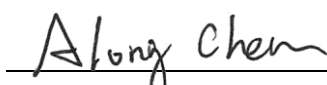


FCC C2PC Test Report

FCC ID : RYK-WPEA128N
Equipment : 802.11abgn Mini PCIe module
Model No. : WPEA-128N
Brand Name : SparkLAN
Applicant : SparkLAN Communications, Inc
Address : 8F., No.257, Sec. 2, Tiding Blvd., Neihu
District, Taipei City 11493, Taiwan.
Standard : 47 CFR FCC Part 15.247
Received Date : Jun. 07, 2017
Tested Date : Jun. 07 ~ Jun. 09, 2017

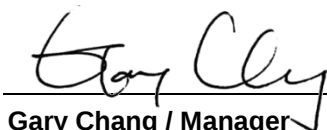
We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:



Along Chen / Assistant Manager

Approved by:



Gary Chang / Manager



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Release Record

Report No.	Version	Description	Issued Date
FR470302-05AC	Rev. 01	Initial issue	Jul. 14, 2017

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.168MHz 49.92 (Margin -15.16dB) - QP	Pass
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 4874.00MHz 53.47 (Margin -0.53dB) - AV	Pass
15.247(b)(3)	Maximum Output Power	Max Power [dBm]: 28.97	Pass
15.247(a)(2)	6dB Bandwidth	Meet the requirement of limit	Pass
15.247(e)	Power Spectral Density	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

1 General Description

1.1 Information

This report is issued as a FCC Class II Permissive Change. The modification is only concerned with adding one antenna.

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N _{TX})	Data Rate / MCS
2400-2483.5	b	2412-2462	1-11 [11]	1	1-11 Mbps
2400-2483.5	g	2412-2462	1-11 [11]	1	6-54 Mbps
2400-2483.5	n (HT20)	2412-2462	1-11 [11]	3	MCS 0-23
2400-2483.5	n (HT40)	2422-2452	3-9 [7]	3	MCS 0-23

Note 1: RF output power specifies that Maximum Peak Conducted Output Power.
 Note 2: 802.11b uses a combination of DSSS-DBPSK, DQPSK, CCK modulation.
 Note 3: 802.11g/n uses a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.

1.1.2 Antenna Details (New addition is marked in boldface.)

Ant. No.	Model	Type	Connector	Operating Frequencies (MHz) / Antenna Gain (dBi)		
				2400~2483.5	5150~5250	5725~5850
1	GEC6200	Dipole	RP-SMA Plug	3	5	5
2	RFA-25-T42-M32-N	Dipole	RP-SMA Plug	2.9	4.5	4.5
3	C1685-510008-A	Dipole	RP-SMA Plug	3.5	4.5	4.5

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.3Vdc from host
-------------------	------------------

1.1.4 Accessories

N/A

1.1.5 Channel List

Frequency band (MHz)		2400~2483.5	
802.11 b / g / n HT20		802.11n HT40	
Channel	Frequency(MHz)	Channel	Frequency(MHz)
1	2412	3	2422
2	2417	4	2427
3	2422	5	2432
4	2427	6	2437
5	2432	7	2442
6	2437	8	2447
7	2442	9	2452
8	2447	---	---
9	2452	---	---
10	2457	---	---
11	2462	---	---

1.1.6 Test Tool and Duty Cycle

Test Tool	ART2-GUI, Version: 1.5		
Duty Cycle and Duty Factor	Mode	Duty cycle (%)	Duty factor (dB)
	11b	100.00%	0.00
	11g	98.34%	0.07
	HT20	98.24%	0.08
	HT40	95.26%	0.21

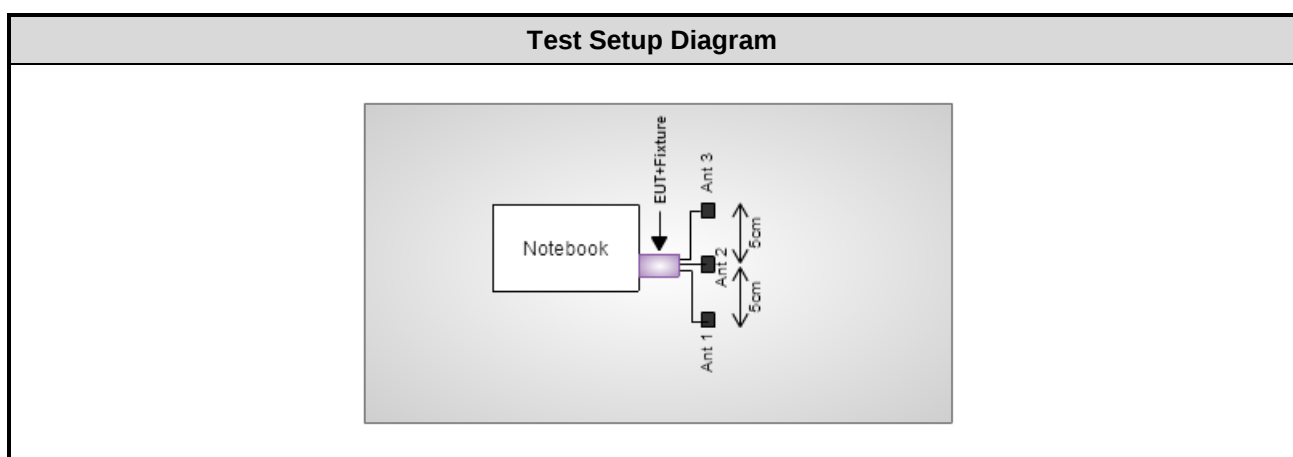
1.1.7 Power Setting

Modulation Mode	Test Frequency (MHz)	Power Set
11b	2412	15.5
11b	2437	14
11b	2462	14
11g	2412	12.5
11g	2437	22.5
11g	2462	13.5
HT20	2412	8
HT20	2437	20
HT20	2462	7.5
HT40	2422	4
HT40	2437	8.5
HT40	2452	4.5

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Signal cable / Length (m)
1	Notebook	DELL	Latitude E6430	DoC	---

1.3 Test Setup Chart



1.4 The Equipment List

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Dec. 21, 2016	Dec. 20, 2017
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 08, 2016	Nov. 07, 2017
RF Cable-CON	EMC	EMCCFD300-BM-BM-6000	50821	Dec. 20, 2016	Dec. 19, 2017
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber 1 / (03CH01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101498	Nov. 25, 2016	Nov. 24, 2017
Receiver	R&S	ESR3	101658	Nov. 24, 2016	Nov. 23, 2017
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Aug. 04, 2016	Aug. 03, 2017
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 21, 2016	Dec. 20, 2017
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 25, 2016	Oct. 24, 2017
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 10, 2016	Nov. 09, 2017
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Dec. 09, 2016	Dec. 08, 2017
Preamplifier	EMC	EMC02325	980225	Aug. 05, 2016	Aug. 04, 2017
Preamplifier	Agilent	83017A	MY39501308	Oct. 06, 2016	Oct. 05, 2017
Preamplifier	EMC	EMC184045B	980192	Aug. 24, 2016	Aug. 23, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Dec. 09, 2016	Dec. 08, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Dec. 09, 2016	Dec. 08, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16139/4	Dec. 09, 2016	Dec. 08, 2017
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	16052	Dec. 09, 2016	Dec. 08, 2017
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Dec. 09, 2016	Dec. 08, 2017
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Dec. 09, 2016	Dec. 08, 2017
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Mar. 15, 2017	Mar. 14, 2018
Power Meter	Anritsu	ML2495A	1241002	Oct. 06, 2016	Oct. 05, 2017
Power Sensor	Anritsu	MA2411B	1207366	Oct. 06, 2016	Oct. 05, 2017
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247

ANSI C63.10-2013

FCC KDB 558074 D01 DTS Meas Guidance v04

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	±34.134 Hz
Conducted power	±0.808 dB
Power density	±0.463 dB
Conducted emission	±2.670 dB
AC conducted emission	±2.90 dB
Radiated emission ≤ 1GHz	±3.66 dB
Radiated emission > 1GHz	±5.63 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	20°C / 57%	Alex Tsai
Radiated Emissions	03CH01-WS	24°C / 60-62%	Vincent Yeh Kevin Lee
RF Conducted	TH01-WS	23°C / 64%	Brad Wu

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- IC site registration No.: 10807A-1

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Frequency (MHz)	Data Rate	Test Configuration
Conducted Emissions	HT20	2437	MCS 0	---
Radiated Emissions ≤1GHz	HT20	2437	MCS 0	---
Radiated Emissions >1GHz	11b	2412 / 2437 / 2462	1 Mbps	---
Maximum Output Power	11g	2412 / 2437 / 2462	6 Mbps	
6dB bandwidth	HT20	2412 / 2437 / 2462	MCS 0	
Power spectral density	HT40	2422 / 2437 / 2452	MCS 0	

3 Transmitter Test Results

3.1 Conducted Emissions

3.1.1 Limit of Conducted Emissions

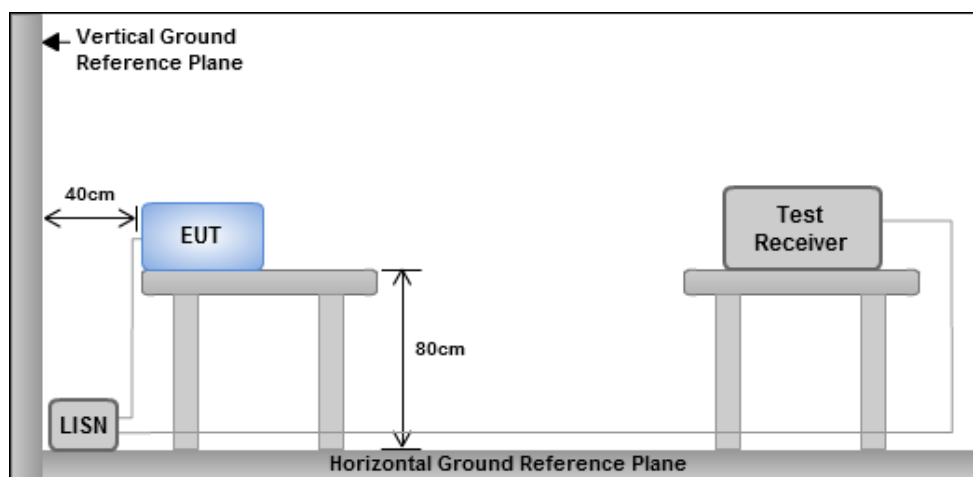
Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

3.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V / 60Hz.

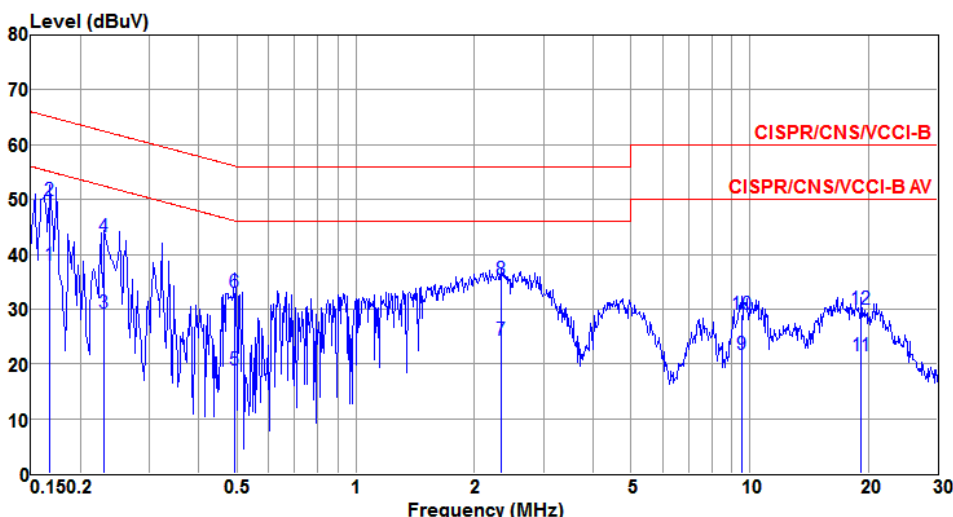
3.1.3 Test Setup



- Note: 1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

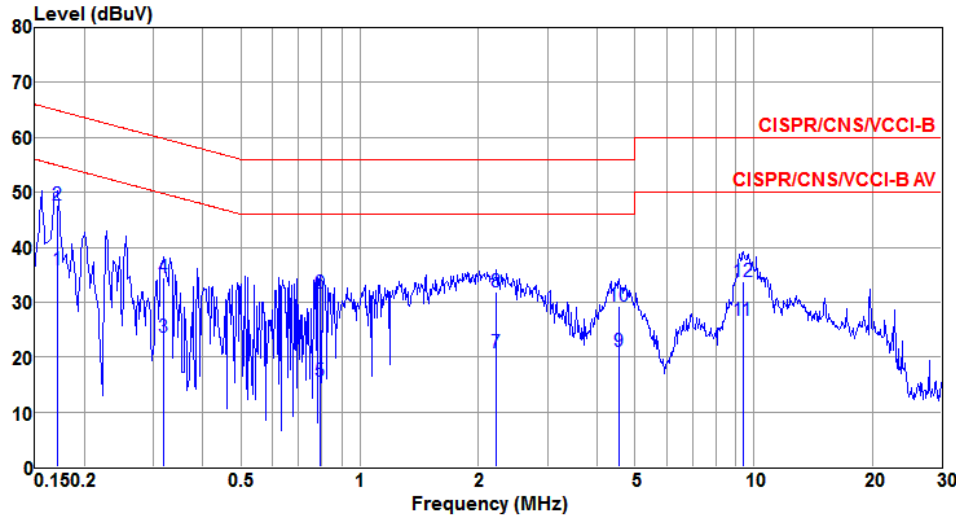
3.1.4 Test Result of Conducted Emissions

