

# RF TEST REPORT

Test item : Wi-Fi Module  
Model No. : TWFM-B001T  
Order No. : 1011-01162  
Date of receipt : 2010-11-03  
Test duration : 2010-11-25 ~ 2010-12-03  
Date of issue : 2010-12-14  
Use of report : FCC Original Grant

Applicant : LG Innotek Co., Ltd.  
978-1, Jangduk-dong, Gwangsan-gu, Gwangju, 506-731, Korea

Test laboratory : Digital EMC Co., Ltd.  
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Kyunggi-Do, 449-080, Korea

Test specification : FCC Part 15.247 Subpart C  
ANSI C63.4-2003

Test environment : See appended test report

Test result :  Pass  Fail

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of Digital EMC Co., Ltd.

Tested by:

Witnessed by:

Reviewed by:



Engineer  
B.G.HAN

N/A



Technical Director  
Harvey Sung

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## 1. Equipment information

### 1.1 Equipment description

FCC Equipment Class	Digital Transmission System (DTS)
Equipment type	Wi-Fi Module
Equipment model name	TWFM-B001T
Equipment add model name	TWFM-B002T, TWFM-B003T, TWFM-B004T
Equipment serial no.	Identical prototype
Frequency band	2.4GHz Band <ul style="list-style-type: none"> <li>▪ 802.11b/g/n(20MHz): 2412 ~ 2462 MHz</li> <li>▪ 802.11n(40MHz): 2422~2452 MHz</li> </ul> 5GHz Band <ul style="list-style-type: none"> <li>▪ 802.11a/n(20MHz): 5745~5825 MHz</li> <li>▪ 802.11n(40MHz): 5755~5795 MHz</li> </ul>
Channel number	2.4GHz Band <ul style="list-style-type: none"> <li>▪ 802.11b/g/n(20MHz): 11</li> <li>▪ 802.11n(40MHz): 9</li> </ul> 5GHz Band <ul style="list-style-type: none"> <li>▪ 802.11a/n(20MHz): 5</li> <li>▪ 802.11n(40MHz): 2</li> </ul>
Modulation type	802.11b: DSSS/CCK 802.11a/g/n: OFDM
Data rate	802.11b: 1, 2, 5.5, 11 Mbps 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11n: 6.5, 13, 19.5, 39, 52, 58.5, 65Mbps
Antenna type	PIFA Antenna(2TX 2RX) <ul style="list-style-type: none"> <li>▪ 2.4GHz Band Max. peak gain: 1.10 dBi</li> <li>▪ 5GHz Band Max. peak gain: 0.99 dBi</li> </ul>
Power Supply	DC 5.0 V

### 1.2 Ancillary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
-	-	-	-	-
-	-	-	-	-

## 2. Information about test items

### 2.1 Test mode

Test Case 1	-
Test Case 2	-

### 2.2 Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
Notebook	X51RL	85N0AS318314227	ASUSTeK Computer Inc.	-
Mouse	M-UAG120	810-000404	ASUSTeK Computer Inc.	-

### 2.3 Frequency / Channel information & Antenna configuration

#### ▪ Frequency / Channel information

Band	Mode	Channel No.	Freq. [MHz]	Channel No.	Freq. [MHz]	Channel No.	Freq. [MHz]
2.4GHz	802.11b/g/n(20MHz)	1	2412	5	2432	9	2452
		2	2417	6	2437	10	2457
		3	2422	7	2442	11	2467
		4	2427	8	2447	-	-
	802.11n(40MHz)	3	2422	6	2437	9	2452
		4	2427	7	2442	-	-
5		2432	8	2447	-	-	
5GHz	802.11a/n(20MHz)	149	5745	157	5785	165	5825
		153	5765	161	5805	-	-
	802.11n(40MHz)	151	5755	159	5795	-	-

#### ▪ Supported Antenna Configuration

Band	Mode	Single Transmitting		Multiple Transmitting (2 TX / 2 RX)
		Chain 0	Chain 1	
2.4GHz	802.11b	Yes	Yes	No
	802.11g	Yes	Yes	No
	802.11n(20MHz)	No	No	Yes
	802.11n(40MHz)	No	No	Yes
5GHz	802.11a	Yes	Yes	No
	802.11n(20MHz)	No	No	Yes
	802.11n(40MHz)	No	No	Yes

### 2.4 Tested environment

Temperature	: 18 ~ 23 °C
Relative humidity content	: 42 ~ 59 % R.H.
Details of power supply	: DC 5.0 V

### 2.5 EMI Suppression Device(s)/Modifications

EMI suppression device(s) added and/or modifications made during testing  
 → None

### 3. Test Report

#### 3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status Note 1
<b>I. Test Items (TX)</b>				
15.247(a)	6 dB Bandwidth	> 500 kHz	Conducted	<b>C</b>
15.247(b)	Transmitter Output Power	< 1Watt		<b>C</b>
15.247(c)	Out of Band Emissions / Band Edge	20dBc in any 100kHz BW		<b>C</b>
15.247(d)	Transmitter Power Spectral Density	< 8dBm / 3kHz		<b>C</b>
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	<FCC 15.209 Limits	Radiated	<b>C</b> Note.2
15.207	AC Conducted Emissions	EN 55022	AC Line Conducted	<b>C</b>
15.203	Antenna Requirements	FCC 15.203	-	<b>C</b>
<p>Note 1: <b>C</b>=Comply    <b>NC</b>=Not Comply    <b>NT</b>=Not Tested    <b>NA</b>=Not Applicable</p> <p>Note 2: This test item was performed in each axis and the worst case data were reported.</p>				

The sample was tested according to the following specification:  
ANSI C-63.4-2003

## 3.2 Transmitter requirements

### 3.2.1 6 dB Bandwidth

#### - Procedure:

The bandwidth at 6 dB below the highest in-band spectral density was measured with a spectrum analyzer connected to the antenna terminal at the highest, middle and the lowest available channels.

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 6dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level.

The marker-delta reading at this point is the 6 dB bandwidth of the emission.

#### - Measurement Data: **Comply**

Mode	Channel	Frequency [MHz]	Test Result [MHz]	
			Chain 0	Chain 1
802.11b	1	2412	<b>8.109</b>	8.109
	6	2437	<b>8.109</b>	8.077
	11	2462	<b>8.109</b>	8.077
802.11g	1	2412	15.128	<b>15.128</b>
	6	2437	15.160	<b>15.160</b>
	11	2462	15.128	<b>15.160</b>
802.11n (20MHz)	1	2412	15.160	<b>16.538</b>
	6	2437	15.160	<b>15.160</b>
	11	2462	15.160	<b>15.128</b>
802.11n (40MHz)	3	2422	35.897	<b>36.458</b>
	6	2437	35.897	<b>36.458</b>
	9	2452	35.978	<b>36.378</b>
802.11a	149	5745	15.641	<b>15.833</b>
	157	5785	15.577	<b>15.673</b>
	165	5825	15.353	<b>15.641</b>
802.11n (20MHz)	149	5745	15.705	<b>17.660</b>
	157	5785	15.673	<b>17.596</b>
	165	5825	15.705	<b>17.660</b>
802.11n (40MHz)	151	5755	36.282	<b>36.410</b>
	159	5795	36.026	<b>36.410</b>

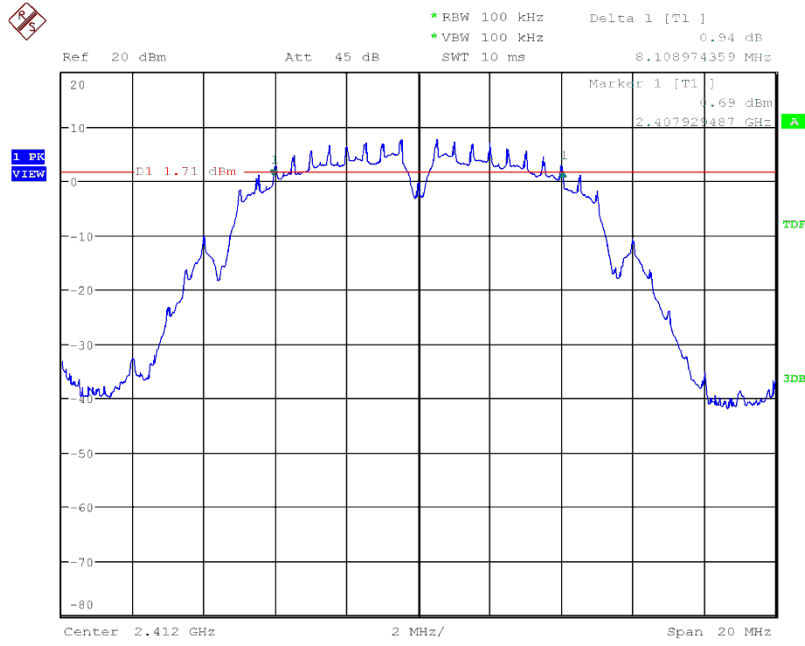
Note 1: The worst case plots are attached on next pages.

#### - Minimum Standard:

The minimum 6 dB bandwidth shall be at least 500 kHz
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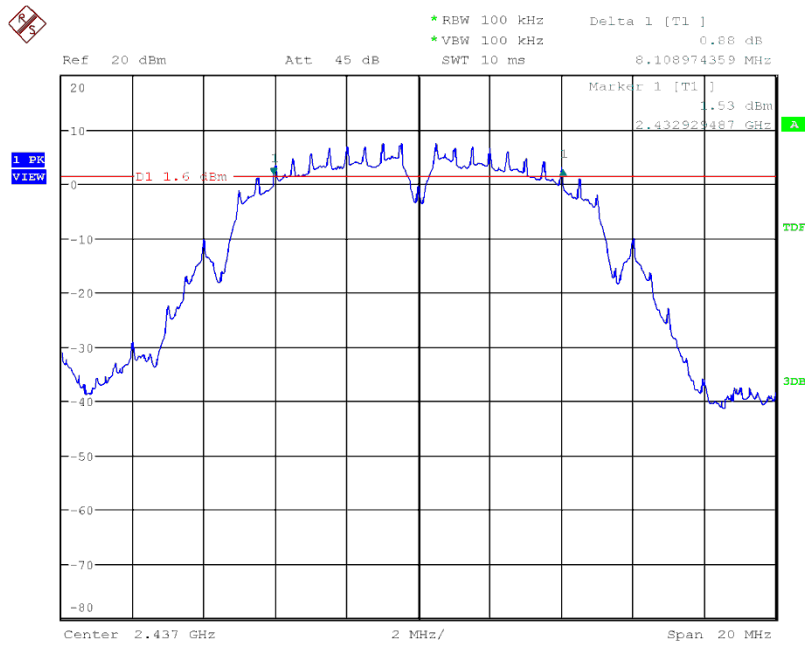
### 6 dB Bandwidth

Test Mode: 802.11b & Ch.1 & Chain 0



### 6 dB Bandwidth

Test Mode: 802.11b & Ch.6 & Chain 0

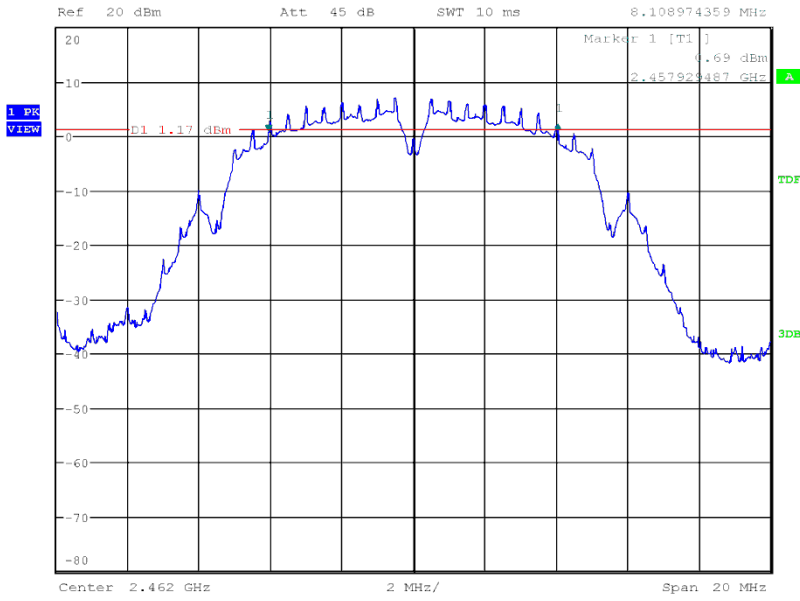


### 6 dB Bandwidth

Test Mode: 802.11b & Ch.11 & Chain 0



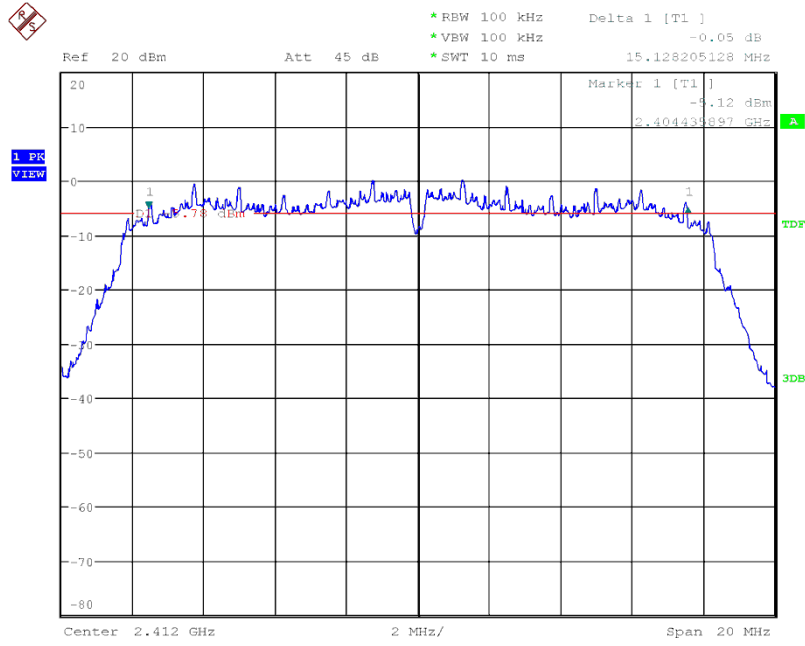
\* RBW 100 kHz    Delta 1 [T1 ]  
\* VBW 100 kHz               1.44 dB  
SWT 10 ms            8.108974359 MHz





