



TEST REPORT

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR25-SRF0116 Page (1) of (78)	KCTL
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1. Client

◦ Name : IRIVER

◦ Address : 5, Bangbae-ro 18-gil, Seocho-gu, Seoul, Republic of Korea

◦ Date of Receipt : 2025-01-14

2. Use of Report : Certification

3. Name of Product / Model : SP4000 / PPF51

4. Manufacturer / Country of Origin : IRIVER / Korea

5. FCC ID : 2BO2WPPF51

5. Date of Test : 2025-05-16 to 2025-06-18

6. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
 (Address: 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

7. Test method used : FCC Part 15 Subpart E, 15.407

8. Test Result : Refer to the test result in the test report

Affirmation	Tested by Name : Hyesom Shin (Signature)	Technical Manager Name : Harim Lee (Signature)
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2025-06-19

Eurofins KCTL Co.,Ltd.

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REPORT REVISION HISTORY

Date	Revision	Page No
2025-06-19	Originally issued	-

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General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ Statement not required by the standard or client used for type testing

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1. General information

Client : IRIVER
 Address : 5, Bangbae-ro 18-gil, Seocho-gu, Seoul, Republic of Korea
 Manufacturer : IRIVER
 Address : 5, Bangbae-ro 18-gil, Seocho-gu, Seoul, Republic of Korea
 Factory : smartelectronics
 Address : (Ochang-eup), 256, Yeocheon 3-gil, Cheongwon-gu, Cheongju-si,
 Chungcheongbuk-do, Korea
 Laboratory : Eurofins KCTL Co.,Ltd.
 Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
 Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132
 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056
 CAB Identifier: KR0040
 ISED Number: 8035A
 KOLAS No.: KT231

2. Device information

Equipment under test : SP4000
 Model : PPF51
 Modulation technique : Bluetooth(BDR/EDR) : GFSK, $\pi/4$ DQPSK, 8DPSK
 Bluetooth(BLE) : GFSK
 WIFI(802.11a/b/g/n/ac) : DSSS, OFDM
 Number of channels : Bluetooth : 79 ch
 BLE : 40 ch
 2.4 GHz WLAN : 11 ch (20 MHz), 7 ch (40 MHz)
 UNII-1 : 4 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
 UNII-3 : 5 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
 Power source : DC 3.8 V
 Antenna specification : LPS Antenna
 Antenna gain : BT/BLE/2.4 GHz WLAN : -2.004 dBi
 5 GHz WLAN UNII-1 : -1.136 dBi
 5 GHz WLAN UNII-3 : -2.483 dBi
 Frequency range : Bluetooth : 2 402 MHz ~ 2 480 MHz (BDR/EDR/BLE)
 2.4 GHz WLAN : 2 412 MHz ~ 2 462 MHz (802.11b/g/n_HT20)
 2 422 MHz ~ 2 452 MHz (802.11n_HT40)
 UNII-1 : 5 180 MHz ~ 5 240 MHz (802.11a/n_HT20)
 5 190 MHz ~ 5 230 MHz (802.11n_HT40)
 5 210 MHz (802.11ac_VHT80)
 UNII-3 : 5 745 MHz ~ 5 825 MHz (802.11a/n_HT20)
 5 755 MHz ~ 5 795 MHz (802.11n_HT40)
 5 775 MHz (802.11ac_VHT80)
 Software version : 1.0
 Hardware version : 1.0
 Test device serial No. : TP-048, TP-068(Conducted)
 TP-071, TP-045(Radiated)
 Operation temperature : -10 °C ~ 50 °C

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2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
Lithium-ion Polymer Battery	Shenzhen Honcell Energy Co., Ltd.	HCP766387PNFC	N/A	DC 3.8 V, 6780 mAh 25.76 Wh

2.2. Frequency/channel operations

This device contains the following capabilities:

WLAN 5 GHz(802.11a/n_HT20/40/ac_VHT80)

UNII-1

Ch.	Frequency (MHz)
36	5 180
40	5 200
48	5 240

UNII-3

Ch.	Frequency (MHz)
149	5 745
157	5 785
165	5 825

Table 2.2.1. 802.11a/n_HT20 mode

UNII-1

Ch.	Frequency (MHz)
38	5 190
46	5 230

UNII-3

Ch.	Frequency (MHz)
151	5 755
159	5 795

Table 2.2.2. 802.11n_HT40 mode

UNII-1

Ch.	Frequency (MHz)
42	5 210

UNII-3

Ch.	Frequency (MHz)
155	5 775

Table 2.2.3 802.11ac_VHT80 mode

2.3. RF power setting in TEST SW

Test Program	Test Mode	Frequency	RF Power setting value
		[MHz]	
QRCT	802.11a	5 180	17
		5 200	17
		5 240	17
		5 745	16
		5 785	16
		5 825	16
	802.11n_HT20	5 180	17
		5 200	17
		5 240	17
		5 745	16
		5 785	16
		5 825	16
	802.11n_HT40	5 190	15
		5 230	15
		5 755	16
		5 795	16
	802.11ac_VHT80	5 210	15
		5 775	16

2.4. Simultaneously transmission condition

Item	Technology	Test Mode	Frequency [MHz]
Case 1	WLAN 2.4 GHz	802.11b	2 412
	Bluetooth	3DH-1	2 402
Case 2	WLAN 5 GHz	802.11ac VHT80	5 775
	Bluetooth	3DH-1	2 402

Notes.

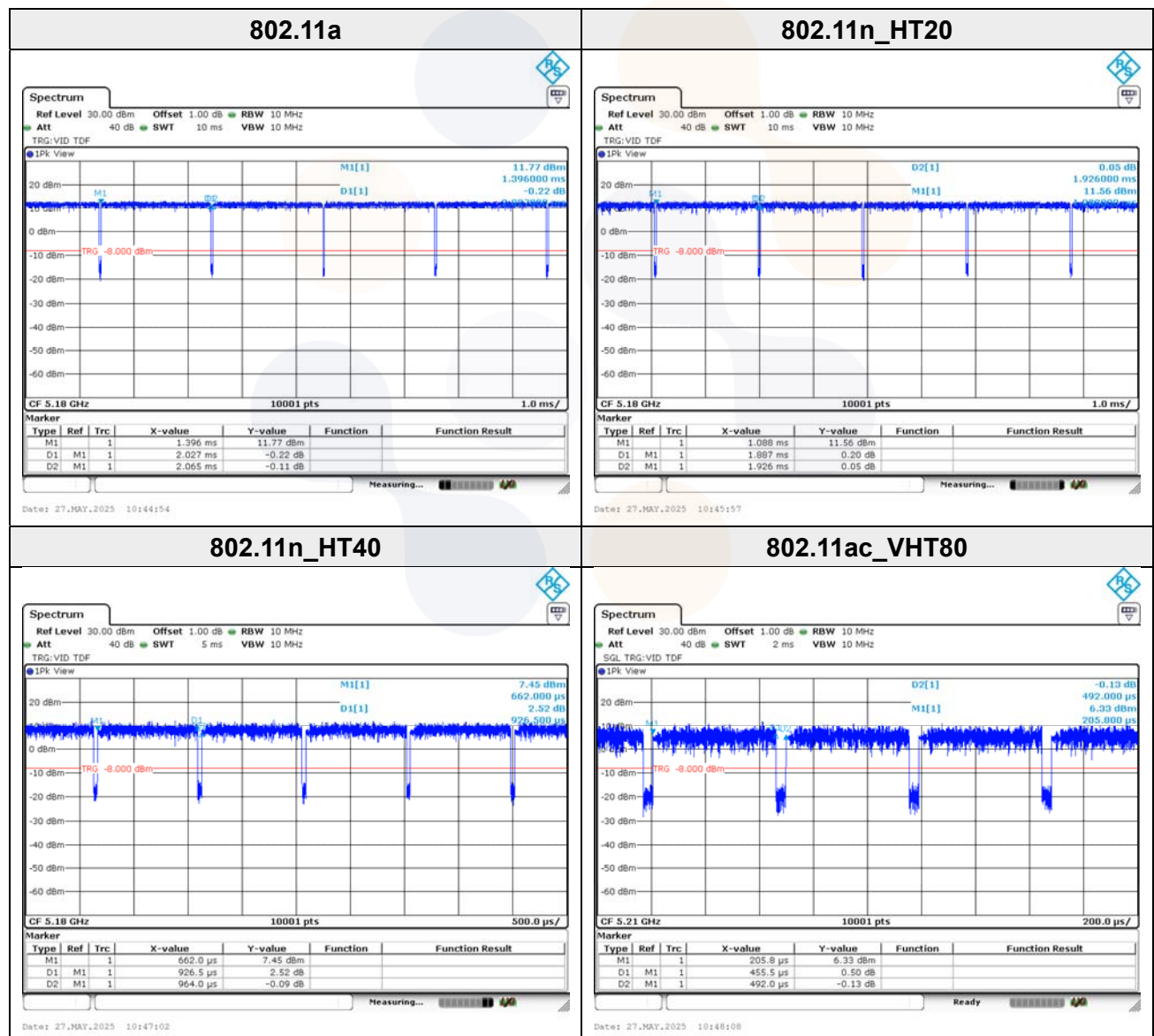
1. Simultaneous condition was performed as a worst case which is configured as a combination of lowest margin for each mode during radiated spurious emission.
2. For simultaneous spurious emission test result, please refer to 15.247_Bluetooth test report.

2.5. Duty Cycle Factor

Test mode	Period (ms)	T _{On} time (ms)	Duty cycle		Duty Cycle Factor (dB)
			(Linear)	(%)	
802.11a	2.065	2.027	0.981 6	98.16	0.08
802.11n_HT20	1.926	1.887	0.979 8	97.98	0.09
802.11n_HT40	0.964	0.927	0.961 6	96.16	0.17
802.11ac_VHT80	0.492	0.456	0.926 8	92.68	0.33

Notes.

1. Duty cycle (Linear) = T_{On} time / Period
2. DCF(Duty cycle factor) = 10log(1/duty cycle)
3. DCF is not compensated to average result if the duty cycle is more than 98%



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3. Antenna requirement

Requirement of FCC part section 15.203:

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

- The transmitter has attached LPS Antenna (internal antenna) on the board.
- The E.U.T Complies with the requirement of §15.203, §15.407



4. Summary of tests

FCC Part section(s)	Parameter	Test Condition	Test results
15.407(a)	Maximum conducted output power	Conducted	Pass
15.407(a)	Maximum power spectral density		Pass
15.407(a)	26 dB Channel Bandwidth		Pass
15.407(e)	6 dB Channel Bandwidth		Pass
15.207(a)	AC Conducted Emissions		Pass
15.407(b), 15.205(a), 15.209(a)	Spurious emission	Radiated	Pass
	Band-edge, restricted band		Pass

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that **X** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **X** orientation.
4. The test procedure(s) in this report were performed in accordance as following.
 - ANSI C63.10-2013
 - KDB 789033 D02 v02r01
5. The worst-case data rates were:
 - 802.11a mode: 6Mbps
 - 802.11n_HT20 mode: MCS0
 - 802.11n_HT40 mode: MCS0
 - 802.11ac_VHT80 mode: MCS0

5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicated a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty ($\pm$)	
Conducted RF Power	0.9 dB	
Conducted spurious emission	2.0 dB	
Radiated Emissions	Below 30 MHz	2.3 dB
	30 MHz to 1 000 MHz	2.6 dB
	1 000 MHz to 18 000 MHz	4.8 dB
	Above 18 000 MHz	4.8 dB
Conducted Emissions	150 kHz to 30 MHz	2.9 dB

6. Measurement results explanation example

The offset level is set in the spectrum analyzer to compensate the RF cable loss factor between EUT conducted output port and spectrum analyzer.

With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Frequency (MHz)	Factor(dB)	Frequency (MHz)	Factor(dB)
30	9.96	11 000	11.44
50	9.98	12 000	11.51
100	9.98	13 000	11.55
200	9.86	14 000	11.65
300	10.12	15 000	11.56
400	9.92	16 000	11.72
500	9.98	17 000	11.78
600	9.59	18 000	11.83
700	9.87	19 000	11.93
800	9.83	20 000	12.18
900	10.31	21 000	12.04
1 000	10.05	22 000	12.17
2 000	10.53	23 000	12.24
3 000	10.64	24 000	12.27
4 000	10.81	25 000	12.35
5 000	10.91	26 000	12.46
6 000	10.99	26 500	12.29
7 000	11.08	27 000	12.37
8 000	11.22	28 000	12.47
9 000	11.28	29 000	13.08
10 000	11.35	30 000	13.08

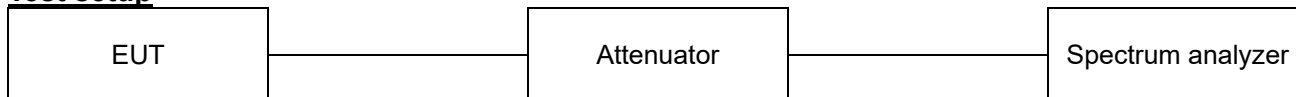
Note.

Offset(dB) = RF cable loss(dB) + Attenuator

7. Test results

7.1. Maximum conducted output power

Test setup



Limit

According to §15.407(a)

Band	EUT category		Limit
UNII-1		Outdoor access point	1 W (30 dBm)
		Indoor access point	
		Fixed point-to-point access point	
	√	Client device	250 mW (23.98 dBm)
UNII-2A			250 mW or 11 dBm + 10logB ¹⁾
UNII-2C			250 mW or 11 dBm + 10logB ¹⁾
UNII-3		√	1 W (30 dBm)

Note:

1) Conducted output power limit B is the 26 dB emission bandwidth.

Test procedure

ANSI C63.10-2013-Section 12.3.2.4

KDB 789033 D02 v02r01 - Section E.2.d)

Test settings

Used test method is Section E.2.d)

◆ KDB 789033 D02 v02r01

Section E.2.d)

Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction):

- (i) Measure the duty cycle, x , of the transmitter output signal as described in II.B..
- (ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- (iii) Set RBW = 1 MHz
- (iv) Set RBW $\geq$ 3 MHz
- (v) Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$. (This ensures that bin-to-bin spacing is $\leq \text{RBW} / 2$, so that narrowband signals are not lost between frequency bins.)
- (vi) Sweep time = auto.
- (vii) Detector = power averaging (rms), if available. Otherwise use sample detector mode.
- (viii) Do not use sweep triggering. Allow the sweep to “free run.”
- (ix) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.
- (x) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument’s band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- (xi) Add $10 \log (1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add $10 \log (1/0.25) = 6 \text{ dB}$ if the duty cycle is 25%.

Test results

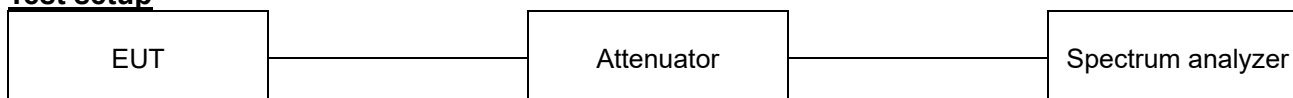
Test mode	Band	Frequency (MHz)	Measured power (dBm)	DCF (dB)	Conducted output power (dBm)	Conducted Power Limit (dBm)
					Average	
802.11a	UNII-1	5 180	5.55	-	5.55	23.98
		5 200	5.20		5.20	
		5 240	6.40		6.40	
	UNII-3	5 745	10.80		10.80	30.00
		5 785	10.84		10.84	
		5 825	11.36		11.36	
802.11n HT20	UNII-1	5 180	5.42	0.09	5.51	23.98
		5 200	5.03		5.12	
		5 240	6.45		6.54	
	UNII-3	5 745	10.76		10.85	30.00
		5 785	10.81		10.90	
		5 825	10.85		10.94	
802.11n HT40	UNII-1	5 190	4.45	0.17	4.62	23.98
		5 230	5.02		5.19	
	UNII-3	5 755	11.19		11.36	30.00
		5 795	11.46		11.63	
802.11ac VHT80	UNII-1	5 210	4.05	0.33	4.38	23.98
	UNII-3	5 775	11.14		11.47	30.00

Note.

1. Result(dBm) = Reading Power + D.C.F

7.2. Maximum Power Spectral Density

Test setup



Limit

According to §15.407(a)

Band	EUT category		Limit
UNII-1		Outdoor access point	17 dBm/MHz
		Indoor access point	
		Fixed point-to-point access point	
	√	Client device	11 dBm/MHz
UNII-2A			11 dBm/MHz
UNII-2C			11 dBm/MHz
UNII-3		√	30 dBm/500 kHz

Notes:

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain if the antenna exceed 6 dBi

Test procedure

KDB 789033 D02 v02r01 - Section F
 ANSI C63.10-2013

Test settings

Section F

The rules requires “maximum power spectral density” measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission. Refer to III.A for additional guidance for devices that use channel aggregation.

- Create an average power spectrum for the EUT operating mode being tested by following the instructions in II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power...” (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
- Search function on the instrument to find the peak of the spectrum and record its value.
- Adjustments to the peak value of the spectrum, if applicable:
 - If Method SA-2 or SA-2 Alternative was used, add $10 \log(1/x)$, where x is the duty cycle, to the peak of the spectrum.
 - If Method SA-3 Alternative was used and the linear mode was used in II.E.2.g) (viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
- The result is the Maximum PSD over 1 MHz reference bandwidth
- For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the preceding procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in Section 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have

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500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:

- a) Set $RBW \geq 1/T$, where T is defined in II.B.I.a).
- b) Set $VBW \geq 3 RBW$.
- c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10 \log (500 \text{ kHz} / RBW)$ to the measured result, whereas $RBW (< 500 \text{ kHz})$ is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
- d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10 \log (1 \text{ MHz} / RBW)$ to the measured result, whereas $RBW (< 1 \text{ MHz})$ is the reduced resolution bandwidth of spectrum analyzer set during measurement.
- e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Notes:

1. As a practical matter, it is recommended to use reduced RBW of 100 kHz for the II.F.5.c) and II.F.5.d), since $RBW = 100 \text{ kHz}$ is available on nearly all spectrum analyzers.

