

## 10. PEAK POWER SPECTRUL DENSITY

### 10.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 45 % R.H.

### 10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$  , the video bandwidth is set to 3 times the resolution bandwidth.



### 10.3 Test Date

March 12, 2021 ~ March 22, 2021

10.4 Test data for 802.11b WLAN Mode

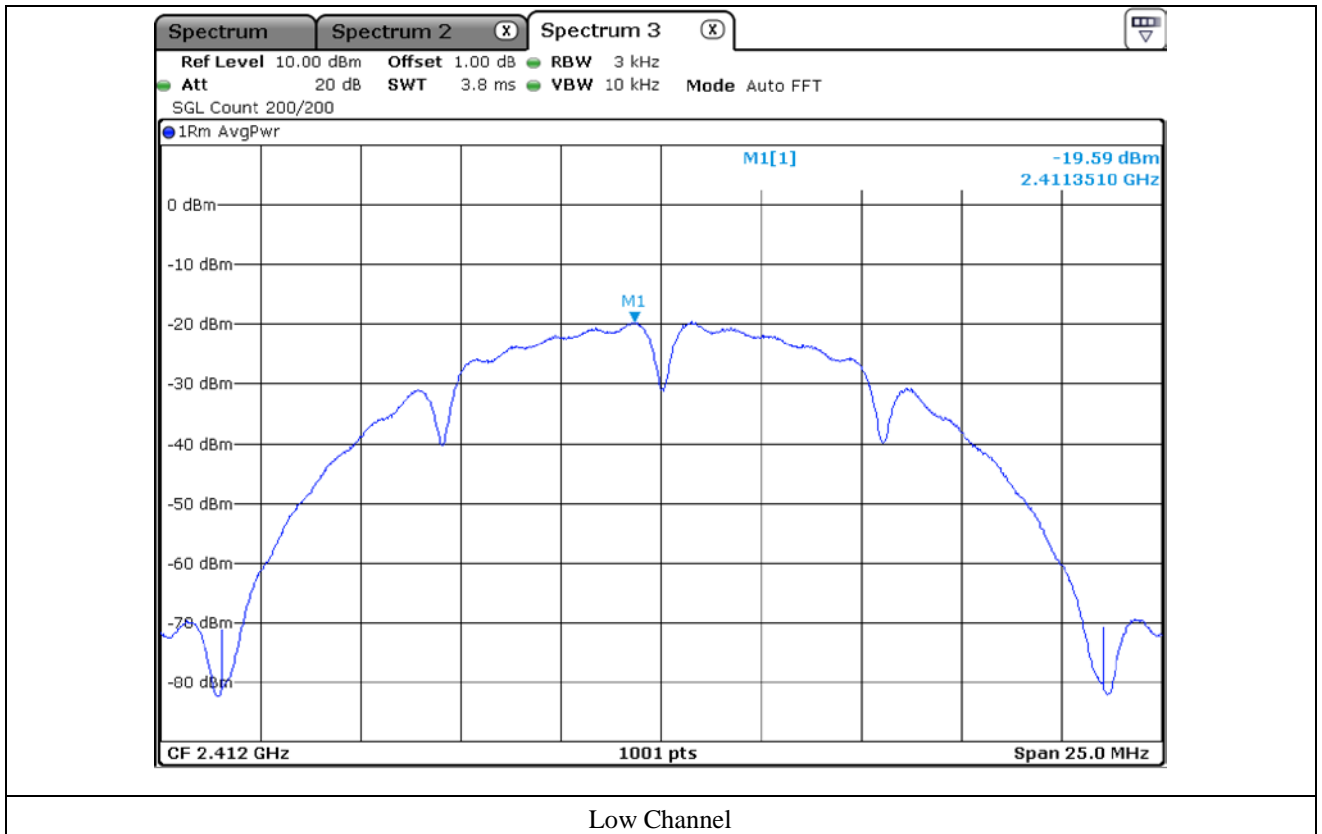
10.4.1 Test data for Antenna 0

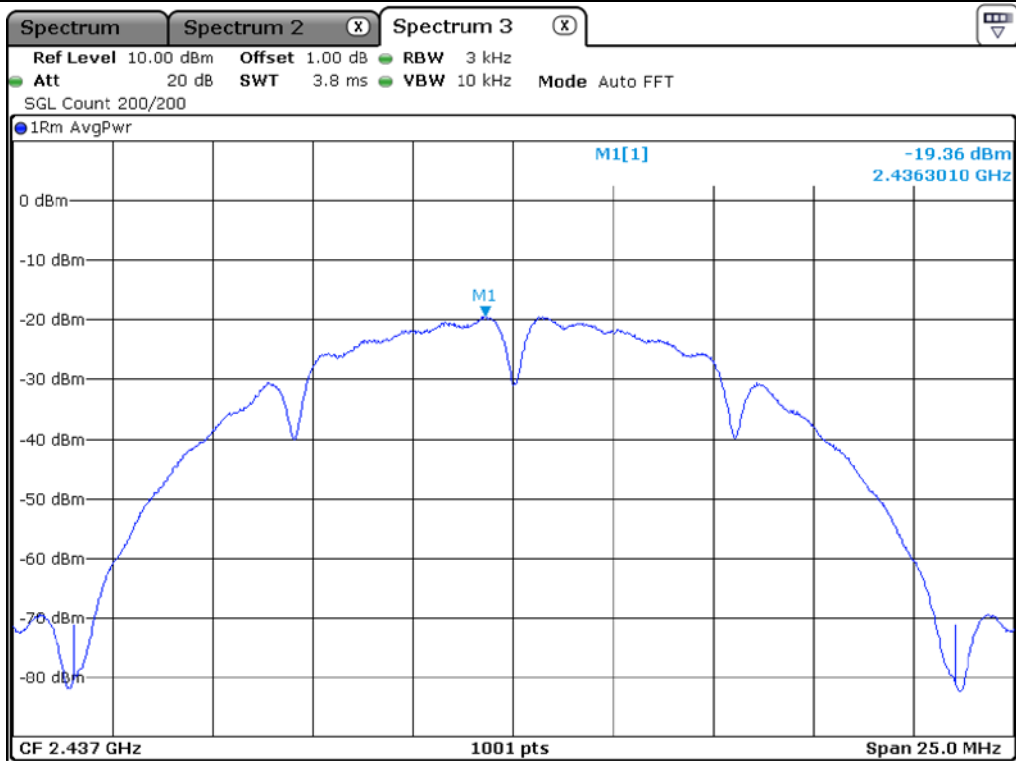
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

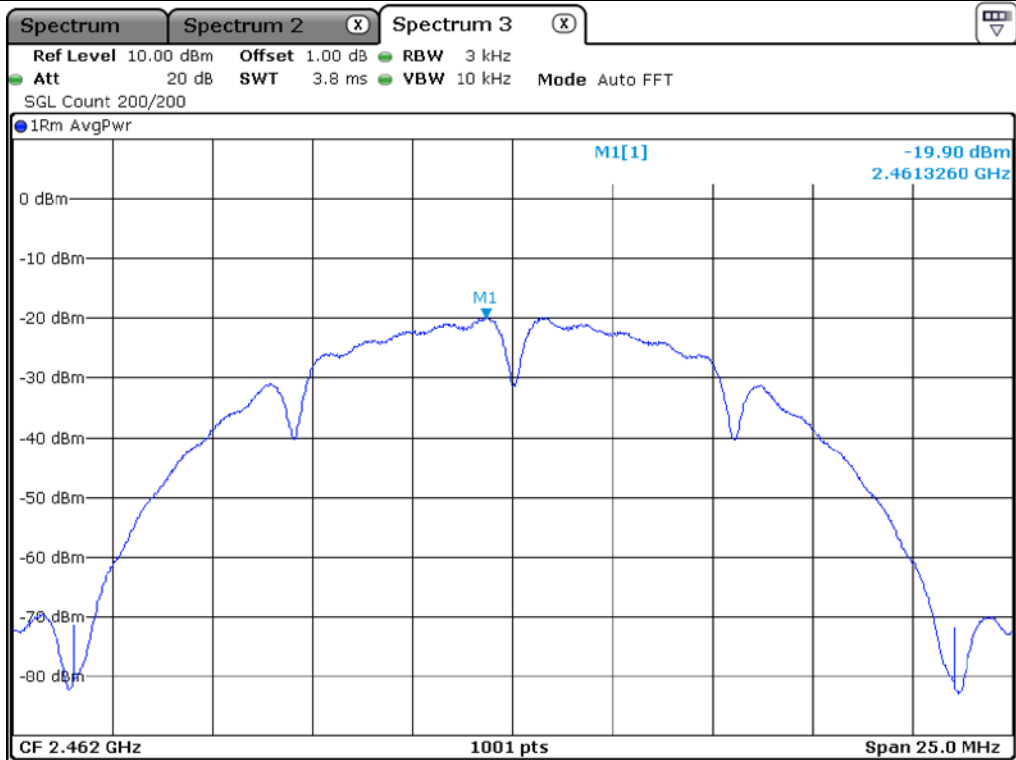
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-19.59	8.00	27.59
Middle	2 437.00	-19.36	8.00	27.36
High 11	2 462.00	-19.90	8.00	27.90
High 12	2 467.00	-23.89	8.00	31.89
High 13	2 472.00	-27.00	8.00	35.00

