



TEST REPORT

KCTL Inc. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr		Report No.: KR21-SRF0204-C Page (1) of (74)	
1. Client - Name : DREAMUS COMPANY - Address : 311, Gangnam-daero, Seocho-gu, Seoul, Republic of Korea - Date of Receipt : 2021-07-05			
2. Use of Report : Certification			
3. Name of Product / Model : SP2000T / PPF34			
4. Manufacturer / Country of Origin : DREAMUS COMPANY / Korea			
5. FCC ID : QDMPPF34			
6. Date of Test : 2021-08-11 to 2021-08-27			
7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing (Address: 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)			
8. Test method used : FCC Part 15 Subpart E, 15.407			
9. Test Result : Refer to the test result in the test report			
Affirmation	Tested by Name : Hosung Lee (Signature)		Technical Manager Name : Heesu Ahn (Signature)
2021-09-16			
KCTL Inc.			
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REPORT REVISION HISTORY

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2021-09-09	Originally issued	-
2021-09-13	Updated	22, 25-27, 42, 46, 49
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Note. The report No. KR21-SRF0204-B is superseded by the report No. KR21-SRF0204-C.

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 : DREAMUS COMPANY
 Address : 311, Gangnam-daero, Seocho-gu, Seoul, Republic of Korea
 Manufacturer : DREAMUS COMPANY
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 Laboratory : KCTL Inc.
 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 : SP2000T
 Model : PPF34
 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 : BT/LE : Bluetooth(BDR/EDR)_79 ch, Bluetooth(BLE)_40 ch
 2.4 GHz band : 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)
 Frequency range : 2.4 GHz band : 2 402 MHz ~ 2 480 MHz (Bluetooth/BLE)
 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)
 Power source : DC 3.8 V
 Antenna specification : PCB Antenna
 Antenna gain : BT/LE : -1.797 dBi
 2.4 GHz band : -1.797 dBi
 UNII-1 : -0.979 dBi
 UNII-3 : -7.773 dBi
 Software version : 1.0
 Hardware version : 1.0
 Operation temperature : -10 °C ~ 50 °C

2.1. Simultaneously transmission condition

Case	Technology	Test Mode	Frequency (MHz)
Case 1	WLAN 2.4 GHz	802.11b	2 462
	Bluetooth	BDR(DH5)	2 402
Case 2	WLAN 2.4 GHz	802.11b	2 462
	Bluetooth Low Energy	BLE (1M Bits/s, 37 Packet)	2 402
Case 3	WLAN 5 GHz	802.11ac_VHT80	5 210
	Bluetooth	BDR(DH5)	2 402
Case 4	WLAN 5 GHz	802.11ac_VHT80	5 210
	Bluetooth Low Energy	BLE (1M Bits/s, 37 Packet)	2 402

Notes.

The lowest margin condition among the channels and modes were selected for test.

2.2. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
Li-ion Polymer Battery	Shenzhen Hypercell Company Limited	HPL616075-4200mAh	-	3.8 V, 4 200 mAh/2

2.3. Frequency/channel operations

This device contains the following capabilities:

Bluetooth(BDR/EDR/BLE), WLAN 2.4 GHz(802.11b/g/n_HT20/HT40)

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

UNII-1

Ch.	Frequency (MHz)
36	5 180
44	5 220
48	5 240

UNII-3

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

Table 2.3.1. 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 2.3.2. 802.11n/ac_HT40 mode

UNII-1

Ch.	Frequency (MHz)
42	5 210

UNII-3

Ch.	Frequency (MHz)
155	5 775

Table 2.3.3 802.11ac_VHT80 mode

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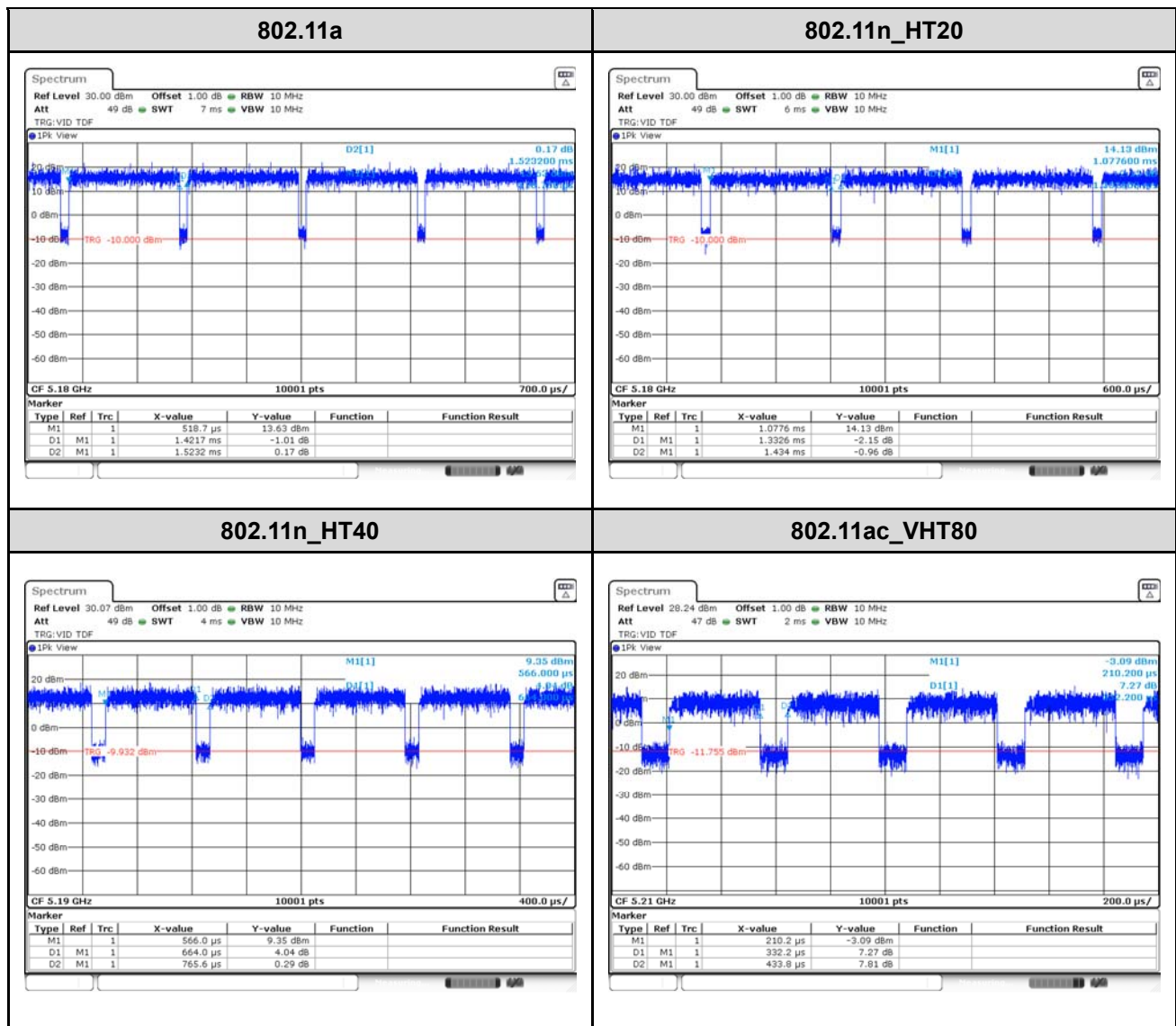
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2.4. Duty Cycle Factor

Test mode	Period (ms)	T _{on} time (ms)	Duty cycle		Duty cycle factor (dB)
			(Linear)	(%)	
802.11a	1.523 2	1.421 7	0.933 4	93.34	0.30
802.11n_HT20	1.434 0	1.332 6	0.929 3	92.93	0.32
802.11n_HT40	0.765 6	0.664 0	0.867 3	86.73	0.62
802.11ac_VHT80	0.433 8	0.332 2	0.765 8	76.58	1.16

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%



2.5. Power level setup in software

Power level setup in software		
Test Mode	Frequency	Software Setup
802.11a	5 180 MHz	11
	5 200 MHz	11
	5 240 MHz	11
	5 745 MHz	10
	5 785 MHz	10
	5 825 MHz	10
802.11n_HT20	5 180 MHz	11
	5 200 MHz	11
	5 240 MHz	11
	5 745 MHz	10
	5 785 MHz	10
	5 825 MHz	10
802.11n_HT40	5 190 MHz	11
	5 230 MHz	11
	5 755 MHz	9
	5 795 MHz	9
802.11ac_VHT80	5 210 MHz	11
	5 775 MHz	11

3. Antenna requirement

According to §15.203, §15.407

“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 PCB 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 results
15.407(a)	Maximum conducted output power	Pass
15.407(a)	Maximum power spectral density	Pass
15.407(a)	26 dB bandwidth	Pass
15.407(e)	6 dB bandwidth	Pass
15.407(d), 15.205(a), 15.209(a)	Spurious emission	Pass
	Band-edge, restricted band	Pass
15.207(a)	AC Conducted emissions	Pass

Notes:

- All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
 - The worst case is stand-alone without connecting accessories.
- 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.
- The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that Y orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y orientation.
- The test procedure(s) in this report were performed in accordance as following.
 - ANSI C63.10-2013
 - KDB 662911 D01 v02r01
 - KDB 789033 D02 v02r01
- 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 emissions	1.6 dB	
Radiated spurious emissions	9 kHz ~ 30 MHz	2.3 dB
	30 MHz ~ 1 000 MHz	2.2 dB
	1 000 MHz ~ 18 000 MHz	5.6 dB
	Above 18 000 GHz	5.7 dB
Conducted emissions	9 kHz ~ 150 kHz	3.7 dB
	150 kHz ~ 30 MHz	3.3 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	10.01	9 000	11.95
50	10.05	10 000	12.03
100	10.10	11 000	12.10
200	10.20	12 000	12.19
300	10.28	13 000	12.23
400	10.33	14 000	12.37
500	10.40	15 000	12.41
600	10.43	16 000	12.35
700	10.49	17 000	12.44
800	10.53	18 000	12.50
900	10.57	19 000	12.52
1 000	10.60	20 000	12.39
2 000	10.88	21 000	12.63
3 000	10.99	22 000	12.94
4 000	11.10	23 000	13.27
5 000	11.44	24 000	13.05
6 000	11.58	25 000	13.36
7 000	11.67	26 000	13.28
8 000	11.65	26 500	13.40

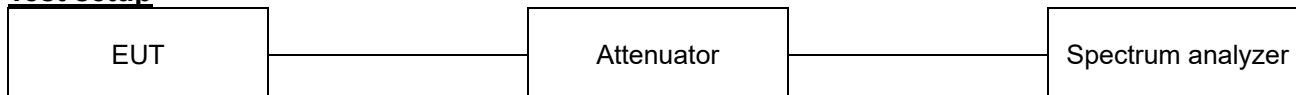
Note.

