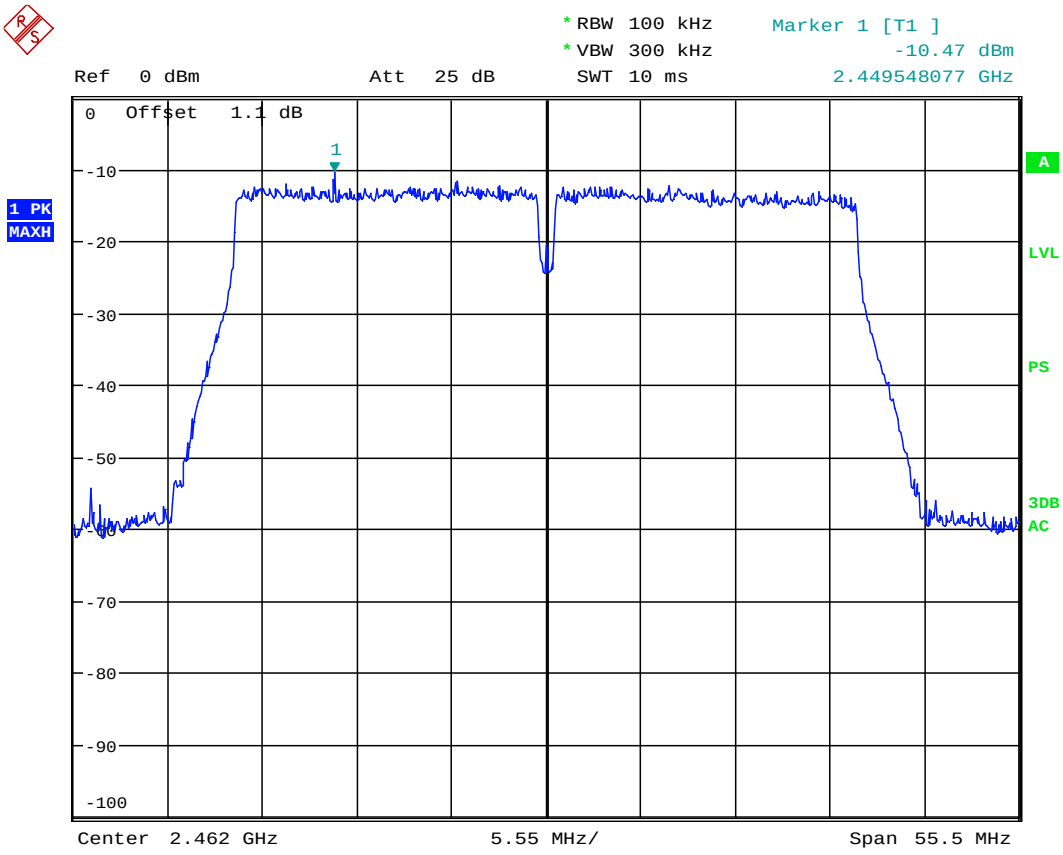
Plot 3. 11



Peak Power Density

Date: 16.AUG.2013 15:25:14

Plot 3. 12



Peak Power Density

Date: 16.AUG.2013 15:25:33

4.4 Out-of-Band Conducted Emissions
FCC 15.247(d)

4.4.1 Requirement

In any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.4.2 Procedure

A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30 MHz to 26 GHz.

4.4.3 Test Result

Refer to the following plots and out-of-band conducted spurious emissions at the Band-Edge, Table 4.1 & 4.2 for the test results:

Table 4.1

Standard	Channel	Frequency MHz	Description	Plot #
802.11b	1	2412	Scan 30 MHz – 26 GHz	4.1
	6	2437	Scan 30 MHz – 26 GHz	4.2
	11	2462	Scan 30 MHz – 26 GHz	4.3
802.11g	1	2412	Scan 30 MHz – 26 GHz	4.4
	6	2437	Scan 30 MHz – 26 GHz	4.5
	11	2462	Scan 30 MHz – 26 GHz	4.6
802.11n HT20	1	2412	Scan 30 MHz – 26 GHz	4.7
	6	2437	Scan 30 MHz – 26 GHz	4.8
	11	2462	Scan 30 MHz – 26 GHz	4.9
802.11n HT40	3	2422	Scan 30 MHz – 26 GHz	4.10
	6	2437	Scan 30 MHz – 26 GHz	4.11
	11	2462	Scan 30 MHz – 26 GHz	4.12

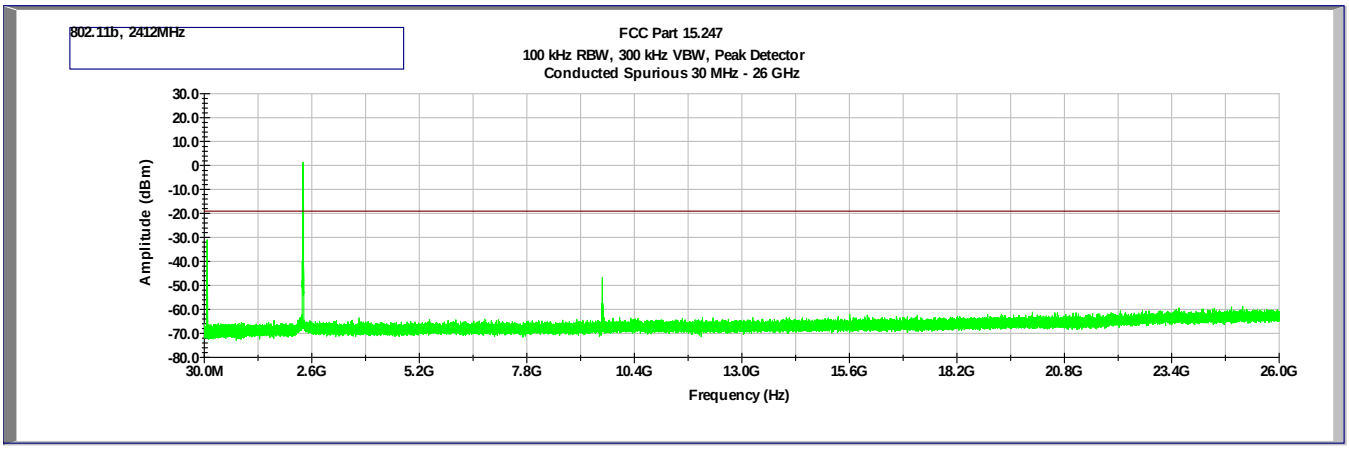
Results	Complies

Out-of-Band Conducted Spurious Emissions at the Band-Edge:

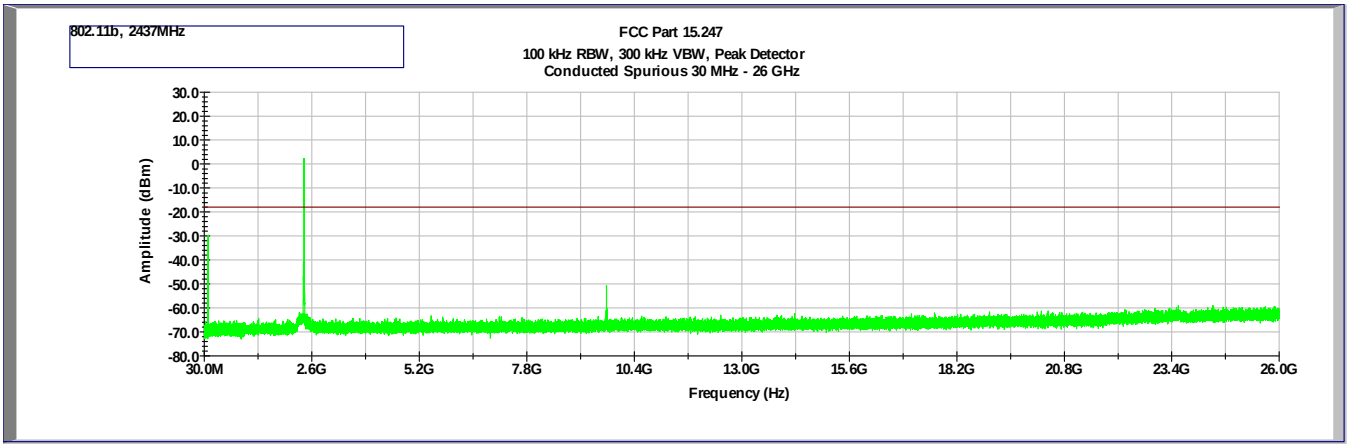
Table 4.2

Standard	Channel	Frequency MHz	Out-band emissions margin to In-band emissions (dB)	Plot #
802.11b	1	2412	-42.32	4.13
	11	2462	-48.11	4.14
802.11g	1	2412	-39.20	4.15
	11	2462	-47.77	4.16
802.11n HT20	1	2412	-38.81	4.17
	11	2462	-51.79	4.18
802.11n HT40	3	2422	-38.30	4.19
	11	2462	-31.42	4.20

