FCC - TEST REPORT

Report Number	:	**68.950.19.2782.01**	Date of Issue:	**2019-12-26**
Model	:	**E3**		
Product Type	:	Dock		
Applicant	:	VR Technology (Shenzhen) Limited		
Address	:	Room 201, 12 Gaoxin South Road, Huiheng Building, Nanshan District, Shenzhen		
Manufacturer	:	VR Technology (Shenzhen) Limited		
Address	:	Room 201, 12 Gaoxin South Road, Huiheng Building, Nanshan District, Shenzhen		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	**50**		

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District Shenzhen 518052 P.R. China
Telephone:	86 755 8828 6998
Fax:	86 755 8828 5299
FCC Registration No.:	514049
FCC Designation Number:	CN5009
IC Registration No.:	10320A

3 Description of the Equipment Under Test

Product:	Dock
Model no.:	E3
FCC ID:	2AKA6-E3
Rating:	Supplied by 5.0Vdc, 3.0A external adapter
RF Transmission Frequency:	2412MHz-2462MHz
No. of Operated Channel:	11
Modulation:	DSSS, OFDM
Antenna Type:	Integrated antenna
Antenna Gain:	2.0dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Dock which support WiFi function operated at 2.4GHz.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2018 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to
KDB 558074 D01 15.247 Meas Guidance v05r02,
KDB 662911 D01 Multiple Transmitter Output v02r01,
ANSI C63.10 (2013).

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5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port	10	Site 1	☒	☐	☐
§15.247 (b) (1)	Conducted peak output power	13	Site 1	☒	☐	☐
§15.247(a)(1)	20dB bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Dwell Time	---	---	☐	☐	☒
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	15	Site 1	☒	☐	☐
§15.247(e)	Power spectral density	26	Site 1	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	31	Site 1	☒	☐	☐
§15.247(d)	Band edge	45	Site 1	☒	☐	☐
§15.247(d)	Spurious radiated emissions for transmitter	49	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 2		☒	☐	☐

Note 1: N/A=Not Applicable.
Note 2: The EUT uses an internal antenna, which gain is 2.0dBi. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AKA6-E3 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date:	August 26, 2019
Testing Start Date:	September 2, 2019
Testing End Date:	December 12, 2019

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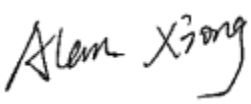
Reviewed by:	Prepared by:	Tested by:
		
John Zhi	Alan Xiong	Tree Zhan
Project Manager	Project Engineer	Test Engineer

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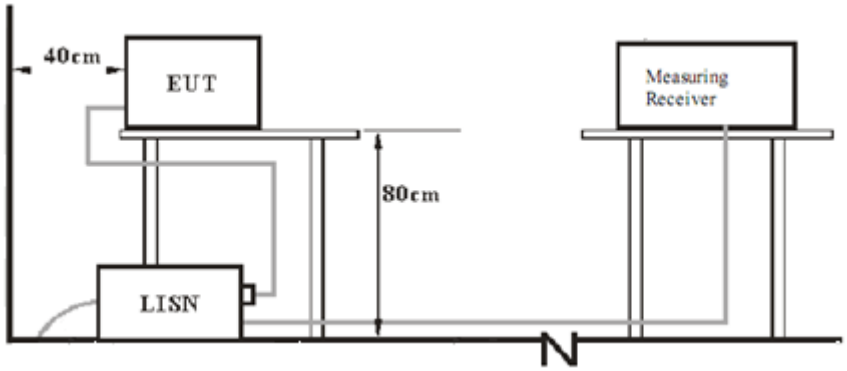
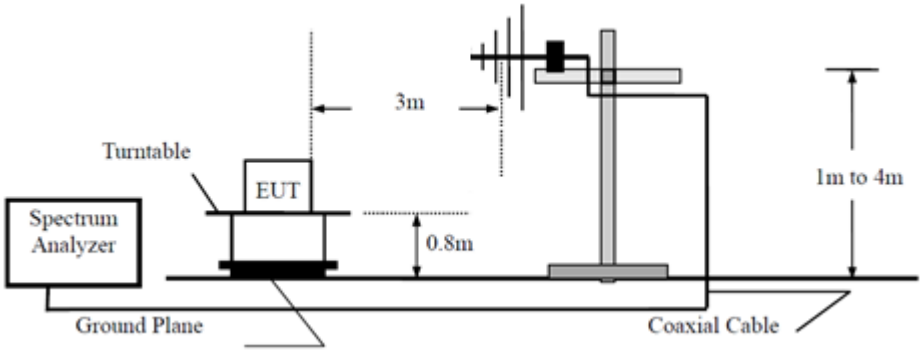
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

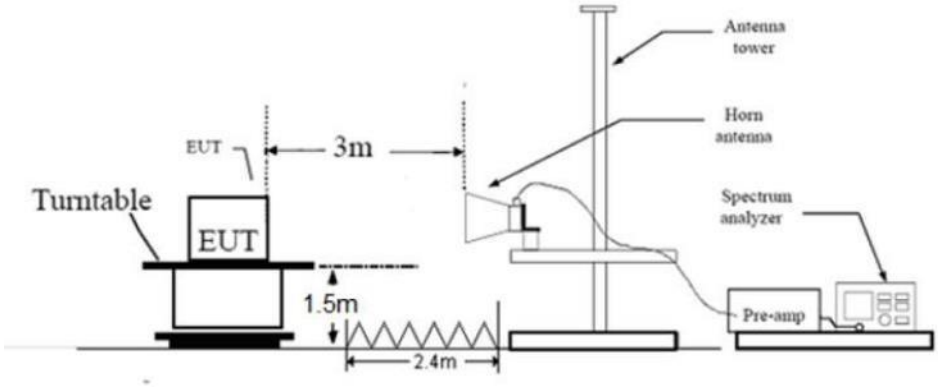


7.2 Radiated test setups

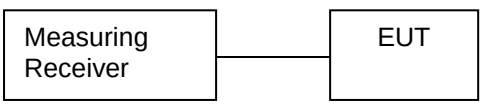
Below 1GHz



Above 1GHz



7.3 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
PC	Lenovo	X240	---

The system was configured to non-hopping mode.

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

Through pre-scan all kind of modulation and all kind of rates, find the 1Mbps of rate is the worst case of 802.11b; the 6Mbps of rate is the worst case of 802.11g; the 6.5Mbps of rate is the worst case of 802.11n20; the 13.5Mbps of rate is the worst case of 802.11n40, only the worst case transmitter rate data mode in recorded in the report.

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Building 12&13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District,
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9 Technical Requirement

9.1 Conducted Emission Test

Test Method

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. Both sides of AC line were checked for maximum conducted interference.
6. The frequency range from 150 kHz to 30 MHz was searched.
7. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

Limit

According to §15.207, conducted emissions limit as below:

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Remark: *Decreasing linearly with logarithm of the frequency

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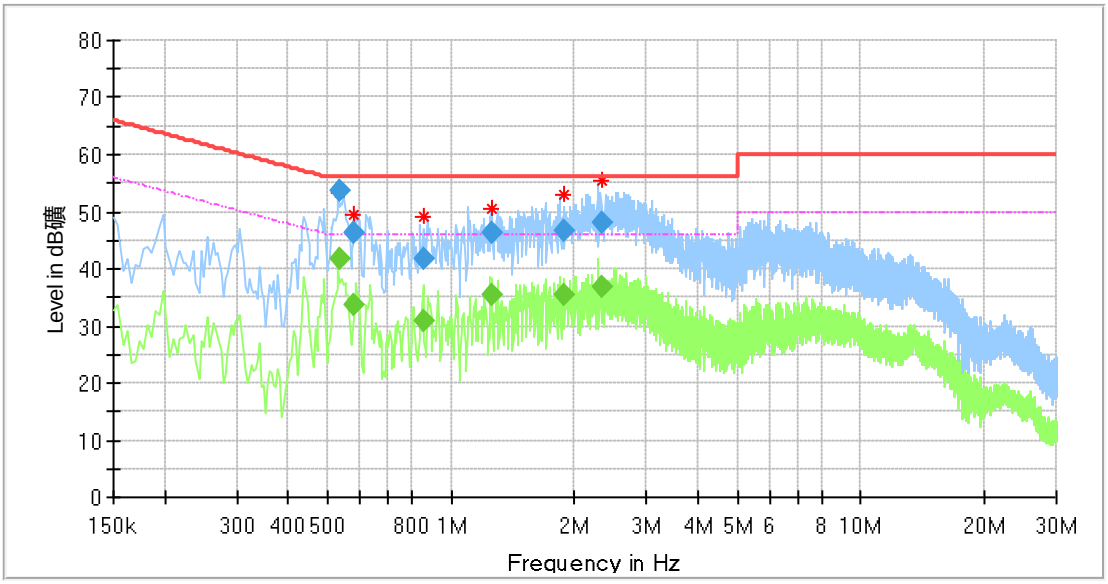
Conducted Emission

Product Type	:	Dock
M/N	:	E3
Operating Condition	:	Normal Working with WiFi traffic Mode (connect to A2 via USB Cable, connect to PC via RJ45, connect to Mouse/Keyboard/USB Dick via USB port, connect to monitor via HDMI Cable)
Test Specification	:	Line
Comment	:	AC 120V/60Hz



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.537000	---	41.83	46.00	4.17	L1	10.3
0.537000	53.56	---	56.00	2.44	L1	10.3
0.577000	---	33.54	46.00	12.46	L1	10.3
0.577000	46.16	---	56.00	9.84	L1	10.3
0.861000	---	30.99	46.00	15.01	L1	10.3
0.861000	41.85	---	56.00	14.15	L1	10.3
1.253000	---	35.34	46.00	10.66	L1	10.3
1.253000	46.44	---	56.00	9.56	L1	10.3
1.877000	---	35.56	46.00	10.44	L1	10.3
1.877000	46.54	---	56.00	9.46	L1	10.3
2.327000	---	36.75	46.00	9.25	L1	10.4
2.327000	48.20	---	56.00	7.80	L1	10.4

Remark:
Max Peak= Read level + Corrector factor
Correct factor=cable loss + LISN factor
(The Reading Level is recorded by software which is not shown in the sheet)

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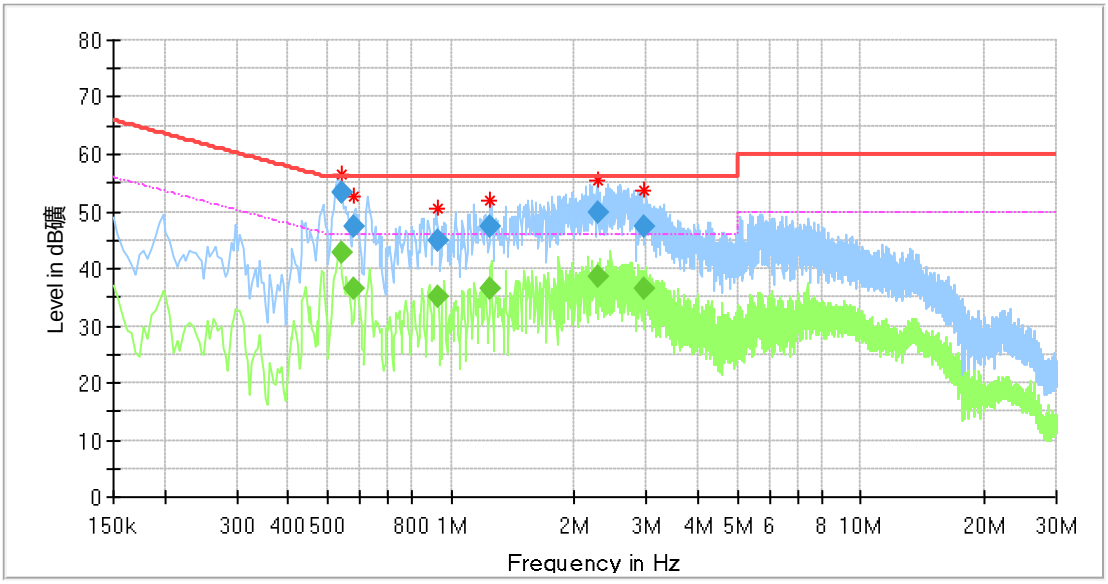
Conducted Emission

Product Type	:	Dock
M/N	:	E3
Operating Condition	:	Normal Working with WiFi traffic Mode (connect to A2 via USB Cable, connect to PC via RJ45, connect to Mouse/Keyboard/USB Dick via USB port, connect to monitor via HDMI Cable)
Test Specification	:	Neutral
Comment	:	AC 120V/60Hz



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.541000	53.46	---	56.00	2.54	N	10.3
0.541000	---	42.91	46.00	3.09	N	10.3
0.581000	---	36.64	46.00	9.36	N	10.3
0.581000	47.35	---	56.00	8.65	N	10.3
0.929000	---	35.00	46.00	11.00	N	10.3
0.929000	44.91	---	56.00	11.09	N	10.3
1.241000	---	36.38	46.00	9.62	N	10.3
1.241000	47.30	---	56.00	8.70	N	10.3
2.273000	---	38.43	46.00	7.57	N	10.4
2.273000	49.78	---	56.00	6.22	N	10.4
2.969000	---	36.41	46.00	9.59	N	10.4
2.969000	47.30	---	56.00	8.70	N	10.4

Remark:
Max Peak= Read level + Corrector factor
Correct factor=cable loss + LISN factor
(The Reading Level is recorded by software which is not shown in the sheet)

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9.2 Conducted peak output power

Test Method

1. The RF output of EUT was connected to the power meter by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following test receiver settings:
   Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
   RBW > the 20dB bandwidth of the emission being measured, VBW≥RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power and record the results in the test report.
5. Repeat above procedures until all frequencies measured were complete.

Limits

According to §15.247 (b) (1), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

Test result as below table

802.11b modulation Test Result

Frequency (MHz)	Conducted Peak Output Power (dBm)	Result
Low channel 2412MHz	4.9	Pass
Middle channel 2437MHz	5.8	Pass
High channel 2462MHz	6.2	Pass

802.11g modulation Test Result

Frequency (MHz)	Conducted Peak Output Power (dBm)	Result
Low channel 2412MHz	5.5	Pass
Middle channel 2437MHz	6.0	Pass
High channel 2462MHz	6.3	Pass

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802.11n20 modulation Test Result

Frequency (MHz)	Conducted Peak Output Power (dBm)	Result
Low channel 2412MHz	5.6	Pass
Middle channel 2437MHz	6.1	Pass
High channel 2462MHz	6.4	Pass

802.11n40 modulation Test Result

Frequency (MHz)	Conducted Peak Output Power (dBm)	Result
Low channel 2422MHz	4.2	Pass
Middle channel 2437MHz	5.0	Pass
High channel 2452MHz	5.5	Pass

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9.3 6dB bandwidth and 99% Occupied Bandwidth

Test Method for 6 dB Bandwidth

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Use the following spectrum analyzer settings:
RBW=100K, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
3. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
4. Allow the trace to stabilize, record the X dB Bandwidth value.