Test results

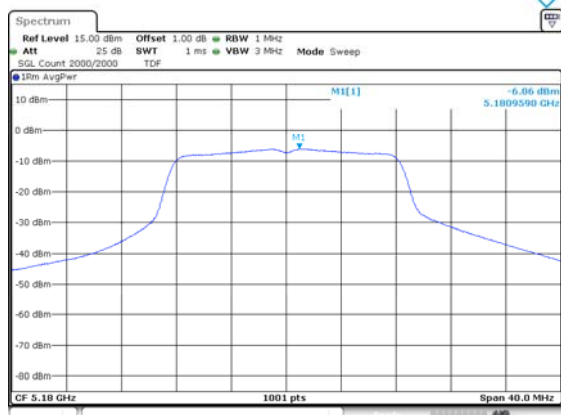
Test mode	Band	Frequency (MHz)	Measured PSD (dB m/MHz)	DCF (dB)	Maximum PSD (dB m/MHz)	Limit (dB m/MHz)		
802.11a	UNII-1	5 180	-6.06	-	-6.06	11.00		
		5 200	-5.62		-5.62			
		5 240	-4.21		-4.21			
802.11n HT20		5 180	-6.48	0.09	-6.39		11.00	
		5 200	-5.97		-5.88			
		5 240	-4.56		-4.47			
802.11n HT40		5 190	-10.28	0.17	-10.11			11.00
		5 230	-8.92		-8.75			
802.11ac VHT80		5 210	-12.94	0.33	-12.61			

Test mode	Band	Frequency (MHz)	Measured PSD (dBm/ 500 kHz)	DCF (dB)	Maximum PSD (dBm/ 500 kHz)	Limit (dBm/ 500 kHz)
802.11a	UNII-3	5 745	-2.95	-	-2.95	30.00
		5 785	-2.52		-2.52	
		5 825	-3.73		-3.73	
802.11n HT20		5 745	-3.46	0.09	-3.37	
		5 785	-2.95		-2.86	
		5 825	-2.52		-2.43	
802.11n HT40		5 755	-5.67	0.17	-5.50	
		5 795	-5.41		-5.24	
802.11ac VHT80		5 775	-8.72	0.33	-8.39	

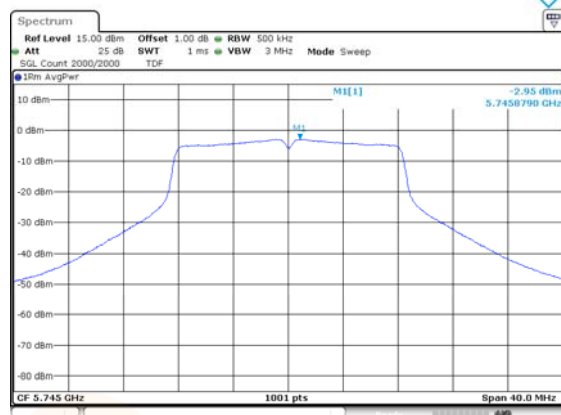
Notes:

- Maximum PSD calculation
 -Maximum PSD = Measured PSD + DCF

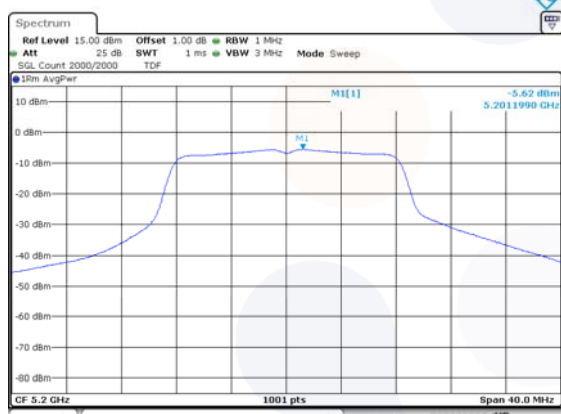
UNII-1 / 802.11a / 5 180 MHz



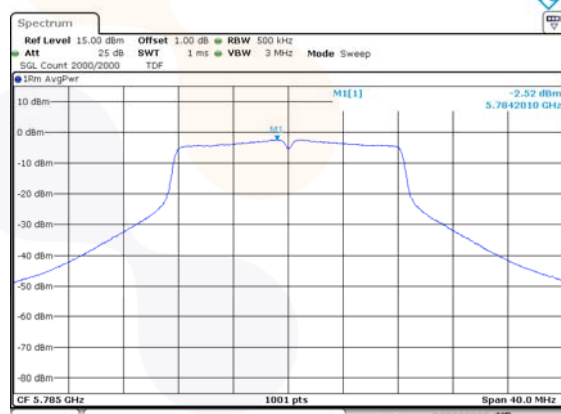
UNII-3 / 802.11a / 5 745 MHz



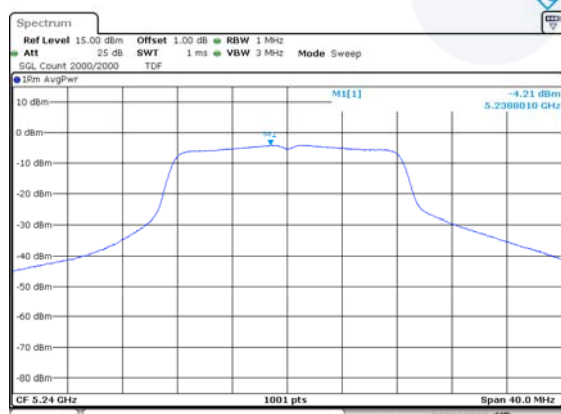
UNII-1 / 802.11a / 5 200 MHz



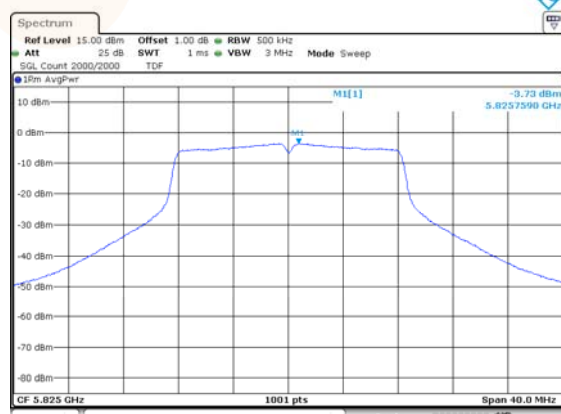
UNII-3 / 802.11a / 5 785 MHz



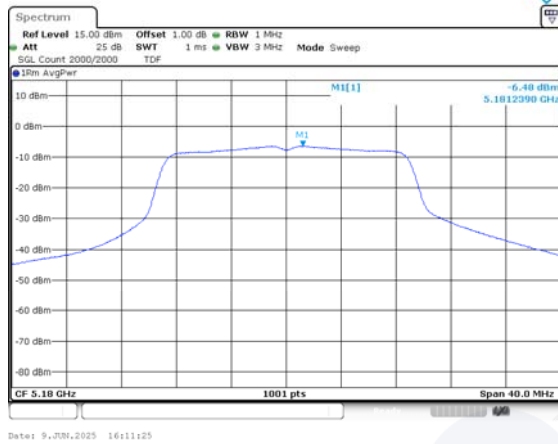
UNII-1 / 802.11a / 5 240 MHz



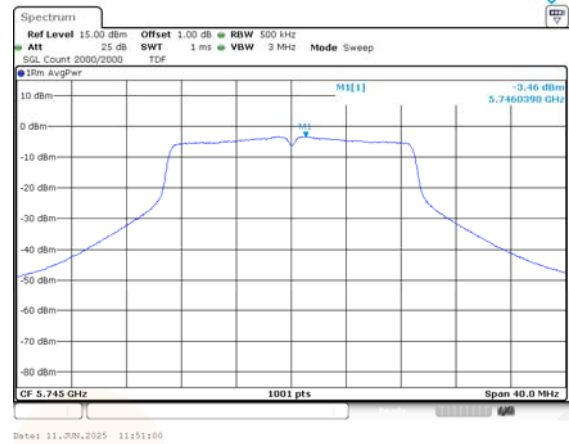
UNII-3 / 802.11a / 5 825 MHz



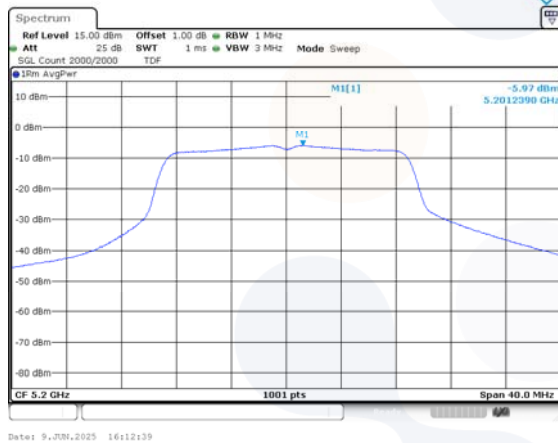
UNII-1 / 802.11n HT20 / 5 180 MHz



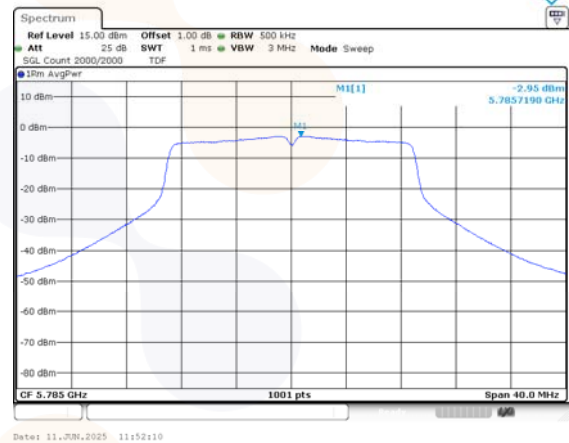
UNII-3 / 802.11n HT20 / 5 745 MHz



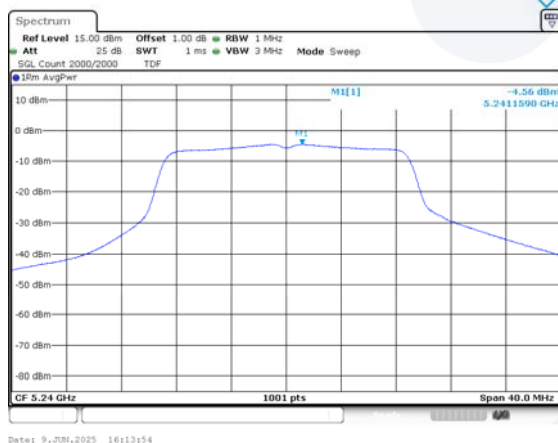
UNII-1 / 802.11n HT20 / 5 200 MHz



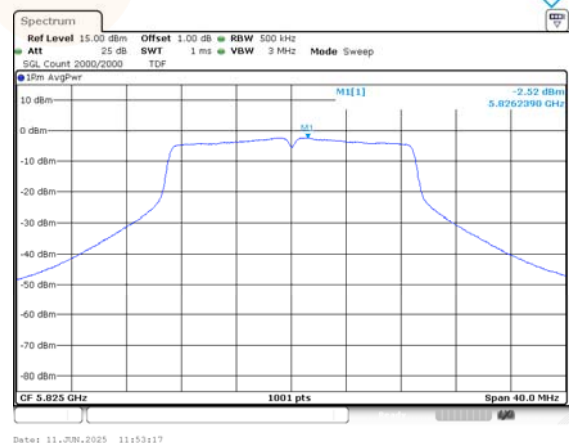
UNII-3 / 802.11n HT20 / 5 785 MHz



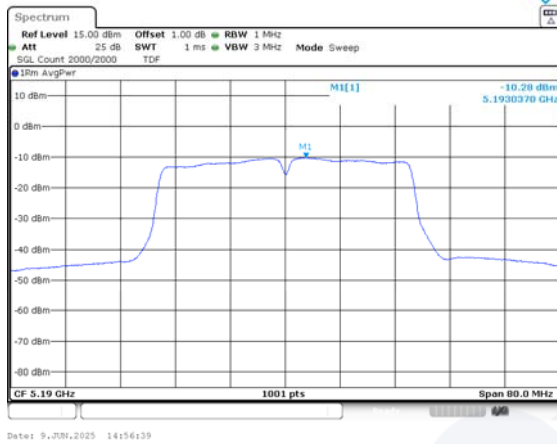
UNII-1 / 802.11n HT20 / 5 240 MHz



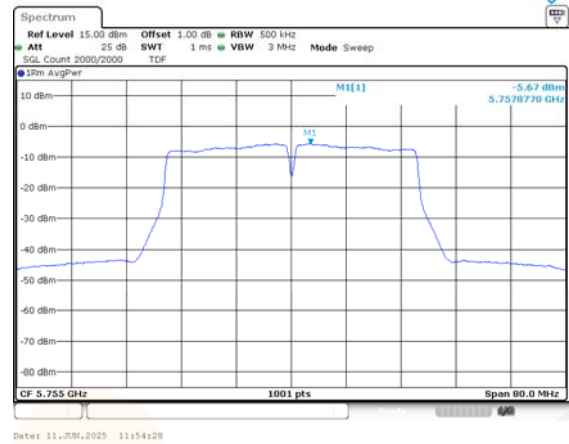
UNII-3 / 802.11n HT20 / 5 825 MHz



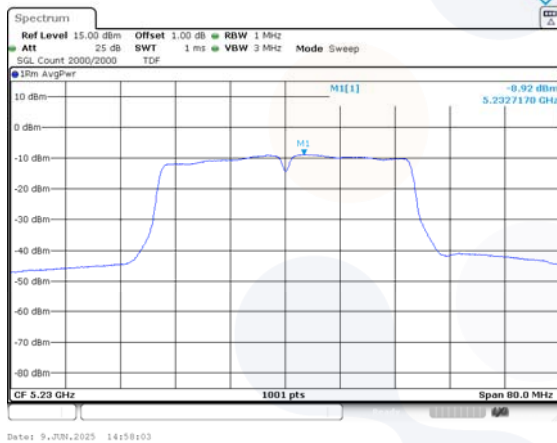
UNII-1 / 802.11n HT40 / 5 190 MHz



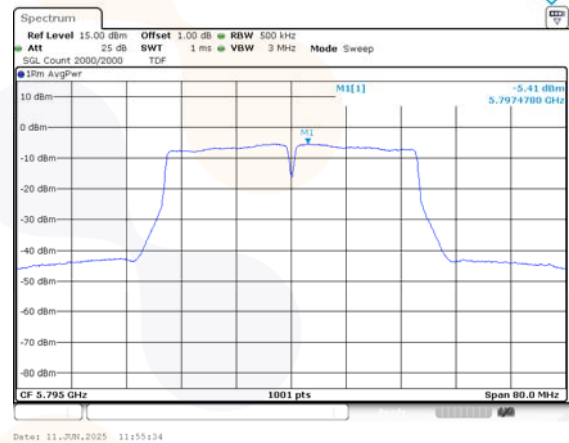
UNII-3 / 802.11n HT40 / 5 755 MHz



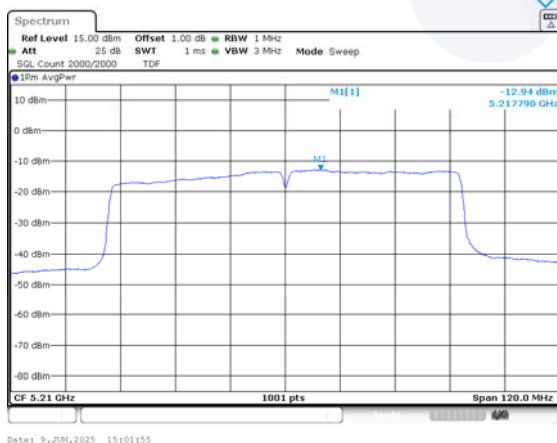
UNII-1 / 802.11n HT40 / 5 230 MHz



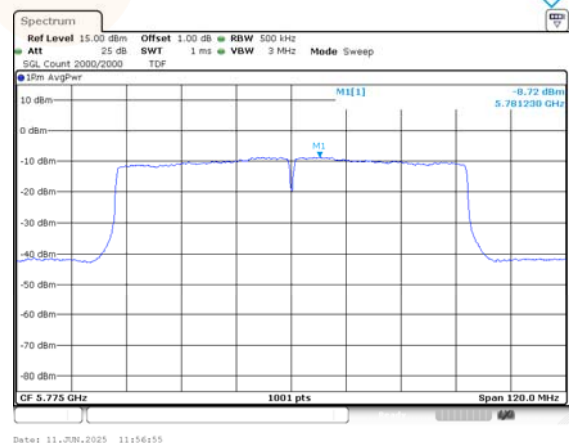
UNII-3 / 802.11n HT40 / 5 795 MHz



UNII-1 / 802.11ac VHT80 / 5 210 MHz

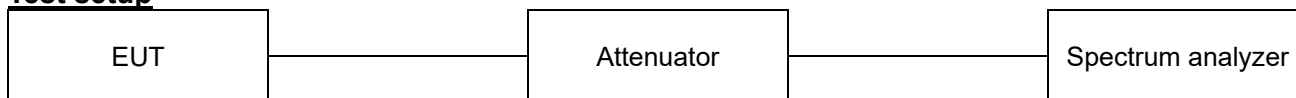


UNII-3 / 802.11ac VHT80 / 5 775 MHz



7.3. 26 dB Bandwidth & 99% Bandwidth

Test setup



Limit

N/A

Test procedure

ANSI C63.10-2013 Section 12.4

KDB 789033 D02 v02r01 - Section C.1 (26dB bandwidth)

KDB 789033 D02 v02r01 - Section D (99% bandwidth)

Test settings

1. 26 dB Bandwidth

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

2. 99% Occupied Bandwidth

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1% to 5% of the OBW
4. Set VBW $\geq 3 \times$ RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99% power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

Test results

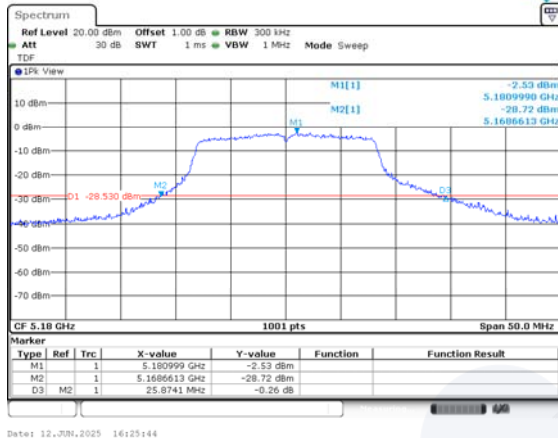
Test mode	Band	Frequency(MHz)	26 dB bandwidth (MHz)	99% bandwidth (MHz)
802.11a	UNII-1	5 180	25.87	17.23
		5 200	25.87	17.23
		5 240	27.02	17.28
802.11n HT20		5 180	27.57	18.18
		5 200	26.12	18.18
		5 240	26.72	18.28
802.11n HT40		5 190	42.06	36.56
		5 230	42.06	36.46
802.11ac VHT80		5 210	104.90	75.88

Note.