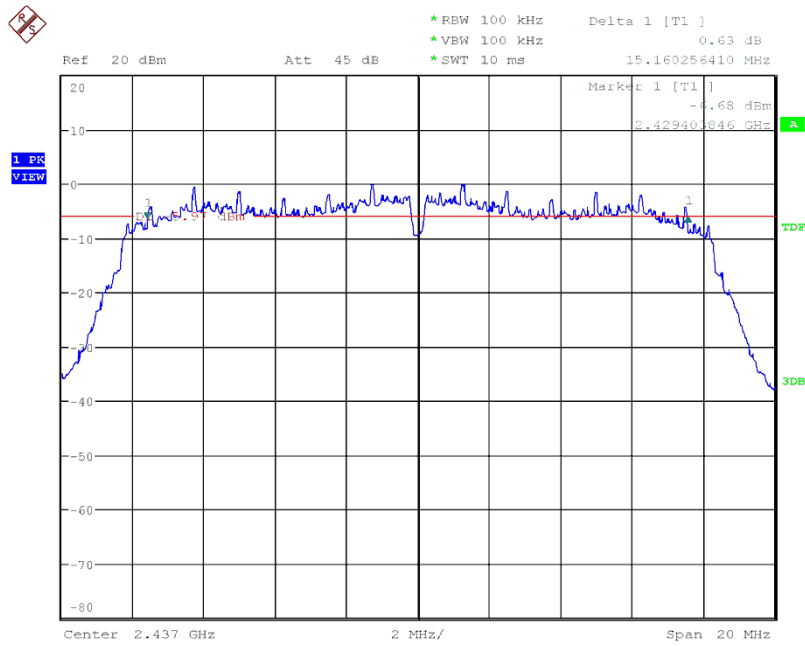
### 6 dB Bandwidth

Test Mode: 802.11g & Ch.1 & Chain 1



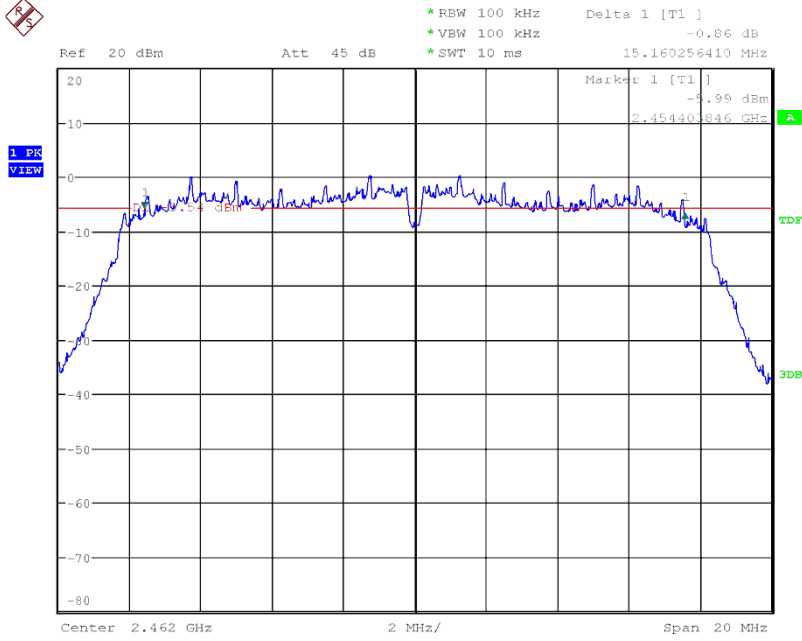
### 6 dB Bandwidth

Test Mode: 802.11g & Ch.6 & Chain 1



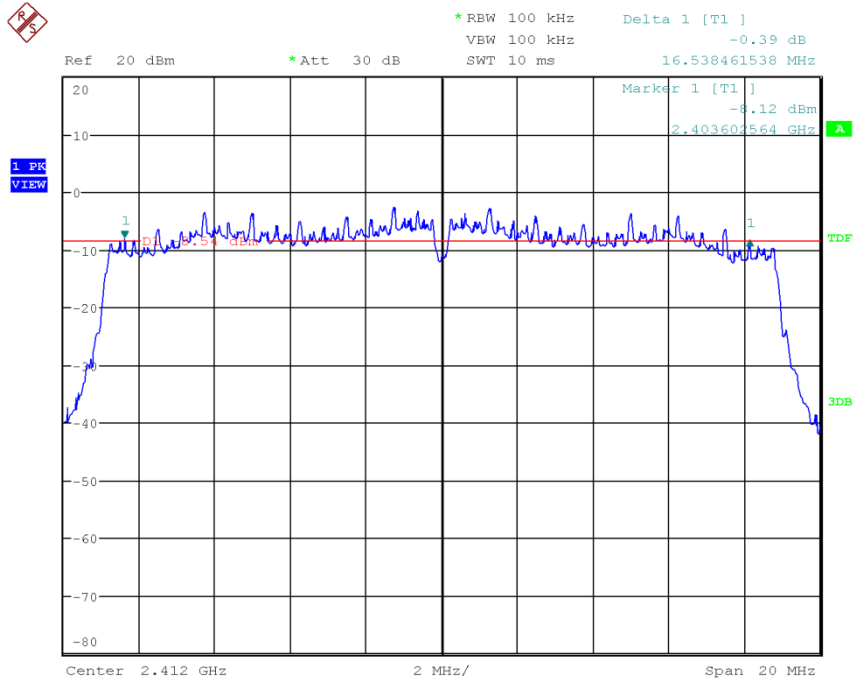
### 6 dB Bandwidth

Test Mode: 802.11g & Ch.11 & Chain 1



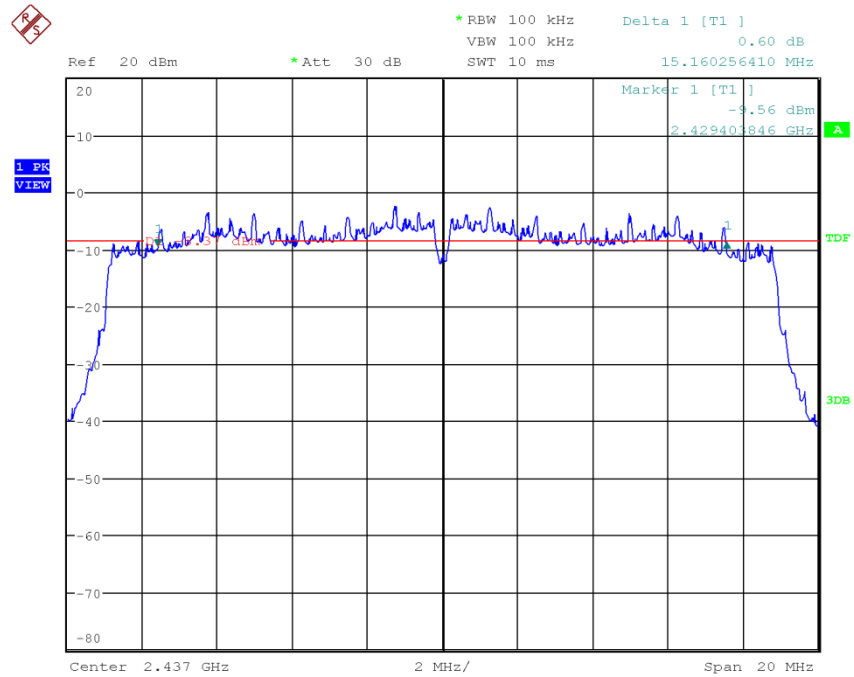
### 6 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.1 & Chain 1



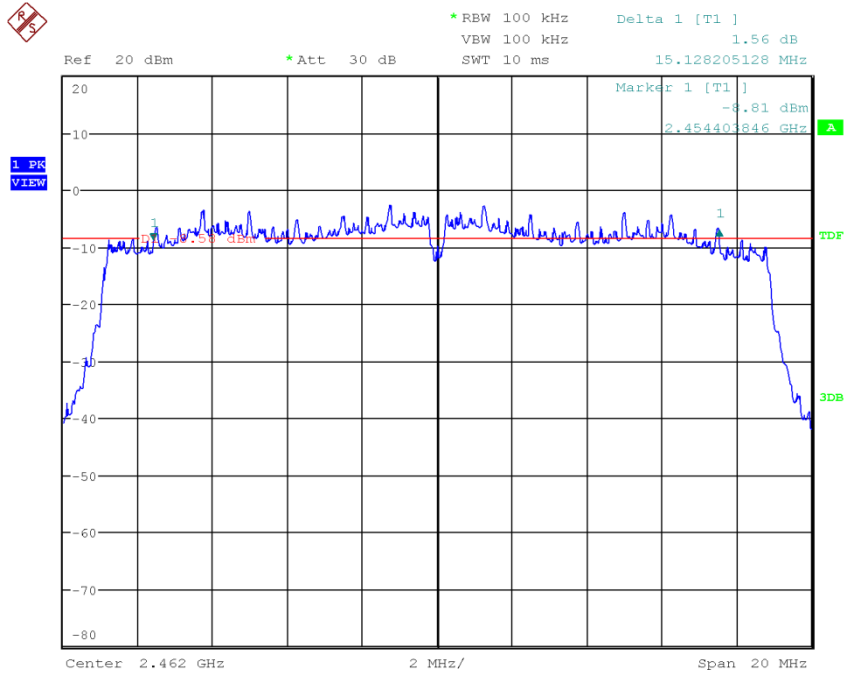
### 6 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.6 & Chain 1



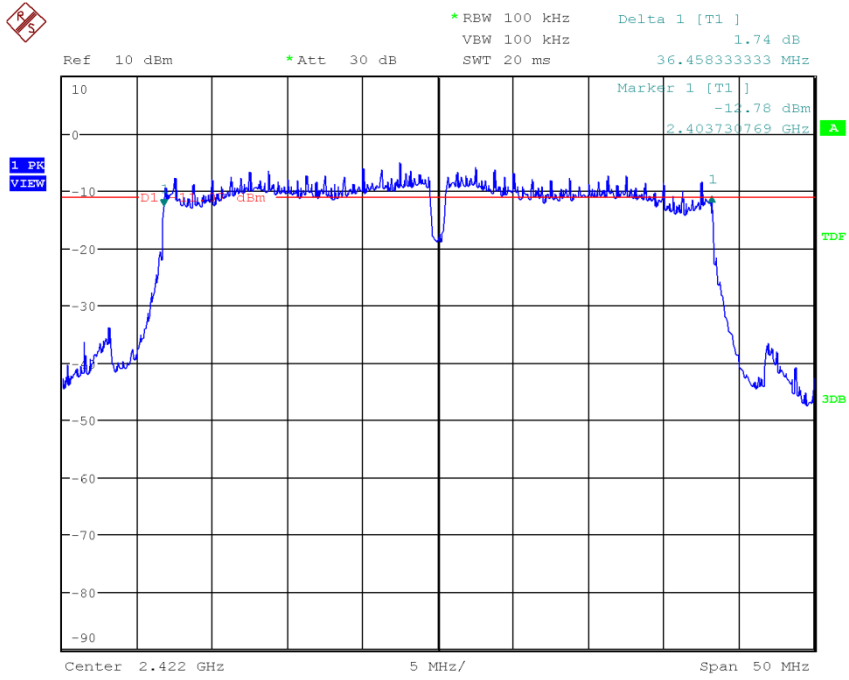
### 6 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.11 & Chain 1



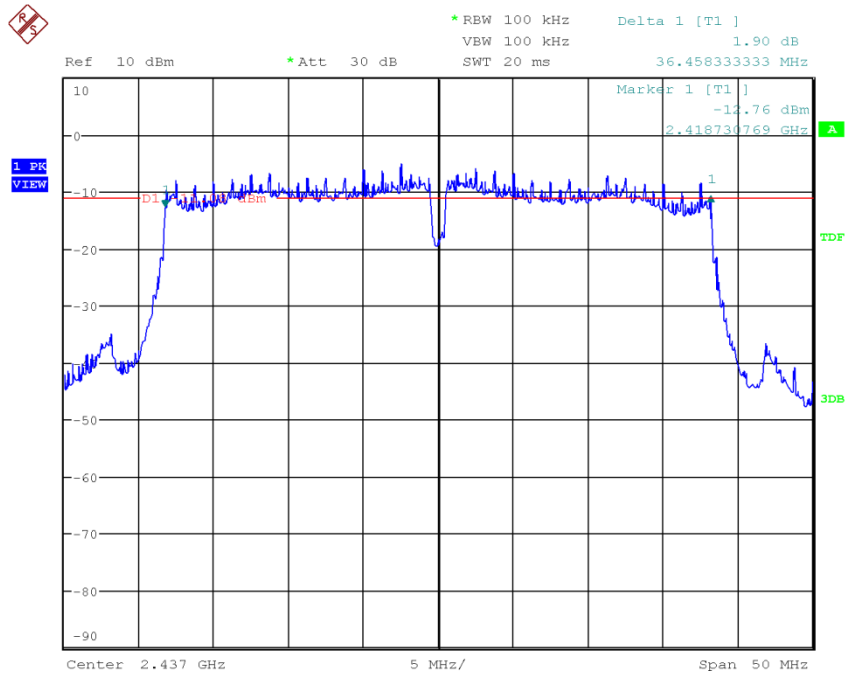
### 6 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.3 & Chain 1



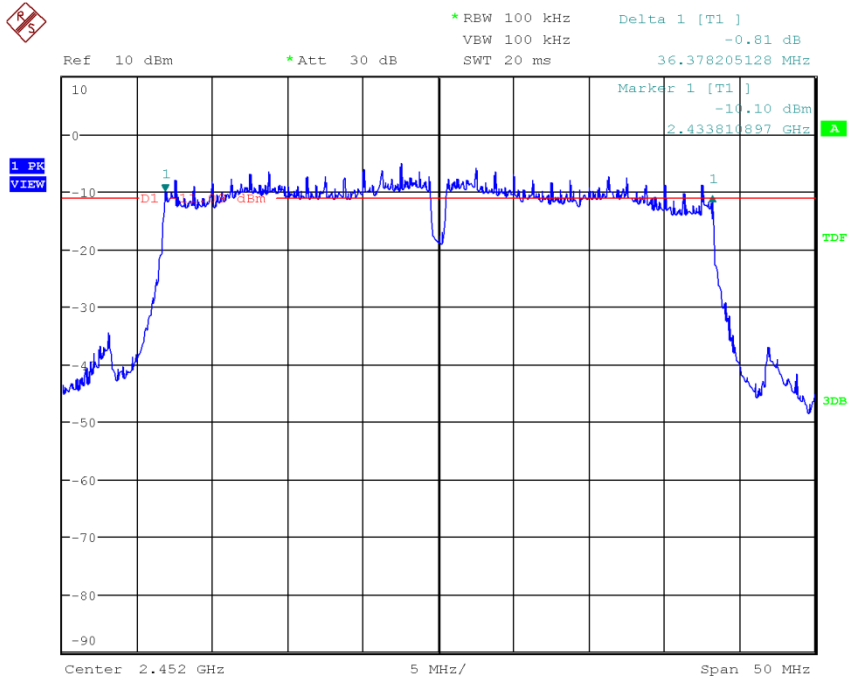
### 6 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.6 & Chain 1



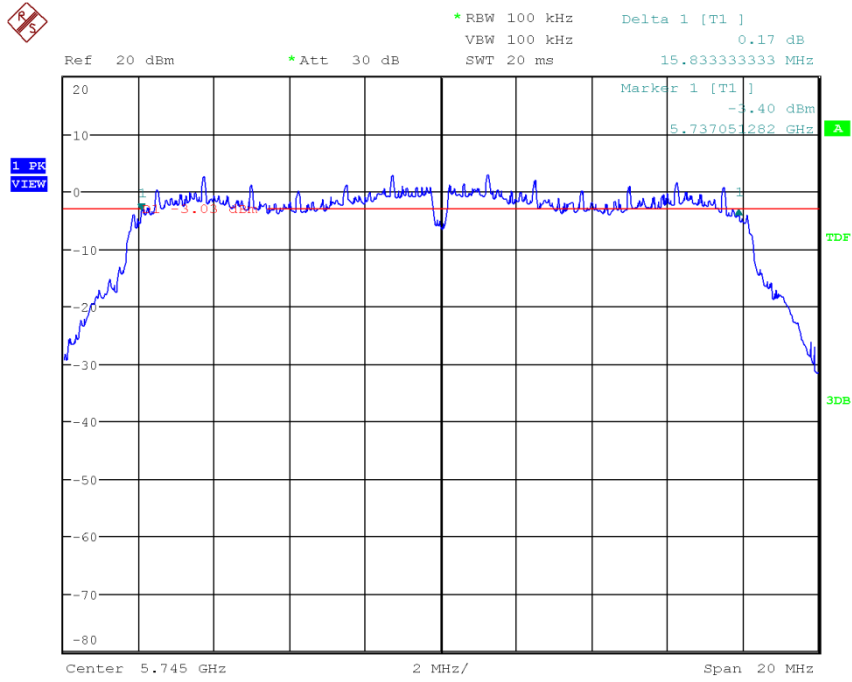
### 6 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.9 & Chain 1