Test Method for 99 % Bandwidth

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Use the following spectrum analyzer settings:
RBW=1% to 5% of the actual occupied, VBW≥3RBW, Sweep = auto,
Detector function = peak, Trace = max hold
3. Use the automatic bandwidth measurement capability of an instrument, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
4. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]
≥500

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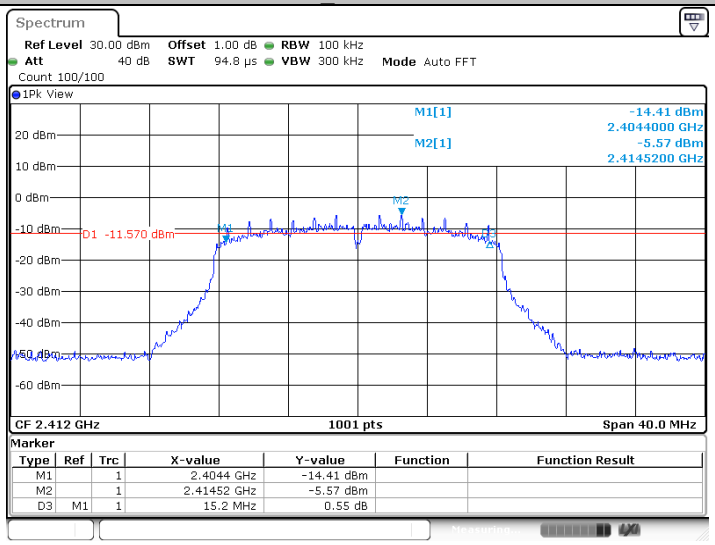
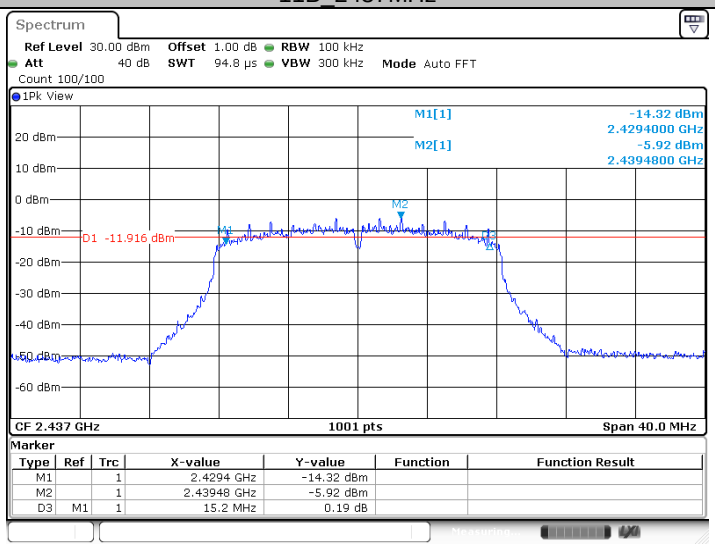
6dB Bandwidth

TestMode	Antenna	Channel [MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	15.200	2404.400	2419.600	0.5	PASS
		2437	15.200	2429.400	2444.600	0.5	PASS
		2462	15.200	2454.400	2469.600	0.5	PASS
11G	Ant1	2412	15.200	2404.400	2419.600	0.5	PASS
		2437	15.200	2429.400	2444.600	0.5	PASS
		2462	15.200	2454.400	2469.600	0.5	PASS
11N20SISO	Ant1	2412	15.200	2404.400	2419.600	0.5	PASS
		2437	15.200	2429.400	2444.600	0.5	PASS
		2462	15.200	2454.400	2469.600	0.5	PASS
11N40SISO	Ant1	2422	34.000	2405.680	2439.680	0.5	PASS
		2437	34.000	2420.600	2454.600	0.5	PASS
		2452	34.080	2435.600	2469.680	0.5	PASS

11B_2412MHz



11B_2437MHz



11B_2462MHz

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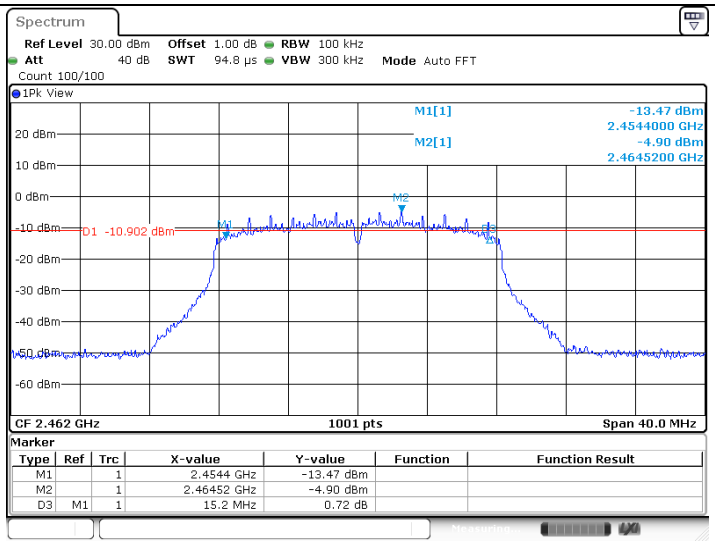
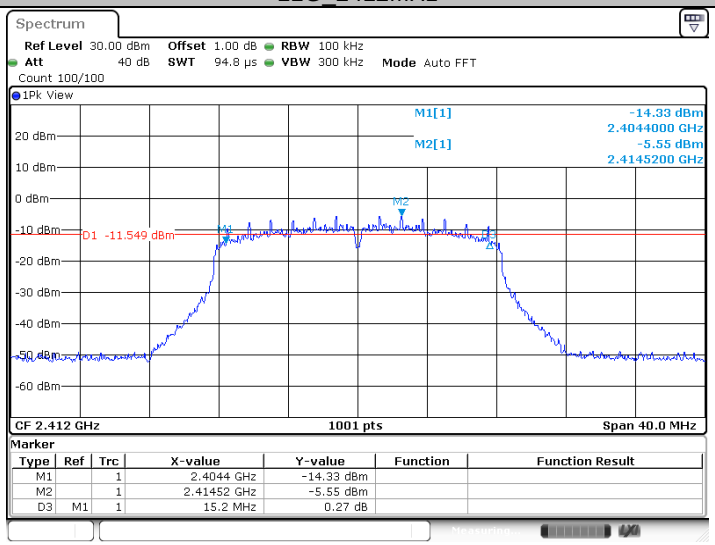
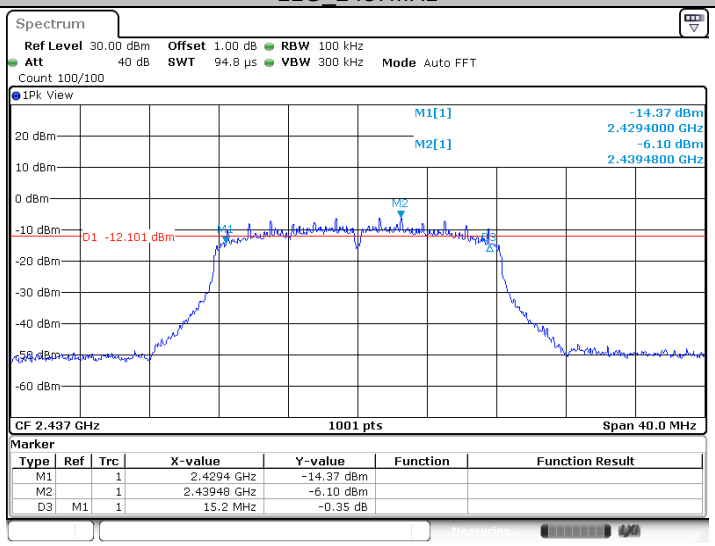


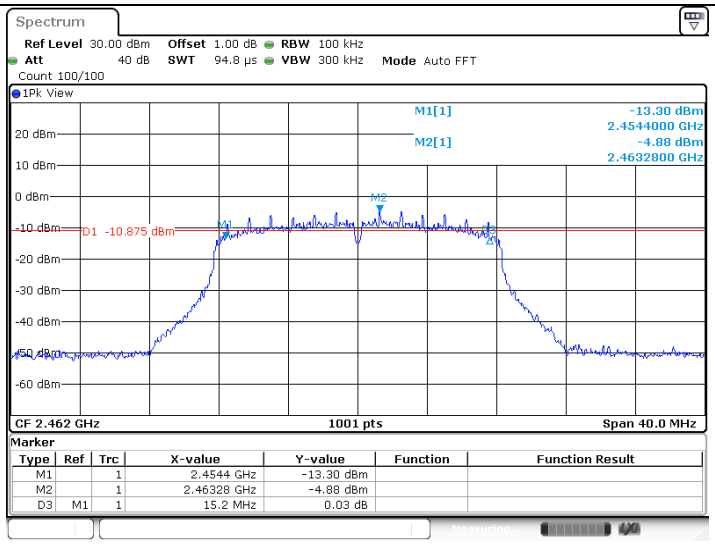
11G_2412MHz



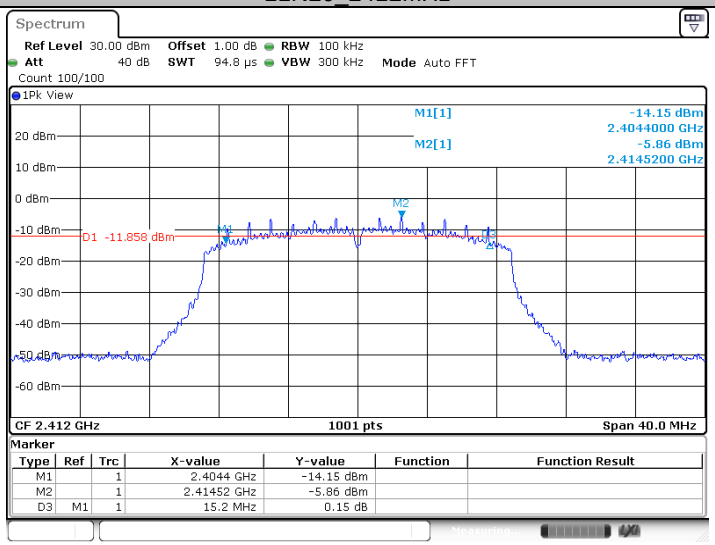
11G_2437MHz



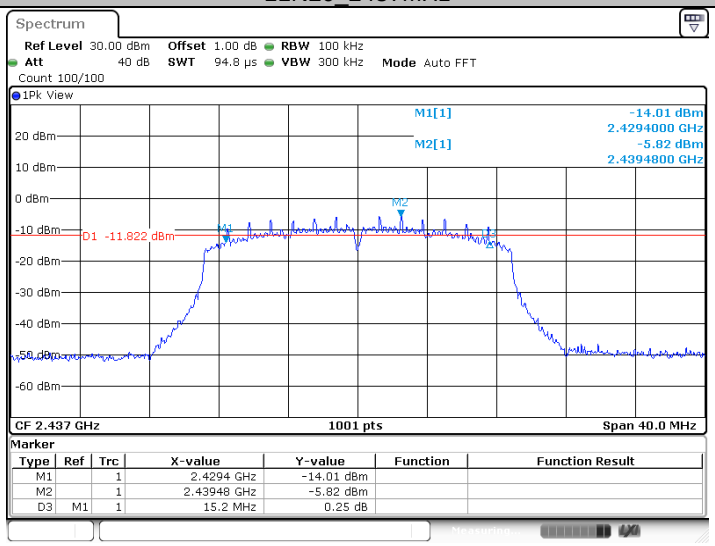
11G_2462MHz



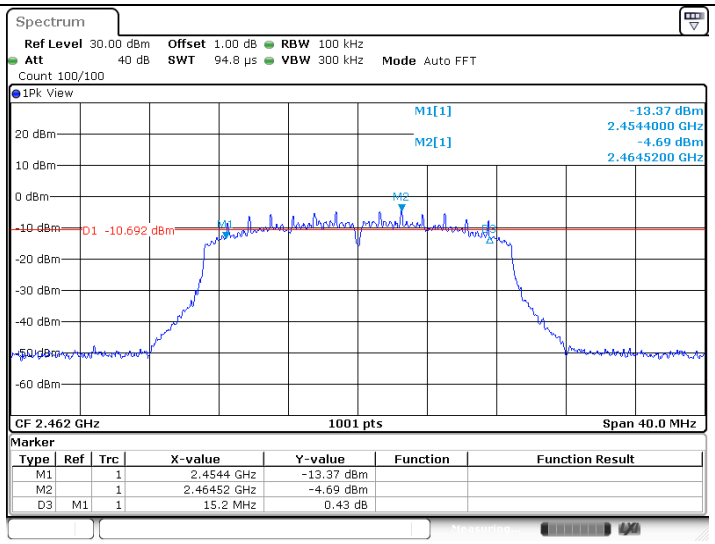
11N20_2412MHz



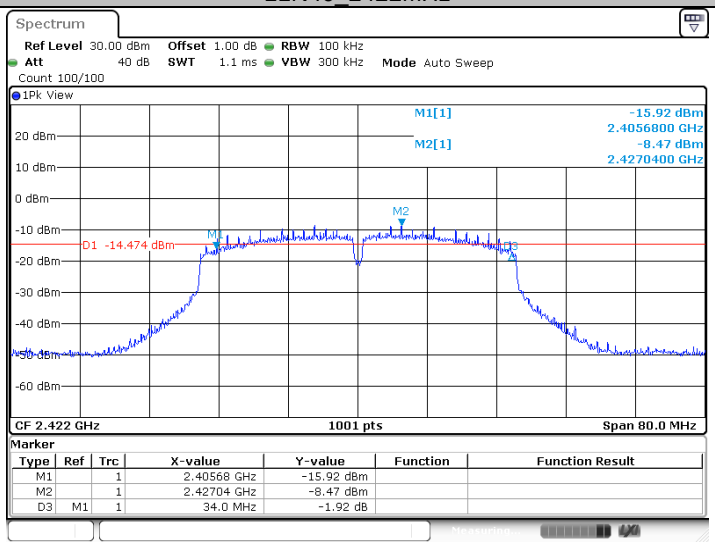
11N20_2437MHz



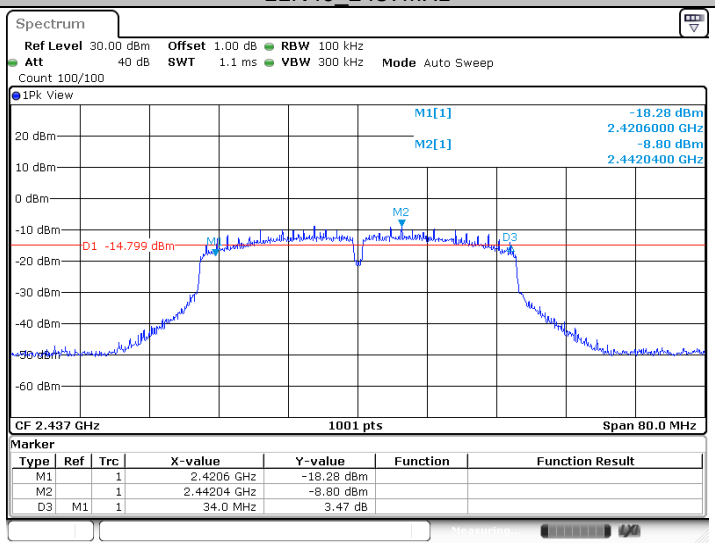
11N20_2462MHz



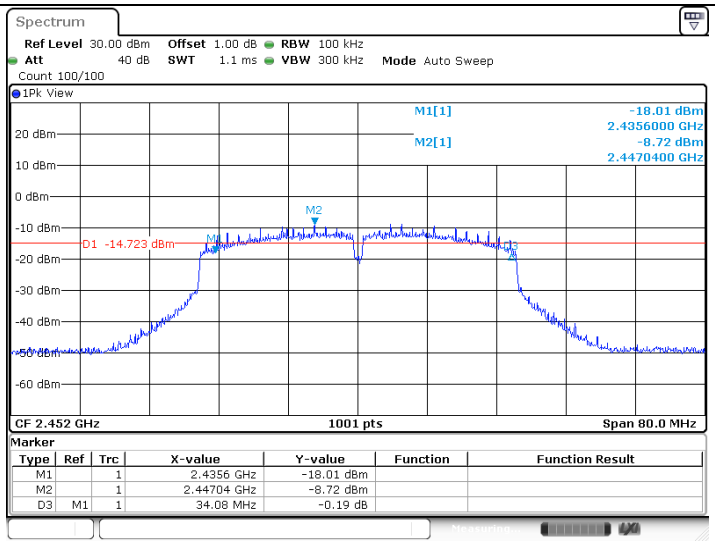
11N40_2422MHz



11N40_2437MHz



11N40_2452MHz



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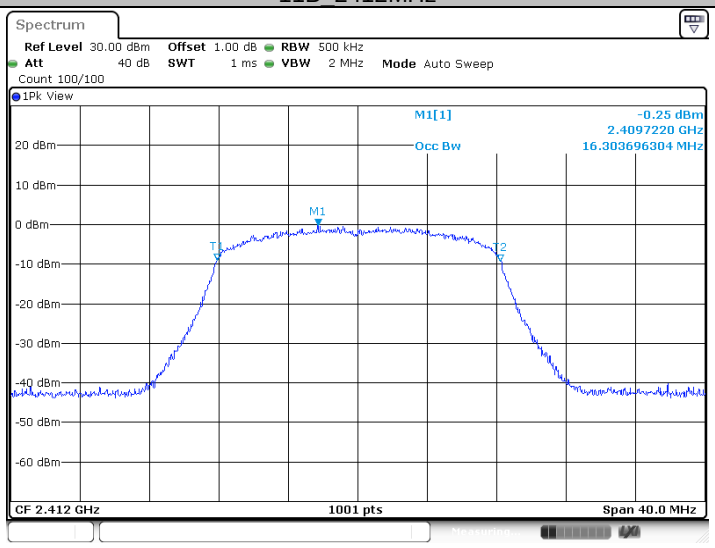
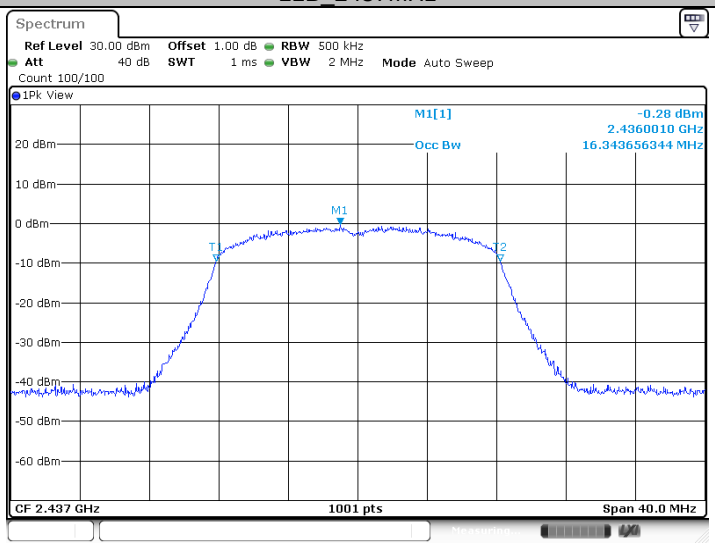
99% Bandwidth