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

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 12.3.3.2 and 14.2
 KDB 789033 D02 v02r01 - Section E.2.d) or e)
 KDB 662911 D01 v02r01 – Section E).1)

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%.

Section E.2.e)

Method SA-2 Alternative (power averaging(rms) detection with slow sweep with each spectrum bin 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) Manually set sweep time $\geq 10 \times (\text{number of points in sweep}) \times (\text{total on/off period of the transmitted signal})$.
- (vii) Set detector = power averaging (rms)
- (viii) Perform a single sweep.
- (ix) 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

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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 spectrum.

- (x) 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%.

Section E.3.a)

Method PM (Measurement using an RF average power meter):

- (xi) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.
- The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
 - At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
 - The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five
- (xii) If the transmitter does not transmit continuously, measure the duty cycle, x , of the transmitter output signal as described in II
- (xiii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
- (xiv) Adjust the measurement in dBm by adding $10 \log (1/x)$ where x is the duty cycle (e.g., $10 \log (1/0.25)$ if the duty cycle is 25%).

Section E.3.b)

Method PM-G (Measurement using a gated RF average power meter):

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

Test results

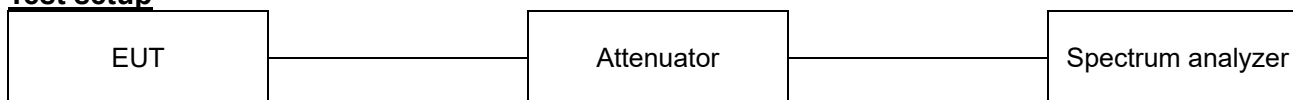
Test mode	Band	Frequency (MHz)	Measured power (dBm)	DCF (dB)	Conducted output power (dBm)	Conducted Power Limit (dBm)
					Average	
802.11a	UNII-1	5 180	12.34	0.30	12.64	23.98
		5 200	12.11	0.30	12.41	
		5 240	12.13	0.30	12.43	
	UNII-3	5 745	11.17	0.30	11.47	30.00
		5 785	11.03	0.30	11.33	
		5 825	10.76	0.30	11.06	
802.11n HT20	UNII-1	5 180	12.04	0.32	12.36	23.98
		5 200	11.75	0.32	12.07	
		5 240	11.69	0.32	12.01	
	UNII-3	5 745	10.60	0.32	10.92	30.00
		5 785	10.55	0.32	10.87	
		5 825	10.51	0.32	10.83	
802.11n HT40	UNII-1	5 190	11.53	0.62	12.15	23.98
		5 230	11.46	0.62	12.08	
	UNII-3	5 755	9.46	0.62	10.08	30.00
		5 795	9.48	0.62	10.10	
802.11ac VHT80	UNII-1	5 210	10.42	1.16	11.58	23.98
	UNII-3	5 775	9.51	1.16	10.67	30.00

Note.

1. Result(dBm) = Reading (dBm) + Duty Factor (dB)

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
 KDB 662911 D01 v02r01 - Section E). 2)
 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

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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 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	2.93	0.30	3.23	11
		5 200	2.88	0.30	3.18	
		5 240	2.64	0.30	2.94	
802.11n HT20		5 180	2.50	0.32	2.82	
		5 200	2.39	0.32	2.71	
		5 240	2.24	0.32	2.56	
802.11n HT40		5 190	-0.73	0.62	-0.11	
		5 230	-0.81	0.62	-0.19	
802.11ac VHT80		5 210	-4.49	1.16	-3.33	

Test mode	Band	Frequency (MHz)	Measured PSD (dBm)	Duty Factor (dB)	Maximum PSD (dBm/ 500 kHz)	Limit (dBm/ 500 kHz)
802.11a	UNII-3	5 745	-1.41	0.30	-1.11	30
		5 785	-1.49	0.30	-1.19	
		5 825	-1.65	0.30	-1.35	
802.11n HT20		5 745	-2.04	0.32	-1.72	
		5 785	-1.73	0.32	-1.41	
		5 825	-2.33	0.32	-2.01	
802.11n HT40		5 755	-6.76	0.62	-6.14	
		5 795	-5.84	0.62	-5.22	
802.11ac VHT80		5 775	-7.64	1.16	-6.48	

Notes:

1. Maximum PSD calculation

- Maximum PSD = Measured PSD + DCF

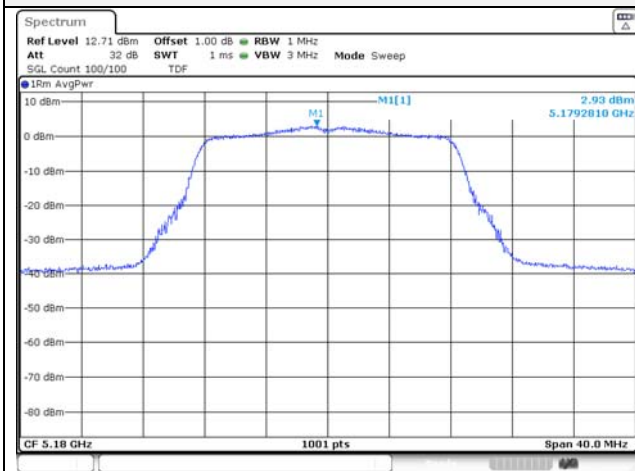
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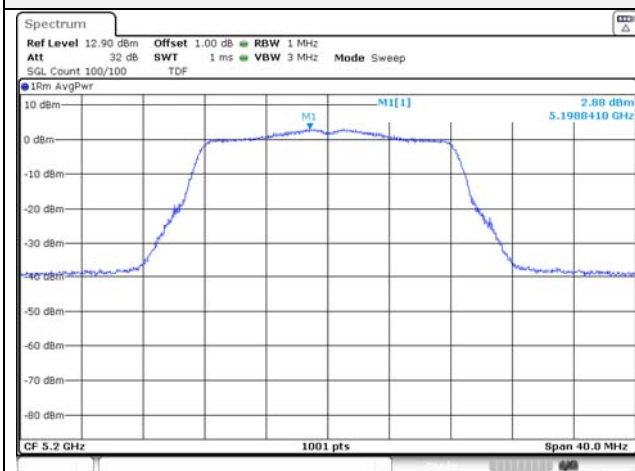
UNII-1 / 802.11a / 5 180 MHz



UNII-3 / 802.11a / 5 745 MHz



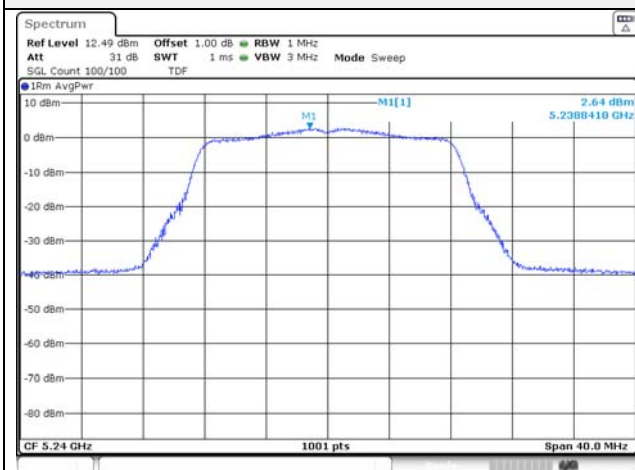
UNII-1 / 802.11a / 5 200 MHz



UNII-3 / 802.11a / 5 785 MHz



UNII-1 / 802.11a / 5 240 MHz



UNII-3 / 802.11a / 5 825 MHz



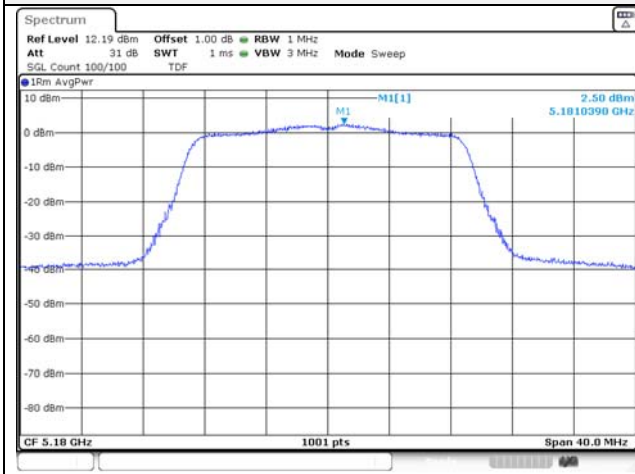
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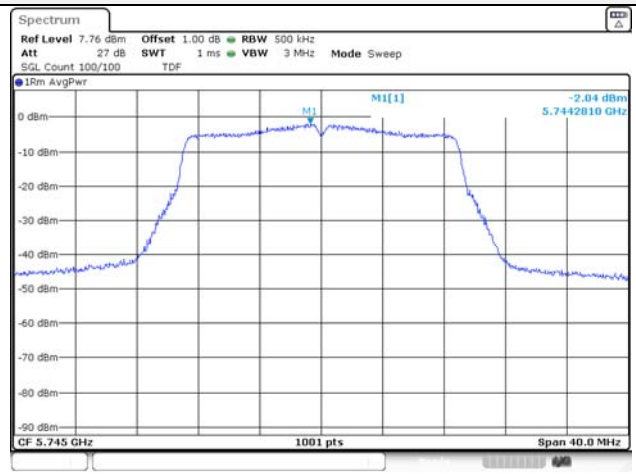
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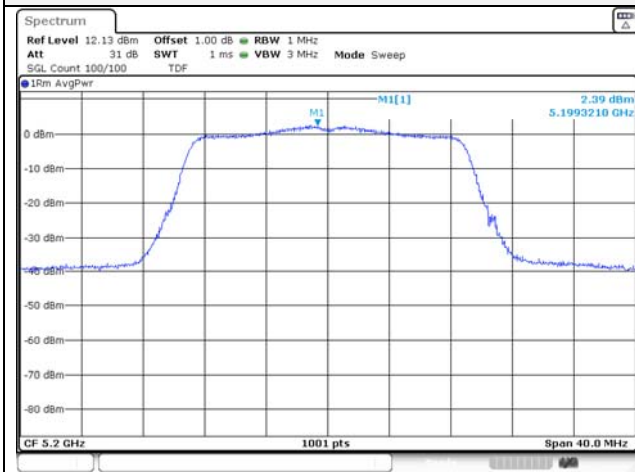
UNII-1 / 802.11n HT20 / 5 180 MHz