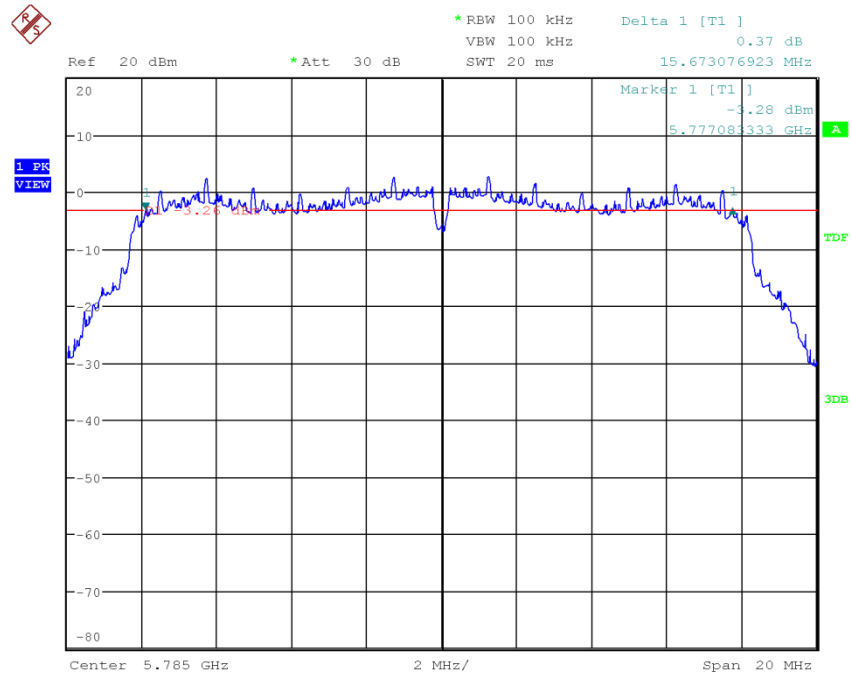
### 6 dB Bandwidth

Test Mode: 802.11a & Ch.149 & Chain 1



### 6 dB Bandwidth

Test Mode: 802.11a & Ch.157 & Chain 1

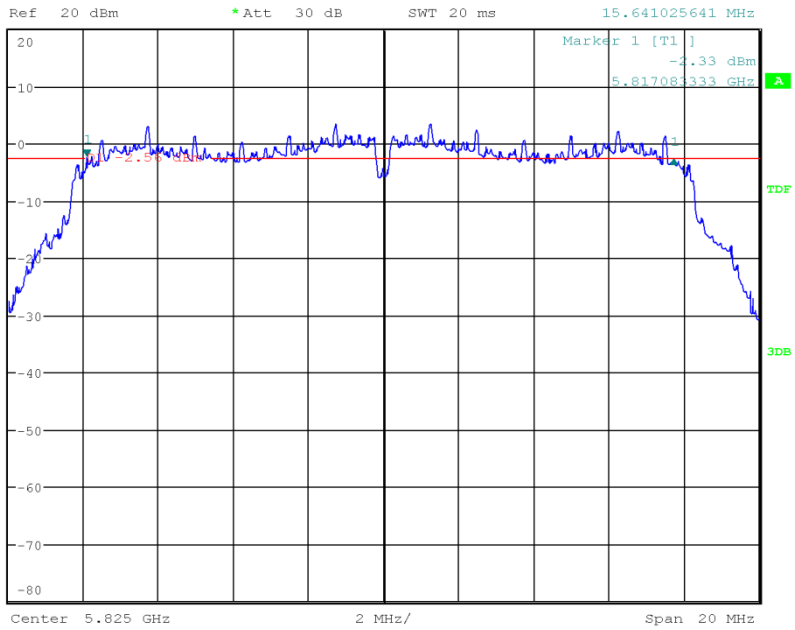


### 6 dB Bandwidth

Test Mode: 802.11a & Ch.165 & Chain 1



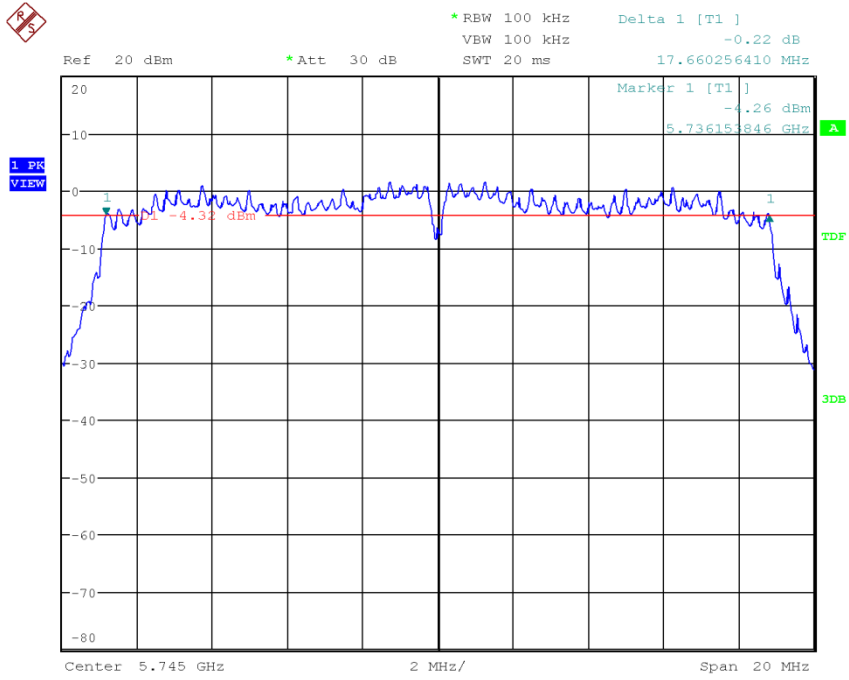
\*RBW 100 kHz    Delta 1 [T1 ]  
VBW 100 kHz    -0.45 dB  
SWT 20 ms      15.641025641 MHz





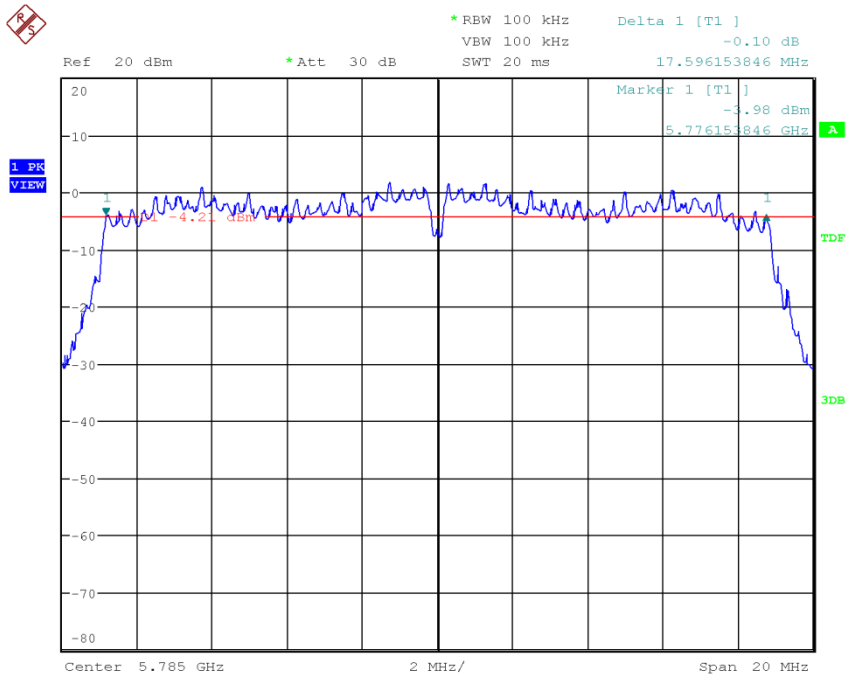
### 6 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.149 & Chain 1



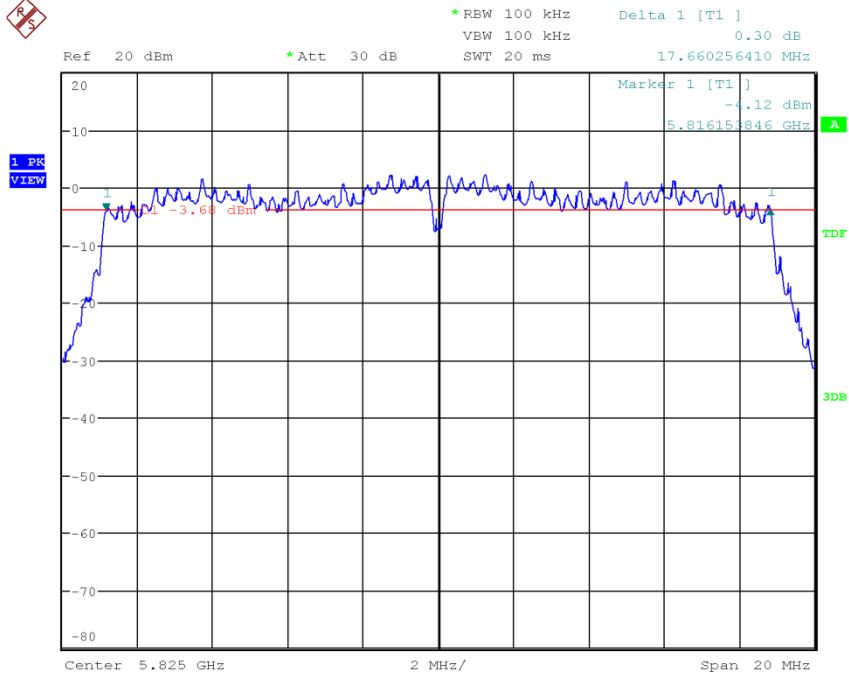
### 6 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.157 & Chain 1



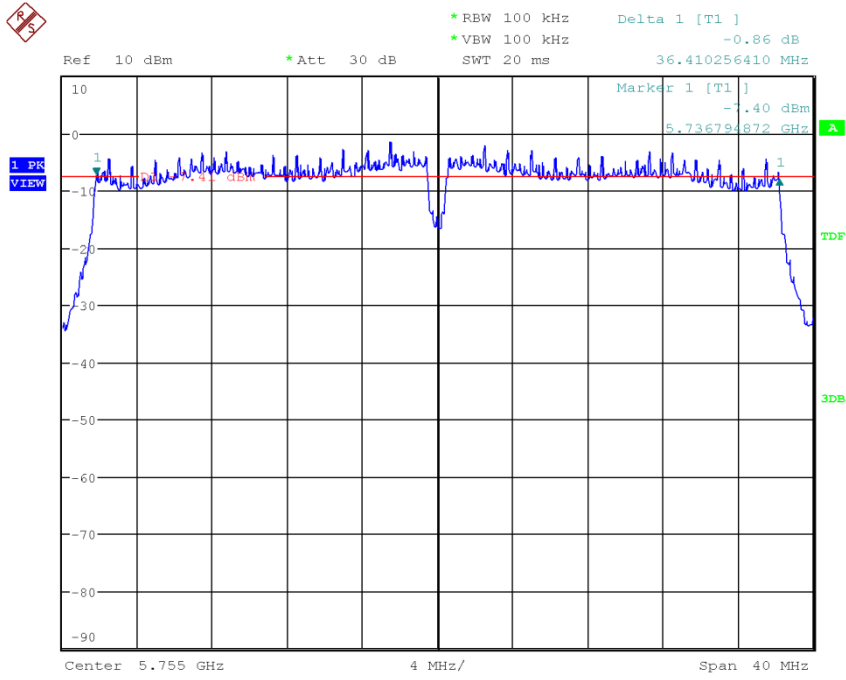
### 6 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.165 & Chain 1



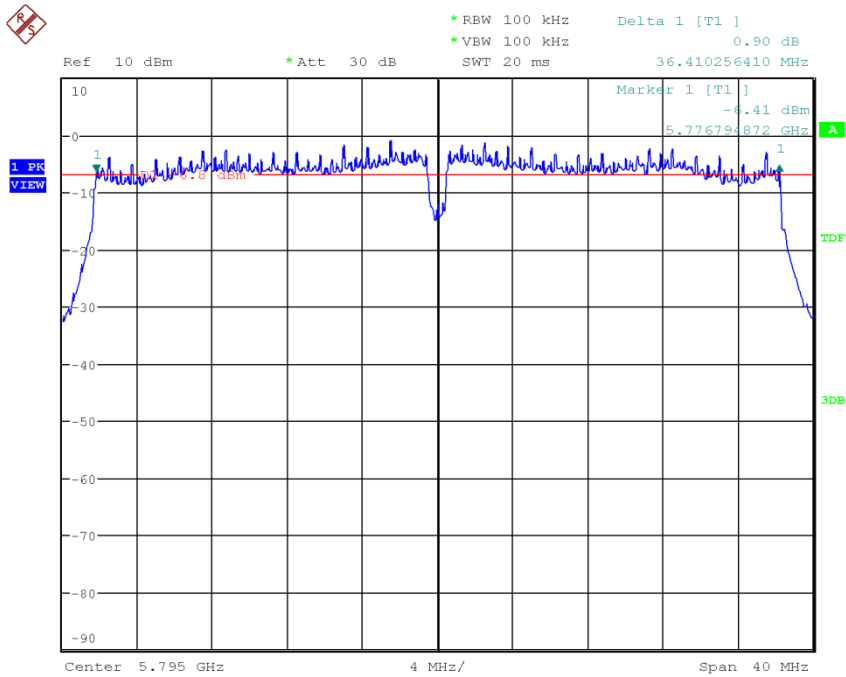
### 6 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.151 & Chain 1



### 6 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.159 & Chain 1



### 3.2.2 Peak Output Power

#### - Test Procedure:

The peak output power was measured RF power sensor. Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.(Power Output Option 1)

#### - Measurement Data: **Comply**

Mode	Channel	Frequency [MHz]	Test Result			
			Chain 0		Chain 1	
			[dBm]	[W]	[dBm]	[W]
802.11b	1	2412	19.97	0.0993	<b>20.51</b>	<b>0.1125</b>
	6	2437	19.94	0.0986	<b>20.42</b>	<b>0.1102</b>
	11	2462	19.98	0.0995	<b>20.29</b>	<b>0.1069</b>
802.11g	1	2412	<b>19.74</b>	<b>0.0942</b>	19.73	0.0940
	6	2437	<b>19.48</b>	<b>0.0887</b>	18.72	0.0745
	11	2462	<b>19.71</b>	<b>0.0935</b>	18.16	0.0655
802.11a	149	5745	20.30	0.1072	<b>20.02</b>	<b>0.1005</b>
	157	5785	19.89	0.0975	<b>20.56</b>	<b>0.1138</b>
	165	5825	19.92	0.0982	<b>20.91</b>	<b>0.1233</b>

Mode	Channel	Frequency [MHz]	Chain 0 [dBm]	Chain 1 [dBm]	Aggregate Power	
					[dBm]	[W]
802.11n HT20	1	2412	15.62	15.30	18.47	0.0704
802.11n HT20	6	2437	15.12	15.31	18.23	0.0665
802.11n HT20	11	2462	14.84	15.41	18.14	0.0652
802.11n HT40	3	2422	15.48	15.87	18.69	0.0740
802.11n HT40	6	2437	15.72	15.73	18.74	0.0747
802.11n HT40	9	2452	15.52	15.43	18.49	0.0706
802.11n HT20	149	5745	19.45	19.84	22.66	0.1845
802.11n HT20	157	5785	20.52	20.54	23.54	0.2260
802.11n HT20	165	5825	20.70	20.99	23.86	0.2431
802.11n HT40	151	5755	20.55	20.56	23.57	0.2273
802.11n HT40	159	5795	20.30	21.28	23.83	0.2414

Note1: Aggregate power calculation =  $10 \log(10^{\frac{\text{chain0}}{10}} + 10^{\frac{\text{chain1}}{10}})$   
 This test item was performed using Peak Power meter.

<b>Minimum Standard:</b>	< 1W
--------------------------	------

### 3.2.3 Out of Band Emissions / Band Edge

**- Procedure:**

Set RBW = 100 kHz, Video bandwidth (VBW) > RBW, scan up through 10th harmonic. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

Note: If the device complies with the use of power option 2 the attenuation under this paragraph shall be 30 dB instead of 20 dB.