TestMode	Antenna	Channel [MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	16.304	2403.888	2420.192	---	PASS
		2437	16.344	2428.848	2445.192	---	PASS
		2462	16.344	2453.848	2470.192	---	PASS
11G	Ant1	2412	16.344	2403.888	2420.232	---	PASS
		2437	16.344	2428.848	2445.192	---	PASS
		2462	16.344	2453.848	2470.192	---	PASS
11N20SISO	Ant1	2412	17.263	2403.409	2420.671	---	PASS
		2437	17.263	2428.409	2445.671	---	PASS
		2462	17.263	2453.409	2470.671	---	PASS
11N40SISO	Ant1	2422	36.044	2404.098	2440.142	---	PASS
		2437	36.124	2419.018	2455.142	---	PASS
		2452	36.124	2434.018	2470.142	---	PASS

11B_2412MHz



11B_2437MHz



11B_2462MHz

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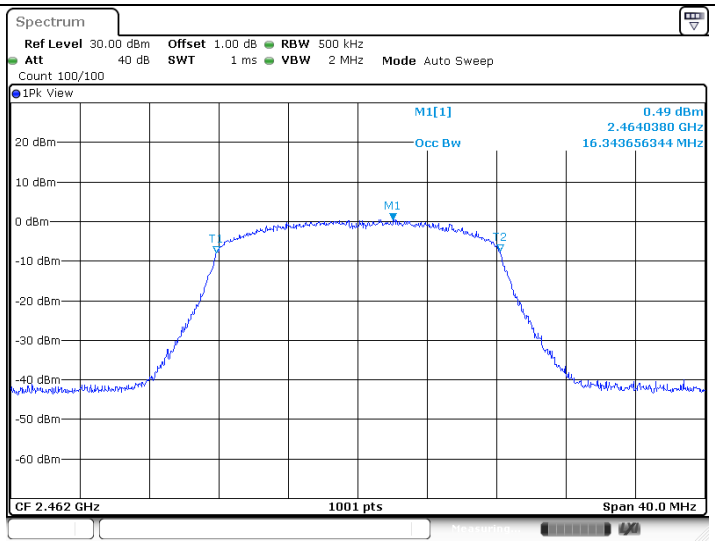
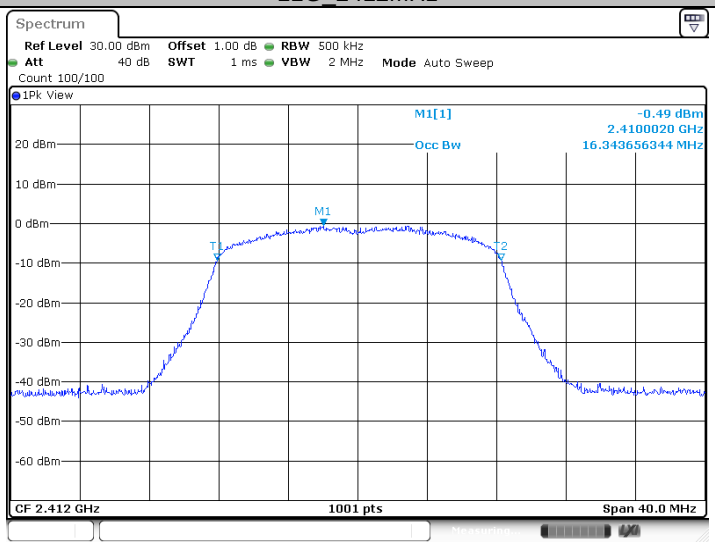
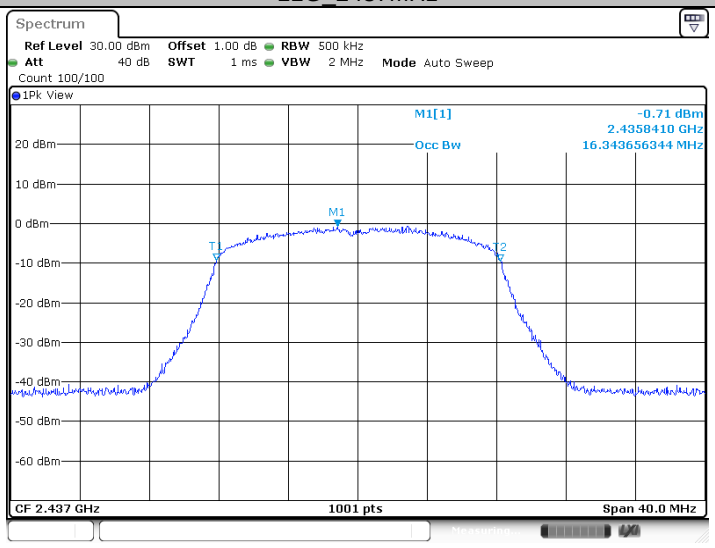


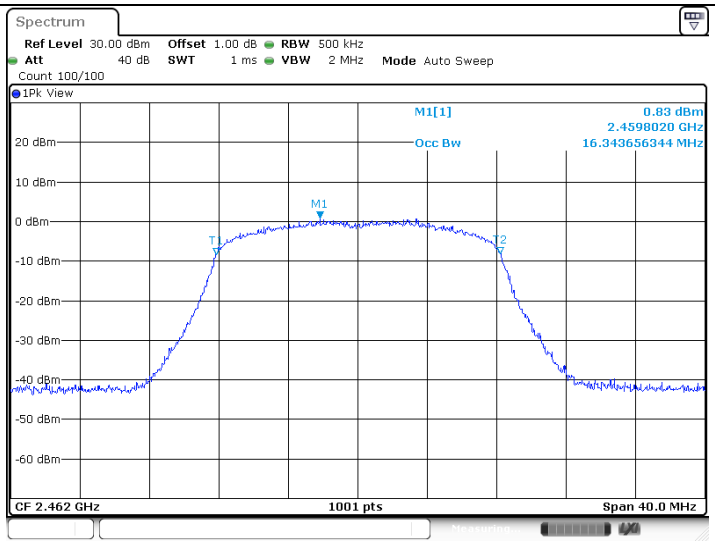
11G_2412MHz



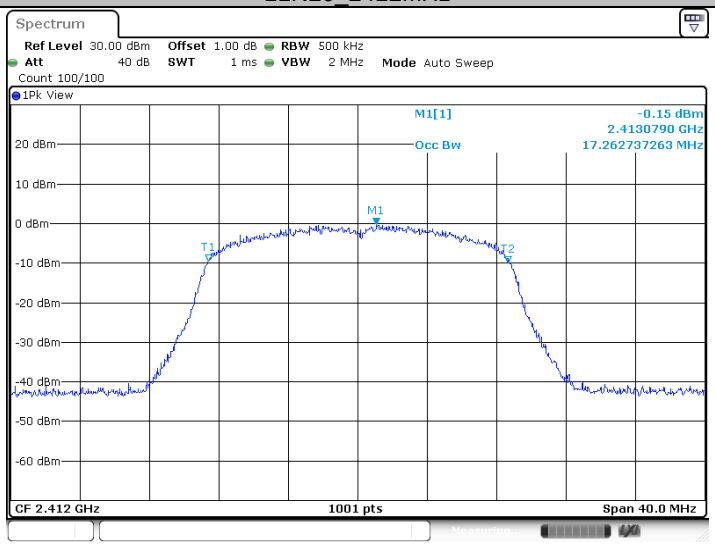
11G_2437MHz



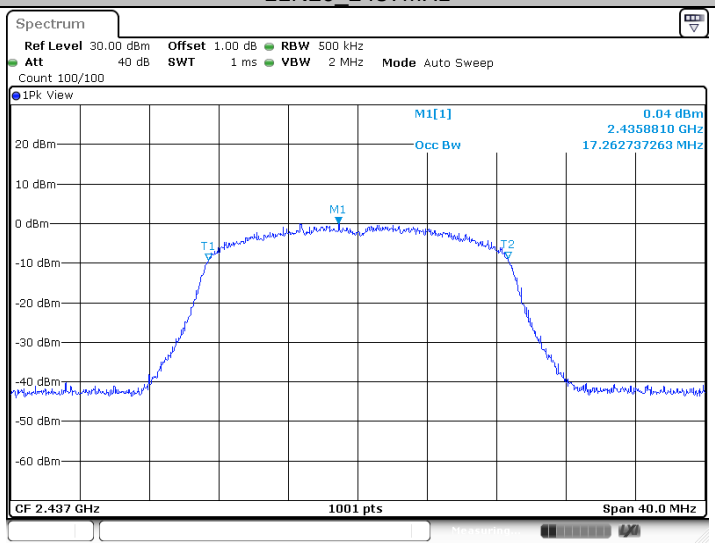
11G_2462MHz



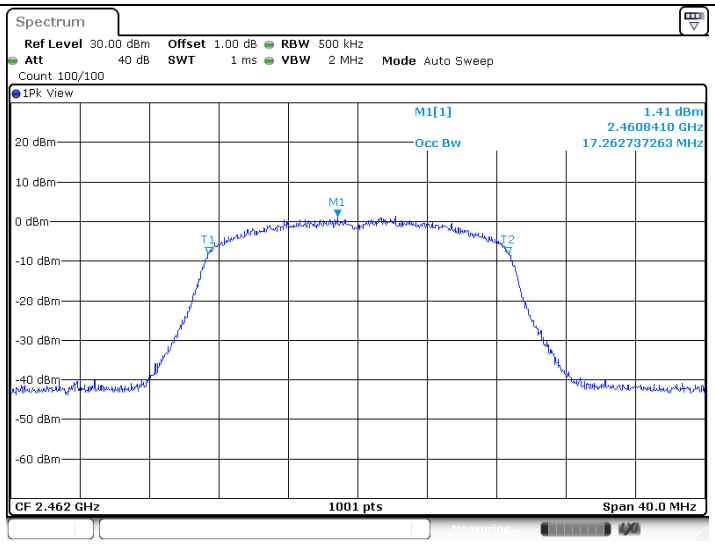
11N20_2412MHz



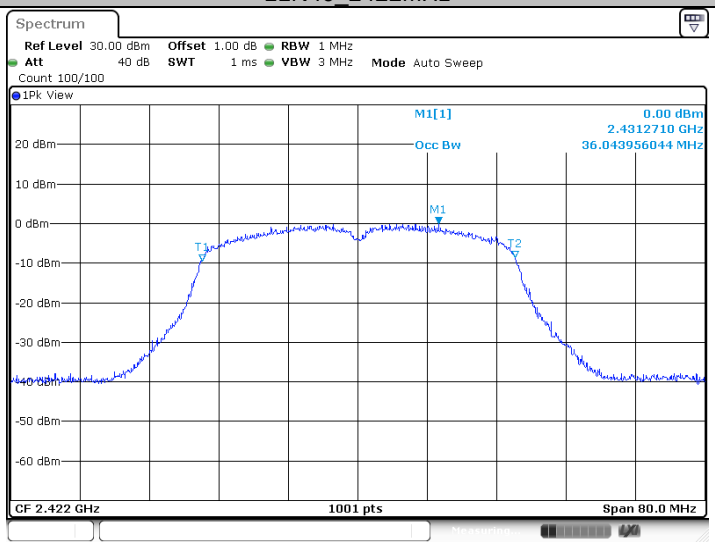
11N20_2437MHz



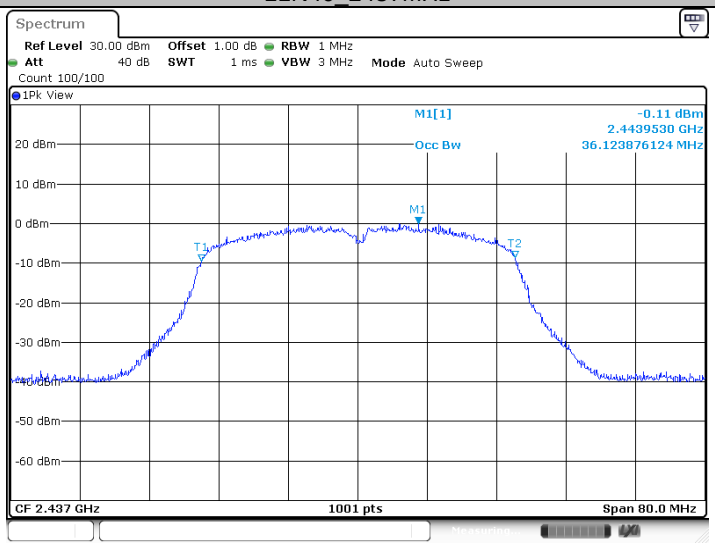
11N20_2462MHz



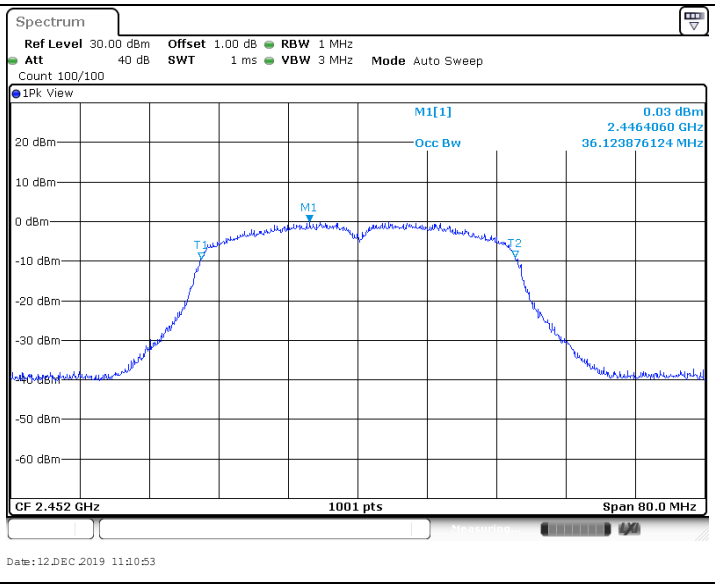
11N40_2422MHz



11N40_2437MHz



11N40_2452MHz



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9.4 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW=3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
3. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
4. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm]
≤8dBm/3KHz

802.11b modulation Test Result

Frequency (MHz)	Power spectral density (dBm/3KHz)	Limit (dBm/3KHz)	Result
Low channel 2412MHz	-18.82	8	Pass
Middle channel 2437MHz	-18.80	8	Pass
High channel 2462MHz	-18.21	8	Pass

802.11g modulation Test Result

Frequency (MHz)	Power spectral density (dBm/3KHz)	Limit (dBm/3KHz)	Result
Low channel 2412MHz	-19.49	8	Pass
Middle channel 2437MHz	-19.27	8	Pass
High channel 2462MHz	-18.29	8	Pass

802.11n-HT20 modulation Test Result

Frequency (MHz)	Power spectral density (dBm/3KHz)	Limit (dBm/3KHz)	Result
Low channel 2412MHz	-20.16	8	Pass
Middle channel 2437MHz	-19.37	8	Pass
High channel 2462MHz	-19.45	8	Pass