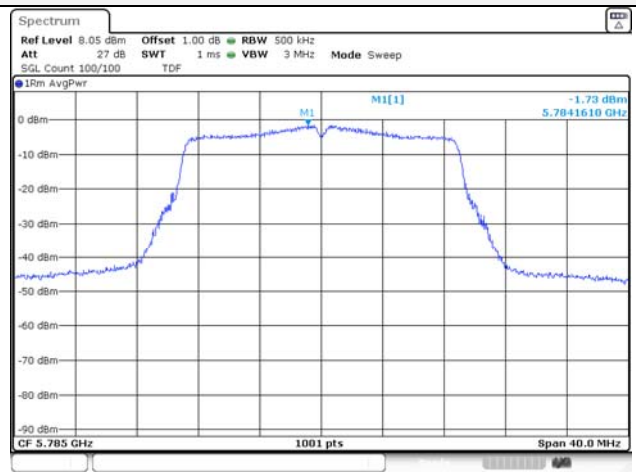
UNII-3 / 802.11n HT20 / 5 745 MHz



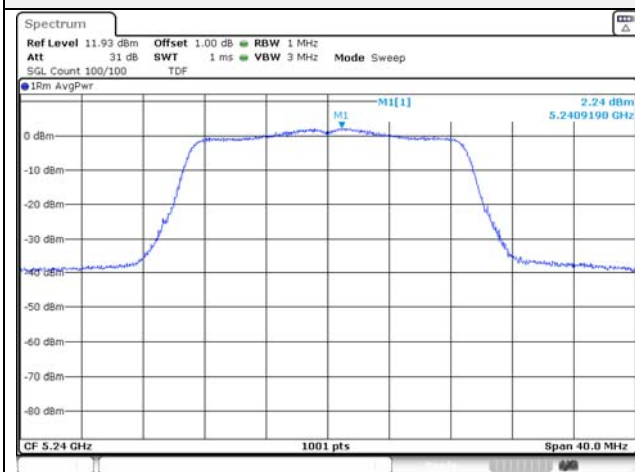
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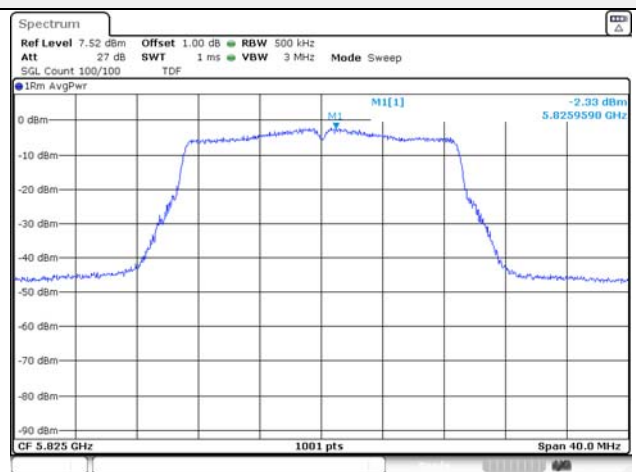
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UNII-1 / 802.11n HT20 / 5 240 MHz



UNII-3 / 802.11n HT20 / 5 825 MHz



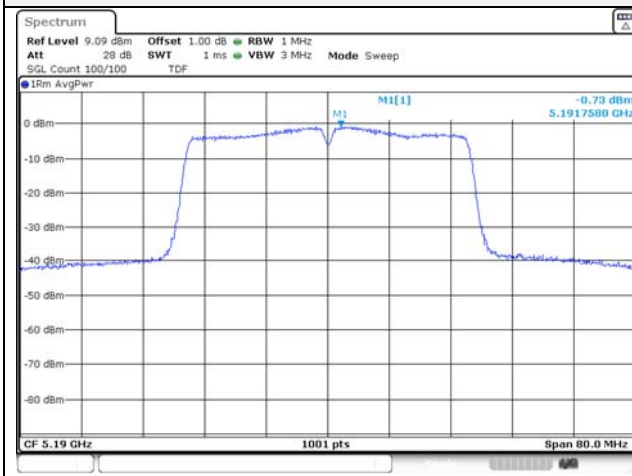
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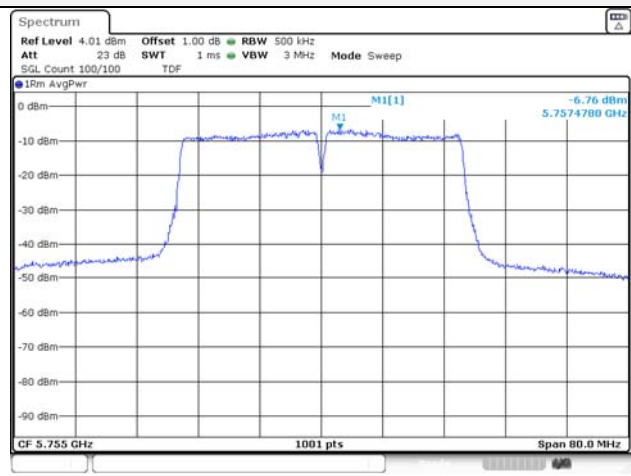
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UNII-1 / 802.11n HT40 / 5 190 MHz



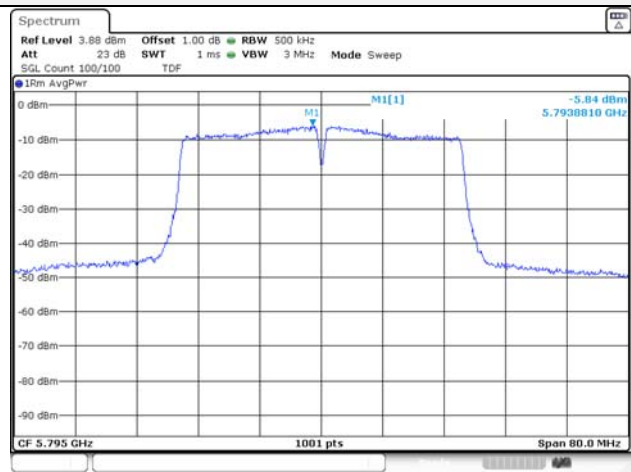
UNII-3 / 802.11n HT40 / 5 755 MHz



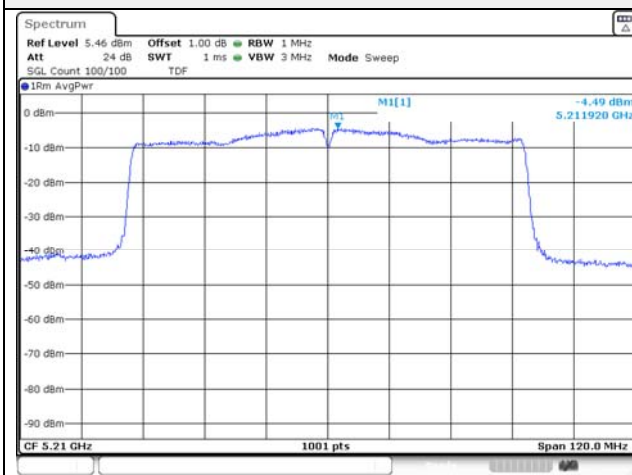
UNII-1 / 802.11n HT40 / 5 230 MHz



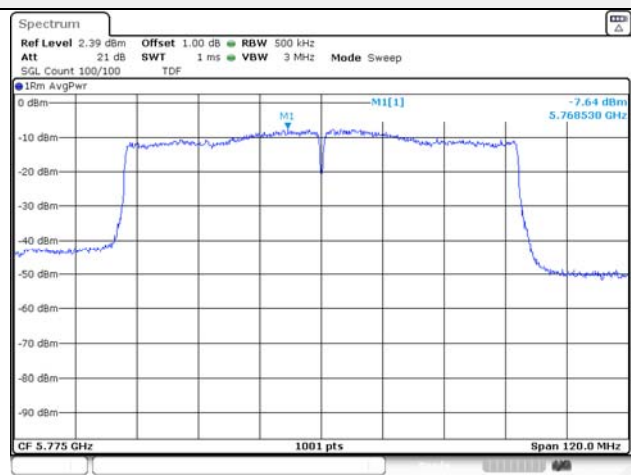
UNII-3 / 802.11n HT40 / 5 795 MHz



UNII-1 / 802.11ac VHT80 / 5 210 MHz

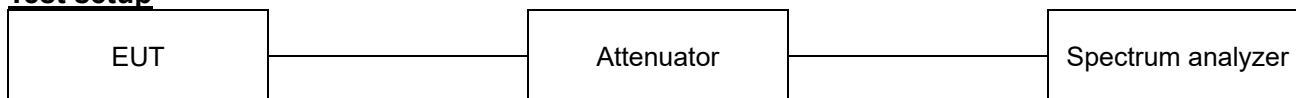


UNII-3 / 802.11ac VHT80 / 5 775 MHz



7.3. 26 dB Bandwidth

Test setup



Limit

N/A

Test procedure

26dB bandwidth

KDB 789033 D02 v02r01 - Section C.1

99% Bandwidth

KDB 789033 D02 v02r01 – Section D

Test settings

◆ **26dB 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%.