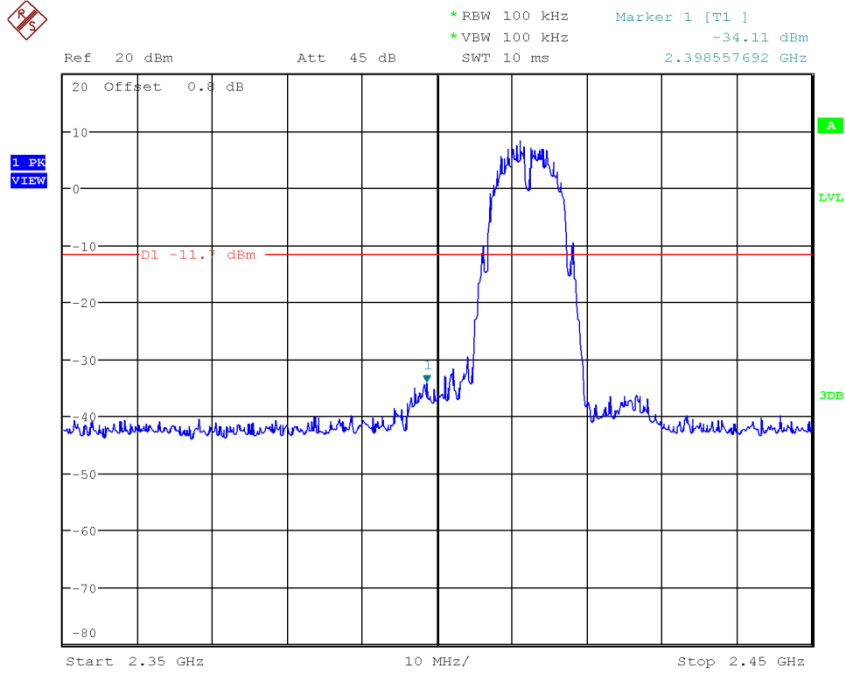
**- Measurement Data: Comply**

Note 1: The worst case plots are attached on next pages.

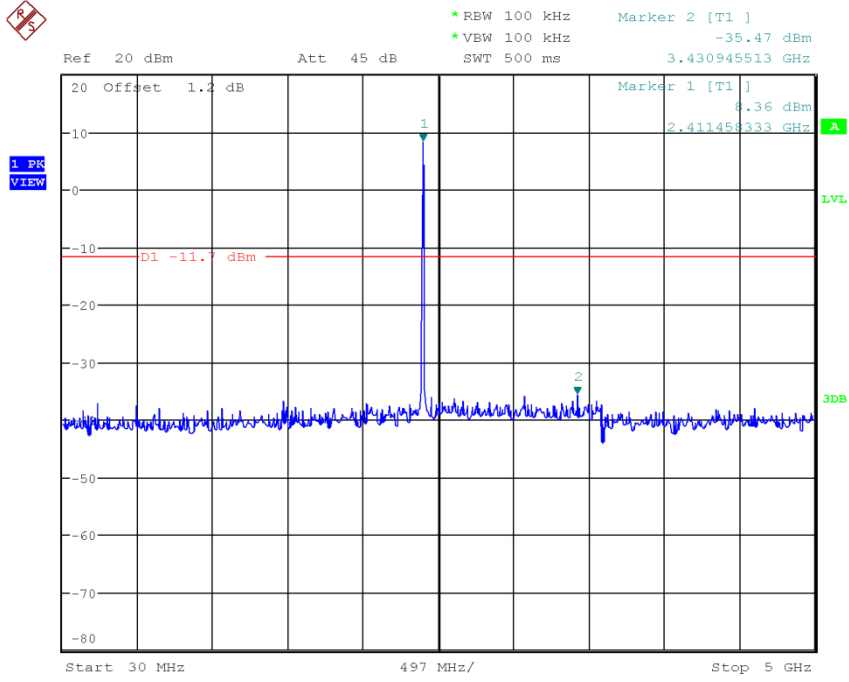
<b>Minimum Standard:</b>	Power Output Option 1 > 20 dBc, Power Output Option 2, 3 > 30 dBc,
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### Low Band-edge at 20 dB blow

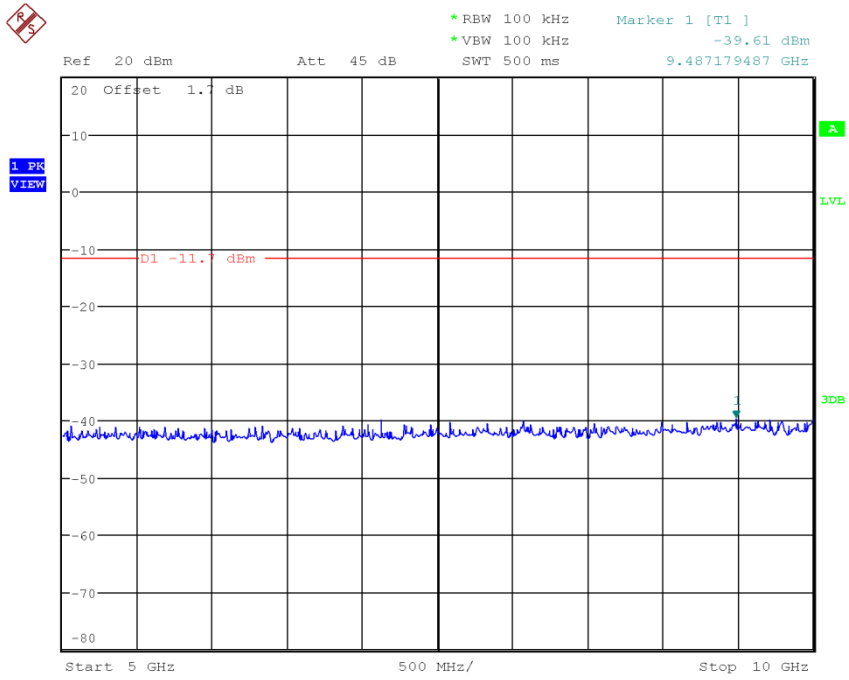
Test Mode: 802.11b & Ch.1 & Chain 1



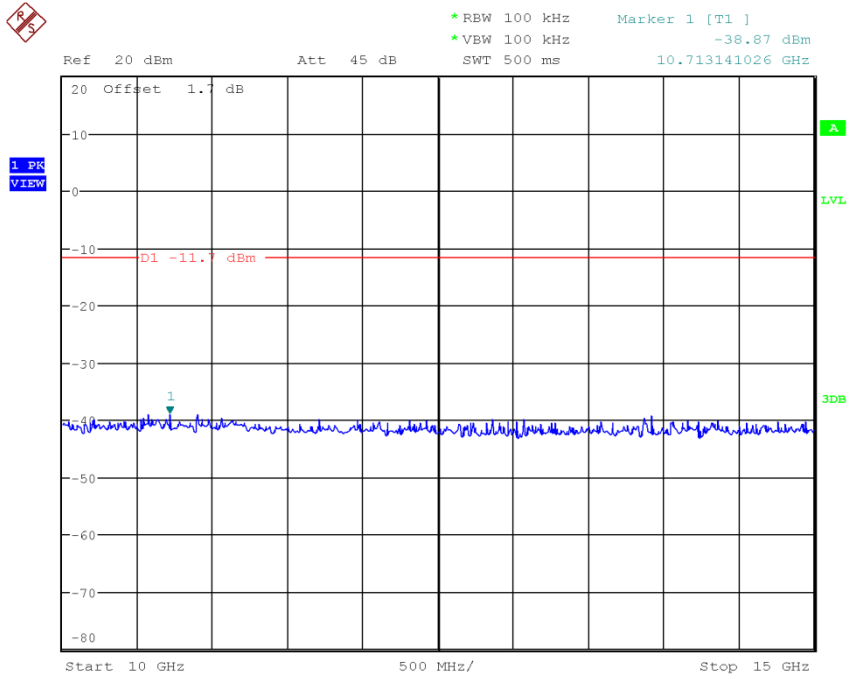
### 30MHz ~ 5GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.1 & Chain 1



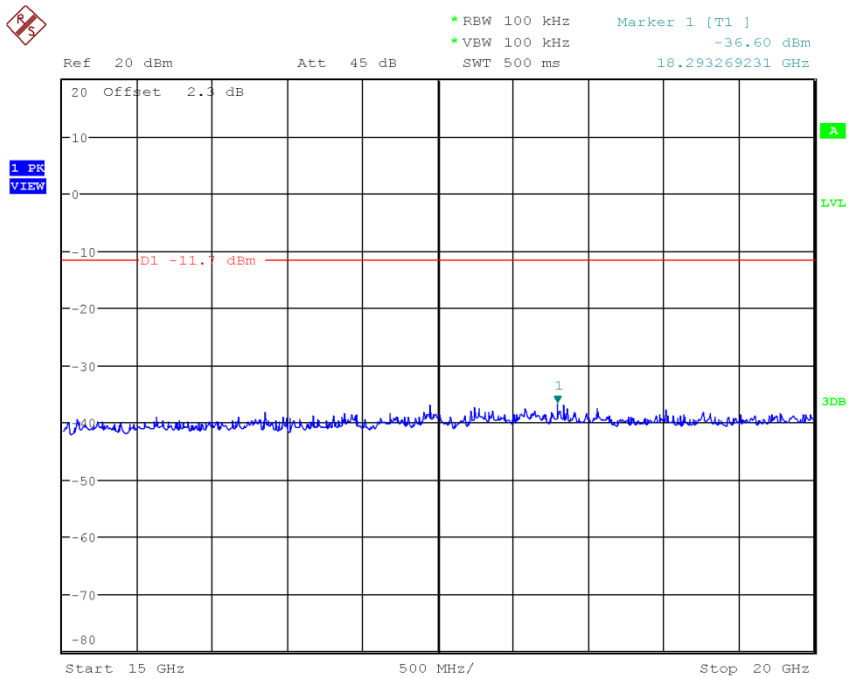
### 5GHz ~ 10GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.1 & Chain 1



### 10GHz ~ 15GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.1 & Chain 1



### 15GHz ~ 20GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.1 & Chain 1





### 20GHz ~ 25GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.1 & Chain 1

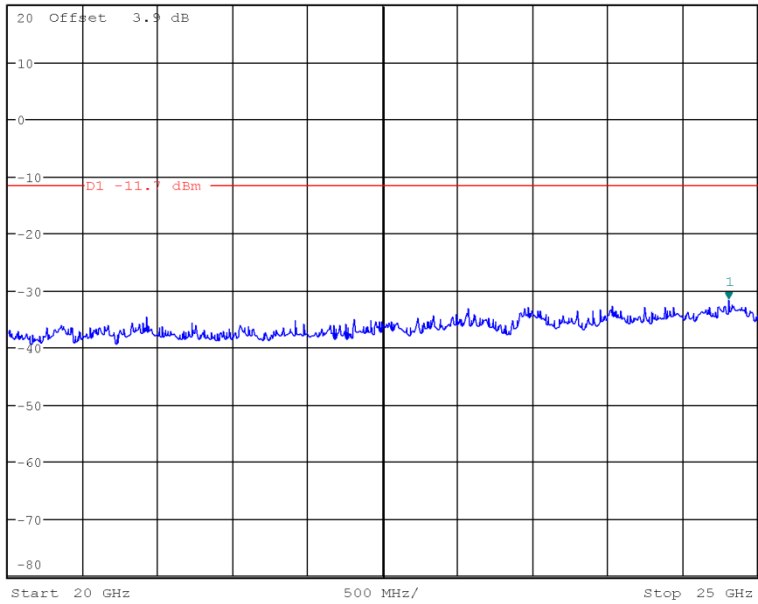


\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz    -31.50 dBm  
SWT 500 ms      24.807692308 GHz

Ref 20 dBm    Att 45 dB

Offset 3.9 dB

1 PK  
VIEW

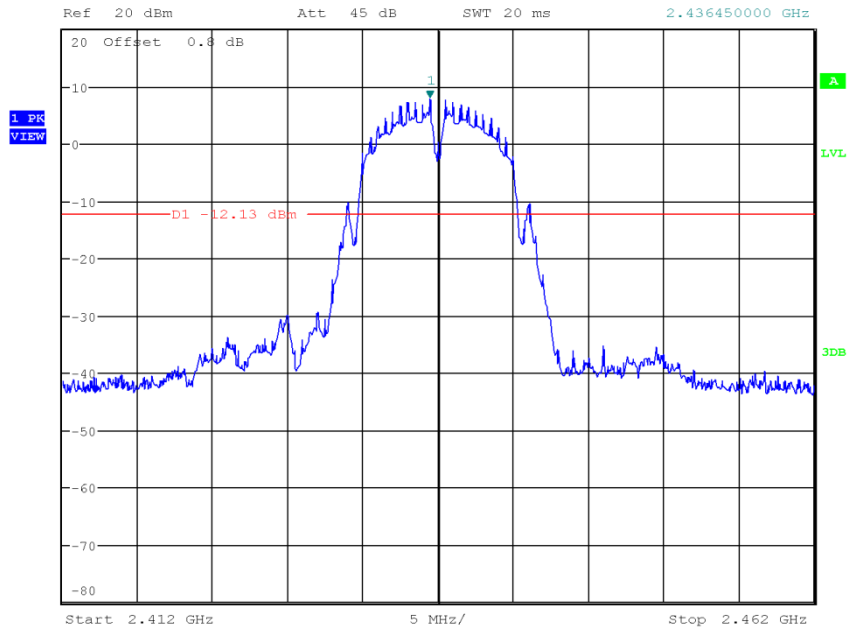


Reference for limit

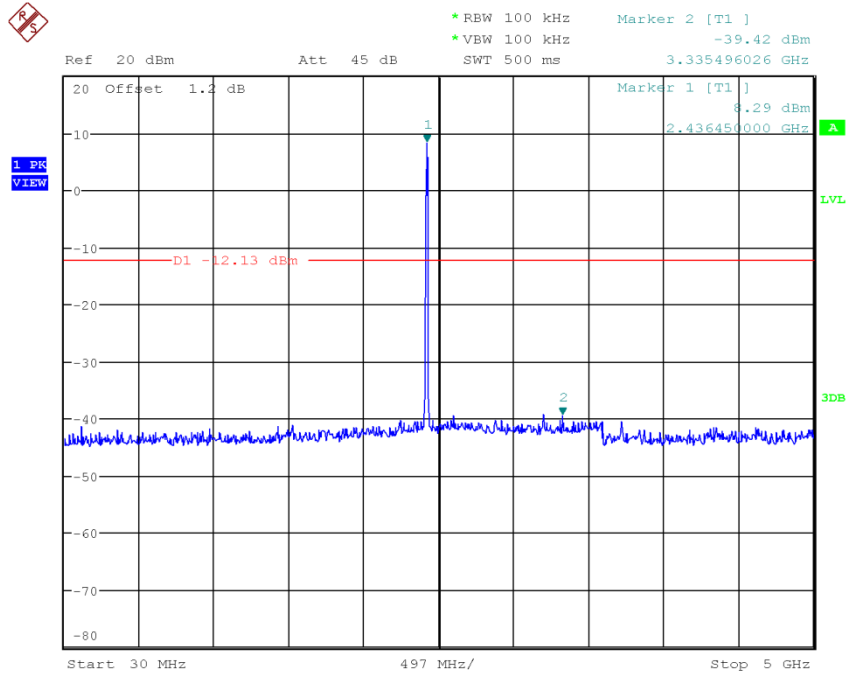
Test Mode: 802.11b & Ch.6 & Chain 1



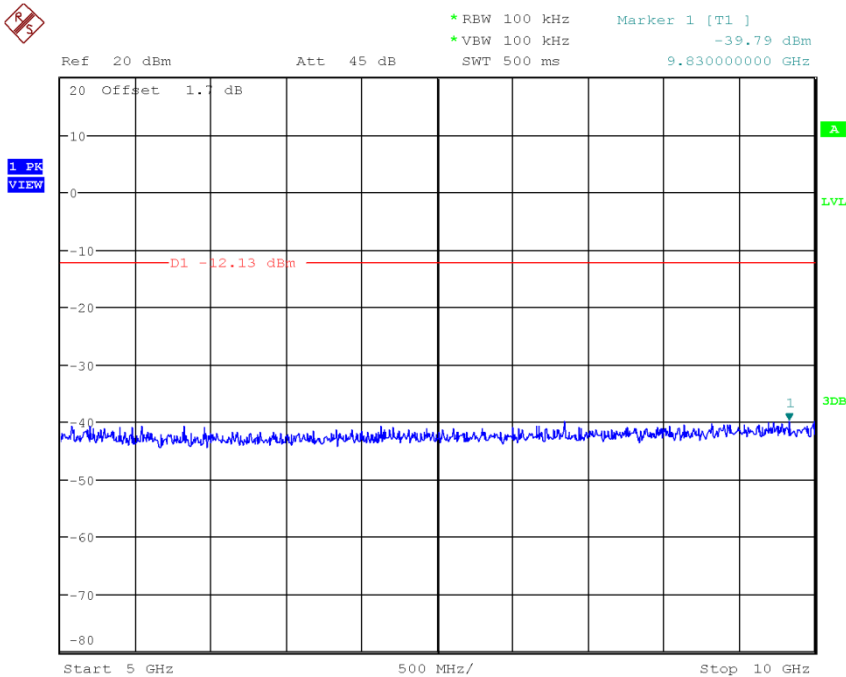
\*RBW 100 kHz    Marker 1 [T1 ]  
\*VW 100 kHz    7.87 dBm  
SWT 20 ms    2.436450000 GHz