If 26dB Bandwidth across Band 2A or Band 1 but 99% test results are within the band no addition DFS test is needed on band 1.

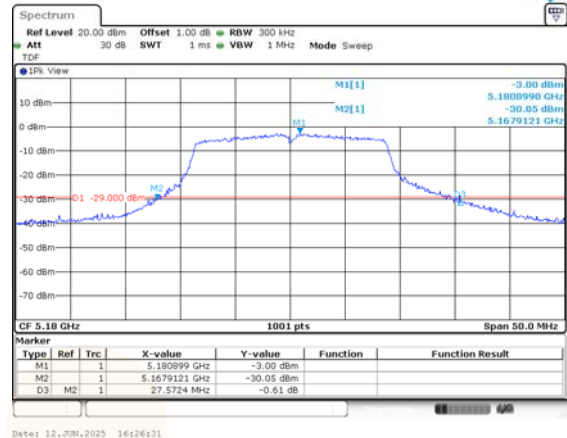
26 dB bandwidth

UNII-1 / 802.11a / 5 180 MHz



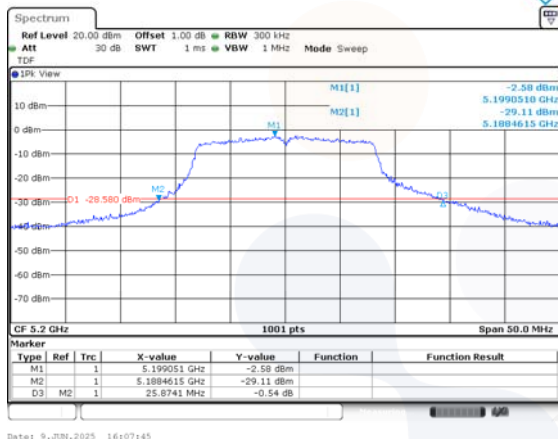
Date: 12..JUN.2025 16:25:44

UNII-1 / 802.11n_HT20 / 5 180 MHz



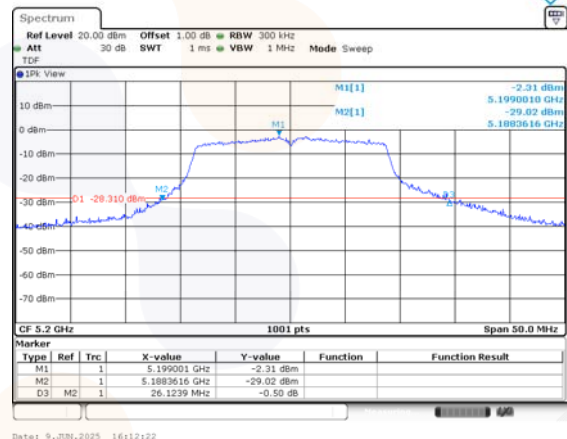
Date: 12..JUN.2025 16:26:31

UNII-1 / 802.11a / 5 200 MHz



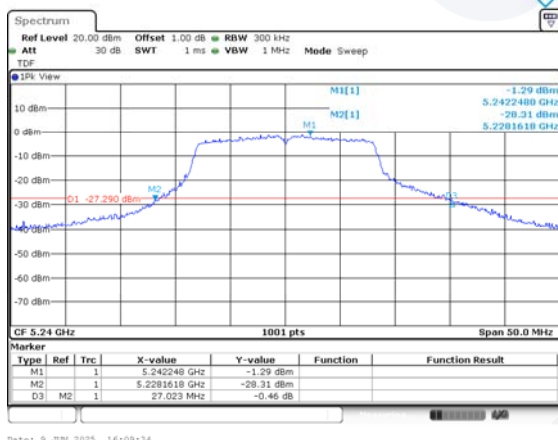
Date: 9..JUN.2025 16:07:45

UNII-1 / 802.11n_HT20 / 5 200 MHz



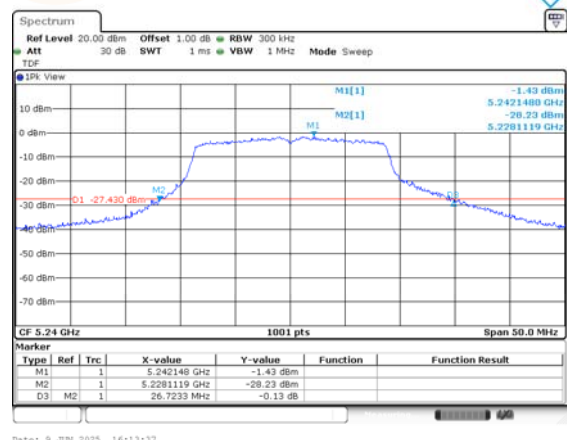
Date: 9..JUN.2025 16:12:22

UNII-1 / 802.11a / 5 240 MHz



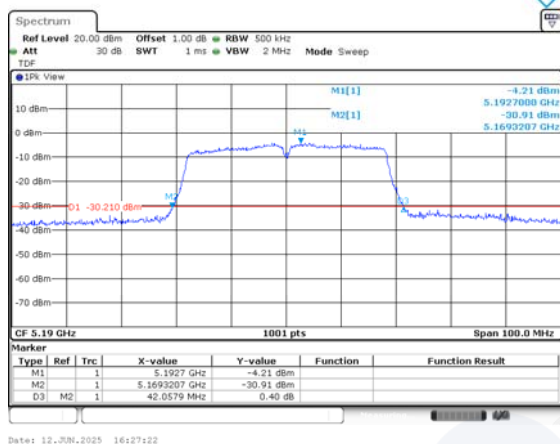
Date: 9..JUN.2025 16:09:34

UNII-1 / 802.11n_HT20 / 5 240 MHz

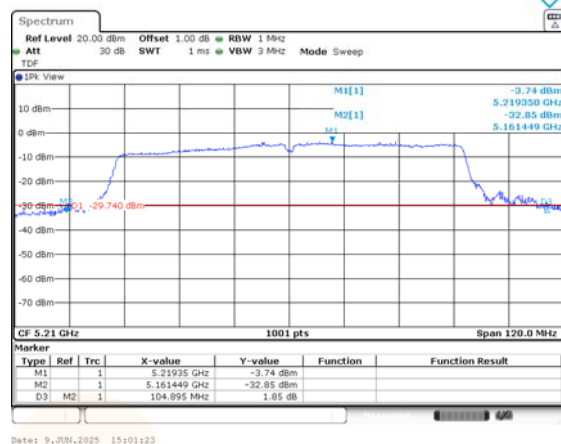


Date: 9..JUN.2025 16:13:37

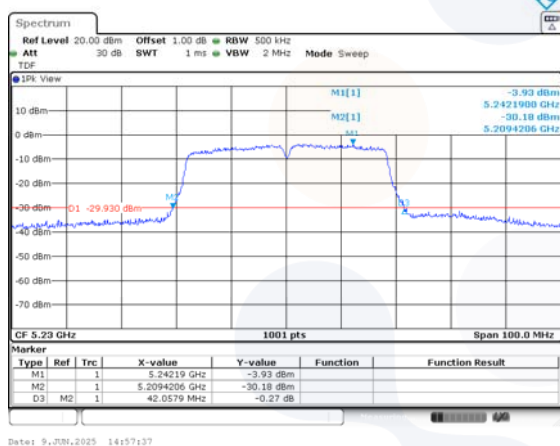
UNII-1 / 802.11n_HT40 / 5 190 MHz



UNII-1 / 802.11ac_VHT80 / 5 210 MHz



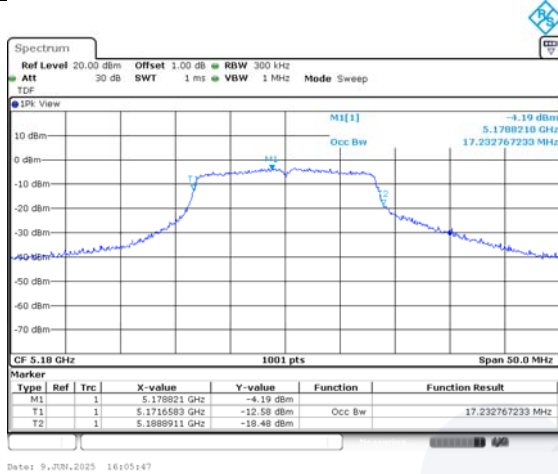
UNII-1 / 802.11n_HT40 / 5 230 MHz



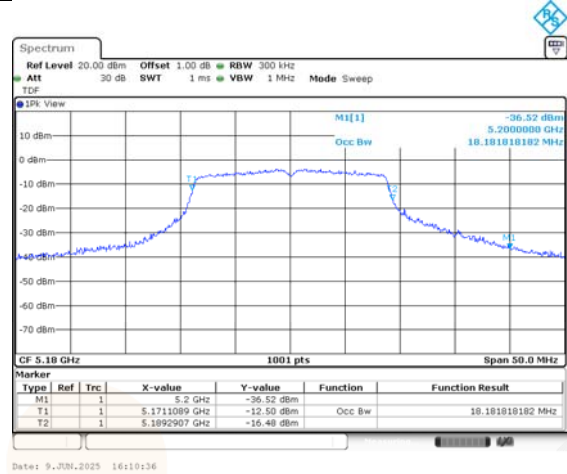
Blank

99% bandwidth

UNII-1 / 802.11a / 5 180 MHz



UNII-1 / 802.11n_HT20 / 5 180 MHz



UNII-1 / 802.11a / 5 200 MHz



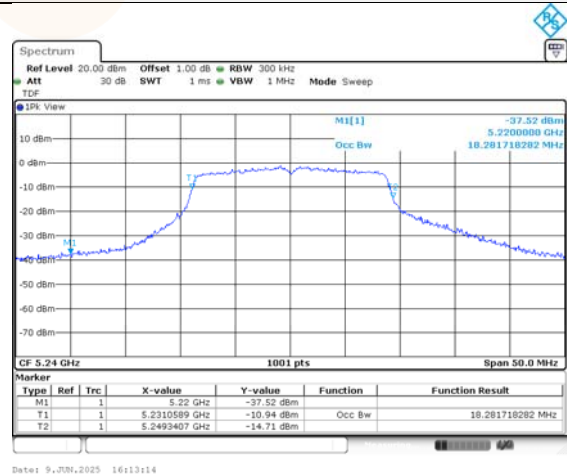
UNII-1 / 802.11n_HT20 / 5 200 MHz



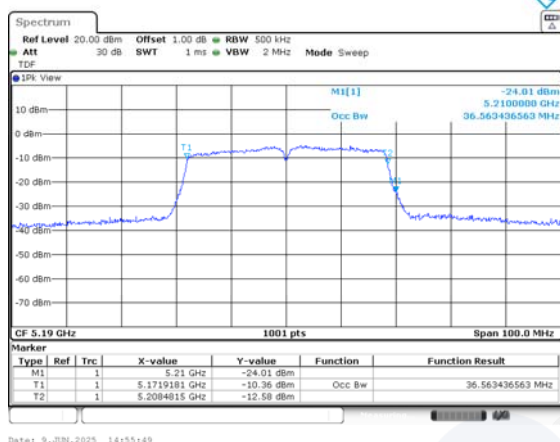
UNII-1 / 802.11a / 5 240 MHz



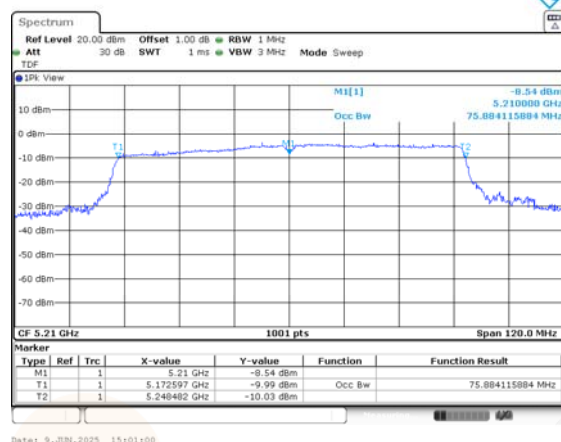
UNII-1 / 802.11n_HT20 / 5 240 MHz



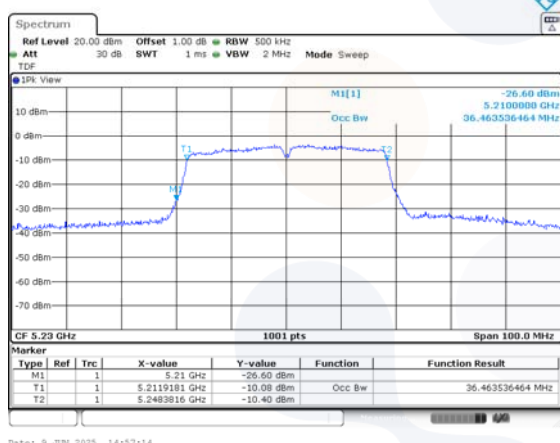
UNII-1 / 802.11n_HT40 / 5 190 MHz



UNII-1 / 802.11ac_VHT80 / 5 210 MHz



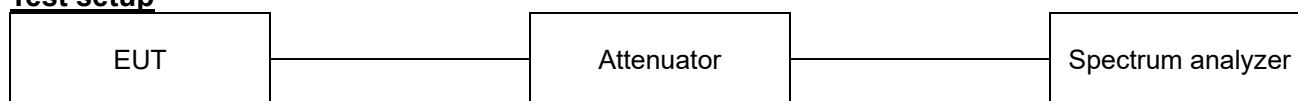
UNII-1 / 802.11n_HT40 / 5 230 MHz



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7.4. 6 dB Bandwidth

Test setup



Limit

According to §15.407(e), Within the 5.725-5.850 GHz band, the minimum 6 dB bandwidth if U-NII devices shall be at least 500 kHz

Test procedure

ANSI C63.10-2013 – Section 6.9.2

KDB 789033 D02 v02r01 - Section C.2

Test settings

Minimum Emission Bandwidth for the band 5.725–5.85 GHz and 5.850–5.895 GHz.

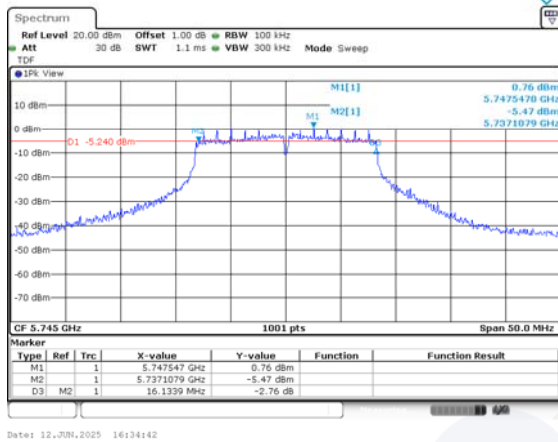
Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 kHz for the band 5.725–5.85 GHz and 5.850-5.895 GHz band. The following procedure shall be used for measuring this Bandwidth:

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

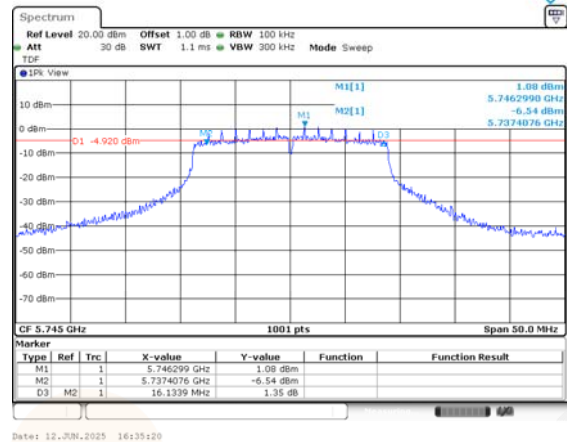
Test results

Test mode	Band	Frequency (MHz)	6 dB bandwidth (MHz)	Limit (MHz)
802.11a	UNII-3	5 745	16.13	0.500
		5 785	15.23	
		5 825	15.73	
802.11n HT20		5 745	16.13	
		5 785	15.88	
		5 825	15.23	
802.11n_HT40		5 755	35.86	
		5 795	35.56	
802.11ac_VHT80		5 775	75.41	