◆ **99% 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

26dB Bandwidth

Test mode	Band	Frequency(MHz)	Measured Bandwidth (MHz)
11a	UNII-1	5 180	21.18
		5 200	21.28
		5 240	21.08
11n HT20	UNII-1	5 180	21.63
		5 200	21.38
		5 240	21.43
11n HT40	UNII-1	5 190	40.06
		5 230	40.46
11ac VHT80	UNII-1	5 210	81.52

99% Bandwidth

Test mode	Band	Frequency(MHz)	Measured Bandwidth (MHz)
11a	UNII-1	5 180	16.68
		5 200	16.67
		5 240	16.65
	UNII-3	5 745	16.64
		5 785	16.66
		5 825	16.69
11n HT20	UNII-1	5 180	17.85
		5 200	17.79
		5 240	17.79
	UNII-3	5 745	17.76
		5 785	17.78
		5 825	17.81
11n HT40	UNII-1	5 190	36.41
		5 230	36.37
	UNII-3	5 755	36.36
		5 795	36.28
11ac VHT80	UNII-1	5 210	75.63
	UNII-3	5 775	75.82

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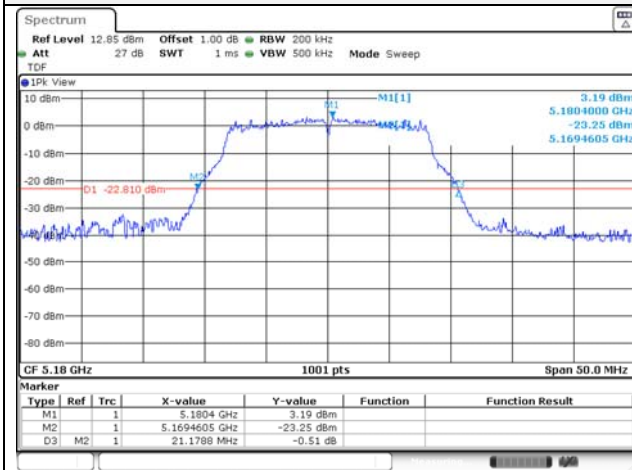
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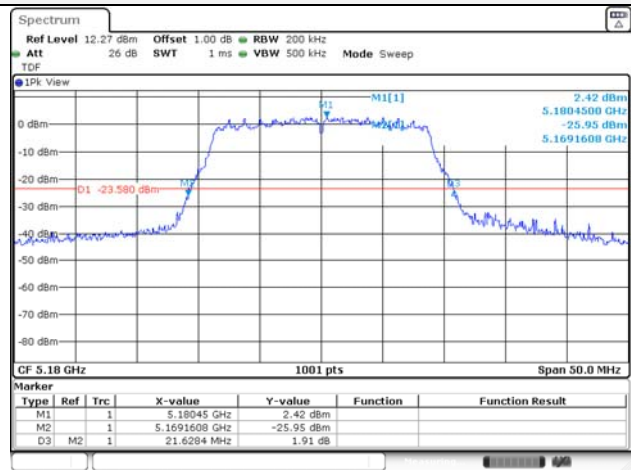
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26 dB bandwidth

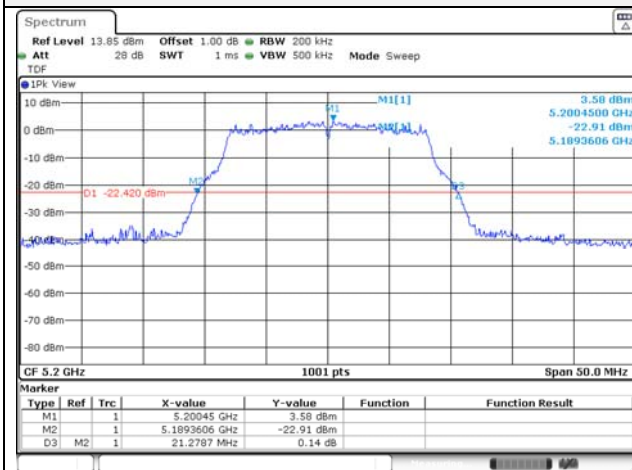
UNII-1 / 802.11a / 5 180 MHz



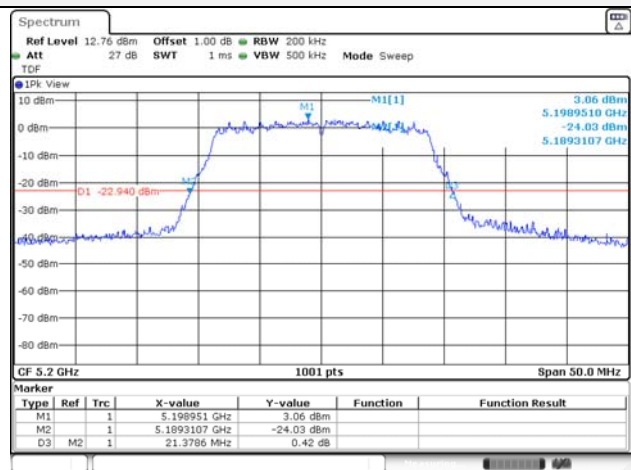
UNII-1 / 802.11n HT20 / 5 180 MHz



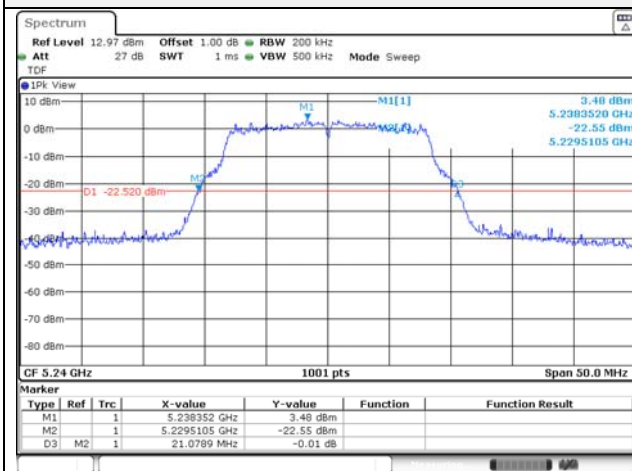
UNII-1 / 802.11a / 5 200 MHz



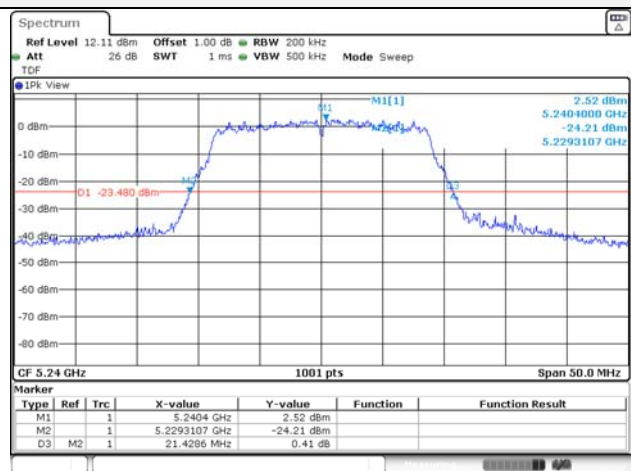
UNII-1 / 802.11n HT20 / 5 200 MHz



UNII-1 / 802.11a / 5 240 MHz



UNII-1 / 802.11n HT20 / 5 240 MHz



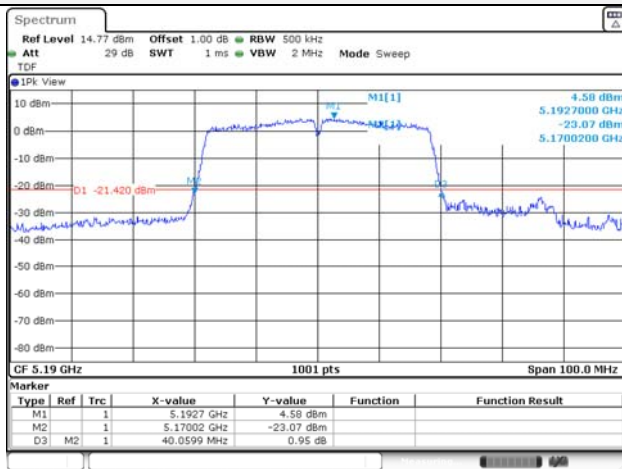
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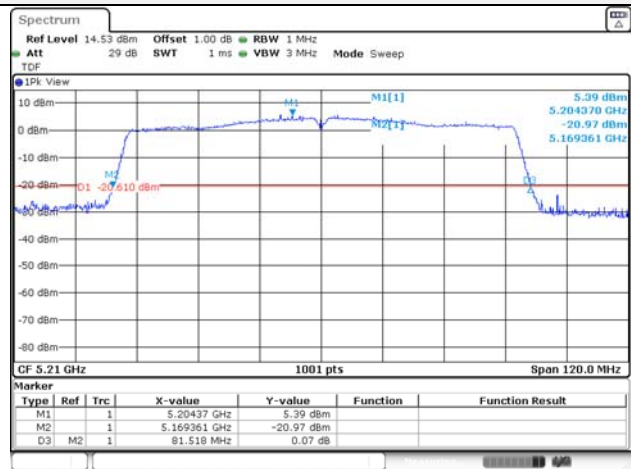
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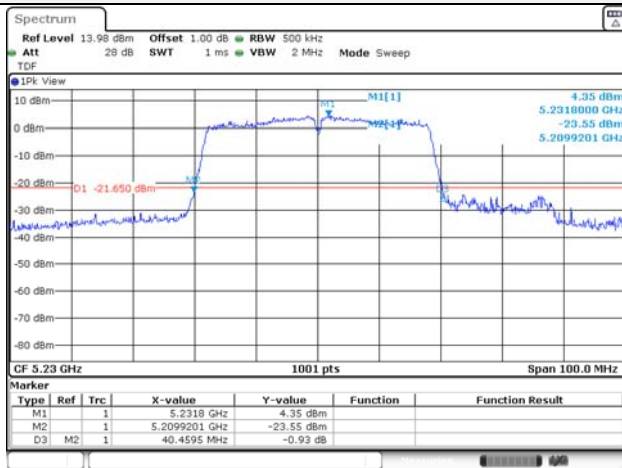
UNII-1 / 802.11n HT40 / 5 190 MHz