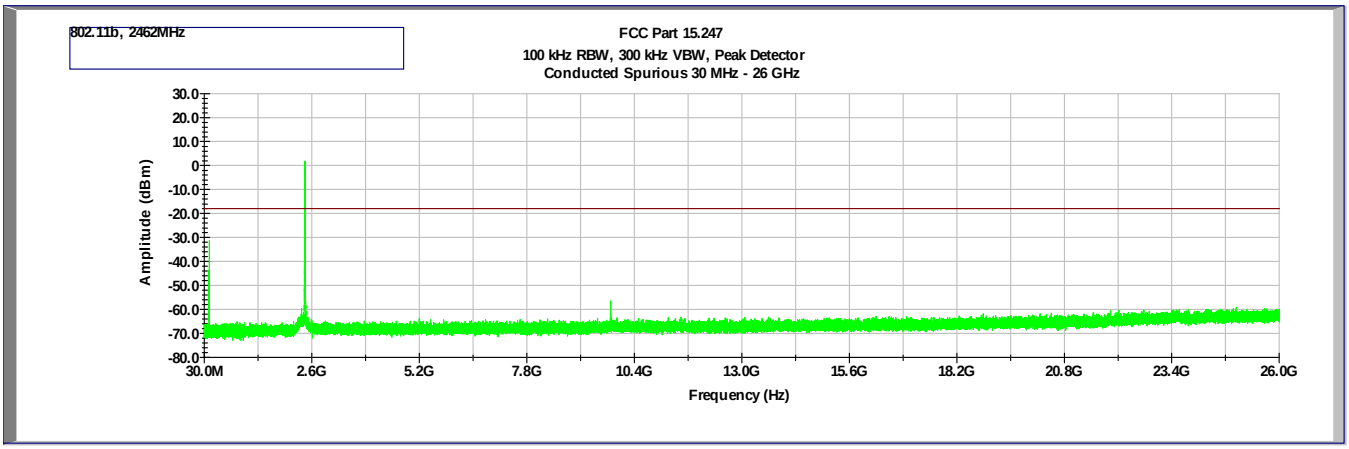
Plot 4.1
Tx @ 2412MHz 802.11b, 1Mbps



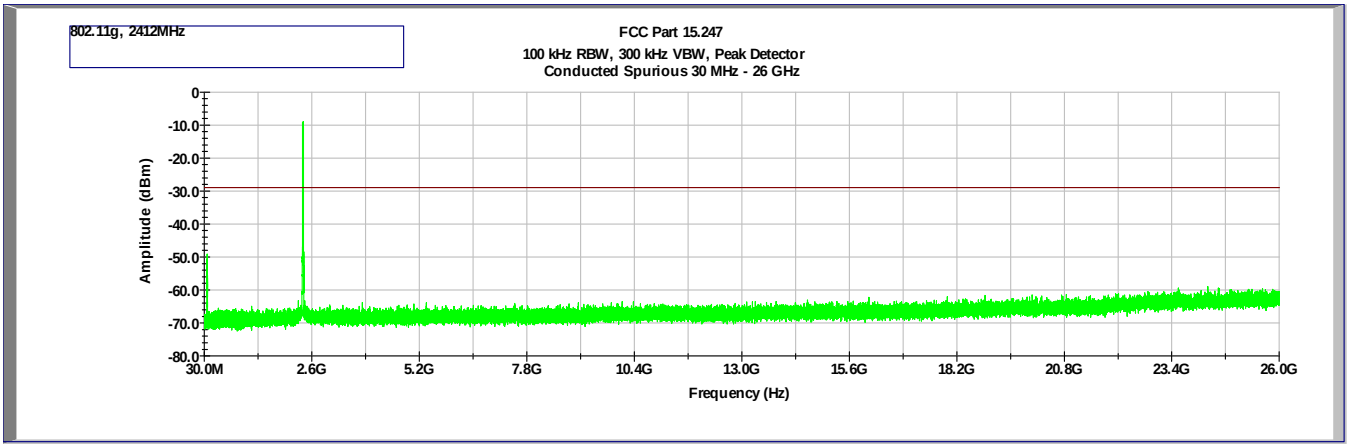
Plot 4.2
Tx @ 2437MHz 802.11b, 1Mbps



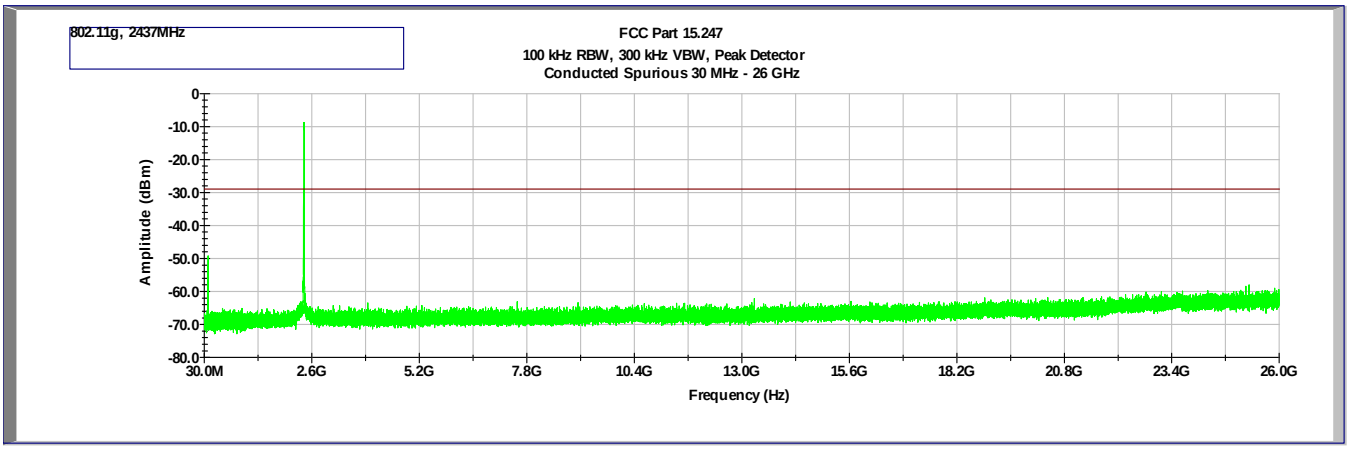
Plot 4.3
Tx @ 2462MHz 802.11b, 1Mbps



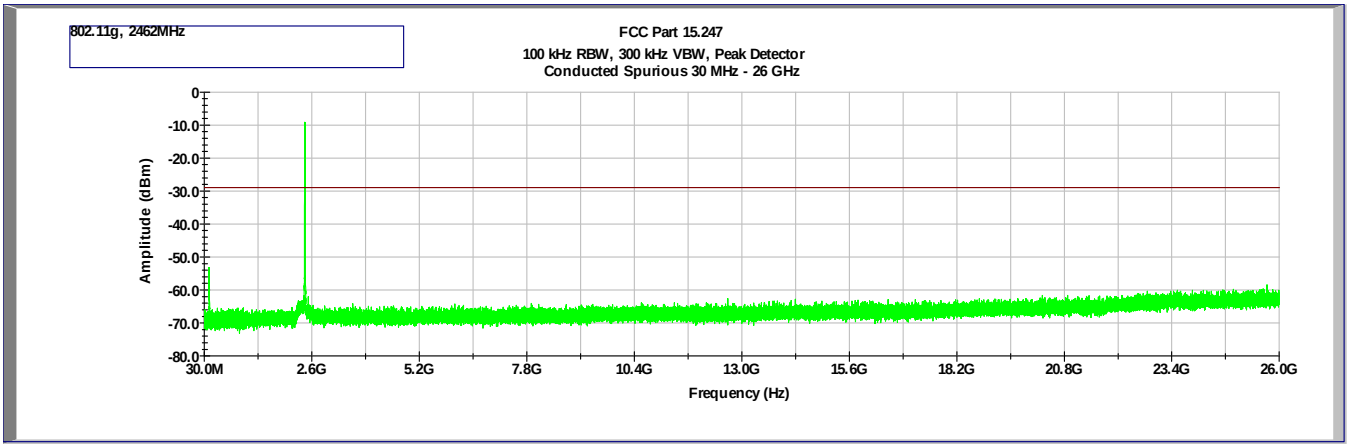
Plot 4.4
Tx @ 2412MHz 802.11g, 6Mbps



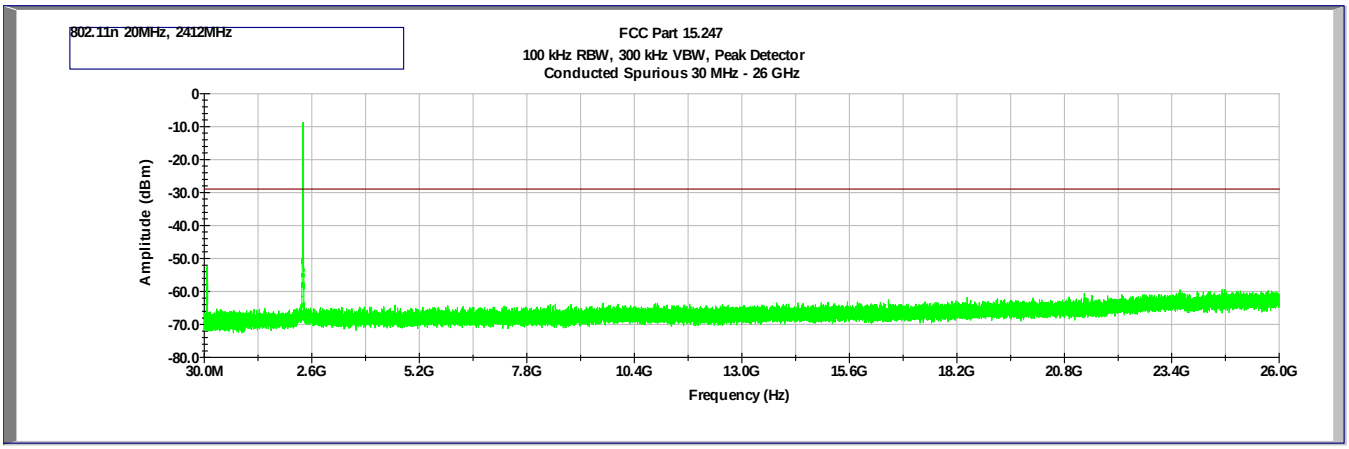
Plot 4.5
Tx @ 2437MHz 802.11g, 6Mbps



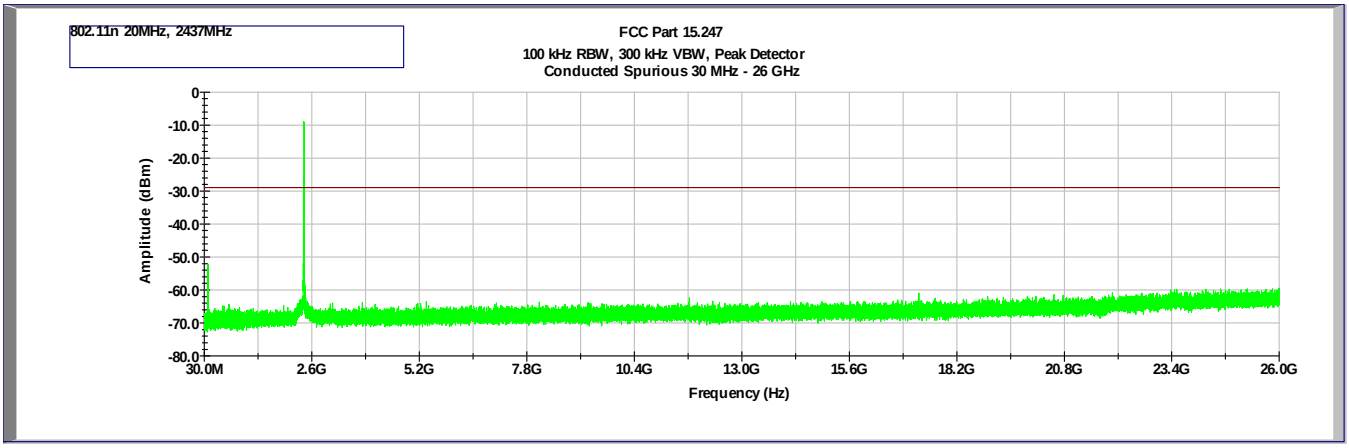
Plot 4.6
Tx @ 2462MHz 802.11g, 6Mbps



Plot 4.7
Tx @ 2412MHz 802.11n, HT20, MCS0

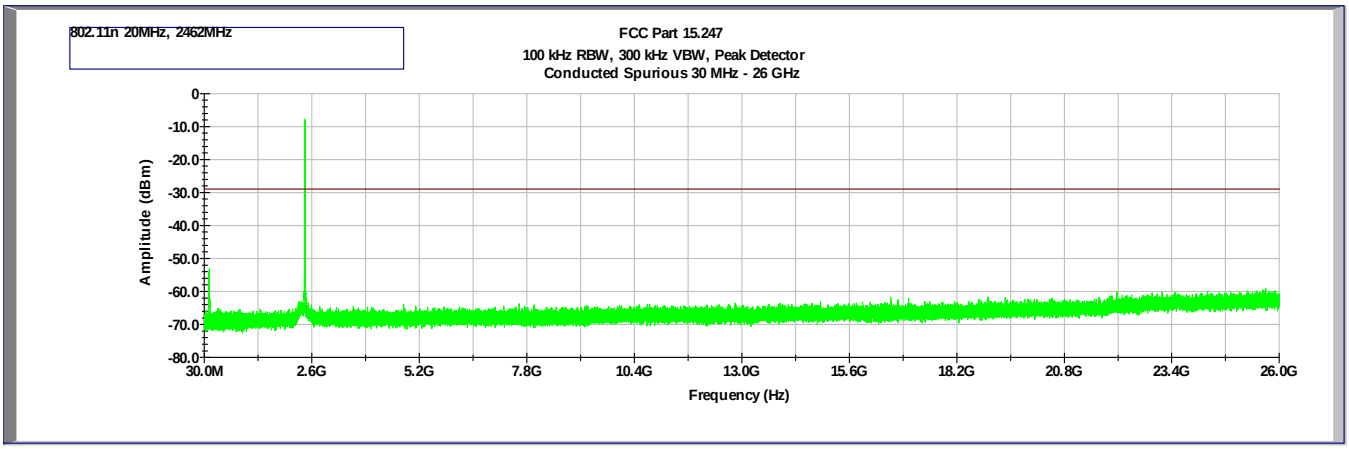


Plot 4.8
Tx @ 2437MHz 802.11n, HT20, MCS0



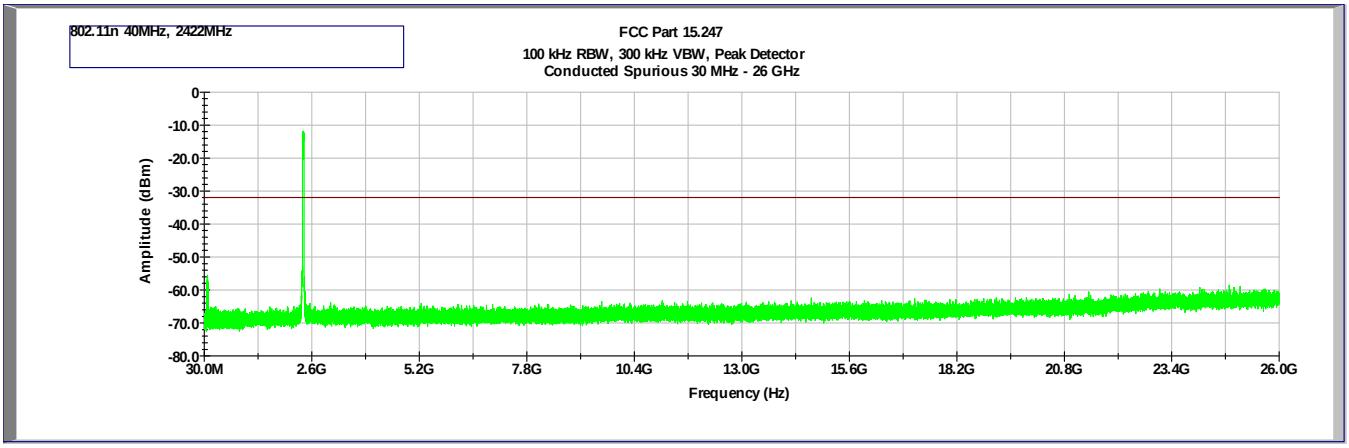
Plot 4.9

Tx @ 2462MHz 802.11n, HT20, MCS0

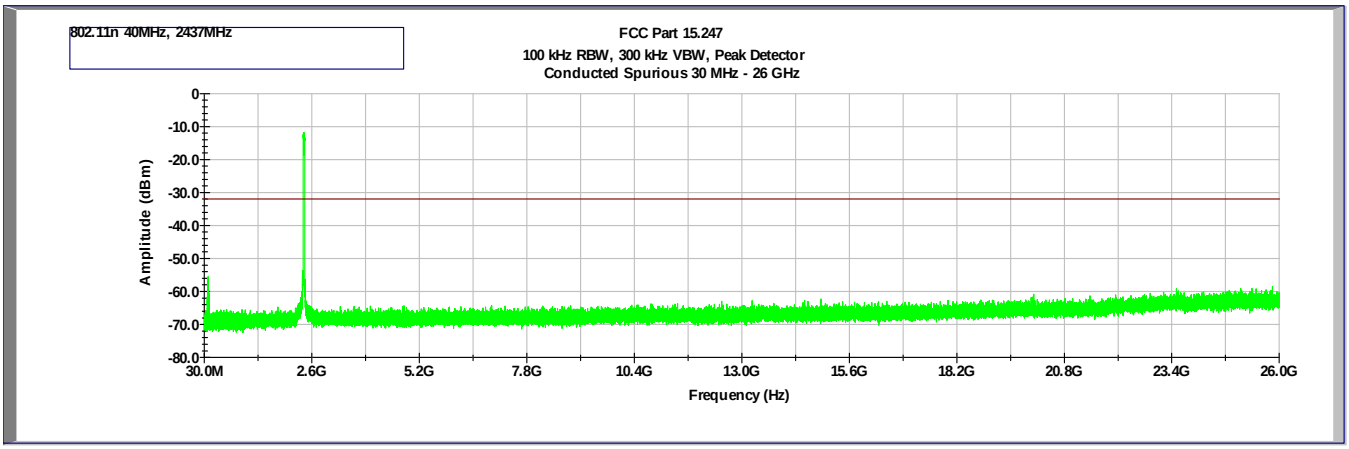


Plot 4.10

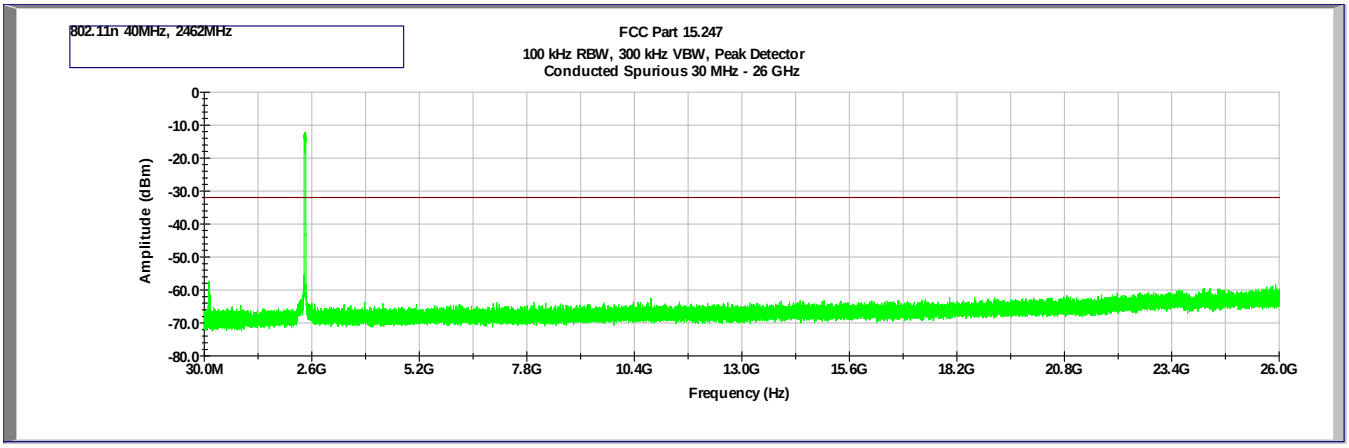
Tx @ 2422MHz 802.11n, HT40, MCS0



Plot 4.11
Tx @ 2437MHz 802.11n, HT40, MCS0

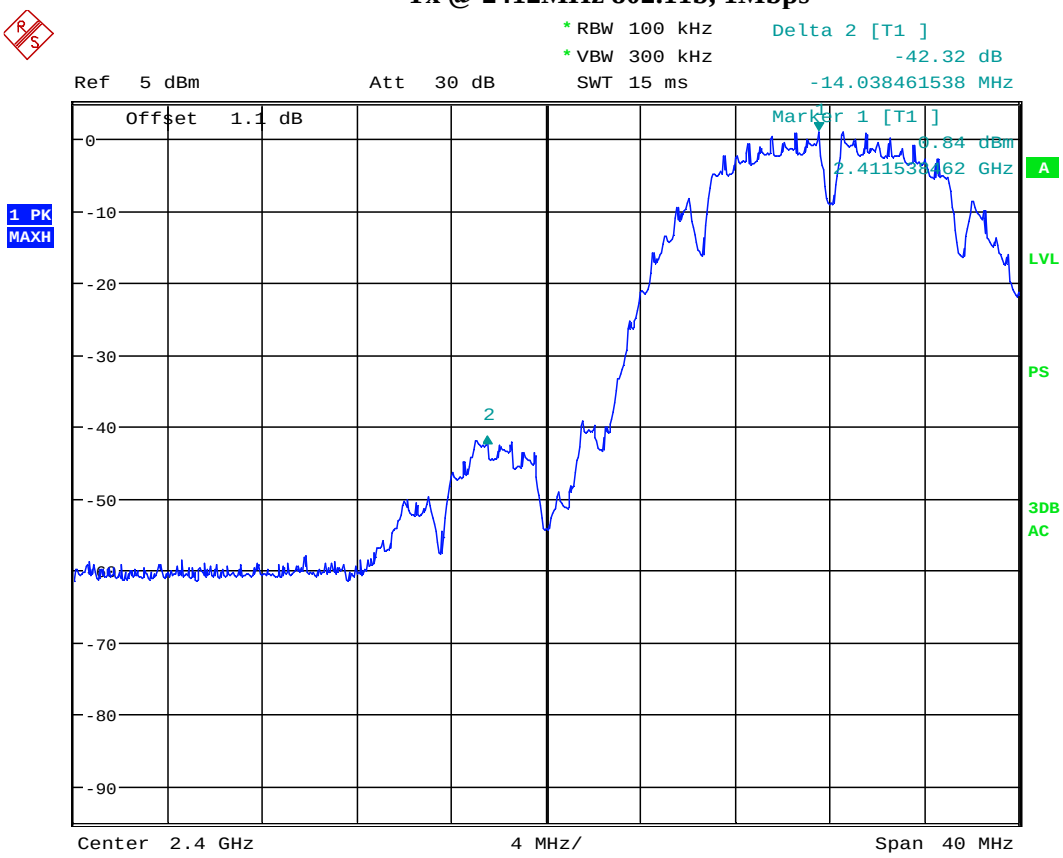


Plot 4.12
Tx @ 2462MHz 802.11n, HT40, MCS0



Plot 4.13

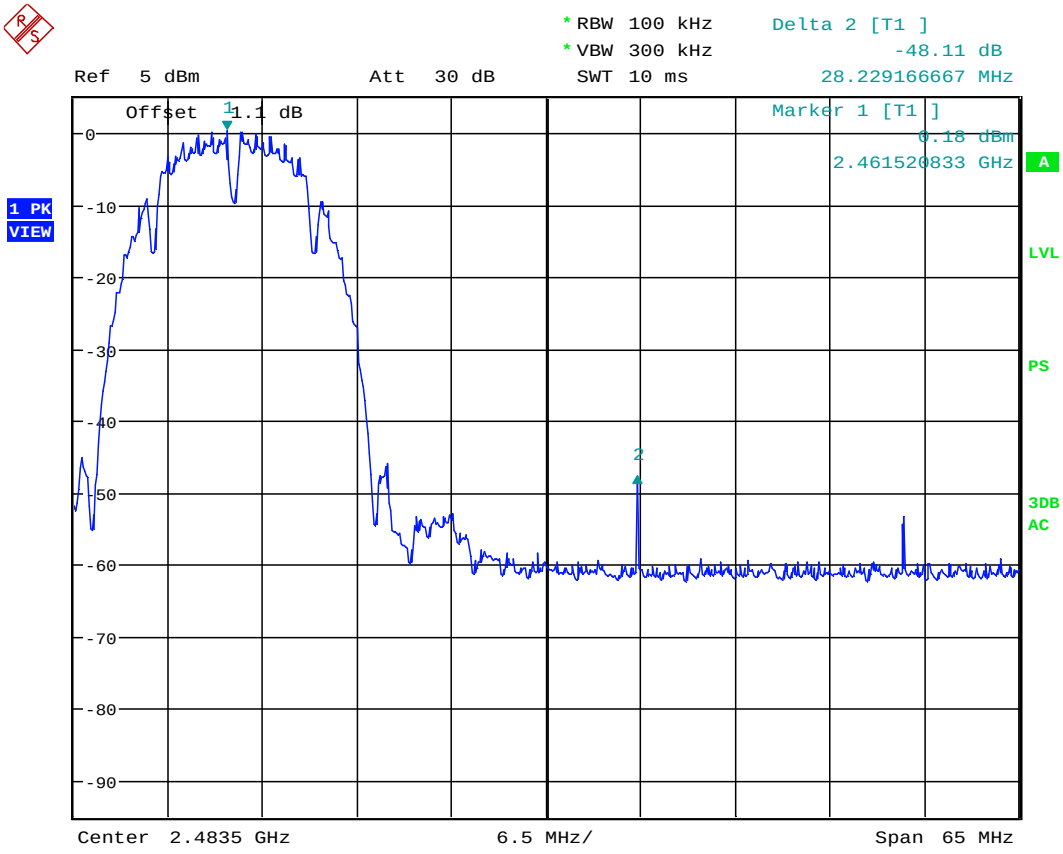
Tx @ 2412MHz 802.11b, 1Mbps



Peak Power Density

Date: 16.AUG.2013 15:35:22

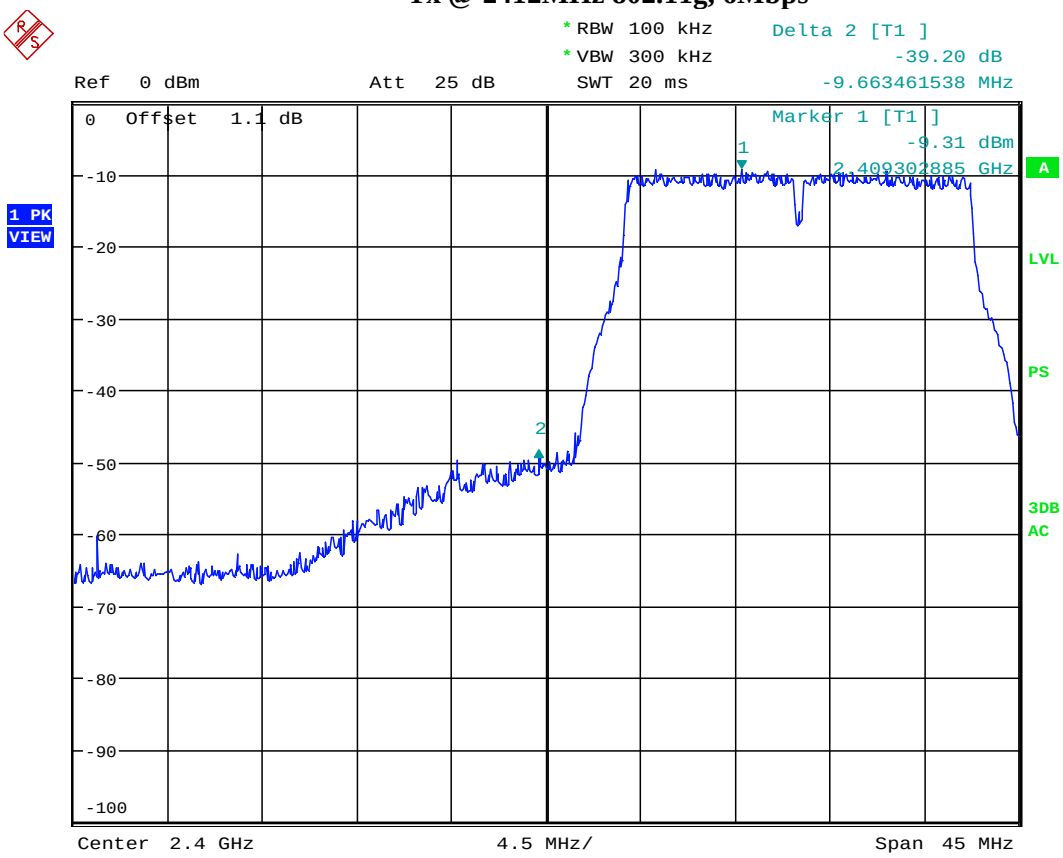
Plot 4.14
Tx @ 2462MHz 802.11b, 1Mbps



Peak Power Density
Date: 16.AUG.2013 15:34:02

Plot 4.15

Tx @ 2412MHz 802.11g, 6Mbps

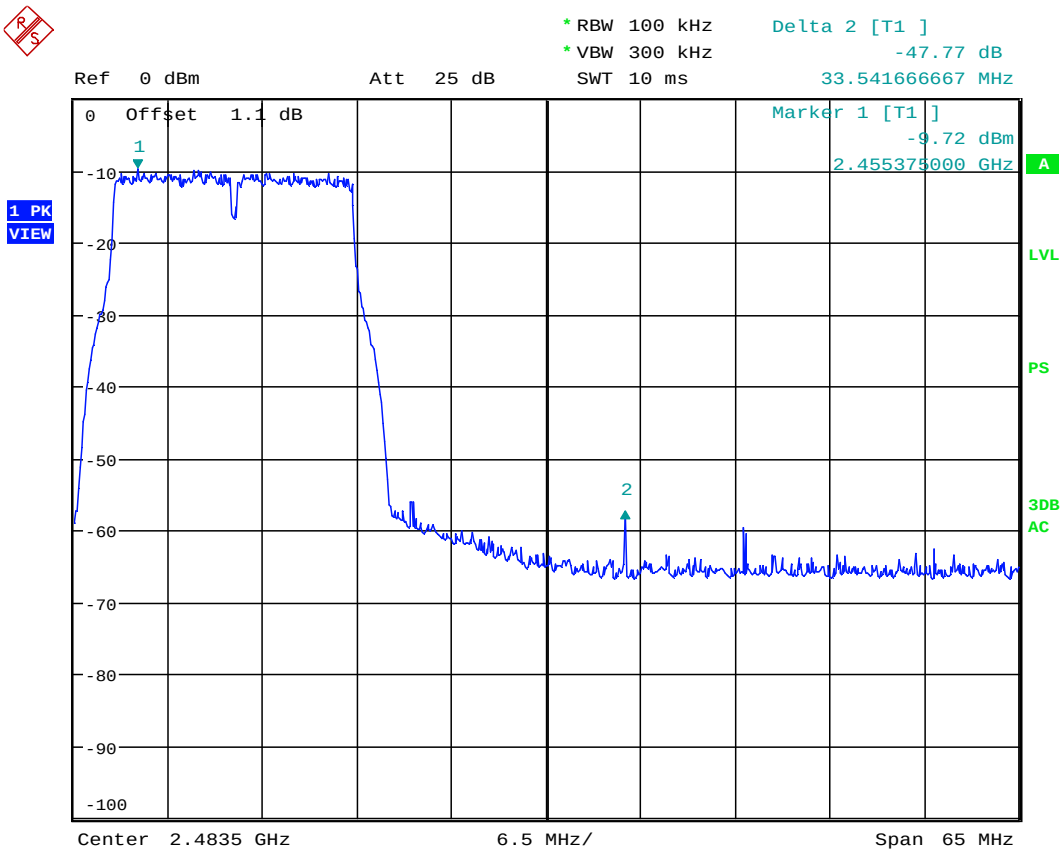


Peak Power Density

Date: 16.AUG.2013 15:36:07

Plot 4.16

Tx @ 2462MHz 802.11g, 6Mbps

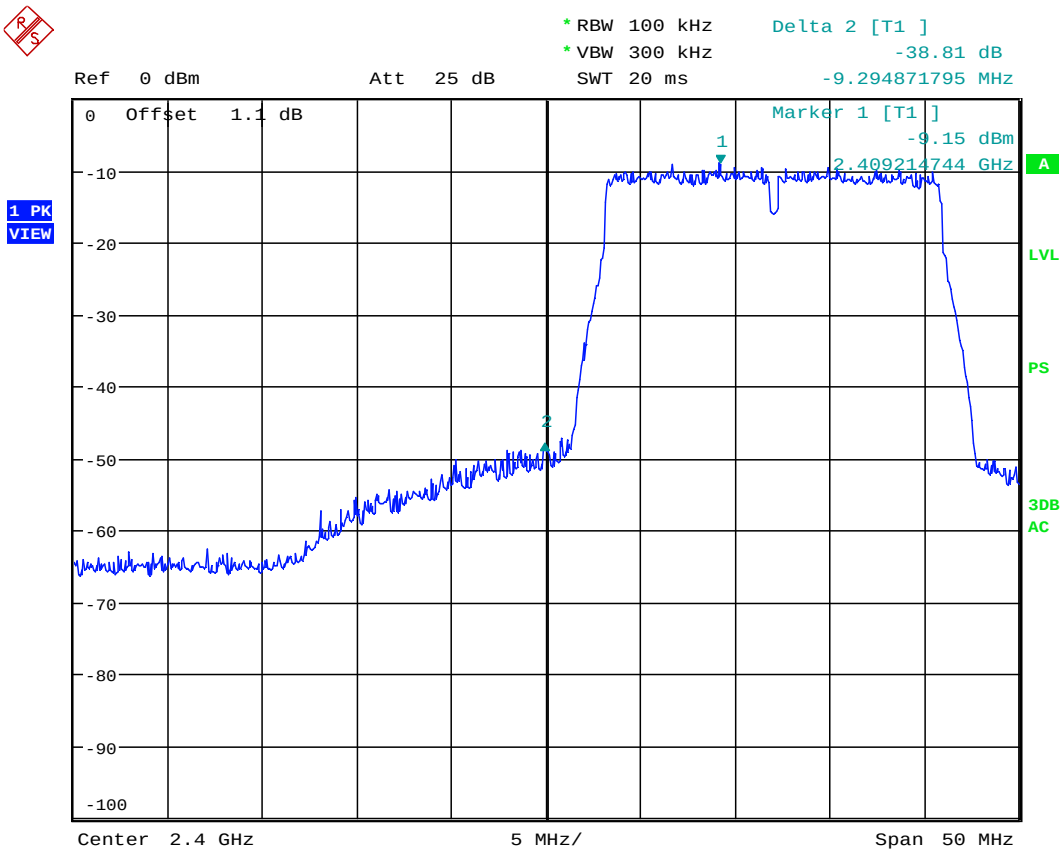


Peak Power Density

Date: 16.AUG.2013 15:32:59

Plot 4.17

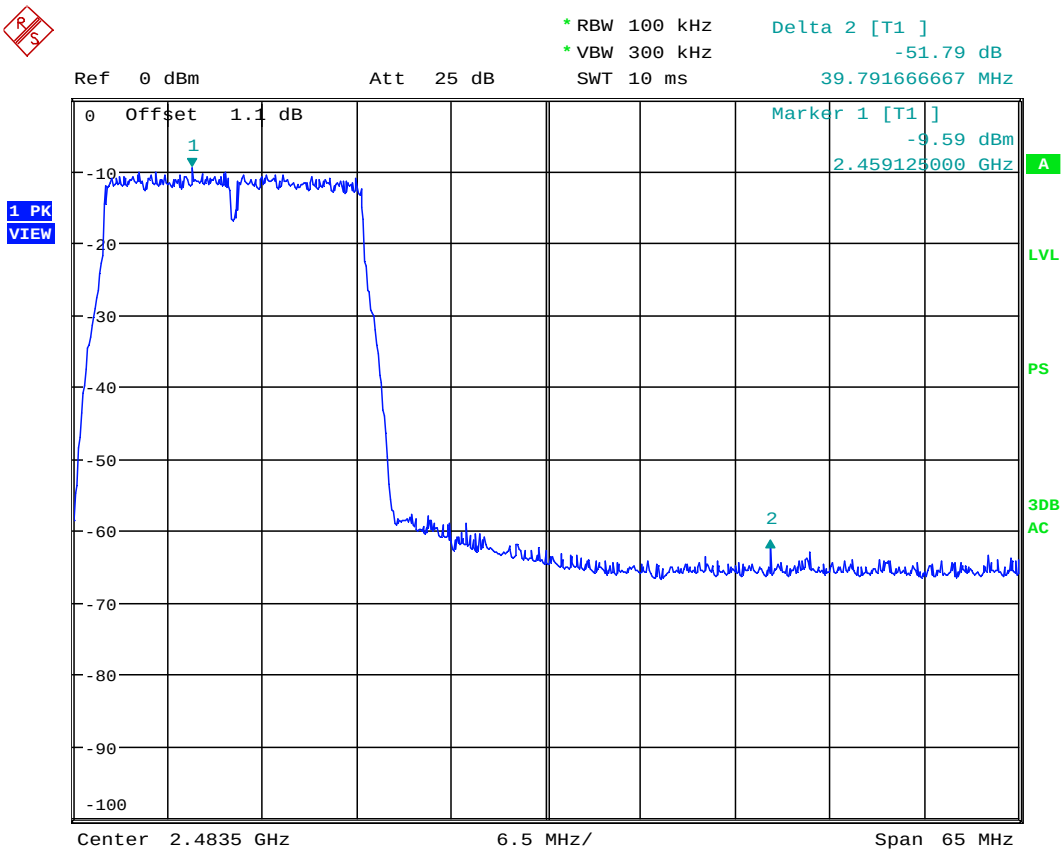
Tx @ 2412MHz 802.11n, HT20, MCS0



Peak Power Density

Date: 16.AUG.2013 15:31:07

Plot 4.18
Tx @ 2462MHz 802.11n, HT20, MCS0