### 30MHz ~ 5GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.6 & Chain 1

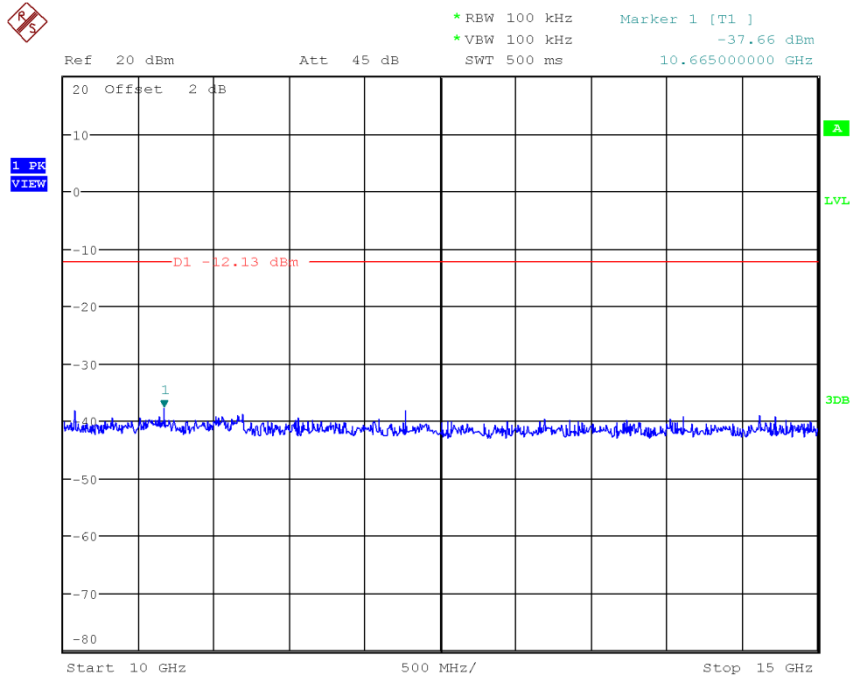


### 5GHz ~ 10GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.6 & Chain 1



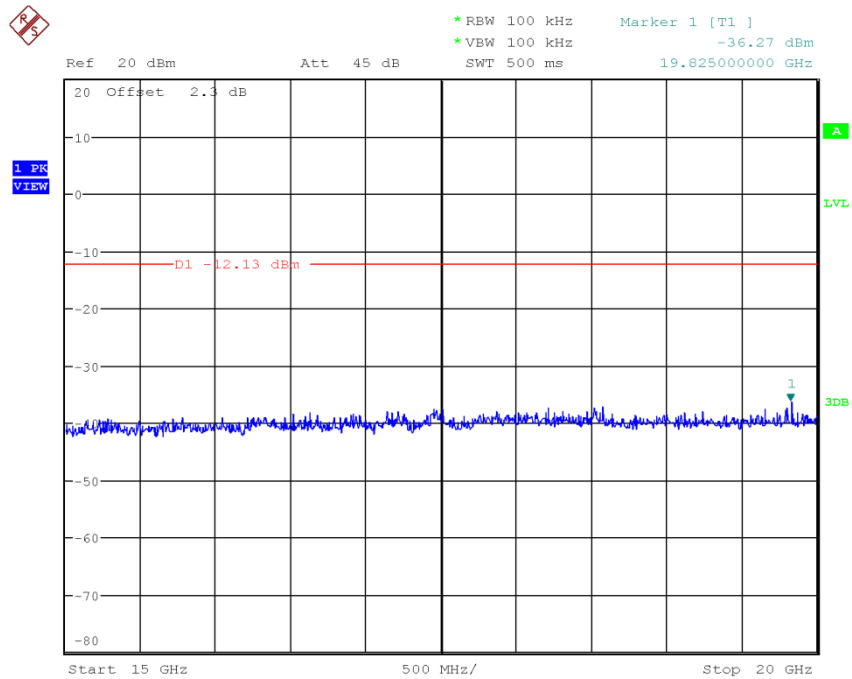
### 10GHz ~ 15GHz Conducted Spurious Emissions

Test Mode: 802.11b & Ch.6 & Chain 1

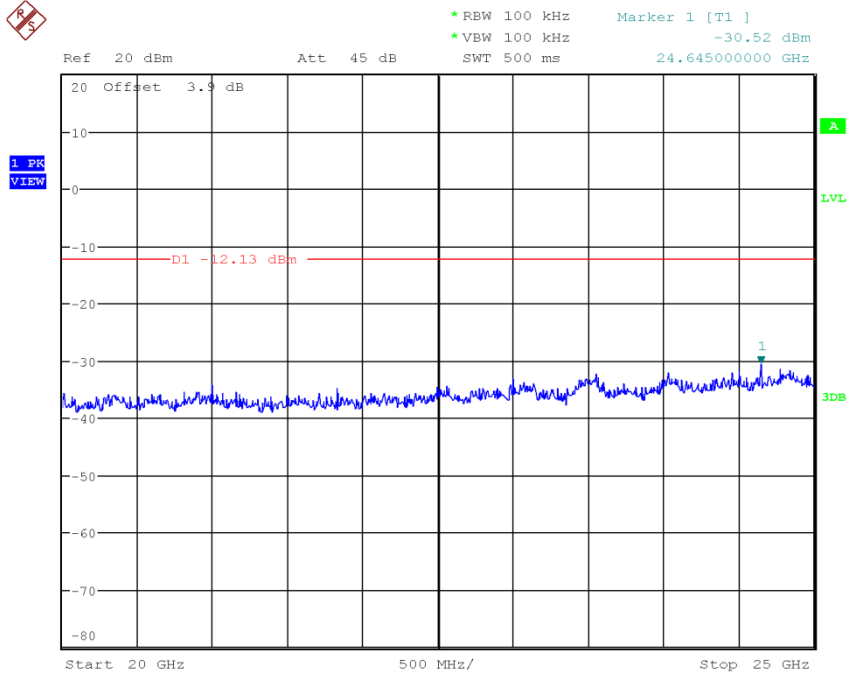


### 15GHz ~ 20GHz Conducted Spurious Emissions

Test Mode: 802.11b & Ch.6 & Chain 1



### 20GHz ~ 25GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.6 & Chain 1

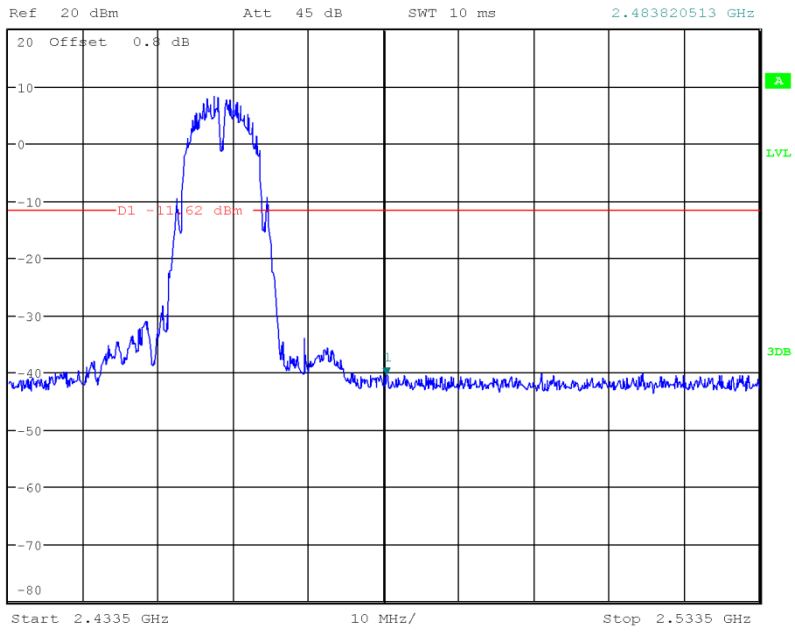


### High Band-edge at 20 dB blow

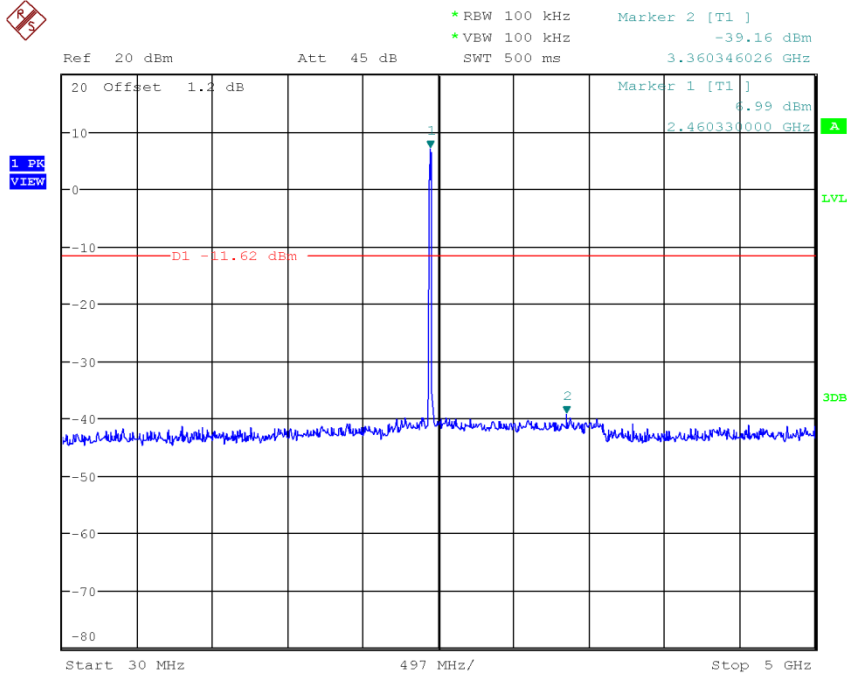
Test Mode: 802.11b & Ch.11 & Chain 1



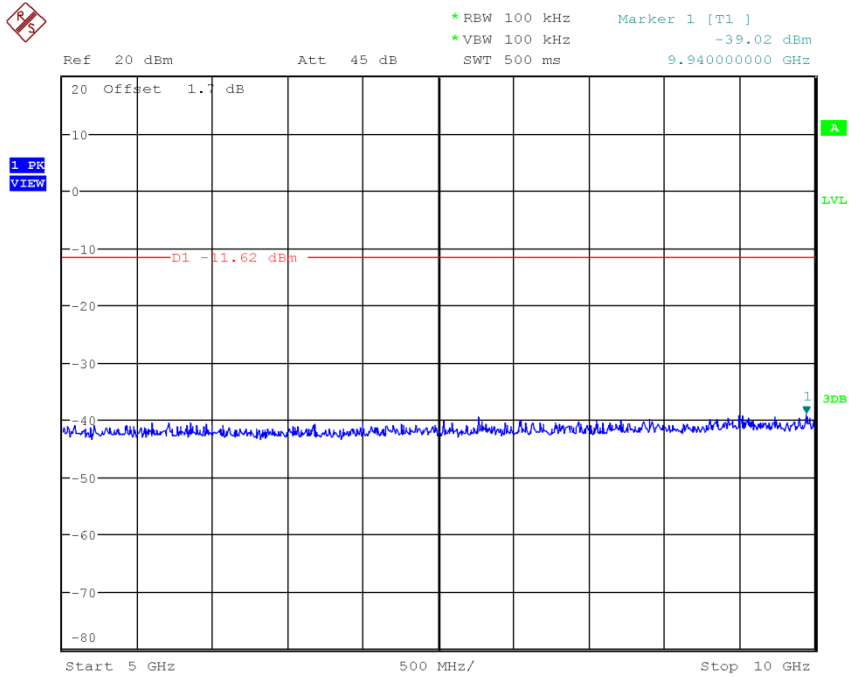
\* RBW 100 kHz    Marker 1 [T1 ]  
\* VBW 100 kHz    -40.46 dBm  
SWT 10 ms        2.483820513 GHz



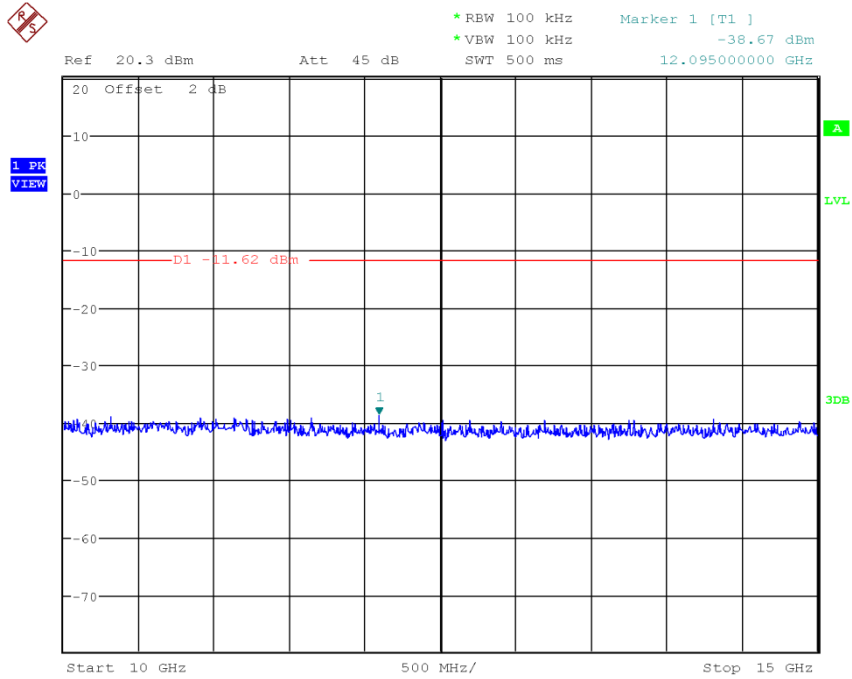
### 30MHz ~ 5GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.11 & Chain 1



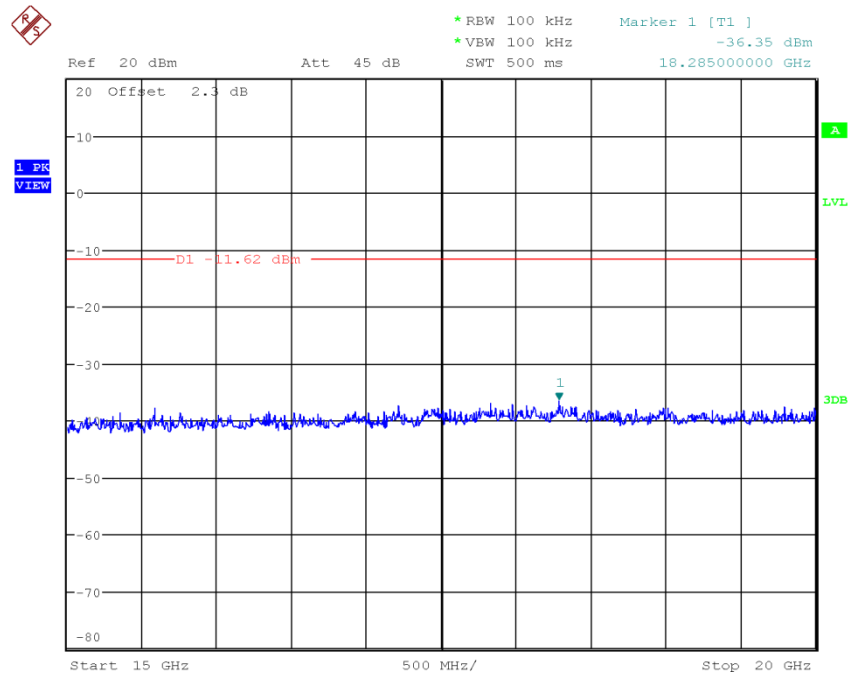
### 5GHz ~ 10GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.11 & Chain 1