Modulation	HT20	Test Freq. (MHz)	2437
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.168	37.89	55.08	-17.19	37.77	0.08	0.04	Average
2	0.168	49.92	65.08	-15.16	49.80	0.08	0.04	QP
3	0.230	29.18	52.44	-23.26	29.05	0.09	0.04	Average
4	0.230	43.23	62.44	-19.21	43.10	0.09	0.04	QP
5	0.494	18.95	46.10	-27.15	18.85	0.06	0.04	Average
6	0.494	32.94	56.10	-23.16	32.84	0.06	0.04	QP
7	2.334	24.30	46.00	-21.70	24.09	0.14	0.07	Average
8	2.334	35.44	56.00	-20.56	35.23	0.14	0.07	QP
9	9.552	21.72	50.00	-28.28	21.30	0.20	0.22	Average
10	9.552	28.94	60.00	-31.06	28.52	0.20	0.22	QP
11	19.197	21.54	50.00	-28.46	20.89	0.39	0.26	Average
12	19.197	29.89	60.00	-30.11	29.24	0.39	0.26	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 Note 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation	HT20	Test Freq. (MHz)	2437																																																																																																																																				
Power Phase	Neutral																																																																																																																																						
Level (dBUV)  <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Over</th><th>Read</th><th>LISN</th><th>cable</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV</th><th>dBuV</th><th>Limit</th><th>Level</th><th>factor</th><th>loss</th><th></th></tr><tr><th></th><th></th><th></th><th>dB</th><th>dBuV</th><th>dB</th><th>dB</th><th></th></tr><tr><td>1</td><td>0.171</td><td>35.99</td><td>54.90</td><td>-18.91</td><td>35.85</td><td>0.10</td><td>0.04</td><td>Average</td></tr><tr><td>2</td><td>0.171</td><td>47.68</td><td>64.90</td><td>-17.22</td><td>47.54</td><td>0.10</td><td>0.04</td><td>QP</td></tr><tr><td>3</td><td>0.318</td><td>23.67</td><td>49.75</td><td>-26.08</td><td>23.51</td><td>0.12</td><td>0.04</td><td>Average</td></tr><tr><td>4</td><td>0.318</td><td>34.52</td><td>59.75</td><td>-25.23</td><td>34.36</td><td>0.12</td><td>0.04</td><td>QP</td></tr><tr><td>5</td><td>0.796</td><td>15.63</td><td>46.00</td><td>-30.37</td><td>15.49</td><td>0.10</td><td>0.04</td><td>Average</td></tr><tr><td>6</td><td>0.796</td><td>31.72</td><td>56.00</td><td>-24.28</td><td>31.58</td><td>0.10</td><td>0.04</td><td>QP</td></tr><tr><td>7</td><td>2.225</td><td>20.84</td><td>46.00</td><td>-25.16</td><td>20.62</td><td>0.16</td><td>0.06</td><td>Average</td></tr><tr><td>8</td><td>2.225</td><td>31.96</td><td>56.00</td><td>-24.04</td><td>31.74</td><td>0.16</td><td>0.06</td><td>QP</td></tr><tr><td>9</td><td>4.549</td><td>21.09</td><td>46.00</td><td>-24.91</td><td>20.76</td><td>0.16</td><td>0.17</td><td>Average</td></tr><tr><td>10</td><td>4.549</td><td>29.25</td><td>56.00</td><td>-26.75</td><td>28.92</td><td>0.16</td><td>0.17</td><td>QP</td></tr><tr><td>11</td><td>9.401</td><td>26.73</td><td>50.00</td><td>-23.27</td><td>26.21</td><td>0.30</td><td>0.22</td><td>Average</td></tr><tr><td>12</td><td>9.401</td><td>33.65</td><td>60.00</td><td>-26.35</td><td>33.13</td><td>0.30</td><td>0.22</td><td>QP</td></tr></table>				Freq	Level	Limit	Over	Read	LISN	cable	Remark	MHz	dBuV	dBuV	Limit	Level	factor	loss					dB	dBuV	dB	dB		1	0.171	35.99	54.90	-18.91	35.85	0.10	0.04	Average	2	0.171	47.68	64.90	-17.22	47.54	0.10	0.04	QP	3	0.318	23.67	49.75	-26.08	23.51	0.12	0.04	Average	4	0.318	34.52	59.75	-25.23	34.36	0.12	0.04	QP	5	0.796	15.63	46.00	-30.37	15.49	0.10	0.04	Average	6	0.796	31.72	56.00	-24.28	31.58	0.10	0.04	QP	7	2.225	20.84	46.00	-25.16	20.62	0.16	0.06	Average	8	2.225	31.96	56.00	-24.04	31.74	0.16	0.06	QP	9	4.549	21.09	46.00	-24.91	20.76	0.16	0.17	Average	10	4.549	29.25	56.00	-26.75	28.92	0.16	0.17	QP	11	9.401	26.73	50.00	-23.27	26.21	0.30	0.22	Average	12	9.401	33.65	60.00	-26.35	33.13	0.30	0.22	QP
Freq	Level	Limit	Over	Read	LISN	cable	Remark																																																																																																																																
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Note 1: Level (dBUV) = Read Level (dBUV) + LISN Factor (dB) + Cable Loss (dB). Note 2: Over Limit (dB) = Level (dBUV) – Limit Line (dBUV).																																																																																																																																							

3.2 6dB and Occupied Bandwidth

3.2.1 Limit of 6dB Bandwidth

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

3.2.2 Test Procedures

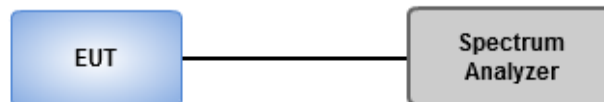
6dB Bandwidth

1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

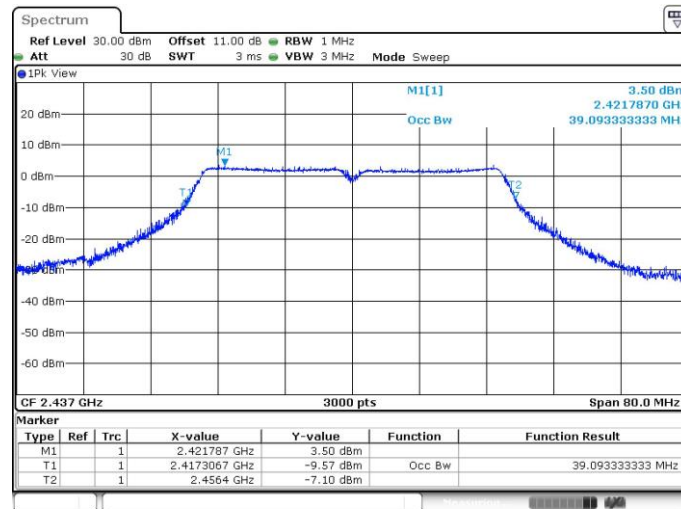
1. Set resolution bandwidth (RBW) = 1 MHz, Video bandwidth = 3 MHz.
2. Detector = Sample, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Use the OBW measurement function of spectrum analyzer to measure the occupied bandwidth.

3.2.3 Test Setup



Modulation Mode	N _{TX}	Freq. (MHz)	99% Occupied Bandwidth (MHz)			
			Chain 0	Chain 1	Chain 2	Chain 3
11b	1	2412	14.13			---
11b	1	2437	14.09			---
11b	1	2462	14.03			---
11g	1	2412	17.24			---
11g	1	2437	25.12			---
11g	1	2462	17.27			---
HT20	3	2412	18.16	18.15	18.07	---
HT20	3	2437	21.39	19.36	20.41	---
HT20	3	2462	18.28	18.09	18.04	---
HT40	3	2422	38.85	38.45	38.40	---
HT40	3	2437	39.09	38.48	38.40	---
HT40	3	2452	38.72	38.35	38.35	---

Worst Plot



3.3 RF Output Power

3.3.1 Limit of RF Output Power

Conducted power shall not exceed 1Watt.

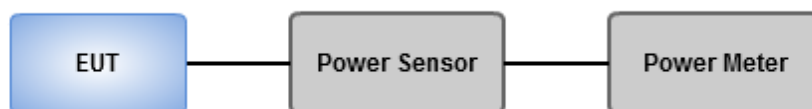
- ☒ Antenna gain $\leq 6\text{dBi}$, no any corresponding reduction is in output power limit.
- ☐ Antenna gain $> 6\text{dBi}$
 - ☐ Non Fixed, point to point operations.
The conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dB
 - ☐ Fixed, point to point operations
Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point Operations, maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations ,no any corresponding reduction is in transmitter peak output power

3.3.2 Test Procedures

- ☒ Maximum Peak Conducted Output Power
 - ☐ **Spectrum analyzer**
 1. Set RBW = 1MHz, VBW = 3MHz, Detector = Peak.
 2. Sweep time = auto, Trace mode = max hold, Allow trace to fully stabilize.
 3. Use the spectrum analyzer channel power measurement function with the band limits set equal to the DTS bandwidth edges.
 - ☒ **Power meter**
 1. A broadband Peak RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.
- ☒ Maximum Conducted Output Power (For reference only)
 - ☒ **Power meter**
 1. A broadband Average RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

3.3.3 Test Setup



3.3.4 Test Result of Maximum Output Power

Modulation Mode	N _{TX}	Freq. (MHz)	Peak conducted Output Power (dBm)							Ant. Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)
			Chain 0	Chain 1	Chain 2	Chain 3	Total Power (mW)	Total Power (dBm)	Limit (dBm)			
11b	1	2412	17.51	---	---	---	56.364	17.51	30.00	3.50	21.01	36.00
11b	1	2437	16.29	---	---	---	42.560	16.29	30.00	3.50	19.79	36.00
11b	1	2462	15.98	---	---	---	39.628	15.98	30.00	3.50	19.48	36.00
11g	1	2412	20.68	---	---	---	116.950	20.68	30.00	3.50	24.18	36.00
11g	1	2437	24.71	---	---	---	295.801	24.71	30.00	3.50	28.21	36.00
11g	1	2462	20.92	---	---	---	123.595	20.92	30.00	3.50	24.42	36.00
HT20	3	2412	16.43	16.46	16.63	---	134.239	21.28	30.00	3.50	24.78	36.00
HT20	3	2437	23.75	24.6	24.2	---	788.567	28.97	30.00	3.50	32.47	36.00
HT20	3	2462	15.38	16.24	16.66	---	122.932	20.90	30.00	3.50	24.40	36.00
HT40	3	2422	12.77	12.79	12.68	---	56.470	17.52	30.00	3.50	21.02	36.00
HT40	3	2437	16.83	16.29	16.94	---	140.186	21.47	30.00	3.50	24.97	36.00
HT40	3	2452	13.94	13.2	13.94	---	70.441	18.48	30.00	3.50	21.98	36.00

Modulation Mode	N _{TX}	Freq. (MHz)	Conducted (Average) Output Power (dBm)				Total Power (mW)	Total Power (dBm)	Limit (dBm)
			Chain 0	Chain 1	Chain 2	Chain 3			
11b	1	2412	15.38	---	---	---	34.514	15.38	---
11b	1	2437	14.18	---	---	---	26.182	14.18	---
11b	1	2462	13.98	---	---	---	25.003	13.98	---
11g	1	2412	13.02	---	---	---	20.045	13.02	---
11g	1	2437	20.98	---	---	---	125.314	20.98	---
11g	1	2462	13.46	---	---	---	22.182	13.46	---
HT20	3	2412	8.11	7.88	7.95	---	18.846	12.75	---
HT20	3	2437	18.68	18.91	18.93	---	229.757	23.61	---
HT20	3	2462	6.98	7.65	7.86	---	16.919	12.28	---
HT40	3	2422	4.79	4.79	4.59	---	8.903	9.50	---
HT40	3	2437	8.78	8.6	8.66	---	22.140	13.45	---
HT40	3	2452	4.68	4.69	4.71	---	8.840	9.46	---

Note: Conducted average output power is for reference only.

3.4 Power Spectral Density

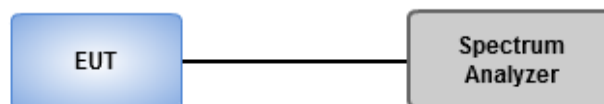
3.4.1 Limit of Power Spectral Density

Power spectral density shall not be greater than 8 dBm in any 3 kHz band.

3.4.2 Test Procedures

- ☒ Maximum peak conducted output power was used to demonstrate compliance to the fundamental output power limit.
 1. Set the RBW = 3kHz, VBW = 10kHz.
 2. Detector = Peak, Sweep time = auto couple.
 3. Trace mode = max hold, allow trace to fully stabilize.
 4. Use the peak marker function to determine the maximum amplitude level.
- ☐ Maximum (average) conducted output power was used to demonstrate compliance to the fundamental output power limit.
 1. Set the RBW = 100kHz, VBW = 300 kHz.
 2. Detector = RMS, Sweep time = auto couple.
 3. Set the sweep time to: $\geq 10 \times (\text{number of measurement points in sweep}) \times (\text{maximum data rate per stream})$.
 4. Perform the measurement over a single sweep.
 5. Use the peak marker function to determine the maximum amplitude level.