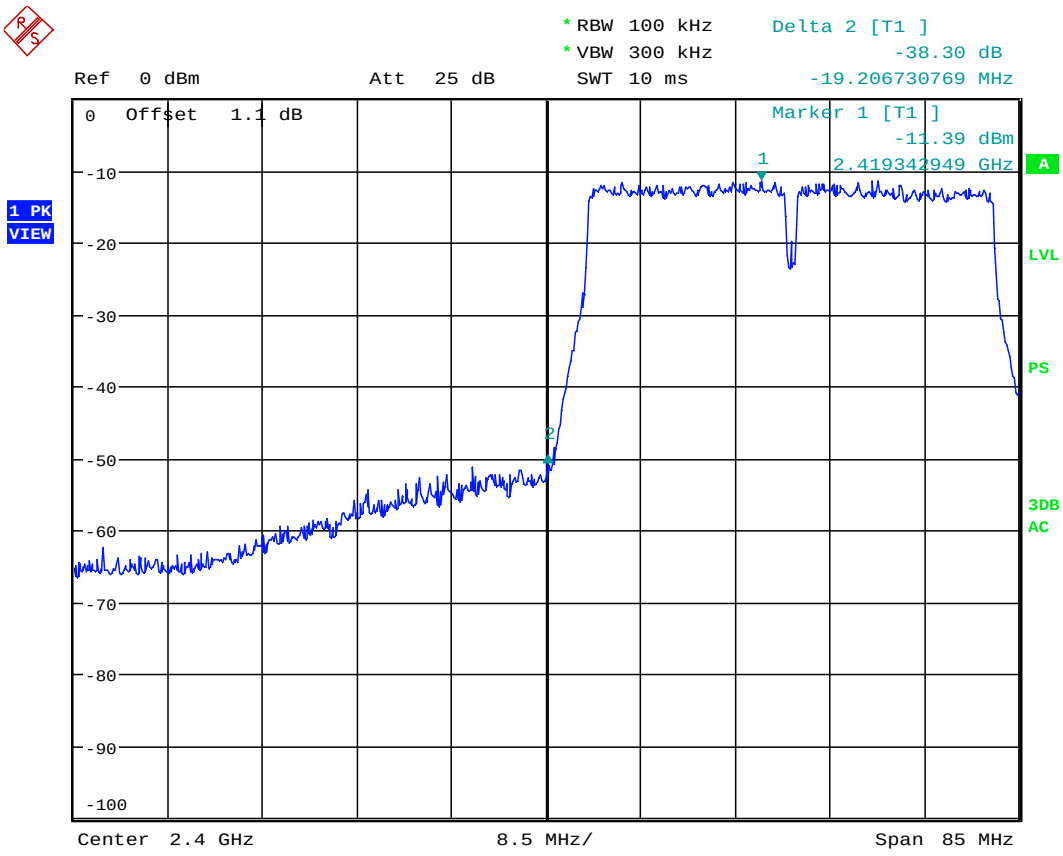


Peak Power Density

Date: 16.AUG.2013 15:32:12

Plot 4.19

Tx @ 2422MHz 802.11n, HT40, MCS0

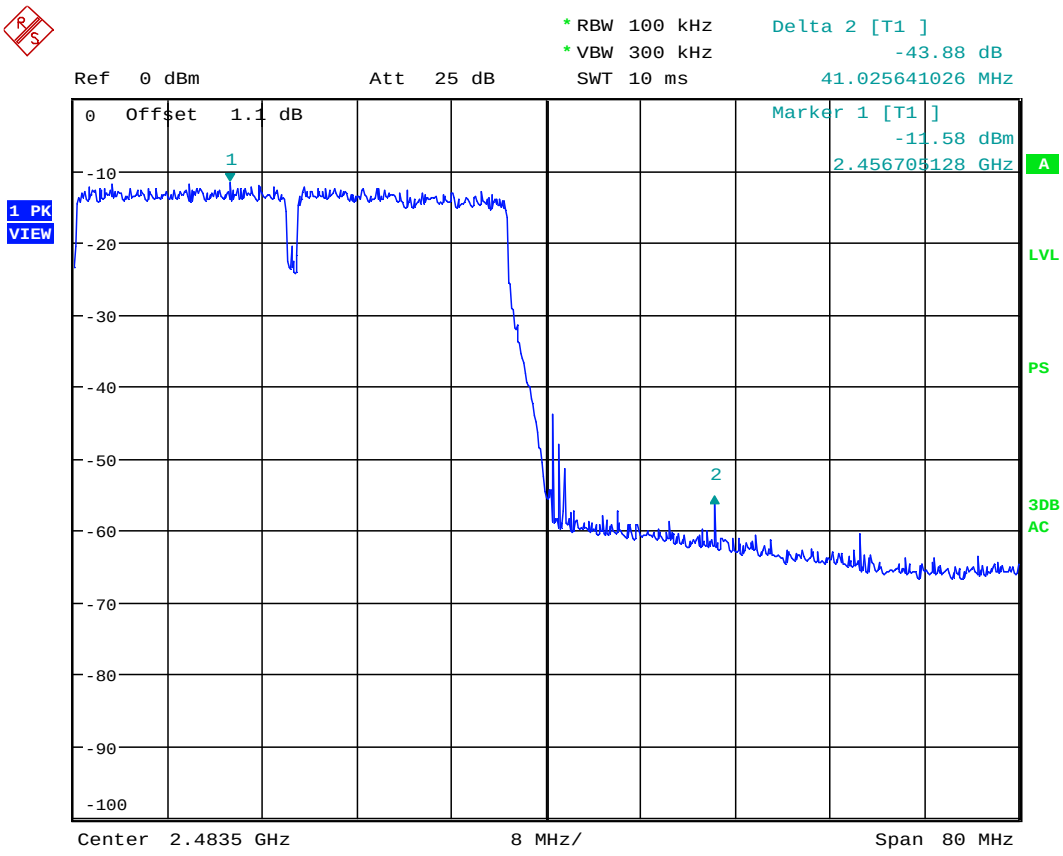


Peak Power Density

Date: 16.AUG.2013 15:29:17

Plot 4.20

Tx @ 2462MHz 802.11n, HT40, MCS0



Peak Power Density

Date: 16.AUG.2013 15:28:08

4.5 Transmitter Radiated Emissions
FCC Rule 15.247(d), 15.209, 15.205

4.5.1 Requirement

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.5.2 Procedure

Radiated emission measurements were performed from 30 MHz to 26,000 MHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz.

The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies above 1 GHz and at 10 meters for frequencies below 1 GHz.

Measurements made from 1 GHz to 18GHz had a 2.4-2.5GHz notch filter in place. A preamp was used from 30MHz to 26GHz.

All measurements were made with a Peak Detector and compared to QP limits for 30MHz – 1GHz and Average limits for 1GHz – 26GHz.

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels).

4.5.3 Field Strength Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – AG; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(µV/m)
RA = Receiver Amplitude (including preamplifier) in dB(µV); AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

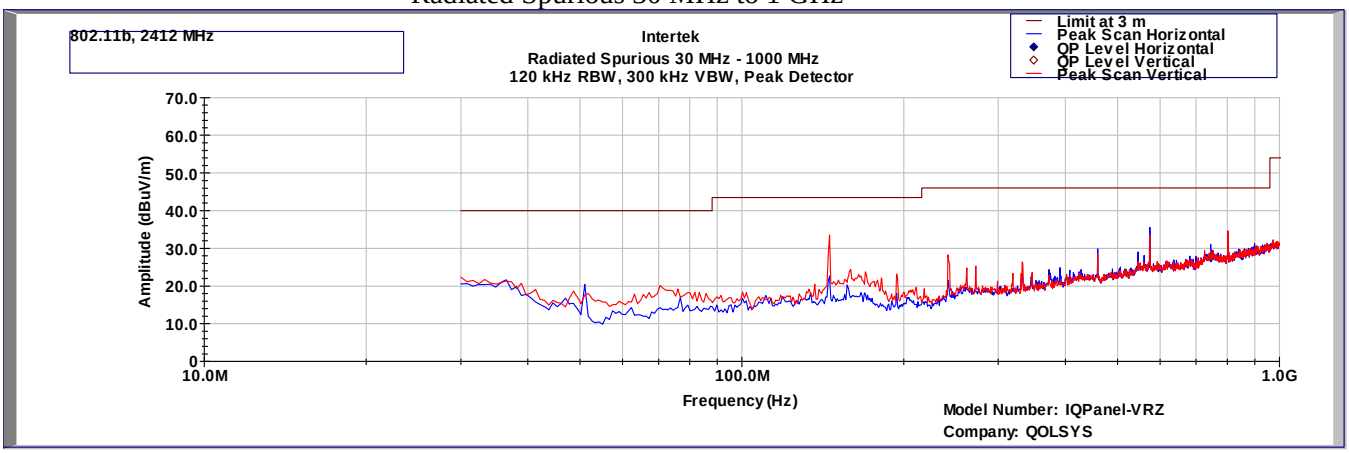
Assume a receiver reading of 52.0 dB(µV) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(µV/m). This value in dB(µV/m) was converted to its corresponding level in µV/m.
RA = 52.0 dB(µV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB
FS = 52.0+7.4+1.6-29.0 = 32 dB(µV/m).
Level in µV/m = Common Antilogarithm [(32 dBµV/m)/20] = 39.8 µV/m.