UNII-1 / 802.11ac VHT80 / 5 210 MHz



UNII-1 / 802.11n HT40 / 5 230 MHz



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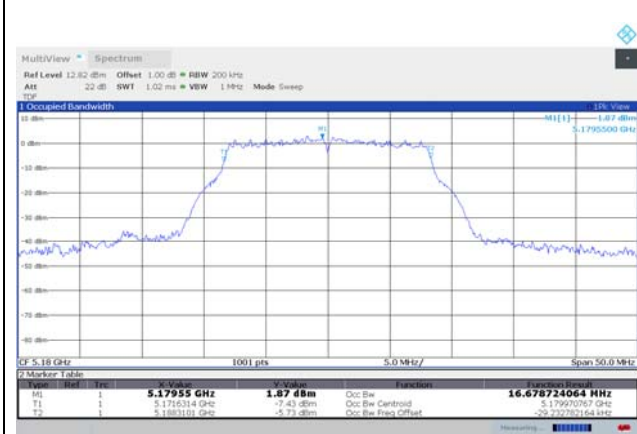
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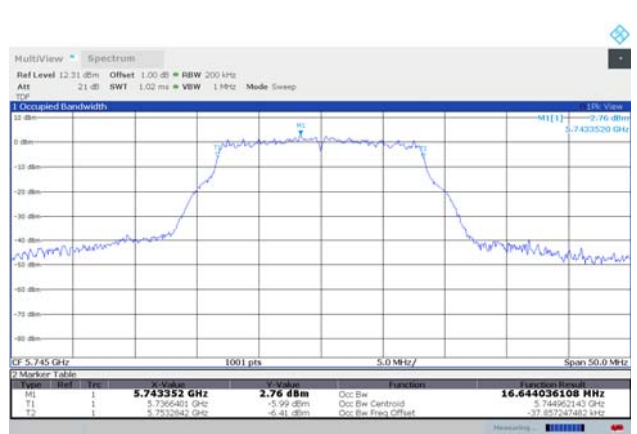
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99 % bandwidth(MHz)

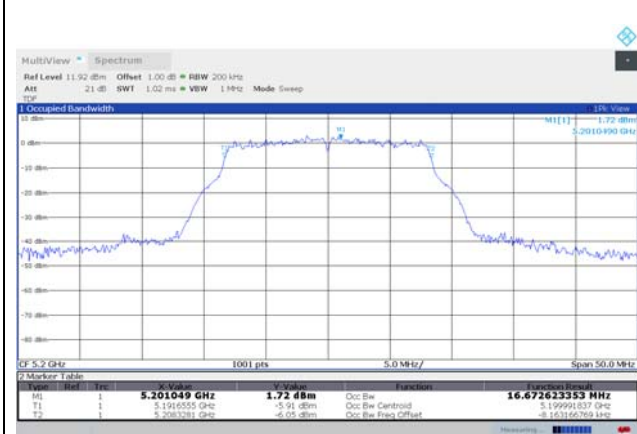
UNII-1 / 802.11a / 5 180 MHz



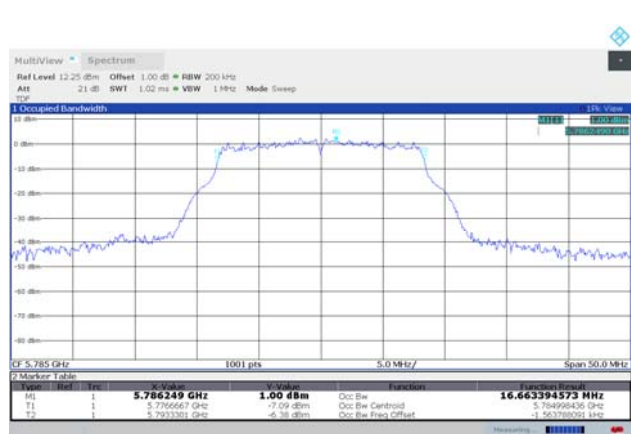
UNII-3 / 802.11a / 5 745 MHz



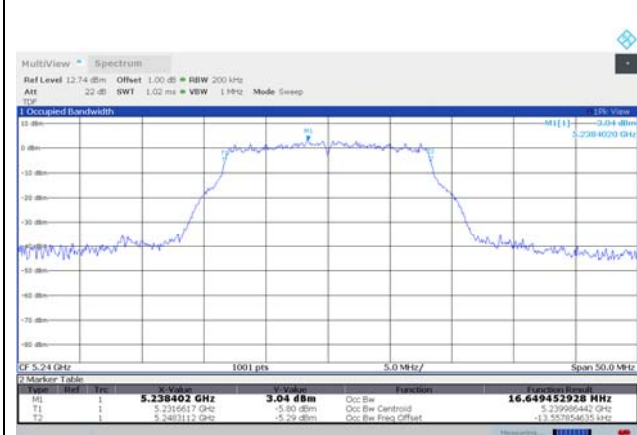
UNII-1 / 802.11a / 5 200 MHz



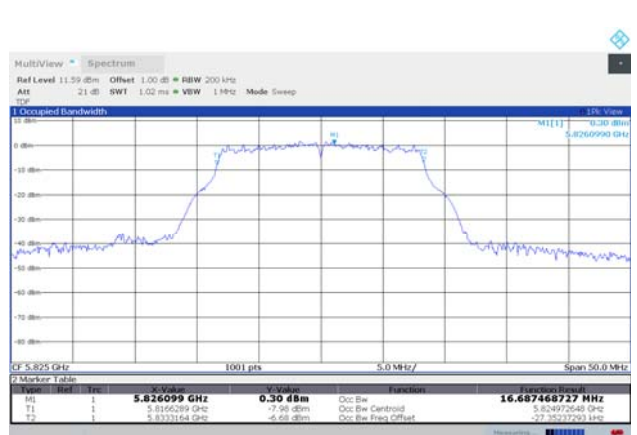
UNII-3 / 802.11a / 5 785 MHz



UNII-1 / 802.11a / 5 240 MHz



UNII-3 / 802.11a / 5 825 MHz

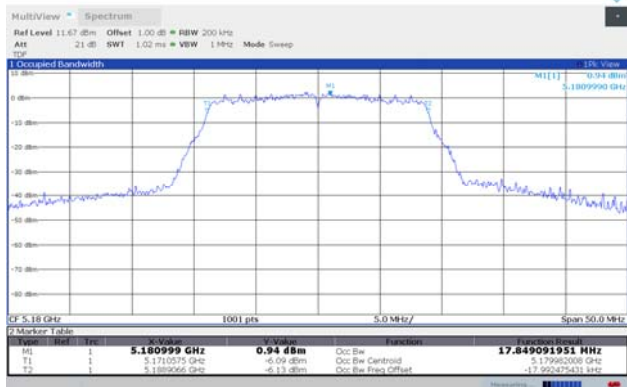


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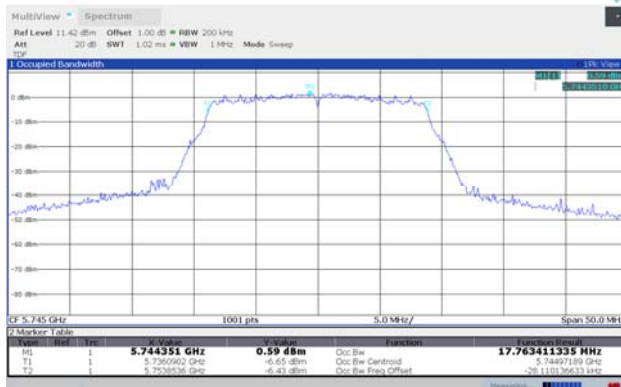
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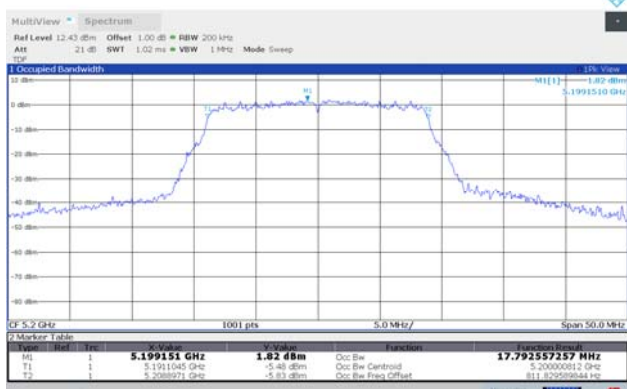
UNII-1 / 802.11n HT20 / 5 180 MHz