802.11n-HT40 modulation Test Result

Frequency (MHz)	Power spectral density (dBm/3KHz)	Limit (dBm/3KHz)	Result
Low channel 2422MHz	-23.38	8	Pass
Middle channel 2437MHz	-23.41	8	Pass
High channel 2452MHz	-23.77	8	Pass

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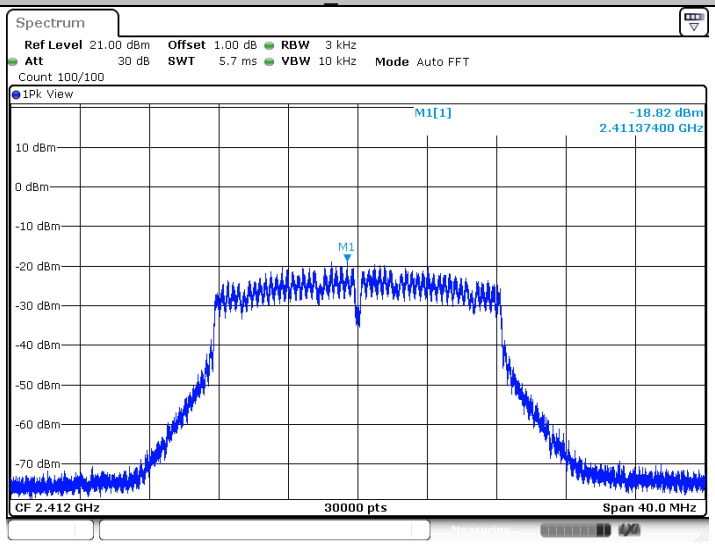
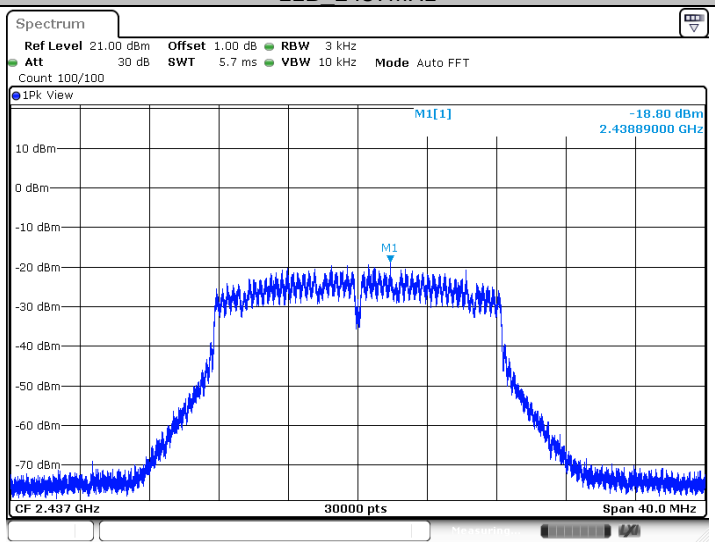
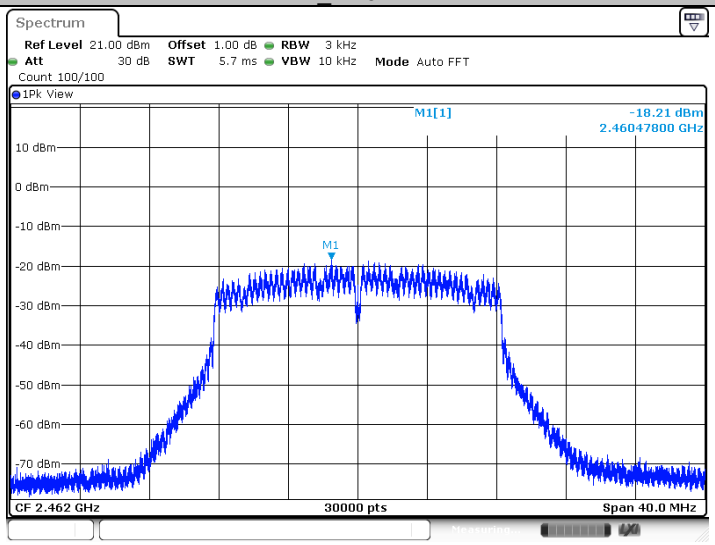
11B _2412MHz



11B_2437MHz



11B_ 2462MHz



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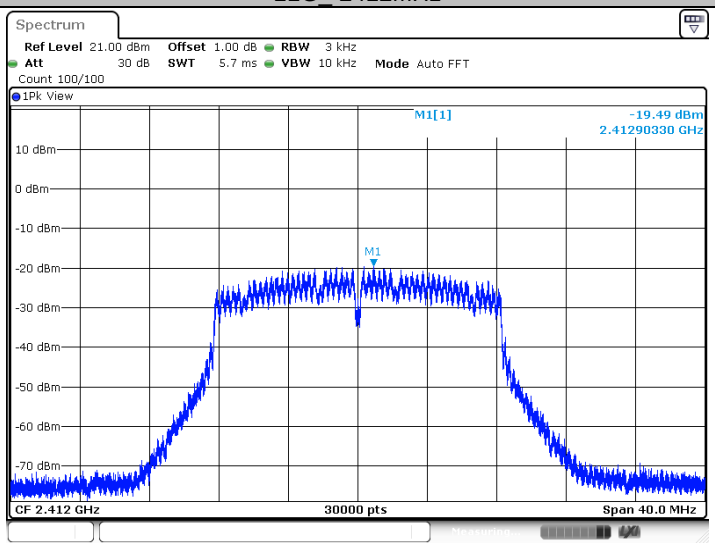
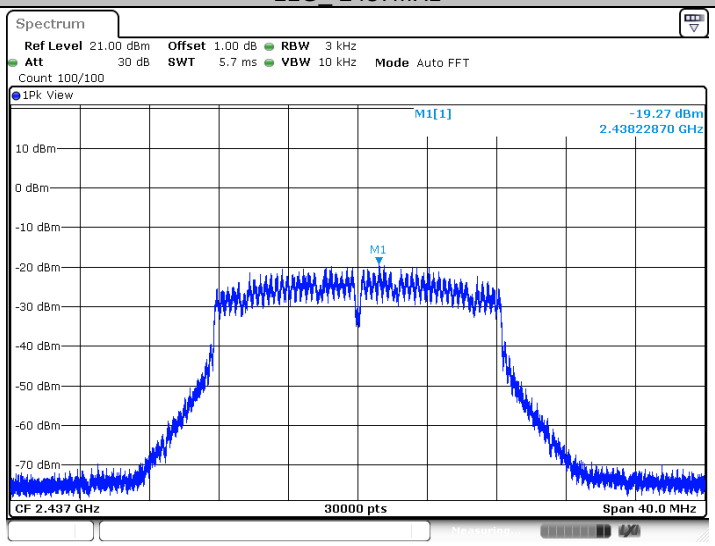
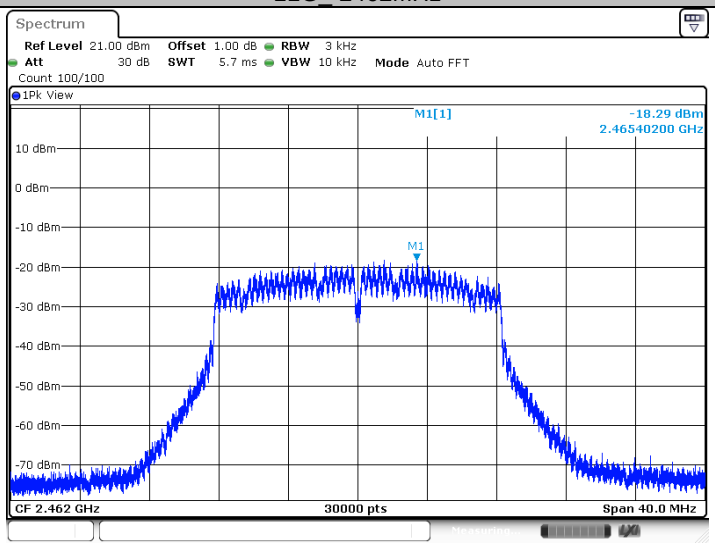
11G_ 2412MHz



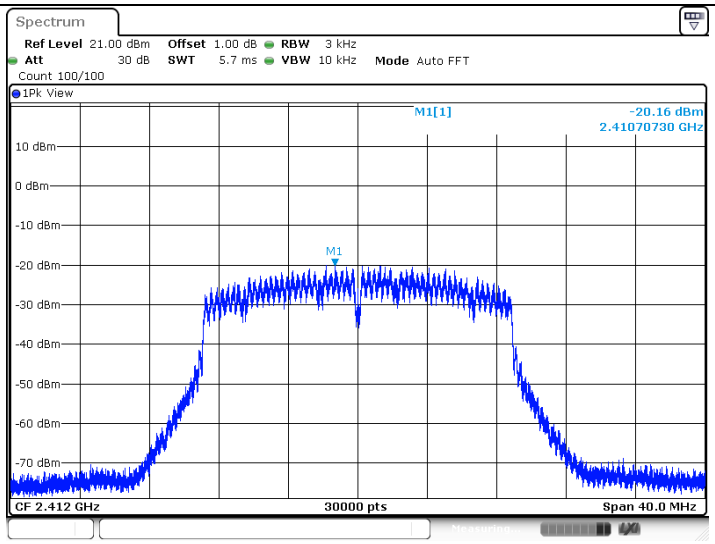
11G_ 2437MHz



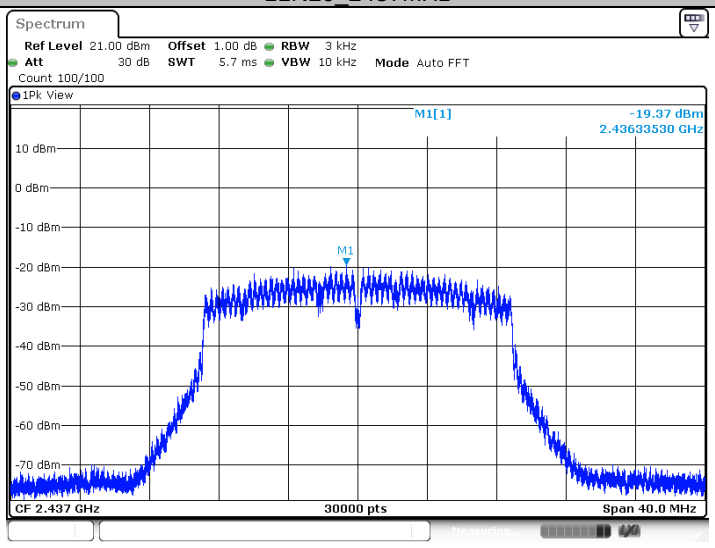
11G_ 2462MHz



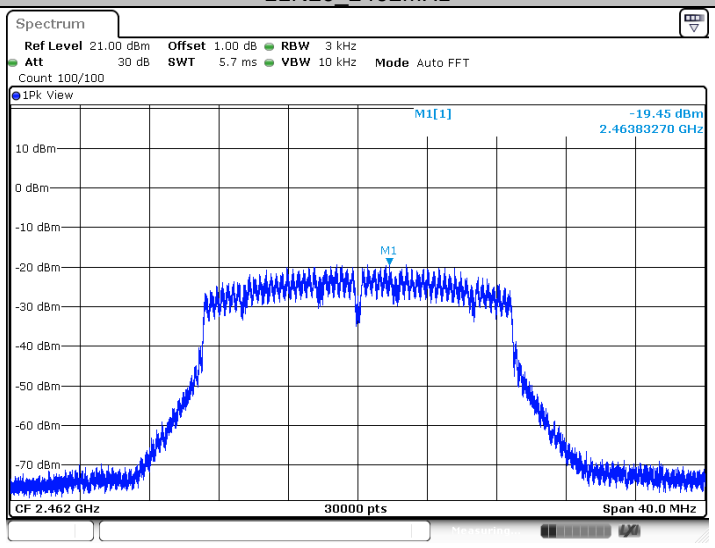
11N20_2412MHz



11N20_2437MHz



11N20_2462MHz



11N40_2422MHz

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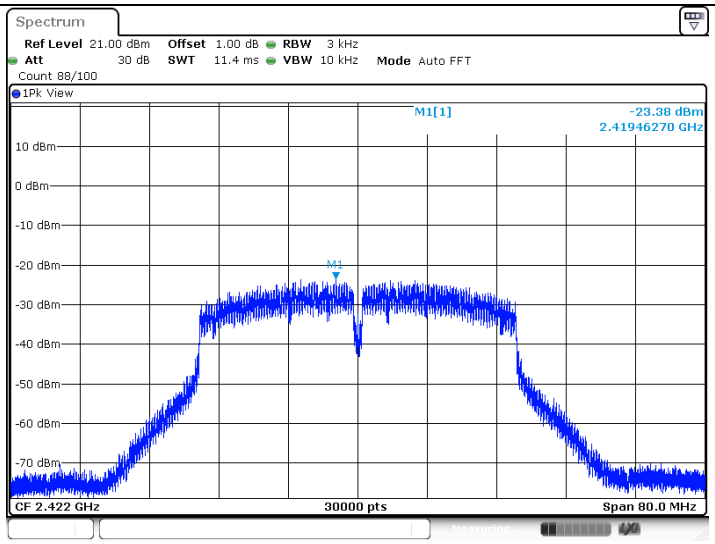
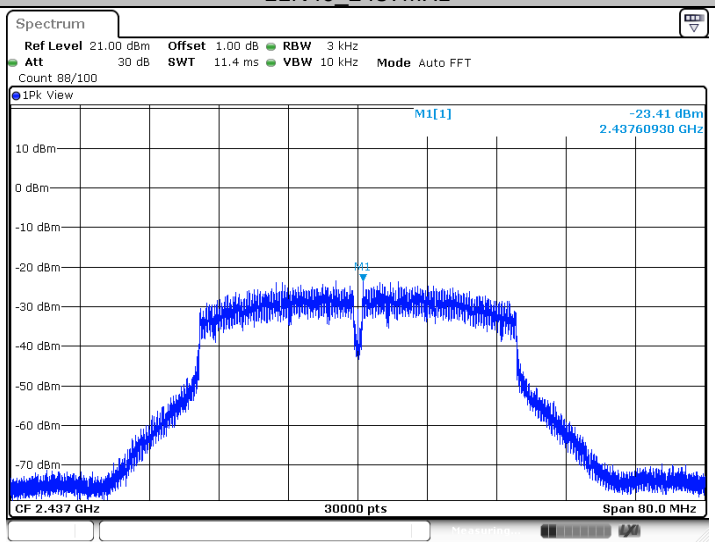
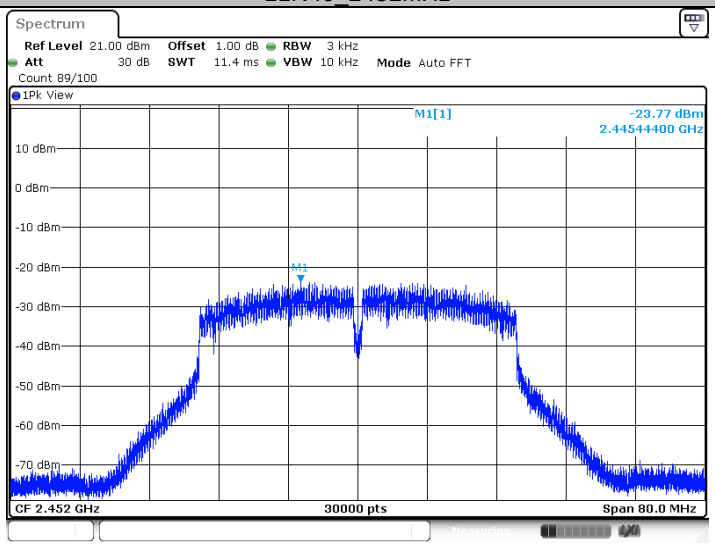


11N40_2437MHz



11N40_2452MHz



9.5 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
3. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
4. The level displayed must comply with the limit specified in this Section. Submit these plots.
5. Repeat above procedures until all frequencies measured were complete.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

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Spurious RF conducted emissions