4.5.3 Test Results

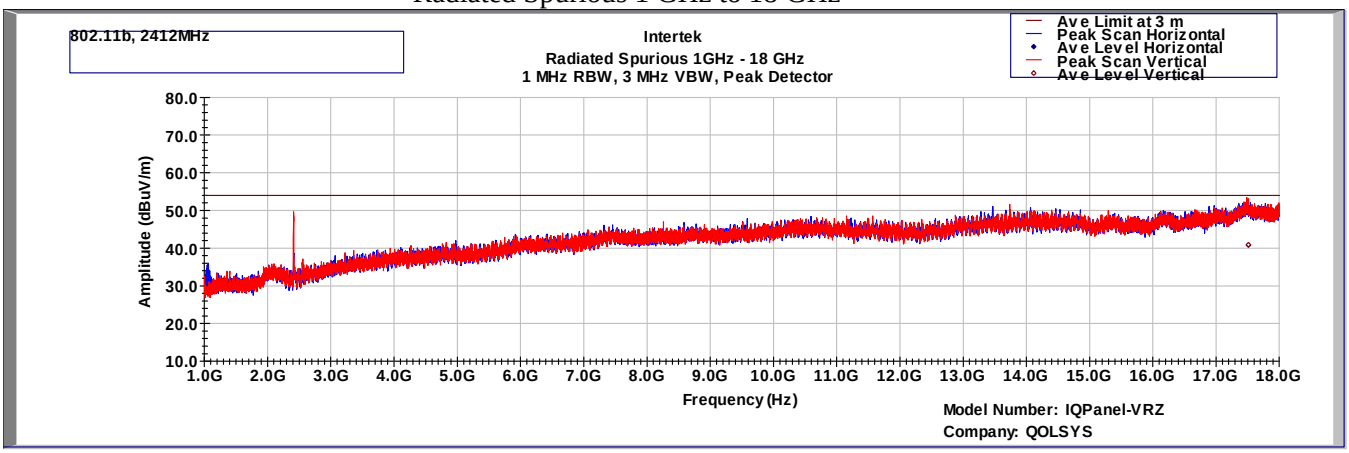
The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Tx @ 2412MHz 802.11b, 1 Mbps

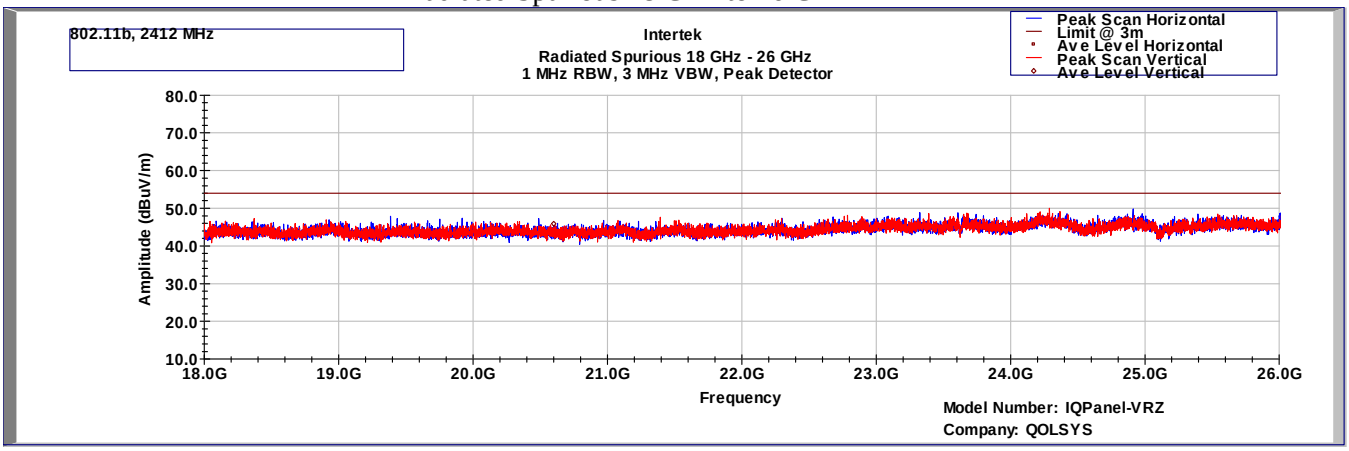
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

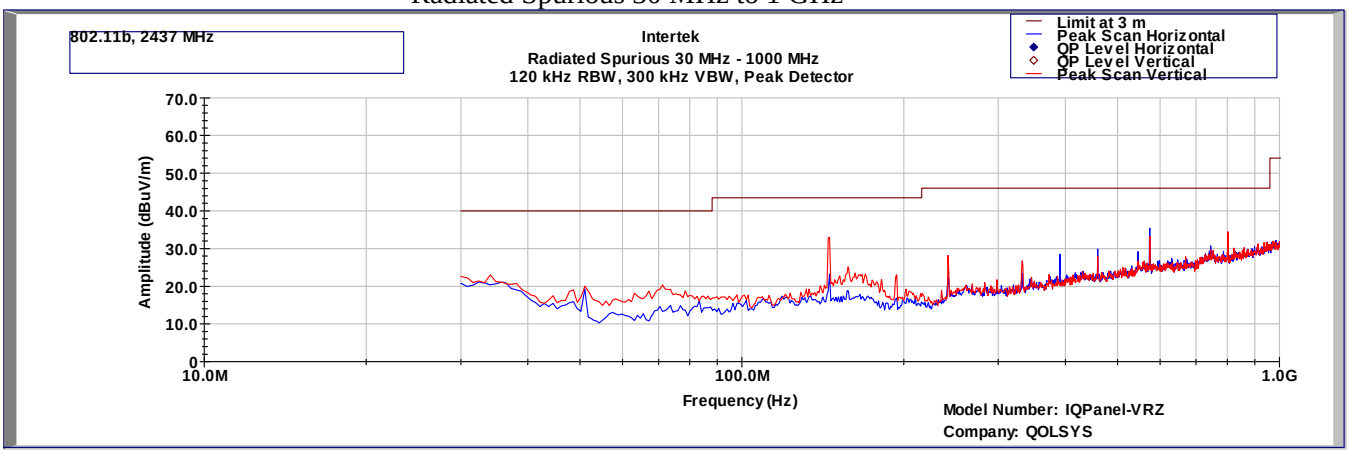


Radiated Spurious 18 GHz to 26 GHz

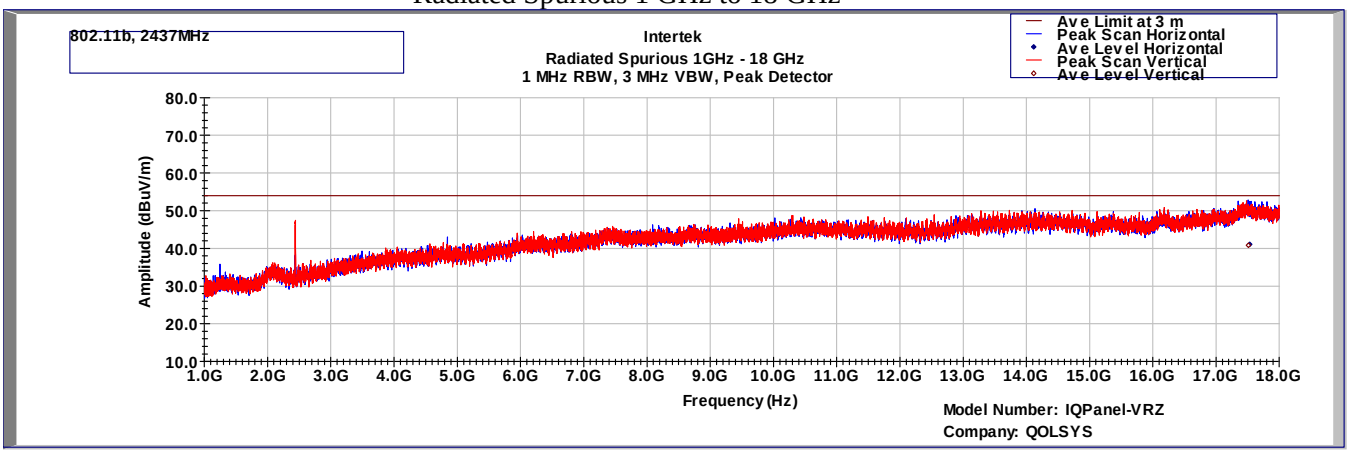


Tx @ 2437MHz 802.11b, 1 Mbps

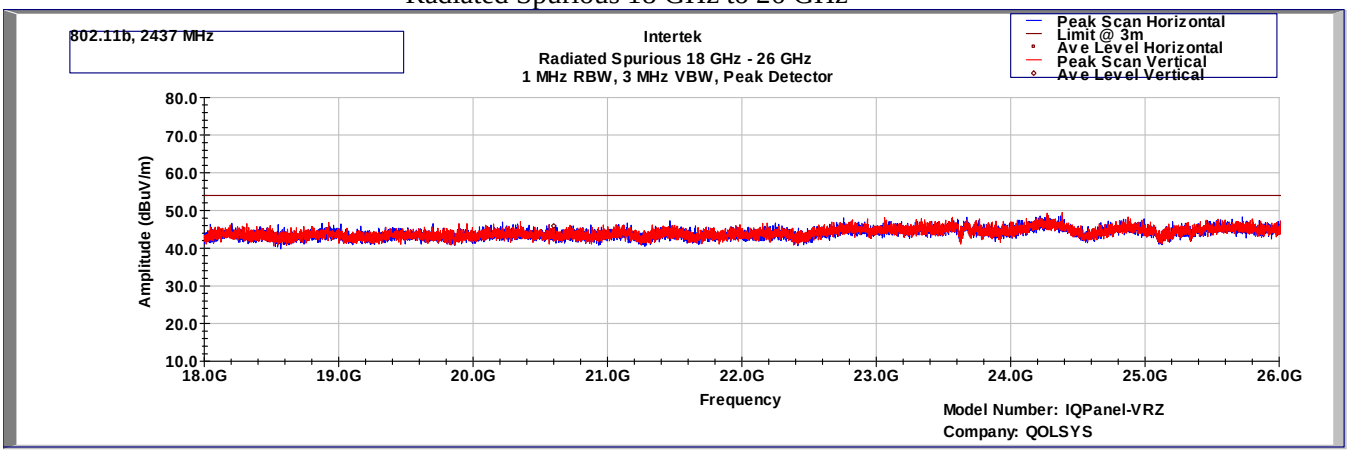
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

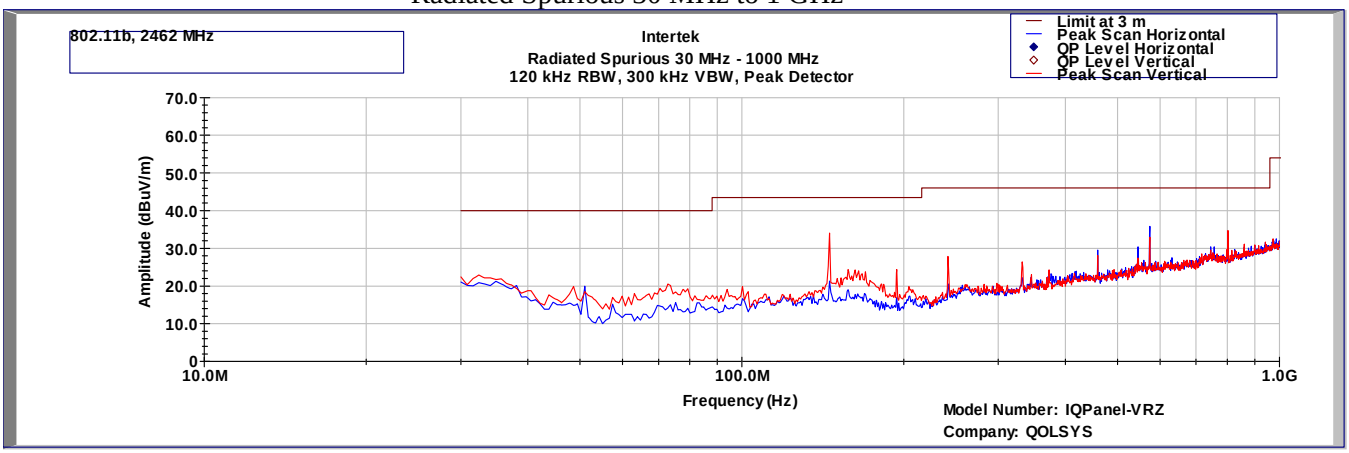


Radiated Spurious 18 GHz to 26 GHz

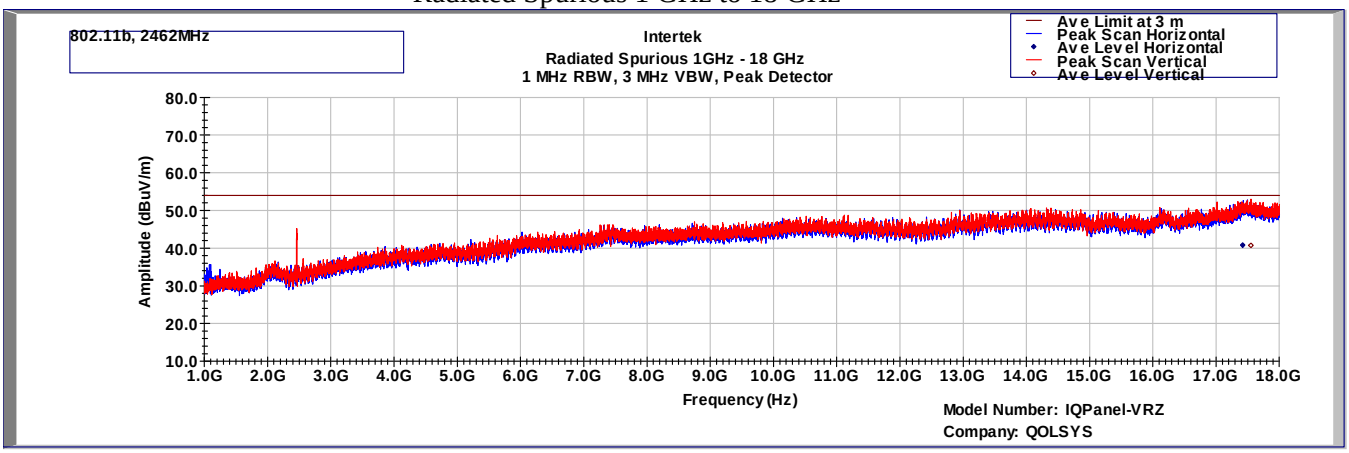


Tx @ 2462MHz 802.11b, 1 Mbps

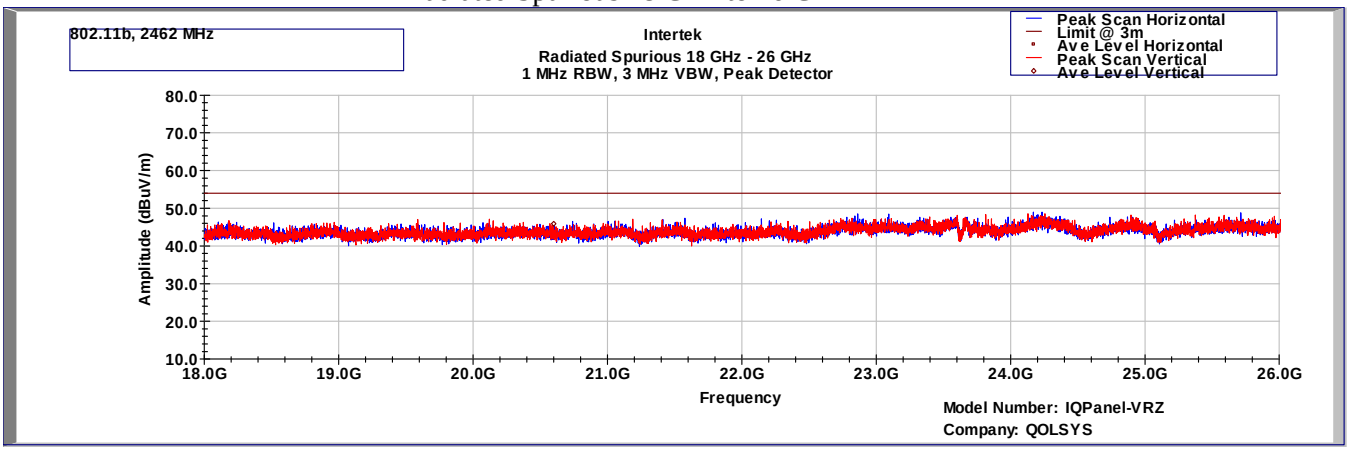
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

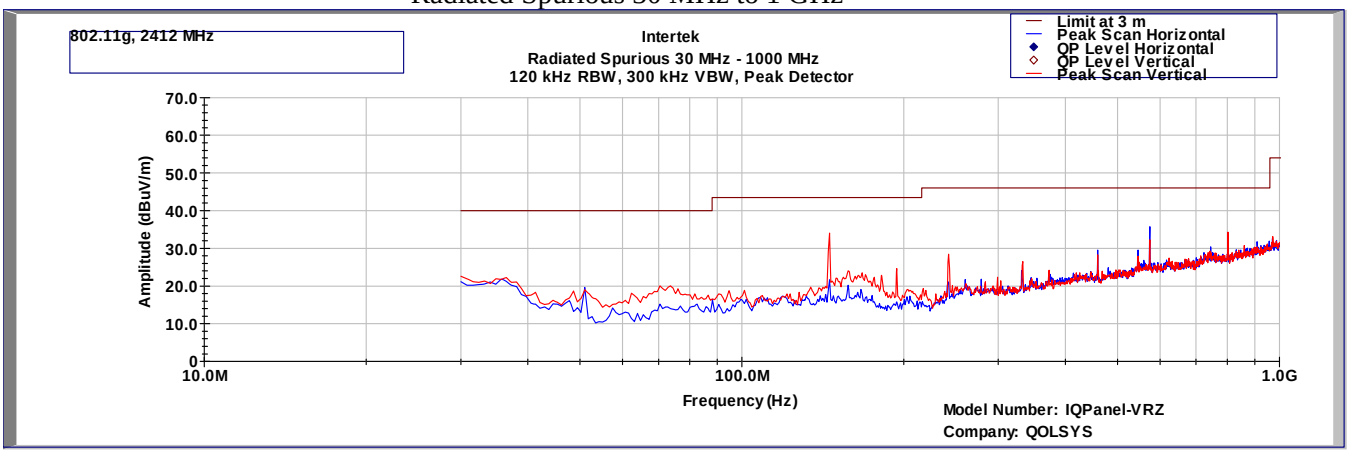


Radiated Spurious 18 GHz to 26 GHz

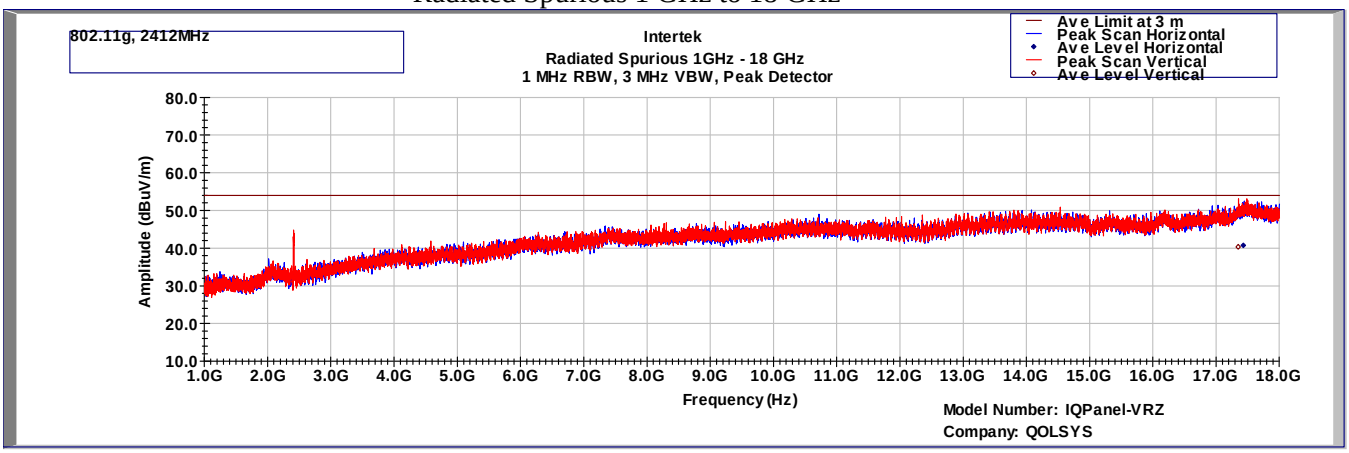


Tx @ 2412MHz 802.11g, 6 Mbps

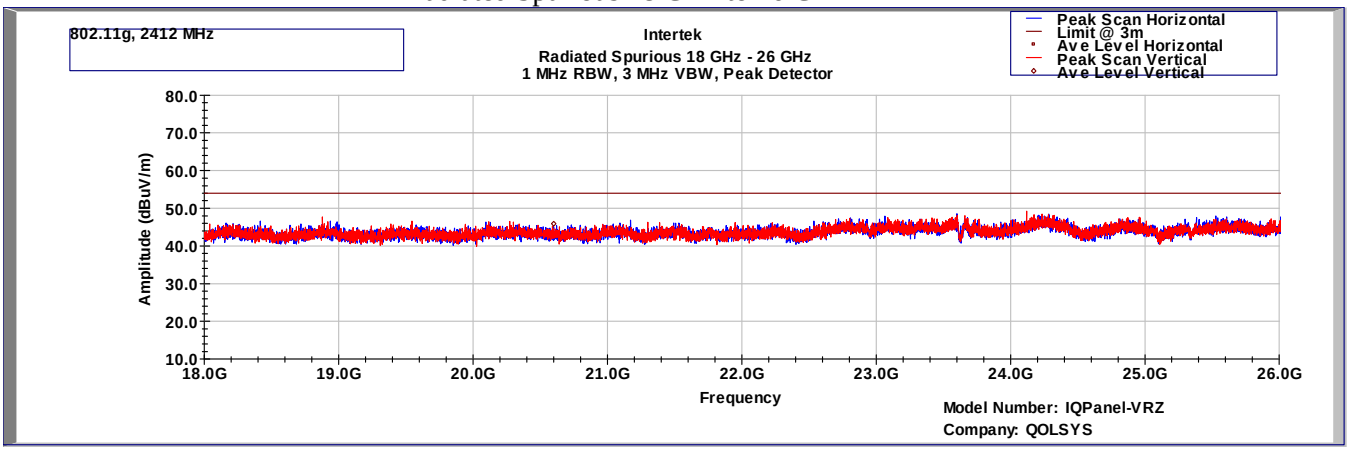
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