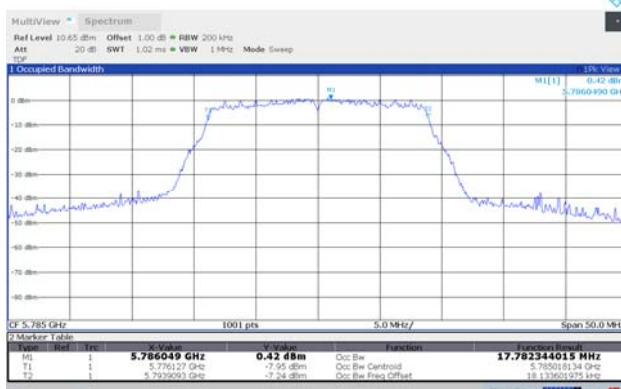
UNII-3 / 802.11n HT20 / 5 745 MHz



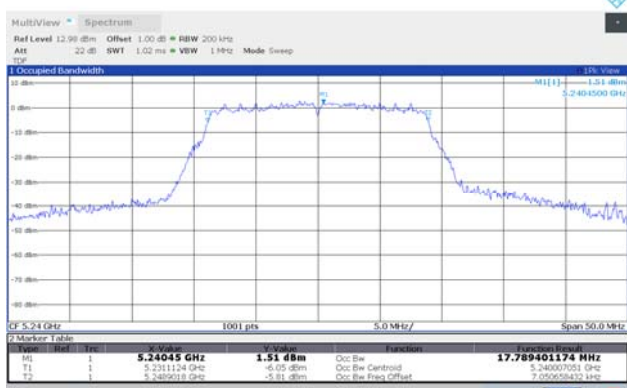
UNII-1 / 802.11n HT20 / 5 200 MHz



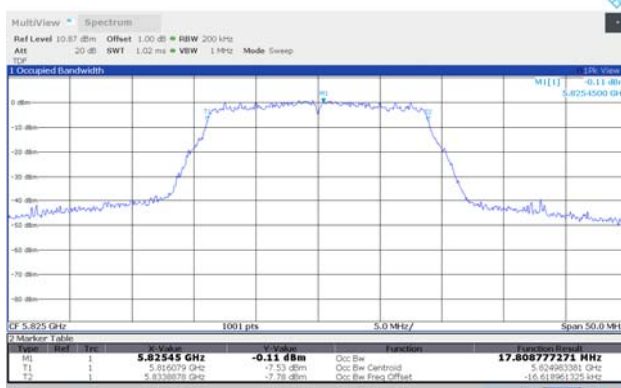
UNII-3 / 802.11n HT20 / 5 785 MHz



UNII-1 / 802.11n HT20 / 5 240 MHz



UNII-3 / 802.11n HT20 / 5 825 MHz



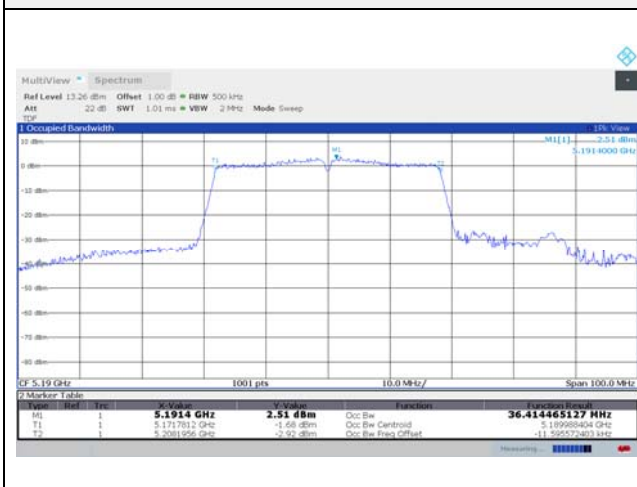
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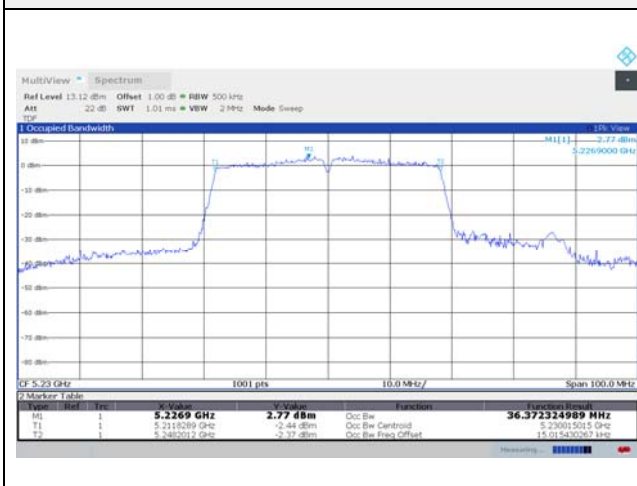
UNII-1 / 802.11n HT40 / 5 190 MHz



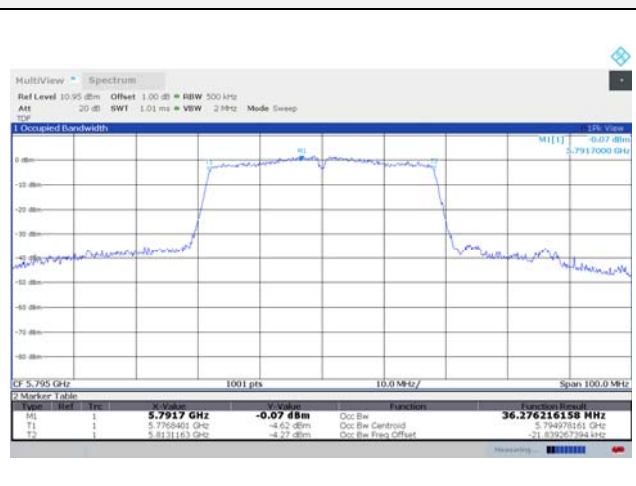
UNII-3 / 802.11n HT40 / 5 755 MHz



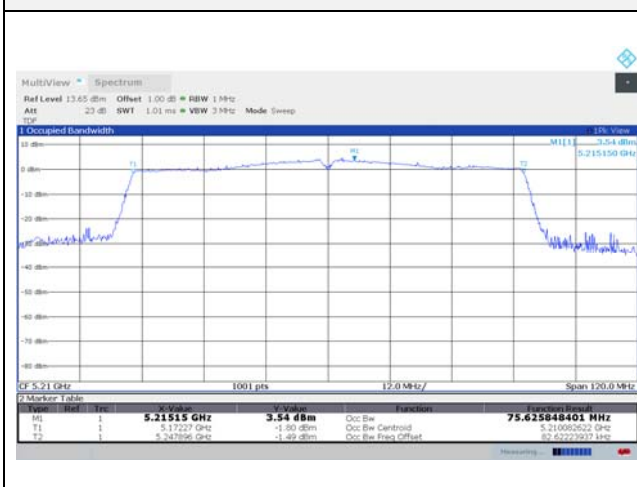
UNII-1 / 802.11n HT40 / 5 230 MHz



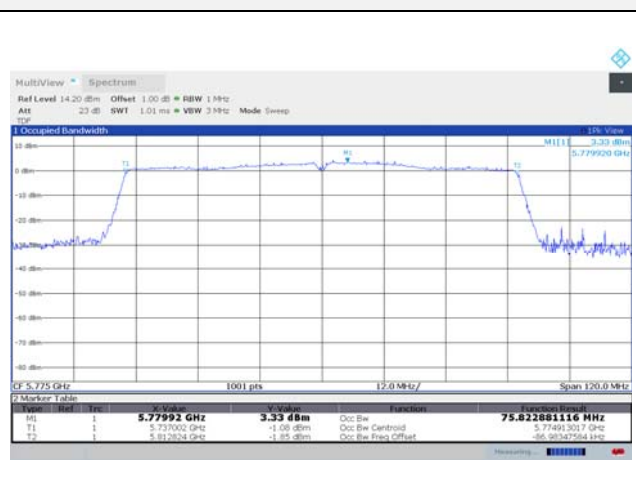
UNII-3 / 802.11n HT40 / 5 795 MHz



UNII-1 / 802.11ac VHT80 / 5 210 MHz

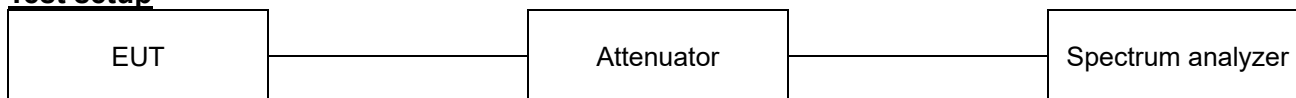


UNII-3 / 802.11ac VHT80 / 5 775 MHz



7.4. 6 dB Bandwidth

Test setup



Limit

Within the 5.725-585 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500kHz

Test procedure

KDB 789033 D02 v02r01 - Section C.2

Test settings

◆ 6dB Bandwidth (Minimum Emission Bandwidth for the band 5.725–5.85 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. 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)	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)
11a	UNII-3	5 745	16.38	0.5
		5 785	16.38	
		5 825	16.43	
11n HT20		5 745	17.63	
		5 785	17.58	
		5 825	17.63	
11n HT40		5 755	36.06	
		5 795	35.96	
11ac VHT80		5 775	75.40	

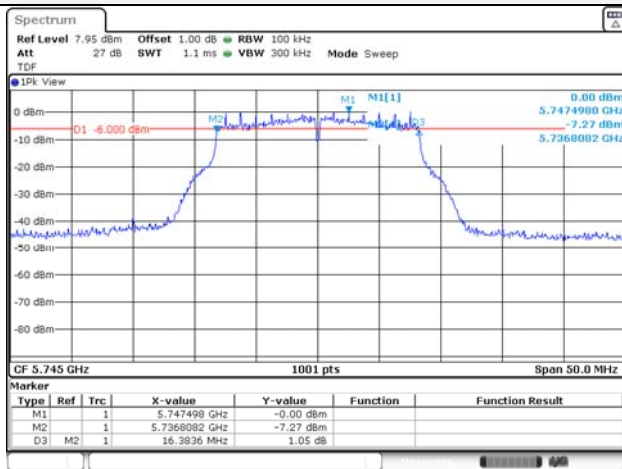
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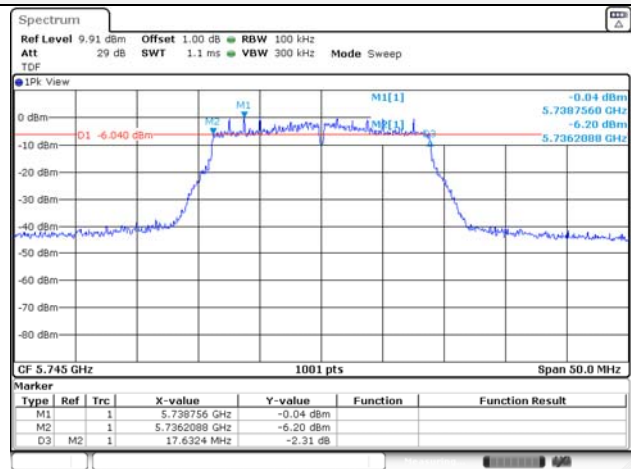
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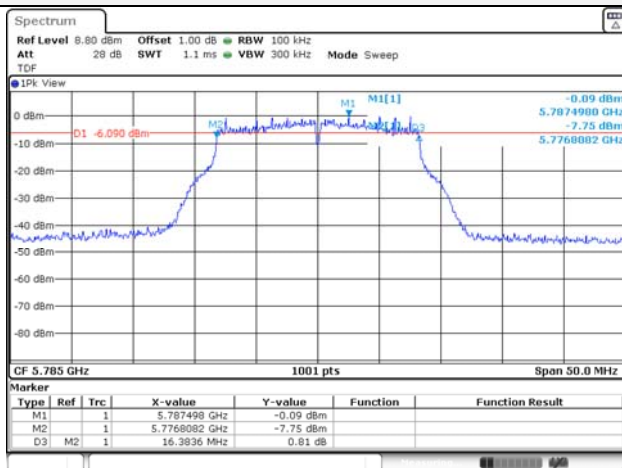
UNII-3 / 802.11a / 5 745 MHz