TestMode	Antenna	Channel [MHz]	FreqRange [MHz]	RefLevel	Result [dBm]	Limit [dBm]	Verdict
11B	Ant1	2412	Reference	-5.62	-5.62	---	PASS
		2412	30~1000	30~1000	-51.36	<=-25.62	PASS
		2412	1000~26500	1000~26500	-52.87	<=-25.62	PASS
		2437	Reference	-8.36	-8.36	---	PASS
		2437	30~1000	30~1000	-51.41	<=-28.36	PASS
		2437	1000~26500	1000~26500	-51.87	<=-28.36	PASS
		2462	Reference	-4.57	-4.57	---	PASS
		2462	30~1000	30~1000	-51.08	<=-24.57	PASS
		2462	1000~26500	1000~26500	-51.46	<=-24.57	PASS
11G	Ant1	2412	Reference	-8.26	-8.26	---	PASS
		2412	30~1000	30~1000	-50.97	<=-28.26	PASS
		2412	1000~26500	1000~26500	-52.6	<=-28.26	PASS
		2437	Reference	-5.94	-5.94	---	PASS
		2437	30~1000	30~1000	-51.12	<=-25.94	PASS
		2437	1000~26500	1000~26500	-51.64	<=-25.94	PASS
		2462	Reference	-4.51	-4.51	---	PASS
		2462	30~1000	30~1000	-51.56	<=-24.51	PASS
		2462	1000~26500	1000~26500	-51.93	<=-24.51	PASS
11N20SISO	Ant1	2412	Reference	-5.58	-5.58	---	PASS
		2412	30~1000	30~1000	-51.33	<=-25.58	PASS
		2412	1000~26500	1000~26500	-52.55	<=-25.58	PASS
		2437	Reference	-5.87	-5.87	---	PASS
		2437	30~1000	30~1000	-51.26	<=-25.87	PASS
		2437	1000~26500	1000~26500	-52.01	<=-25.87	PASS
		2462	Reference	-4.58	-4.58	---	PASS
		2462	30~1000	30~1000	-51.6	<=-24.58	PASS
		2462	1000~26500	1000~26500	-52.4	<=-24.58	PASS
11N40SISO	Ant1	2422	Reference	-8.53	-8.53	---	PASS
		2422	30~1000	30~1000	-47.51	<=-28.53	PASS
		2422	1000~26500	1000~26500	-52.06	<=-28.53	PASS
		2437	Reference	-9.00	-9.00	---	PASS
		2437	30~1000	30~1000	-51.3	<=-29	PASS
		2437	1000~26500	1000~26500	-51.16	<=-29	PASS
		2452	Reference	-9.14	-9.14	---	PASS
		2452	30~1000	30~1000	-51.31	<=-29.14	PASS
		2452	1000~26500	1000~26500	-52.06	<=-29.14	PASS

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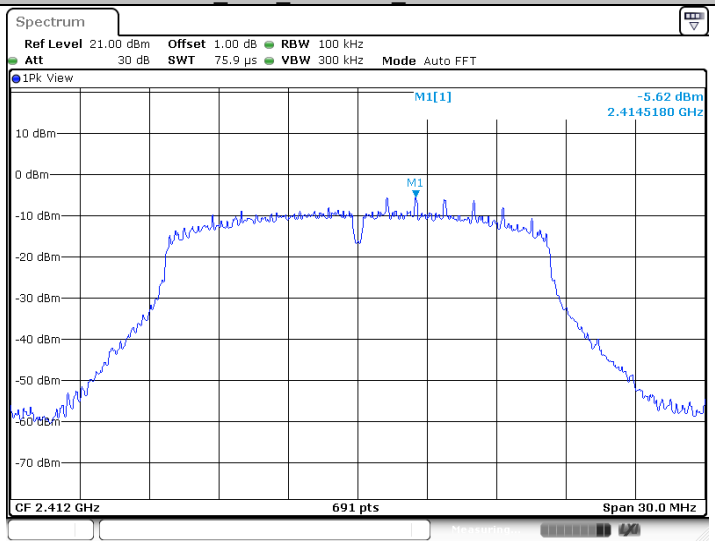
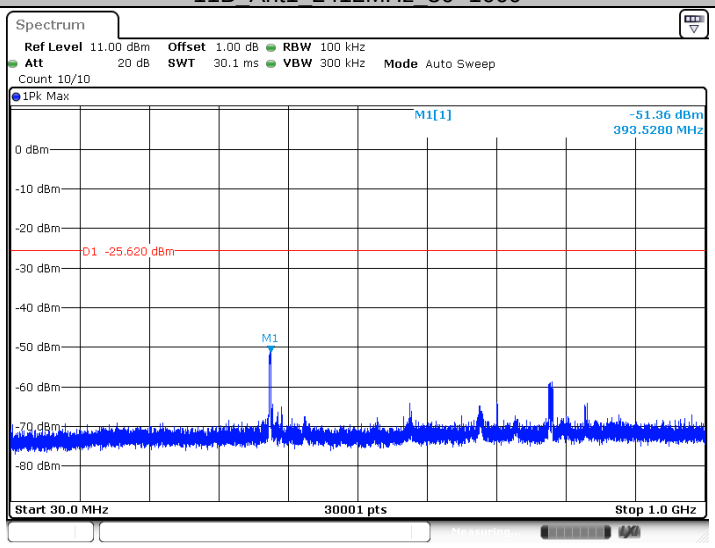
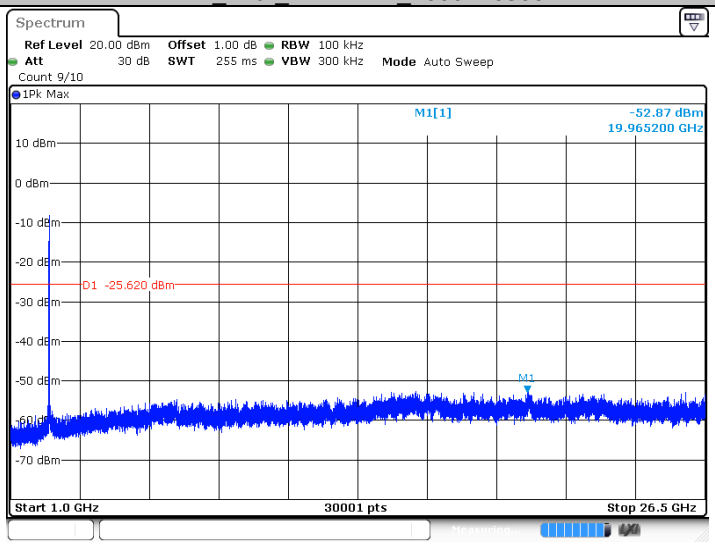
11B_Ant1_2412MHz_0~Reference



11B_Ant1_2412MHz_30~1000



11B_Ant1_2412MHz _1000~26500



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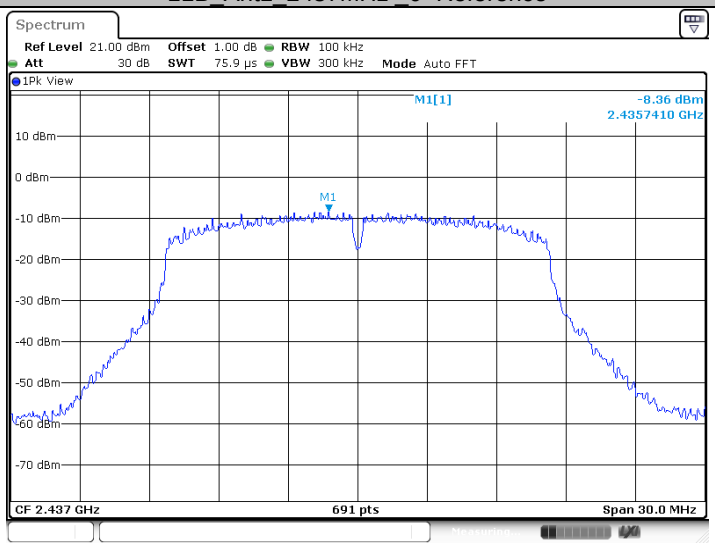
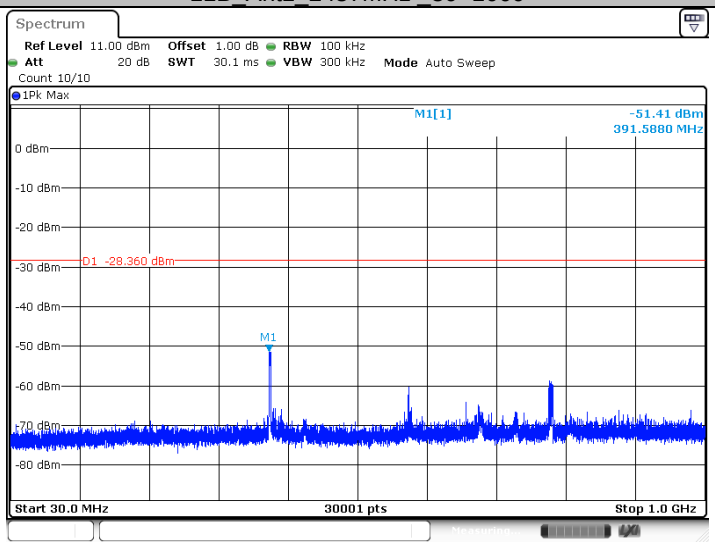
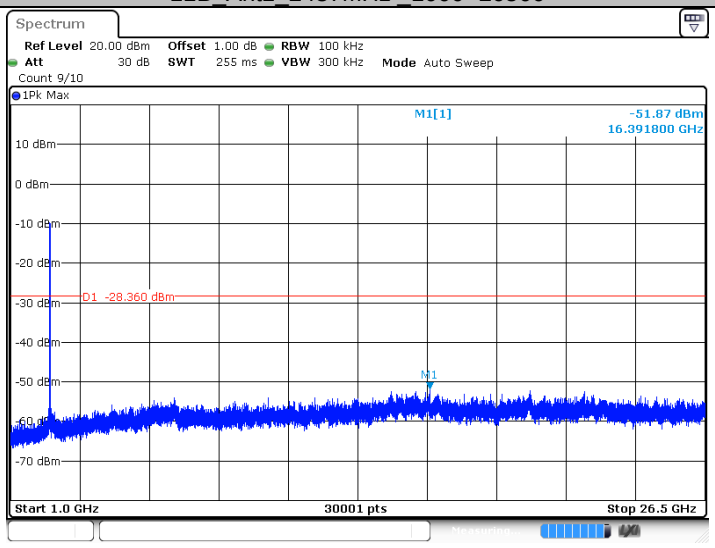
11B_Ant1_2437MHz _0~Reference



11B_Ant1_2437MHz _30~1000



11B_Ant1_2437MHz _1000~26500



11B_Ant1_2462MHz _0~Reference

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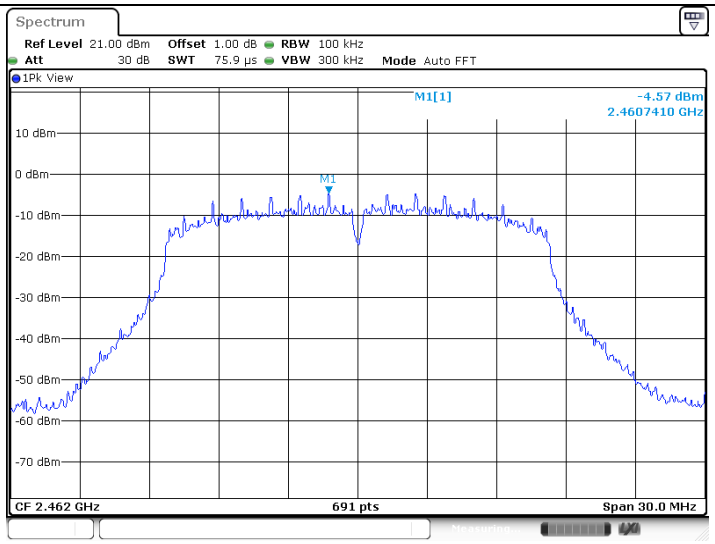
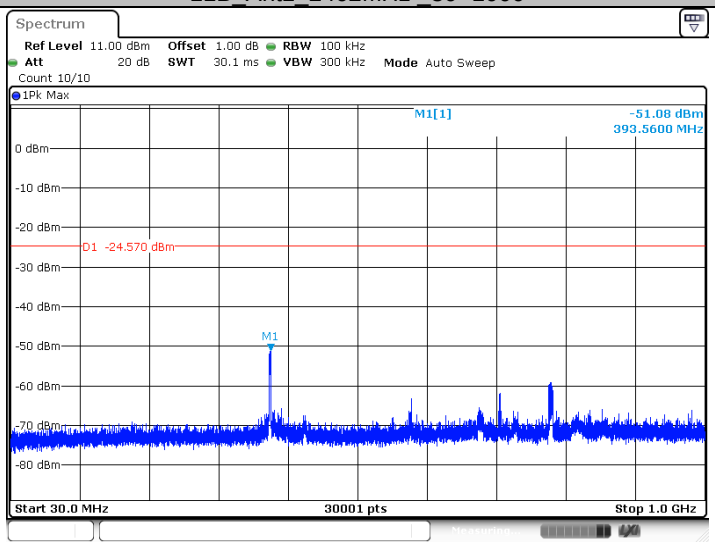
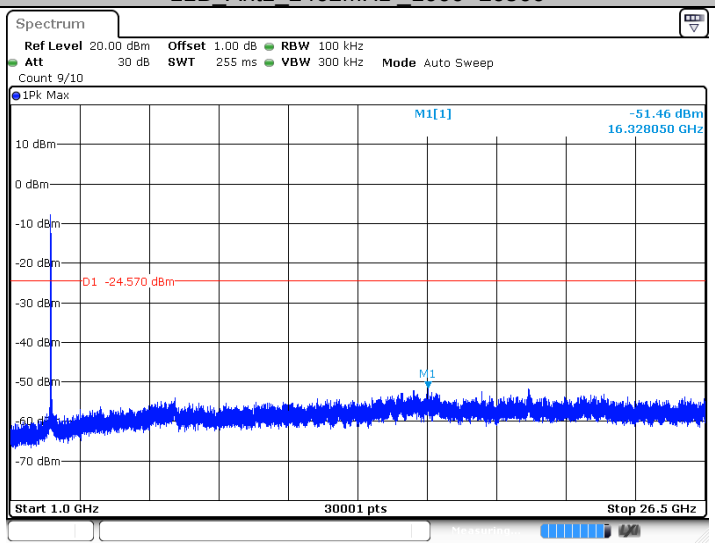