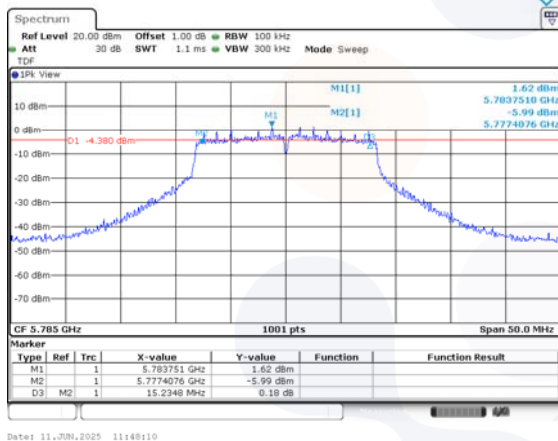
UNII-3 / 802.11a / 5 745 MHz



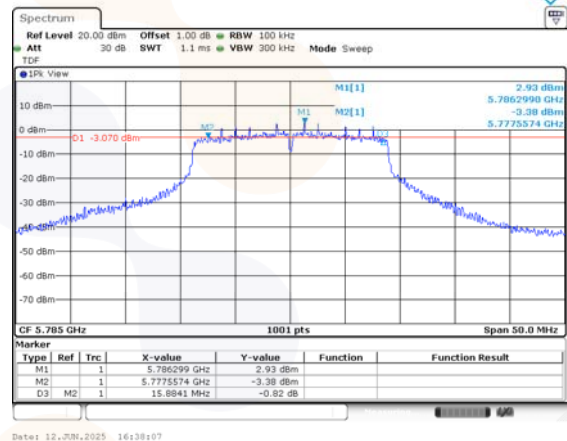
UNII-3 / 802.11n_HT20 / 5 745 MHz



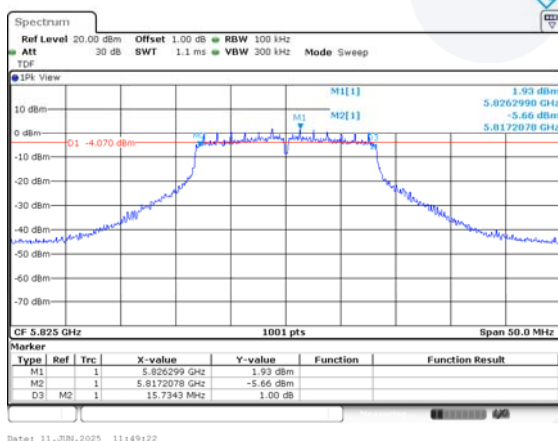
UNII-3 / 802.11a / 5 785 MHz



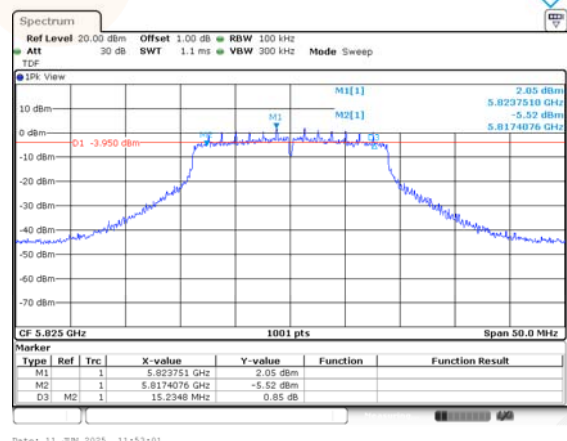
UNII-3 / 802.11n_HT20 / 5 785 MHz



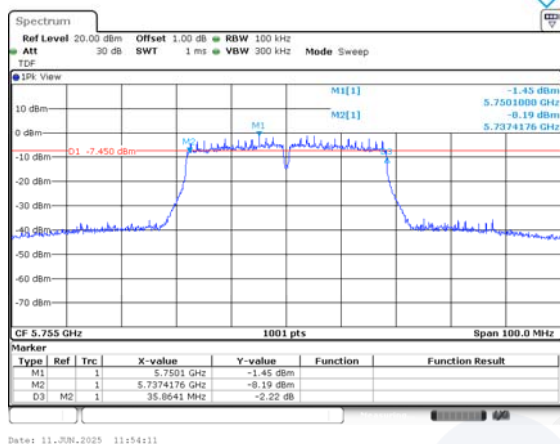
UNII-3 / 802.11a / 5 825 MHz



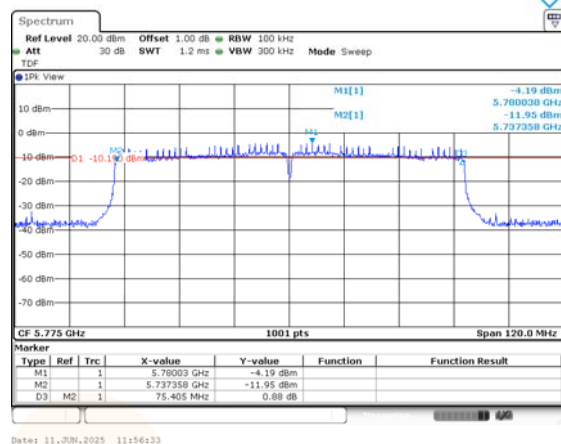
UNII-3 / 802.11n_HT20 / 5 825 MHz



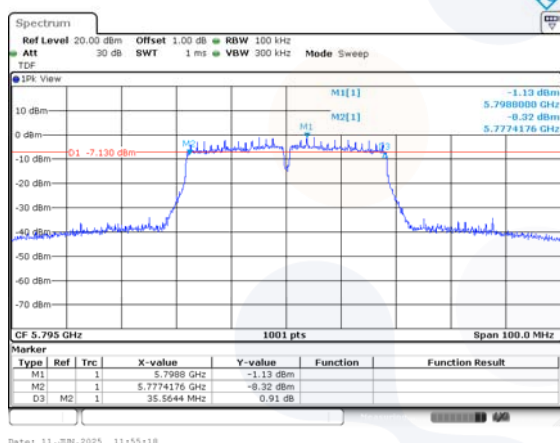
UNII-3 / 802.11n_HT40 / 5 755 MHz



UNII-3 / 802.11ac_VHT80 / 5 775 MHz



UNII-3 / 802.11n_HT40 / 5 795 MHz

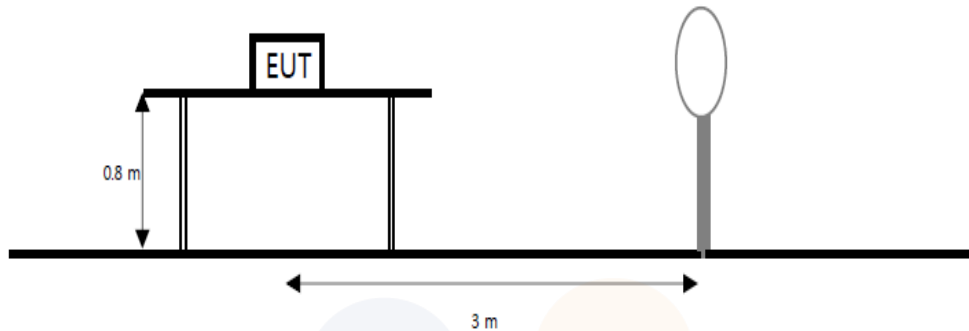


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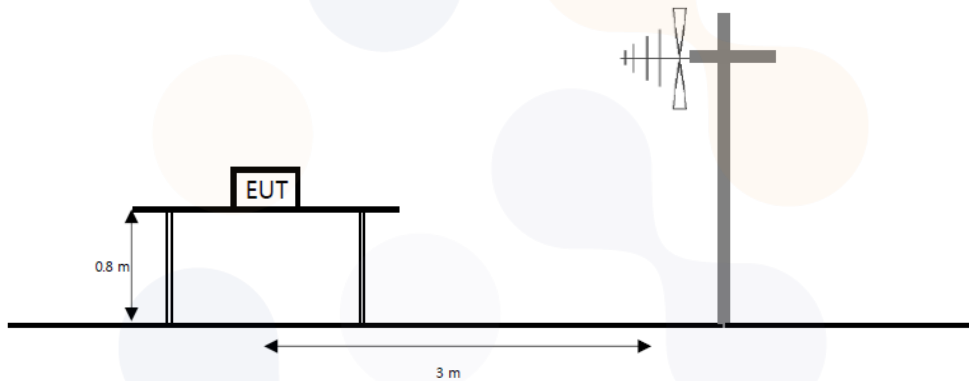
7.5. Spurious Emission, Band Edge and Restricted bands

Test setup

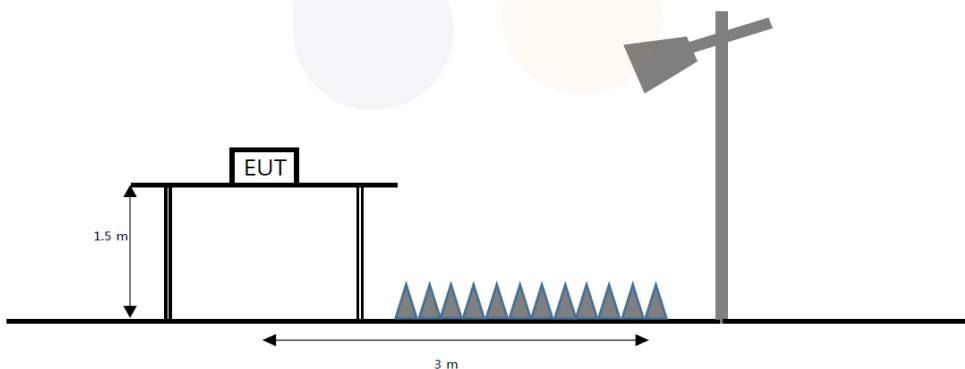
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz emissions, whichever is lower.



Limit

According to section 15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength ($\mu V/m$)	Measurement distance (m)
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/F(kHz)	30
1.705 - 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., Section 15.231 and 15.241.

According to section 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 - 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 - 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 - 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 - 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 - 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 - 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 - 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 - 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525	2 483.5 - 2 500	17.7 - 21.4
8.376 25 - 8.386 75	25	2 690 - 2 900	22.01 - 23.12
8.414 25 - 8.414 75	156.7 - 156.9	3 260 - 3 267	23.6 - 24.0
12.29 - 12.293	162.012 5 - 167.17	3 332 - 3 339	31.2 - 31.8
12.519 75 - 12.520 25	167.72 - 173.2	3 345.8 - 3 358	36.43 - 36.5
12.576 75 - 12.577 25	240 - 285	3 600 - 4 400	Above 38.6
13.36 - 13.41	322 - 335.4		

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in section 15.209. At frequencies equal to or less than 1 000 MHz, compliance with the limits in section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in section 15.35 apply to these measurements.

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR25-SRF0116 Page (33) of (78)	
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According to section 15.407(b), undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz

For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.



Test procedure

ANSI C63.10-2013 Section 12.7.5, 12.7.6, 12.7.7.2
KDB 789033 D02 V02r01 – Section G

Test settings

Peak field strength measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in table
3. VBW $\geq$ (3 $\times$ RBW)
4. Detector = peak
5. Sweep time = auto
6. Trace mode = max hold
7. Allow sweeps to continue until the trace stabilizes

Table. RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1 000 MHz	100 kHz to 120 kHz
> 1 000 MHz	1 MHz

Average field strength measurements

Trace averaging with continuous EUT transmission at full power

If the EUT can be configured or modified to transmit continuously ($D \geq 98\%$), then the average emission levels shall be measured using the following method (with EUT transmitting continuously):

1. RBW = 1 MHz (unless otherwise specified).
2. VBW $\geq$ (3 $\times$ RBW).
3. Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq (\text{RBW} / 2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
4. Averaging type = power (i.e., rms):
 - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
 - 2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces.

Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT ($D \geq 98\%$) cannot be achieved and the duty cycle is constant (duty cycle variations are less than $\pm 2\%$), then the following procedure shall be used:

1. The EUT shall be configured to operate at the maximum achievable duty cycle.
2. Measure the duty cycle D of the transmitter output signal as described in 11.6.
3. RBW = 1 MHz (unless otherwise specified).
4. VBW $\geq$ [3 $\times$ RBW].
5. Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq (\text{RBW} / 2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

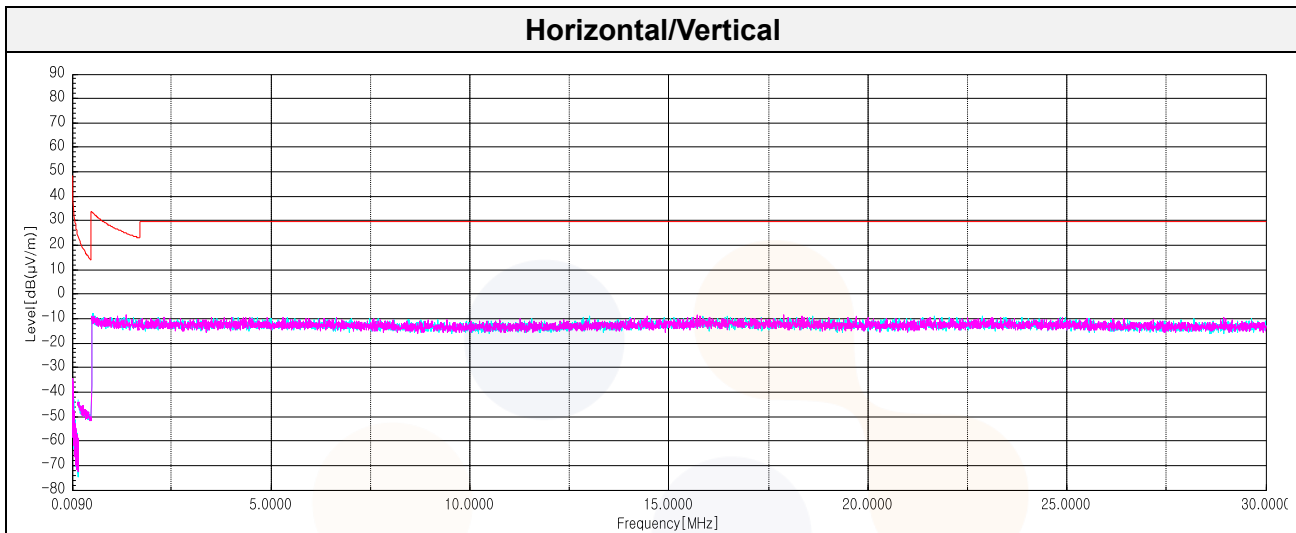
6. Averaging type = power (i.e., rms):
 - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
 - 2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.
7. Sweep time = auto.
8. Perform a trace average of at least 100 traces.
9. 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 step f), then the applicable correction factor is $[10 \log (1 / D)]$, where D is the duty cycle.
 - 2) If linear voltage averaging mode was used in step f), then the applicable correction factor is $[20 \log (1 / D)]$, where D is the duty cycle.
 - 3) If a specific emission is demonstrated to be continuous ($D \geq 98\%$) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Notes:

1. $f < 30$ MHz, extrapolation factor of 40 dB/decade of distance. $F_d = 40 \log(D_m/D_s)$
 $f \geq 30$ MHz, extrapolation factor of 20 dB/decade of distance. $F_d = 20 \log(D_m/D_s)$
Where:
 F_d = Distance factor in dB
 D_m = Measurement distance in meters
 D_s = Specification distance in meters
2. Factors(dB) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) + or F_d (dB)
3. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
4. Average test would be performed if the peak result were greater than the average limit.
5. ¹⁾ means restricted band.
6. According to part 15.31(f)(2), an extrapolation factor of 40 dB/decade is applied because measured distance of radiated emission is 3m
7. Below 30 MHz frequency range, In order to search for the worst result, all orientations about parallel, perpendicular, and ground-parallel were investigated then reported. when the emission level was higher than 20 dB of the limit, then the following statement shall be made: "No spurious emissions were detected within 20 dB of the limit."
8. For above 1 GHz pre-scan to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 kHz for peak measurements.

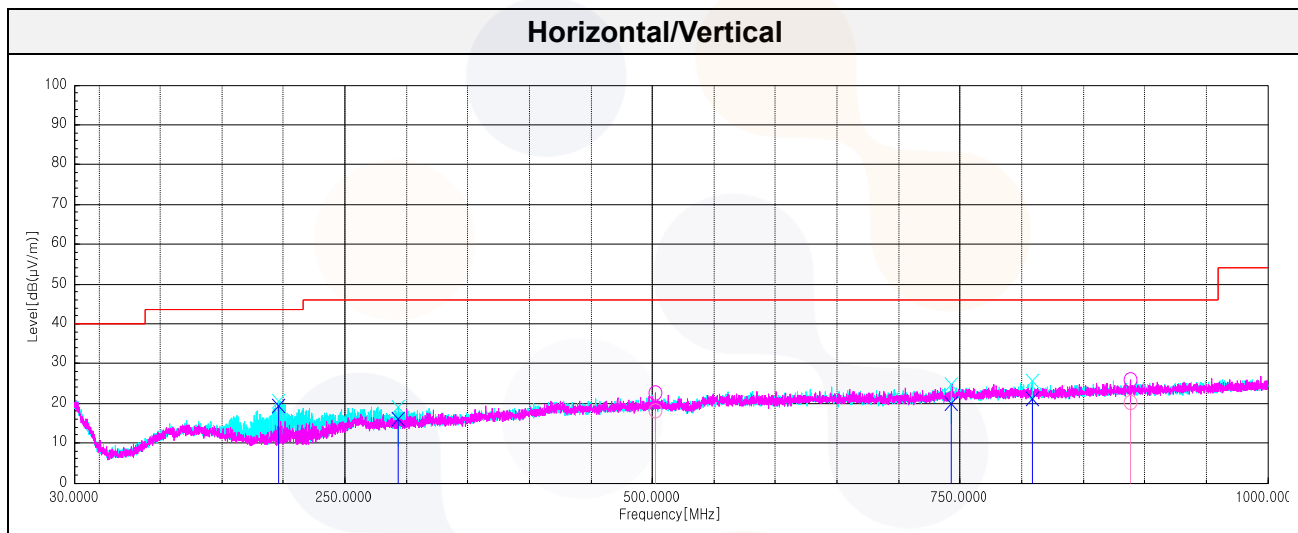
Test results (Below 30 MHz) – Worst case: 802.11n HT40_UNII 3_5 795 MHz

Frequency	Pol.	Reading	Cable Loss	Amp Gain	Antenna Factor	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
No spurious emissions were detected within 20 dB of the limit.									