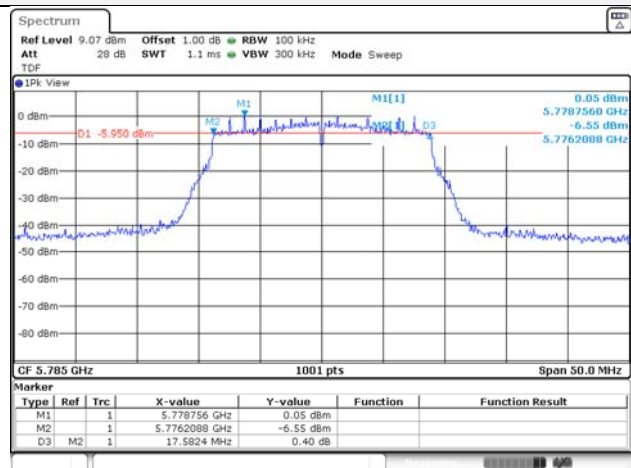
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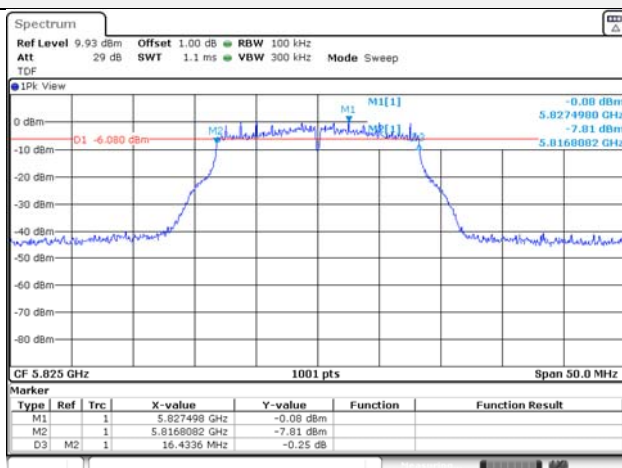
UNII-3 / 802.11a / 5 785 MHz



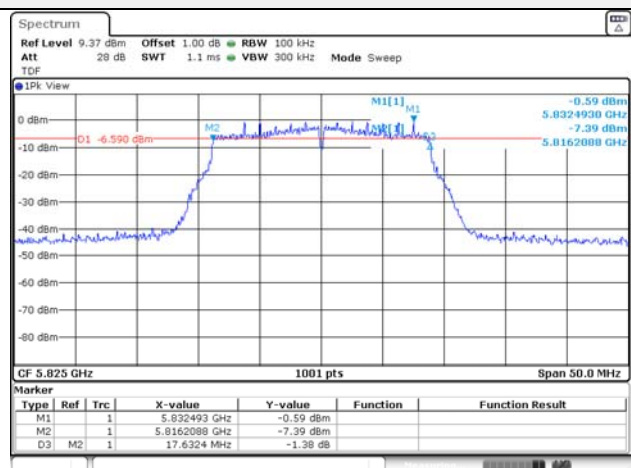
UNII-3 / 802.11n HT20 / 5 785 MHz



UNII-3 / 802.11a / 5 825 MHz



UNII-3 / 802.11n HT20 / 5 825 MHz



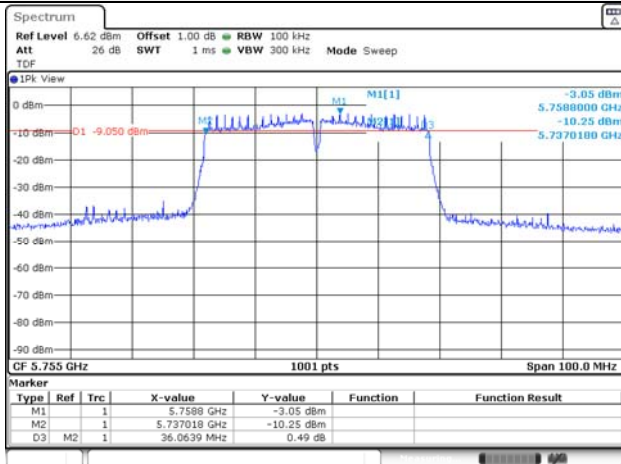
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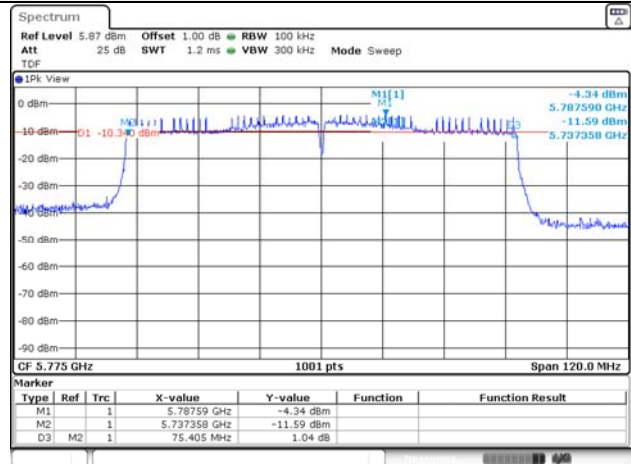
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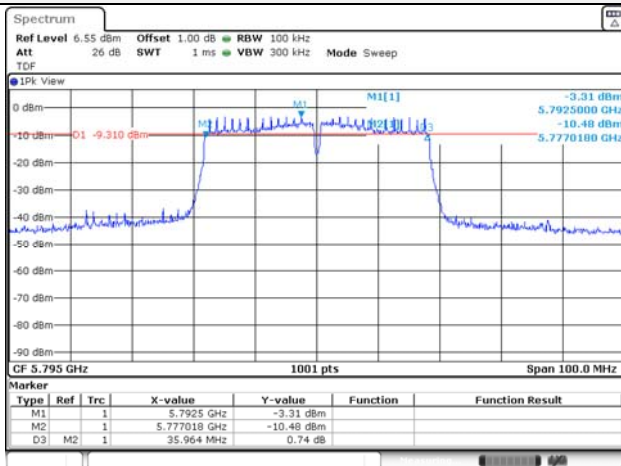
UNII-3 / 802.11n HT40 / 5 755 MHz



UNII-3 / 802.11ac VHT80 / 5 775 MHz



UNII-3 / 802.11n HT40 / 5 795 MHz

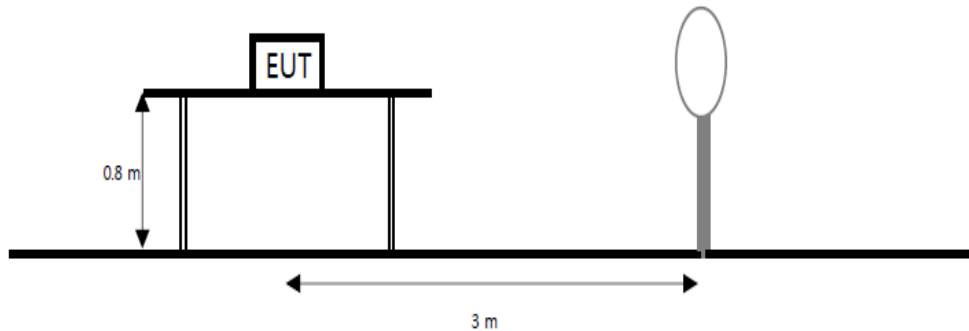


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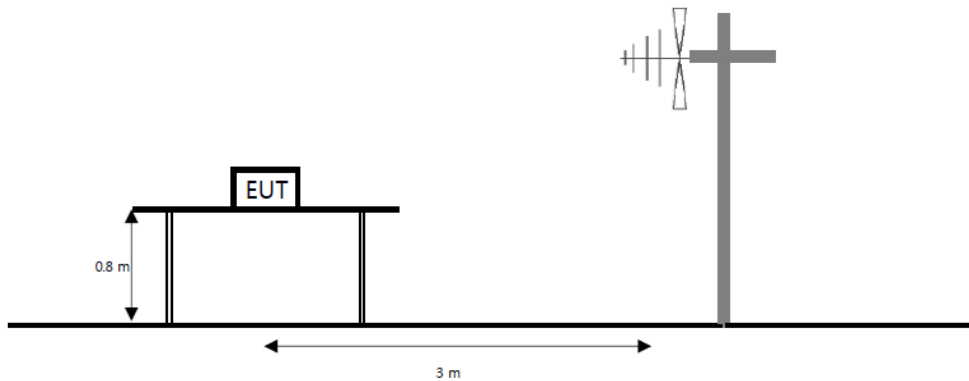
7.5. Spurious Emission, Band Edge and Restricted bands

Test setup

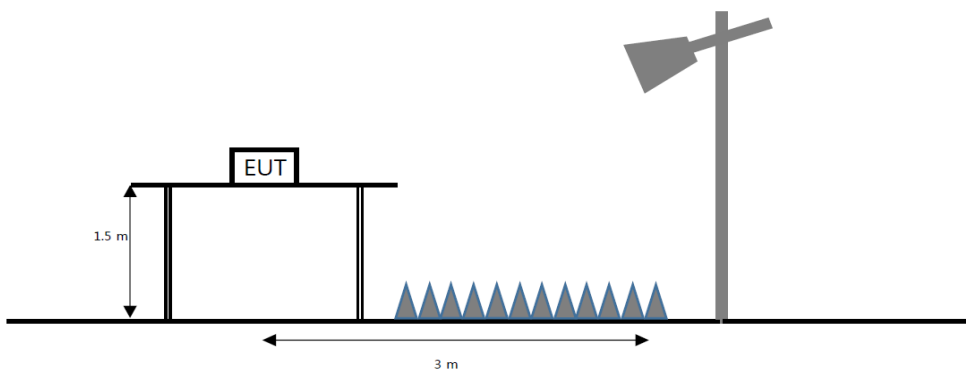
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions



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.

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 6.4.6

KDB 558074 D01 V05r02

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.

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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 $\geq [3 \times \text{RBW}]$.
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. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz ($\geq 1/T$) for Average detection (AV) at frequency above 1 GHz. (where T = pulse width)
2. $f < 30 \text{ MHz}$, extrapolation factor of 40 dB/decade of distance. $F_d = 40 \log(D_m/D_s)$
 $f \geq 30 \text{ MHz}$, 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
3. Factors(dB) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) + or F_d (dB)
4. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
5. Average test would be performed if the peak result were greater than the average limit.
6. ¹⁾ means restricted band.
7. According to part 15.31(f)(2), an extrapolation factor of 40 dB/decade is applied because measured distance of radiated emission is 3 m.