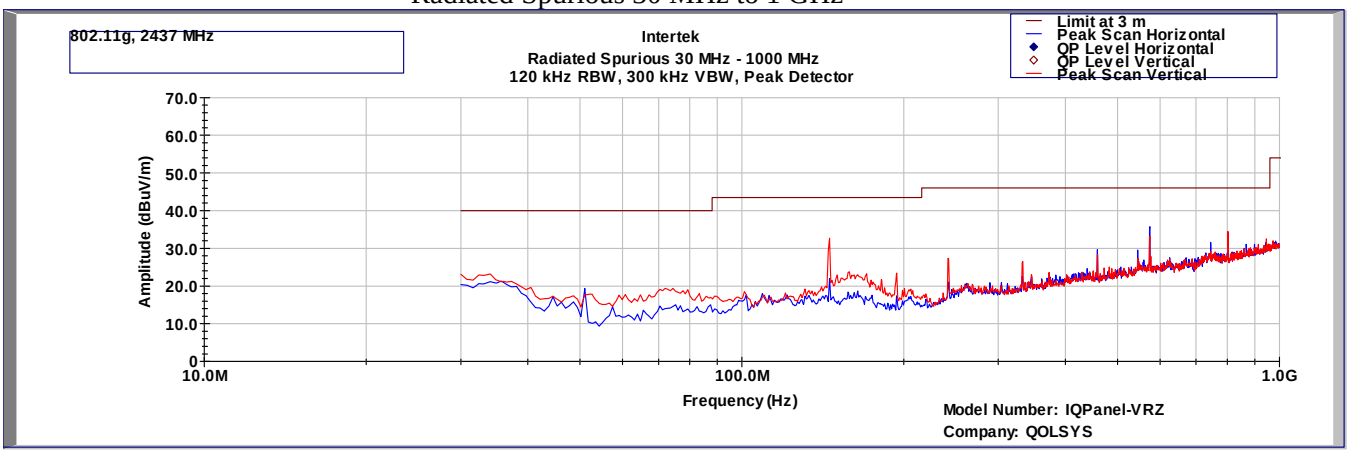


Radiated Spurious 18 GHz to 26 GHz

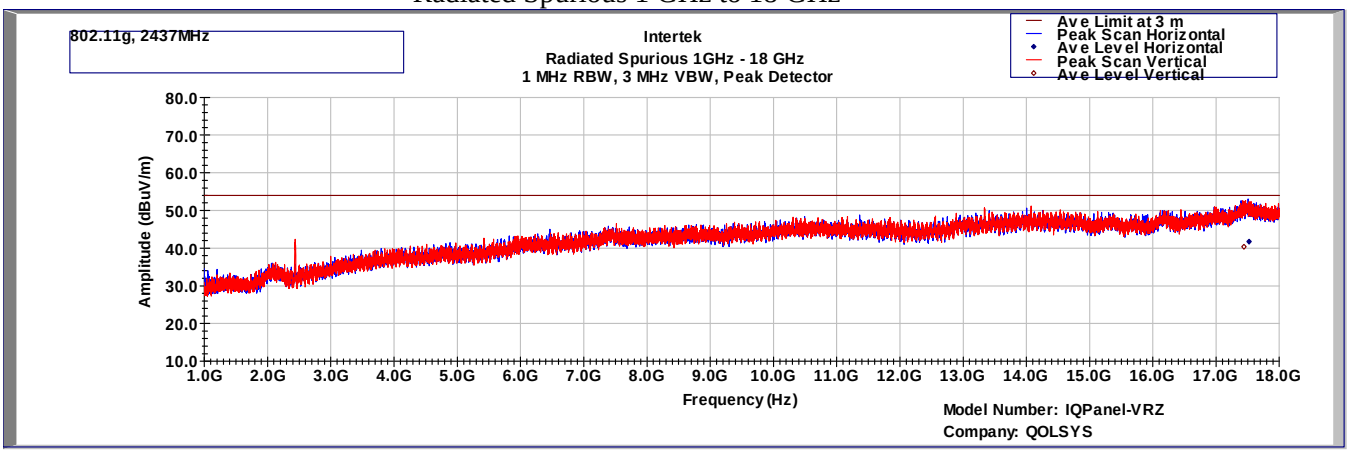


Tx @ 2437MHz 802.11g, 6 Mbps

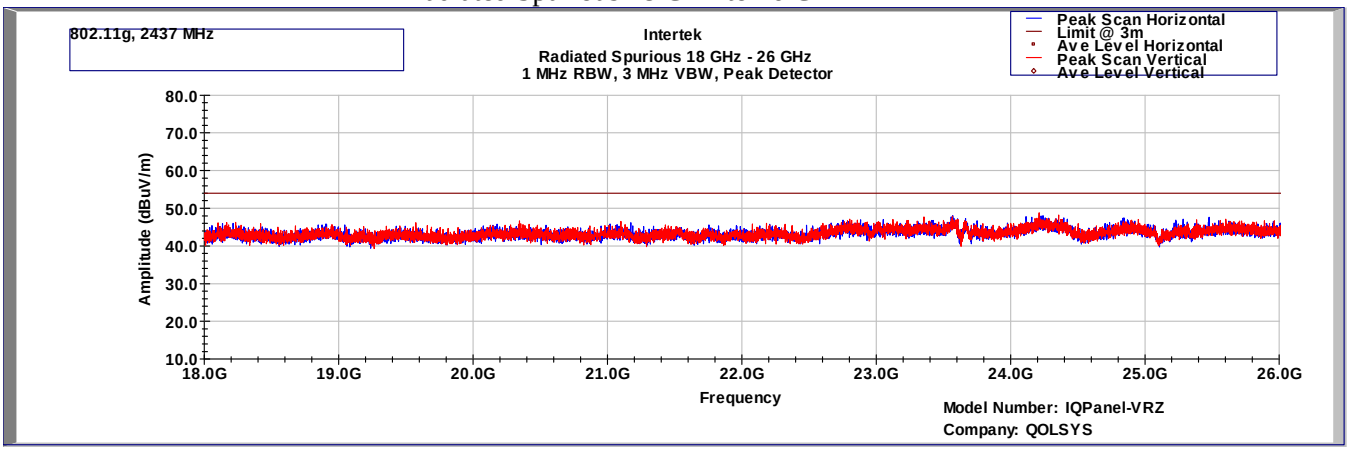
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

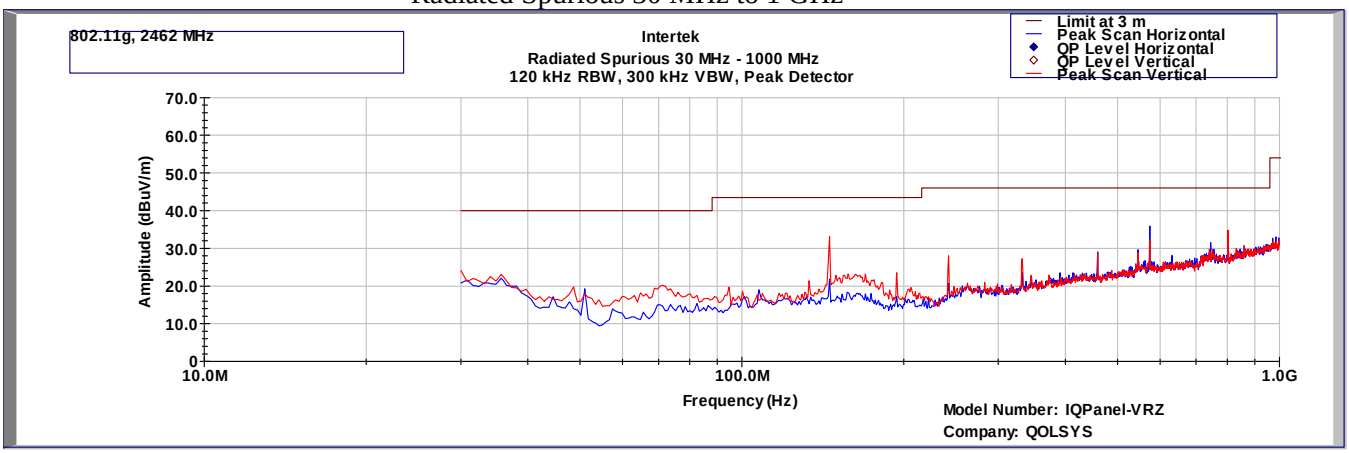


Radiated Spurious 18 GHz to 26 GHz

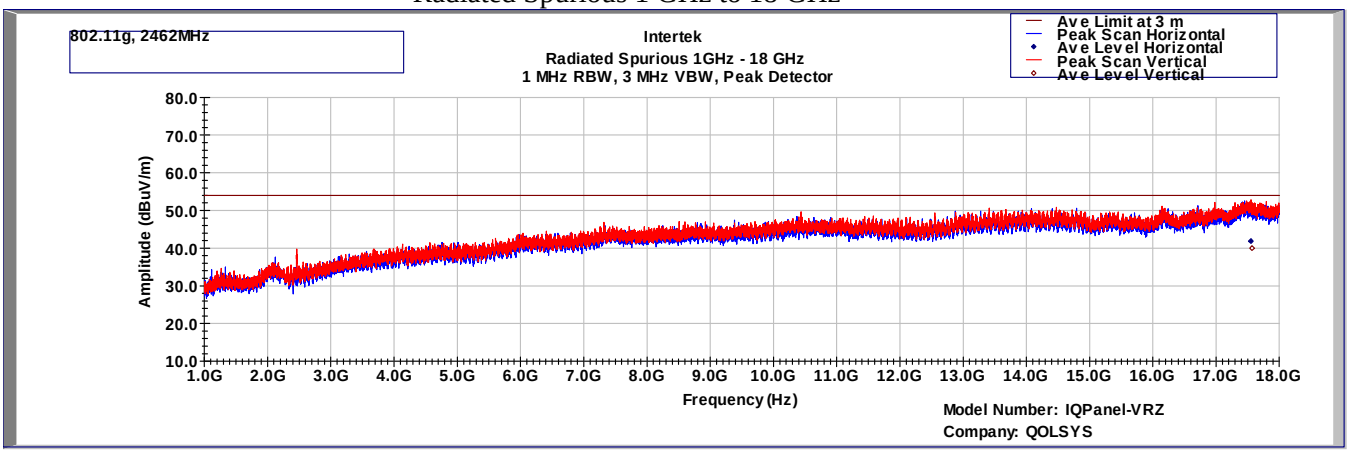


Tx @ 2462MHz 802.11g, 6 Mbps

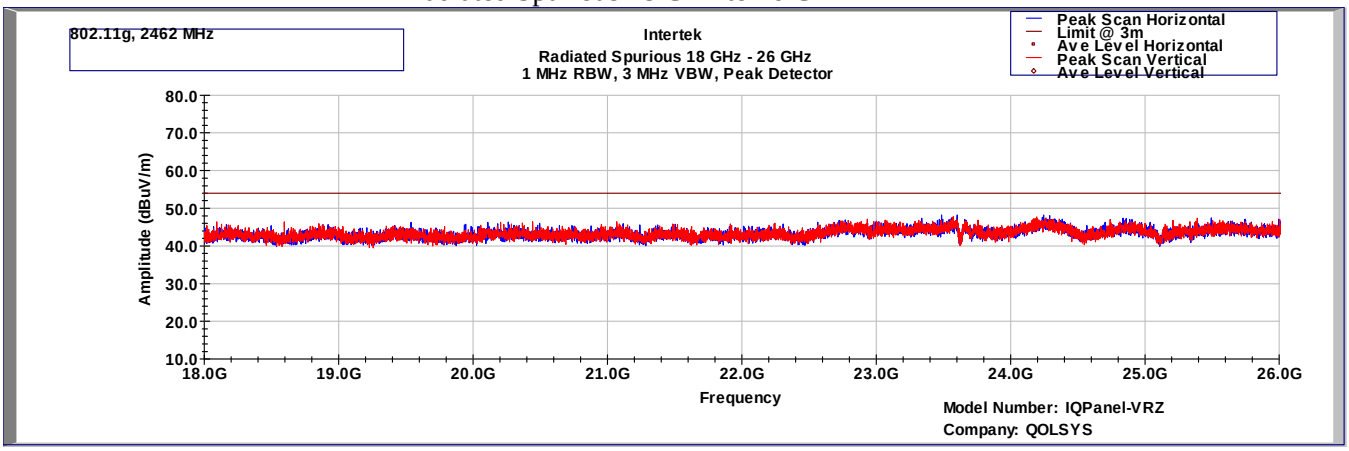
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

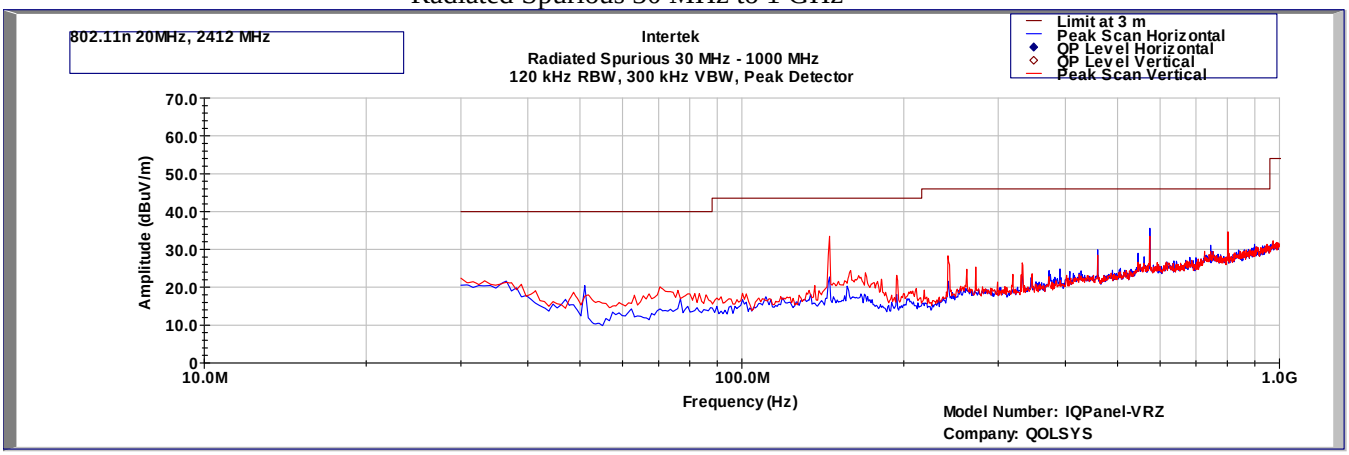


Radiated Spurious 18 GHz to 26 GHz

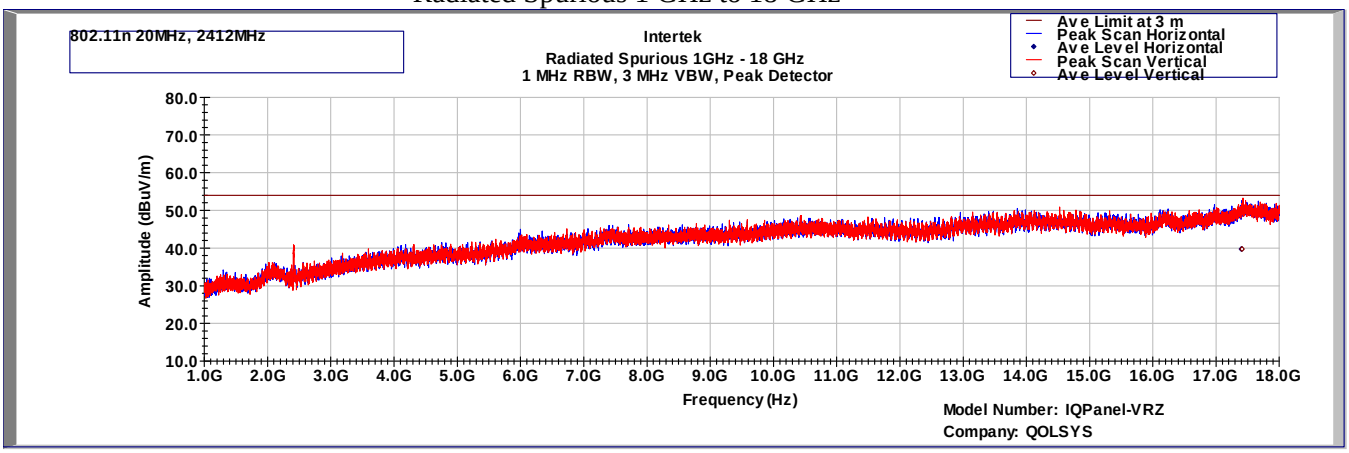


Tx @ 2412MHz 802.11n, HT20, MCS0

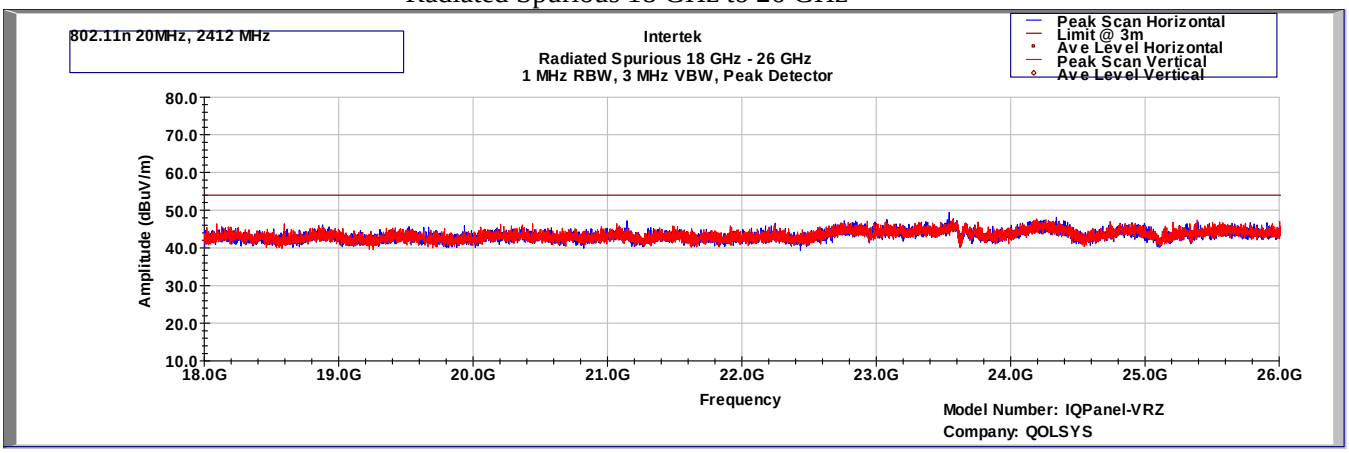
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