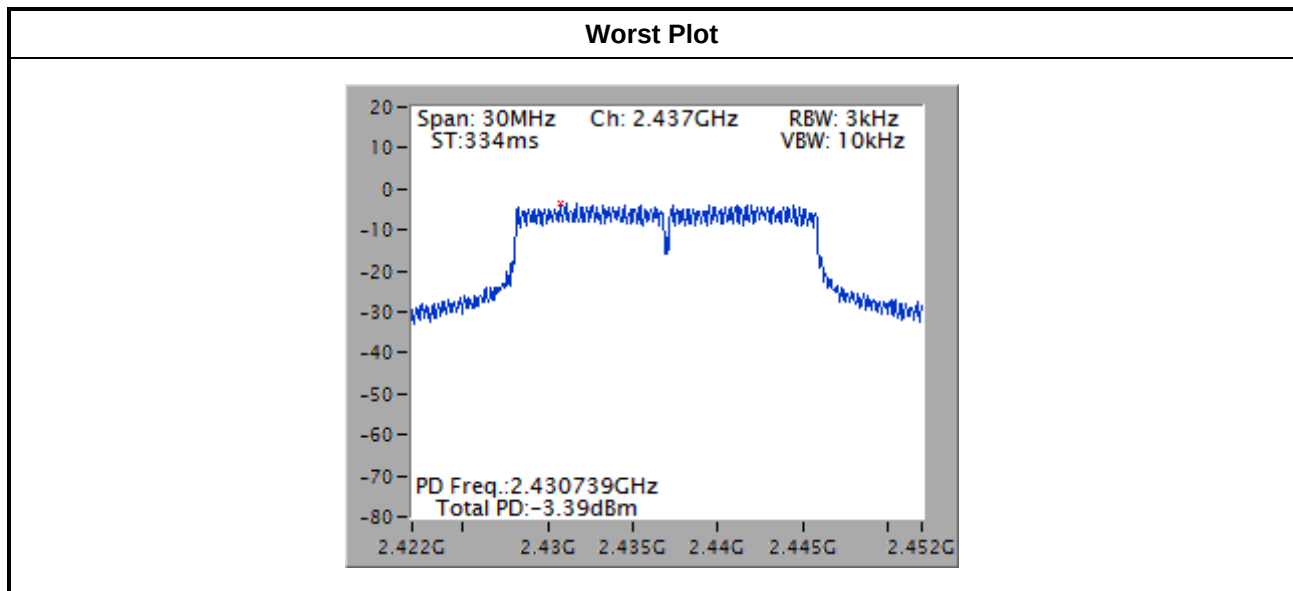
3.4.3 Test Setup



3.4.4 Test Result of Power Spectral Density

Modulation Mode	N _{TX}	Freq. (MHz)	Total Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
11b	1	2412	-9.19	8.00
11b	1	2437	-10.58	8.00
11b	1	2462	-10.75	8.00
11g	1	2412	-11.90	8.00
11g	1	2437	-4.12	8.00
11g	1	2462	-12.14	8.00
HT20	3	2412	-14.15	8.00
HT20	3	2437	-3.39	8.00
HT20	3	2462	-14.80	8.00
HT40	3	2422	-19.35	8.00
HT40	3	2437	-15.25	8.00
HT40	3	2452	-20.15	8.00

Note: Test result for HT20 / HT40 is bin-by-bin summing measured value of each TX port.



3.5 Unwanted Emissions into Restricted Frequency Bands

3.5.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Quasi-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.5.2 Test Procedures

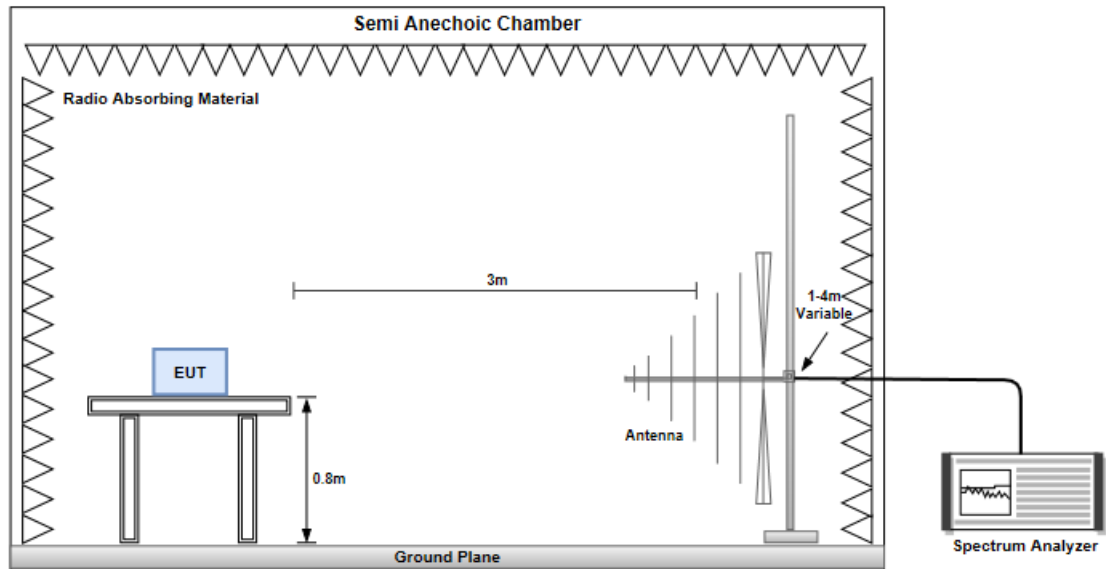
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

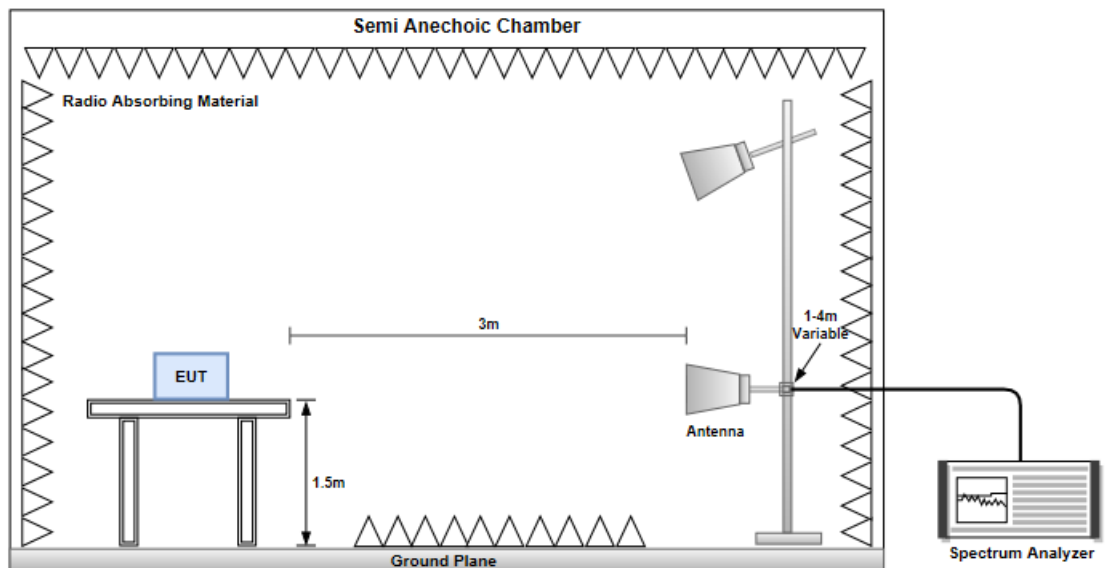
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.5.3 Test Setup

Radiated Emissions below 1 GHz

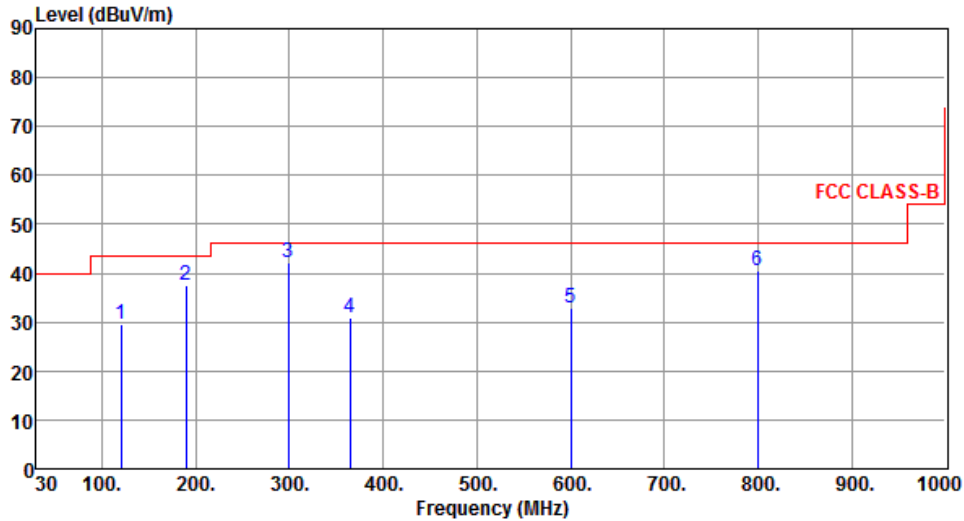


Radiated Emissions above 1 GHz



3.5.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation	HT20	Test Freq. (MHz)	2437
Polarization	Horizontal		

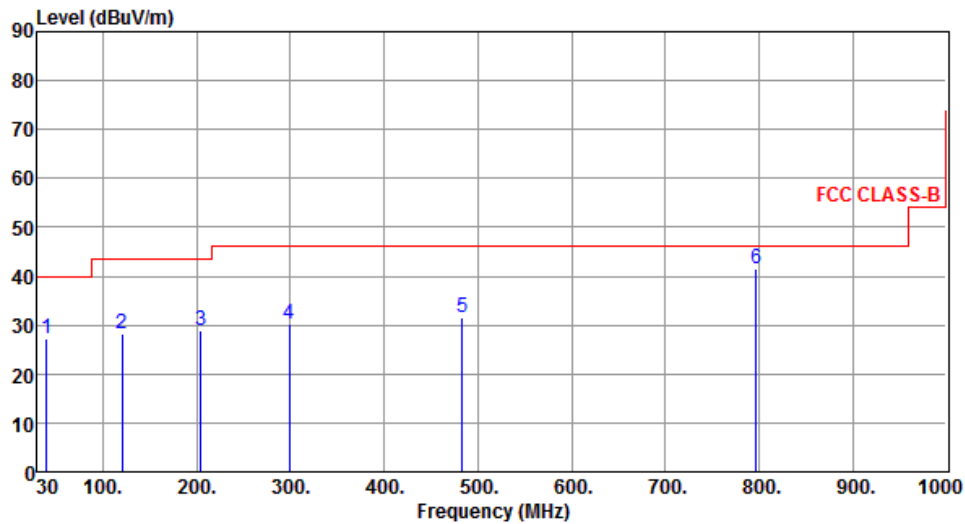


The graph displays the radiated unwanted emissions level in dBUV/m against frequency in MHz from 30 to 1000 MHz. A red line represents the FCC CLASS-B limit, which is 40 dBUV/m from 30 to 100 MHz, 45 dBUV/m from 100 to 300 MHz, 46 dBUV/m from 300 to 1000 MHz, and 55 dBUV/m above 1000 MHz. Six blue vertical lines indicate measured peaks at 120.21, 190.05, 298.69, 364.65, 600.36, and 799.21 MHz, all of which are below the limit line.