Test results (Below 1 000 MHz) – Worst case: 802.11n HT40_UNII 3_5 795 MHz

Frequency	Pol.	Reading	Amp. + Cable	Antenna Factor	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data								
196.36	V	35.10	15.40	-31.33	-	19.17	43.50	24.33
293.72	V	28.10	19.00	-31.23	-	15.87	46.00	30.13
502.15	H	25.50	23.50	-31.04	-	17.96	46.00	28.04
742.34	V	24.80	25.62	-30.47	-	19.95	46.00	26.05
808.30	V	25.20	26.00	-30.03	-	21.17	46.00	24.83
888.09	H	23.00	26.50	-29.36	-	20.14	46.00	25.86

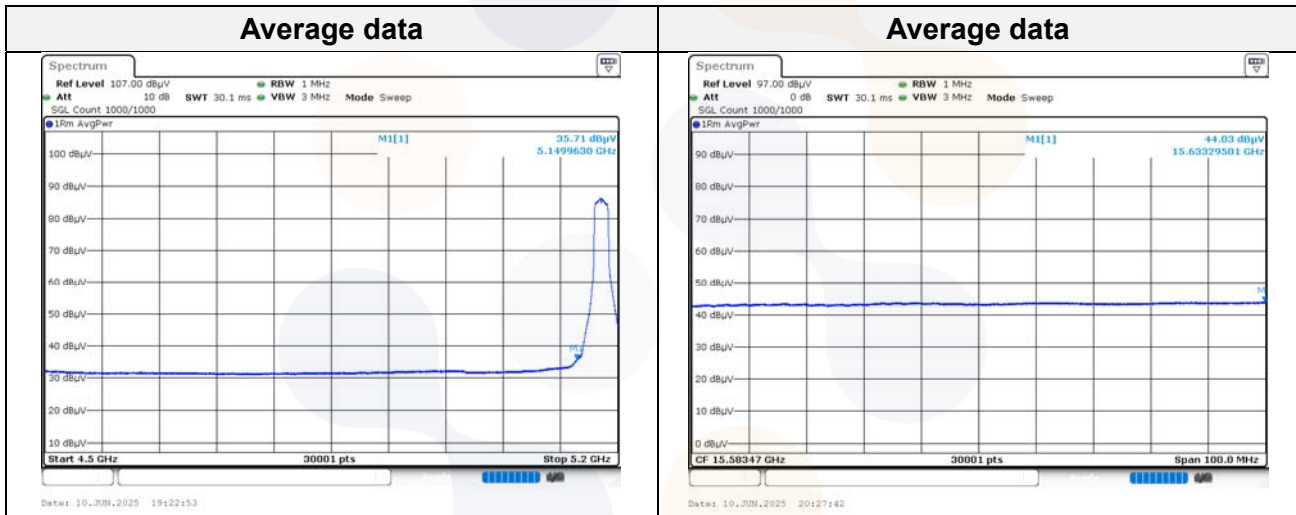


Test results (Above 1 000 MHz)

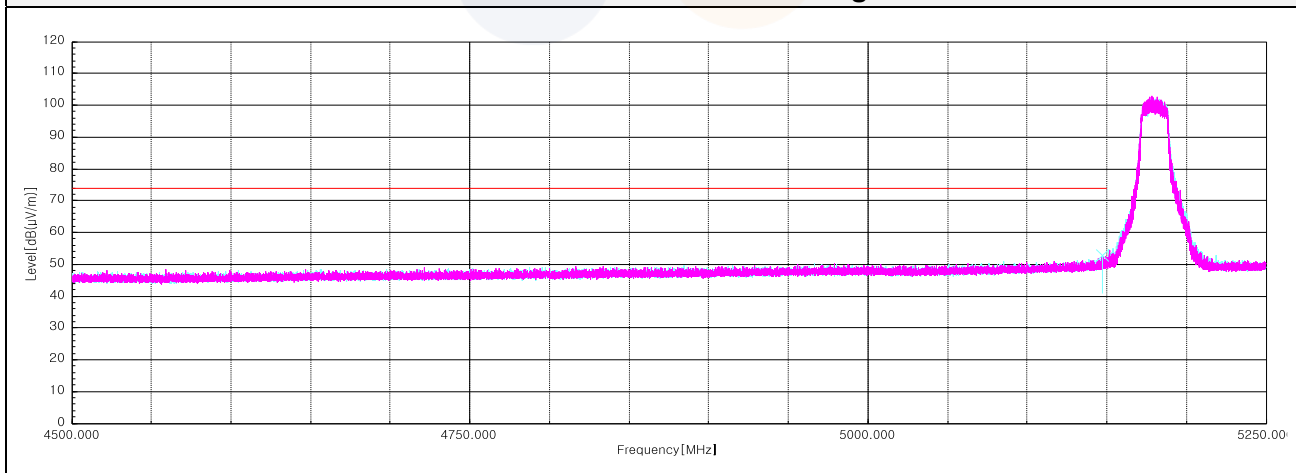
802.11a UNII 1

Lowest Channel (5 180 MHz)

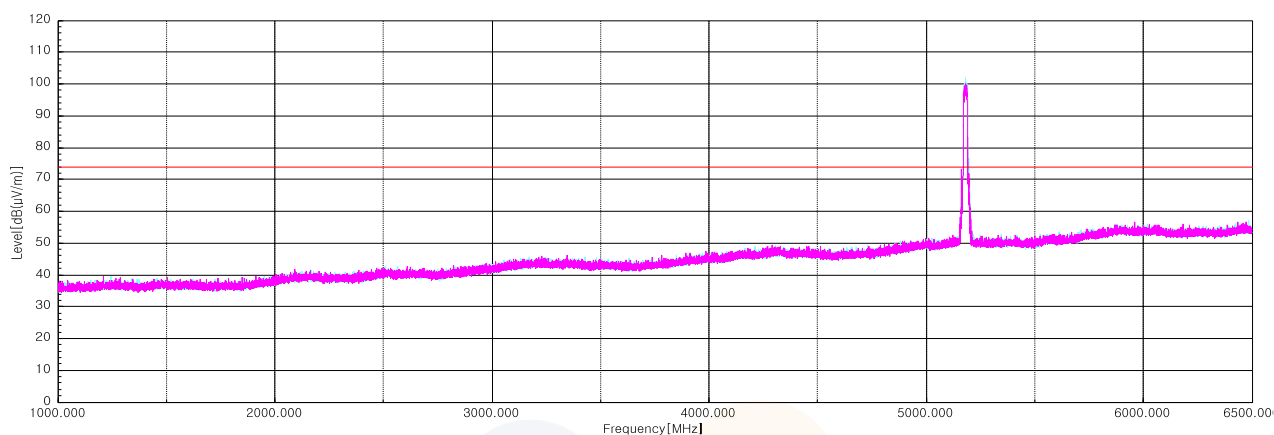
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
5 149.96 ¹⁾	V	46.20	33.20	-26.63	-	52.77	74.00	21.23
10 366.68	H	55.80	38.77	-43.04	-	51.53	68.20	16.67
15 633.30 ¹⁾	V	54.60	37.83	-40.93	-	51.50	74.00	22.50
Average Data								
5 149.96 ¹⁾	V	35.71	33.20	-26.63	-	42.28	54.00	11.72
15 633.30 ¹⁾	V	44.03	37.83	-40.93	-	40.93	54.00	13.07



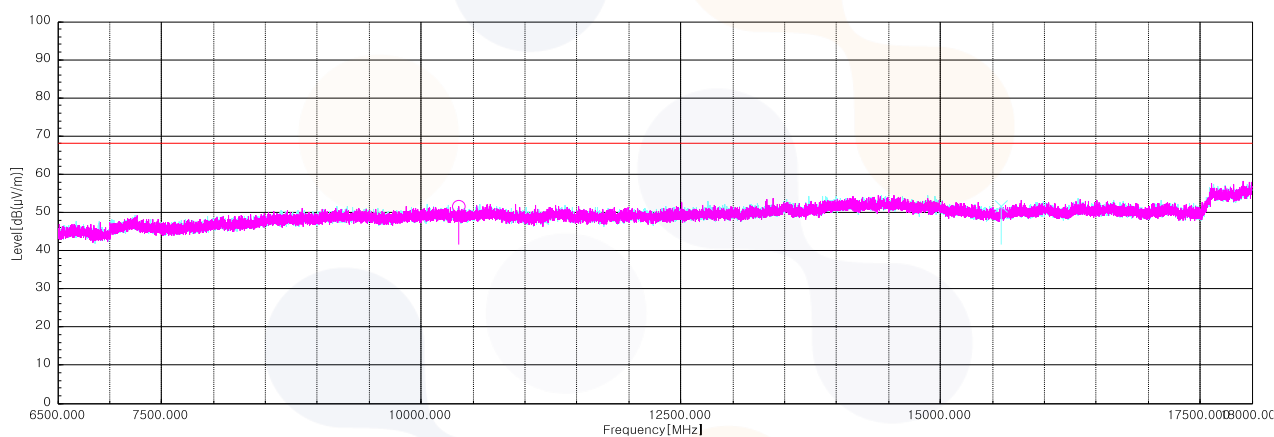
Horizontal/Vertical for Band-edge



Horizontal/Vertical for 1 GHz ~ 6.5 GHz

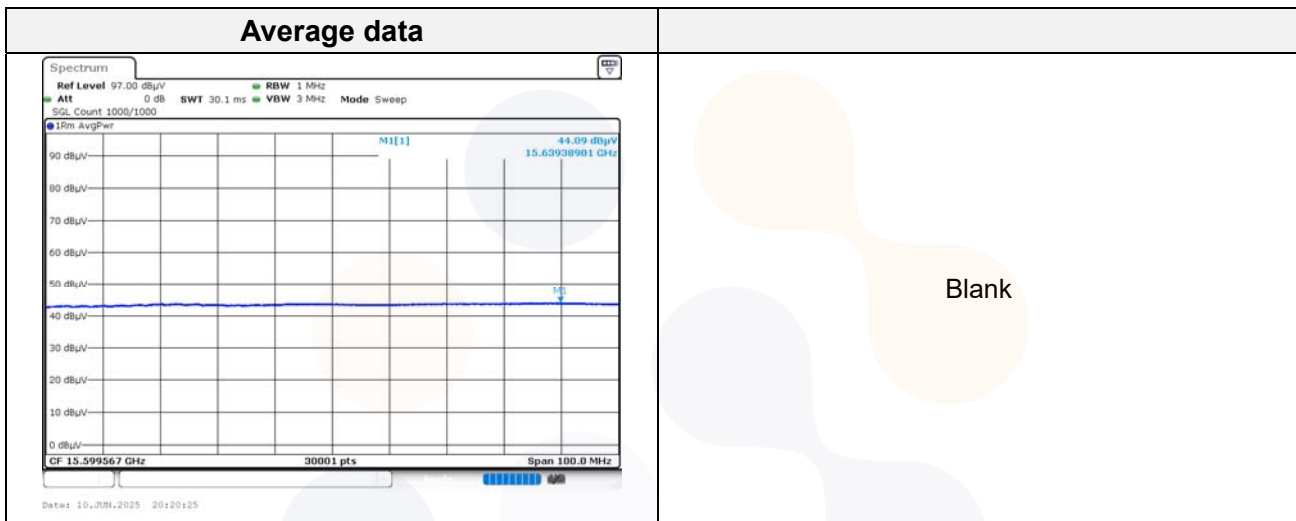


Horizontal/Vertical for 6.5 GHz ~ 18 GHz

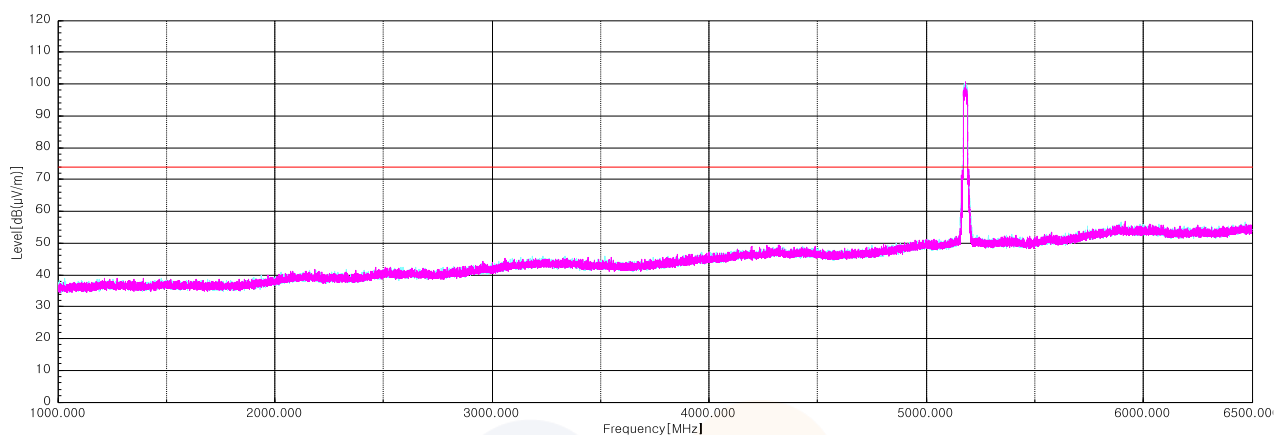


Middle Channel (5 200 MHz)

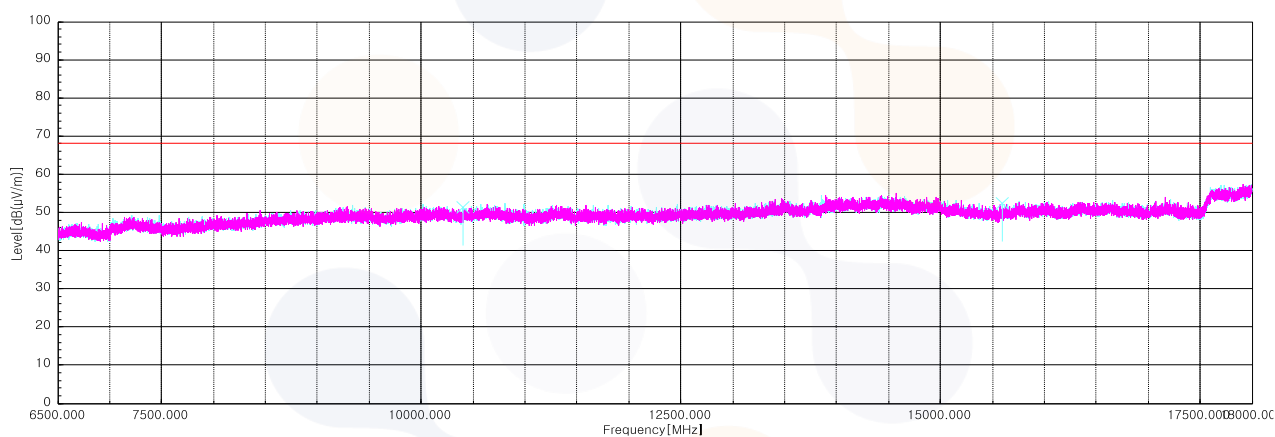
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
10 406.17	V	55.60	38.80	-43.05	-	51.35	68.20	16.85
15 639.39 ¹⁾	V	55.40	37.82	-40.92	-	52.30	74.00	21.70
Average Data								
15 639.39 ¹⁾	V	44.09	37.82	-40.92	-	40.99	54.00	13.01



Horizontal/Vertical for 1 GHz ~ 6.5 GHz

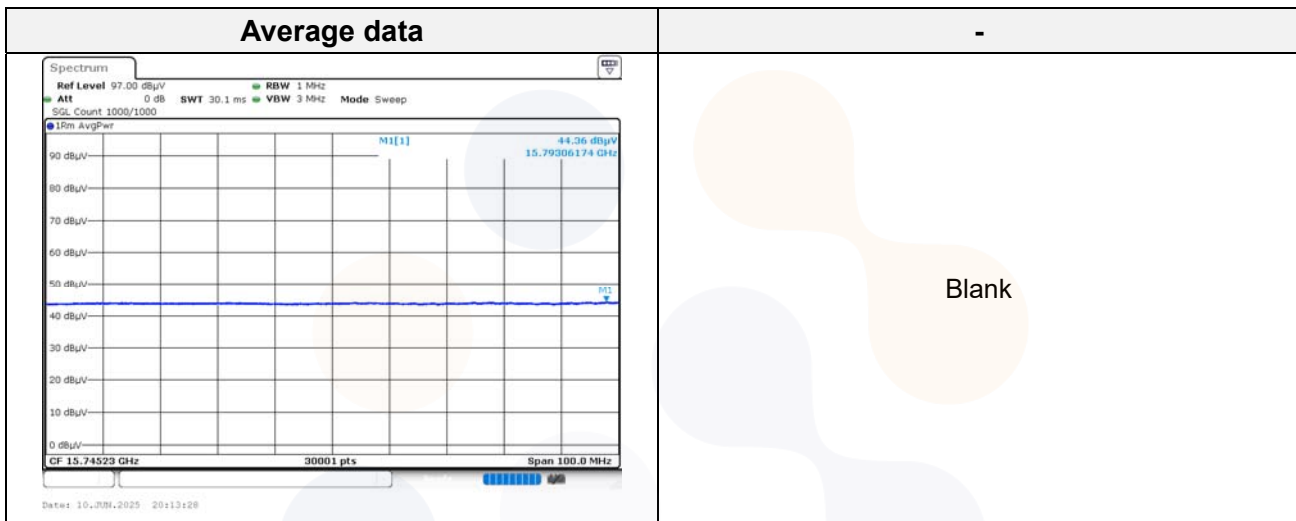


Horizontal/Vertical for 6.5 GHz ~ 18 GHz

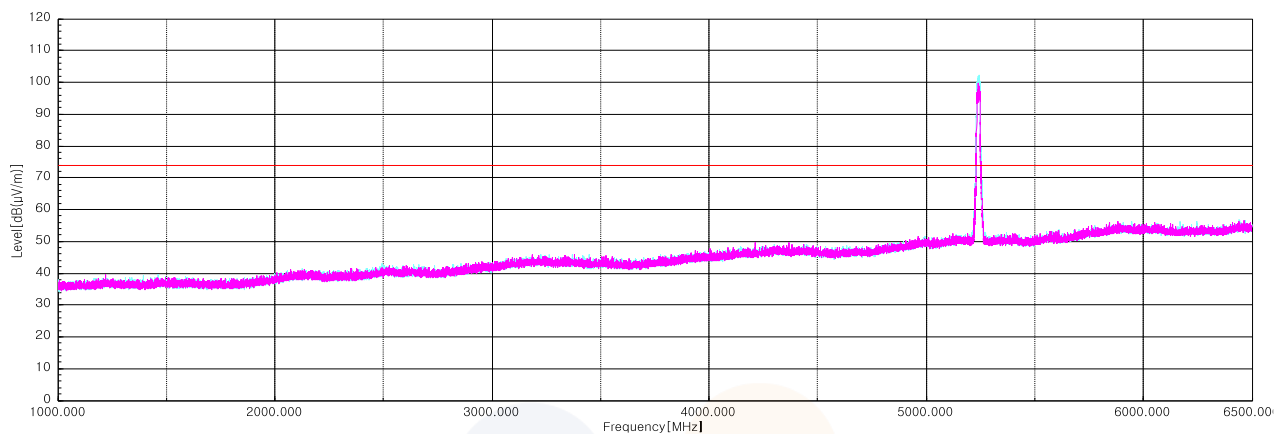


Highest Channel (5 240 MHz)

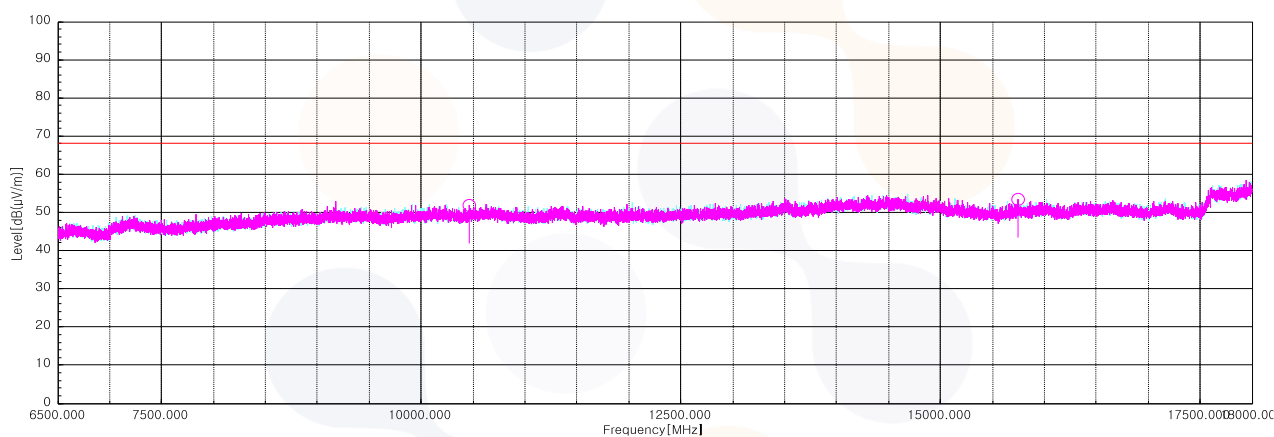
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
10 464.43	H	55.90	38.93	-43.06	-	51.77	68.20	16.43
15 793.06 ¹⁾	H	56.20	37.90	-40.75	-	53.35	74.00	20.65
Average Data								
15 793.06 ¹⁾	H	44.36	37.90	-40.75	-	41.51	54.00	12.49