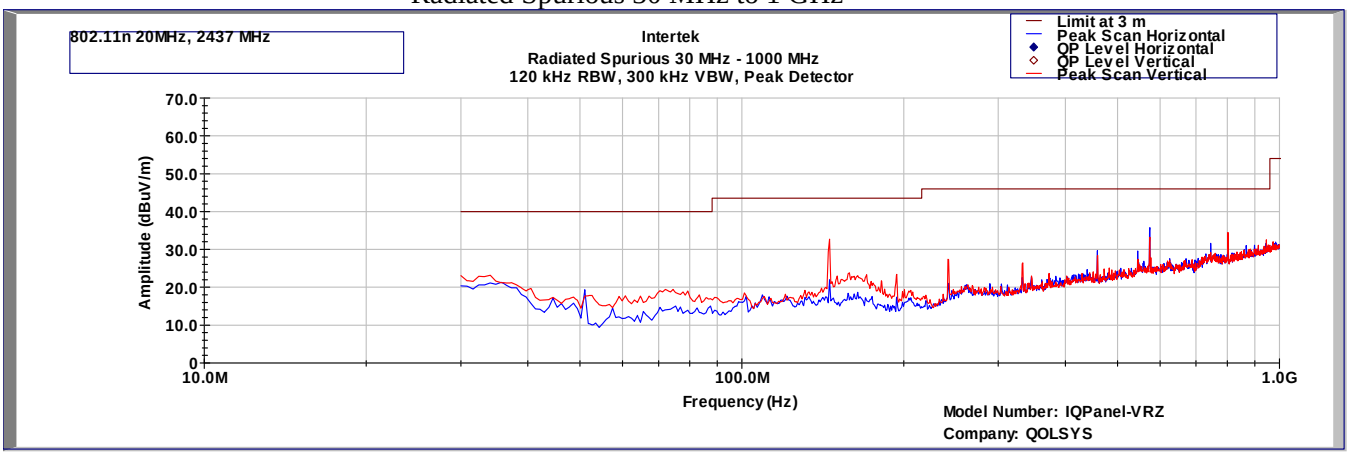


Radiated Spurious 18 GHz to 26 GHz

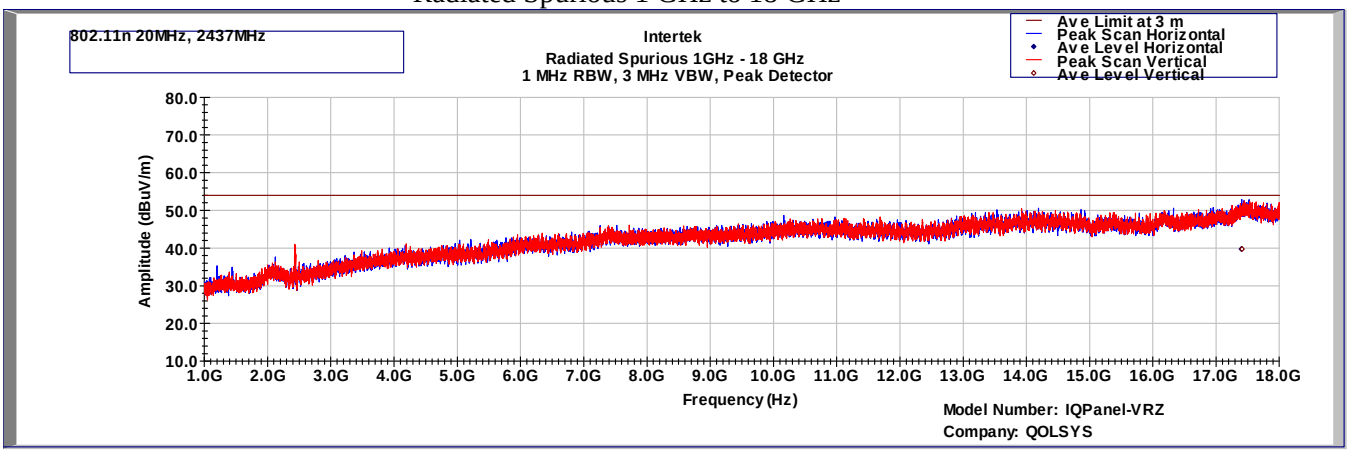


Tx @ 2437MHz 802.11n, HT20, MCS0

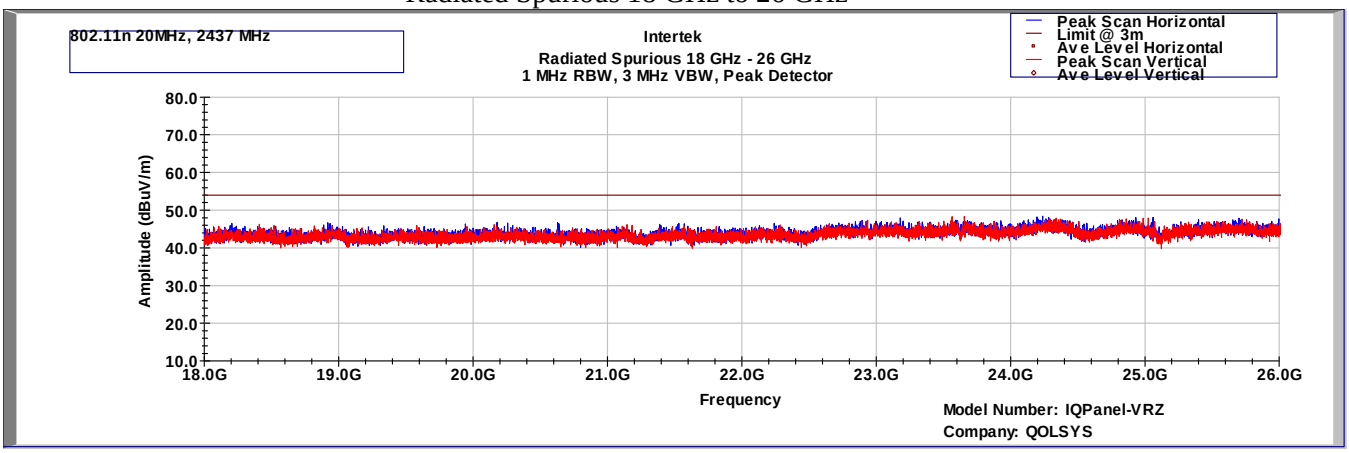
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

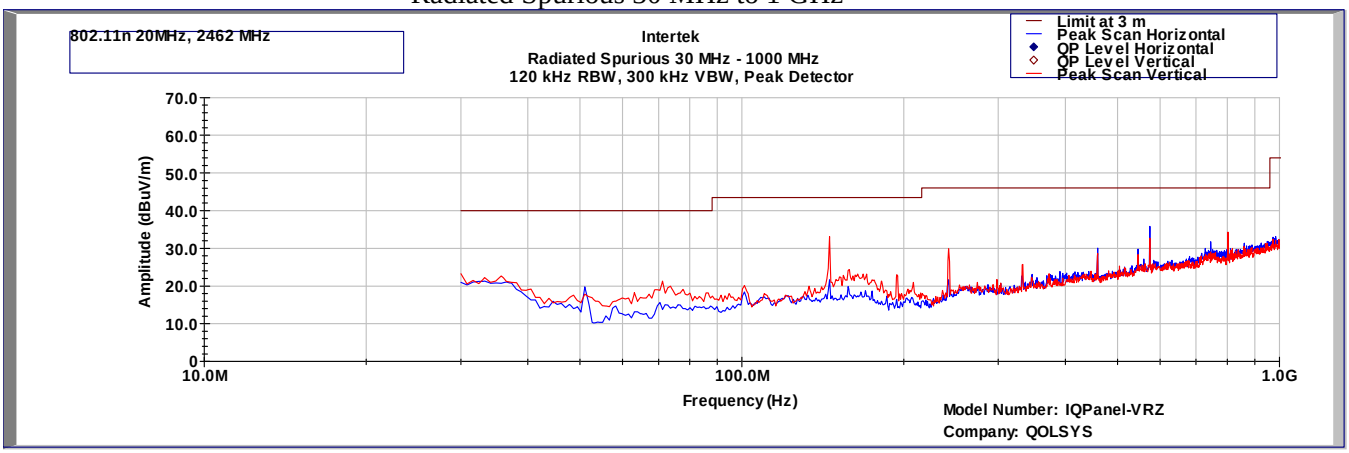


Radiated Spurious 18 GHz to 26 GHz

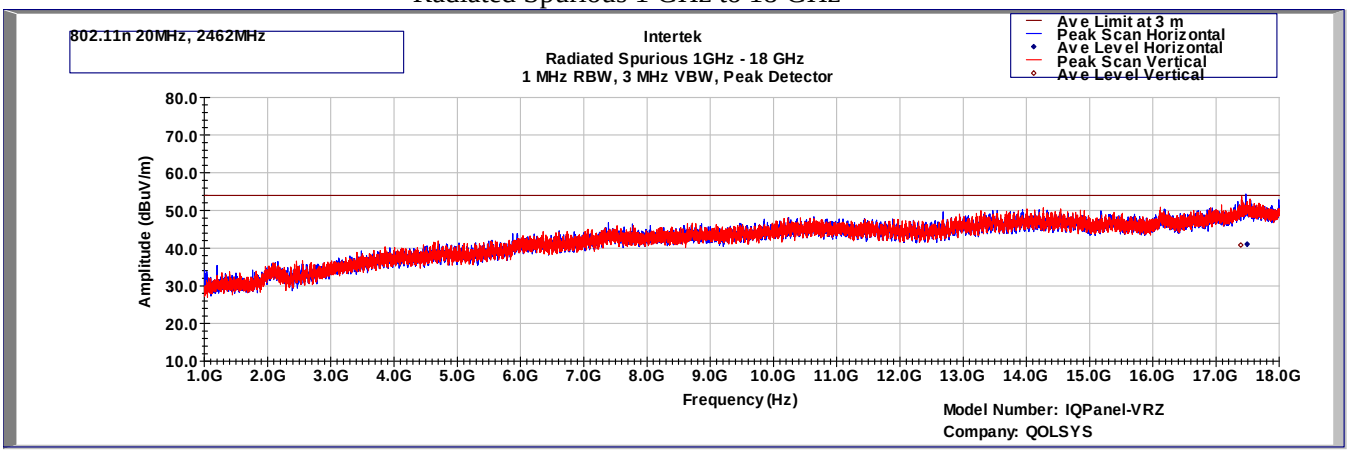


Tx @ 2462MHz 802.11n, HT20, MCS0

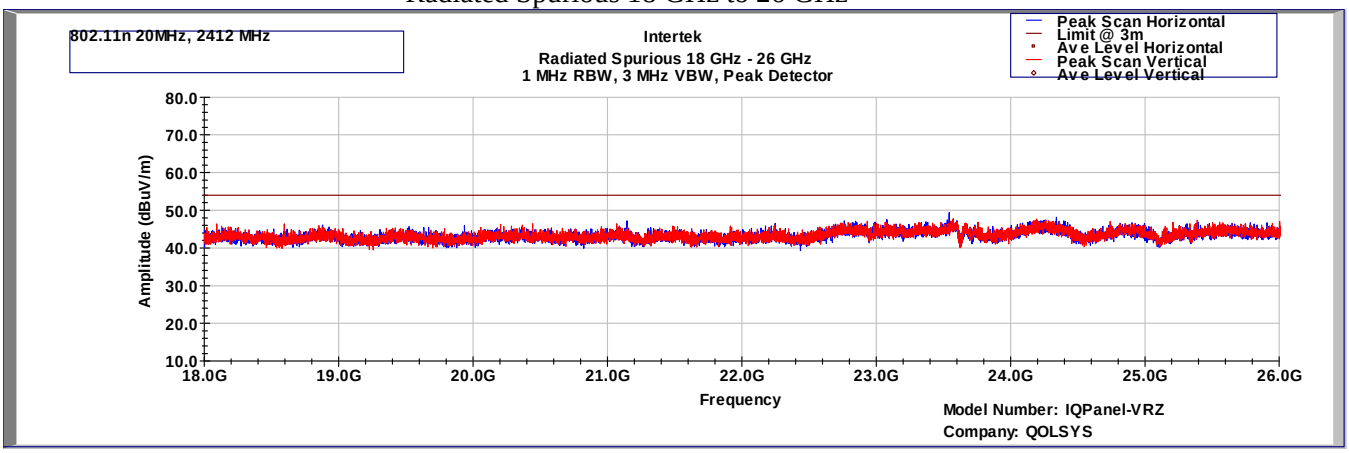
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

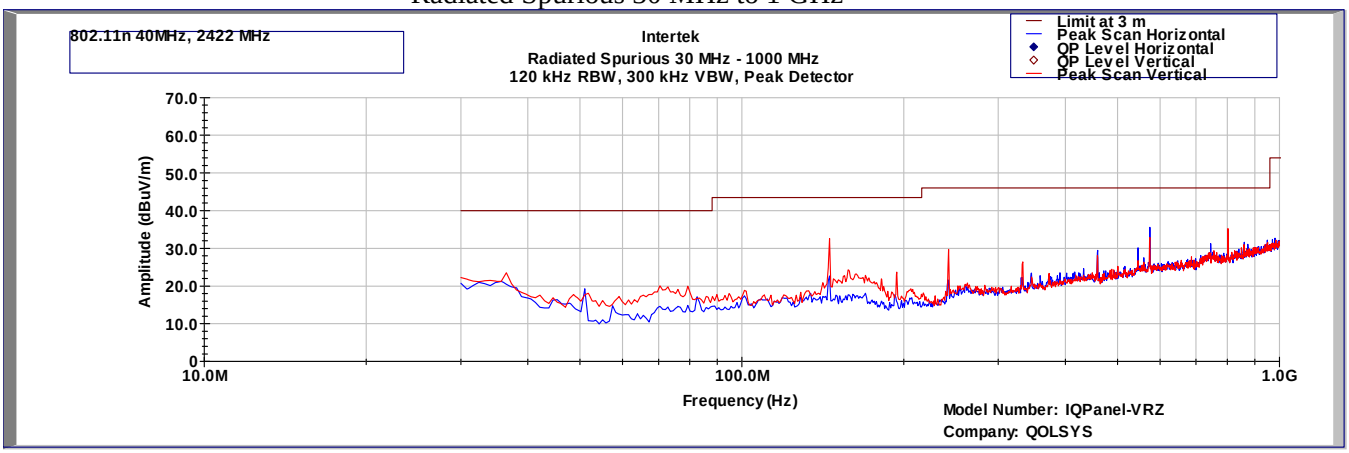


Radiated Spurious 18 GHz to 26 GHz

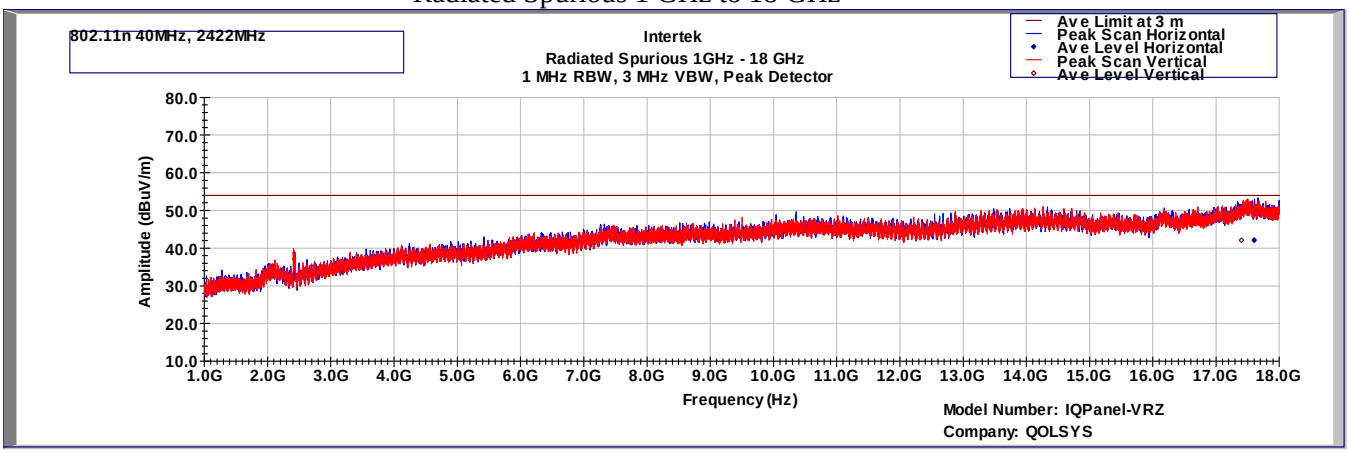


Tx @ 2422MHz 802.11n, HT40, MCS0

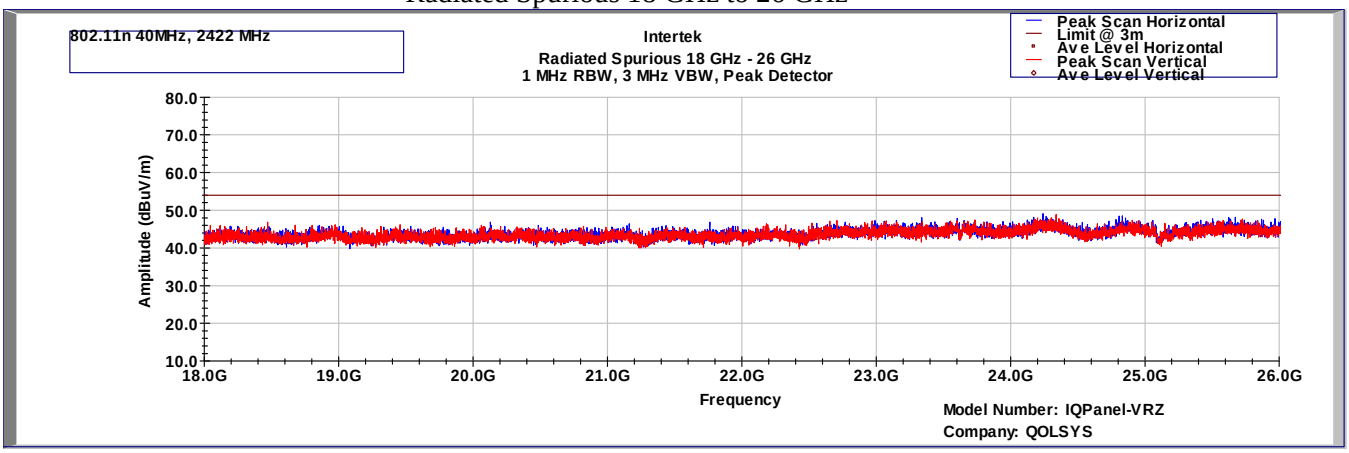
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