	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	120.21	29.70	43.50	-13.80	39.83	-10.13	Peak	---	---
2	190.05	37.52	43.50	-5.98	48.45	-10.93	Peak	---	---
3	298.69	42.28	46.00	-3.72	49.82	-7.54	Peak	---	---
4	364.65	30.98	46.00	-15.02	36.86	-5.88	Peak	---	---
5	600.36	32.97	46.00	-13.03	33.62	-0.65	Peak	---	---
6	799.21	40.39	46.00	-5.61	38.00	2.39	Peak	---	---

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	HT20	Test Freq. (MHz)	2437
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	39.70	27.11	40.00	-12.89	34.96	-7.85	Peak	---	---
2	120.21	28.29	43.50	-15.21	38.42	-10.13	Peak	---	---
3	204.60	28.74	43.50	-14.76	39.68	-10.94	Peak	---	---
4	298.69	30.35	46.00	-15.65	37.89	-7.54	Peak	---	---
5	482.99	31.70	46.00	-14.30	34.82	-3.12	Peak	---	---
6	797.27	41.48	46.00	-4.52	39.11	2.37	Peak	---	---

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

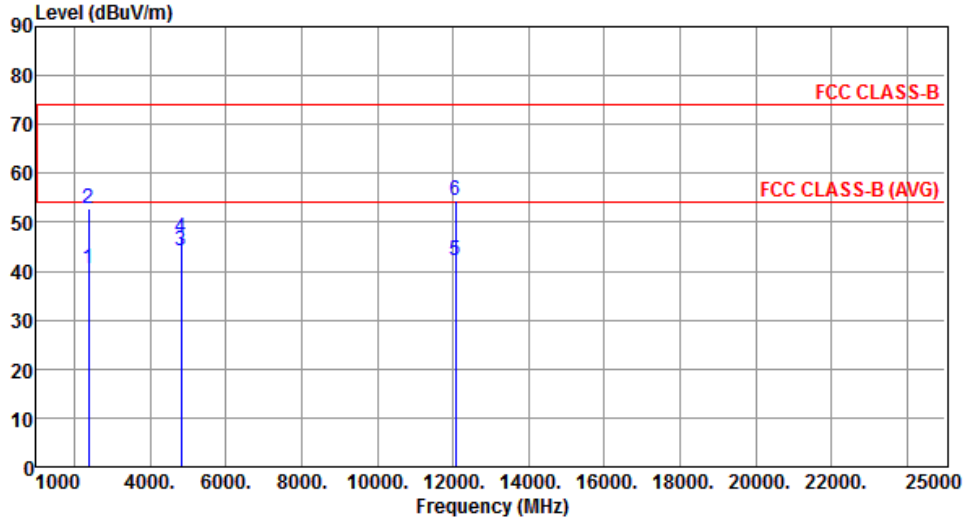
*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.5.5 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 11b

Modulation	11b	Test Freq. (MHz)	2412
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	40.39	54.00	-13.61	43.57	-3.18	Average	323	152
2	2390.00	52.66	74.00	-21.34	55.84	-3.18	Peak	323	152
3	4824.00	44.14	54.00	-9.86	40.36	3.78	Average	100	237
4	4824.00	46.92	74.00	-27.08	43.14	3.78	Peak	100	237
5	12060.00	42.11	54.00	-11.89	28.53	13.58	Average	100	128
6	12060.00	54.34	74.00	-19.66	40.76	13.58	Peak	100	128

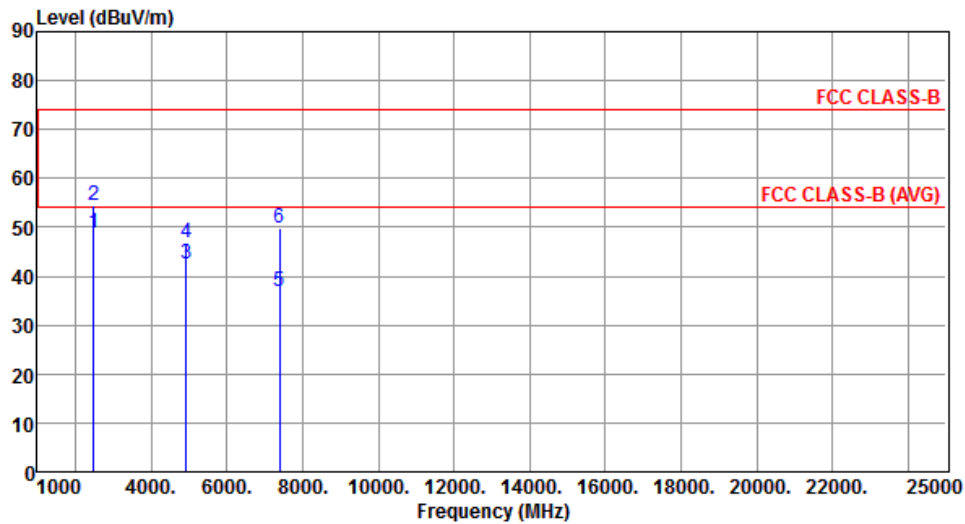
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	11b	Test Freq. (MHz)	2412
Polarization	Vertical		
Level (dBUV/m) </			

Modulation	11b	Test Freq. (MHz)	2437
Polarization	Horizontal		
Level (dBuV/m) </			

Modulation	11b	Test Freq. (MHz)	2437
Polarization	Vertical		
Level (dBuV/m) </			

Modulation	11b	Test Freq. (MHz)	2462
Polarization	Horizontal		



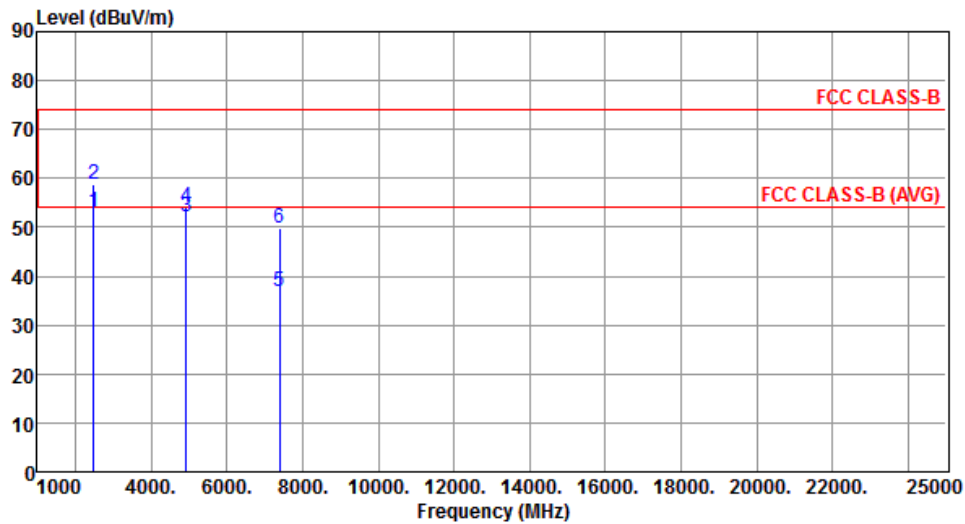
	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	48.91	54.00	-5.09	51.71	-2.80	Average	311	152
2	2483.50	54.43	74.00	-19.57	57.23	-2.80	Peak	311	152
3	4924.00	42.63	54.00	-11.37	38.53	4.10	Average	100	349
4	4924.00	46.84	74.00	-27.16	42.74	4.10	Peak	100	349
5	7386.00	36.81	54.00	-17.19	28.37	8.44	Average	100	173
6	7386.00	49.98	74.00	-24.02	41.54	8.44	Peak	100	173

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	11b	Test Freq. (MHz)	2462
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	53.20	54.00	-0.80	56.00	-2.80	Average	294	268
2	2483.50	58.77	74.00	-15.23	61.57	-2.80	Peak	294	268
3	4924.00	52.12	54.00	-1.88	48.02	4.10	Average	100	116
4	4924.00	54.28	74.00	-19.72	50.18	4.10	Peak	100	116
5	7386.00	36.74	54.00	-17.26	28.30	8.44	Average	100	82
6	7386.00	49.70	74.00	-24.30	41.26	8.44	Peak	100	82

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

3.5.6 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 11g

Modulation	11g	Test Freq. (MHz)	2412
Polarization	Horizontal		

	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	42.40	54.00	-11.60	45.58	-3.18	Average	100	152
2	2390.00	64.16	74.00	-9.84	67.34	-3.18	Peak	100	152
3	4824.00	33.52	54.00	-20.48	29.74	3.78	Average	100	191
4	4824.00	45.53	74.00	-28.47	41.75	3.78	Peak	100	191
5	12060.00	43.73	54.00	-10.27	30.15	13.58	Average	137	226
6	12060.00	55.87	74.00	-18.13	42.29	13.58	Peak	137	226

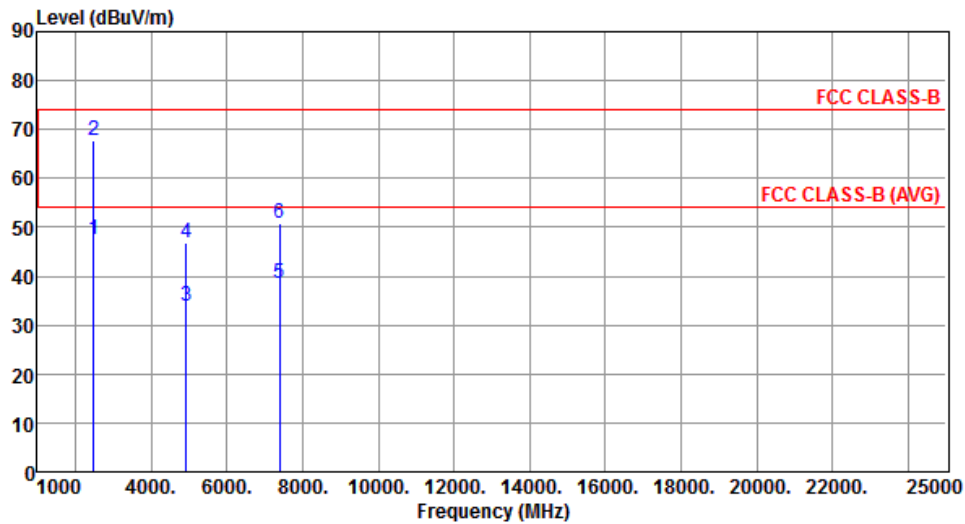
Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	11g	Test Freq. (MHz)	2412
Polarization	Vertical		
Level (dBUV/m) </			

Modulation	11g	Test Freq. (MHz)	2437
Polarization	Horizontal		
Level (dBuV/m) </			

Modulation	11g	Test Freq. (MHz)	2437
Polarization	Vertical		
Level (dBuV/m) </			

Modulation	11g	Test Freq. (MHz)	2462
Polarization	Horizontal		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	47.51	54.00	-6.49	50.31	-2.80	Average	100	164
2	2483.50	67.89	74.00	-6.11	70.69	-2.80	Peak	100	164
3	4924.00	33.72	54.00	-20.28	29.62	4.10	Average	100	193
4	4924.00	46.94	74.00	-27.06	42.84	4.10	Peak	100	193
5	7386.00	38.49	54.00	-15.51	30.05	8.44	Average	137	248
6	7386.00	50.76	74.00	-23.24	42.32	8.44	Peak	137	248

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

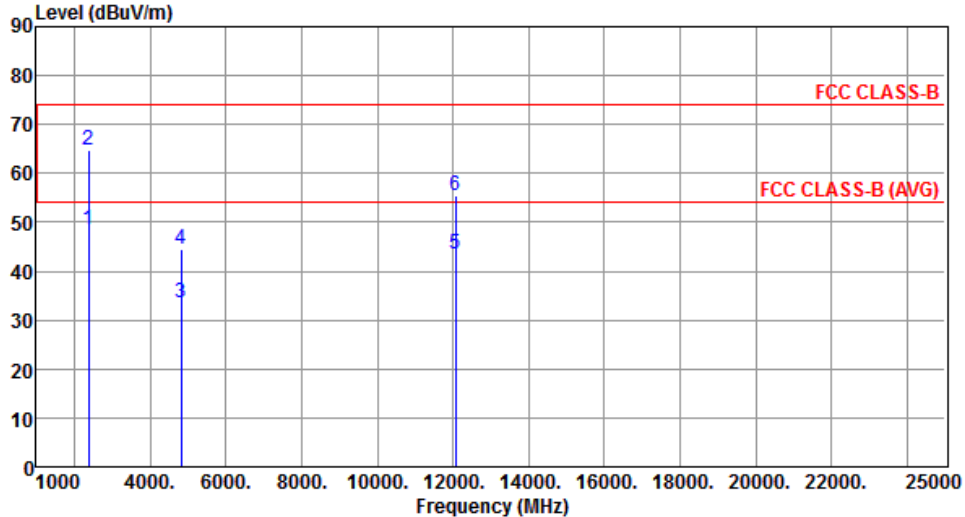
*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	11g	Test Freq. (MHz)	2462
Polarization	Vertical		
Level (dBuV/m) </			

3.5.7 Transmitter Radiated Unwanted Emissions (Above 1GHz) for HT20

Modulation	HT20	Test Freq. (MHz)	2412
Polarization	Horizontal		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	48.41	54.00	-5.59	51.59	-3.18	Average	100	138
2	2390.00	64.86	74.00	-9.14	68.04	-3.18	Peak	100	138
3	4824.00	33.40	54.00	-20.60	29.62	3.78	Average	100	185
4	4824.00	44.59	74.00	-29.41	40.81	3.78	Peak	100	185
5	12060.00	43.41	54.00	-10.59	29.83	13.58	Average	125	207
6	12060.00	55.35	74.00	-18.65	41.77	13.58	Peak	125	207

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	HT20	Test Freq. (MHz)	2412
Polarization	Vertical		
Level (dBUV/m) </			

Modulation	HT20	Test Freq. (MHz)	2437
Polarization	Horizontal		
Level (dBuV/m) </			

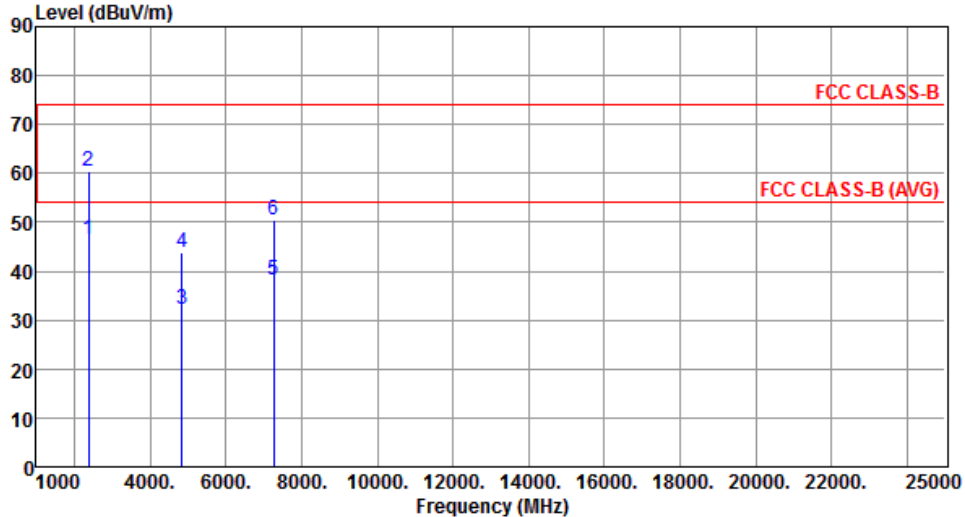
Modulation	HT20	Test Freq. (MHz)	2437
Polarization	Vertical		
Level (dBUV/m)			