Remark. Margin = Limit – Measured value

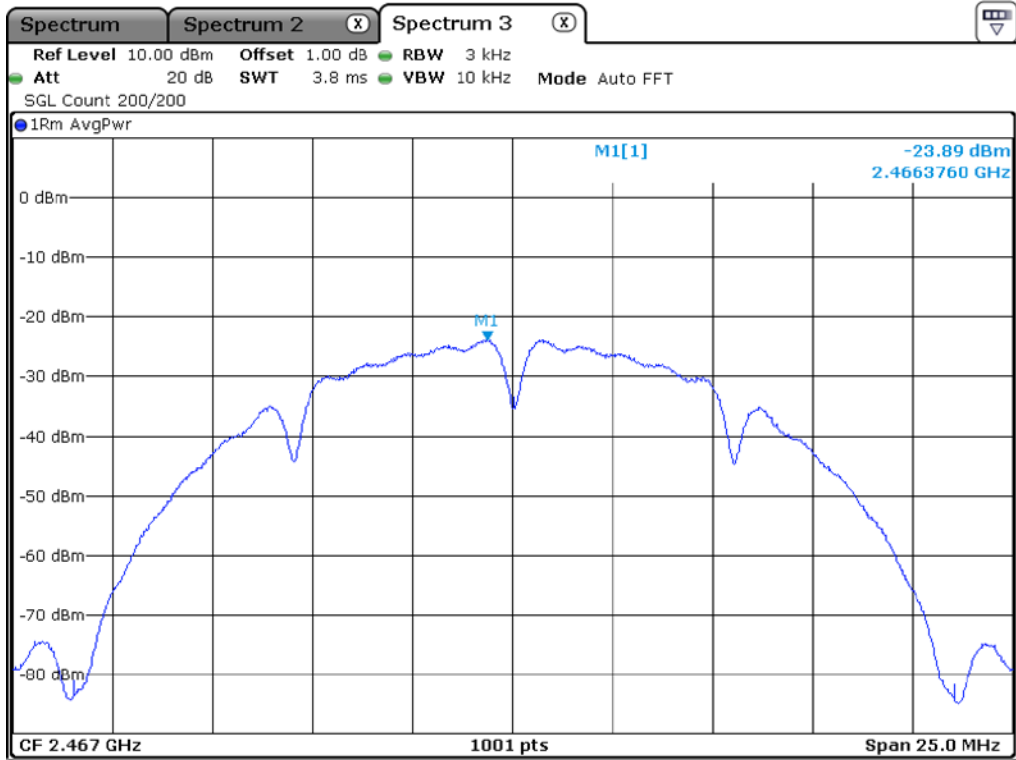




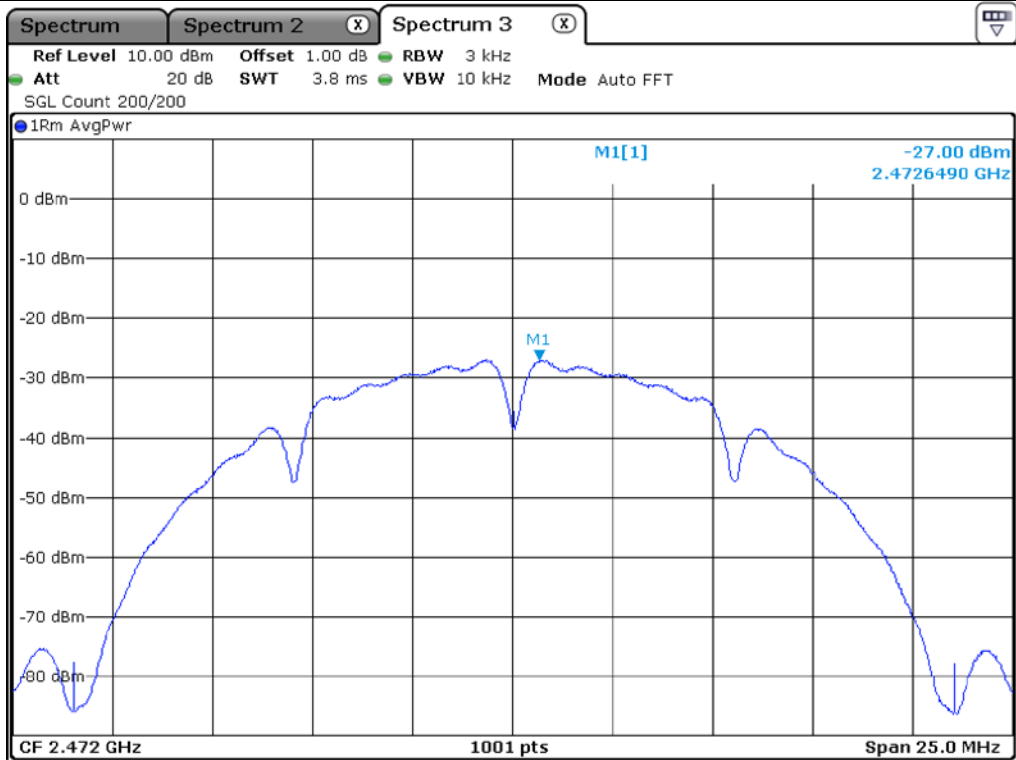
Middle Channel



High Channel 11



High Channel 12



High Channel 13

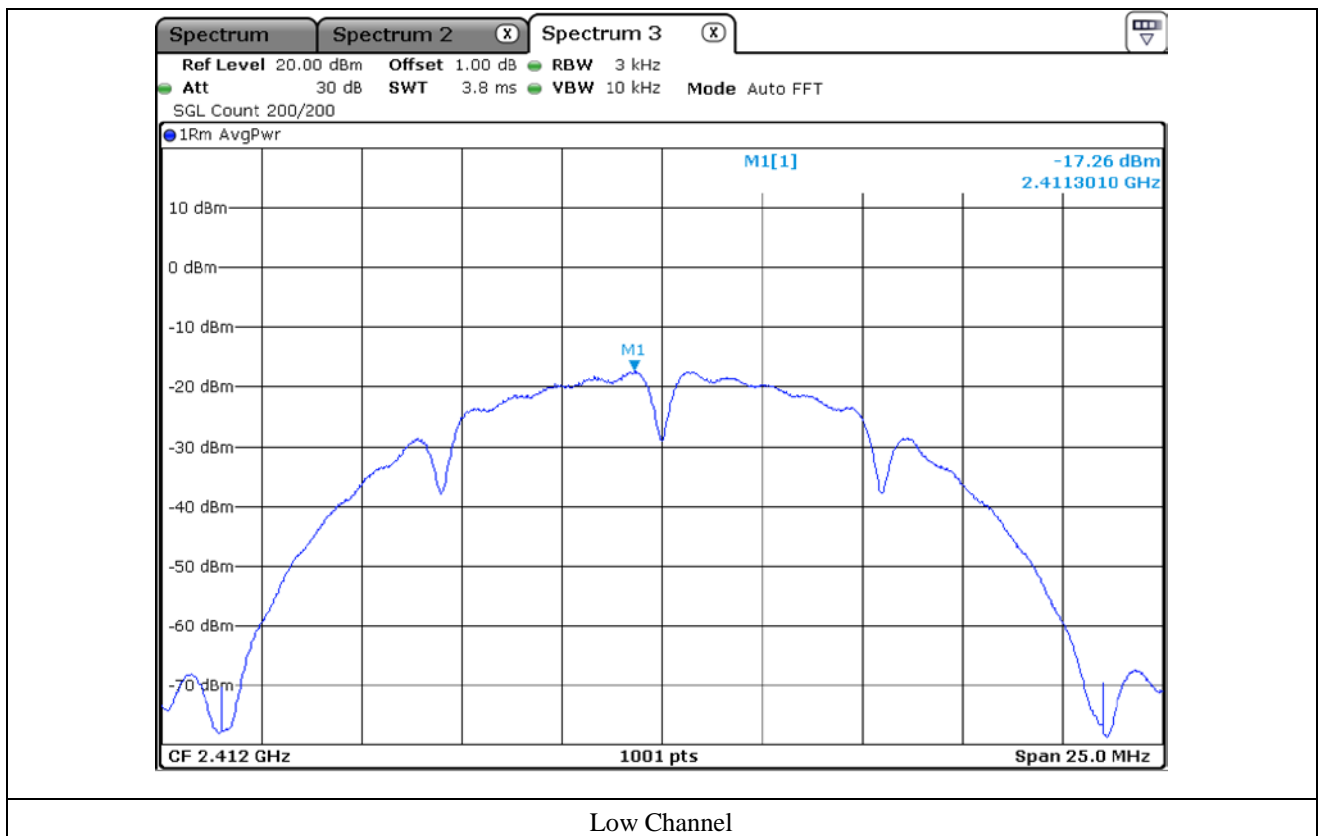
### 10.4.2 Test data for Antenna 1

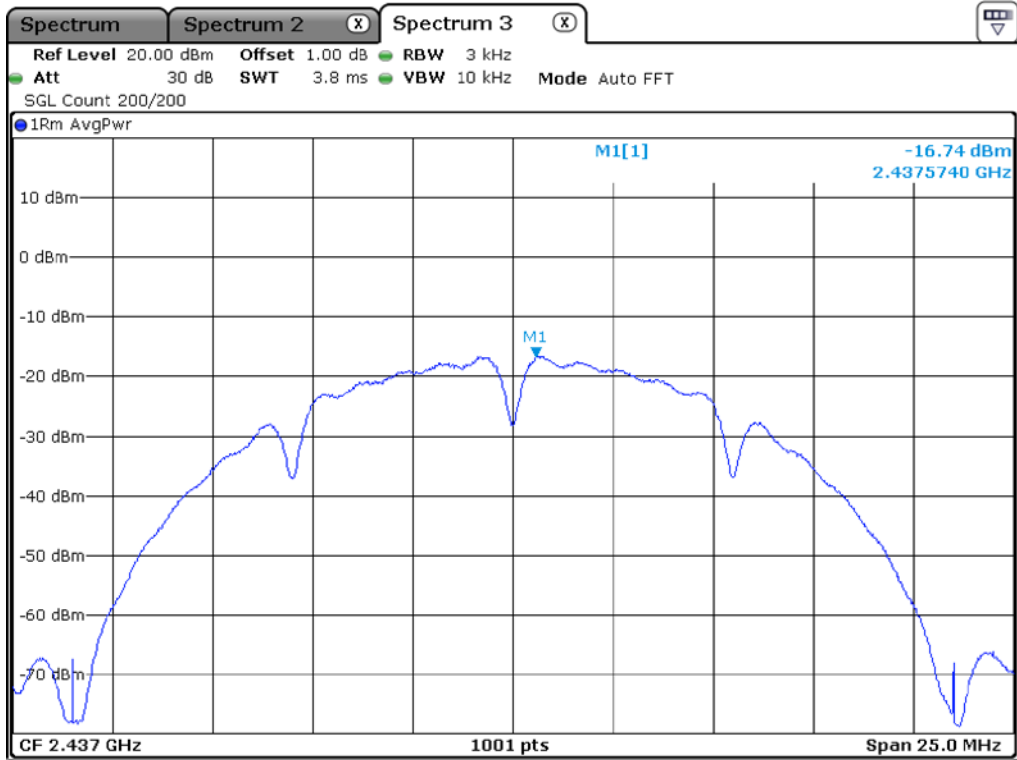
- Test Result : Pass

- Operating Condition : Continuous transmitting mode

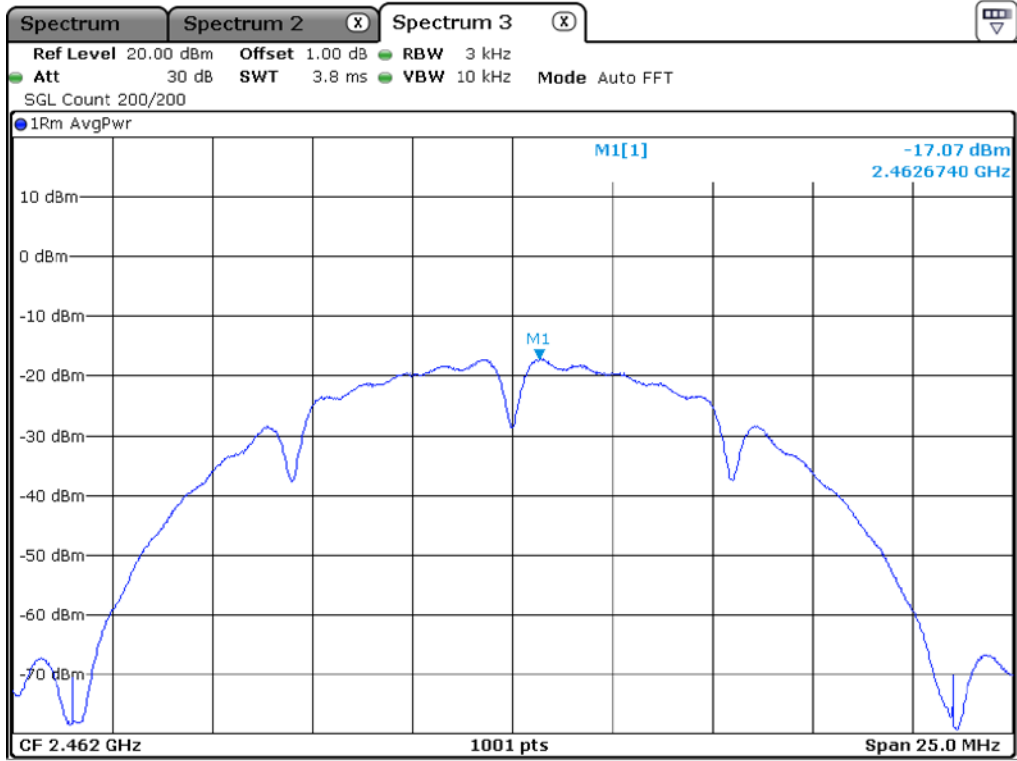
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-17.26	8.00	25.26
Middle	2 437.00	-16.74	8.00	24.74
High 11	2 462.00	-17.07	8.00	25.07
High 12	2 467.00	-19.14	8.00	27.14
High 13	2 472.00	-21.05	8.00	29.05

Remark. Margin = Limit – Measured value

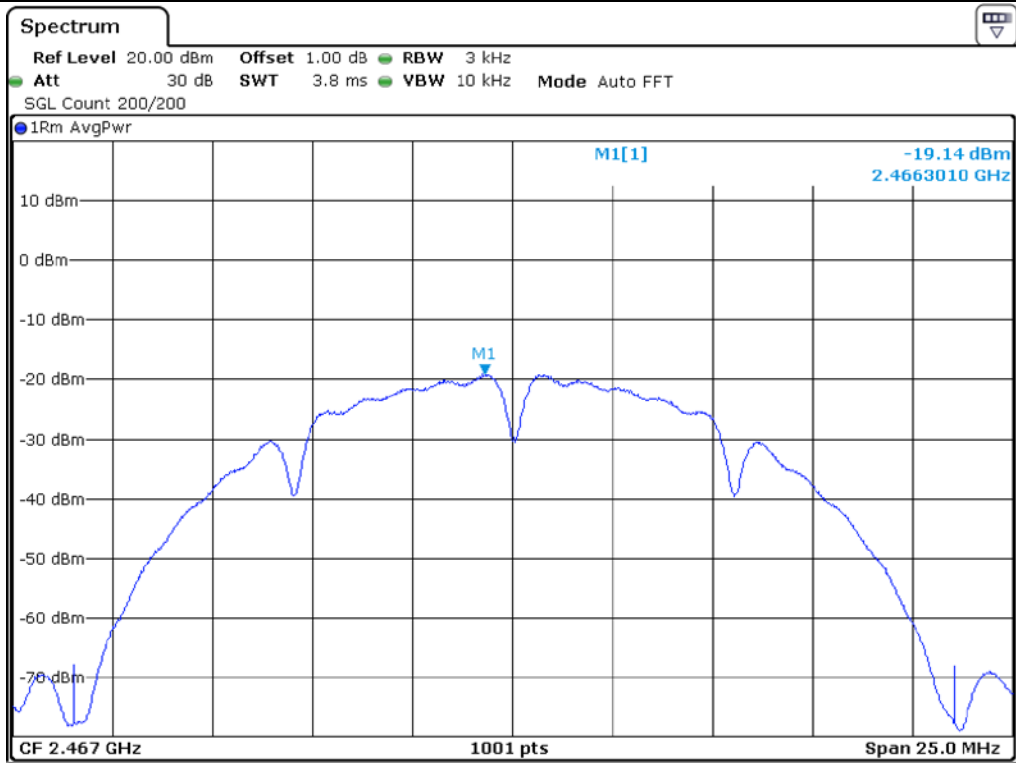




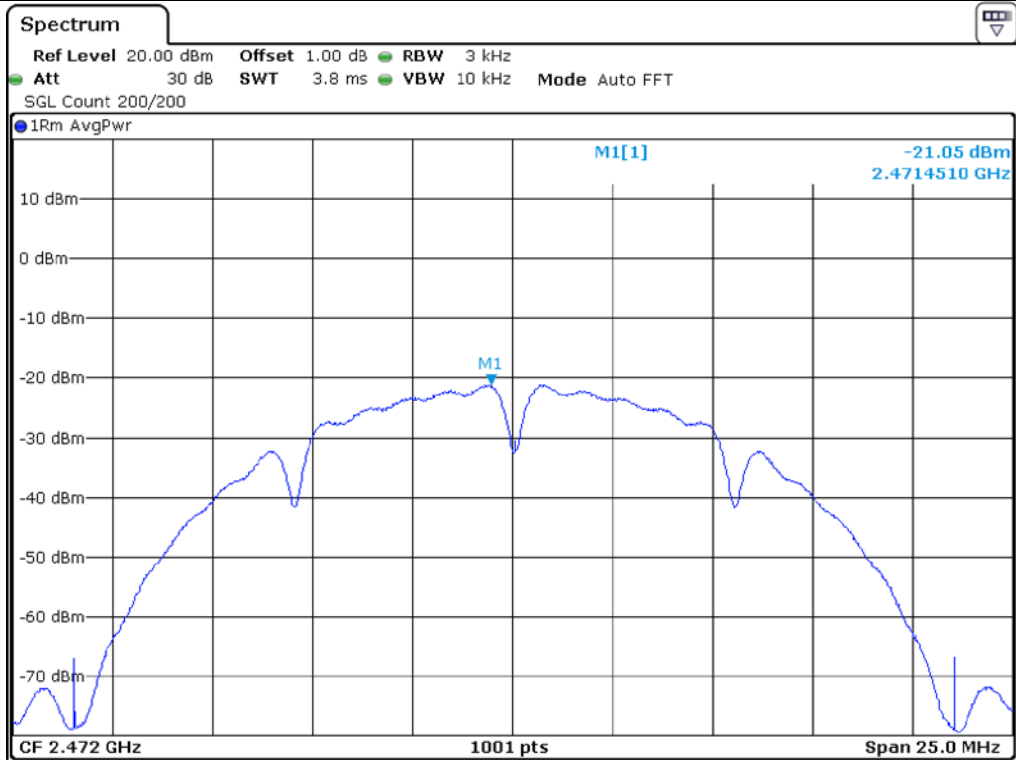
Middle Channel



High Channel 11



High Channel 12



High Channel 13

### 10.5 Test data for 802.11g WLAN Mode

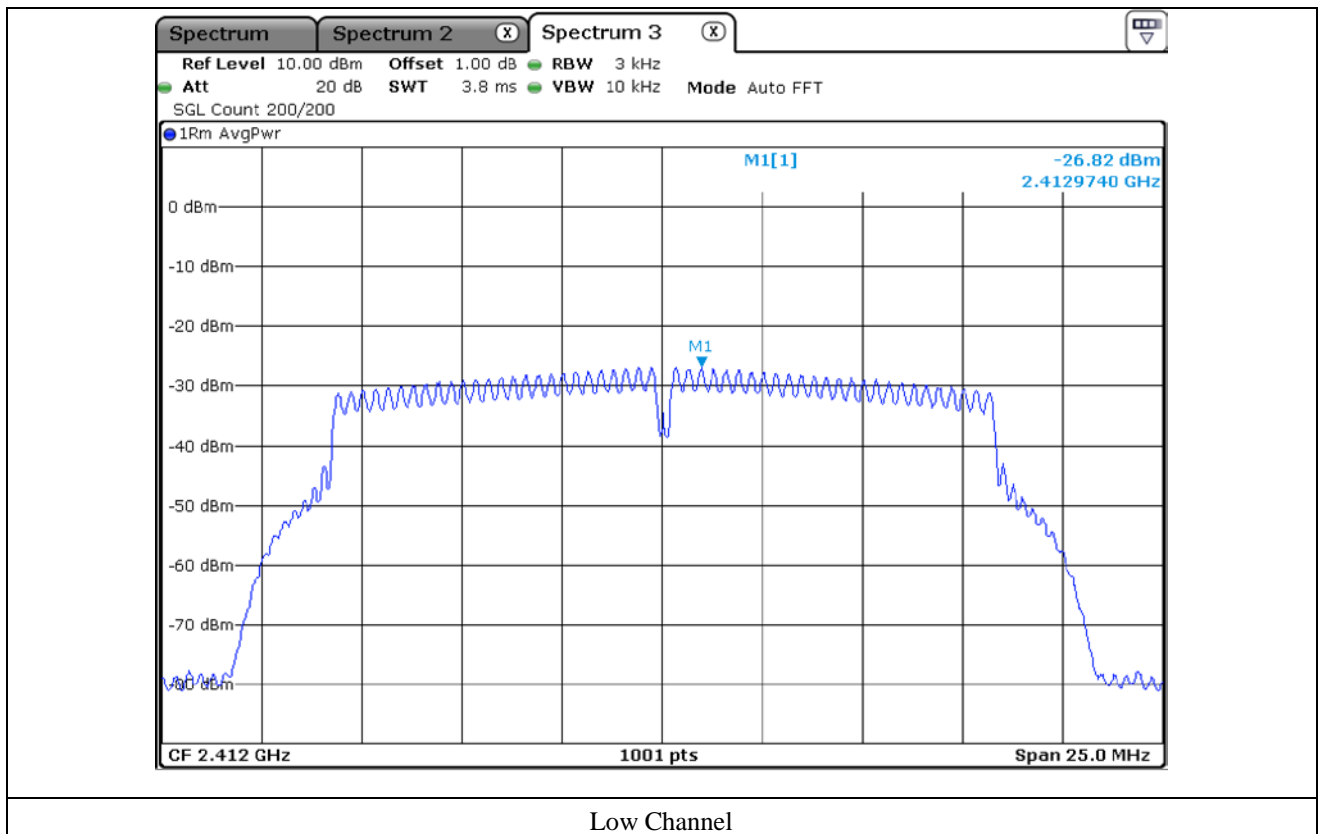
#### 10.5.1 Test data for Antenna 0

-. Test Result : Pass

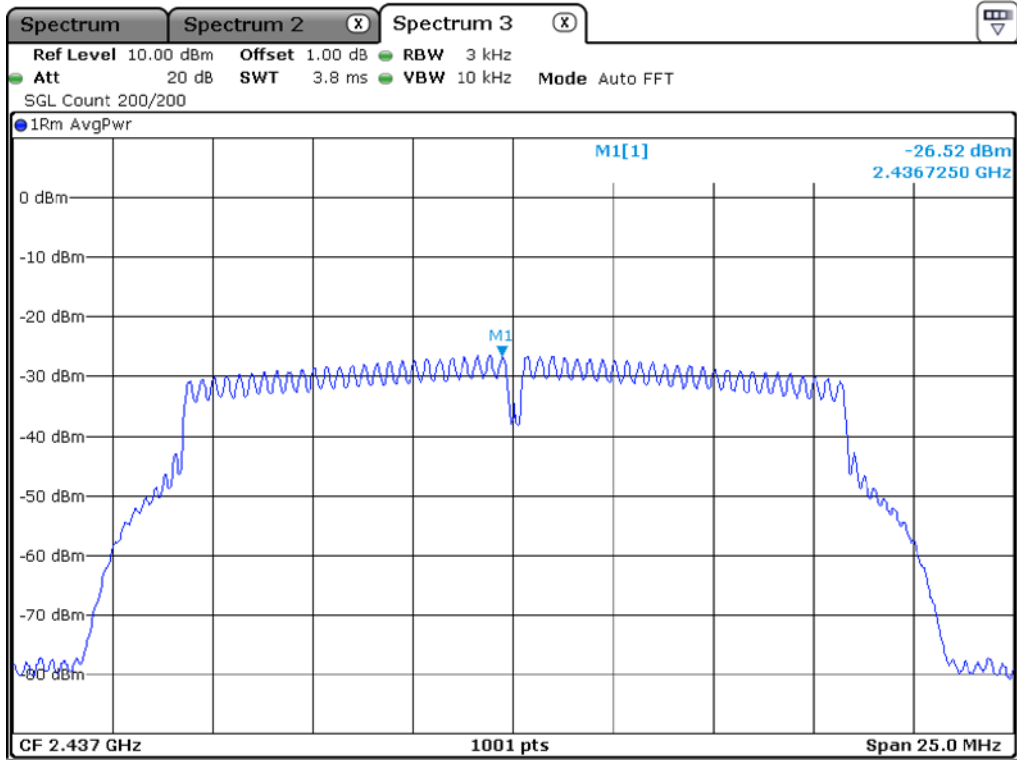
-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-26.82	8.00	34.82
Middle	2 437.00	-26.52	8.00	34.52
High 11	2 462.00	-26.80	8.00	34.80
High 12	2 467.00	-32.09	8.00	40.09
High 13	2 472.00	-34.09	8.00	42.09