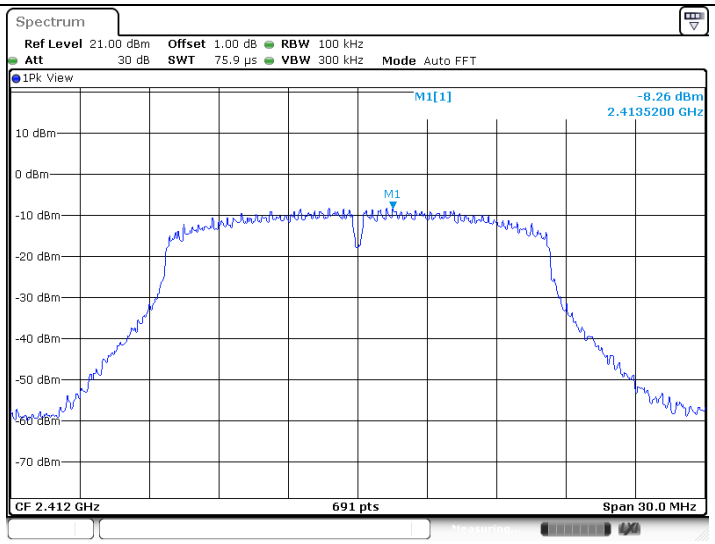
11B_Ant1_2462MHz _30~1000



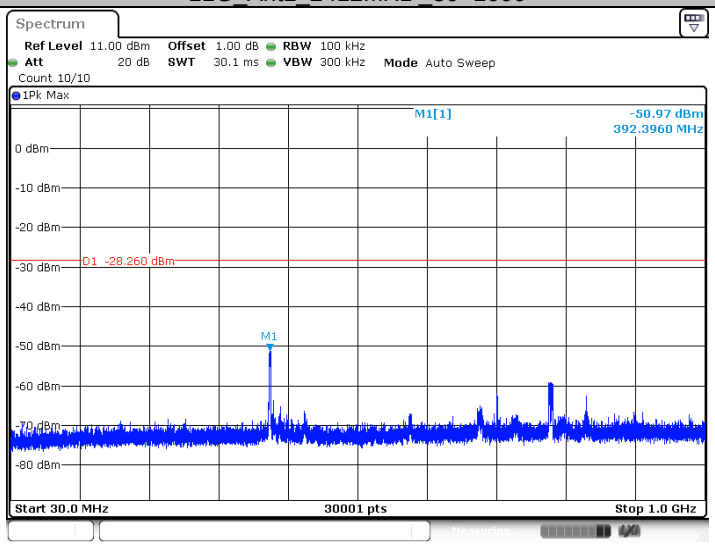
11B_Ant1_2462MHz _1000~26500



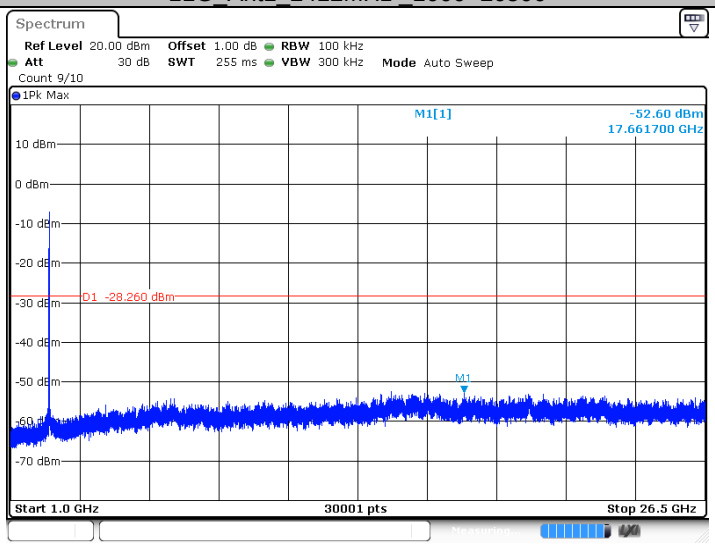
11G_Ant1_2412MHz _0~Reference



11G_Ant1_2412MHz _30~1000



11G_Ant1_2412MHz _1000~26500



11G_Ant1_2437MHz _0~Reference

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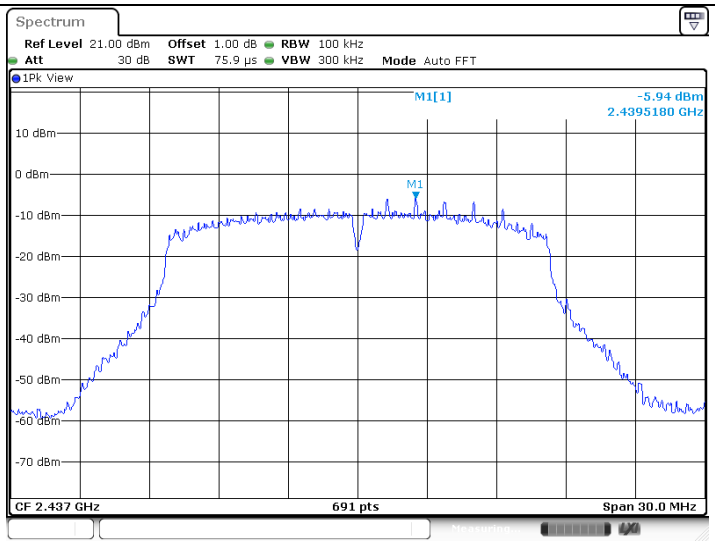
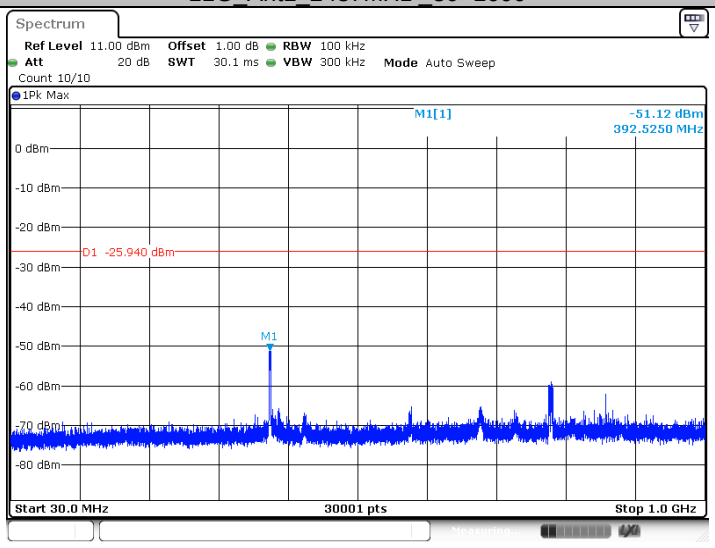
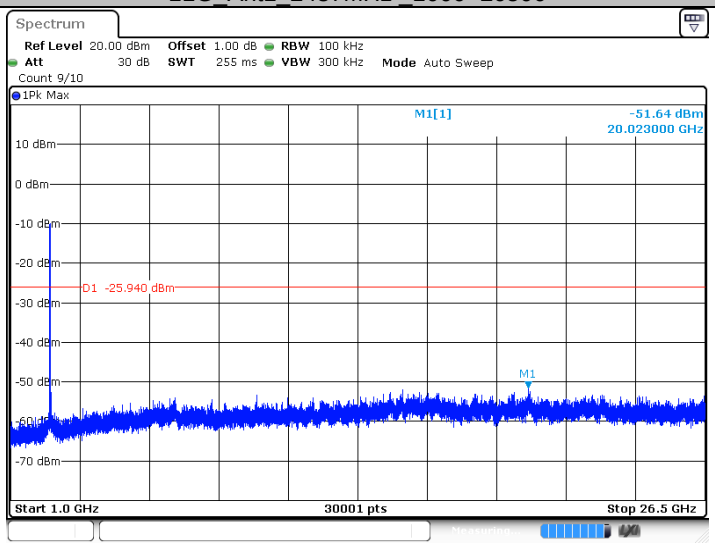


11G_Ant1_2437MHz _30~1000



11G_Ant1_2437MHz _1000~26500



11G_Ant1_2462MHz _0~Reference

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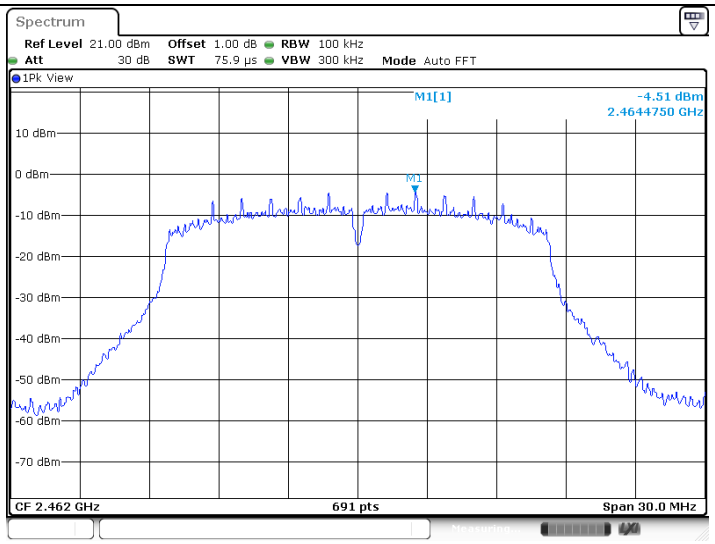
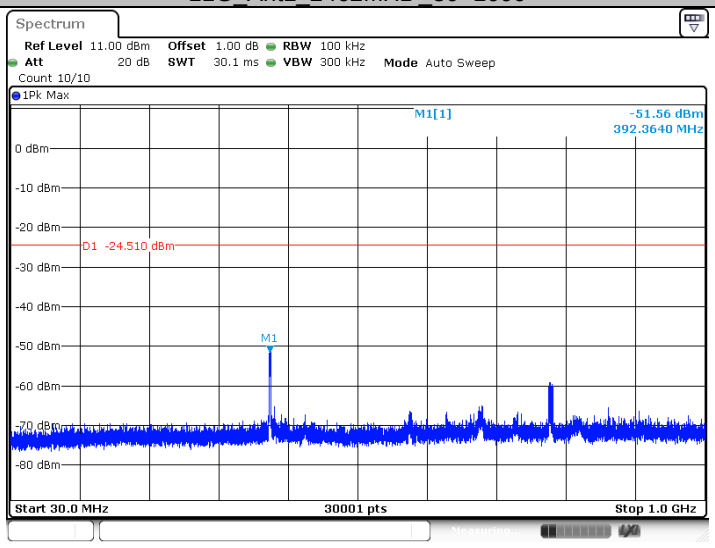
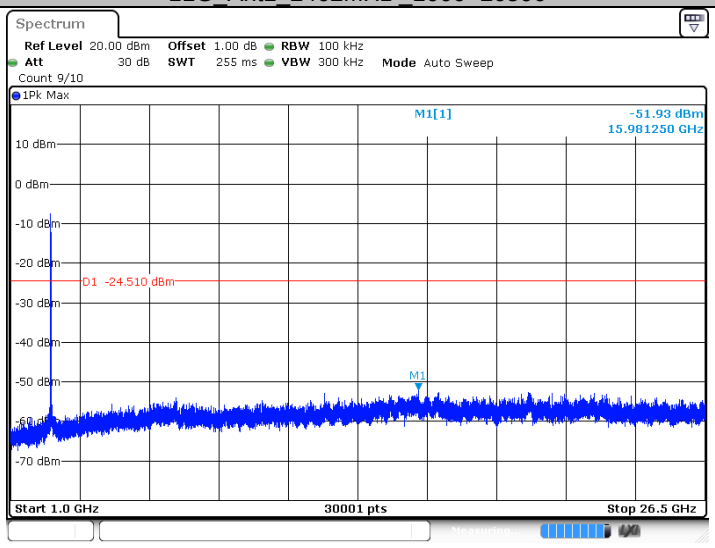


11G_Ant1_2462MHz _30~1000



11G_Ant1_2462MHz _1000~26500



11N20SISO_Ant1_2412MHz _0~Reference

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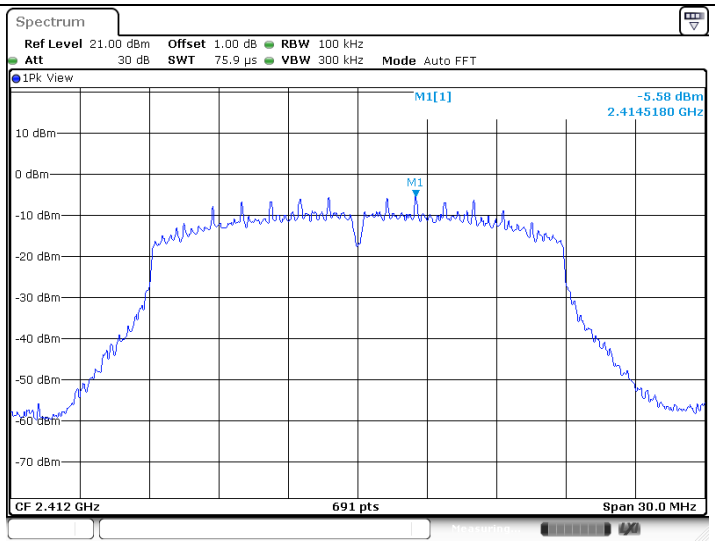
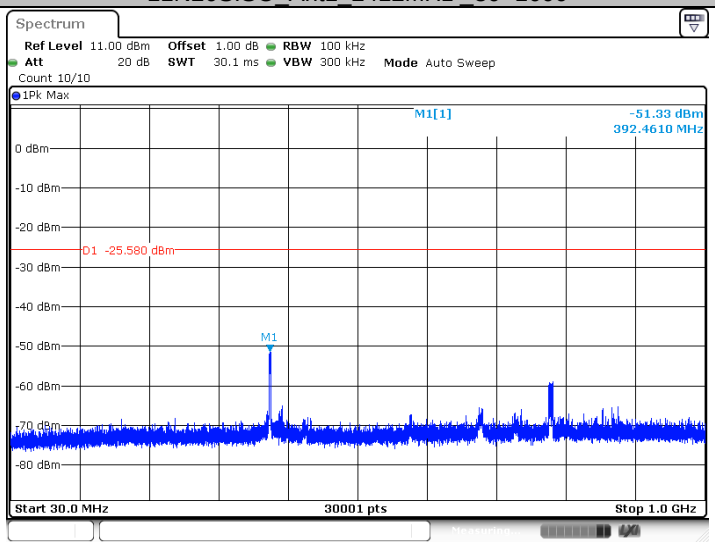
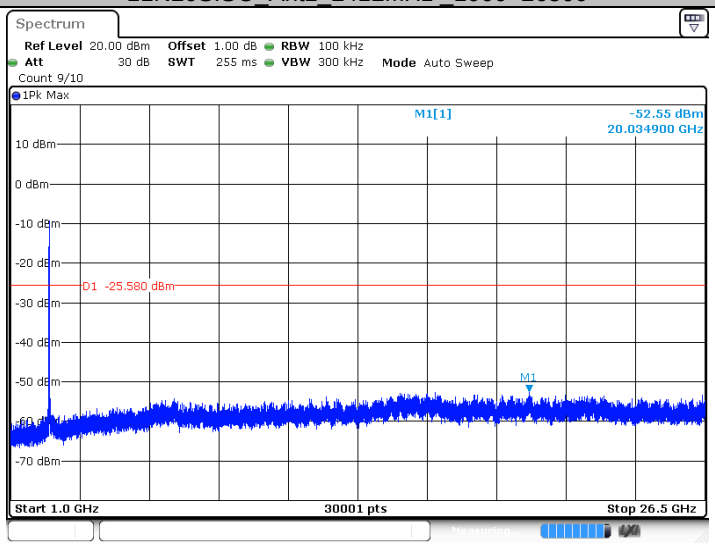


11N20SISO_Ant1_2412MHz _30~1000



11N20SISO_Ant1_2412MHz _1000~26500



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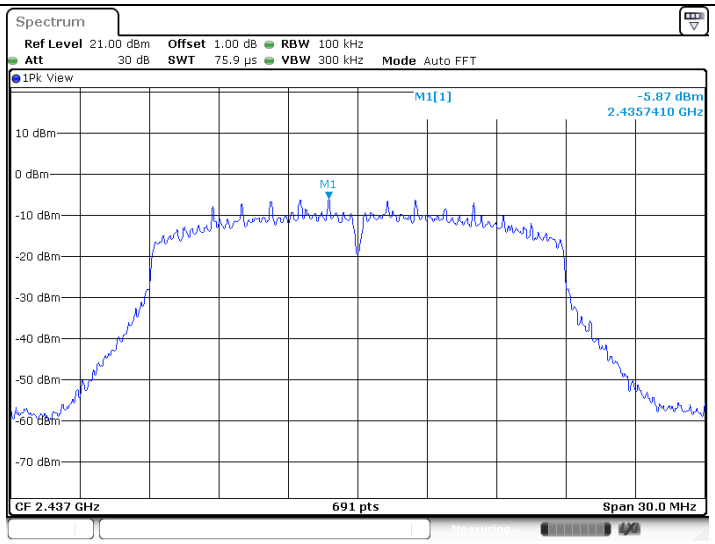
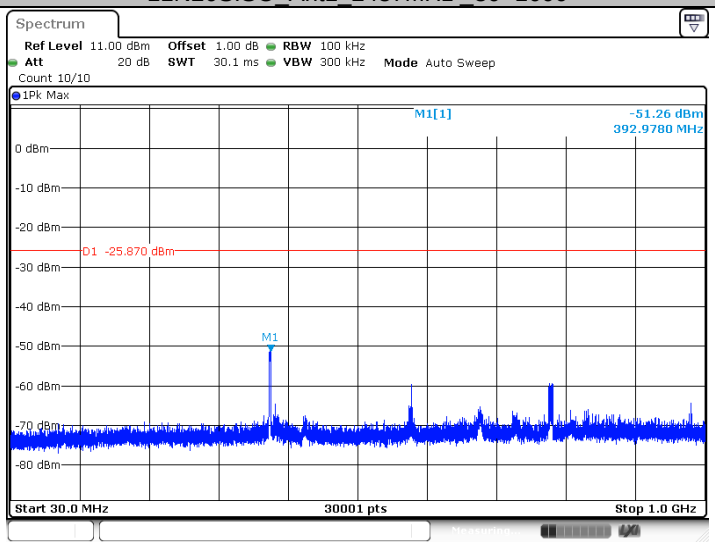
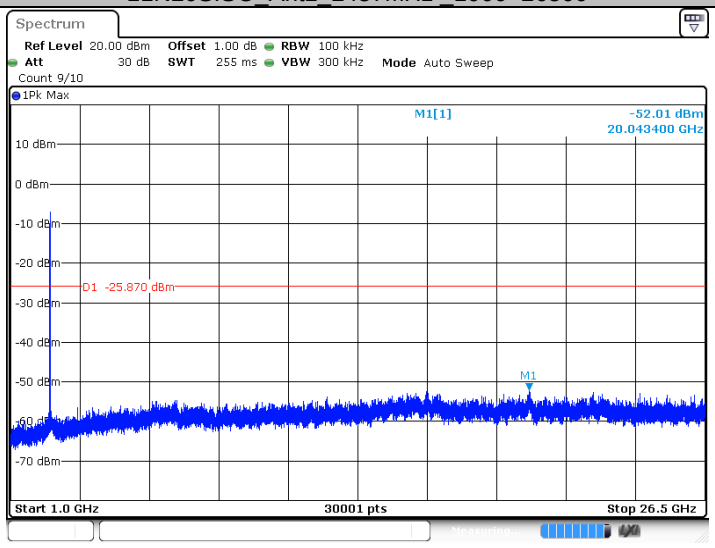