Modulation	HT20	Test Freq. (MHz)	2462
Polarization	Horizontal		
Level (dBuV/m) </			

Modulation	HT20	Test Freq. (MHz)	2462
Polarization	Vertical		
Level (dBUV/m)			

3.5.8 Transmitter Radiated Unwanted Emissions (Above 1GHz) for HT40

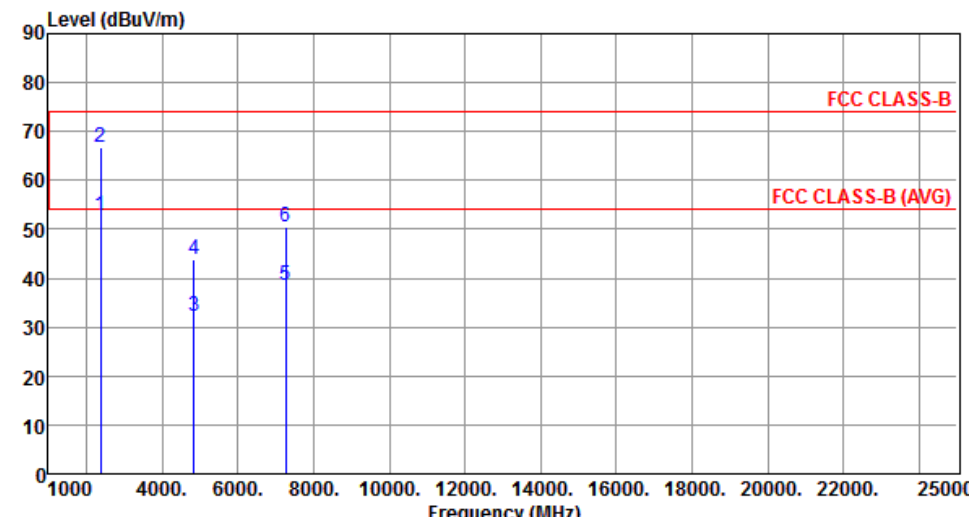
Modulation	HT40	Test Freq. (MHz)	2422
Polarization	Horizontal		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	46.46	54.00	-7.54	49.64	-3.18	Average	100	42
2	2390.00	60.34	74.00	-13.66	63.52	-3.18	Peak	100	42
3	4844.00	32.32	54.00	-21.68	28.47	3.85	Average	100	163
4	4844.00	43.93	74.00	-30.07	40.08	3.85	Peak	100	163
5	7266.00	38.33	54.00	-15.67	29.94	8.39	Average	100	295
6	7266.00	50.44	74.00	-23.56	42.05	8.39	Peak	100	295

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	HT40	Test Freq. (MHz)	2422
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	52.81	54.00	-1.19	55.99	-3.18	Average	140	278
2	2390.00	66.66	74.00	-7.34	69.84	-3.18	Peak	140	278
3	4844.00	32.37	54.00	-21.63	28.52	3.85	Average	100	127
4	4844.00	43.68	74.00	-30.32	39.83	3.85	Peak	100	127
5	7266.00	38.49	54.00	-15.51	30.10	8.39	Average	100	13
6	7266.00	50.36	74.00	-23.64	41.97	8.39	Peak	100	13

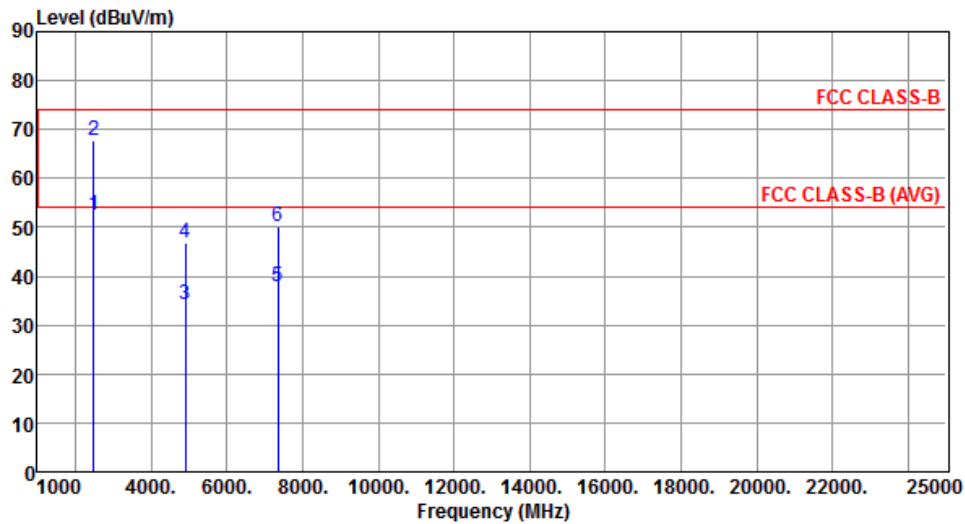
Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	HT40	Test Freq. (MHz)	2437
Polarization	Horizontal		
Level (dBUV/m) </			

Modulation	HT40	Test Freq. (MHz)	2437
Polarization	Vertical		
Level (dBuV/m) </			

Modulation	HT40	Test Freq. (MHz)	2452
Polarization	Horizontal		
Level (dBUV/m) </			

Modulation	HT40	Test Freq. (MHz)	2452
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	52.55	54.00	-1.45	55.35	-2.80	Average	258	100
2	2483.50	67.69	74.00	-6.31	70.49	-2.80	Peak	258	100
3	4904.00	34.09	54.00	-19.91	30.04	4.05	Average	100	304
4	4904.00	46.76	74.00	-27.24	42.71	4.05	Peak	100	304
5	7356.00	38.02	54.00	-15.98	29.59	8.43	Average	139	173
6	7356.00	50.27	74.00	-23.73	41.84	8.43	Peak	139	173

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

3.6 Emissions in Non-Restricted Frequency Bands

3.6.1 Emissions in Non-Restricted Frequency Bands Limit

Peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz

3.6.2 Test Procedures

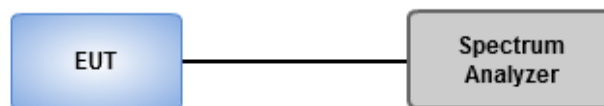
Reference level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Use the peak marker function to determine the maximum PSD level

Emission level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Scan Frequency range is up to 25GHz
4. Use the peak marker function to determine the maximum amplitude level

3.6.3 Test Setup

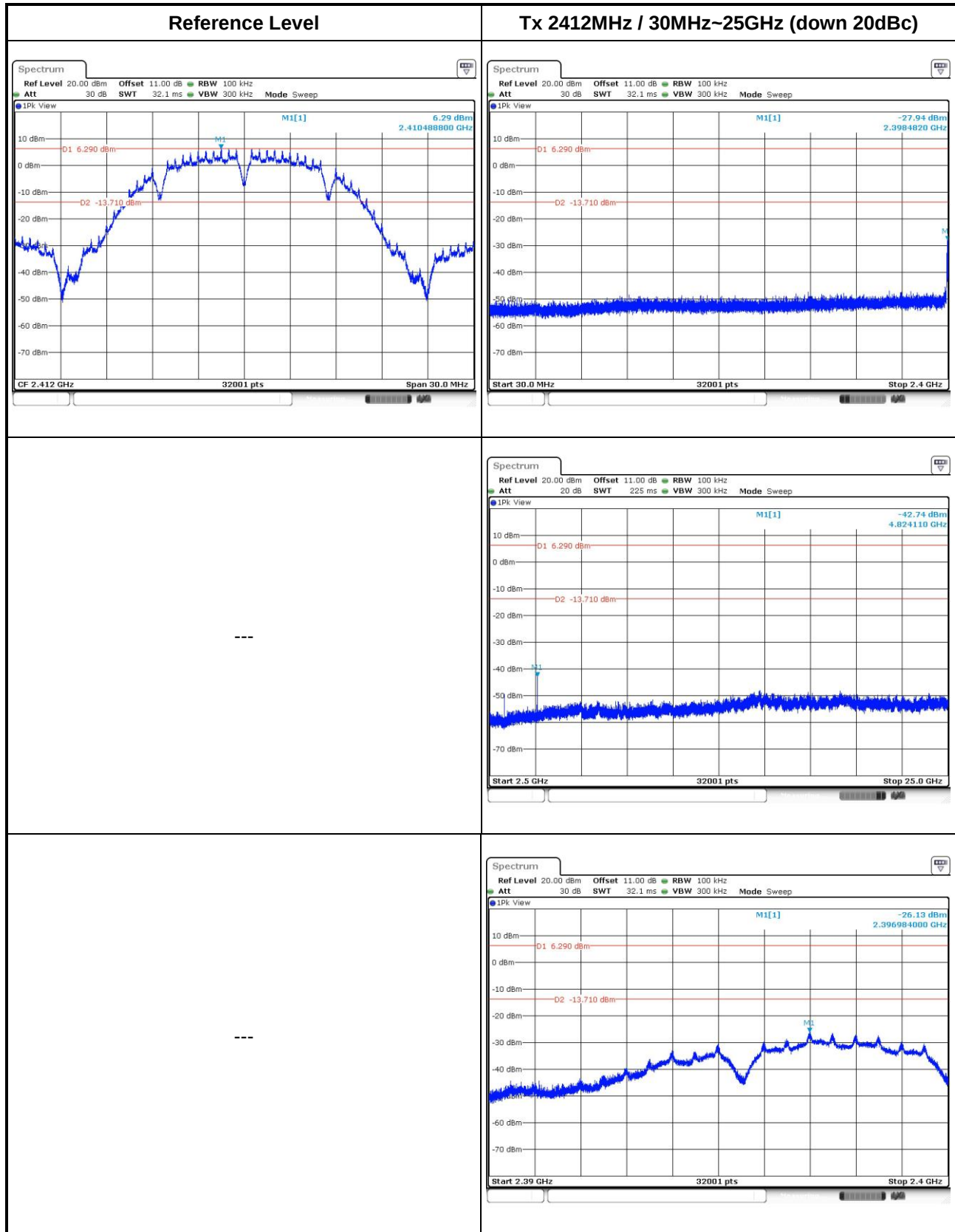


3.6.4 Test Result of Emissions in non-restricted frequency bands

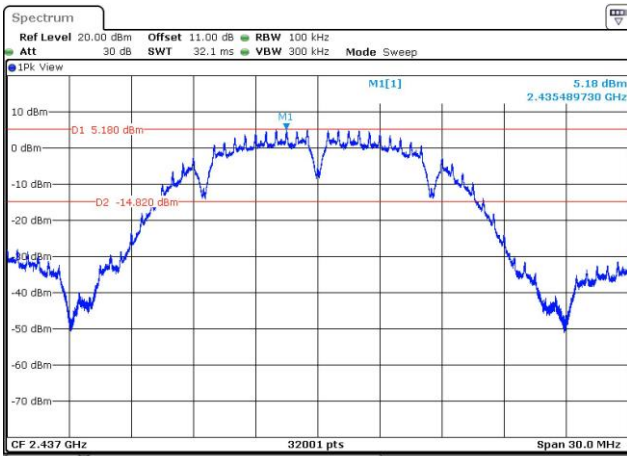
This test item is performed on each TX output individually without summing or adding $10 \log(N_{ANT})$ since measurements are made relative to the in-band emissions on the individual outputs. Only worst test result of each operating mode is presented.