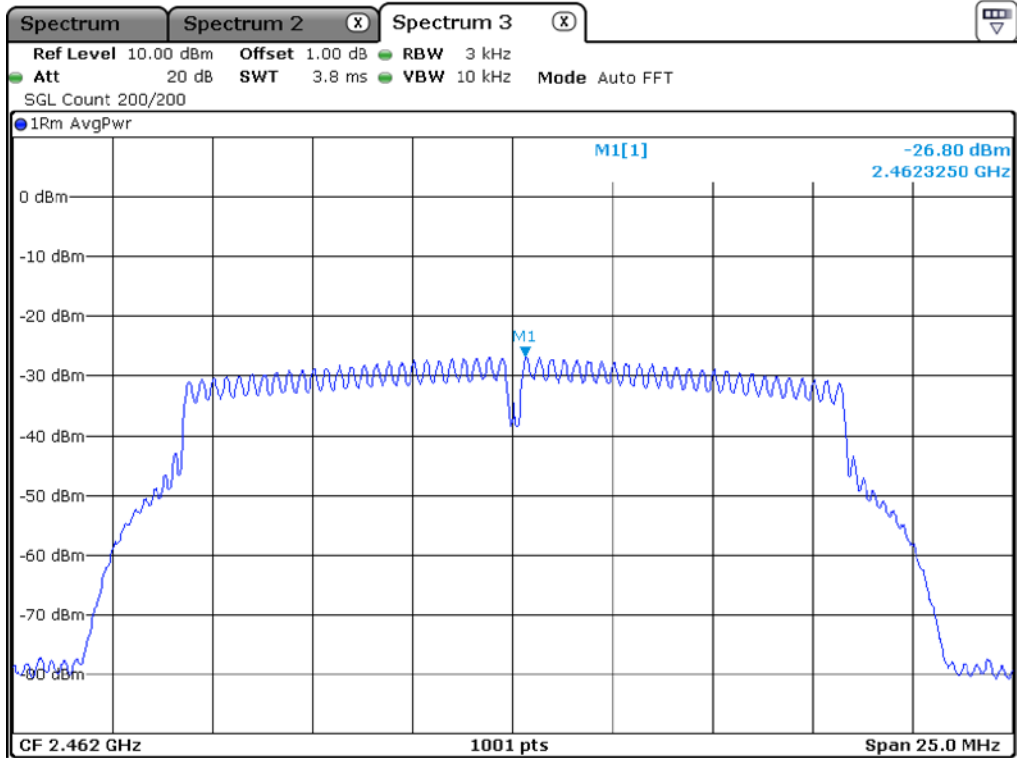
Remark. Margin = Limit – Measured value



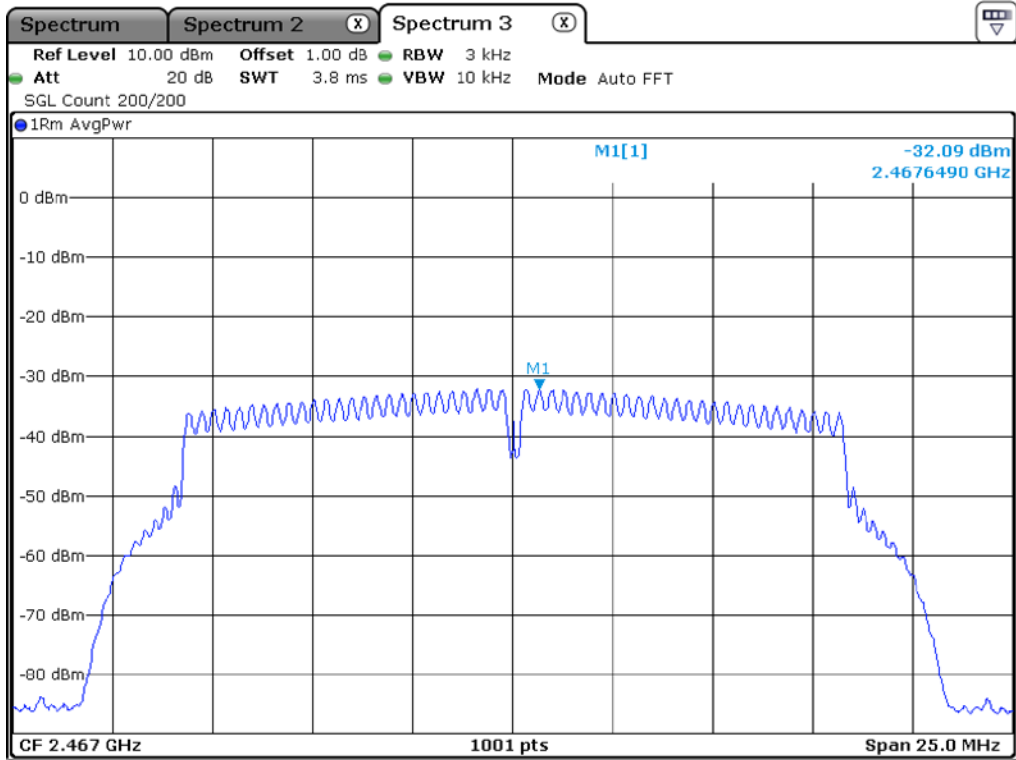




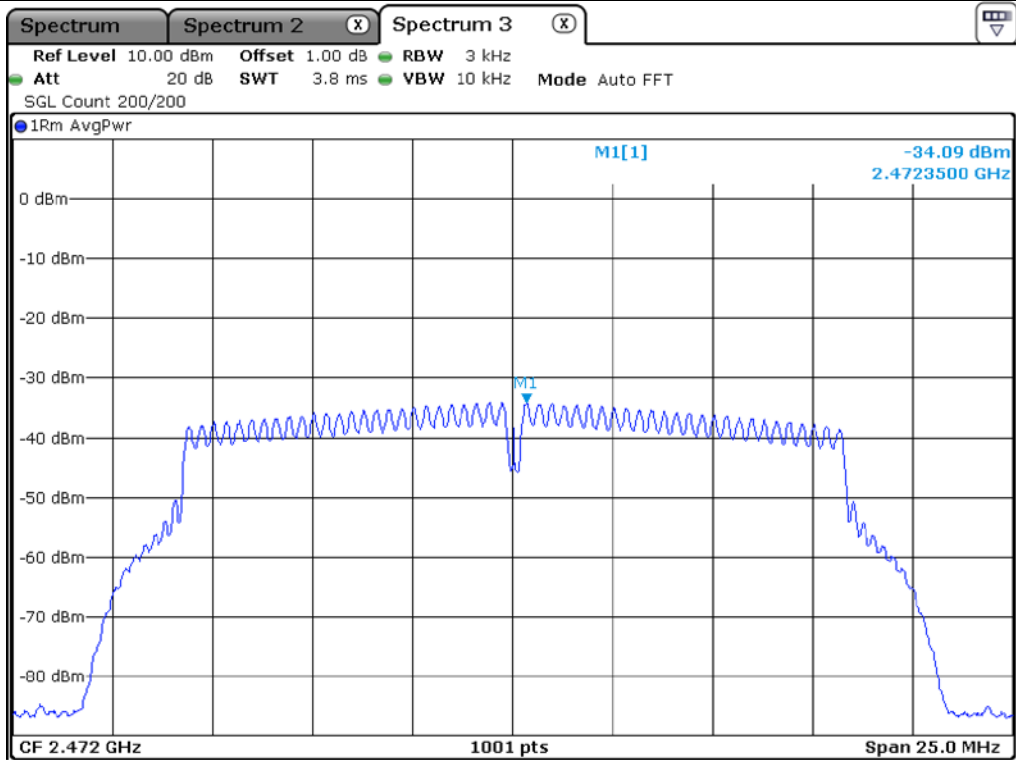
Middle Channel



High Channel 11



High Channel 12



High Channel 13

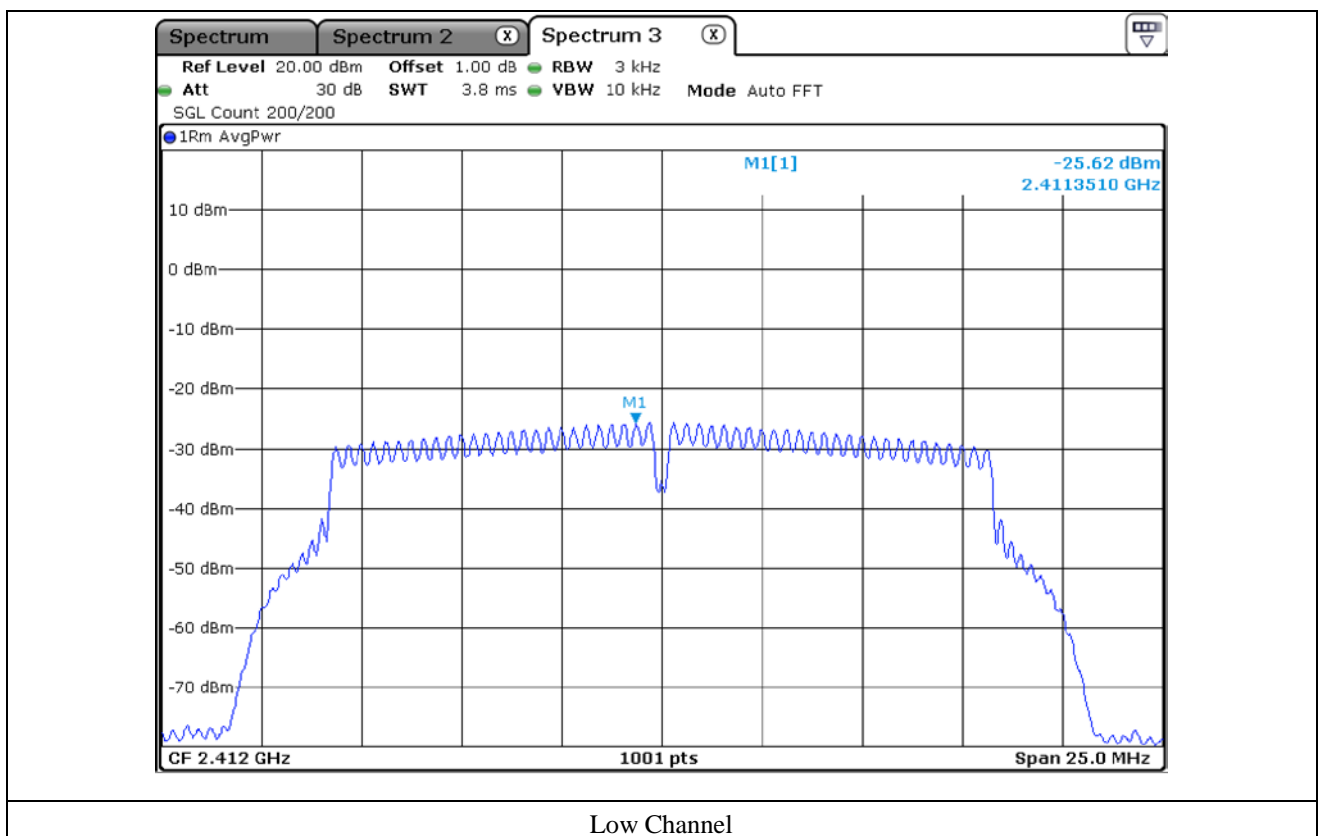
### 10.5.2 Test data for Antenna 1

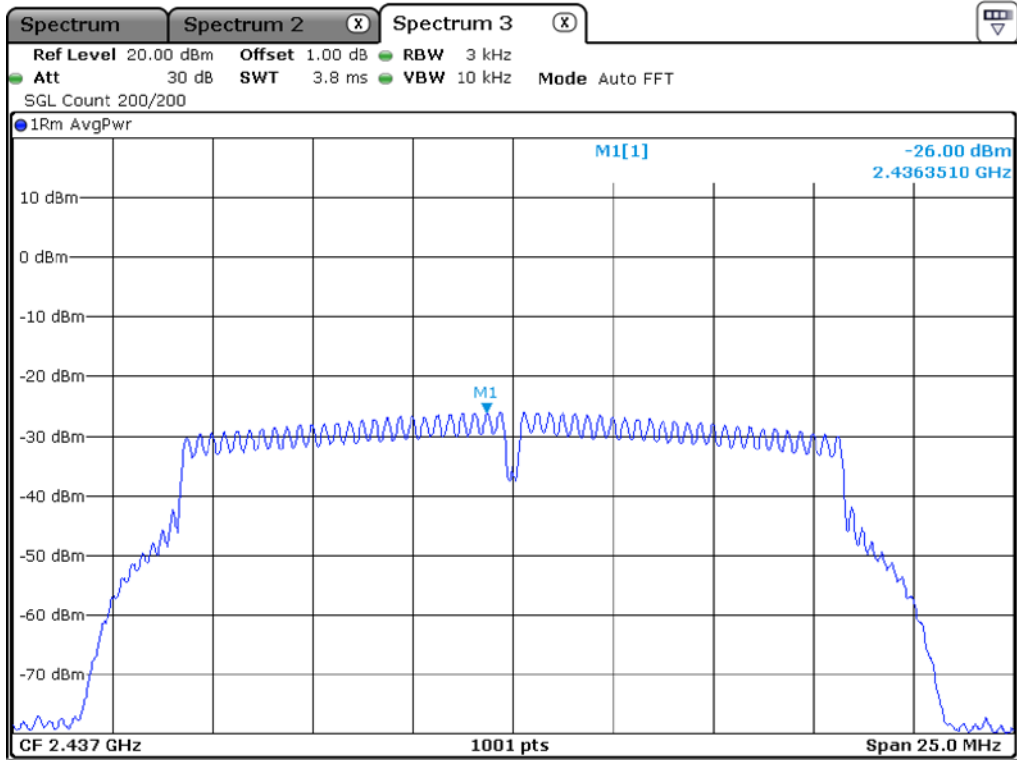
- Test Result : Pass

- Operating Condition : Continuous transmitting mode

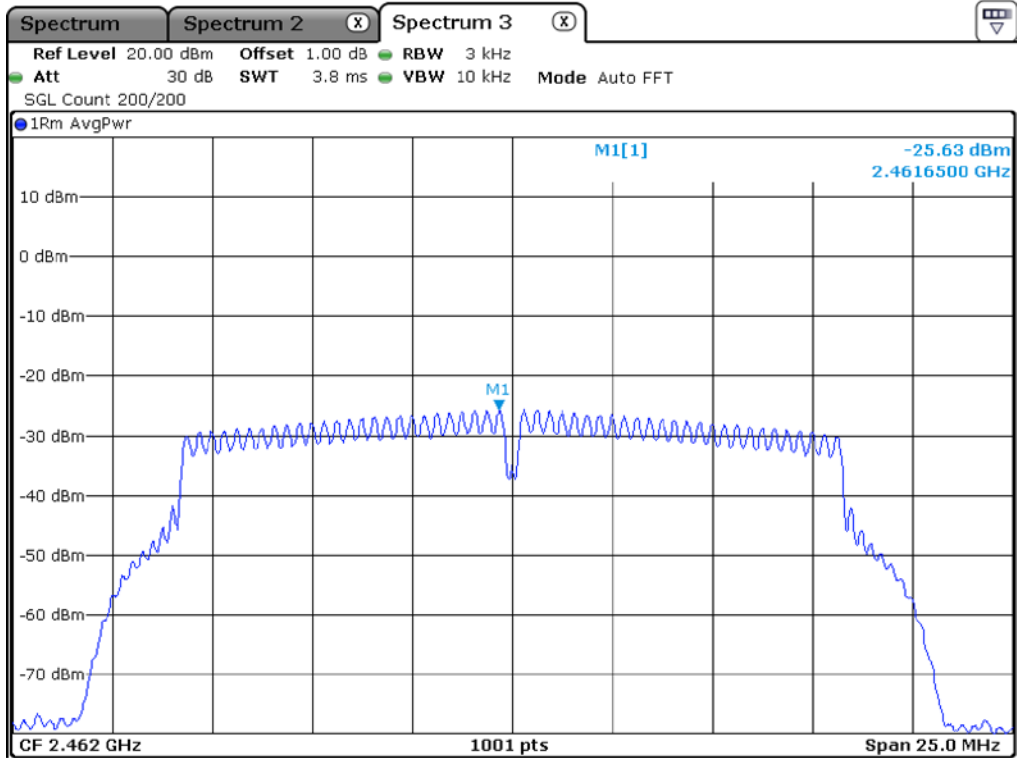
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-25.62	8.00	33.62
Middle	2 437.00	-26.00	8.00	34.00
High 11	2 462.00	-25.63	8.00	33.63
High 12	2 467.00	-31.03	8.00	39.03
High 13	2 472.00	-33.12	8.00	41.12