11N20SISO_Ant1_2437MHz _30~1000



11N20SISO_Ant1_2437MHz _1000~26500



11N20SISO_Ant1_2462MHz _0~Reference

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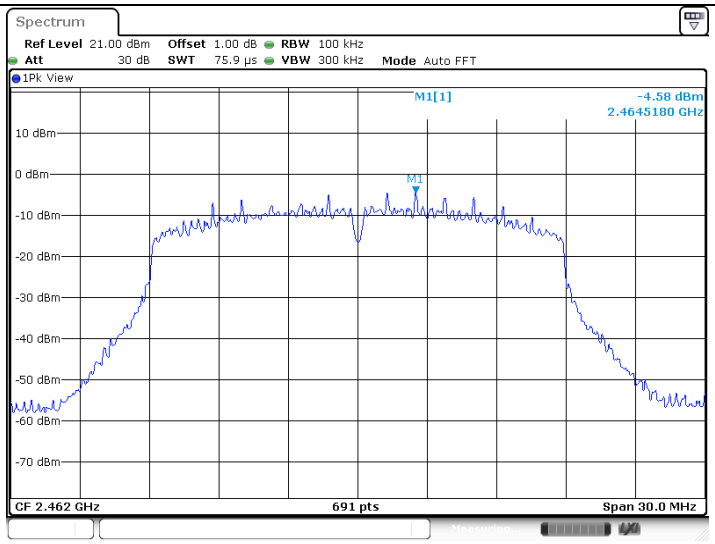
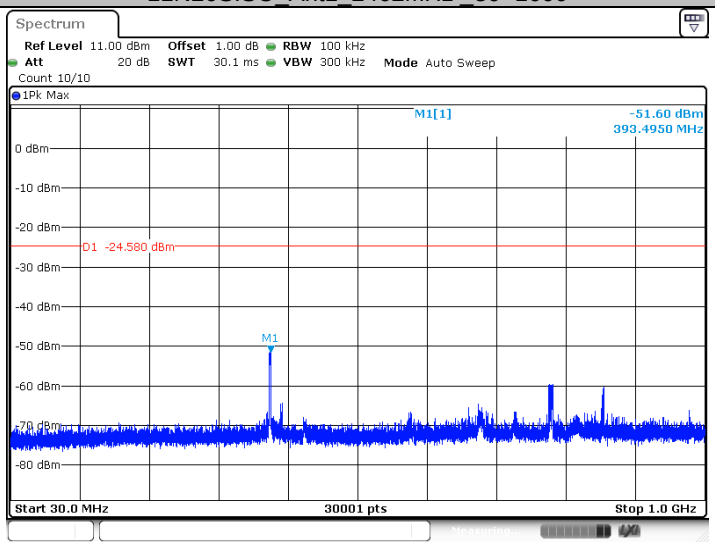
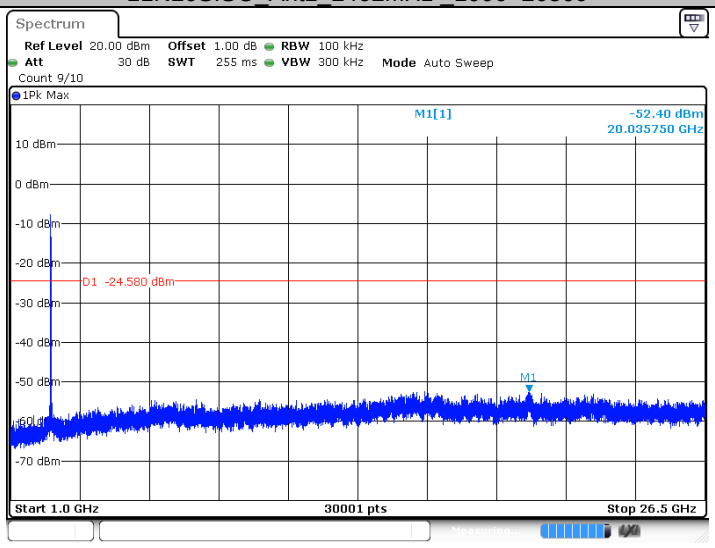


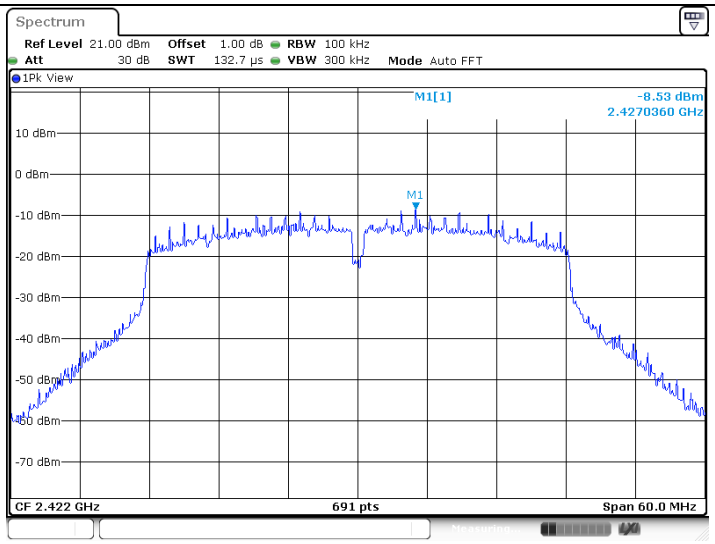
11N20SISO_Ant1_2462MHz _30~1000



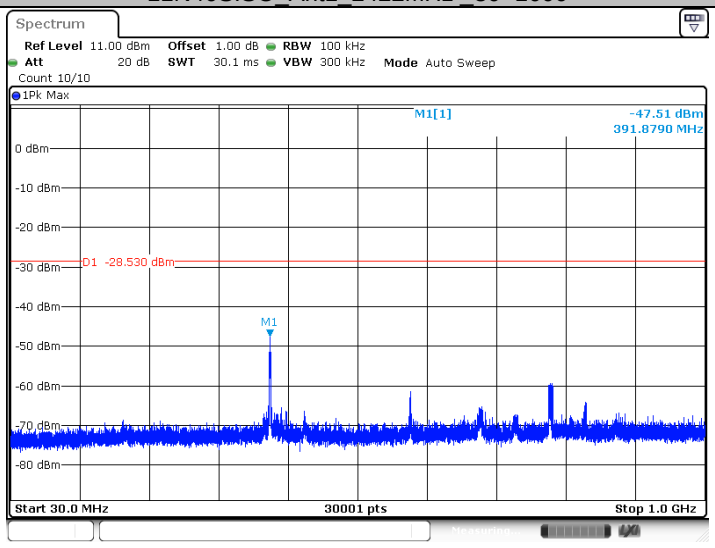
11N20SISO_Ant1_2462MHz _1000~26500



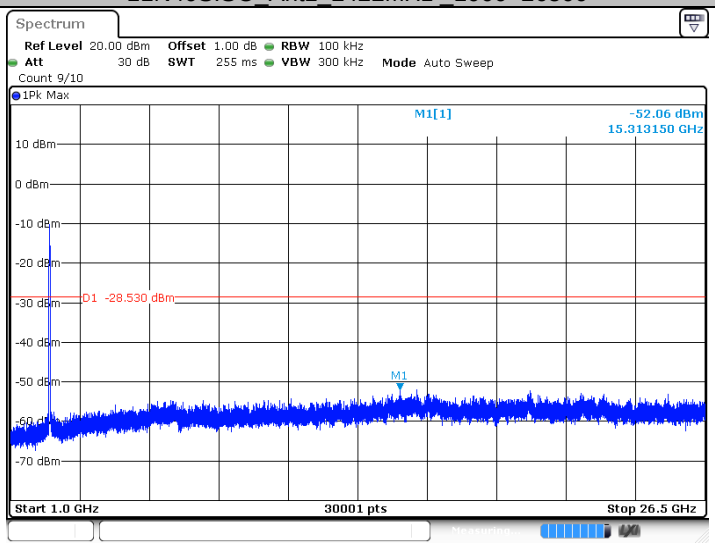
11N40SISO_Ant1_2422MHz _0~Reference



11N40SISO_Ant1_2422MHz _30~1000



11N40SISO_Ant1_2422MHz _1000~26500



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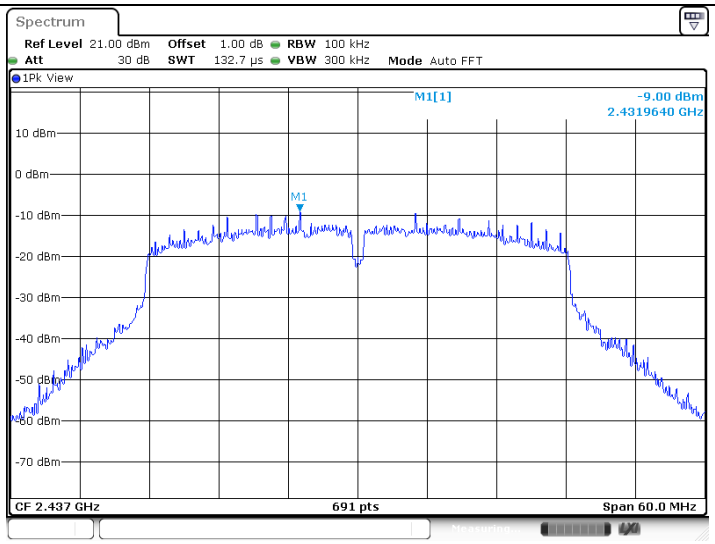
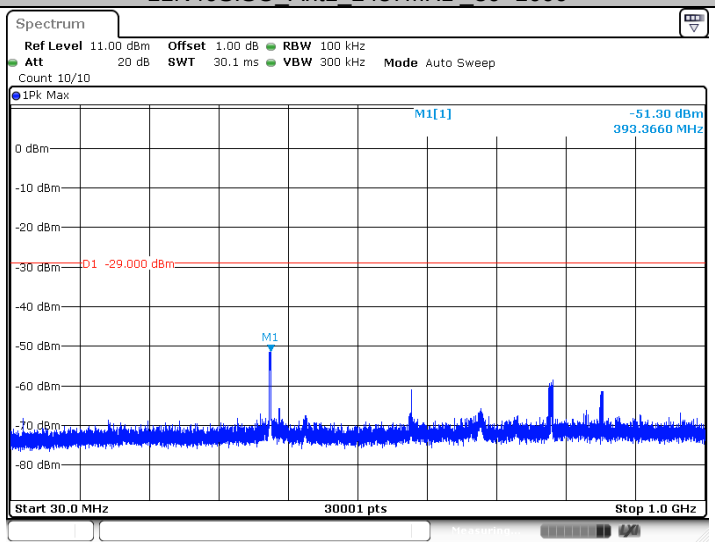
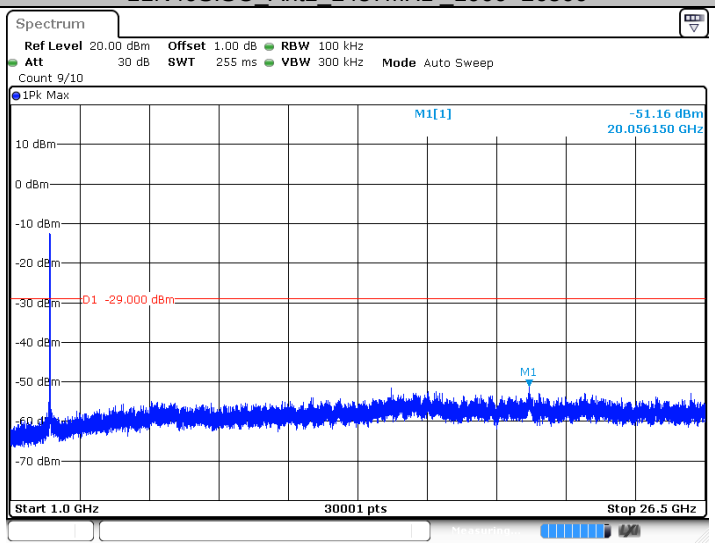


11N40SISO_Ant1_2437MHz _30~1000



11N40SISO_Ant1_2437MHz _1000~26500



11N40SISO_Ant1_2452MHz _0~Reference

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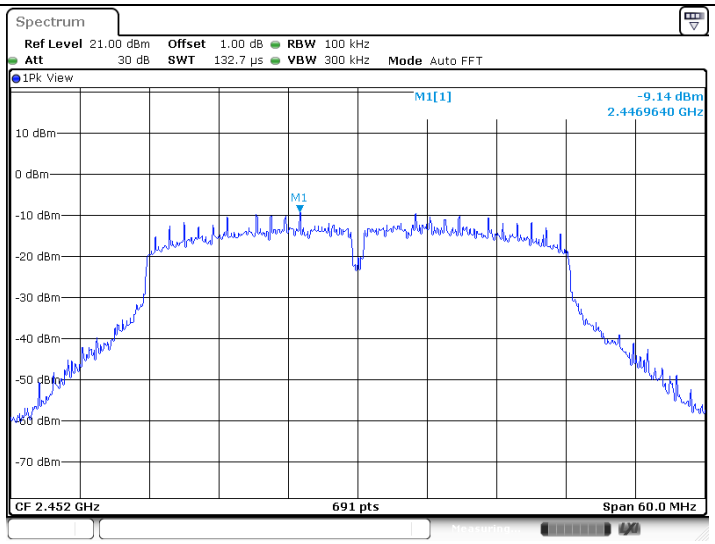
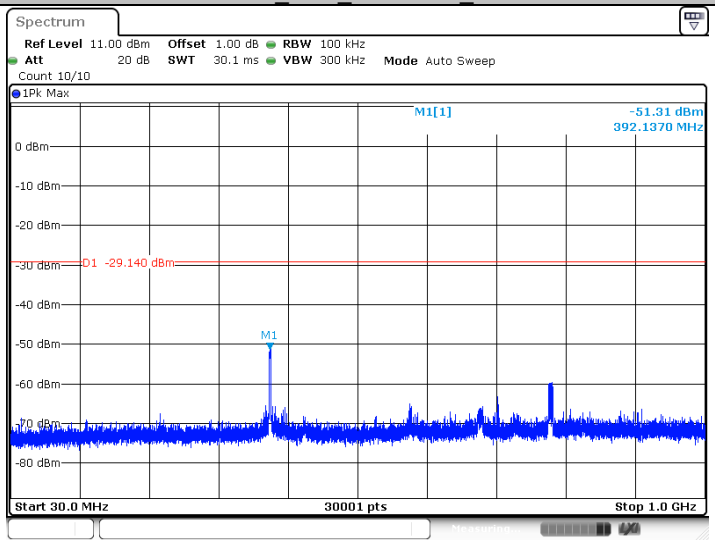
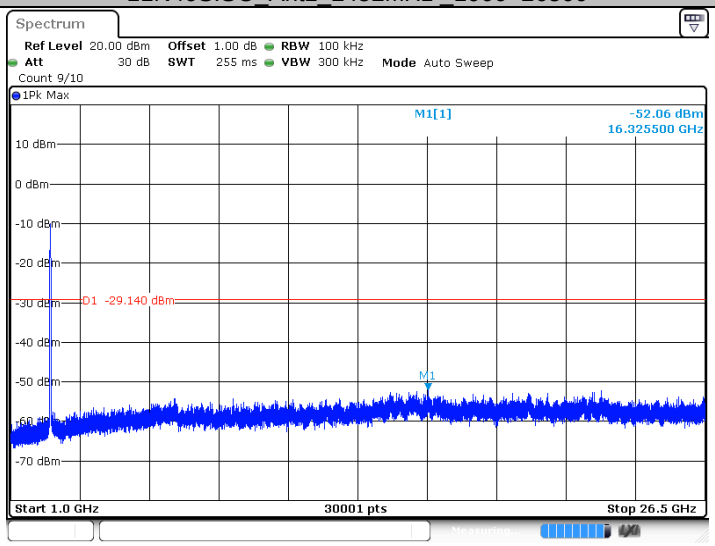


11N40SISO_Ant1_2452MHz _30~1000



11N40SISO_Ant1_2452MHz _1000~26500



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9.6 Band edge testing

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious
   RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
3. Allow the trace to stabilize, use the peak and delta measurement to record the result.
4. The level displayed must comply with the limit specified in this Section.
5. Repeat above procedures until all frequencies measured were complete.