3.6.5 Unwanted Emissions into Non-Restricted Frequency Bands

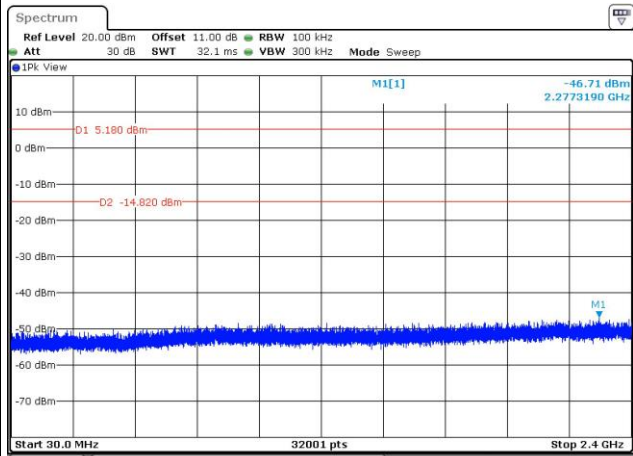
802.11b

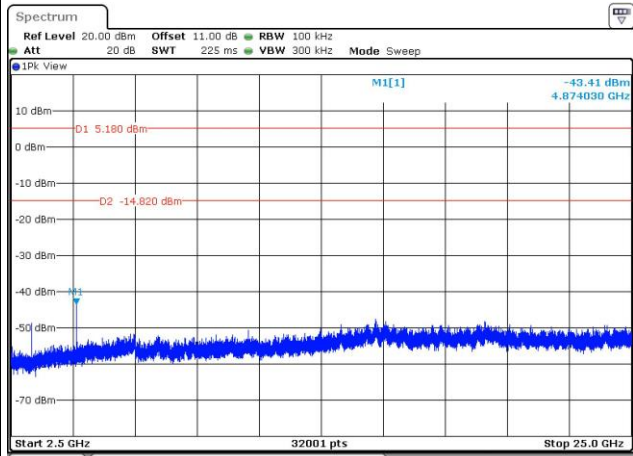


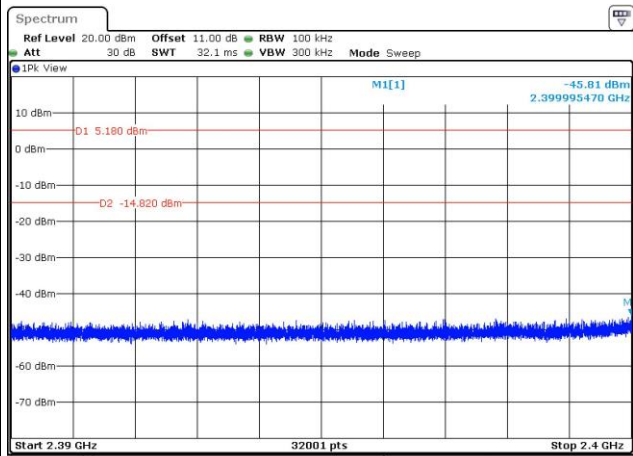
Reference Level



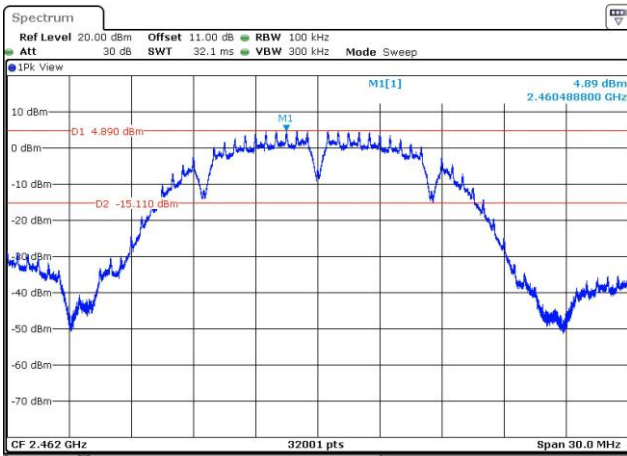
Tx 2437MHz / 30MHz~25GHz (down 20dBc)



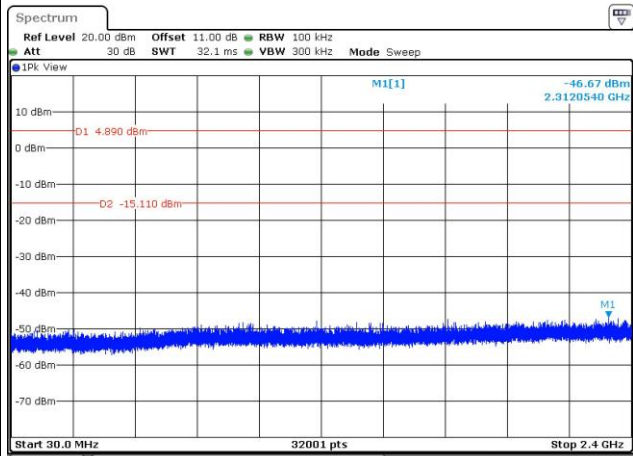


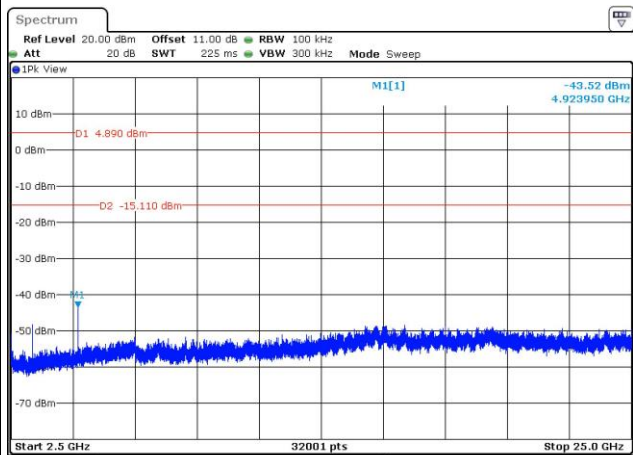


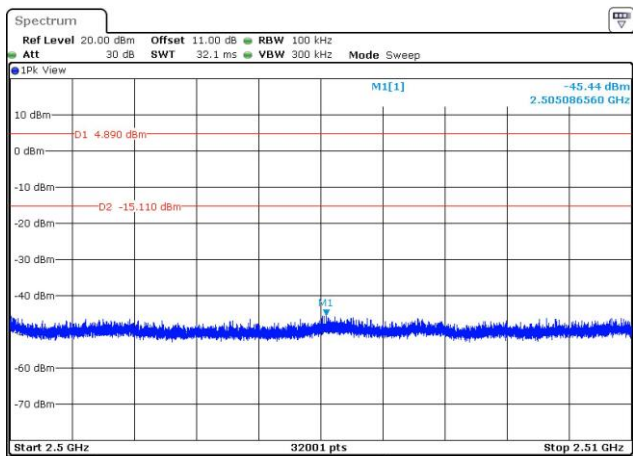
Reference Level



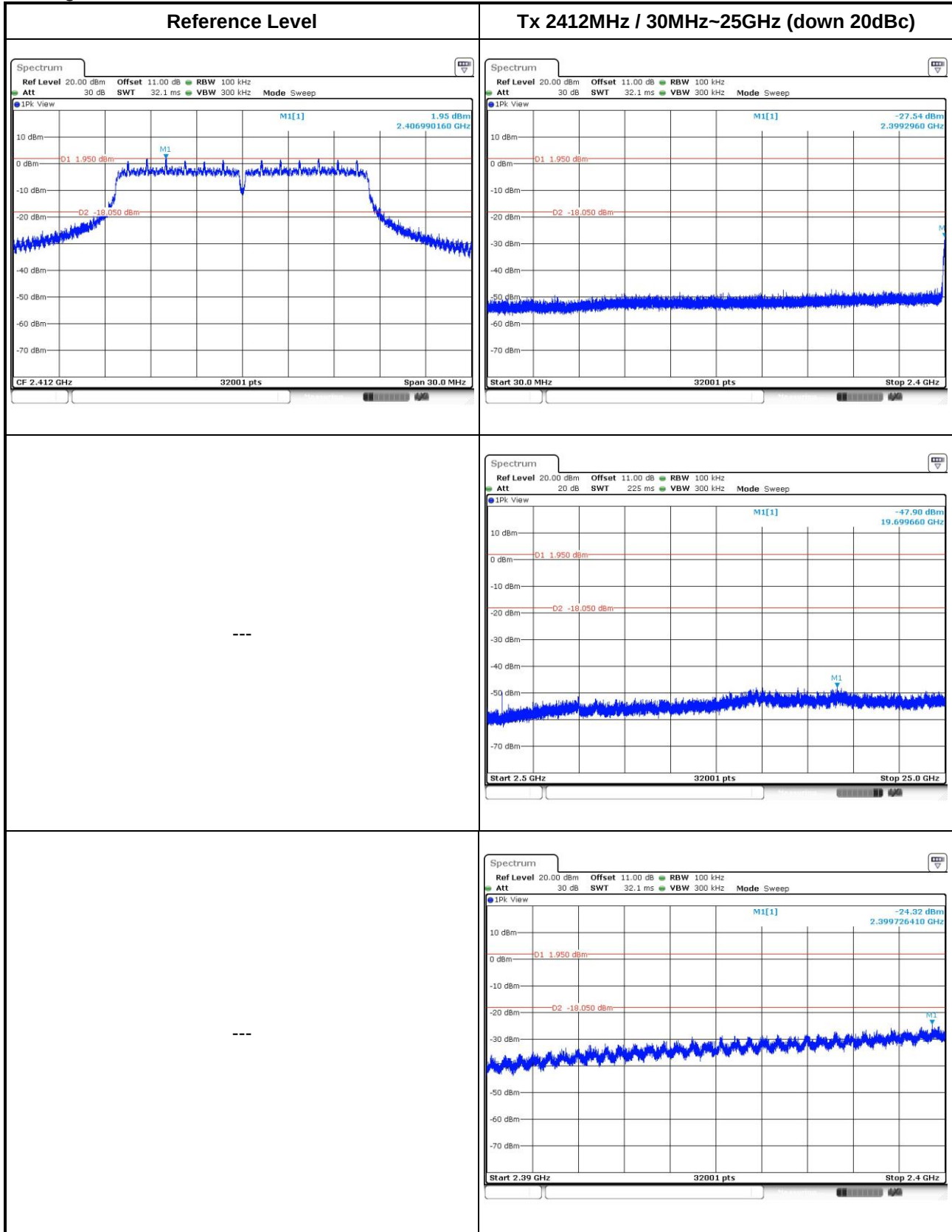
Tx 2462MHz / 30MHz~25GHz (down 20dBc)