Horizontal/Vertical for 1 GHz ~ 6.5 GHz



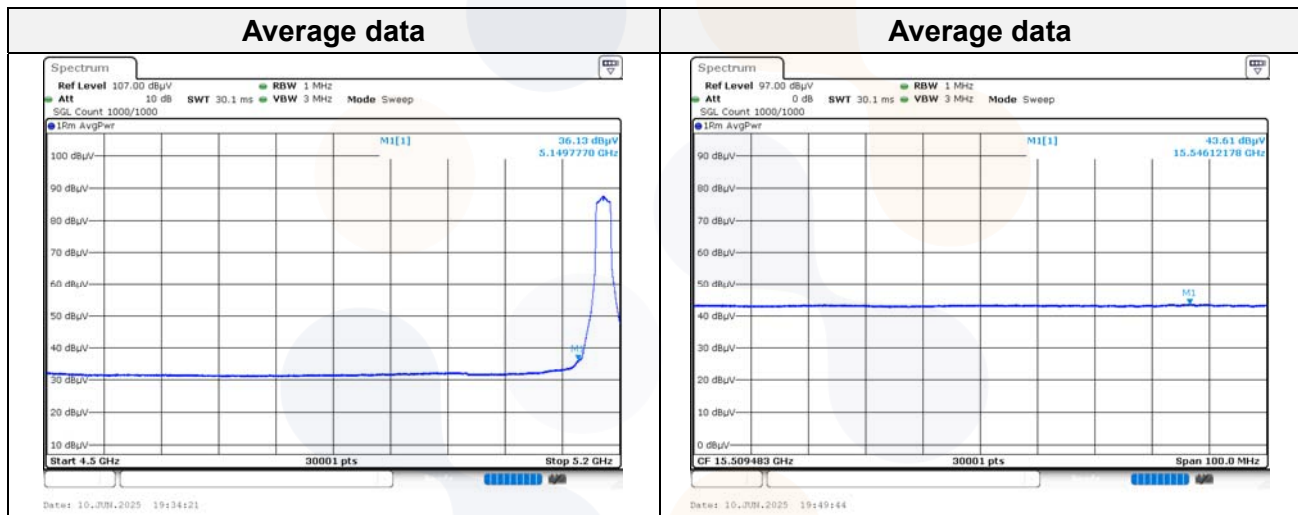
Horizontal/Vertical for 6.5 GHz ~ 18 GHz



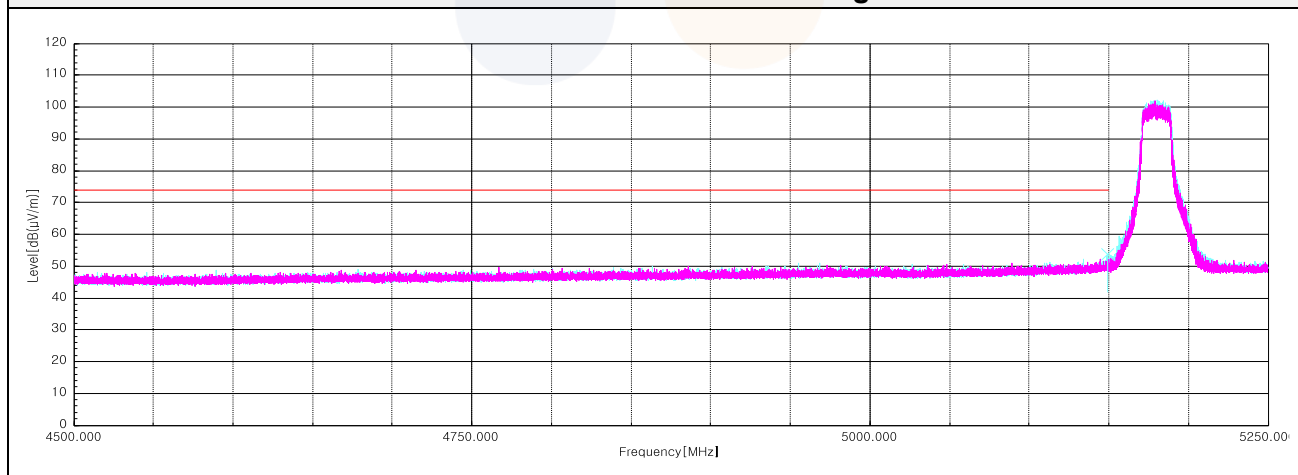
802.11n HT20 UNII 1

Lowest Channel (5 180 MHz)

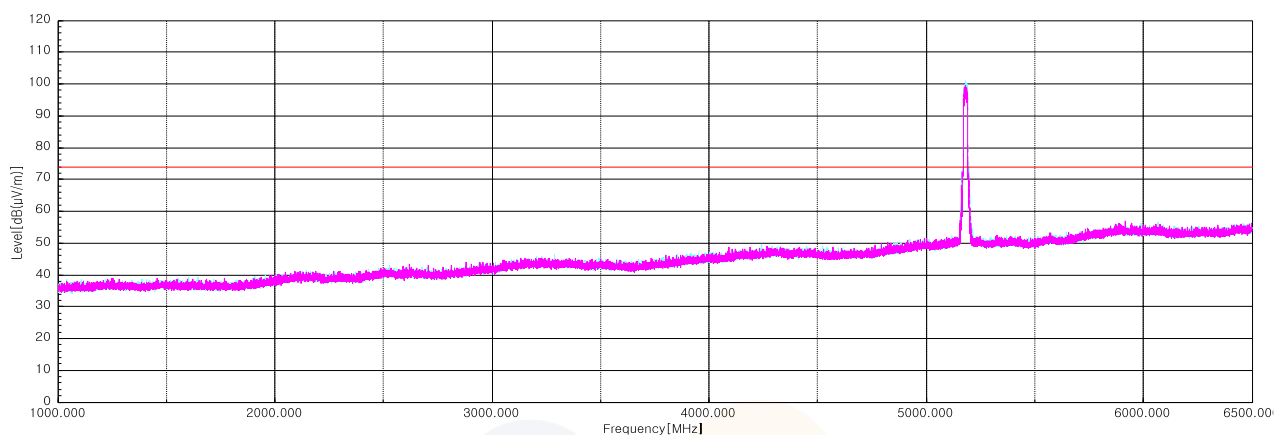
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
5 149.78 ¹⁾	V	47.10	33.20	-26.63	-	53.67	74.00	20.33
10 364.38	H	55.40	38.77	-43.04	-	51.13	68.20	17.07
15 546.12 ¹⁾	V	55.30	38.11	-41.03	-	52.38	74.00	21.62
Average Data								
5 149.78 ¹⁾	V	36.13	33.20	-26.63	0.09	42.79	54.00	11.21
15 546.12 ¹⁾	V	43.61	38.11	-41.03	0.09	40.78	54.00	13.22



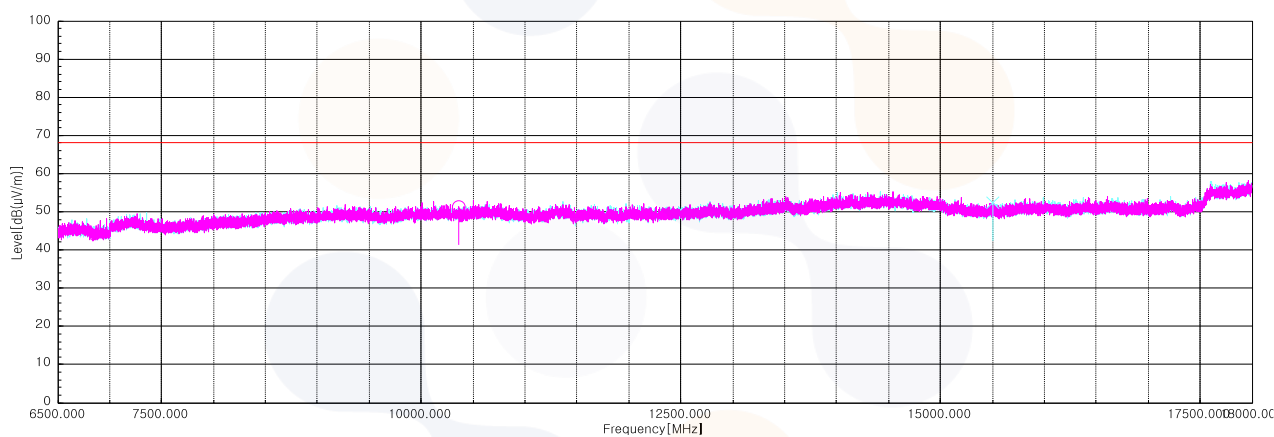
Horizontal/Vertical for Band-edge



Horizontal/Vertical for 1 GHz ~ 6.5 GHz

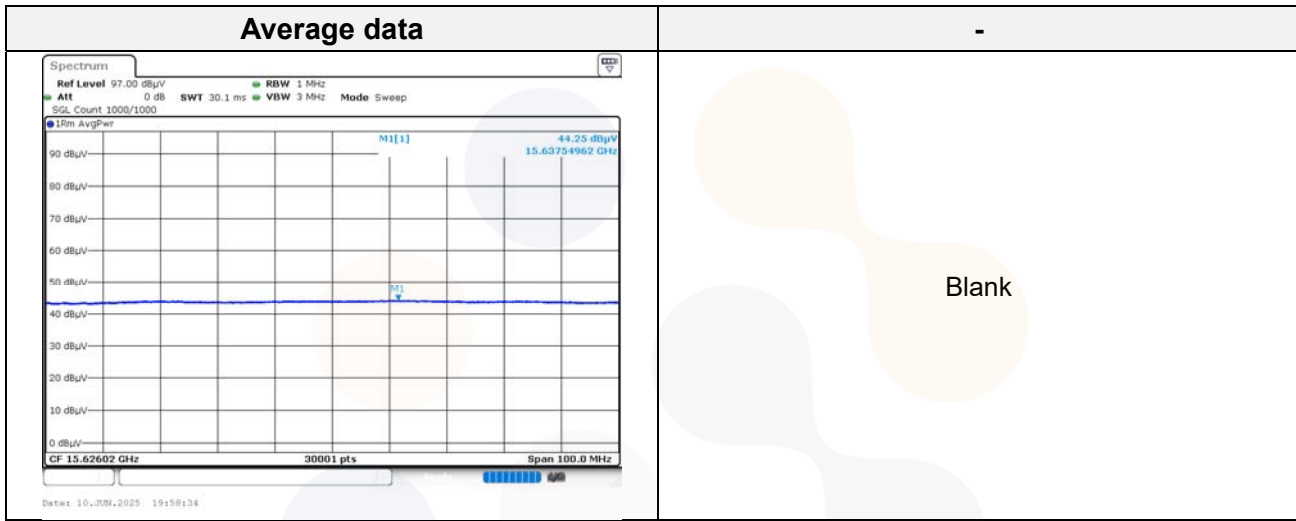


Horizontal/Vertical for 6.5 GHz ~ 18 GHz

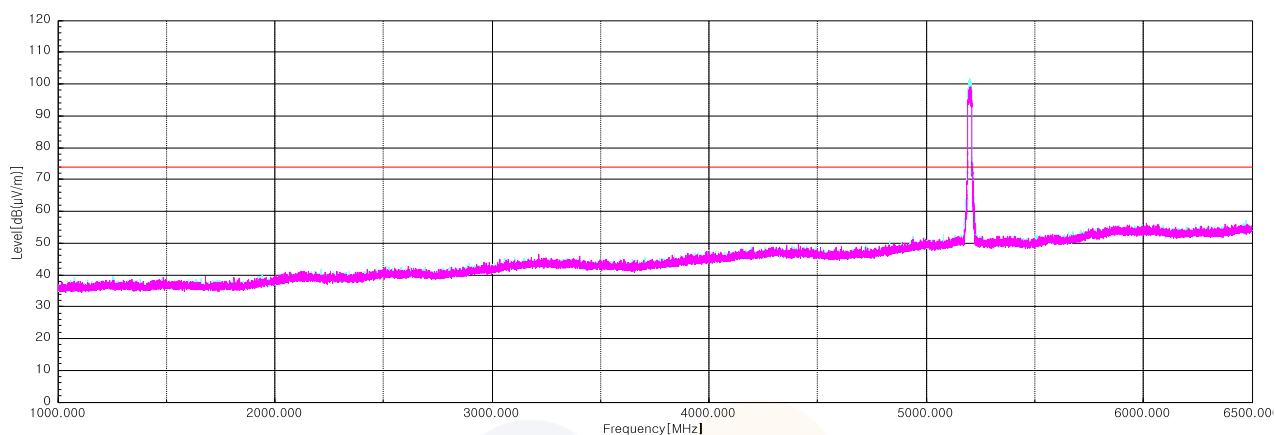


Middle Channel (5 200 MHz)

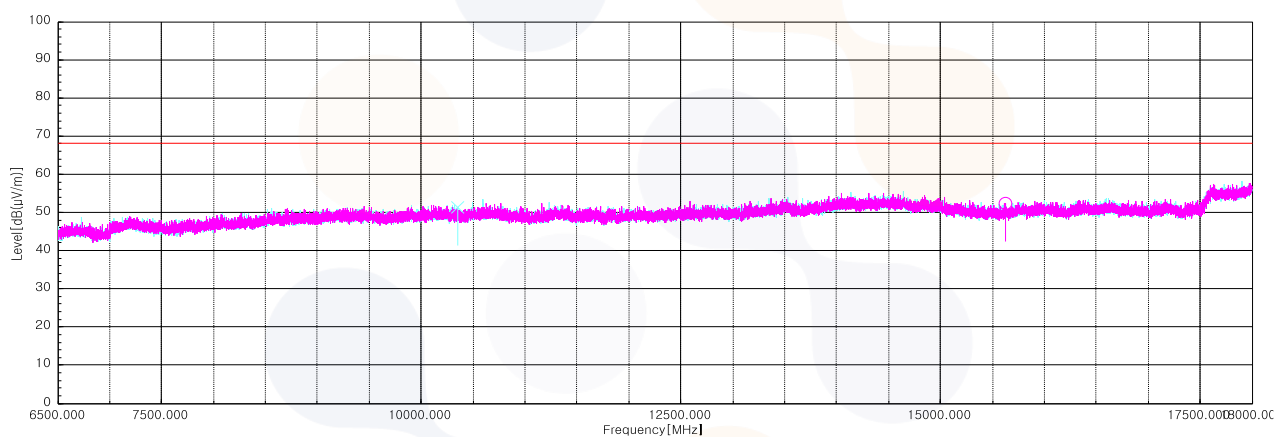
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
10 350.97	V	55.50	38.80	-43.04	-	51.26	68.20	16.94
15 637.55 ¹⁾	H	55.30	37.82	-40.92	-	52.20	74.00	21.80
Average Data								
15 637.55 ¹⁾	H	44.25	37.82	-40.92	0.09	41.24	54.00	12.76



Horizontal/Vertical for 1 GHz ~ 6.5 GHz

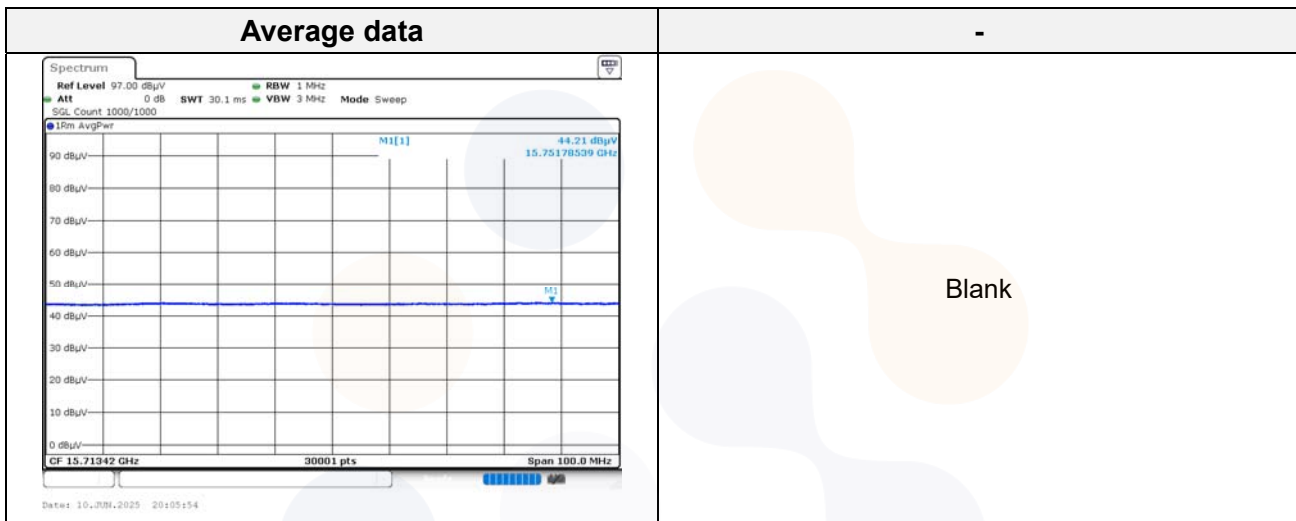


Horizontal/Vertical for 6.5 GHz ~ 18 GHz

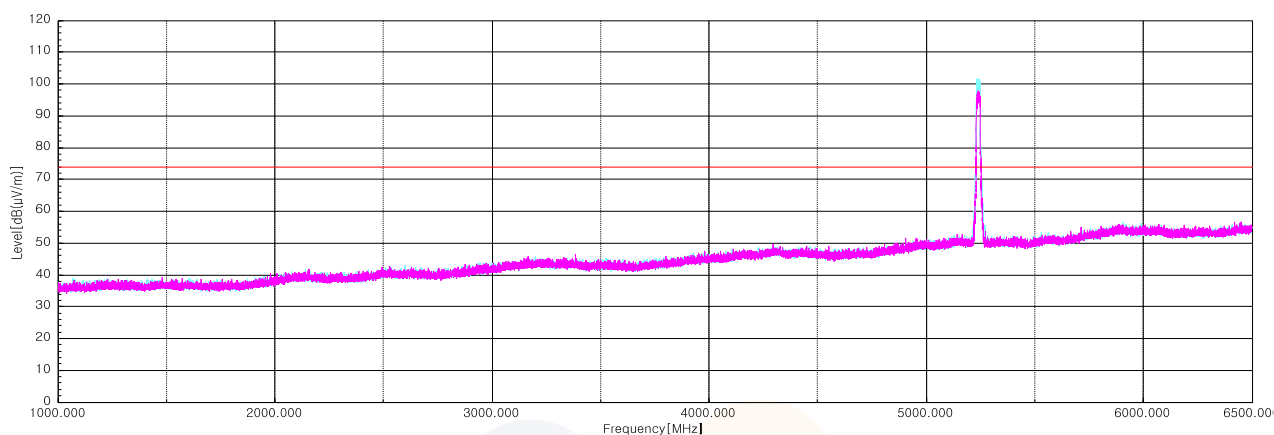


Highest Channel (5 240 MHz)