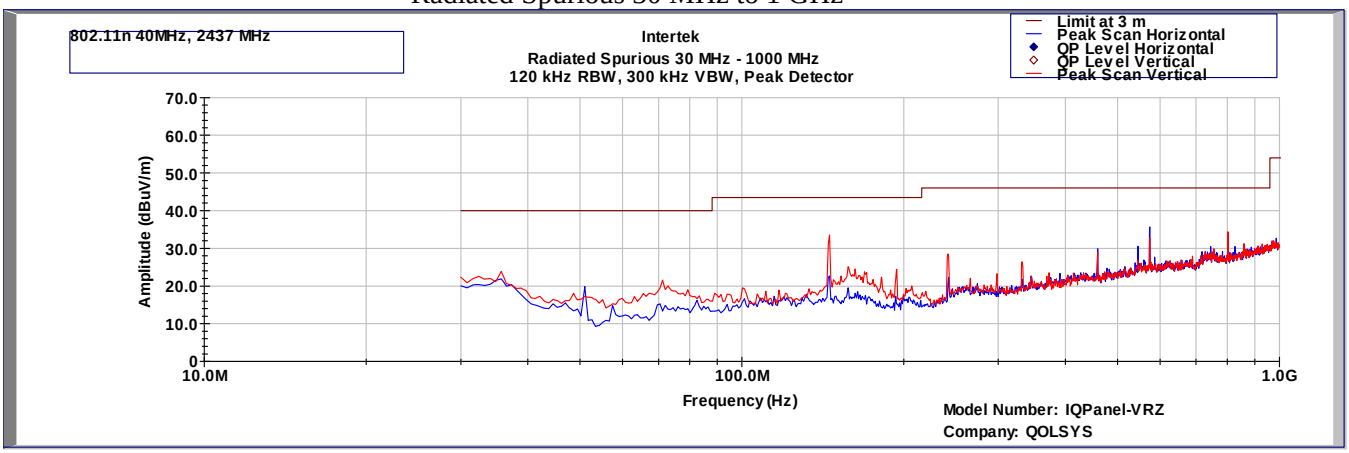


Radiated Spurious 18 GHz to 26 GHz

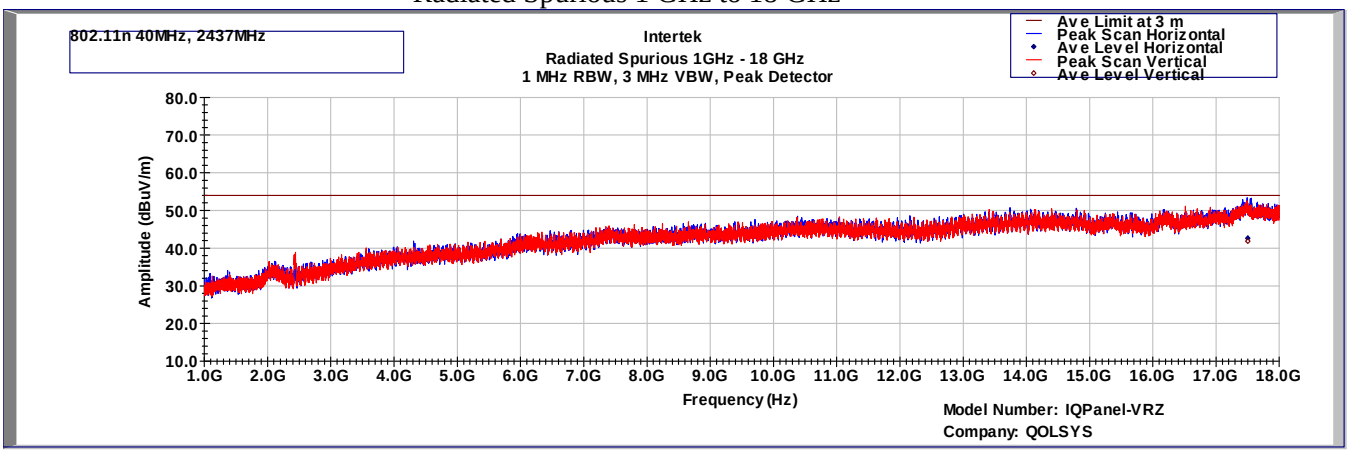


Tx @ 2437MHz 802.11n, HT40, MCS0

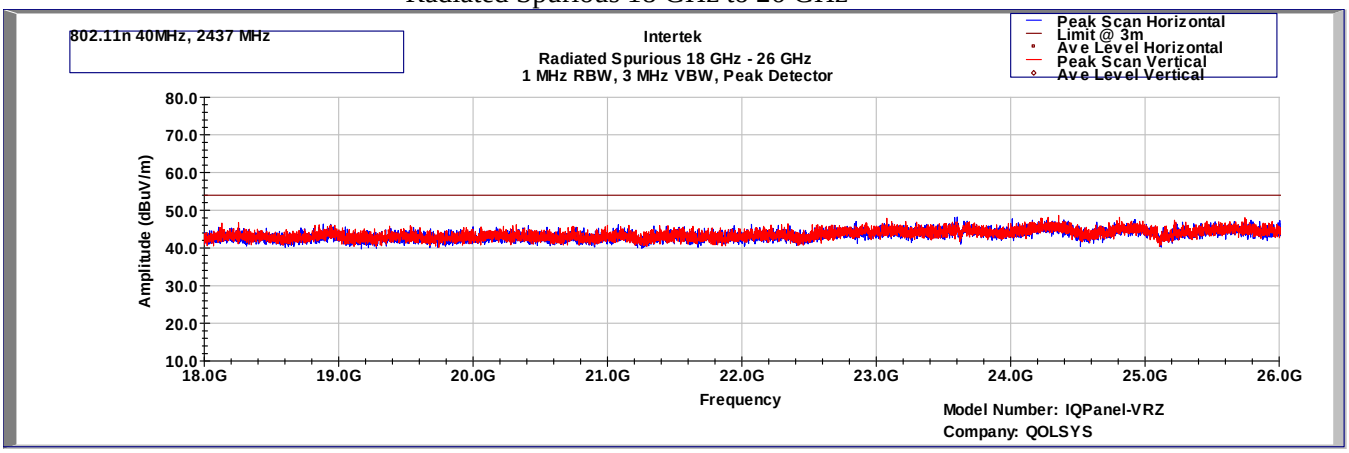
Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz

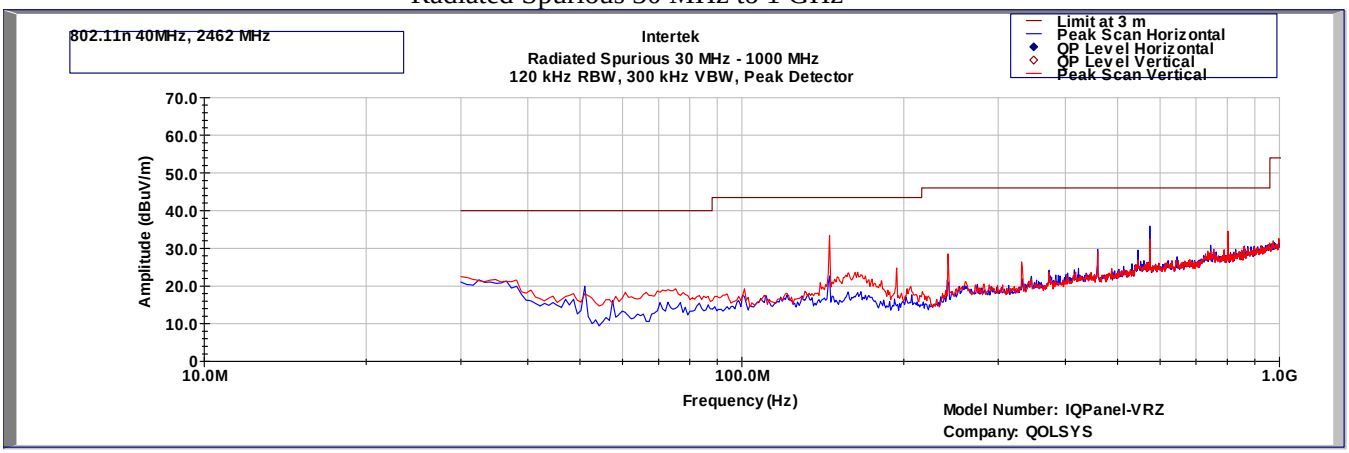


Radiated Spurious 18 GHz to 26 GHz

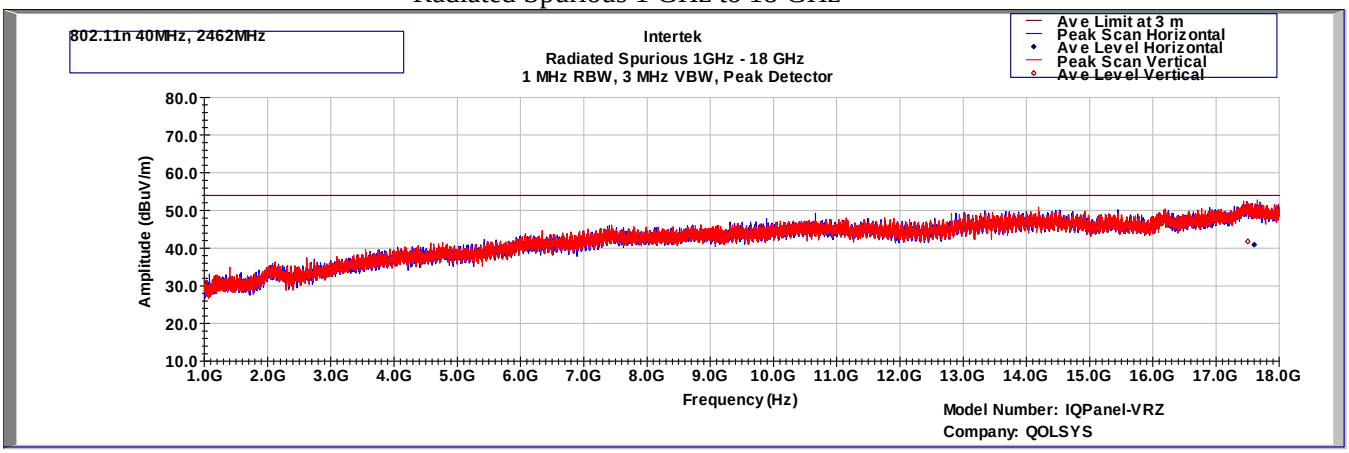


Tx @ 2462MHz 802.11n, HT40, MCS0

Radiated Spurious 30 MHz to 1 GHz



Radiated Spurious 1 GHz to 18 GHz



Radiated Spurious 18 GHz to 26 GHz

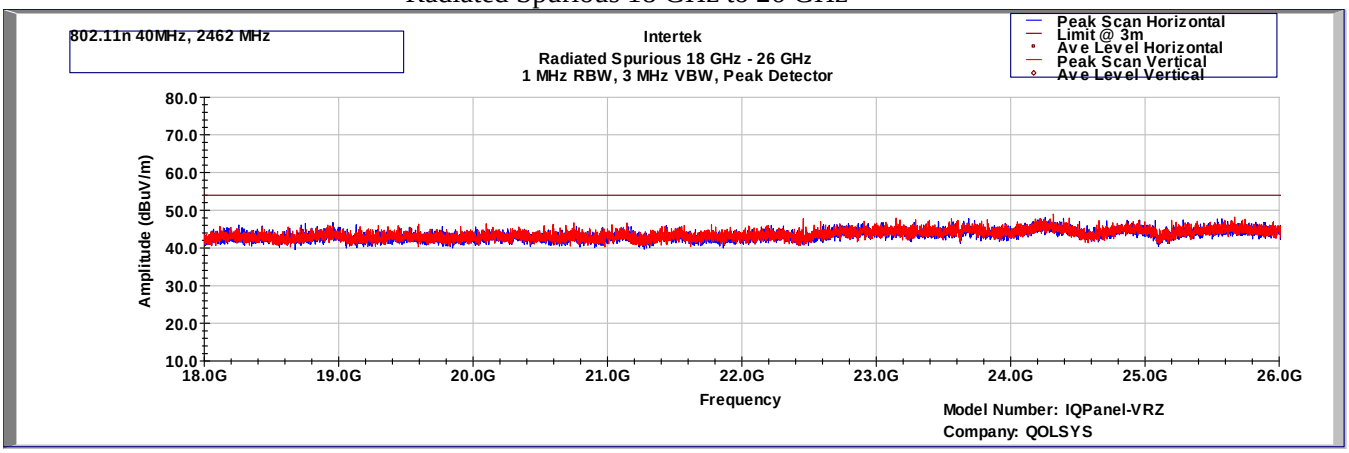


Table 5.1
Out-of-Band Radiated spurious emissions at the Band-edge
2310–2390 MHz

Standard	Detector	EUT Channel	Frequency	Raw Amplitude	Corr. Factor	FS at 3m	FS Limit	Margin
			MHz	dB(uV)	dB	dB(uV/m)	dB(uV/m)	dB
802.11b	Peak	1	2412	32.95	31.04	63.99	74	-10.01
	Avg	1	2412	14.21	31.04	45.25	54	-8.75
802.11g	Peak	1	2412	33.29	31.04	64.33	74	-9.67
	Avg	1	2412	14.48	31.04	45.52	54	-8.48
802.11n HT20	Peak	1	2412	35.21	31.04	66.25	74	-7.75
	Avg	1	2412	14.03	31.04	45.07	54	-8.93
802.11 HT40	Peak	3	2422	28.36	31.04	59.40	74	-14.6
	Avg	3	2422	13.62	31.04	44.66	54	-9.34

a) Factor @ 2.39GHz= Cable loss + Antenna factor
b) FS at 3m = SA reading + Correction Factor

Table 5.2
Out-of-Band Radiated spurious emissions at the Band-edge
2483.5–2500 MHz

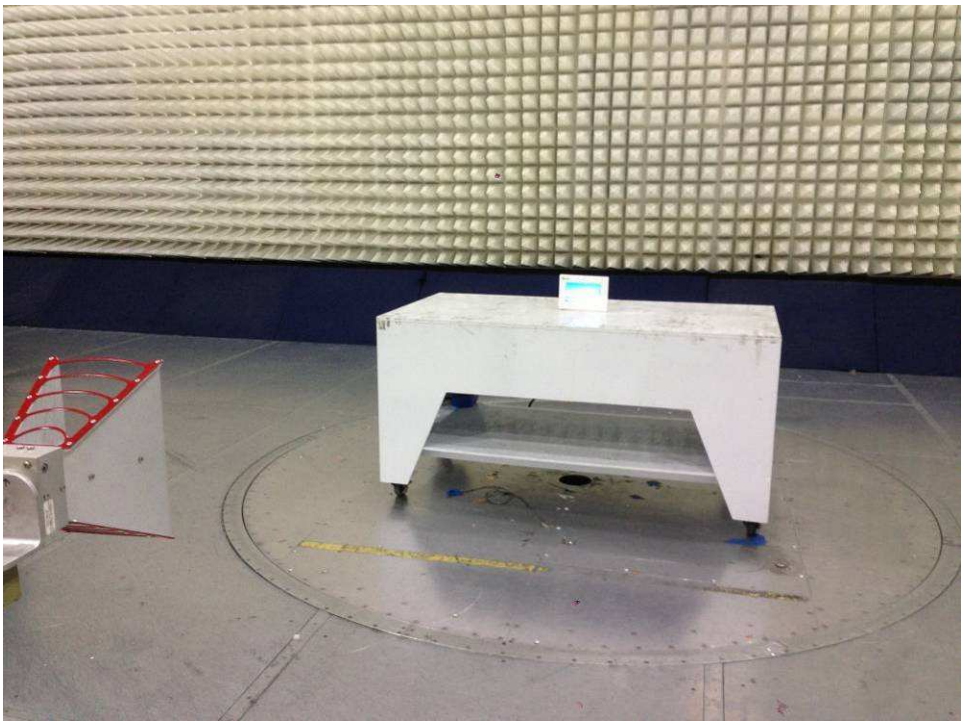
Standard	Detector	EUT Channel	Frequency	Raw Amplitude	Corr. Factor	FS at 3m	FS Limit	Margin
			MHz	dB(uV)	dB	dB(uV/m)	dB(uV/m)	dB
802.11b	Peak	11	2462	33.87	31.52	65.39	74	-8.61
	Avg	11	2462	14.67	31.52	46.19	54	-7.81
802.11g	Peak	11	2462	34.47	31.52	65.99	74	-8.01
	Avg	11	2462	14.73	31.52	46.25	54	-7.75
802.11n HT20	Peak	11	2462	34.82	31.52	66.34	74	-7.66
	Avg	11	2462	13.92	31.52	45.44	54	-8.56
802.11 HT40	Peak	11	2462	32.10	31.52	63.62	74	-10.38
	Avg	11	2462	15.54	31.52	47.06	54	-6.94

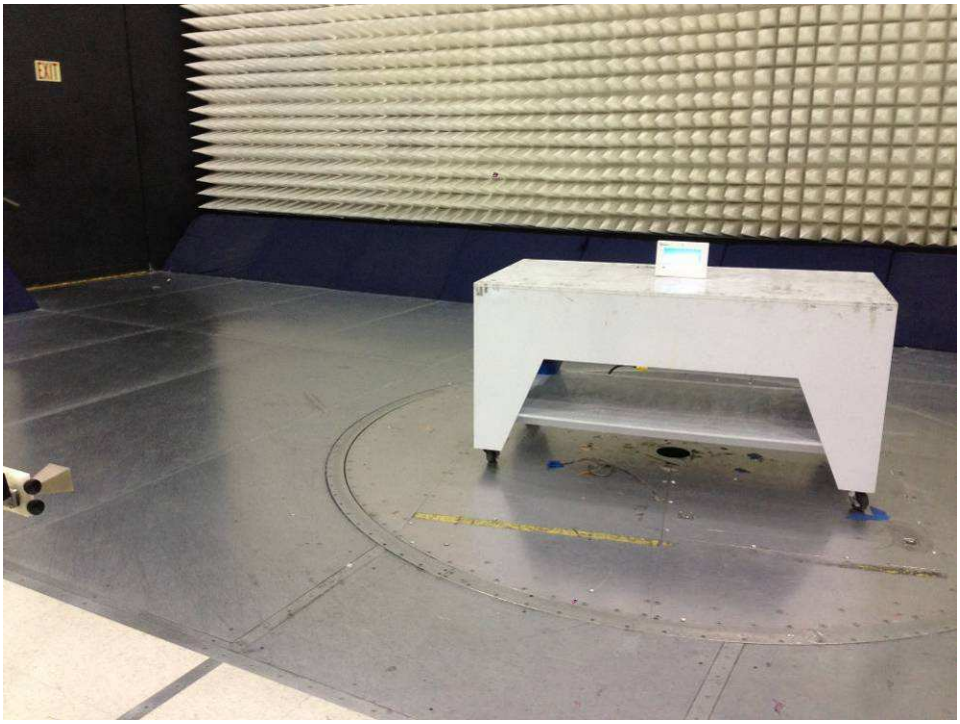
a) Correction Factor @ 2483.5MHz=Cable loss + Antenna factor
b) FS at 3m = SA reading + Correction Factor

4.5.4 Test Setup Photographs

The following photographs show the testing configurations used.