### 10GHz ~ 15GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.11 & Chain 1

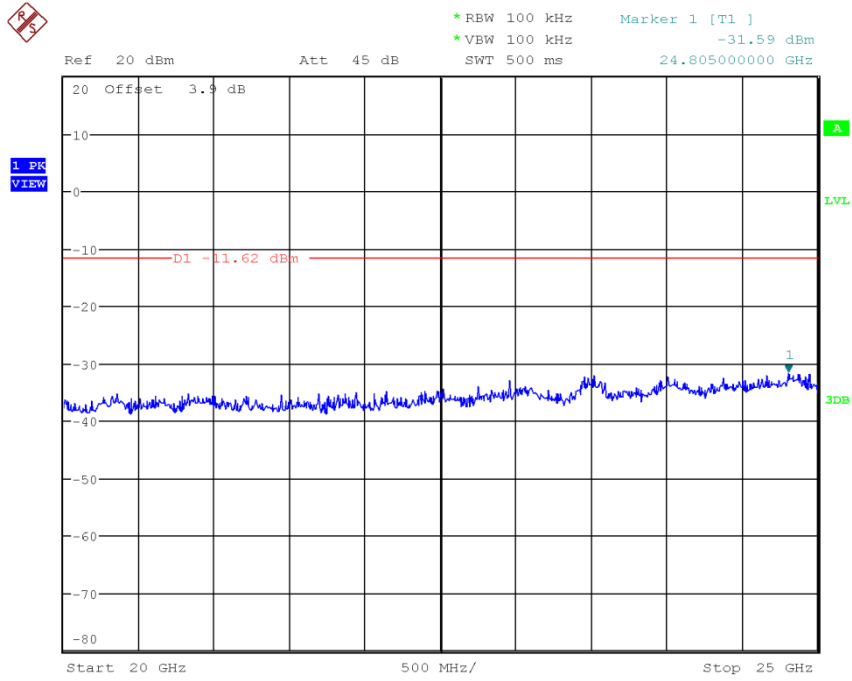


### 15GHz ~ 20GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.11 & Chain 1



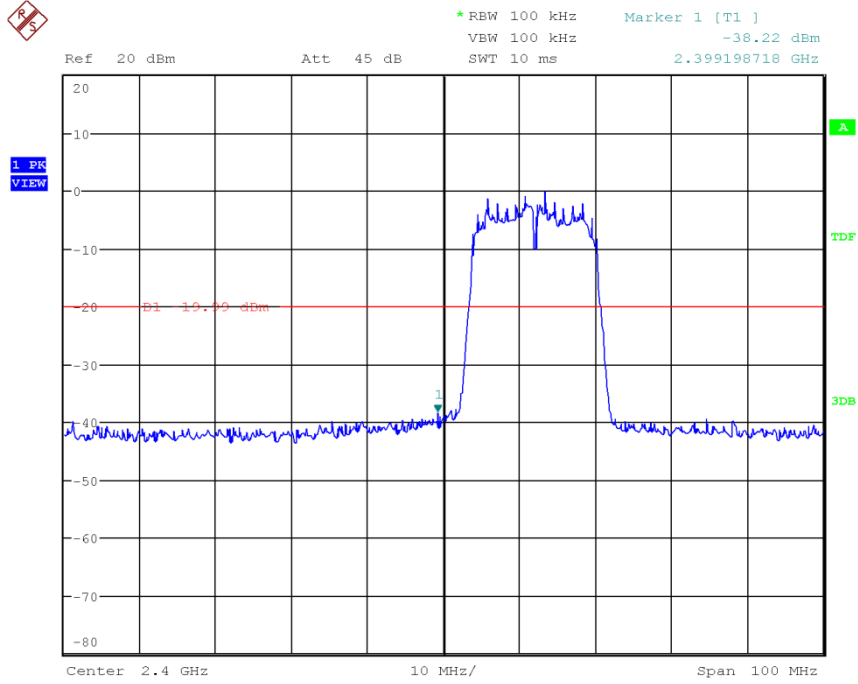


### 20GHz ~ 25GHz Conducted Spurious Emissions Test Mode: 802.11b & Ch.11 & Chain 1

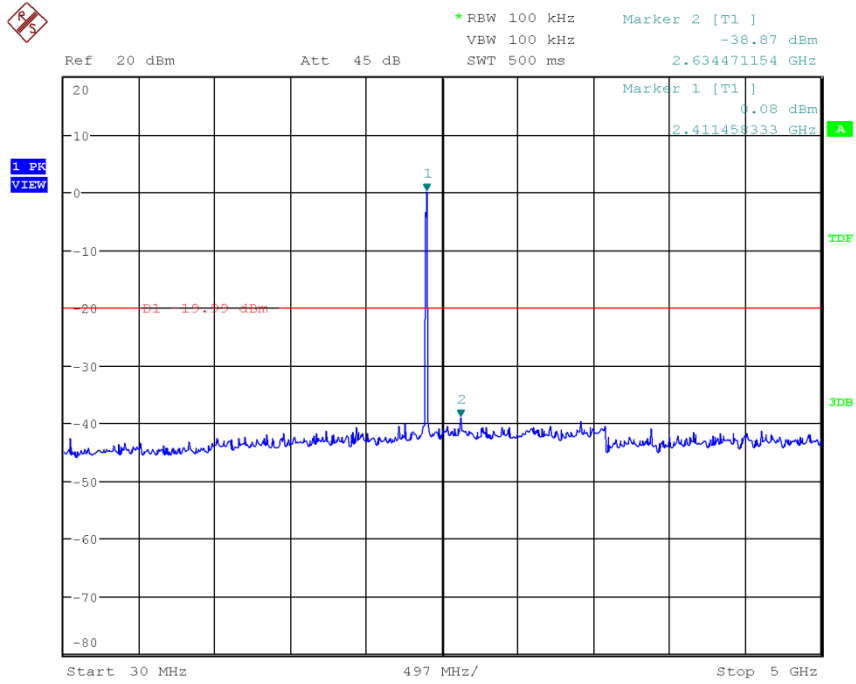


### Low Band-edge at 20 dB blow

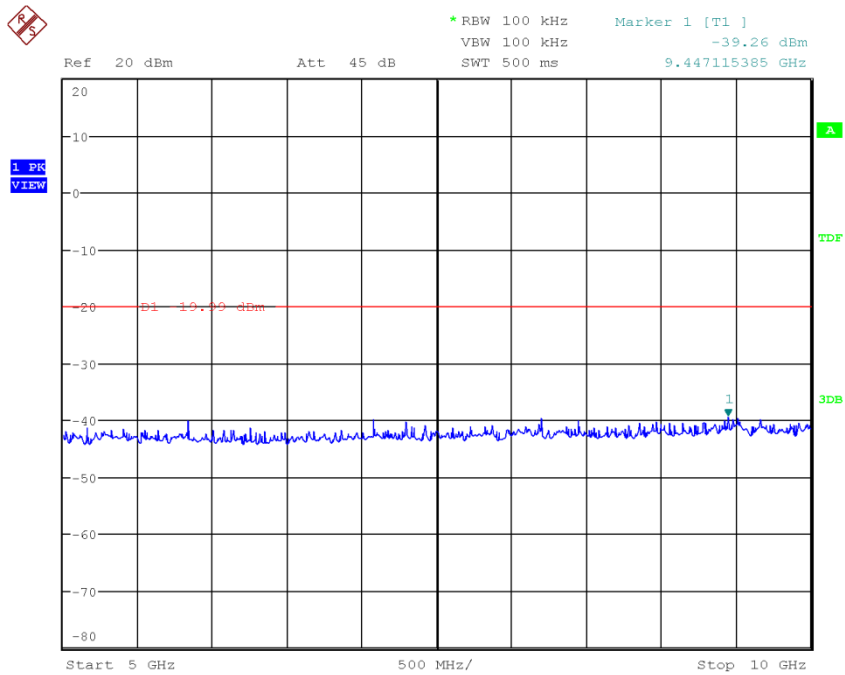
Test Mode: 802.11g & Ch.1 & Chain 0



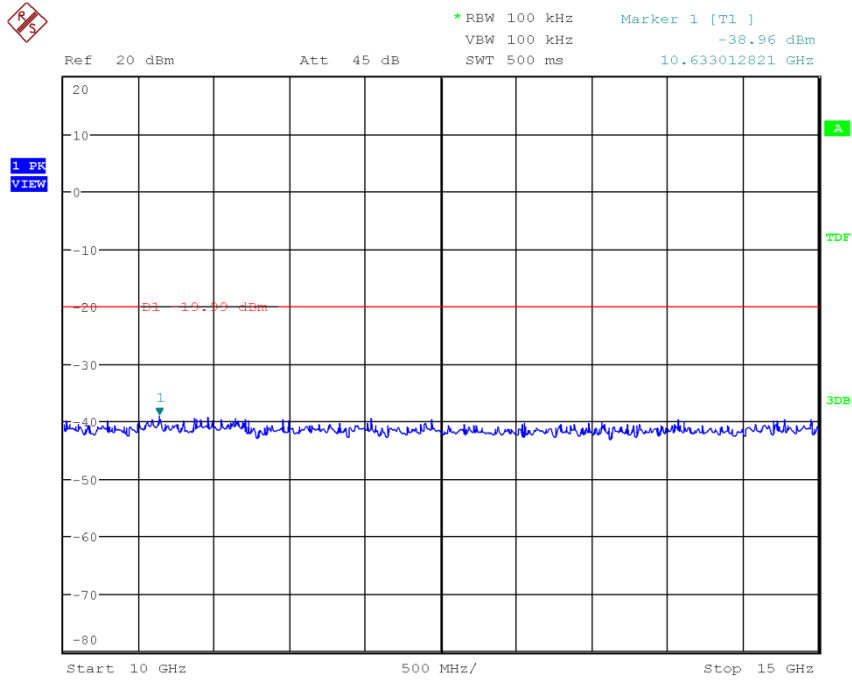
### 30MHz ~ 5GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.1 & Chain 0



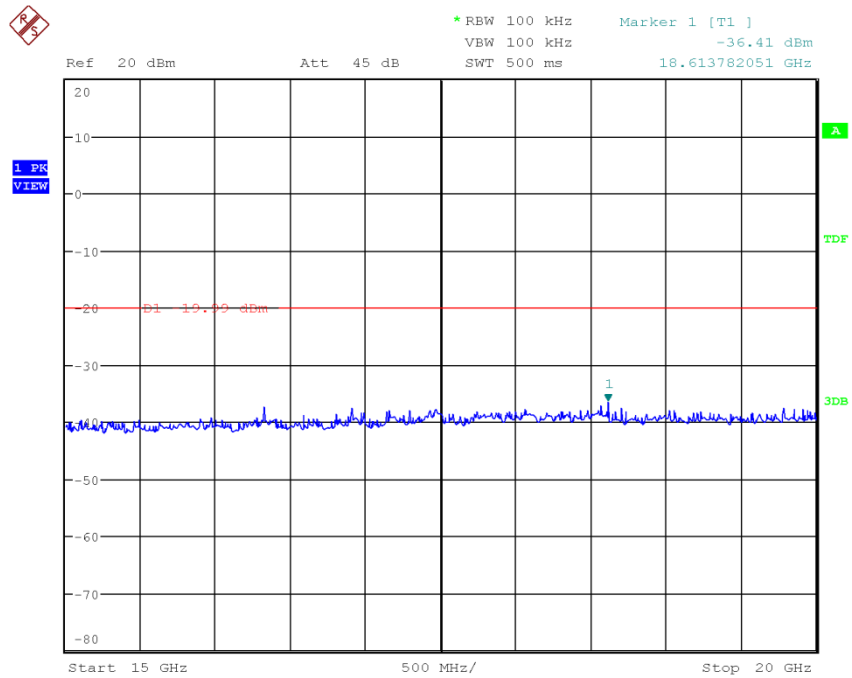
### 5GHz ~ 10GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.1 & Chain 0



### 10GHz ~ 15GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.1 & Chain 0



### 15GHz ~ 20GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.1 & Chain 0



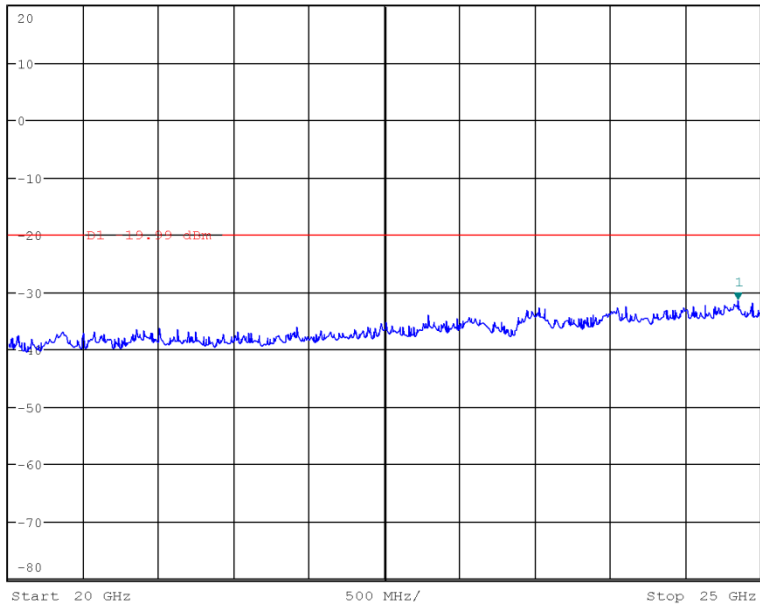
### 20GHz ~ 25GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.1 & Chain 0



\* RBW 100 kHz    Marker 1 [T1 ]  
VW 100 kHz    -31.43 dBm  
SWT 500 ms    24.847756410 GHz