Remark. Margin = Limit – Measured value

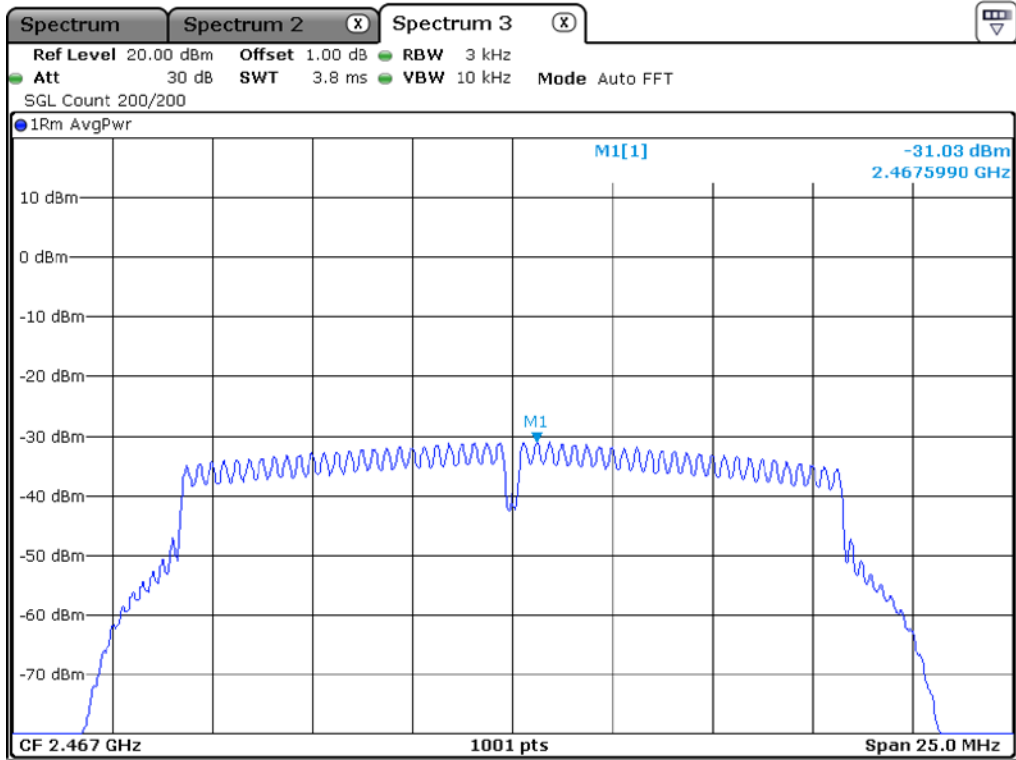




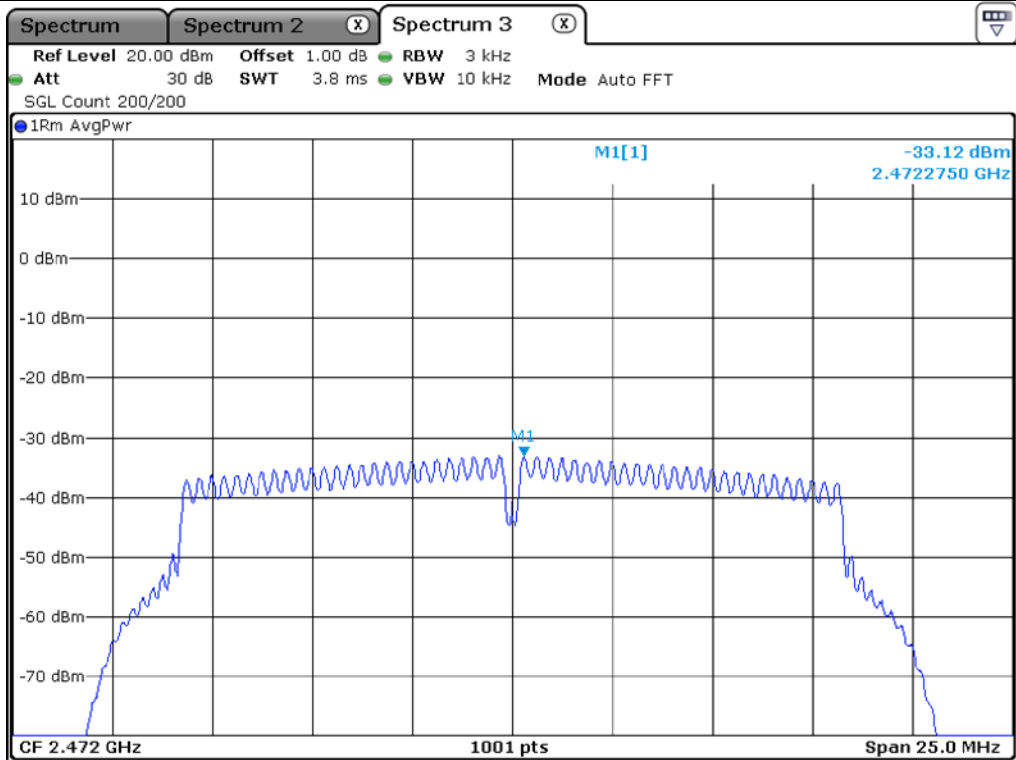
Middle Channel



High Channel 11



High Channel 12



High Channel 13

### 10.5.3 Test data for Multiple Transmit

-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-23.17	8.00	31.17
Middle	2 437.00	-23.24	8.00	31.24
High 11	2 462.00	-23.17	8.00	31.17
High 12	2 467.00	-28.52	8.00	36.52
High 13	2 472.00	-30.57	8.00	38.57

Remark 1 : Margin = Limit – Measured value

Remark 2 : Calculated Power Density =  $10\log(10^{(\text{Antenna 0 Power Density}/10)} + 10^{(\text{Antenna 1 Power Density}/10)})$

Remark 3 : Directional gain =  $10*\log[(10^{G0/20} + 10^{G1/20})^2/N]$  dBi

10.6 Test data for 802.11n\_HT20 WLAN Mode

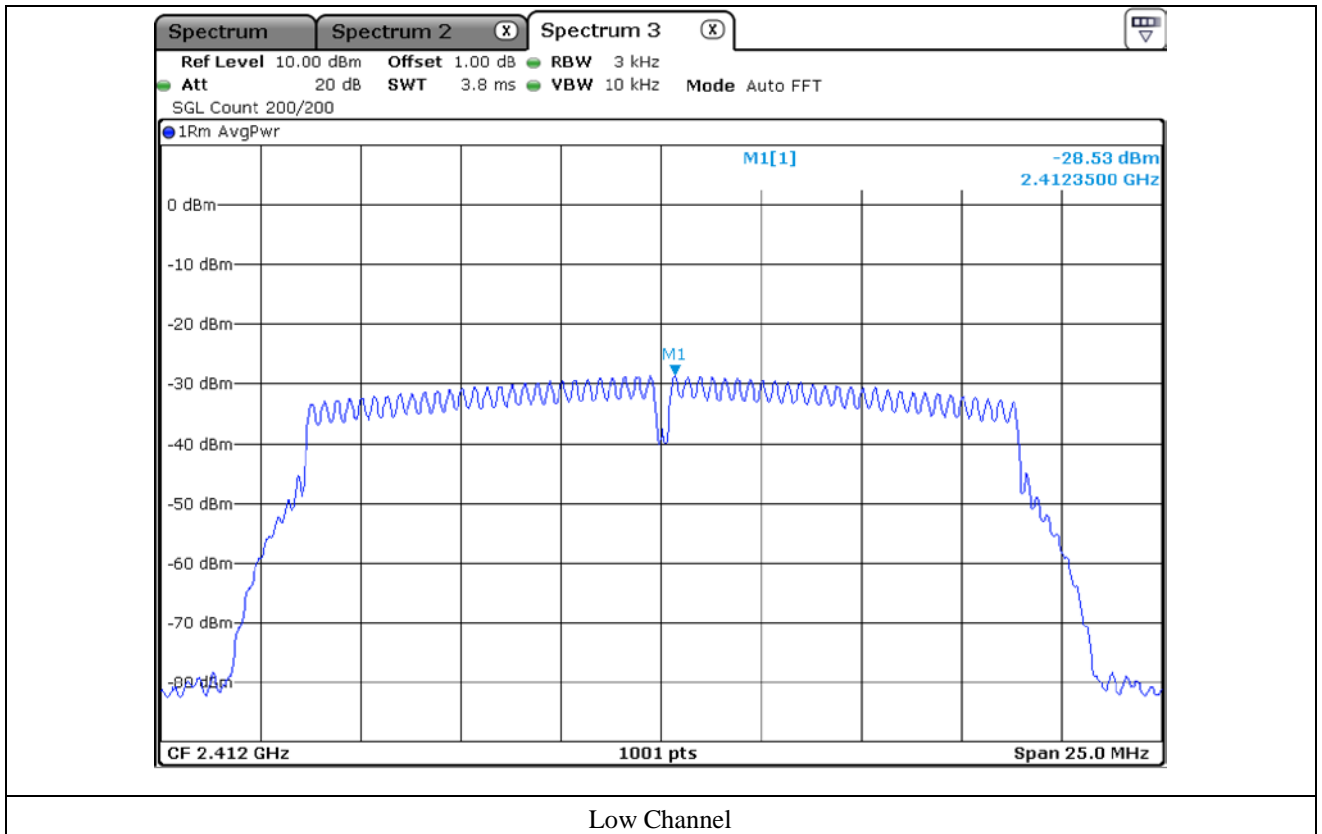
10.6.1 Test data for Antenna 0

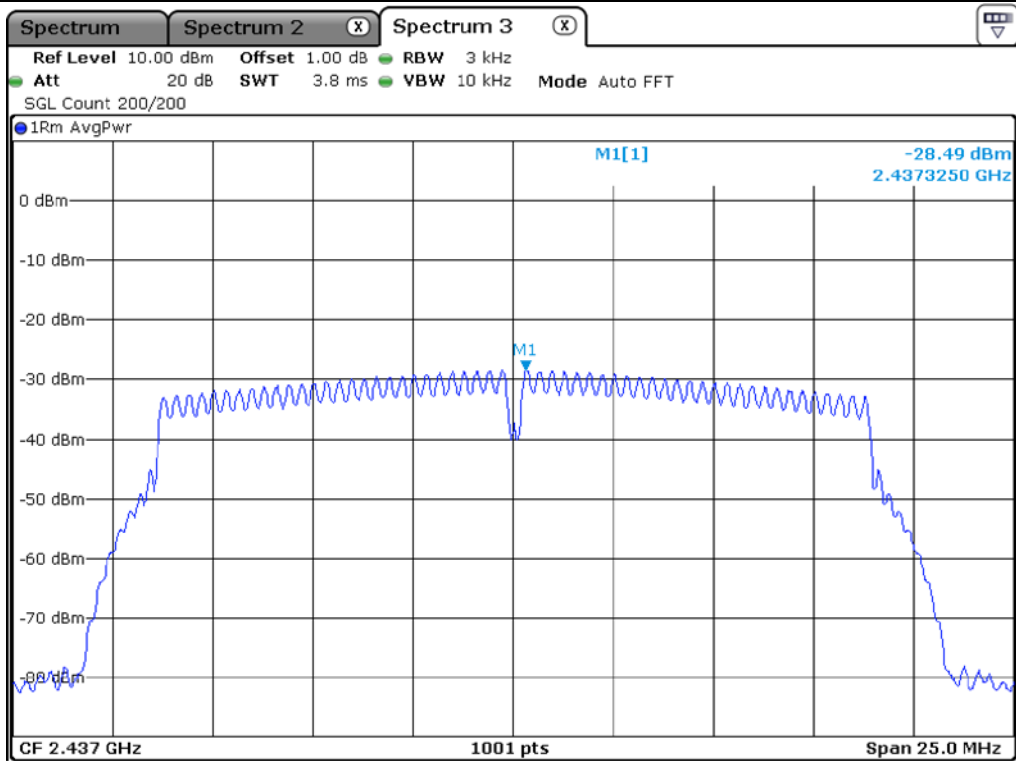
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

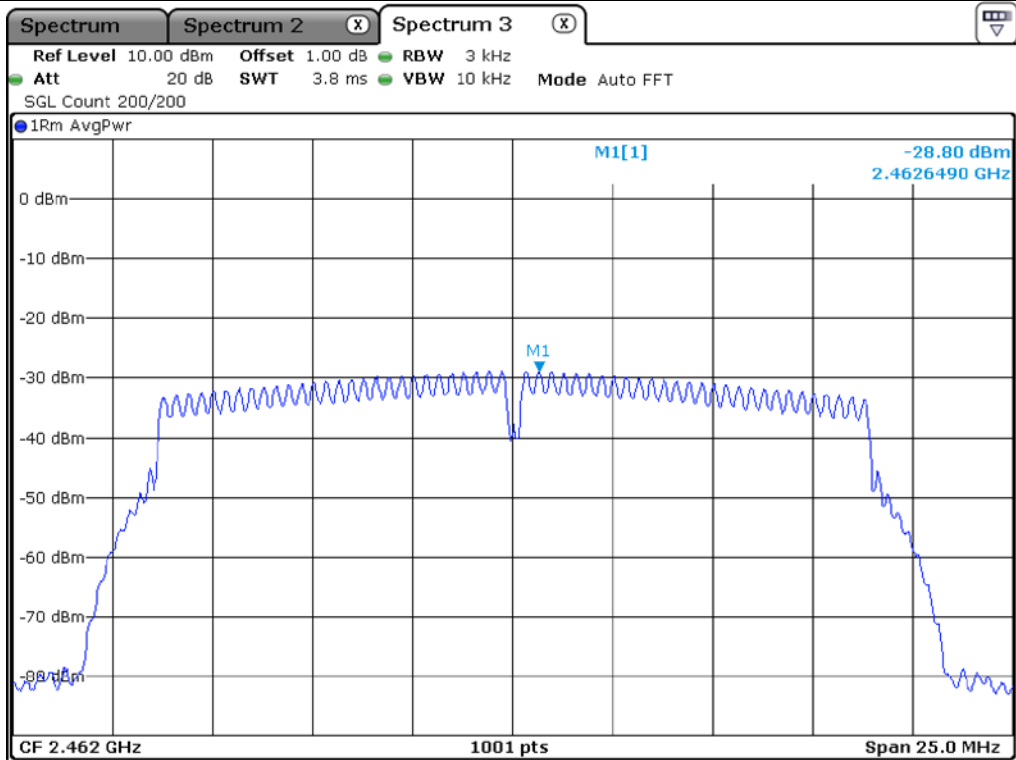
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-28.53	8.00	36.53
Middle	2 437.00	-28.49	8.00	36.49
High 11	2 462.00	-28.80	8.00	36.80
High 12	2 467.00	-31.93	8.00	39.93
High 13	2 472.00	-32.97	8.00	40.97