4.5.4 Test Setup Photographs





4.6 AC Line Conducted Emission
FCC 15.207

4.6.1 Requirement

Frequency Band MHz	Class B Limit dB (μV)	
	Quasi-Peak	**Average**
0.15-0.50	66 to 56 Decreases linearly with the logarithm of the frequency	56 to 46 Decreases linearly with the logarithm of the frequency
0.50-5.00	56	46
5.00-30.00	60	50

Note: At the transition frequency the lower limit applies.

4.6.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

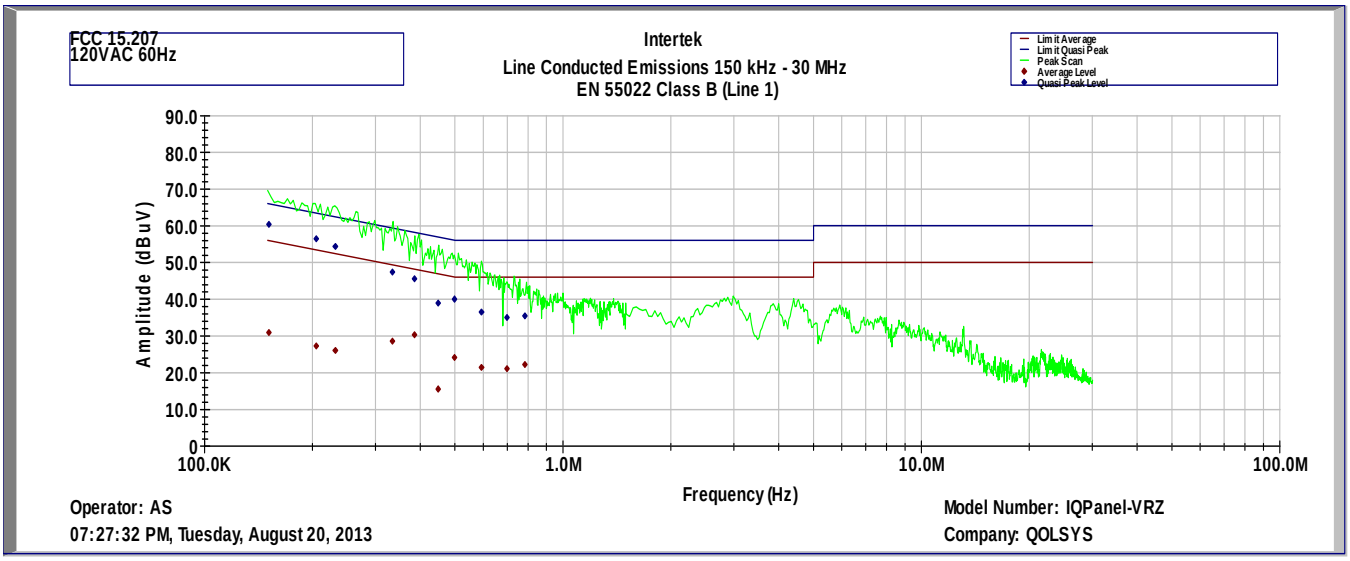
The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

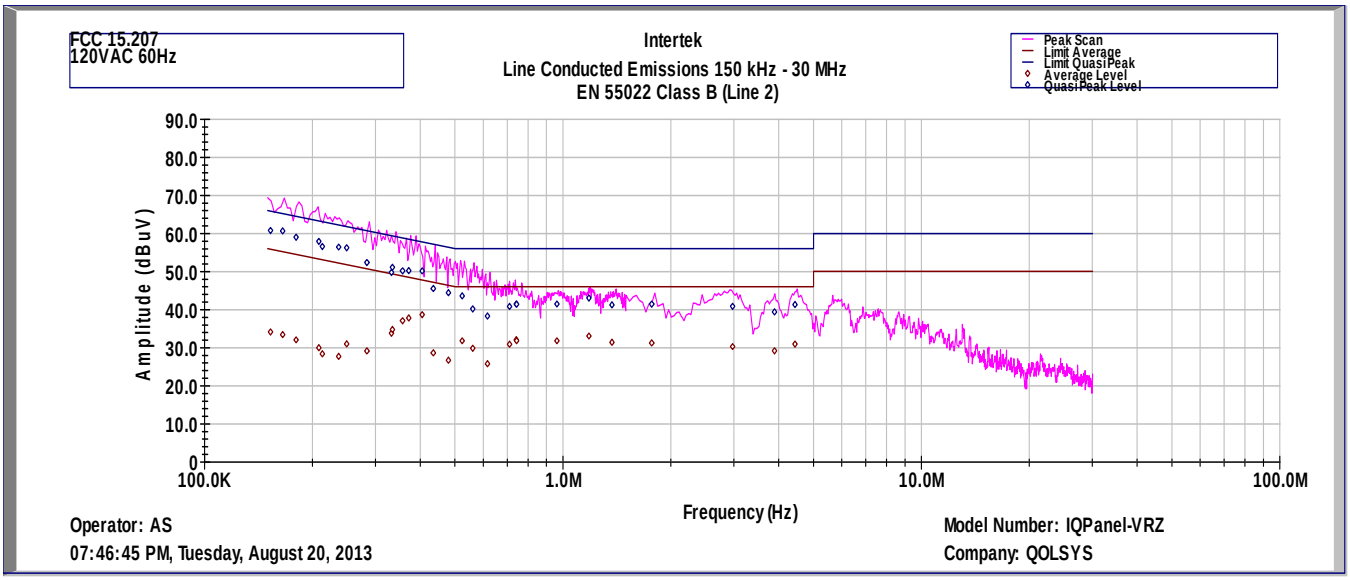
Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4.

4.6.3 Test Result

Conducted Disturbance at AC Mains
Line 1



Conducted Disturbance at AC Mains
Line 2



Conducted Disturbance at AC Mains Line 1

Intertek Testing Services

Line Conducted Emissions 150 kHz - 30 MHz

FCC 15.207 (Line 1)

Model Number: IQPanel-VRZ

Frequency	Av Level	QP Level	Av Limit	QP Limit	Av Margin	QP Margin
Hz	dBuV	dBuV	dBuV	dBuV	dB	dB
151290	30.9	60.3	56	66	-25.1	-5.6
205160	27.3	56.4	54.4	64.4	-27.1	-8.0
231770	26.1	54.4	53.7	63.7	-27.6	-9.3
334320	28.6	47.4	50.7	60.7	-22.1	-13.3
385770	30.3	45.5	49.3	59.3	-18.9	-13.7
448870	15.5	38.9	47.5	57.5	-31.9	-18.5
498610	24.1	40.0	46	56	-21.9	-16.0
592940	21.4	36.5	46	56	-24.6	-19.5
697790	21.1	35.0	46	56	-24.9	-21.0
783020	22.2	35.4	46	56	-23.8	-20.6

120VAC 60Hz

Conducted Disturbance at AC Mains Line 2

Intertek Testing Services

Line Conducted Emissions 150 kHz - 30 MHz

FCC 15.207 (Line 2)

Model Number: IQPanel-VRZ

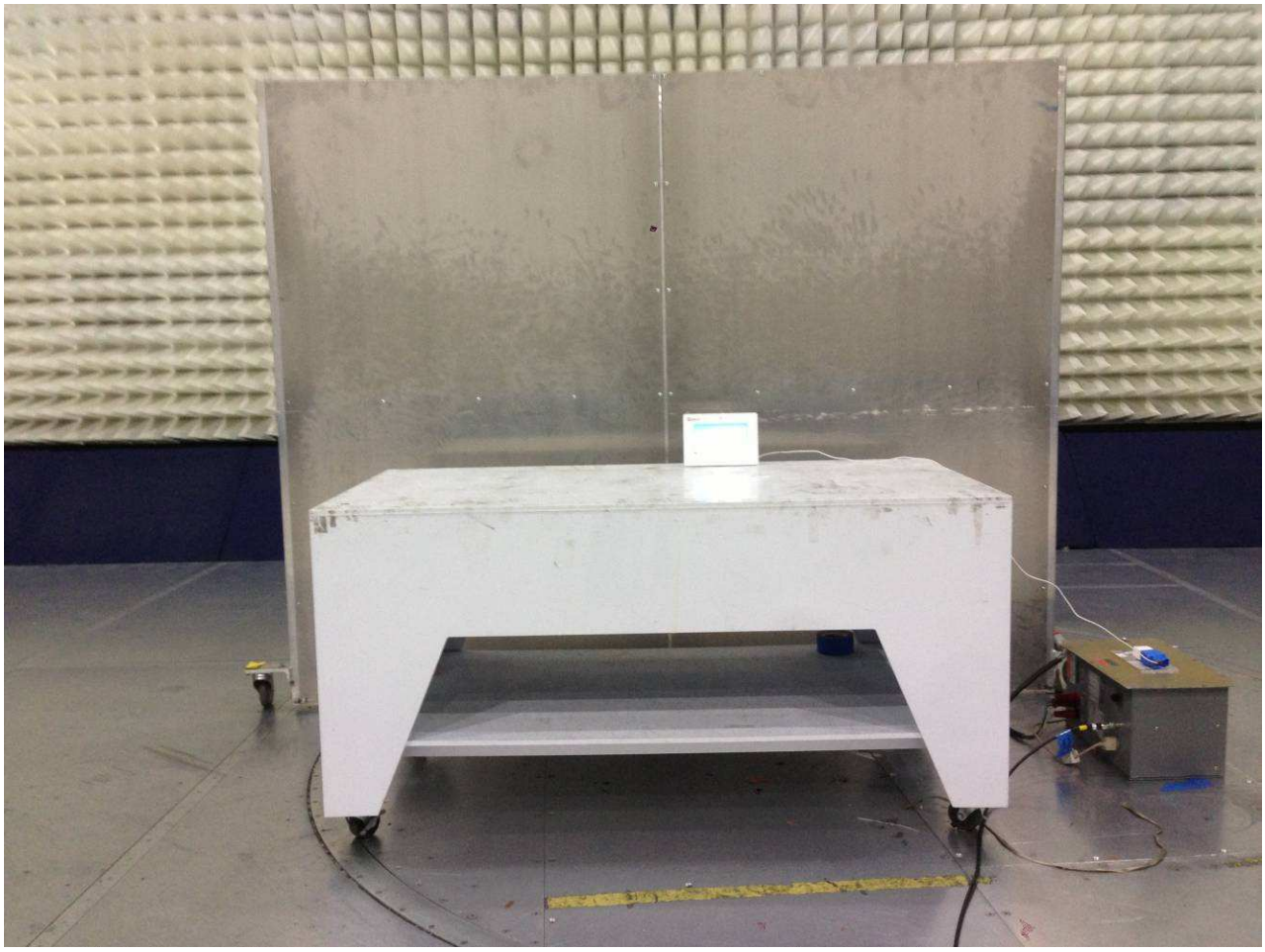
Frequency	Av Level	QP Level	Av Limit	QP Limit	Av Margin	QP Margin
Hz	dBuV	dBuV	dBuV	dBuV	dB	dB
152841	34.2	60.8	55.9	65.9	-21.8	-5.1
165414	33.4	60.6	55.6	65.6	-22.1	-4.9
180271	32.0	59.0	55.1	65.1	-23.1	-6.1
208490	30.0	57.9	54.3	64.3	-24.4	-6.4
213320	28.4	56.6	54.2	64.2	-25.8	-7.6
236790	27.7	56.4	53.5	63.5	-25.8	-7.1
249130	31.0	56.2	53.2	63.2	-22.2	-6.9
284050	29.1	52.4	52.2	62.2	-23.0	-9.8
332290	33.8	49.7	50.8	60.8	-17.0	-11.0
334720	34.8	51.1	50.7	60.7	-15.9	-9.6
356790	37.1	50.2	50.1	60.1	-13.0	-9.9
371650	37.8	50.2	49.7	59.7	-11.9	-9.5
404700	38.7	50.2	48.7	58.7	-10.1	-8.6
434840	28.6	45.5	47.9	57.9	-19.2	-12.3
479620	26.7	44.4	46.6	56.6	-19.9	-12.2
523290	31.8	43.6	46	56	-14.2	-12.4
560480	29.9	40.2	46	56	-16.1	-15.8
615710	25.8	38.3	46	56	-20.2	-17.7
709850	30.9	40.8	46	56	-15.1	-15.2
741010	32.1	41.5	46	56	-13.9	-14.5
742030	31.8	41.4	46	56	-14.2	-14.6
961530	31.8	41.5	46	56	-14.2	-14.5
1.18E+06	33.1	43.1	46	56	-12.9	-12.9
1.37E+06	31.4	41.2	46	56	-14.6	-14.8
1.77E+06	31.2	41.4	46	56	-14.8	-14.6
2.97E+06	30.3	40.9	46	56	-15.7	-15.1
3.89E+06	29.2	39.4	46	56	-16.8	-16.6
4.44E+06	31.0	41.3	46	56	-15.0	-14.7

120VAC 60Hz

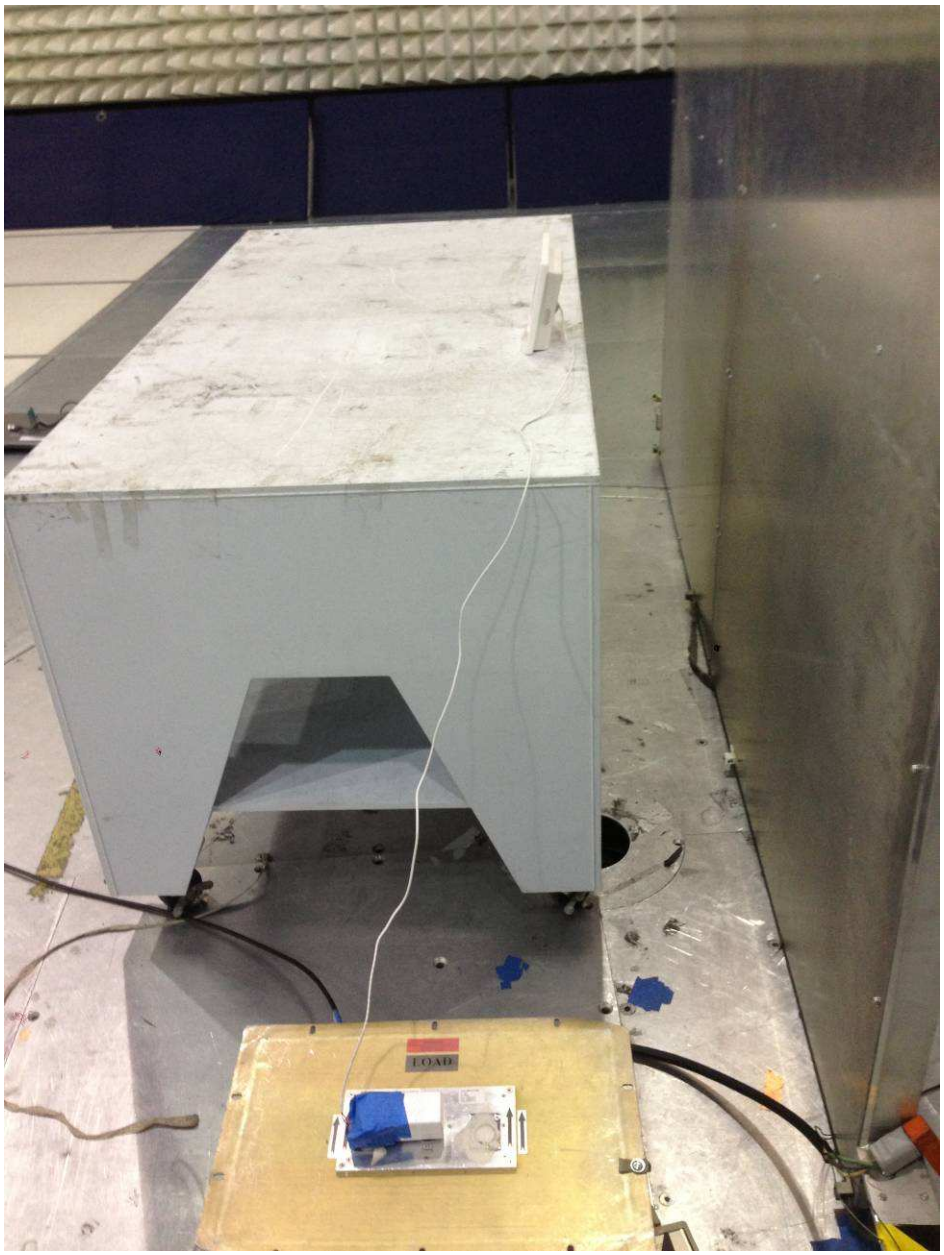
Results	**Complies** by 4.9 dB

4.6.4 Test Configuration Photographs

The following photographs show the testing configurations used.



4.6.4 Test Configuration Photographs (continued)



5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due
Spectrum Analyzer	Rohde&Schwarz	ESU	100172	12	10/05/13
Pyramidal Horn Antenna	EMCO	3160-09	Not Labeled	#	#
Pyramidal Horn Antenna	EMCO	3160-10	Not Labeled	#	#
Pre-Amplifier	Sonoma	310N	293620	12	11/11/12
Pre-Amplifier	Miteq	JSD44-18004000-30-5P	1071636	12	05/13/14
Signal Generator	Hewlett Packard	SMR40	100445	12	09/06/13
RF Filter Section	Hewlett Packard	85460A	3448A00267	12	03/12/14
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	03/12/14
Bilog Antenna	Teseq	CBL 6111D	31222	12	11/07/13
Pre-Amplifier	Sonoma Instrument	310	185634	12	12/12/13
LISN	FCC	FCC-LISN-50-50-M-H	2011	12	02/28/14
Spectrum Analyzer	Rohde and Schwartz	FSP	100030	12	11/19/13
Horn Antenna	ETS Lindgren	3115	00126795	12	11/15/13
Pre-Amplifier (1-18GHz)	Miteq	AMF-4D-001180-24-10P	799159	12	09/10/13
Spectrum Analyzer	Rohde and Schwarz	FSU	200482	12	04/05/14

No Calibration required

6.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / G100825363	AS	August 22, 2013	Original document