Limit:

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, 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 Section 15.205(c)).

Frequency Range MHz	Limit (dBc)
30-25000	-20

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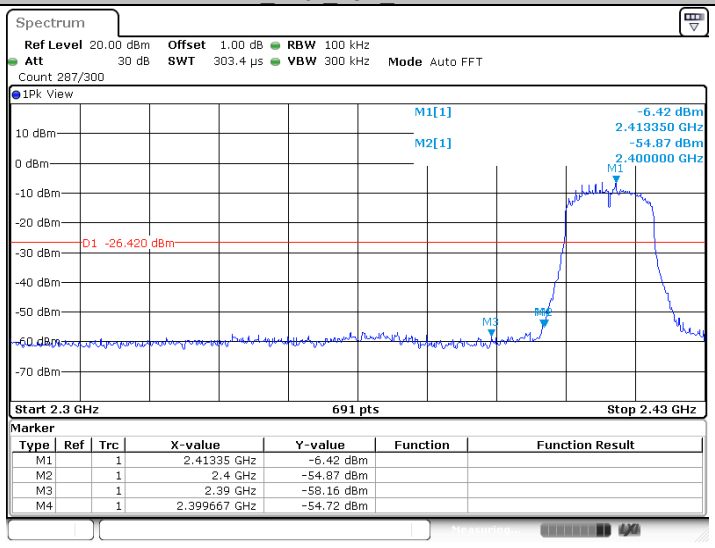
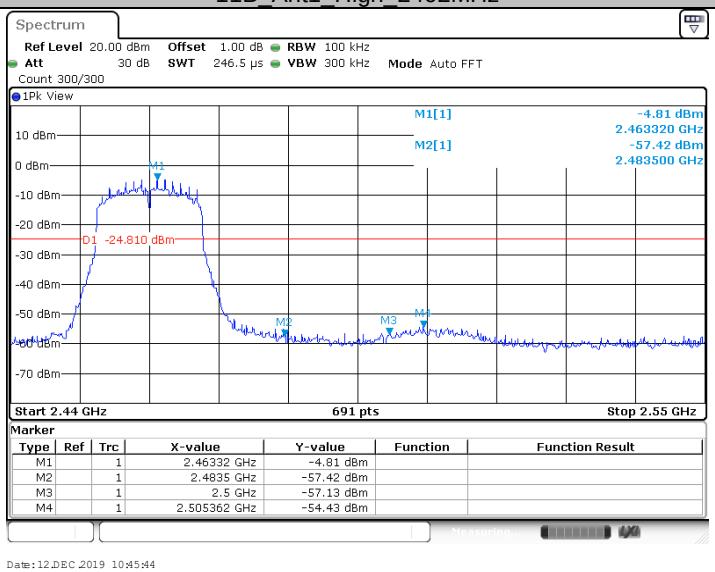
Band edge testing

TestMode	Antenna	ChName	Channel [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
11B	Ant1	Low	2412	-6.42	-54.72	<=-26.42	PASS
		High	2462	-4.81	-54.43	<=-24.81	PASS
11G	Ant1	Low	2412	-6.27	-53.24	<=-26.27	PASS
		High	2462	-4.69	-54.57	<=-24.69	PASS
11N20SISO	Ant1	Low	2412	-5.69	-54.46	<=-25.69	PASS
		High	2462	-5.40	-54.39	<=-25.4	PASS
11N40SISO	Ant1	Low	2422	-9.09	-40.3	<=-29.09	PASS
		High	2452	-8.87	-54.95	<=-28.87	PASS

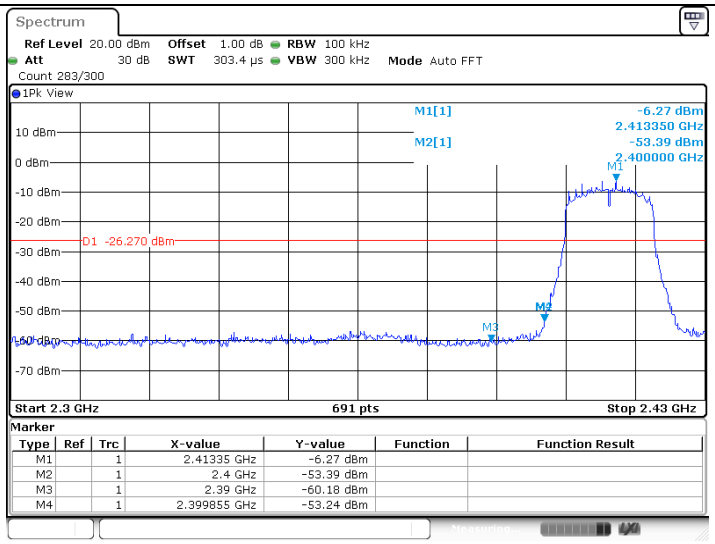
11B_Ant1_Low_2412MHz



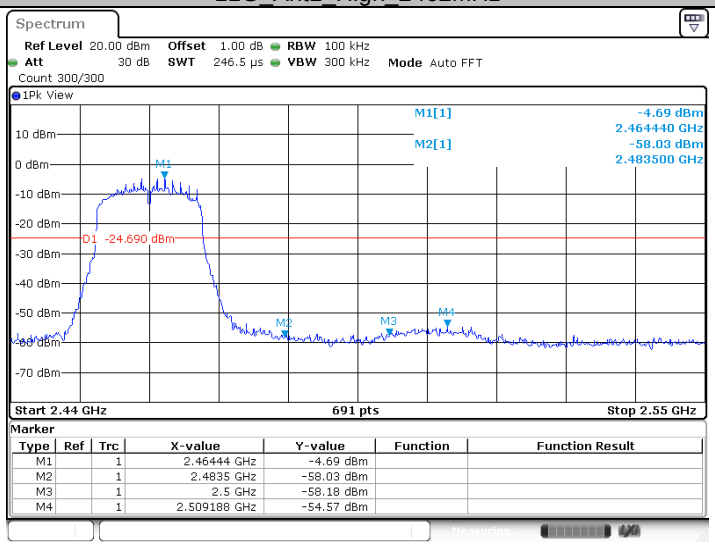
11B_Ant1_High_2462MHz



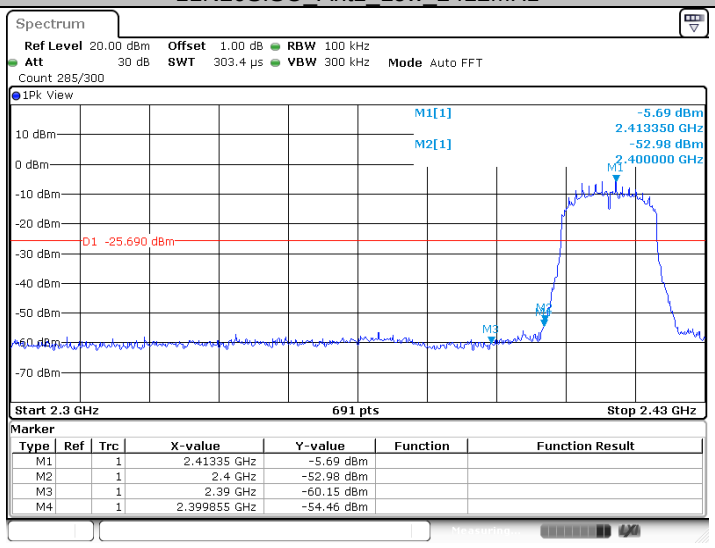
11G_Ant1_Low_2412MHz



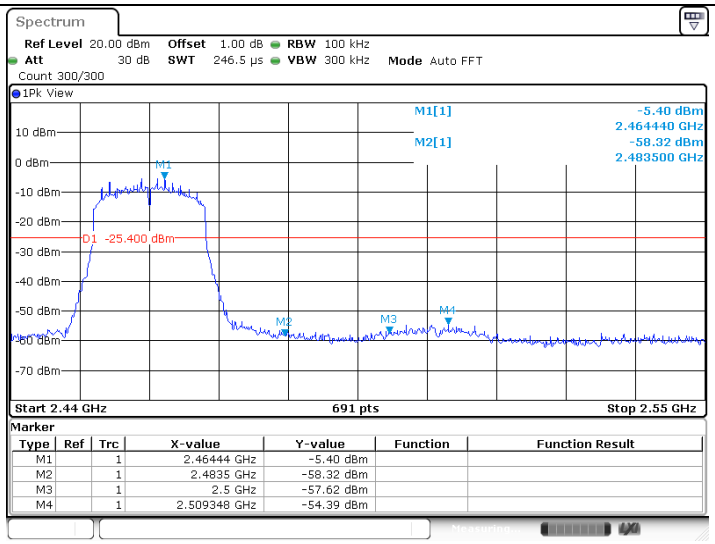
11G_Ant1_High_2462MHz



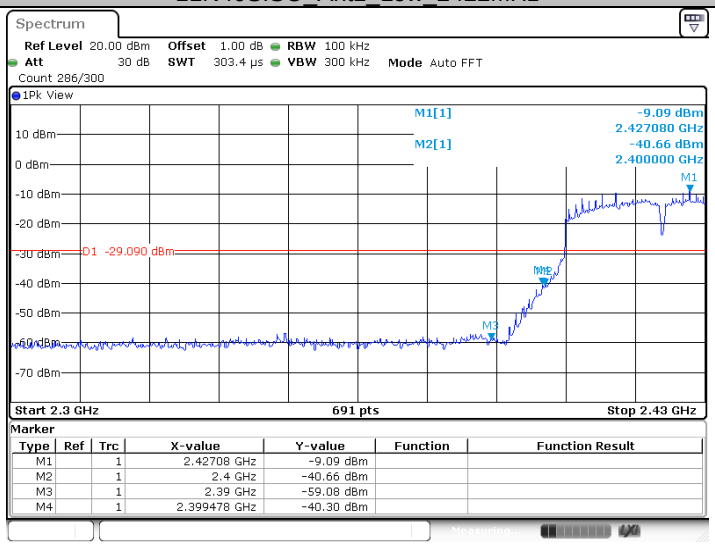
11N20SISO_Ant1_Low_2412MHz



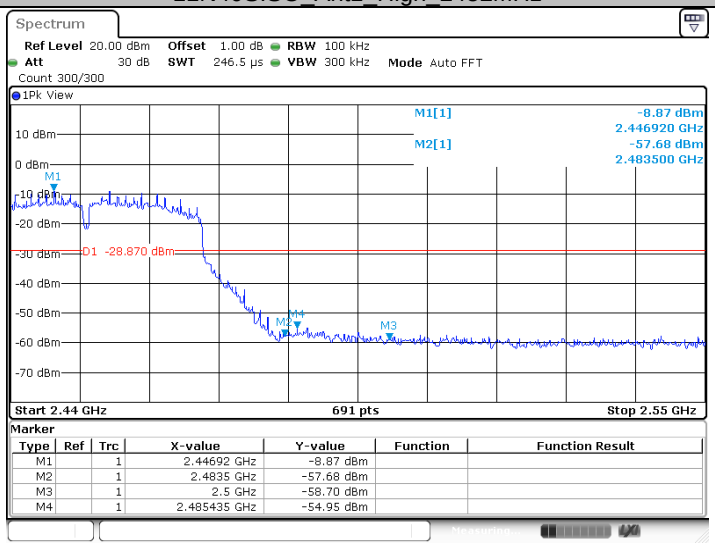
11N20SISO_Ant1_High_2462MHz



11N40SISO_Ant1_Low_2422MHz



11N40SISO_Ant1_High_2452MHz



9.7 Spurious radiated emissions for transmitter

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5: Use the following spectrum analyzer settings According to C63.10:
For Below 1GHz
Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 KHz to 120KHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:
Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥RBW for peak measurement ,Sweep = auto, Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz

a) RBW = 1 MHz.
b) VBW \ [3 × RBW].
c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D,where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty

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cycle was 50%, then 3 dB shall be added to the measured emission levels.
2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength µ V/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

The only worse case (802.11B_2412MHz mode) test result is listed in the report.

Transmitting spurious emission test result as below:

802.11B Modulation 2412MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBµV/m		dBµV/m		dBµV/m	(dB)	
30-1000MHz	77.59	32.54	H	40.00	QP	7.46	11.4	Pass
	101.84	36.29	H	43.50	QP	7.21	16.0	Pass
	178.47	37.01	H	43.50	QP	6.49	14.1	Pass
	295.11	38.92	H	46.00	QP	7.08	18.6	Pass
	391.75	37.15	H	46.00	QP	8.85	21.0	Pass
	434.01	39.30	H	46.00	QP	6.70	22.1	Pass
	Other Frequencies	--	H	--	QP	--	--	Pass
	42.31	33.78	V	40.00	QP	6.22	17.2	Pass
	95.17	34.31	V	43.50	QP	9.19	15.4	Pass
	184.17	35.78	V	43.50	QP	7.72	14.7	Pass
	428.19	38.67	V	46.00	QP	7.33	22.0	Pass
	589.51	42.52	V	46.00	QP	3.48	25.3	Pass
	624.97	40.69	V	46.00	QP	5.31	25.9	Pass
	Other Frequencies	--	V	--	QP	--	--	Pass
1000-25000MHz	1563.63	32.89	H	74	PK	41.11	-10.8	Pass
	1962.69	33.26	H	74	PK	40.74	-9.3	Pass
	Other Frequencies	--	H	--	PK	--	--	Pass
	1375.00	34.52	V	74	PK	39.48	-11.5	Pass
	1568.19	31.41	V	74	PK	42.59	-10.8	Pass
	Other Frequencies	--	V	--	PK	--	--	Pass

Remark:

(1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.

(2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

(3) Corrected Amplitude = Read level + Corrector factor
Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12&13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District,
Shenzhen City, 518052, P. R. China Tel. +86 755 8828 6998, Fax: +86 755 8828 5299

10 Test Equipment List

Conducted Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-14-001	101782	2020-6-28
LISN	Rohde & Schwarz	ENV432	68-4-87-16-001	101318	2020-7-19
Attenuator	Shanghai Huaxiang	TS2-26-3	68-4-81-16-003	080928189	2020-6-28
Test software	Rohde & Schwarz	EMC32	68-4-90-14-003-A10	Version9.15.00	N/A

Radiated Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	2020-6-28
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	68-4-80-14-002	707	2020-8-20
Horn Antenna	Rohde & Schwarz	HF907	68-4-80-14-005	102294	2020-6-22
Loop Antenna	Rohde & Schwarz	HFH2-Z2	68-4-80-14-006	100398	2020-7-7
Pre-amplifier	Rohde & Schwarz	SCU 18	68-4-29-14-001	102230	2020-6-28
Signal Generator	Rohde & Schwarz	SMY01	68-4-48-16-001	839369/005	2020-6-28
Attenuator	Agilent	8491A	68-4-81-16-001	MY39264334	2020-6-28
3m Semi-anechoic chamber	TDK	9X6X6	68-4-90-14-001	----	2020-7-7
Test software	Rohde & Schwarz	EMC32	68-4-90-14-001-A10	Version9.15.00	N/A

Conducted RF Test System

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	2020-6-28
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	68-4-93-14-003	101226/100851	2020-6-28
Power Splitter	Weinschel	1580	68-4-85-14-001	SC319	2020-7-7
Test software	Tonscend	System for BT/WIFI	68-4-74-14-006-A13	Version 2.5.77.0418	N/A

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.91dB; Vertical: 4.89dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.80dB; Vertical: 4.79dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6×10^{-7} or 1%
Uncertainty for Conducted Emission 150kHz-30MHz	3.21dB

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