Remark. Margin = Limit – Measured value



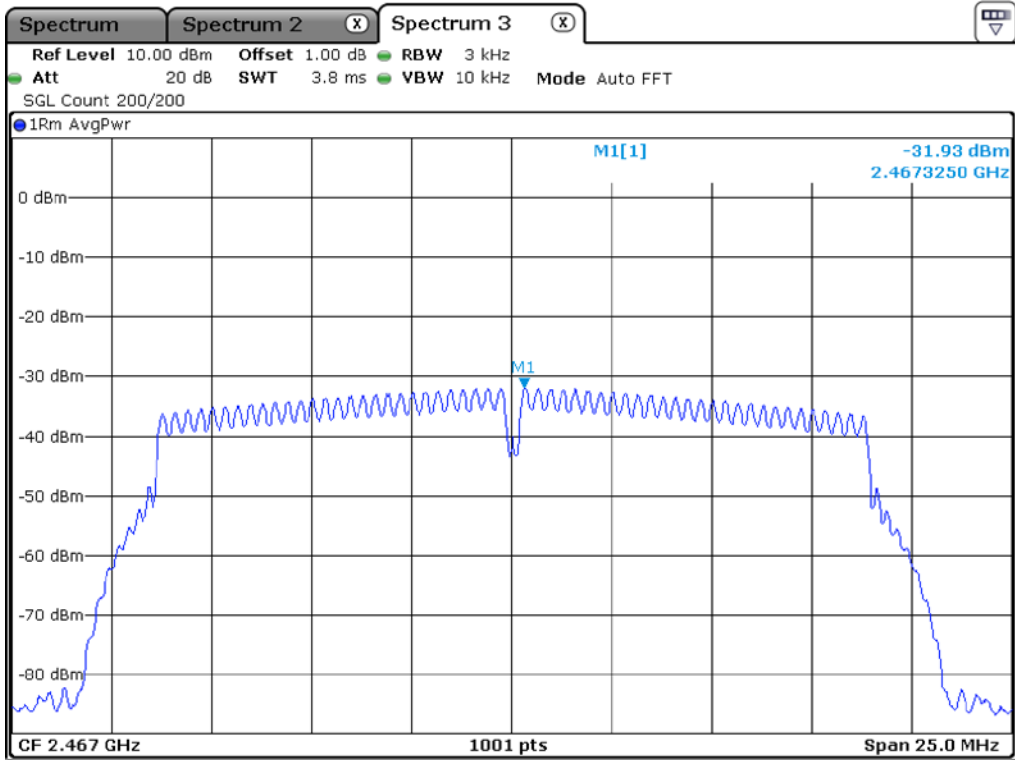


Middle Channel

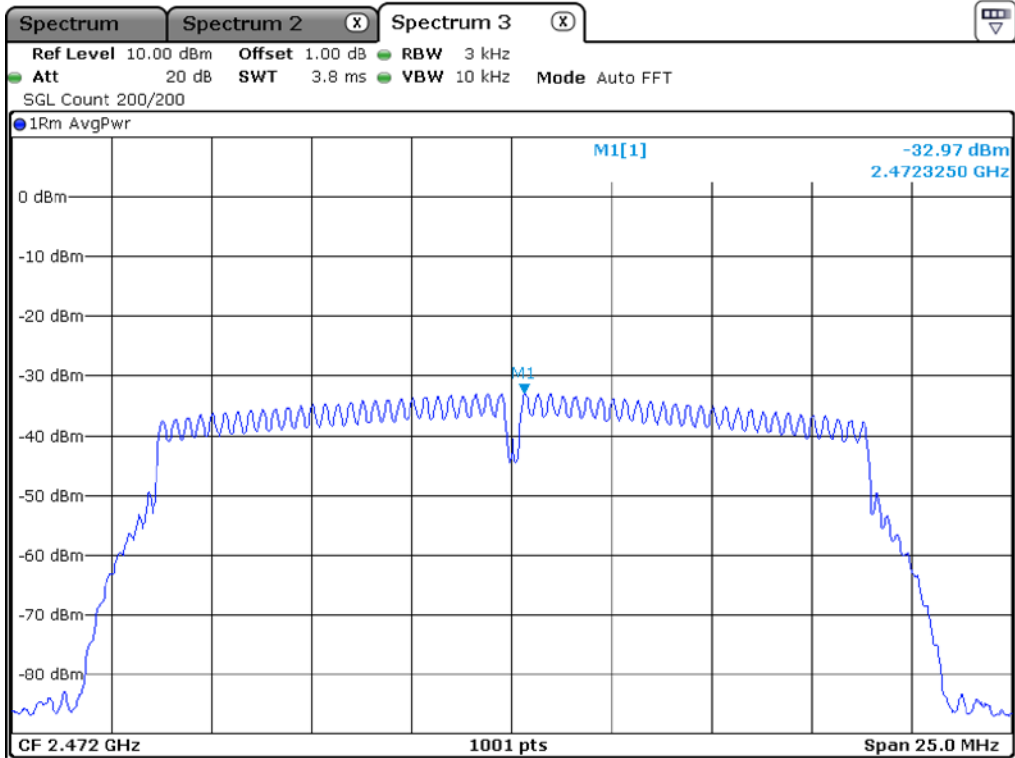


High Channel 11





High Channel 12



High Channel 13

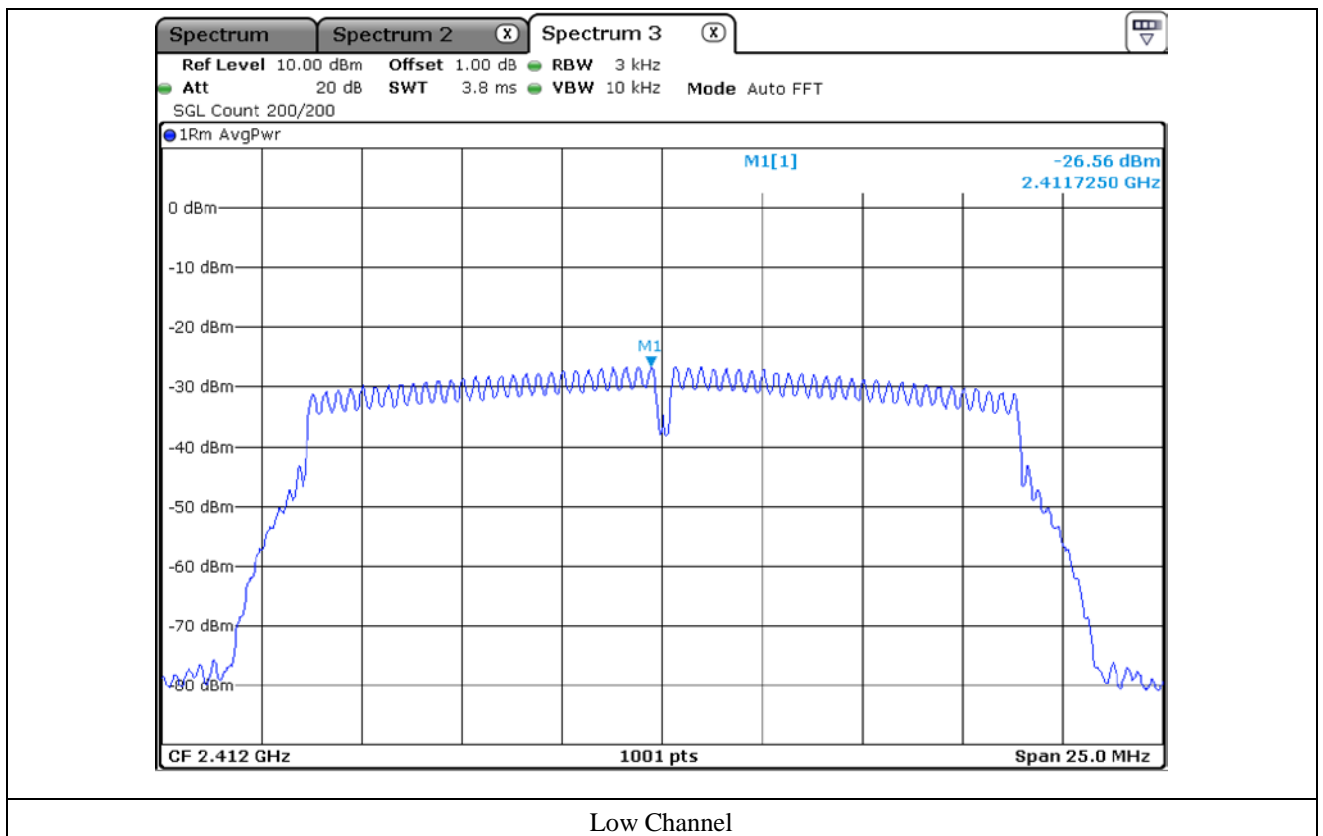
**10.6.2 Test data for Antenna 1**

- Test Result : Pass

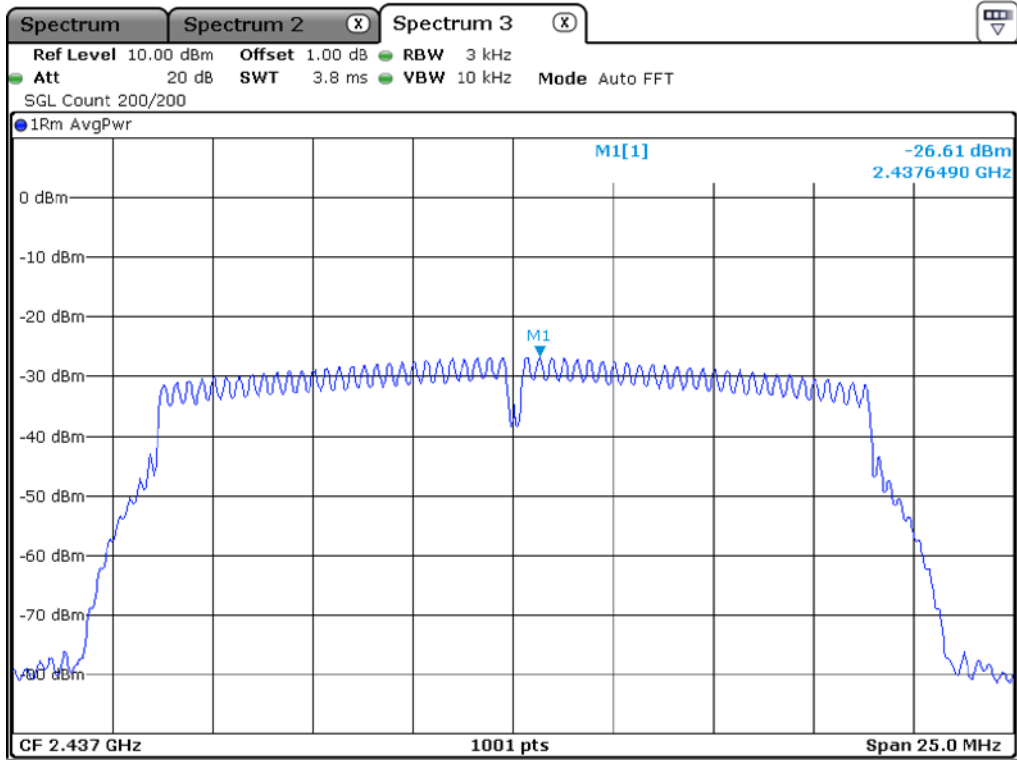
- Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-26.56	8.00	34.56
Middle	2 437.00	-26.61	8.00	34.61
High 11	2 462.00	-27.11	8.00	35.11
High 12	2 467.00	-30.62	8.00	38.62
High 13	2 472.00	-31.64	8.00	39.64

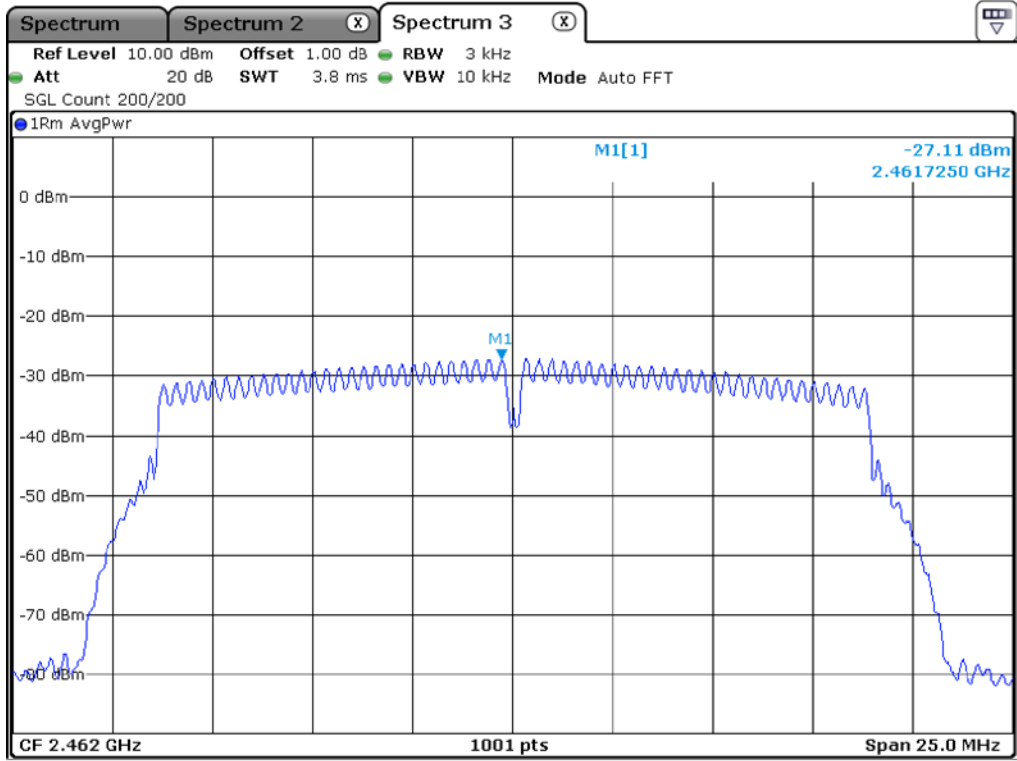
Remark. Margin = Limit – Measured value



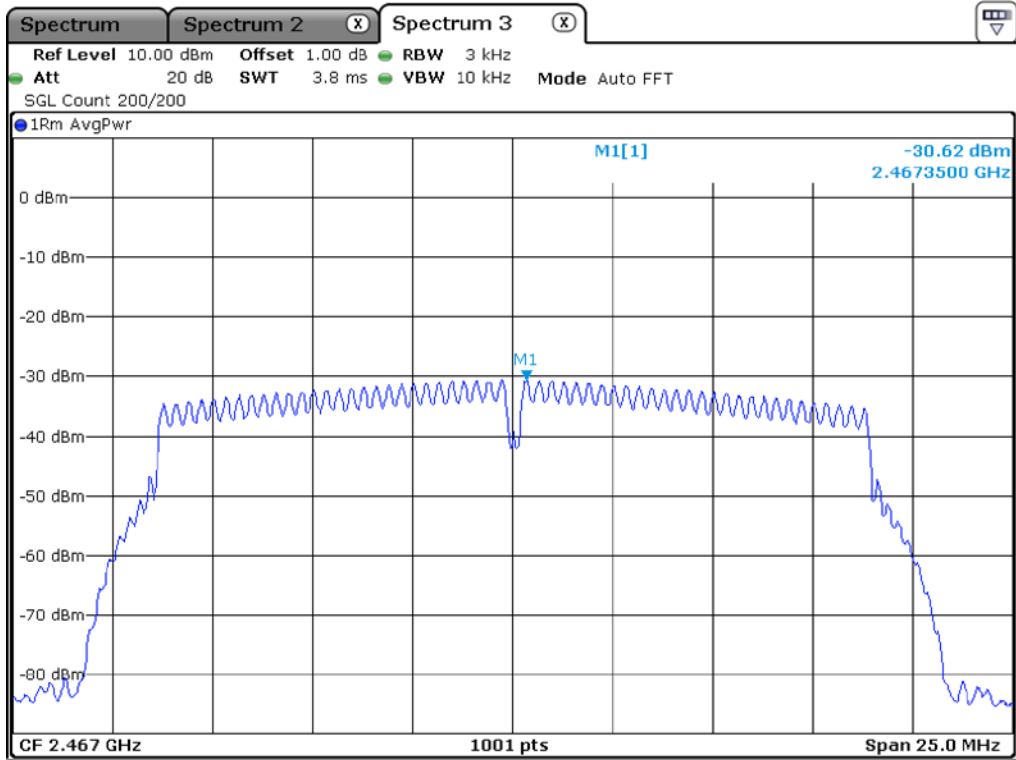
Low Channel



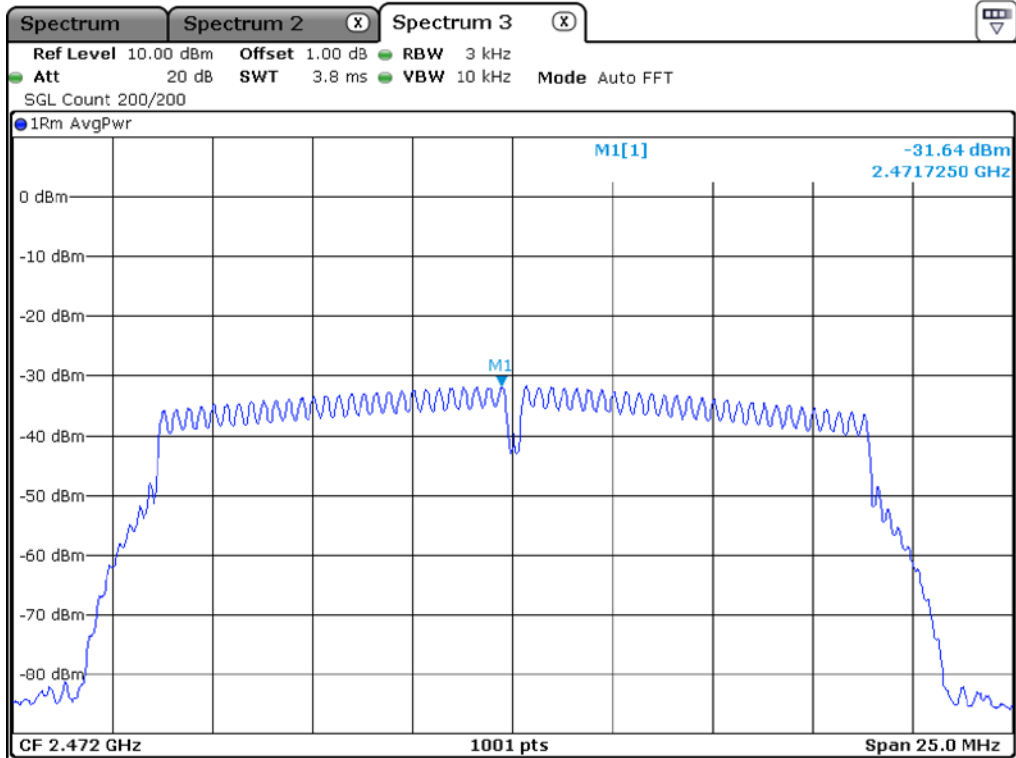
Middle Channel



High Channel 11



High Channel 12



High Channel 13

### 10.6.3 Test data for Multiple Transmit

-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-24.42	8.00	32.42
Middle	2 437.00	-24.44	8.00	32.44
High 11	2 462.00	-24.86	8.00	32.86
High 12	2 467.00	-28.22	8.00	36.22
High 13	2 472.00	-29.24	8.00	37.24

Remark 1 : Margin = Limit – Measured value

Remark 2 : Calculated Power Density =  $10\log(10^{(\text{Antenna 0 Power Density}/10)} + 10^{(\text{Antenna 1 Power Density}/10)})$