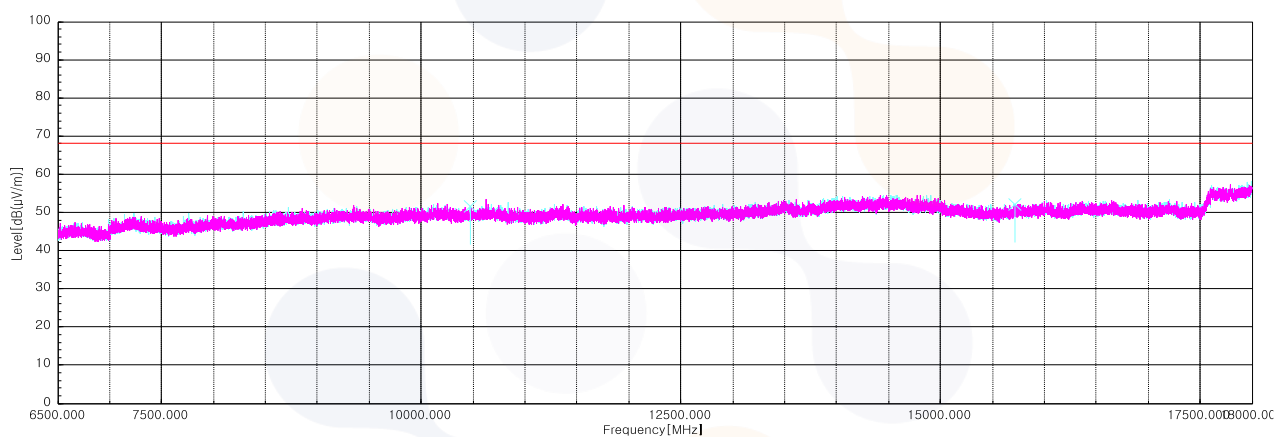
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
10 475.17	V	55.80	38.95	-43.06	-	51.69	68.20	16.51
15 751.79 ¹⁾	V	55.10	37.90	-40.79	-	52.21	74.00	21.79
Average Data								
15 751.79 ¹⁾	V	44.21	37.90	-40.79	0.09	41.41	54.00	12.59



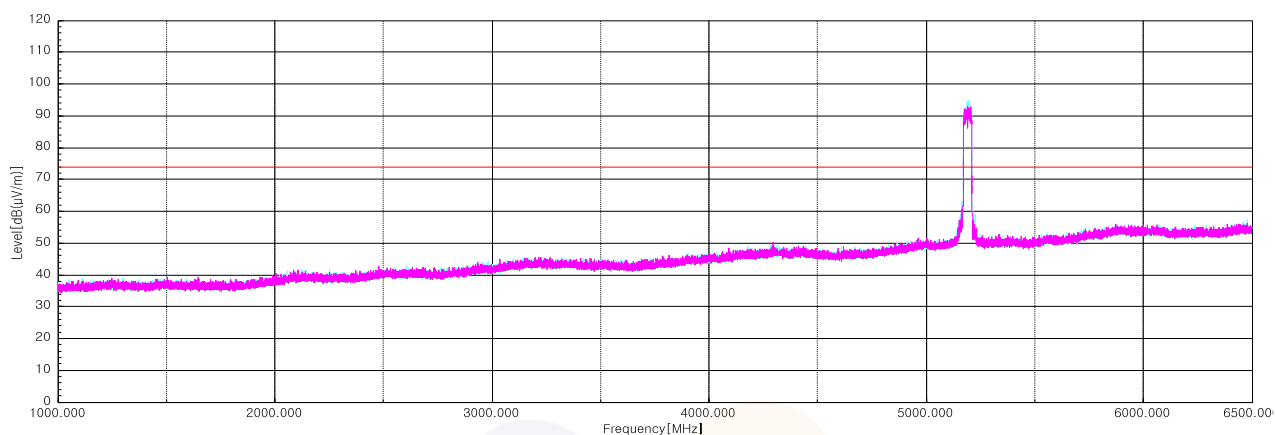
Horizontal/Vertical for 1 GHz ~ 6.5 GHz



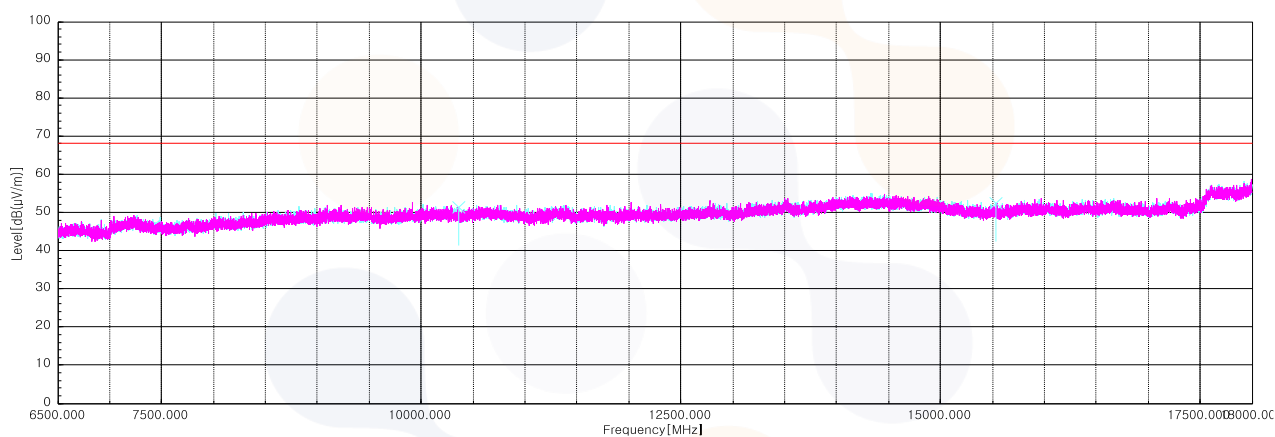
Horizontal/Vertical for 6.5 GHz ~ 18 GHz



Horizontal/Vertical for 1 GHz ~ 6.5 GHz

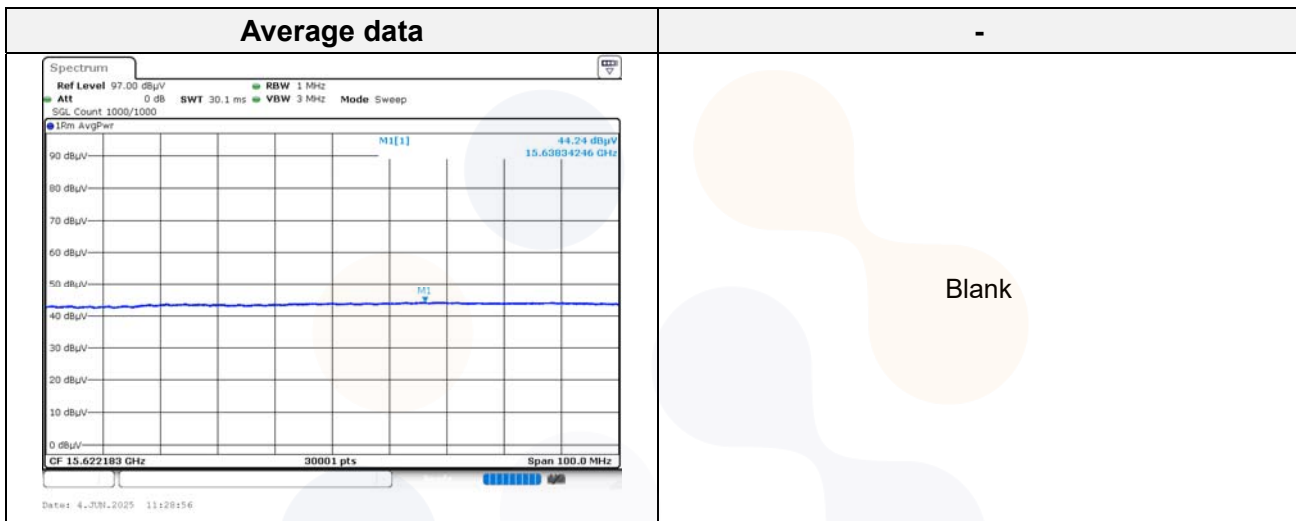


Horizontal/Vertical for 6.5 GHz ~ 18 GHz

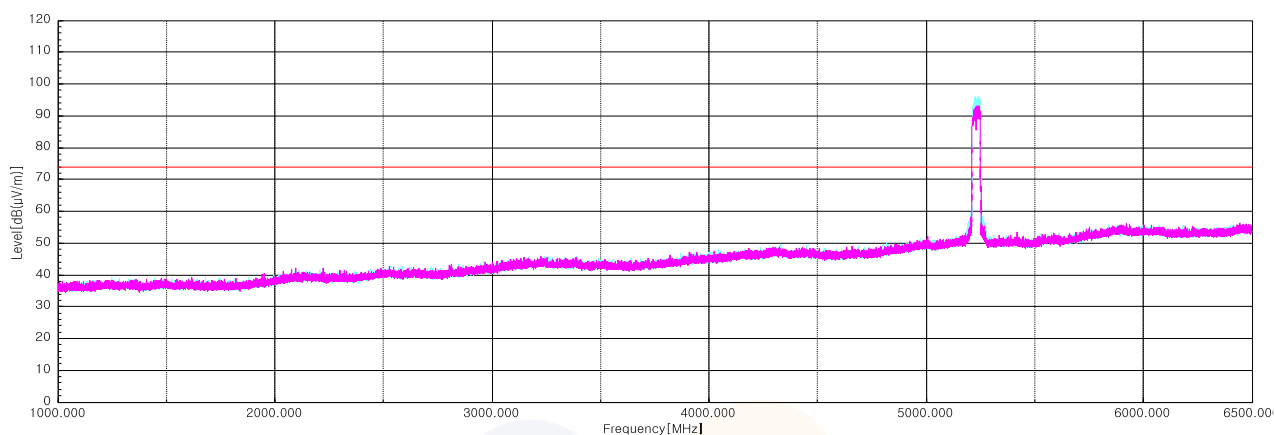


Highest Channel (5 230 MHz)

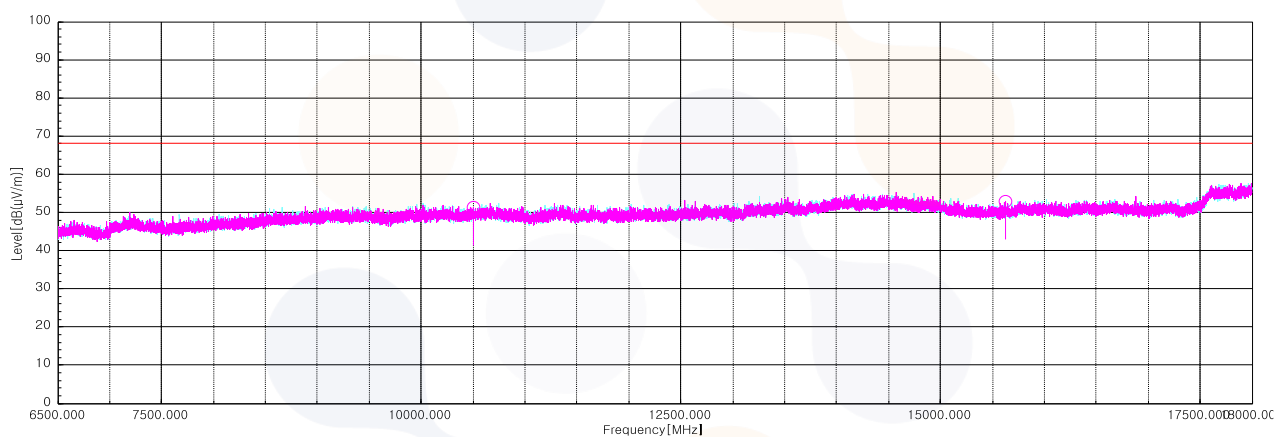
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
10 503.53	H	55.60	38.90	-43.07	-	51.43	68.20	16.77
15 638.34 ¹⁾	H	55.80	37.82	-40.92	-	52.70	74.00	21.30
Average Data								
15 638.34 ¹⁾	H	44.24	37.82	-40.92	0.17	41.31	54.00	12.69



Horizontal/Vertical for 1 GHz ~ 6.5 GHz



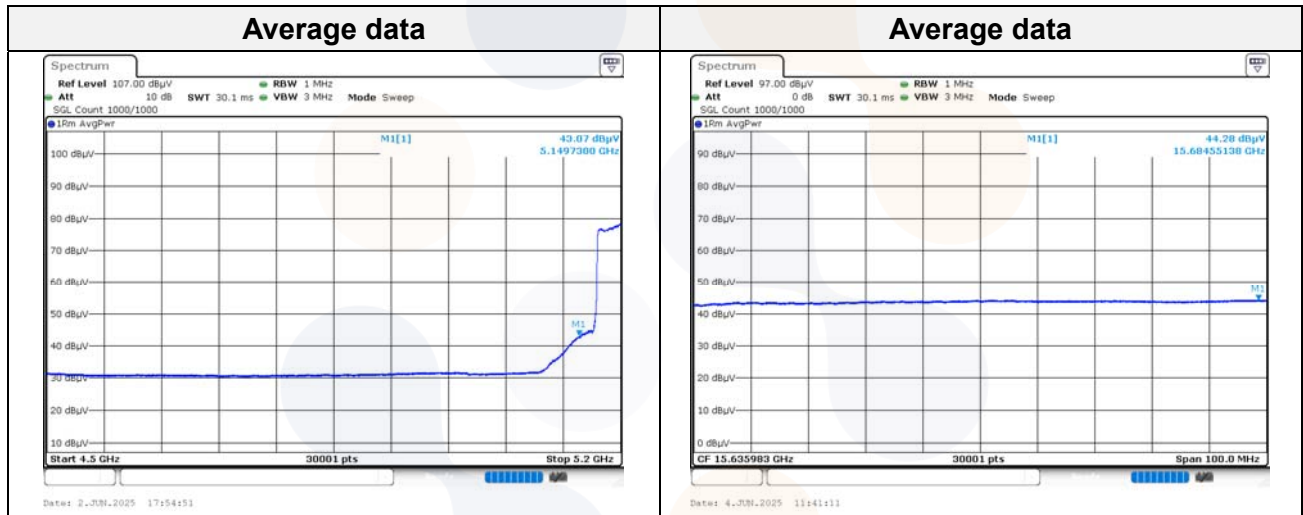
Horizontal/Vertical for 6.5 GHz ~ 18 GHz



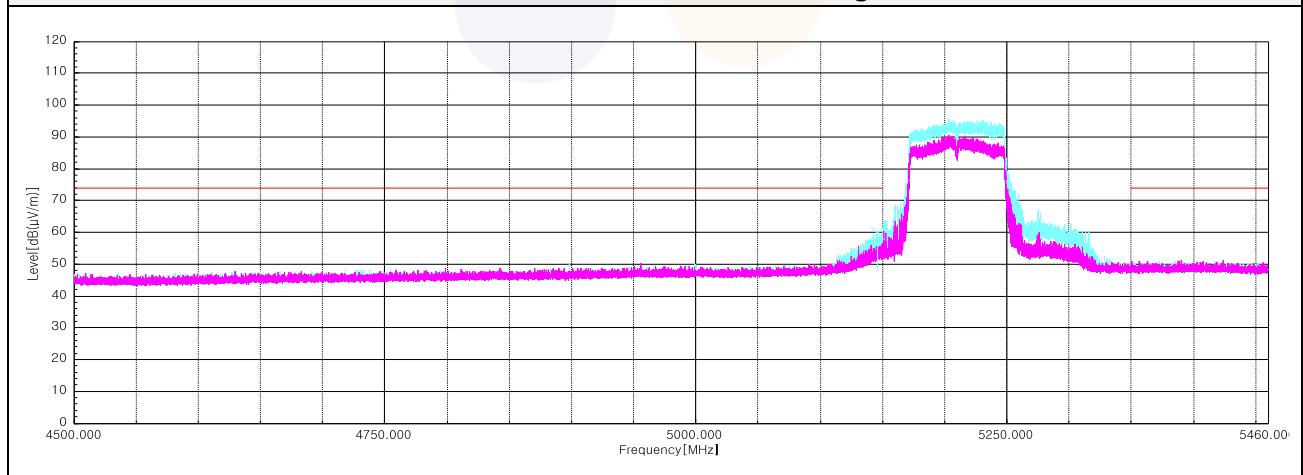
802.11ac VHT80 UNII 1

Lowest Channel (5 210 MHz)

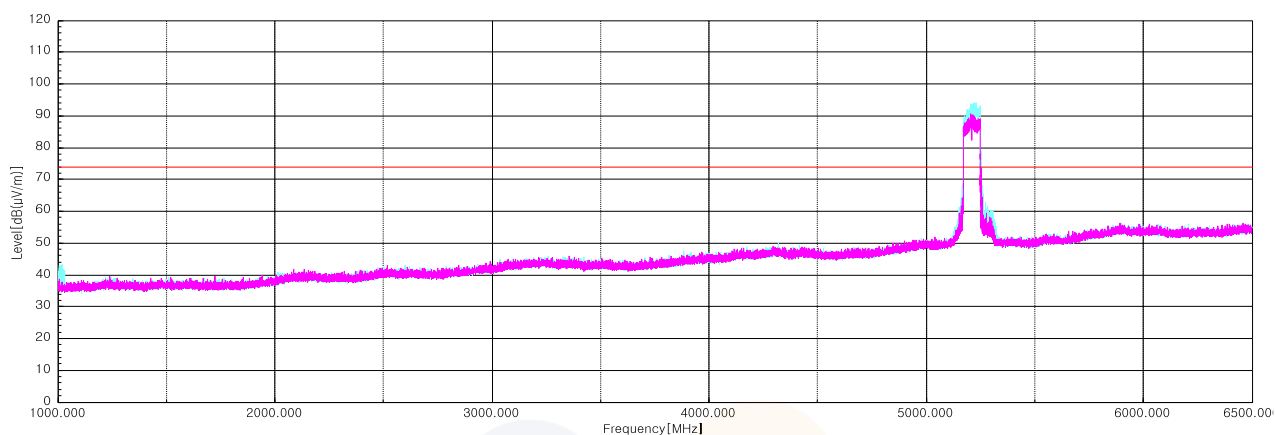
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
5 149.73 ¹⁾	V	52.90	33.20	-26.63	-	59.47	74.00	14.53
10 464.05	V	55.60	38.93	-43.06	-	51.47	68.20	16.73
15 684.55 ¹⁾	V	54.90	37.90	-40.87	-	51.93	74.00	22.07
Average Data								
5 149.73 ¹⁾	V	43.07	33.20	-26.63	0.33	49.97	54.00	4.03
15 684.55 ¹⁾	V	44.28	37.90	-40.87	0.33	41.64	54.00	12.36