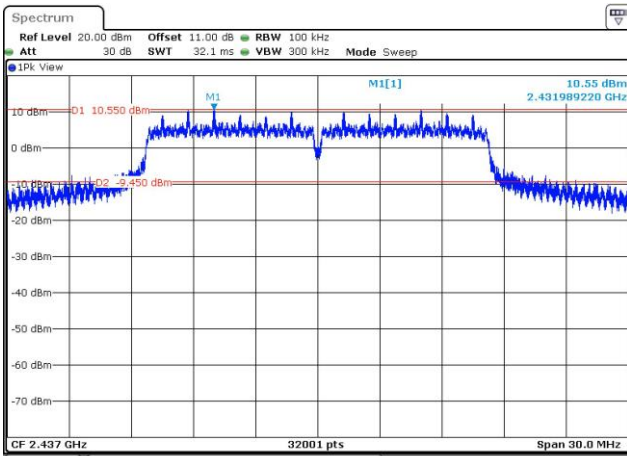




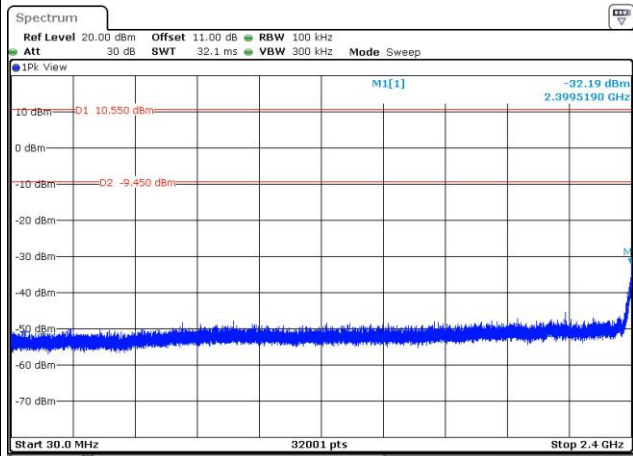
802.11g

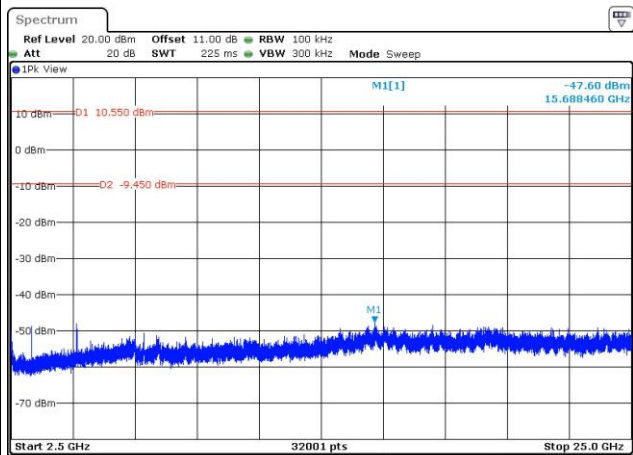


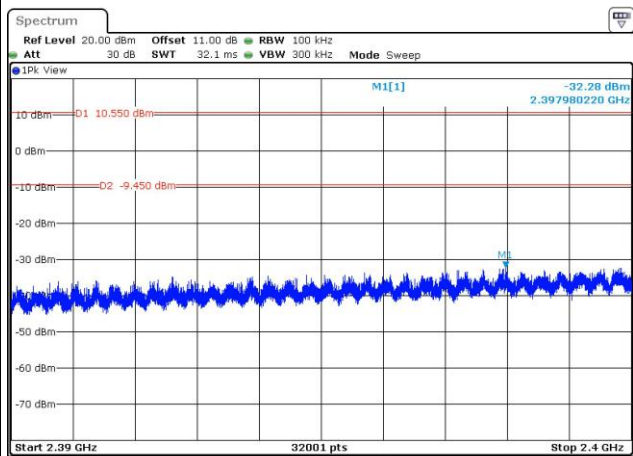
Reference Level

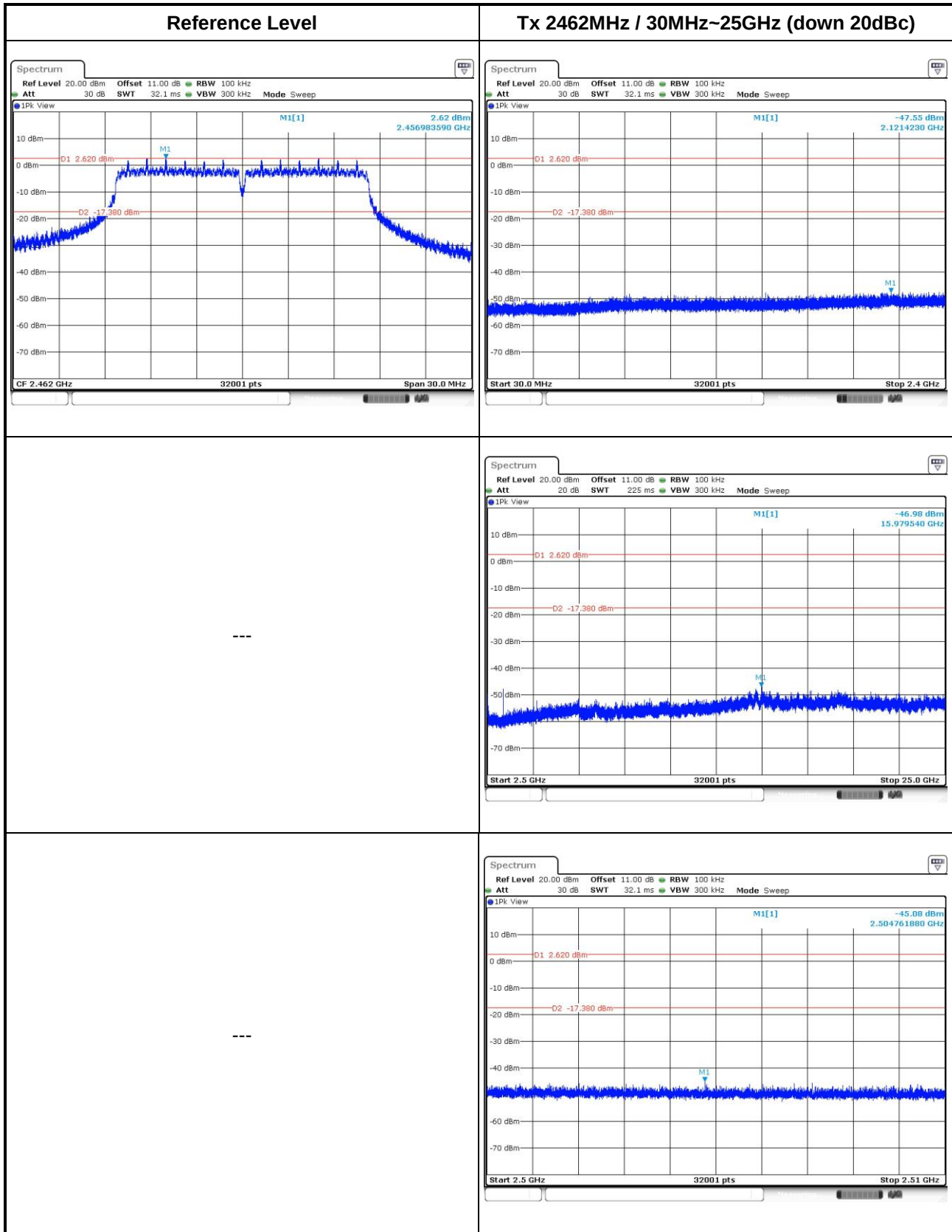


Tx 2437MHz / 30MHz~25GHz (down 20dBc)

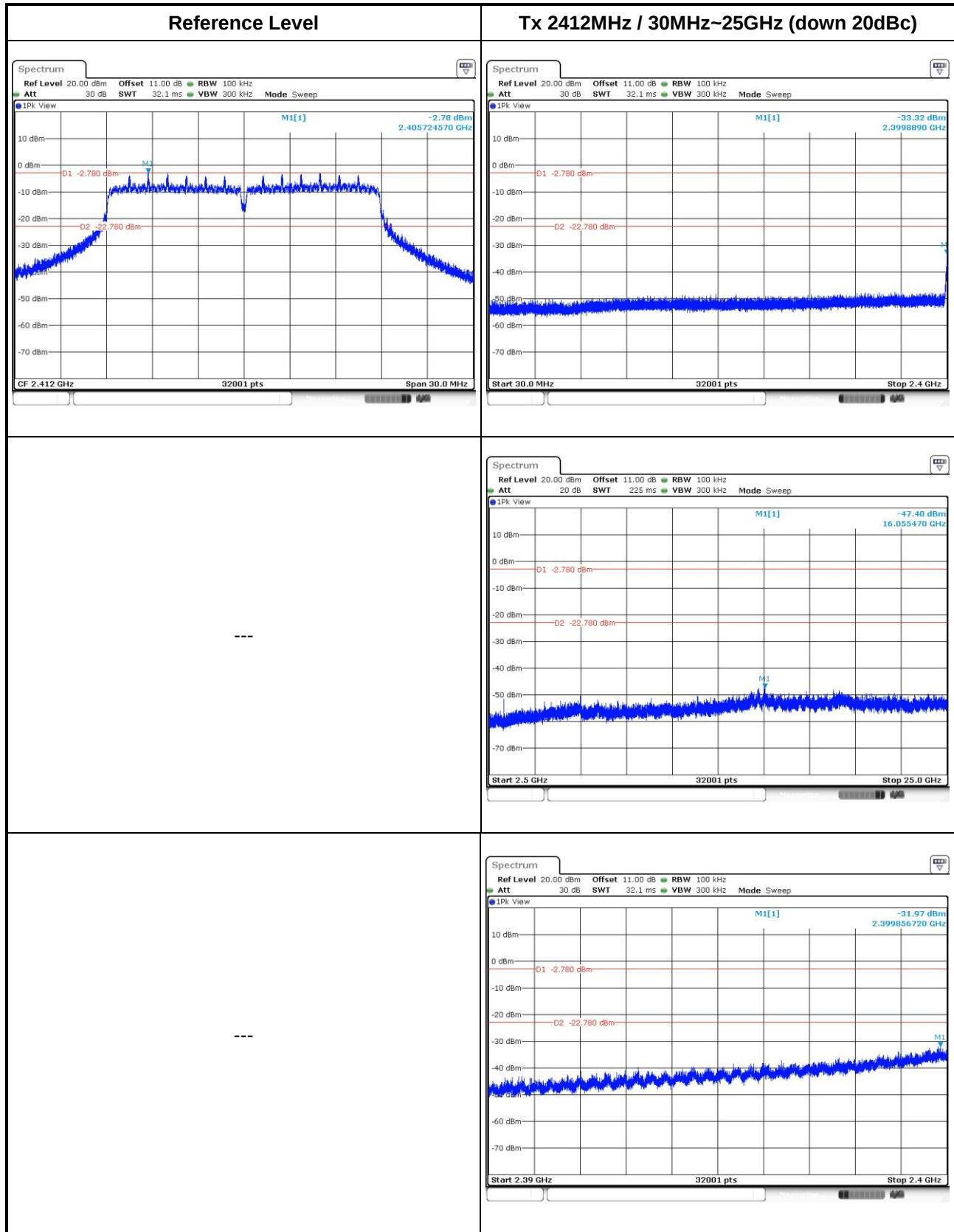




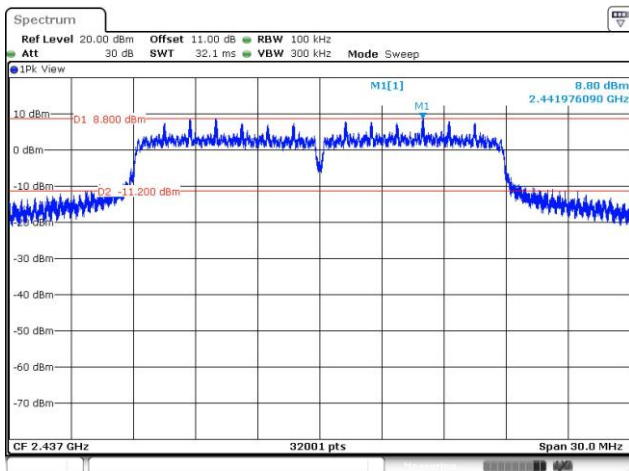




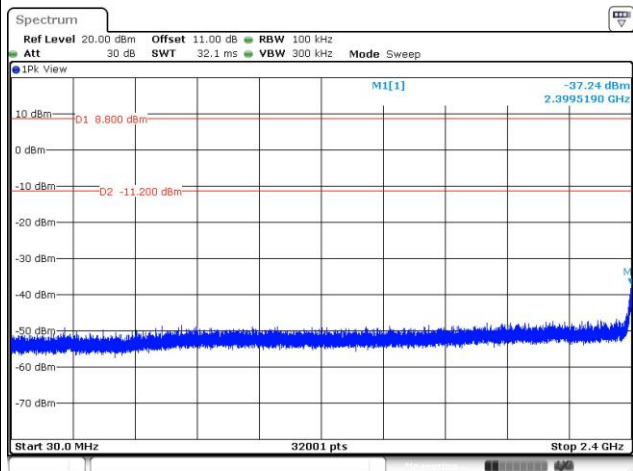
802.11n HT20

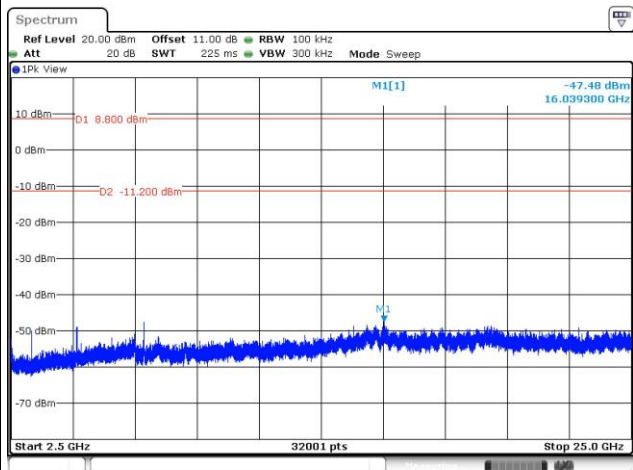


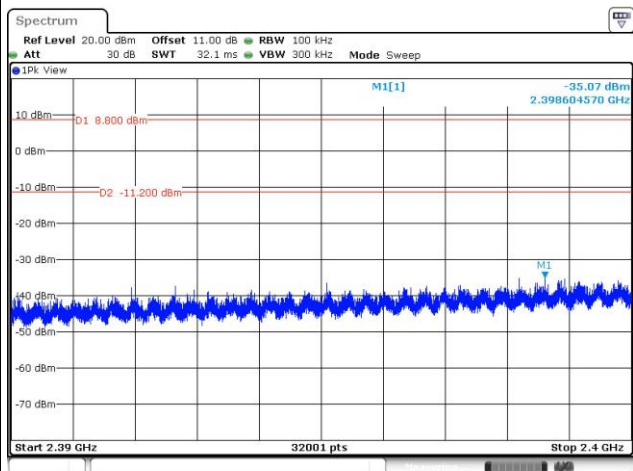
Reference Level

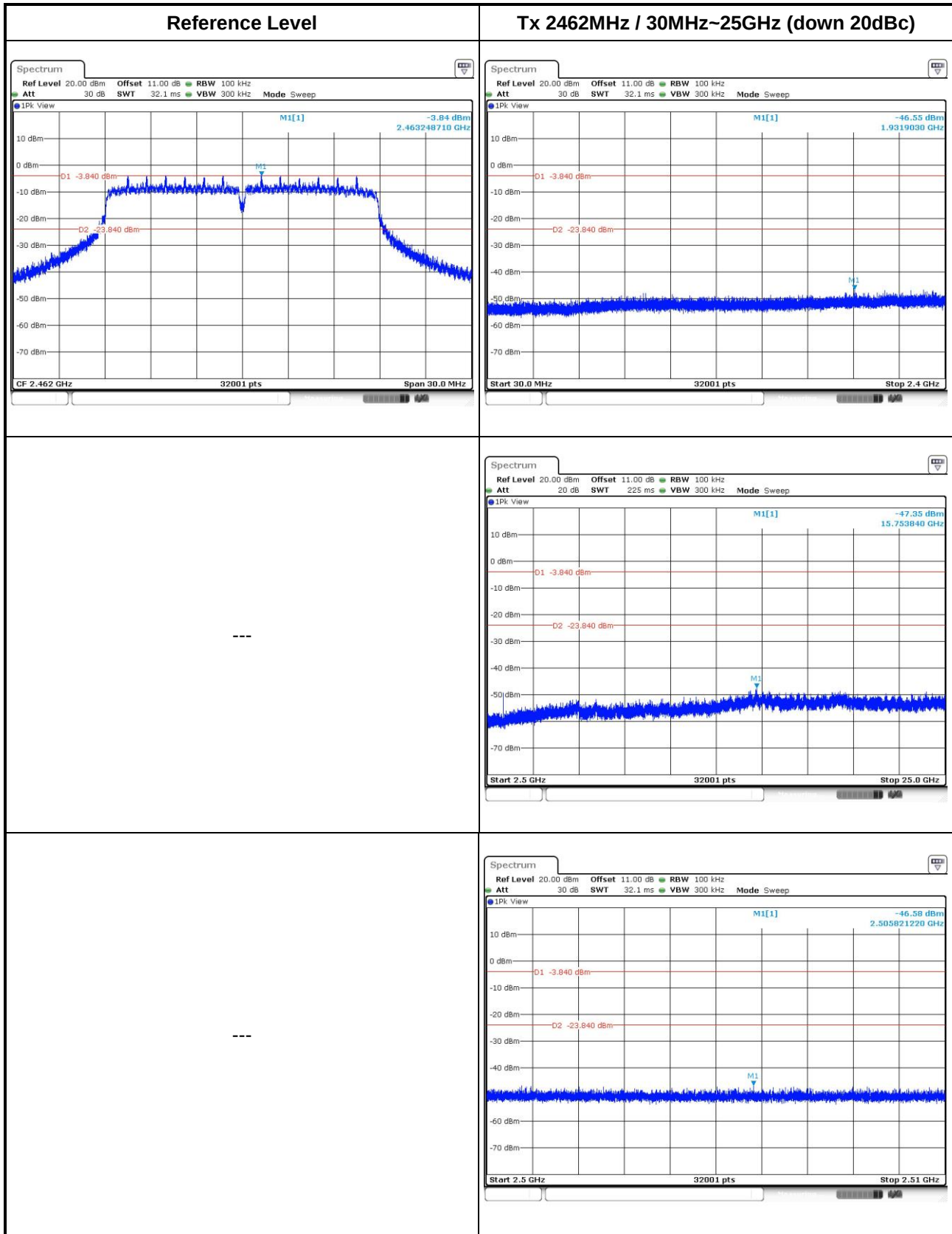


Tx 2437MHz / 30MHz~25GHz (down 20dBc)