Remark 3 : Directional gain =  $10*\log[(10^{G0/20} + 10^{G1/20})^2/N]$  dBi

10.7 Test data for 802.11n\_HT40 WLAN Mode

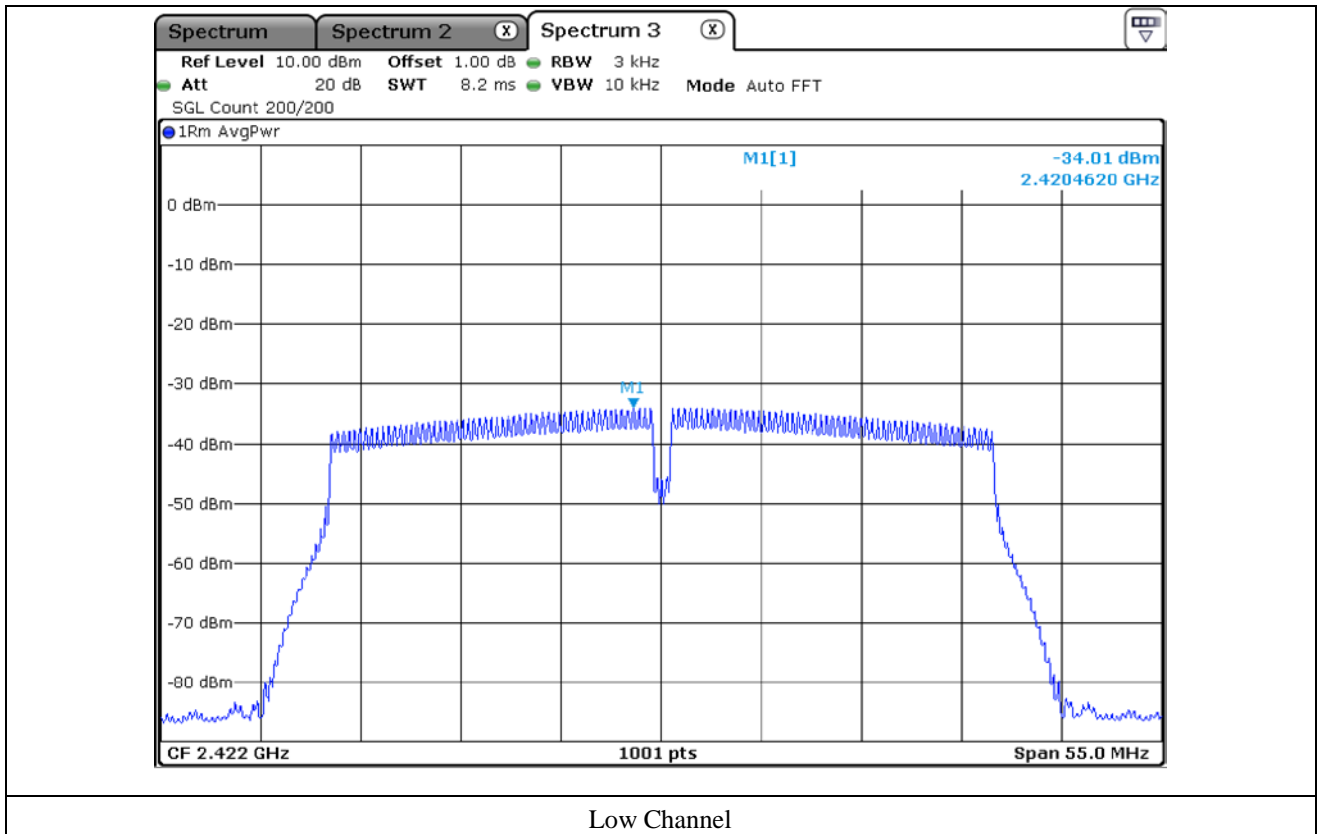
10.7.1 Test data for Antenna 0

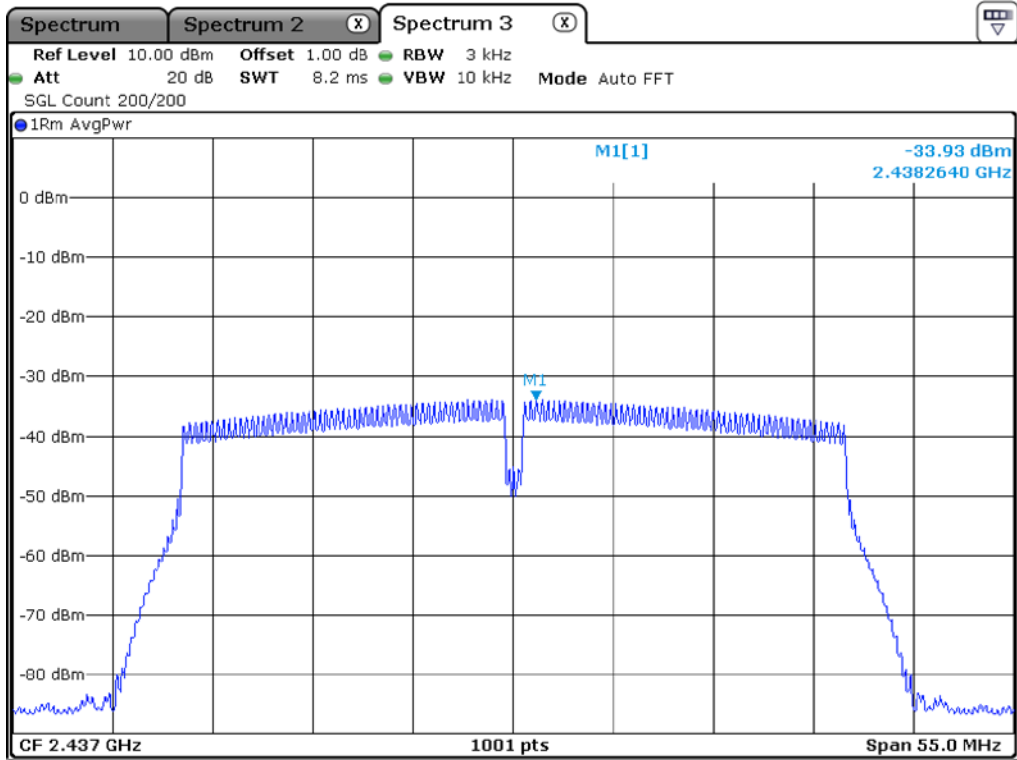
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

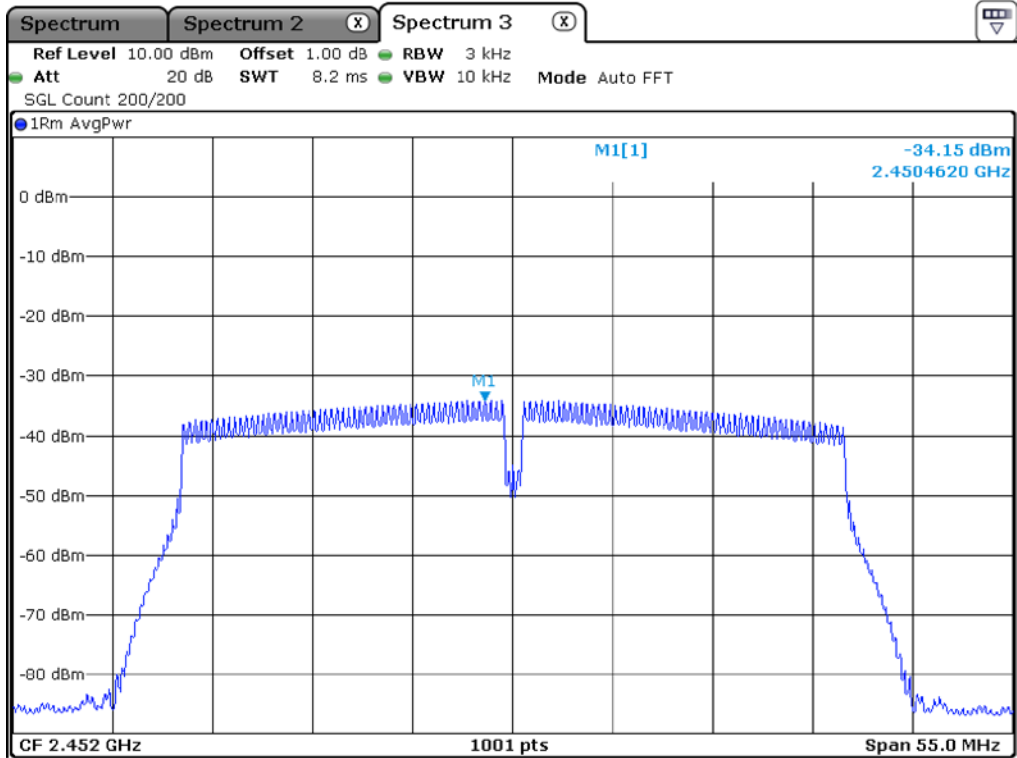
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-34.01	8.00	42.01
Middle	2 437.00	-33.93	8.00	41.93
High 9	2 452.00	-34.15	8.00	42.15
High 10	2 457.00	-35.43	8.00	43.43
High 11	2 462.00	-35.52	8.00	43.52

Remark. Margin = Limit – Measured value

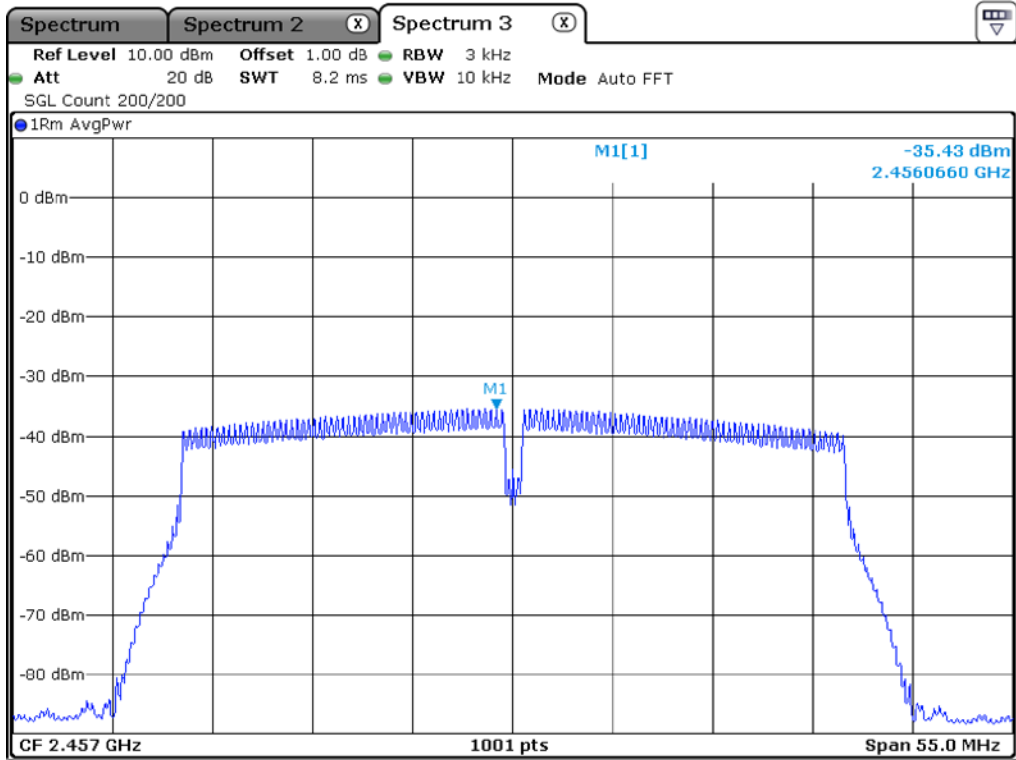




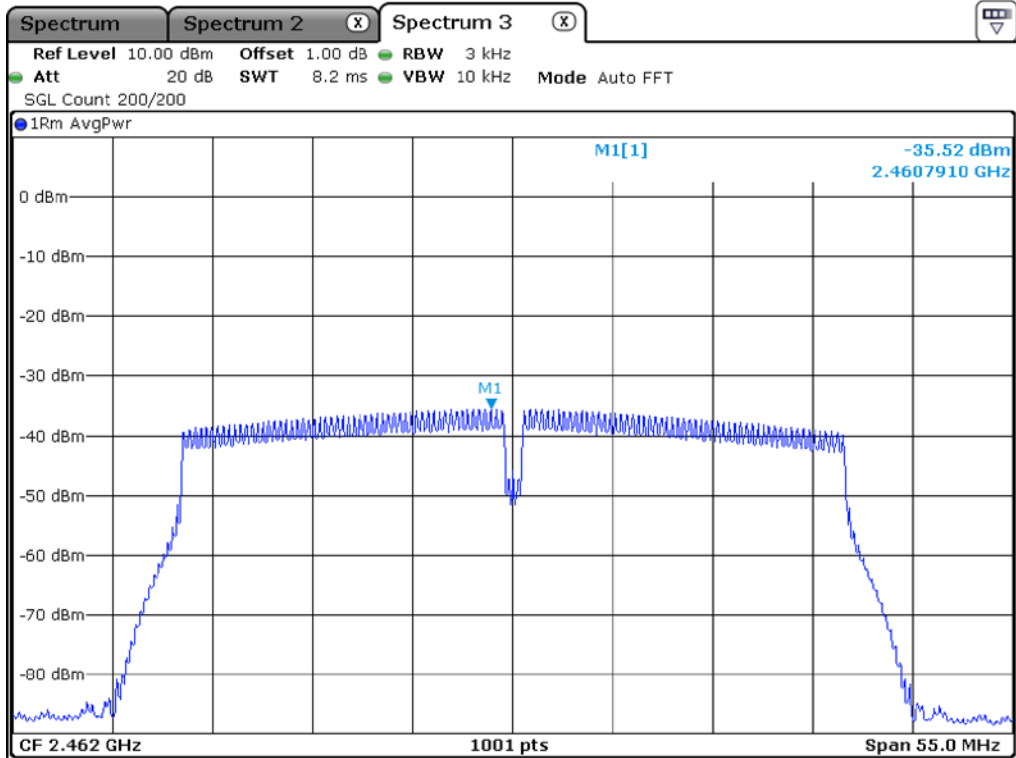
Middle Channel



High Channel 9



High Channel 10



High Channel 11



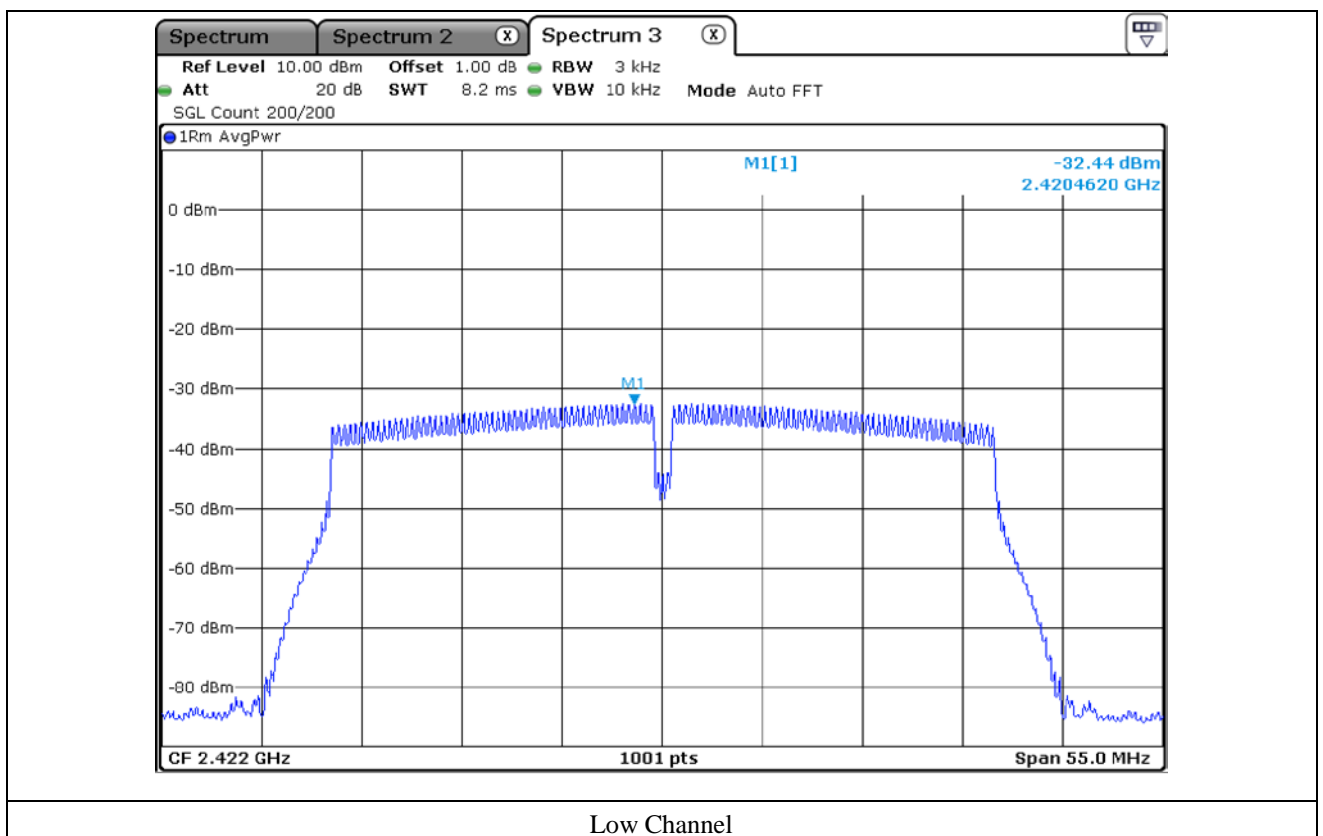
**10.7.2 Test data for Antenna 1**

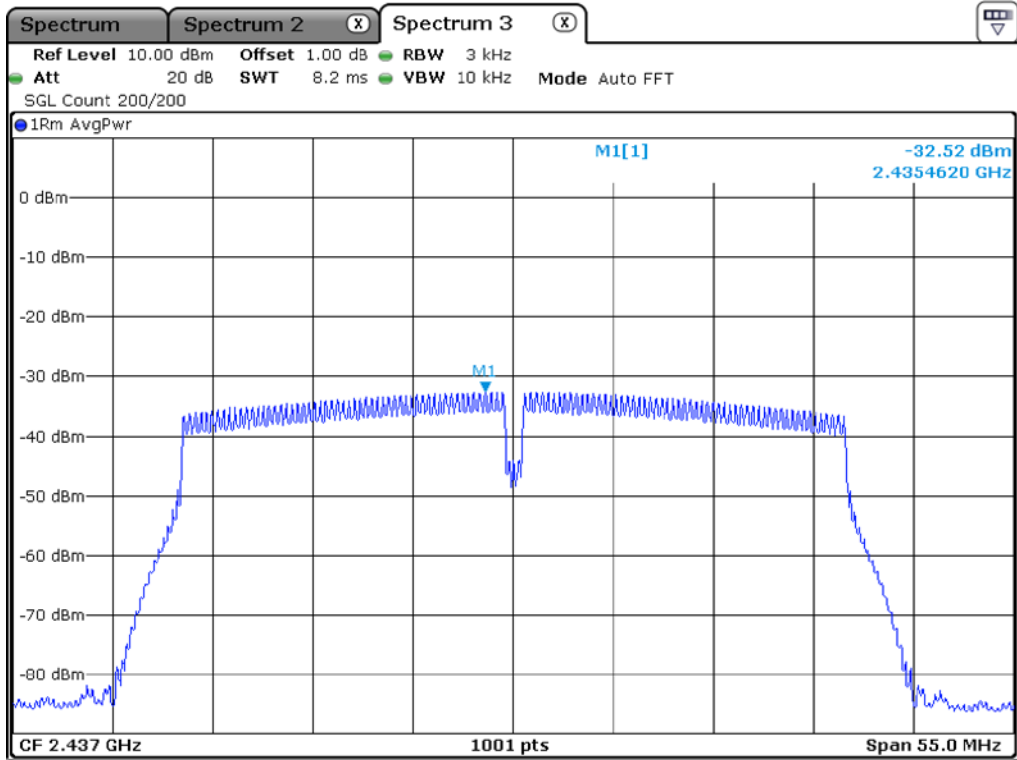
- Test Result : Pass

- Operating Condition : Continuous transmitting mode

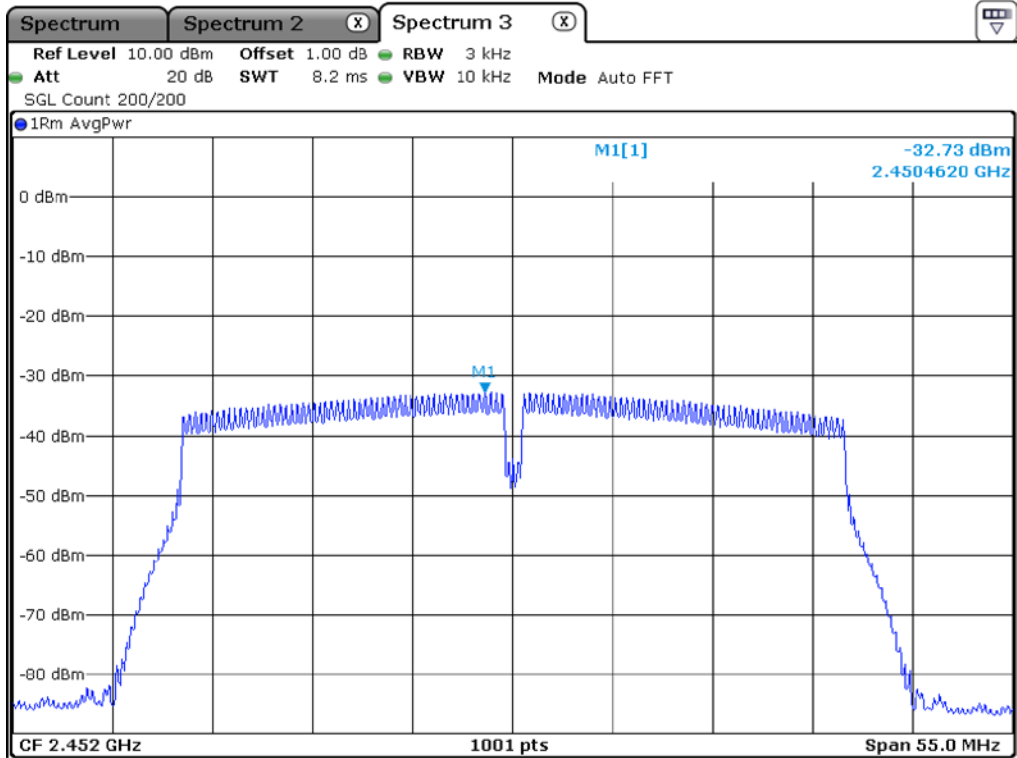
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-32.44	8.00	40.44
Middle	2 437.00	-32.52	8.00	40.52
High 9	2 452.00	-32.73	8.00	40.73
High 10	2 457.00	-34.02	8.00	42.02
High 11	2 462.00	-33.89	8.00	41.89

Remark. Margin = Limit – Measured value

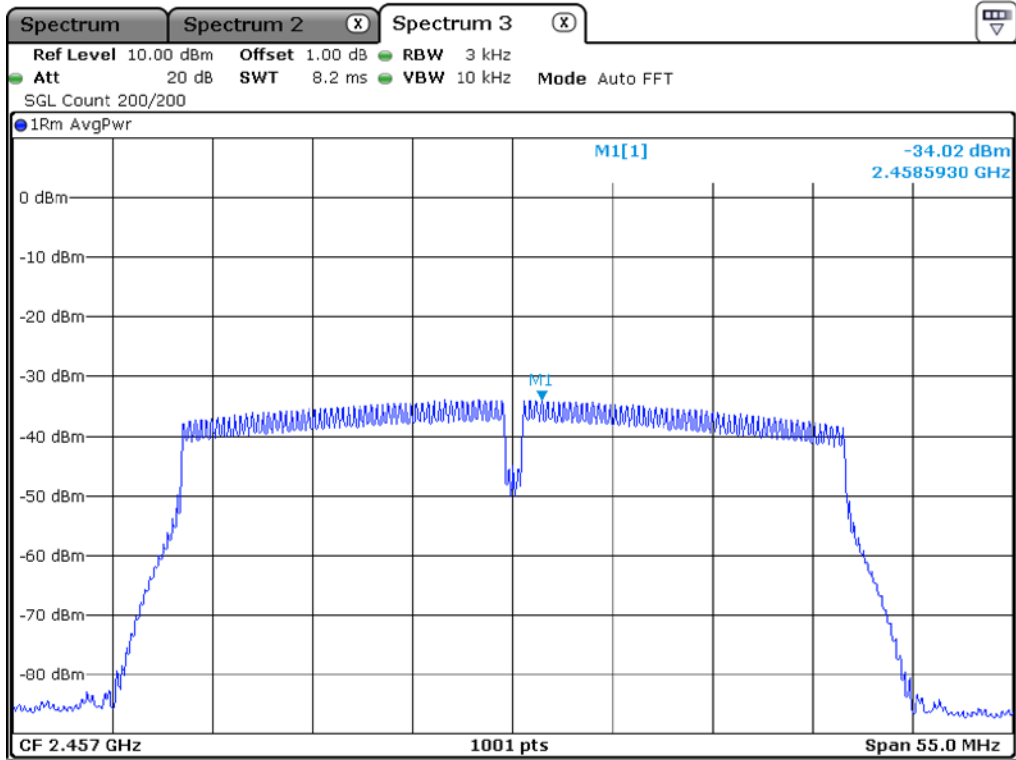




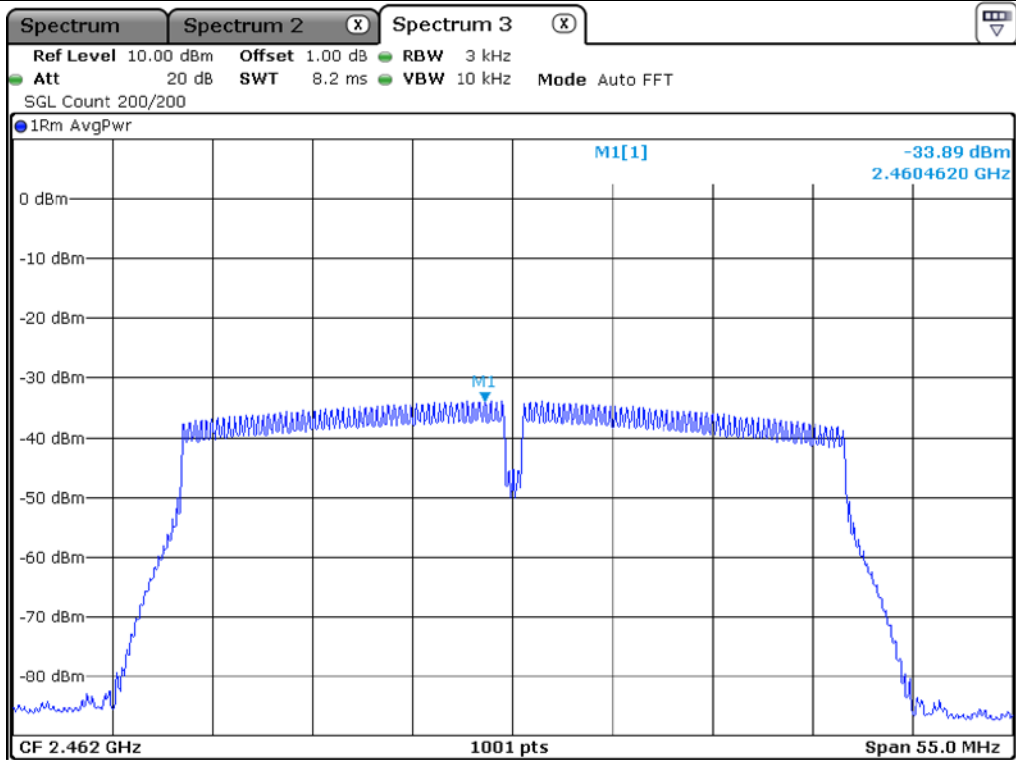
Middle Channel



High Channel 9



High Channel 10



High Channel 11

### 10.7.3 Test data for Multiple Transmit

-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-30.14	8.00	38.14
Middle	2 437.00	-30.16	8.00	38.16
High 9	2 452.00	-30.37	8.00	38.37
High 10	2 457.00	-31.66	8.00	39.66
High 11	2 462.00	-31.62	8.00	39.62

Remark 1 : Margin = Limit – Measured value

Remark 2 : Calculated Power Density =  $10\log(10^{(\text{Antenna 0 Power Density}/10)} + 10^{(\text{Antenna 1 Power Density}/10)})$

Remark 3 : Directional gain =  $10*\log[(10^{G0/20} + 10^{G1/20})^2/N]$  dBi

## 11. RADIATED EMISSION TEST

### 11.1 Operating environment

Temperature : 23 °C  
Relative humidity : 45 % R.H.

### 11.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

### 11.3 Test Date

March 12, 2021 ~ March 22, 2021

11.4 Test data for 30 MHz ~ 1 000 MHz

11.4.1 Test data for WLAN 2.4 GHz

Humidity Level : 45 % R.H.

Temperature: 23 °C

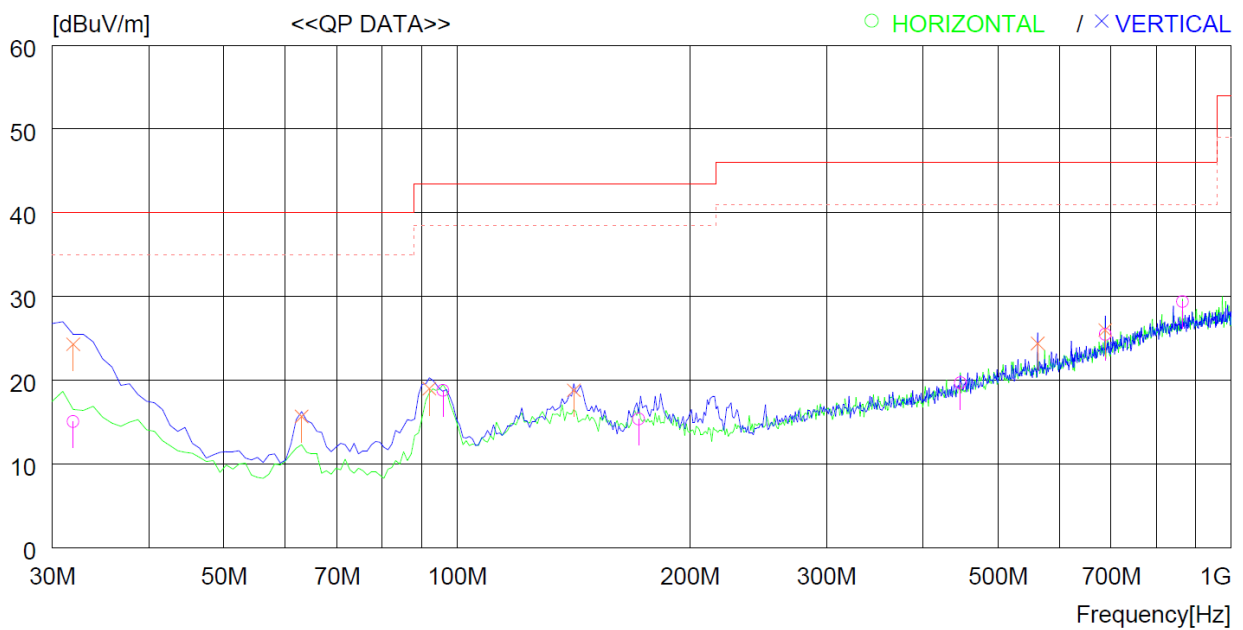
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : WI-FI Transceiver

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

-. Antenna 0, Antenna 1 and Multiple transmit tested, but the worst data were recorded.



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	31.940	26.0	20.3	0.8	32.0	15.1	40.0	24.9	300	1
2	95.960	35.0	14.6	1.2	32.0	18.8	43.5	24.7	300	359
3	171.620	28.7	17.1	1.6	32.0	15.4	43.5	28.1	200	0
4	447.101	27.6	21.8	2.5	32.2	19.7	46.0	26.3	400	167
5	687.655	29.0	25.4	3.4	32.3	25.5	46.0	20.5	300	359
6	865.160	29.4	27.4	4.4	31.8	29.4	46.0	16.6	400	328
----- Vertical -----										
7	31.940	35.2	20.3	0.8	32.0	24.3	40.0	15.7	100	53
8	62.980	34.6	12.3	0.9	32.1	15.7	40.0	24.3	100	0
9	92.080	35.9	13.9	1.2	32.0	19.0	43.5	24.5	100	136
10	141.550	30.0	19.4	1.4	32.0	18.8	43.5	24.7	100	0
11	562.529	30.1	23.8	2.9	32.4	24.4	46.0	21.6	100	0
12	687.655	29.5	25.4	3.4	32.3	26.0	46.0	20.0	300	209

**11.4.2 Test data for Intermodulation Mode(WLAN 2.4 GHz + WLAN 5 GHz)**

Humidity Level : 45 % R.H. Temperature: 23 °C

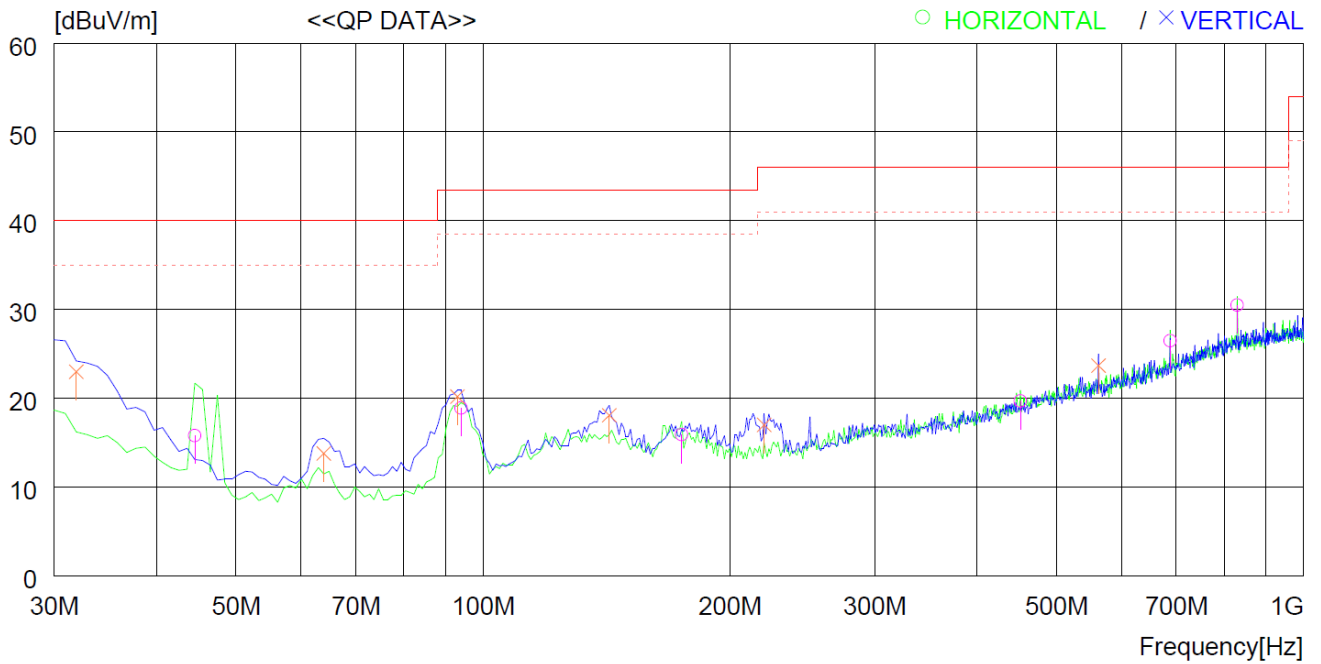
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : WI-FI Transceiver

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

-. Antenna 0, Antenna 1 and Multiple transmit tested, but the worst data were recorded.



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	44.550	31.5	15.4	0.9	32.0	15.8	40.0	24.2	100	359
2	94.020	35.5	14.2	1.2	32.0	18.9	43.5	24.6	200	0
3	174.530	29.2	17.0	1.7	32.0	15.9	43.5	27.6	200	148
4	451.951	27.5	21.9	2.5	32.2	19.7	46.0	26.3	200	0
5	687.655	30.0	25.4	3.4	32.3	26.5	46.0	19.5	300	16
6	830.241	31.1	27.2	4.1	31.9	30.5	46.0	15.5	200	132
----- Vertical -----										
7	31.940	33.9	20.3	0.8	32.0	23.0	40.0	17.0	100	3
8	63.950	32.6	12.4	0.9	32.1	13.8	40.0	26.2	100	104
9	93.050	37.0	14.0	1.2	32.0	20.2	43.5	23.3	100	0
10	142.520	29.4	19.3	1.4	32.0	18.1	43.5	25.4	100	113
11	220.120	30.6	16.5	1.9	32.0	17.0	46.0	29.0	100	104
12	562.529	29.4	23.8	2.9	32.4	23.7	46.0	22.3	100	307

**11.5 Test data for Below 30 MHz**

- Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- Frequency range : 9 kHz ~ 30 MHz
- Measurement distance : 3 m
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.									