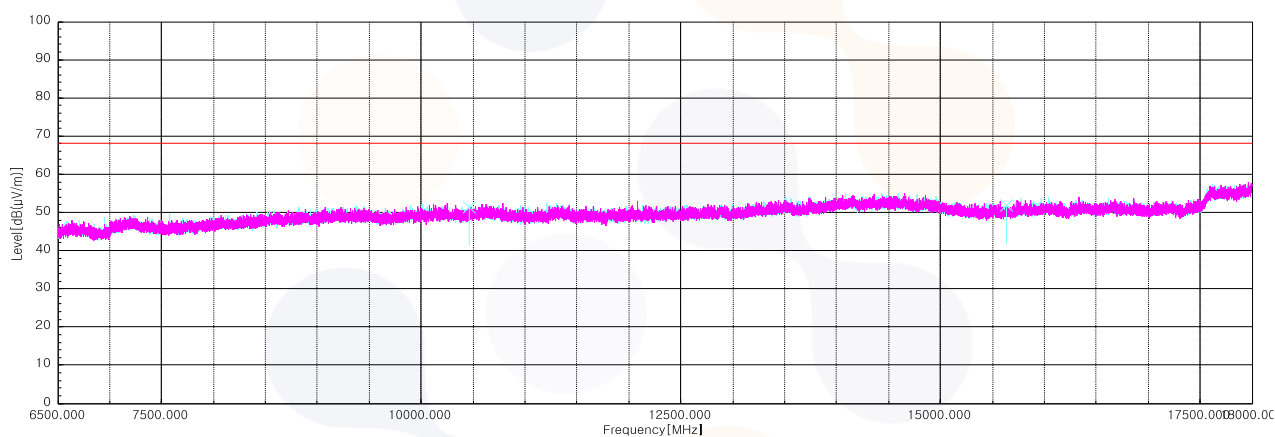
Horizontal/Vertical for Band-edge



Horizontal/Vertical for 1 GHz ~ 6.5 GHz

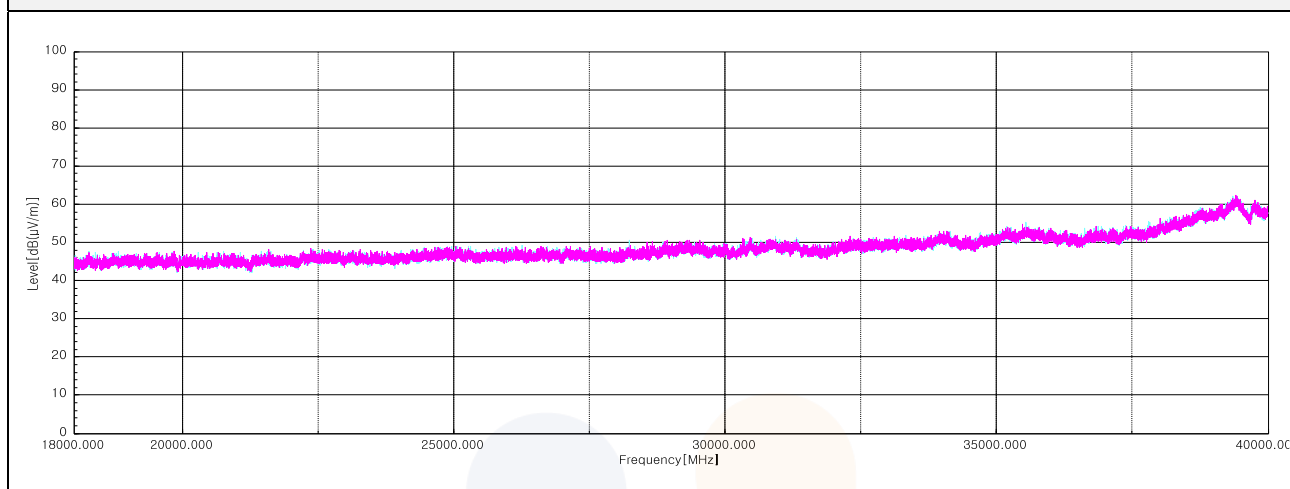


Horizontal/Vertical for 6.5 GHz ~ 18 GHz



Test results (Above 18 GHz) – Worst case: 802.11ac VHT80_UNII 1_5 210 MHz

Horizontal/Vertical for 18 GHz ~ 40 GHz

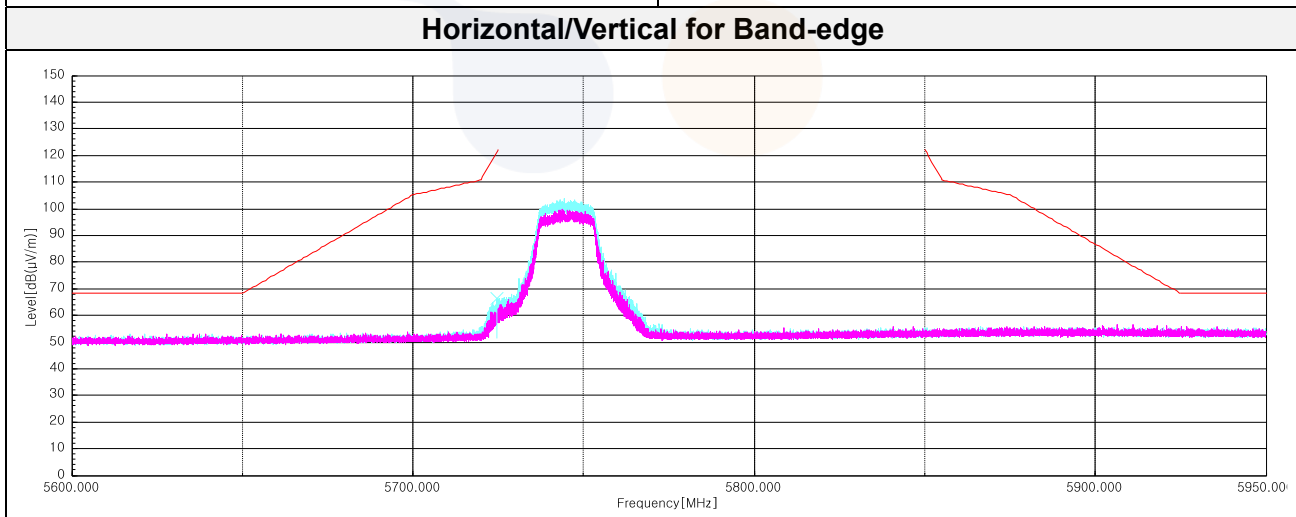
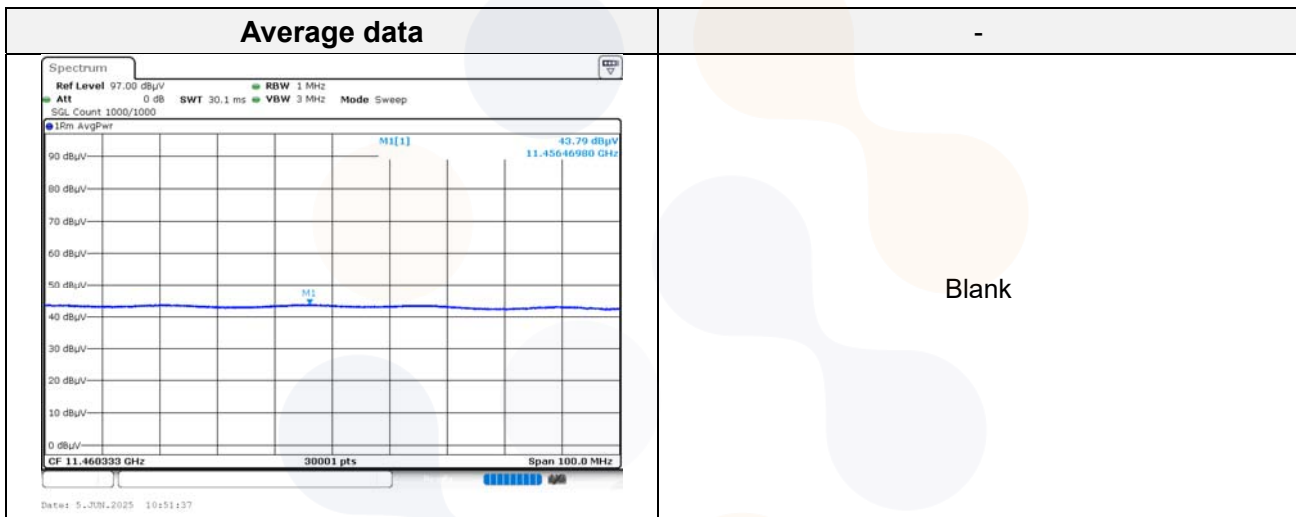


Note: The Worst case was based on the lowest margin condition considering Harmonic and Spurious Emission.

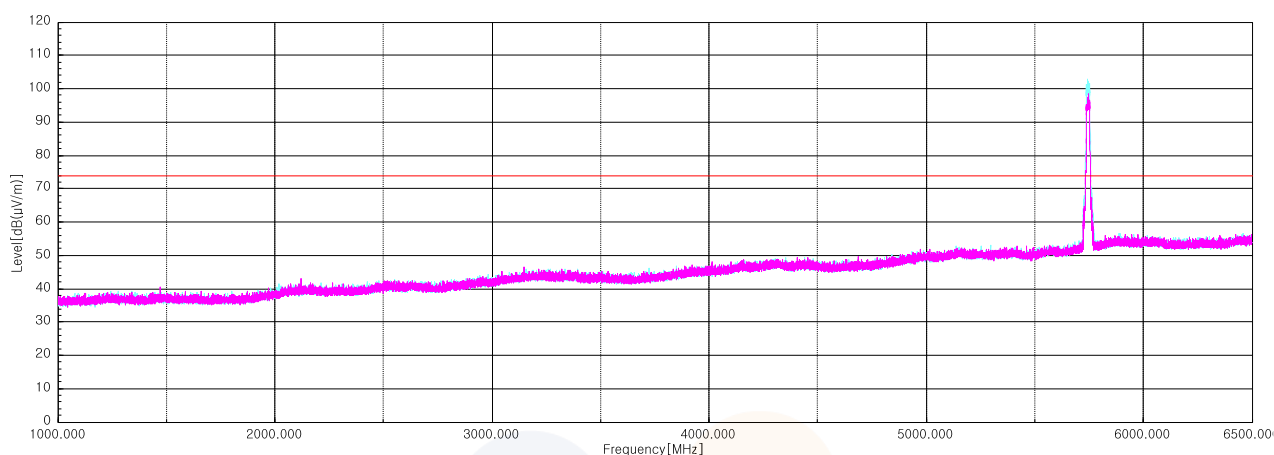
802.11a UNII 3

Lowest Channel (5 745 MHz)

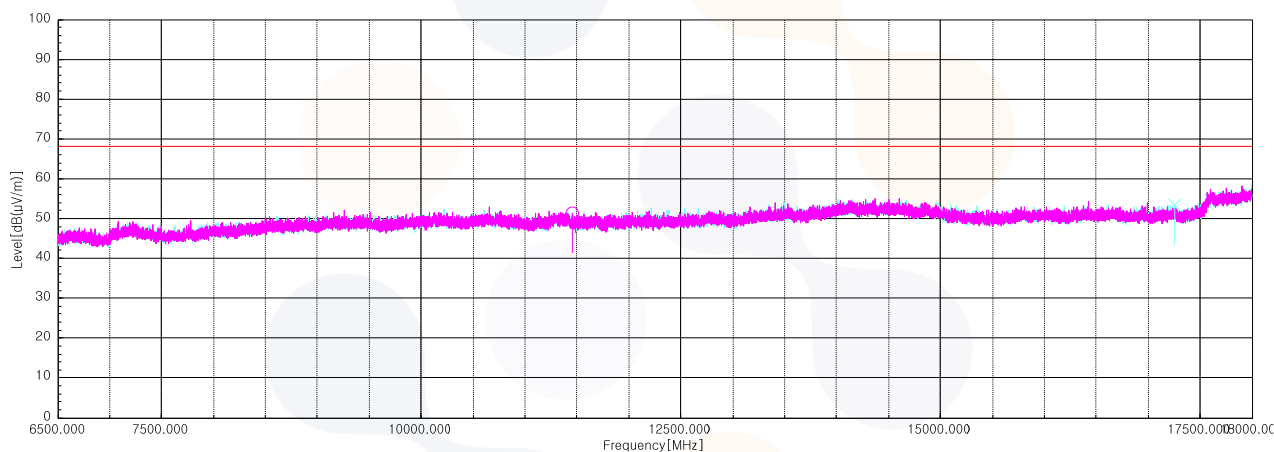
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
5 724.73	V	58.40	33.50	-25.67	-	66.23	121.60	55.37
11 456.47 ¹⁾	H	54.50	38.99	-42.28	-	51.21	74.00	22.79
17 254.03	V	55.60	38.22	-40.51	-	53.31	68.20	14.89
Average Data								
11 456.47 ¹⁾	H	43.79	38.99	-42.28	-	40.50	54.00	13.50



Horizontal/Vertical for 1 GHz ~ 6.5 GHz

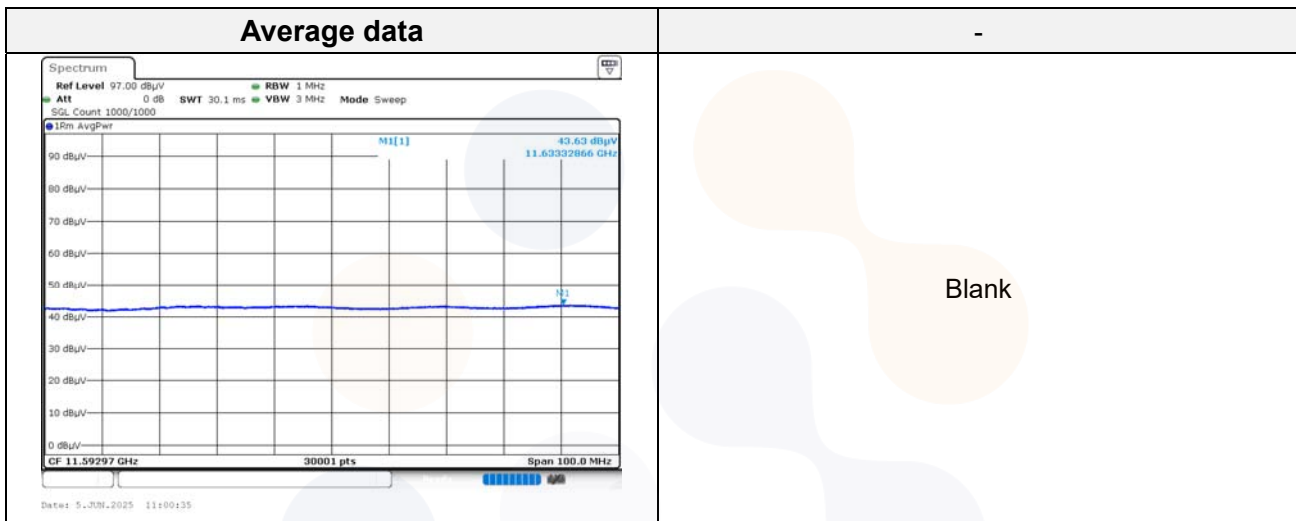


Horizontal/Vertical for 6.5 GHz ~ 18 GHz

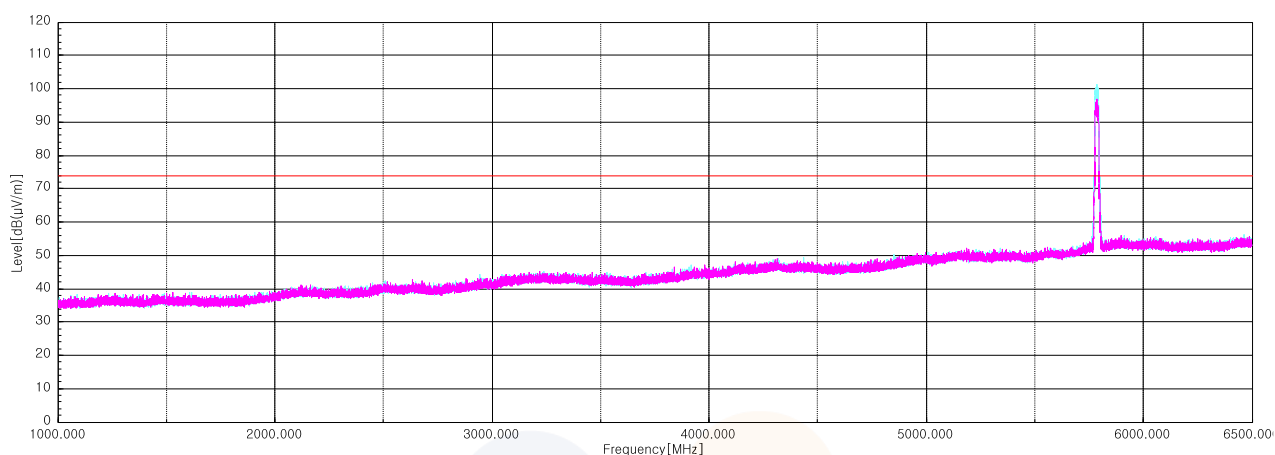


Middle Channel (5 785 MHz)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
11 633.33 ¹⁾	V	54.30	38.63	-41.73	-	51.20	74.00	22.80
17 326.87	V	55.30	38.51	-40.78	-	53.03	68.20	15.17
Average Data								
11 633.33 ¹⁾	V	43.63	38.63	-41.73	-	40.53	54.00	13.47



Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz