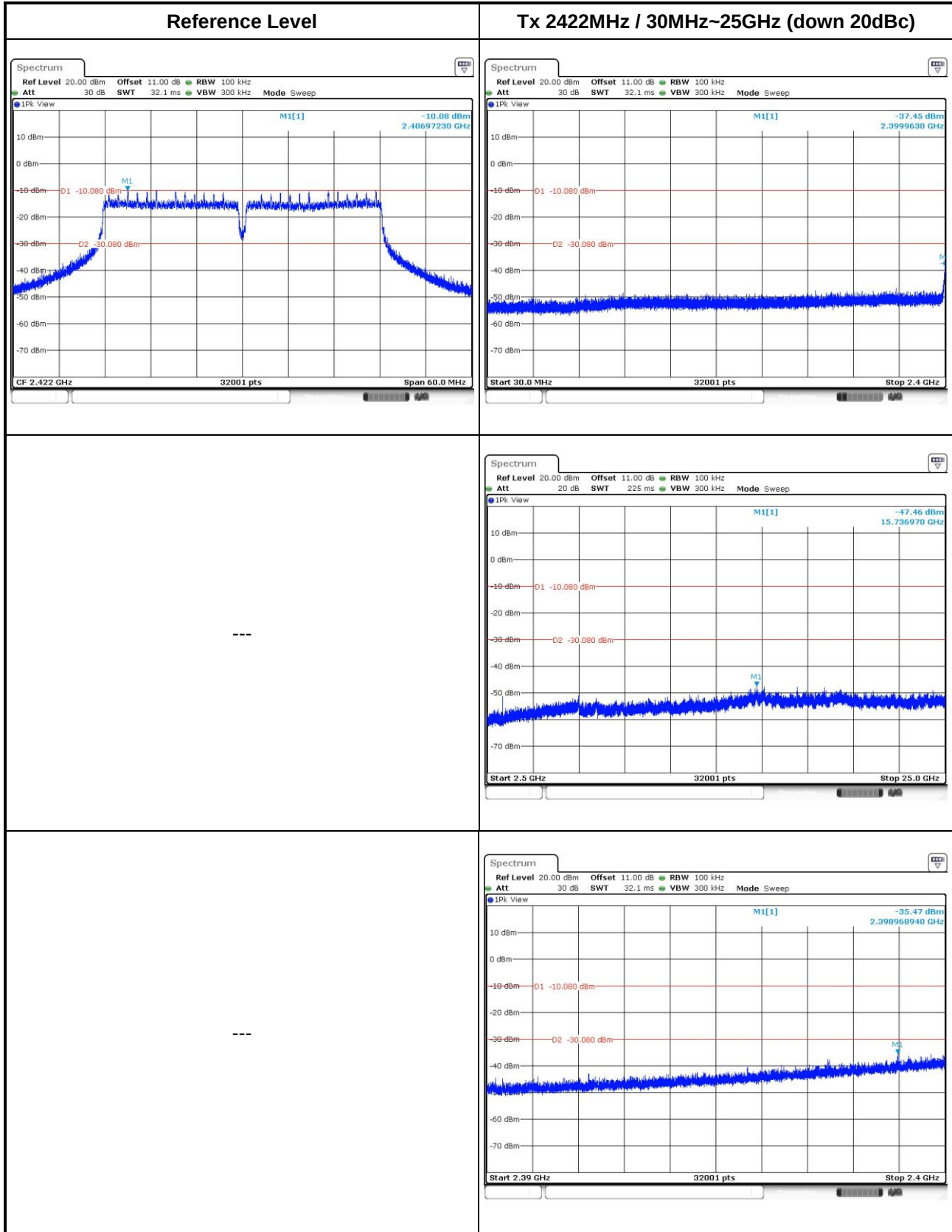


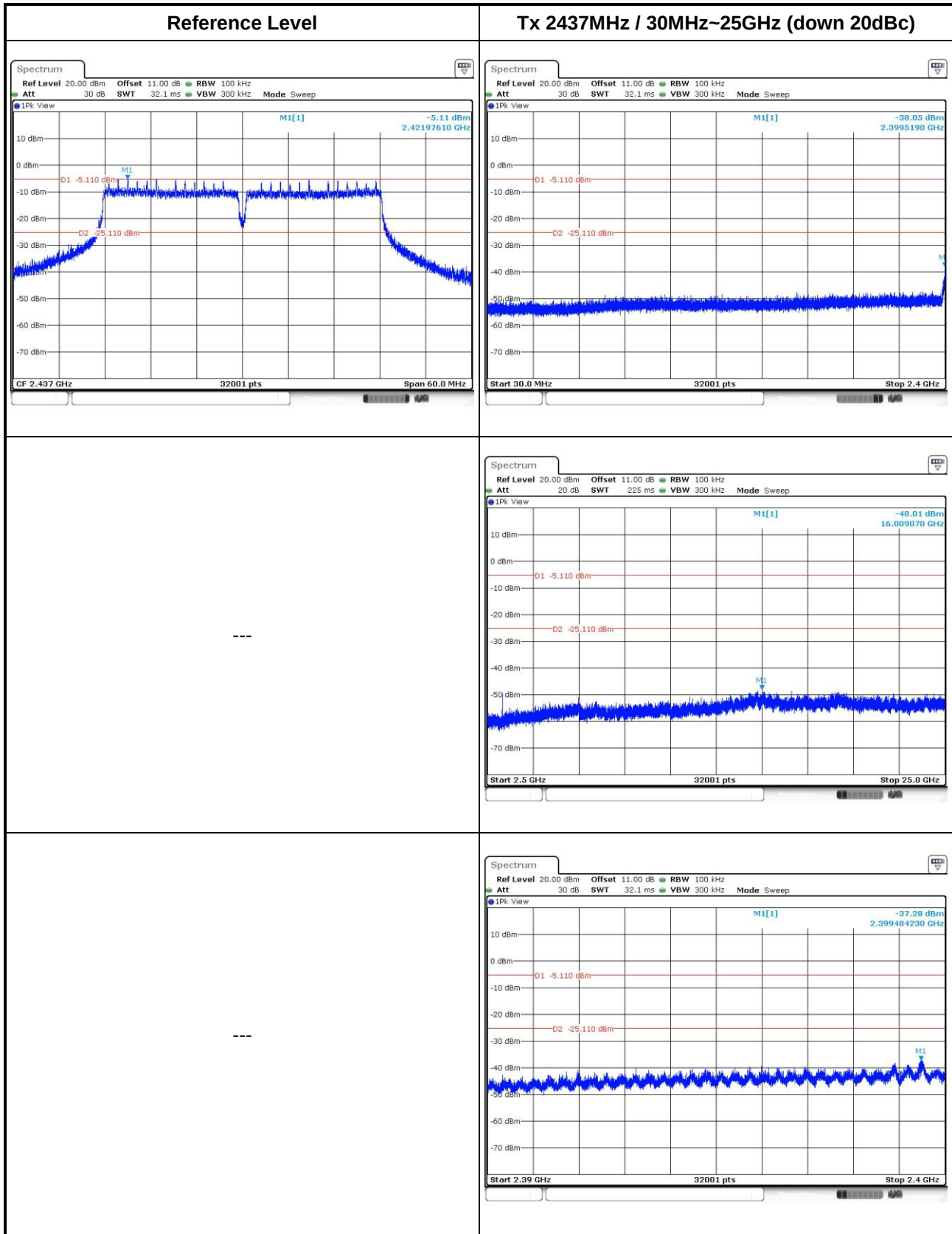


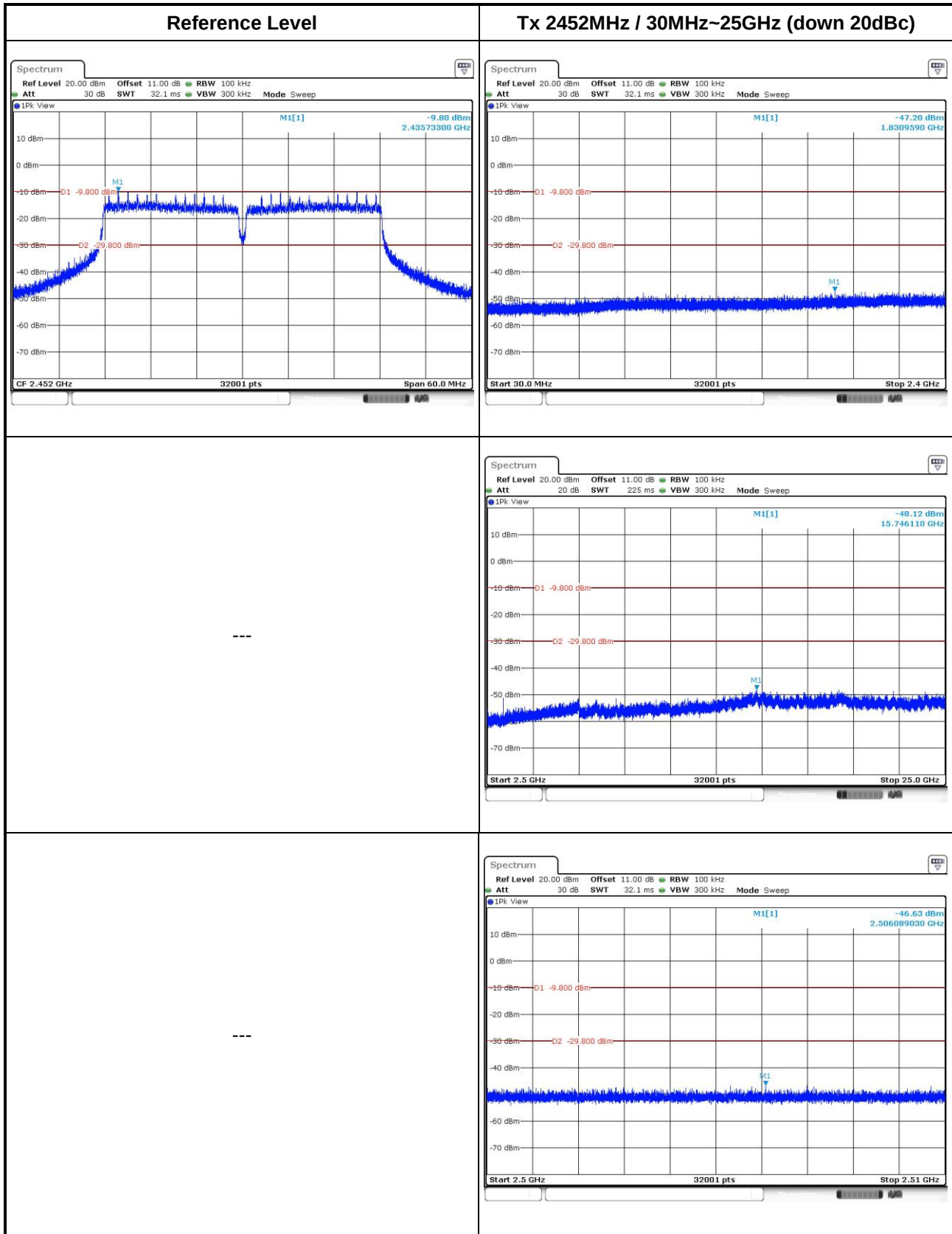




802.11n HT40







4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

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Taiwan, R.O.C.

Kwei Shan

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Kwei Shan Site II

Tel: 886-3-271-8640

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St., Kwei Shan District, Tao Yuan
City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information.

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Email: ICC_Service@icertifi.com.tw

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