Ref 20 dBm    Att 45 dB

1 PK  
VIEW

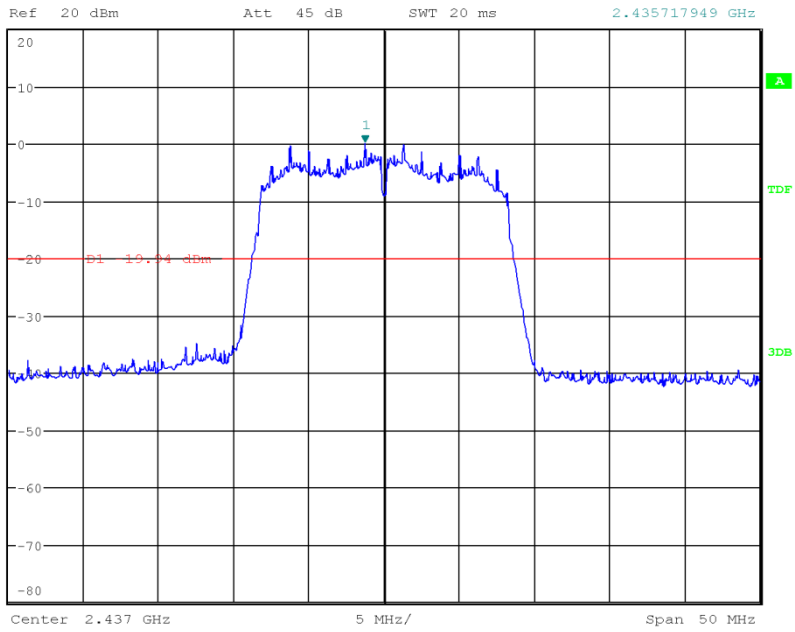


Reference for limit

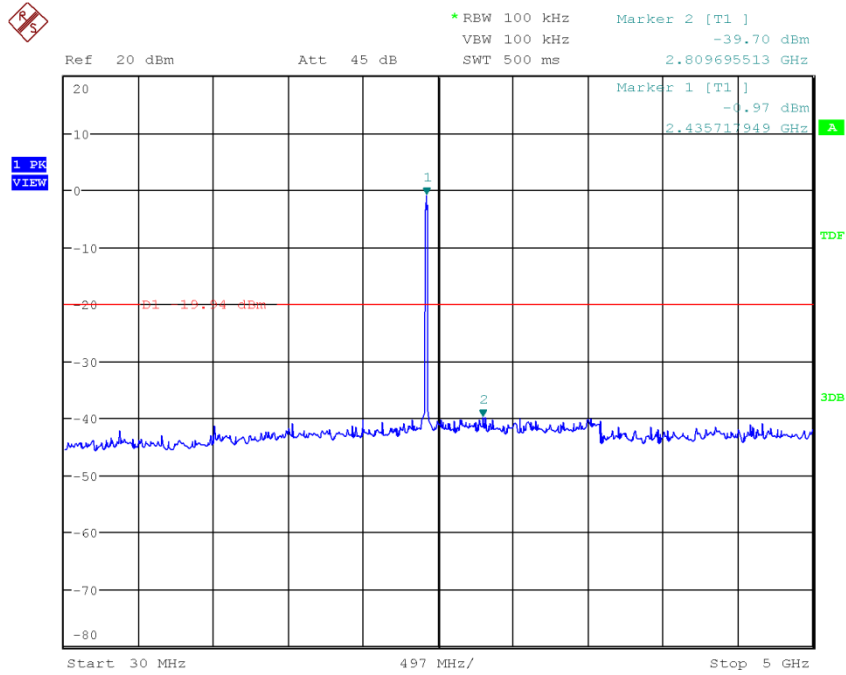
Test Mode: 802.11g & Ch.6 & Chain 0



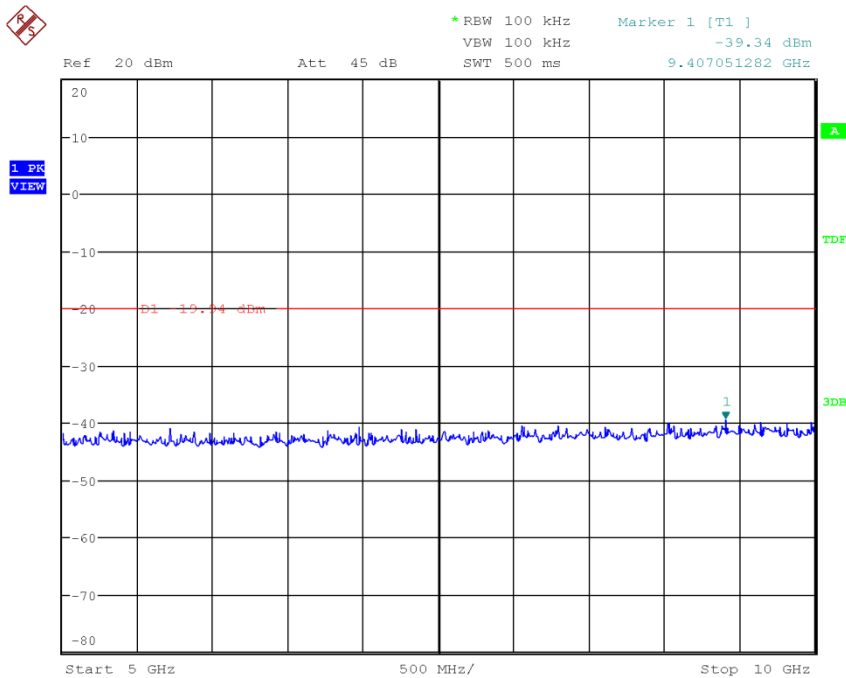
\*RBW 100 kHz    Marker 1 [T1 ]  
VW 100 kHz        0.06 dBm  
SWT 20 ms        2.435717949 GHz



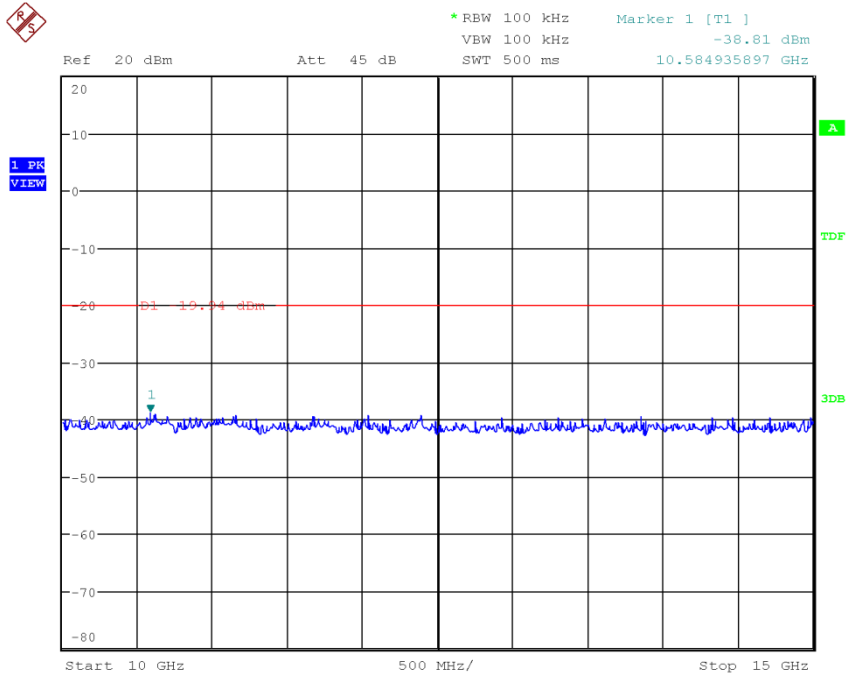
### 30MHz ~ 5GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.6 & Chain 0



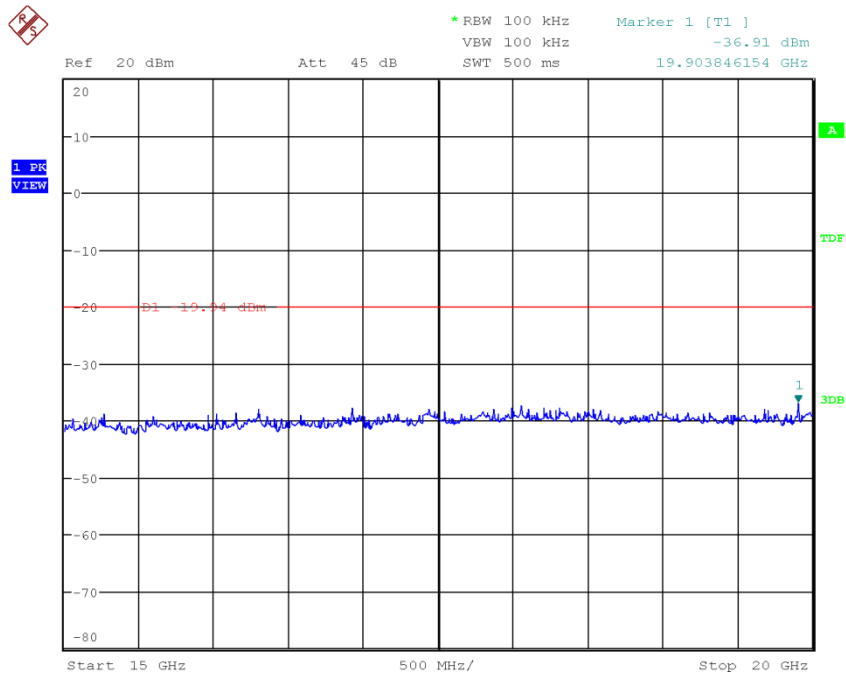
### 5GHz ~ 10GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.6 & Chain 0



### 10GHz ~ 15GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.6 & Chain 0



### 15GHz ~ 20GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.6 & Chain 0

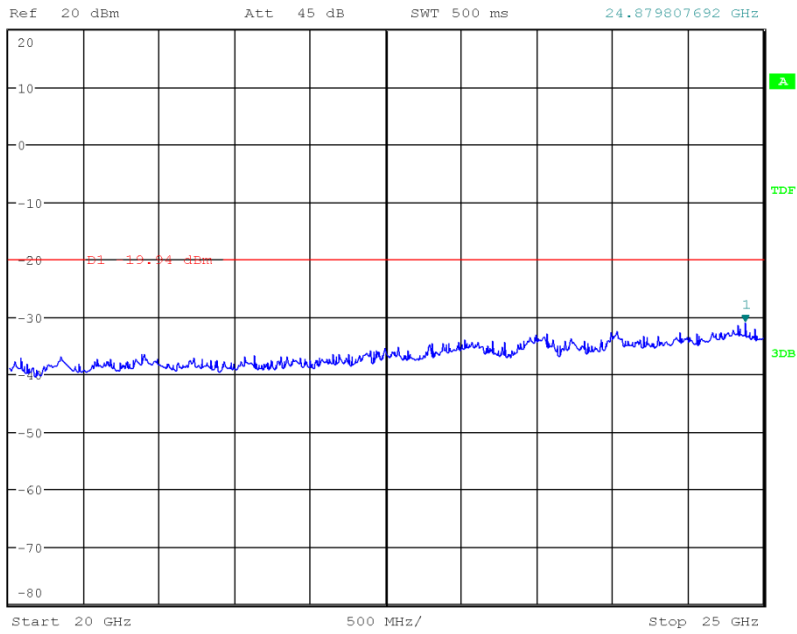




### 20GHz ~ 25GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.6 & Chain 0



\*RBW 100 kHz    Marker 1 [T1 ]  
VW 100 kHz        -31.01 dBm  
SWT 500 ms        24.879807692 GHz

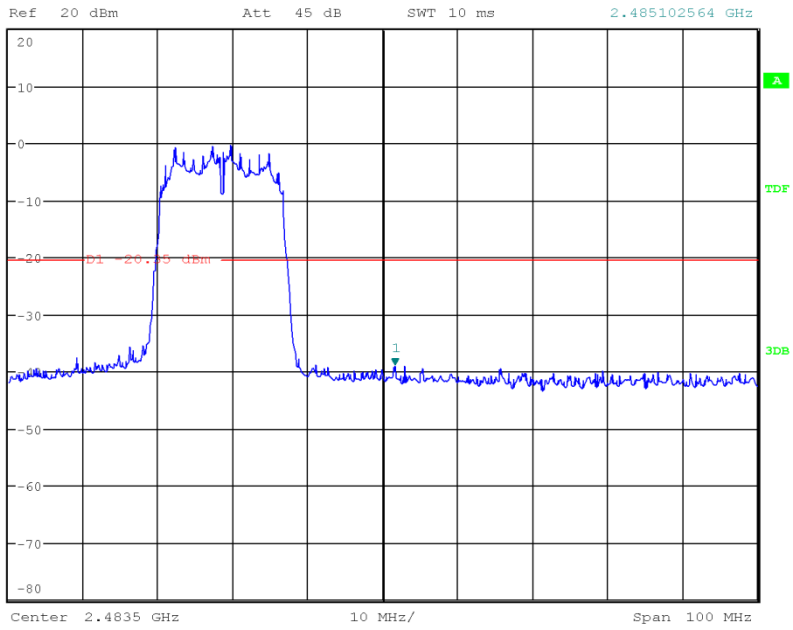


### High Band-edge at 20 dB blow

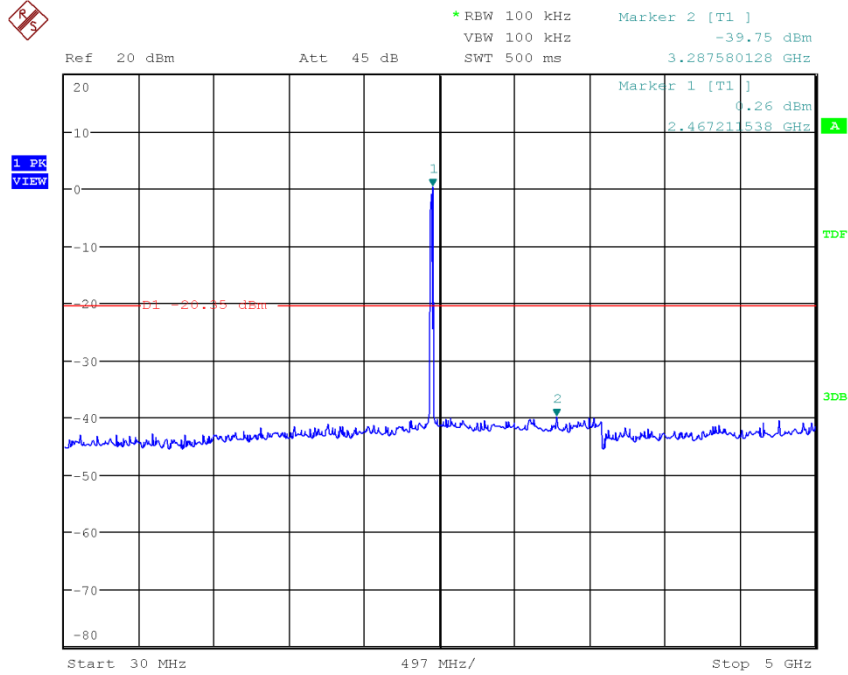
Test Mode: 802.11g & Ch.11 & Chain 0



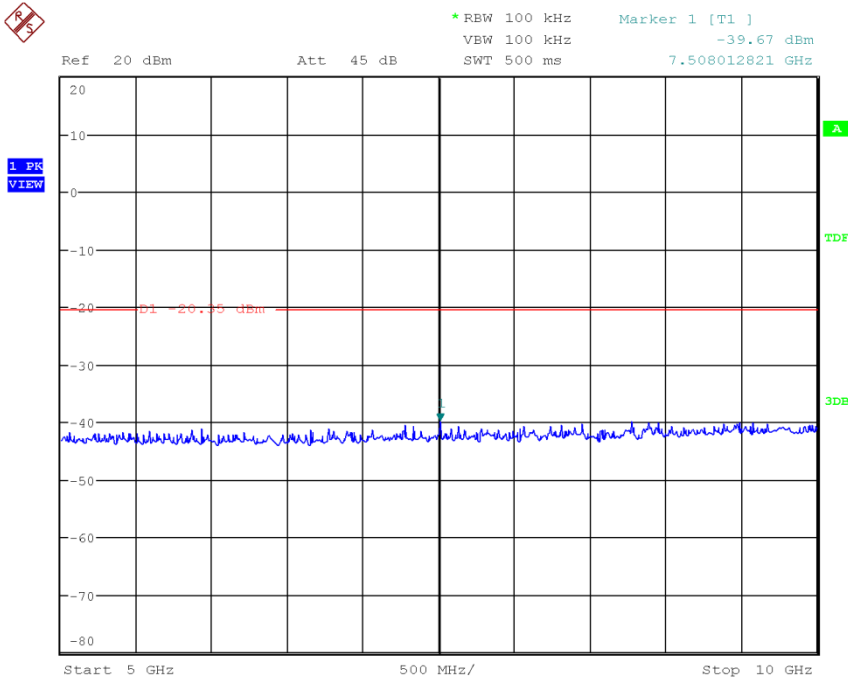
\*RBW 100 kHz    Marker 1 [T1 ]  
VBW 100 kHz    -38.99 dBm  
SWT 10 ms      2.485102564 GHz