**11.6 Test data for above 1 GHz**

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode  
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.									



## 12. CONDUCTED EMISSION TEST

### 12.1 Operating environment

Temperature : 23 °C  
Relative humidity : 45 % R.H.

### 12.2 Test set-up

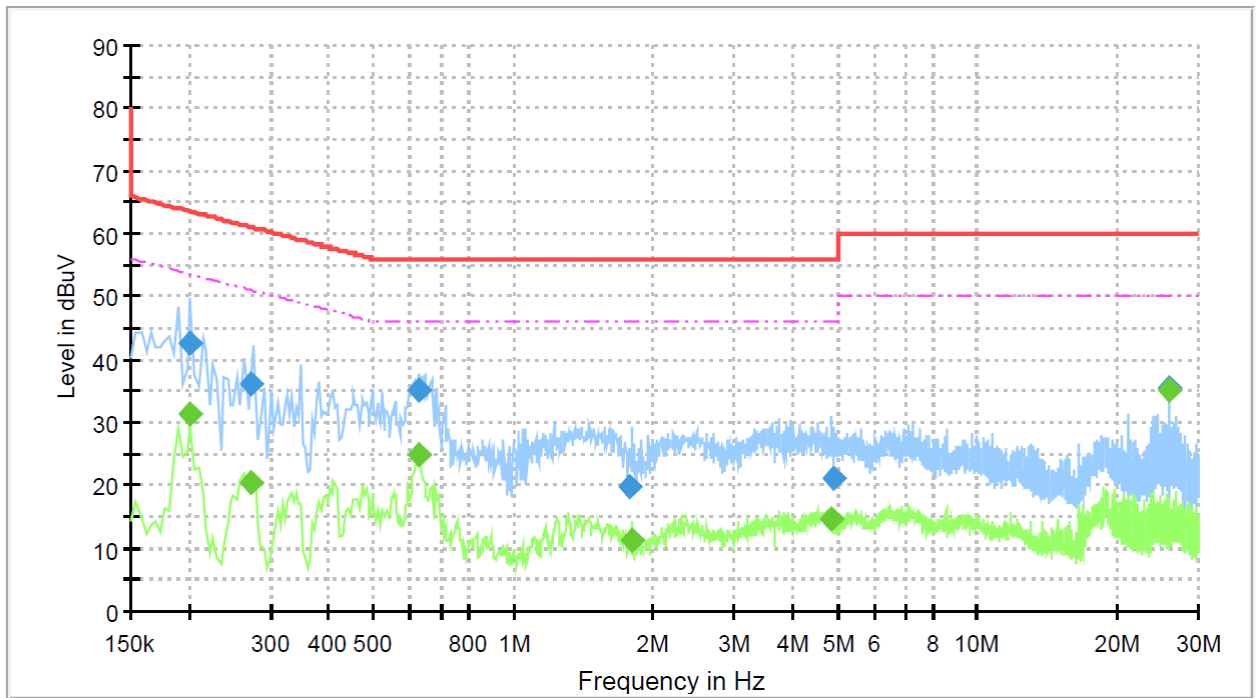
The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50  $\Omega$  / 50  $\mu$ H + 5  $\Omega$  Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

### 12.3 Test Date

March 12, 2021 ~ March 22, 2021

**12.4 Test data for WLAN 2.4 GHz**

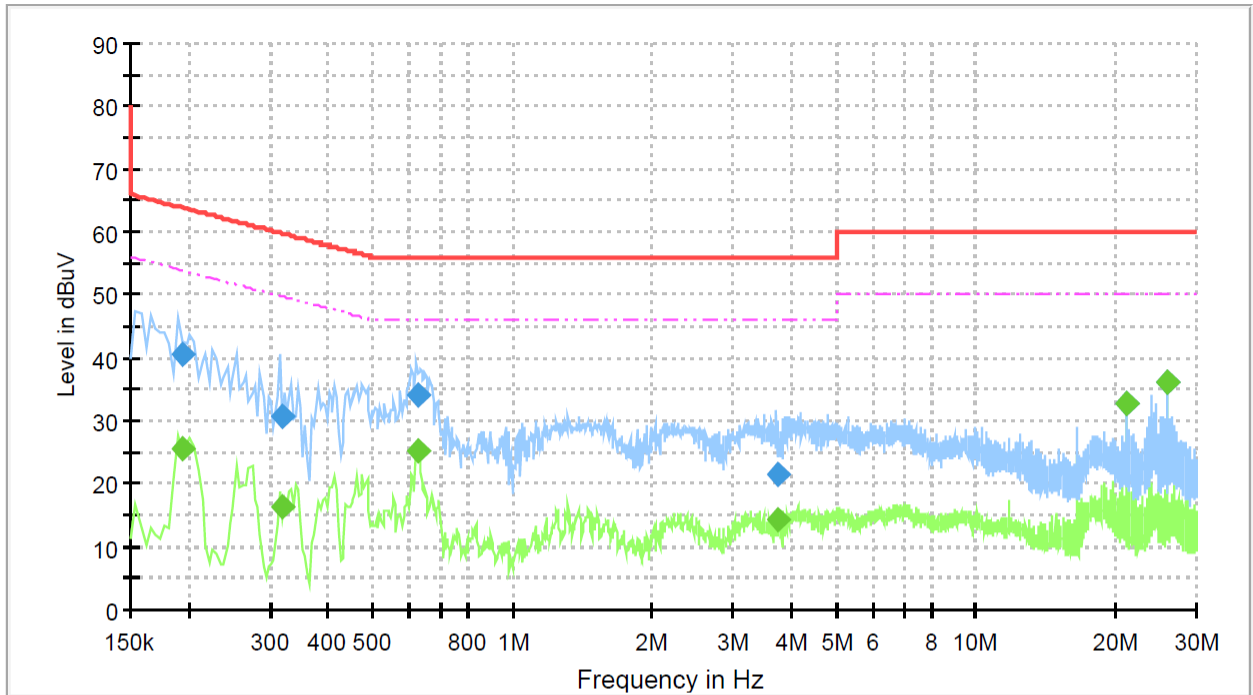
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : LIVE LINE
- Antenna 0, Antenna 1 and Multiple transmit tested, but the worst data were recorded.



**Final Result**

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.202	---	31.31	53.55	22.23	3000.0	9.0	L1	9.93
0.202	42.50	---	63.55	21.05	3000.0	9.0	L1	9.93
0.273	---	20.37	51.01	30.64	3000.0	9.0	L1	9.93
0.273	36.03	---	61.01	24.98	3000.0	9.0	L1	9.93
0.628	---	24.89	46.00	21.11	3000.0	9.0	L1	9.94
0.628	35.27	---	56.00	20.73	3000.0	9.0	L1	9.94
1.788	19.81	---	56.00	36.19	3000.0	9.0	L1	10.00
1.804	---	11.10	46.00	34.90	3000.0	9.0	L1	10.00
4.830	---	14.53	46.00	31.47	3000.0	9.0	L1	10.07
4.878	20.98	---	56.00	35.02	3000.0	9.0	L1	10.07
25.871	---	35.26	50.00	14.74	3000.0	9.0	L1	10.68
25.871	35.48	---	60.00	24.52	3000.0	9.0	L1	10.68

-. Tested Line : NEUTRAL LINE



### Final Result

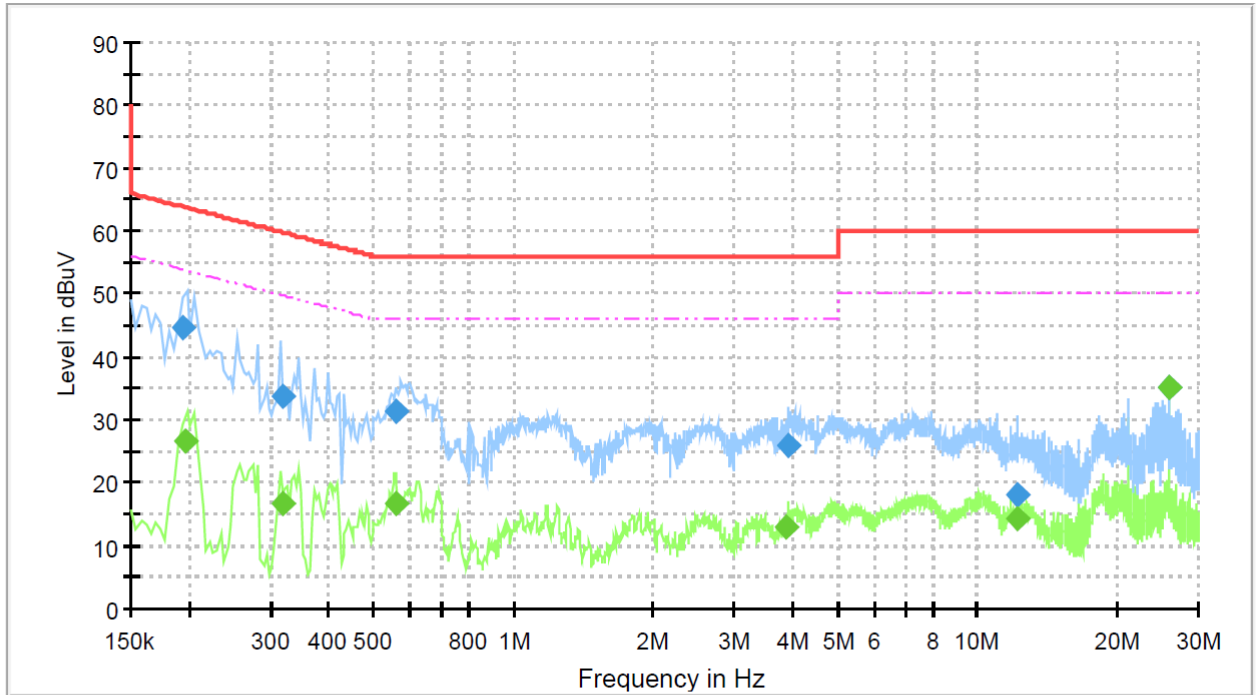
Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.195	---	25.52	53.84	28.32	3000.0	9.0	N	9.94
0.195	40.69	---	63.84	23.16	3000.0	9.0	N	9.94
0.318	---	16.24	49.77	33.53	3000.0	9.0	N	9.94
0.318	30.58	---	59.77	29.19	3000.0	9.0	N	9.94
0.624	---	25.33	46.00	20.67	3000.0	9.0	N	9.95
0.624	34.01	---	56.00	21.99	3000.0	9.0	N	9.95
3.729	---	14.31	46.00	31.69	3000.0	9.0	N	10.06
3.745	21.47	---	56.00	34.53	3000.0	9.0	N	10.06
21.166	32.64	---	60.00	27.36	3000.0	9.0	N	10.73
21.166	---	32.74	50.00	17.26	3000.0	9.0	N	10.73
25.871	---	36.08	50.00	13.92	3000.0	9.0	N	10.76
25.871	36.16	---	60.00	23.84	3000.0	9.0	N	10.76

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

### 12.5 Test data for Intermodulation Mode(WLAN 2.4 GHz + WLAN 5 GHz)

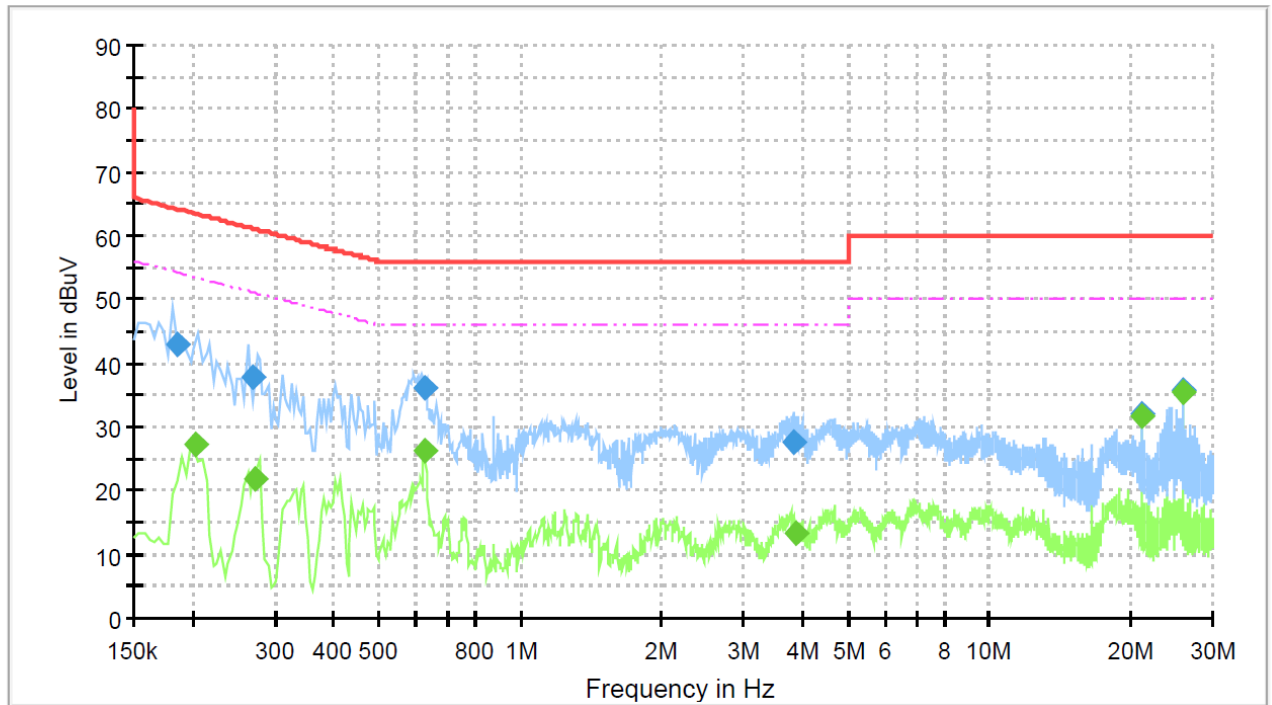
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : LIVE LINE



### Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.194	44.67	---	63.89	19.21	3000.0	9.0	L1	9.93
0.198	---	26.68	53.72	27.03	3000.0	9.0	L1	9.93
0.319	---	16.66	49.75	33.09	3000.0	9.0	L1	9.93
0.319	33.77	---	59.75	25.98	3000.0	9.0	L1	9.93
0.556	31.21	---	56.00	24.79	3000.0	9.0	L1	9.93
0.556	---	16.60	46.00	29.40	3000.0	9.0	L1	9.93
3.883	---	12.86	46.00	33.14	3000.0	9.0	L1	10.05
3.911	26.07	---	56.00	29.93	3000.0	9.0	L1	10.05
12.153	---	14.31	50.00	35.69	3000.0	9.0	L1	10.39
12.217	18.10	---	60.00	41.90	3000.0	9.0	L1	10.39
25.871	---	35.04	50.00	14.96	3000.0	9.0	L1	10.68
25.871	35.21	---	60.00	24.79	3000.0	9.0	L1	10.68

-. Tested Line : NEUTRAL LINE



### Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.187	42.97	---	64.19	21.22	3000.0	9.0	N	9.94
0.203	---	27.10	53.51	26.40	3000.0	9.0	N	9.94
0.269	37.86	---	61.13	23.27	3000.0	9.0	N	9.94
0.274	---	21.70	51.01	29.31	3000.0	9.0	N	9.94
0.624	---	26.08	46.00	19.92	3000.0	9.0	N	9.95
0.624	36.27	---	56.00	19.73	3000.0	9.0	N	9.95
3.848	27.63	---	56.00	28.37	3000.0	9.0	N	10.07
3.876	---	13.35	46.00	32.65	3000.0	9.0	N	10.07
21.166	31.96	---	60.00	28.04	3000.0	9.0	N	10.73
21.166	---	31.55	50.00	18.45	3000.0	9.0	N	10.73
25.871	---	35.59	50.00	14.41	3000.0	9.0	N	10.76
25.871	35.81	---	60.00	24.19	3000.0	9.0	N	10.76

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

### 13. LIST OF TEST EQUIPMENT

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
FSV40-N	Rohde & Schwarz	Signal Analyzer	102177	Apr. 20, 2020 (1Y)
FSW43	Rohde & Schwarz	Signal Analyzer	104544	Jul. 15, 2020 (1Y)
ESW	Rohde & Schwarz	EMI Test Receiver	101851	Mar. 22, 2021 (1Y)
310N	Sonoma Instrument	Pre-Amplifier	392756	Oct. 16, 2020 (1Y)
PAM-118A	Com-Power	Pre-Amplifier	18040081	Oct. 12, 2020 (1Y)
PAM-840A	Com-Power	Pre-Amplifier	461339	Oct. 16, 2020 (1Y)
DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
NRP-Z81	Rohde & Schwarz	Wide band Sensor	101975	Feb. 09, 2021 (1Y)
FMZB 1513	Schwarzbeck	Loop Antenna	1513-235	Mar. 24, 2020 (2Y)
HLP-2008	TDK	Hybrid Antenna	131316	Feb. 27, 2020 (2Y)
AH-118	Com-Power	Horn Antenna	10050061	Oct. 15, 2020 (1Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2021(1Y)
ESR3	Rohde & Schwarz	EMI TEST RECEIVER	102602	Mar. 15, 2021 (1Y)
NSLK8126	Schwarzbeck	AMN	8126-404	Mar. 15, 2021 (1Y)
ESH3Z2	Rohde & Schwarz	PULSE LIMITER	357.8810.52	Mar. 15, 2021 (1Y)