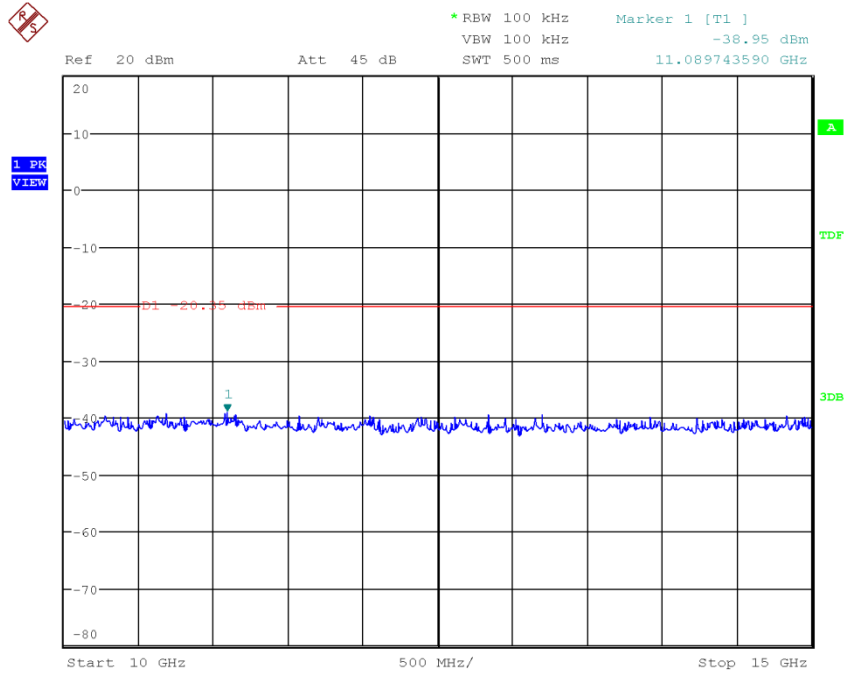
### 30MHz ~ 5GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.11 & Chain 0



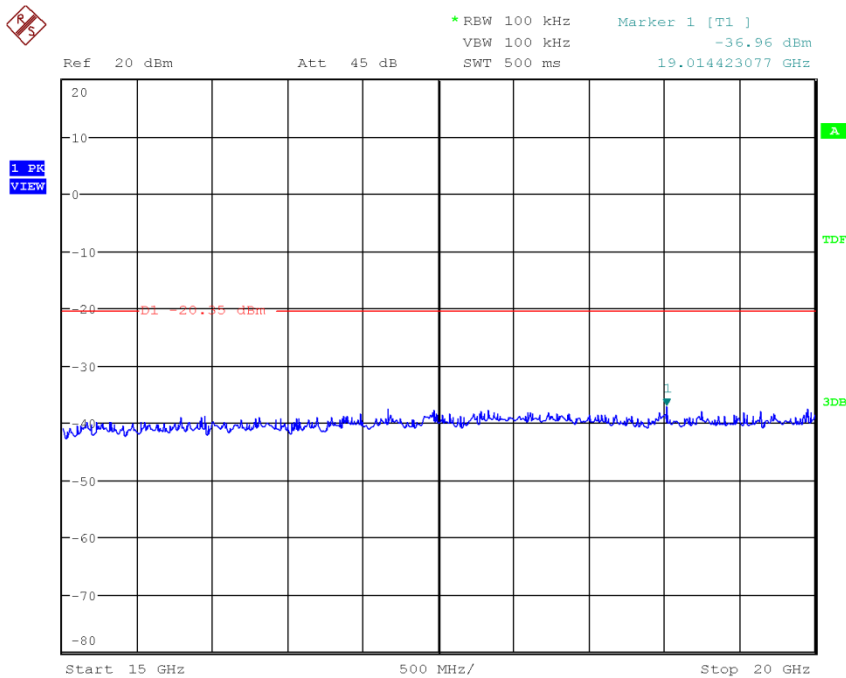
### 5GHz ~ 10GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.11 & Chain 0



### 10GHz ~ 15GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.11 & Chain 0



### 15GHz ~ 20GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.11 & Chain 0



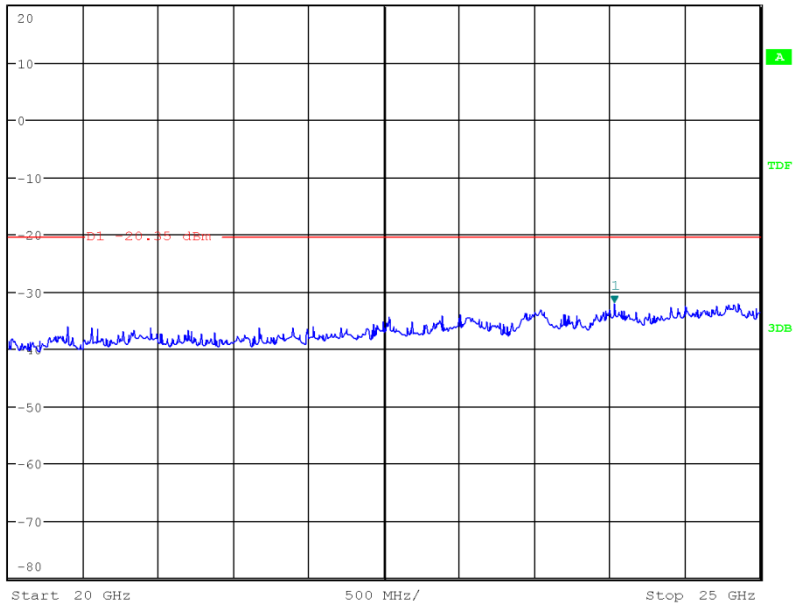
### 20GHz ~ 25GHz Conducted Spurious Emissions Test Mode: 802.11g & Ch.11 & Chain 0



\*RBW 100 kHz    Marker 1 [T1 ]  
VW 100 kHz    -31.91 dBm  
SWT 500 ms    24.030448718 GHz

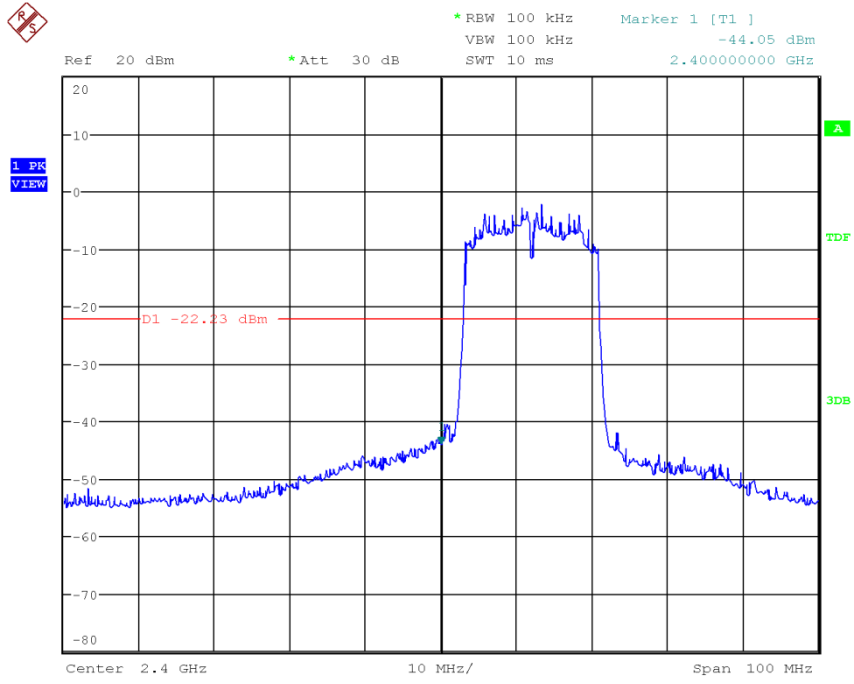
Ref 20 dBm    Att 45 dB

1 PK  
VIEW

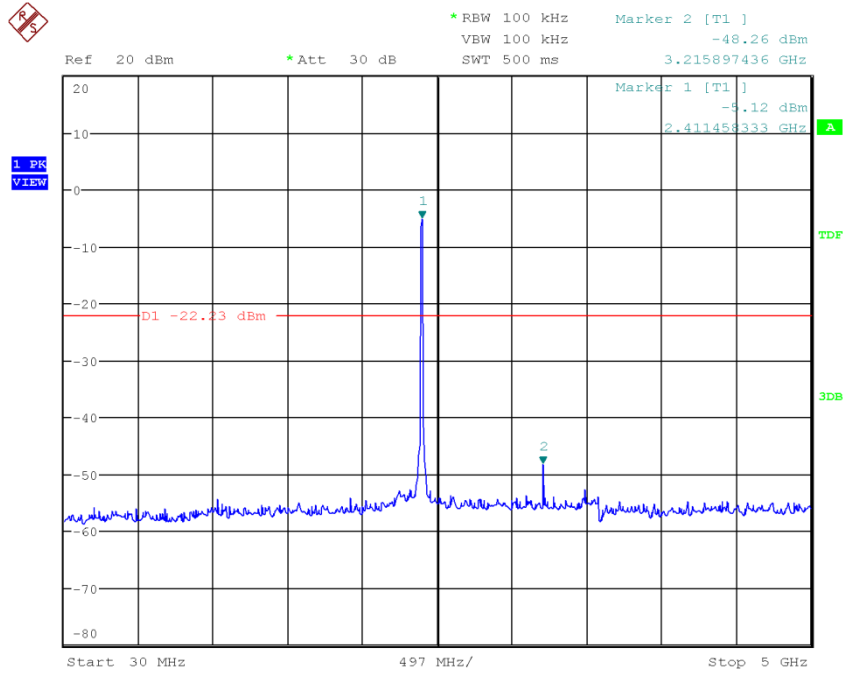


### Low Band-edge at 20 dB blow

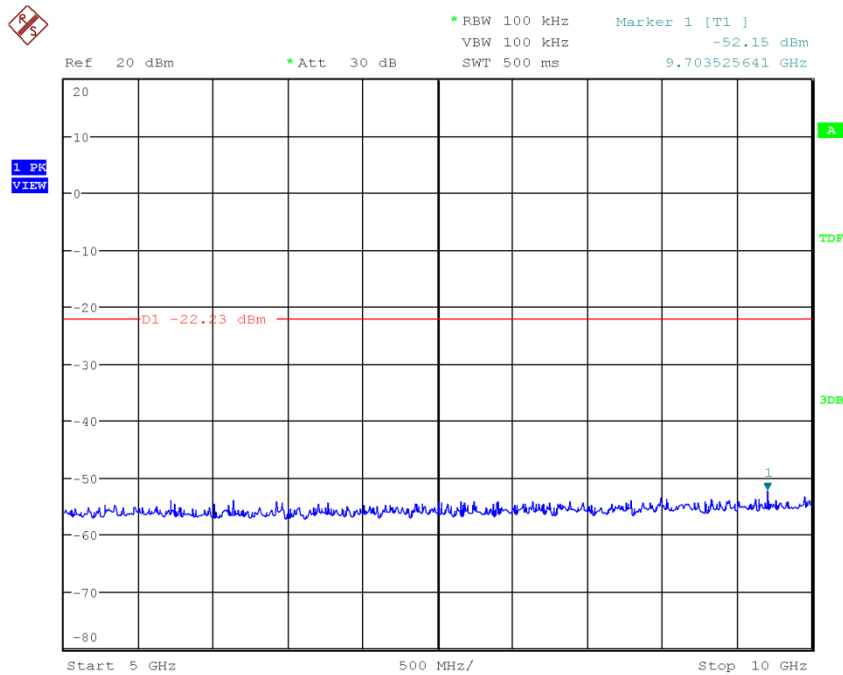
Test Mode: 802.11n HT20 & Ch.1 & Chain 1



### 30MHz ~ 5GHz Conducted Spurious Emissions Test Mode: 802.11n HT20 & Ch.1 & Chain 1

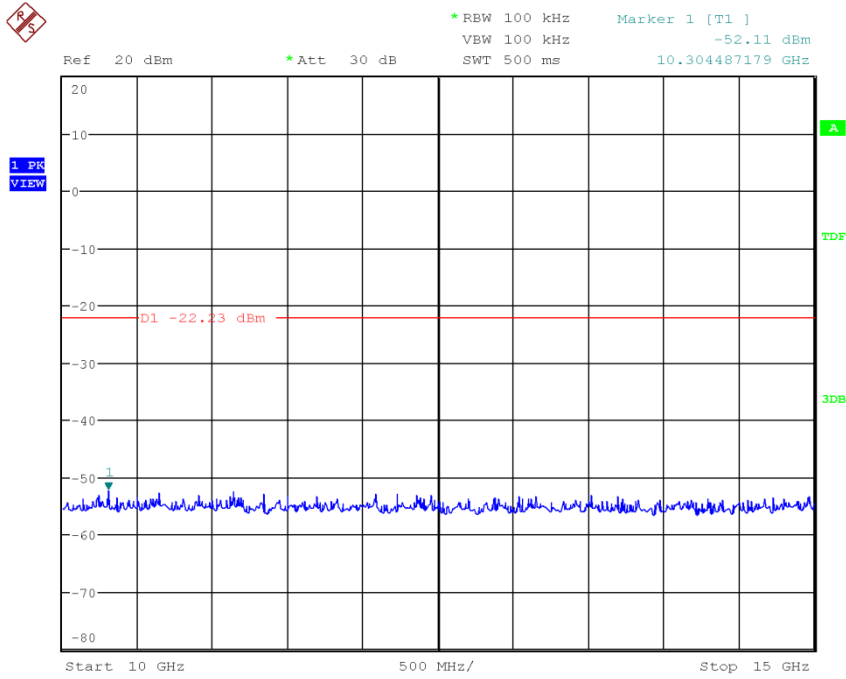


### 5GHz ~ 10GHz Conducted Spurious Emissions Test Mode: 802.11n HT20 & Ch.1 & Chain 1



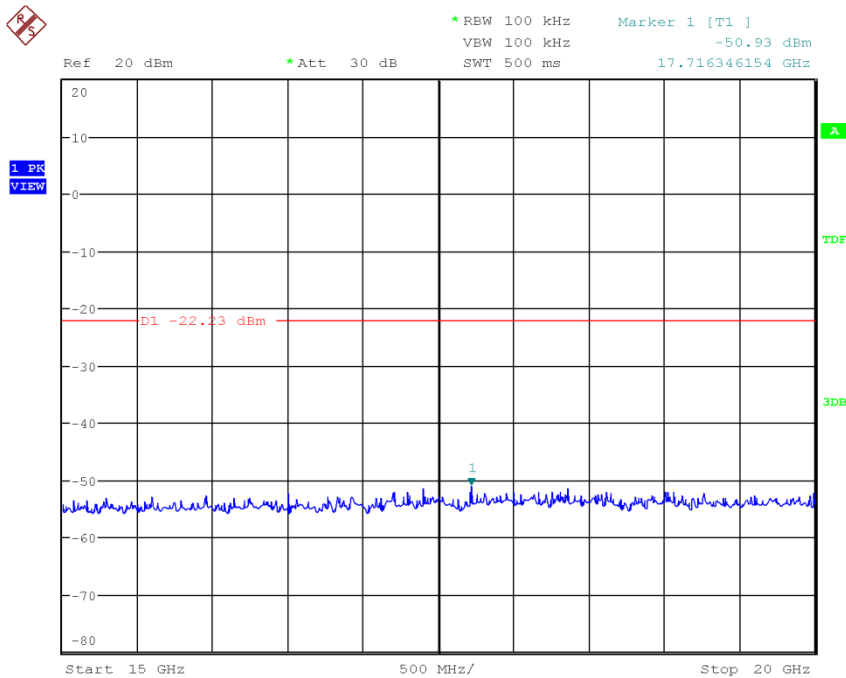
### 10GHz ~ 15GHz Conducted Spurious Emissions

Test Mode: 802.11n HT20 & Ch.1 & Chain 1



### 15GHz ~ 20GHz Conducted Spurious Emissions

Test Mode: 802.11n HT20 & Ch.1 & Chain 1





20GHz ~ 25GHz Conducted Spurious Emissions Test Mode: 802.11n HT20 & Ch.1 & Chain 1



\*RBW 100 kHz Marker 1 [T1 ]  
VBW 100 kHz -46.55 dBm  
SWT 500 ms 24.831730769 GHz

Ref 20 dBm \*Att 30 dB

1 PK  
VIEW