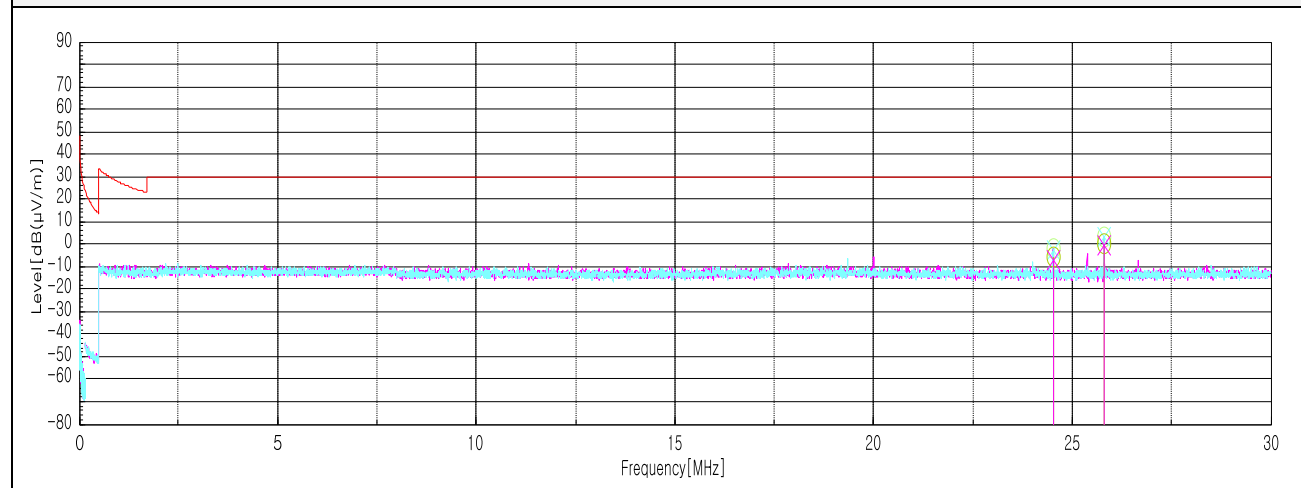
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KCTL**Test results (Below 30 MHz) – Worst case: 802.11ac VHT80_UNII 1_5 210 MHz**

Frequency	Pol.	Reading	Cable Loss	Amp Gain	Antenna Factor	DCCF	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.									

Horizontal/Vertical

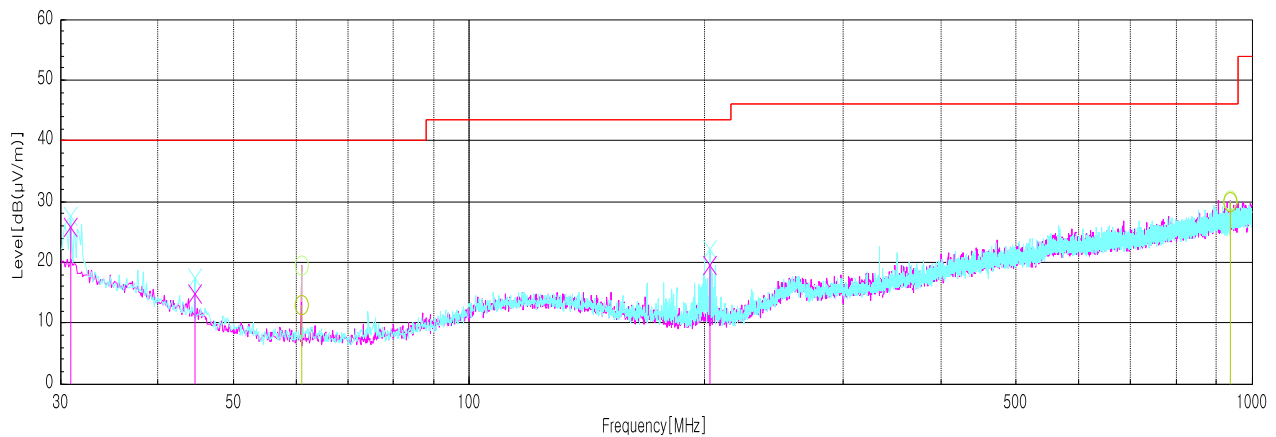
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KCTL**Test results (Below 1 000 MHz) – Worst case: 802.11ac VHT80_UNII 1_5 210 MHz**

Frequency	Pol.	Reading	Amp. + Cable	Antenna Factor	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Quasi peak data								
30.97	V	31.40	24.61	-30.47	-	25.54	40.00	14.46
44.55	V	28.40	16.43	-30.09	-	14.74	40.00	25.26
61.04	H	30.40	12.20	-29.67	-	12.93	40.00	27.07
203.02	V	31.40	15.26	-27.09	-	19.57	43.50	23.93
939.38	H	22.40	26.59	-19.08	-	29.91	46.00	16.09

Horizontal/Vertical

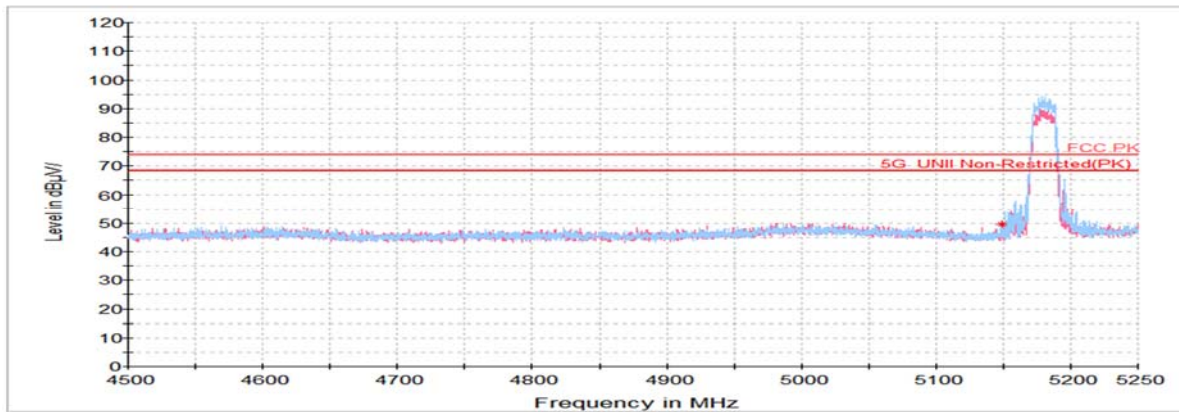
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KCTL**Test results (Above 1 000 MHz)****802.11a UNII 1****Lowest Channel (5 180 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
5 148.89 ¹⁾	H	42.11	34.17	-26.52	-	49.76	74.00	24.24
10 395.98	H	57.22	37.60	-49.73	-	45.09	68.20	23.11
15 573.14 ¹⁾	V	54.68	39.97	-45.57	-	49.08	74.00	24.92
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for Band-edge

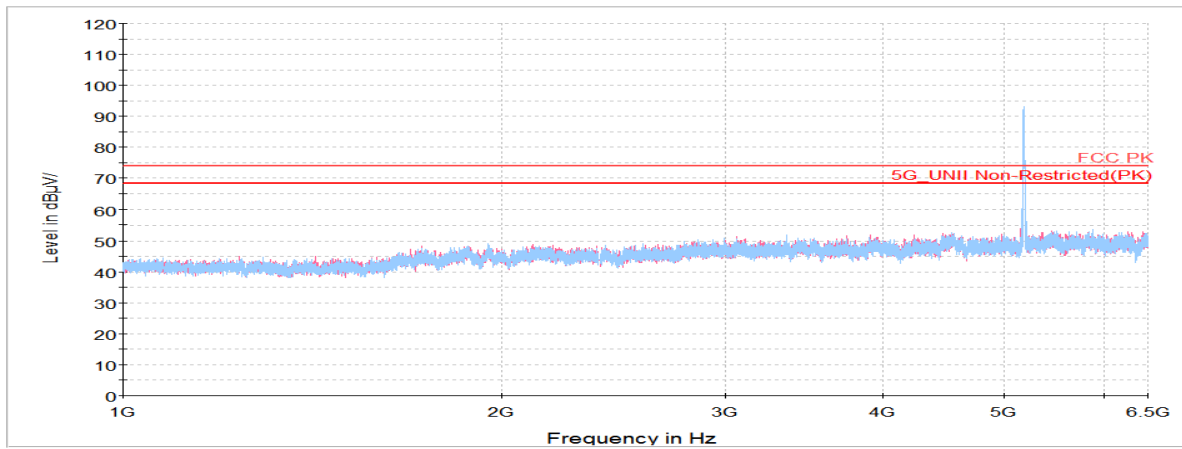
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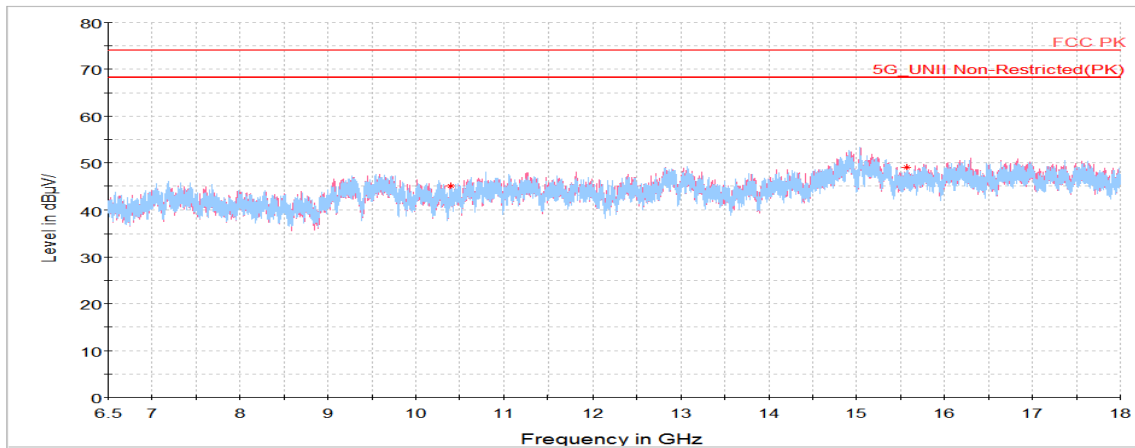
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



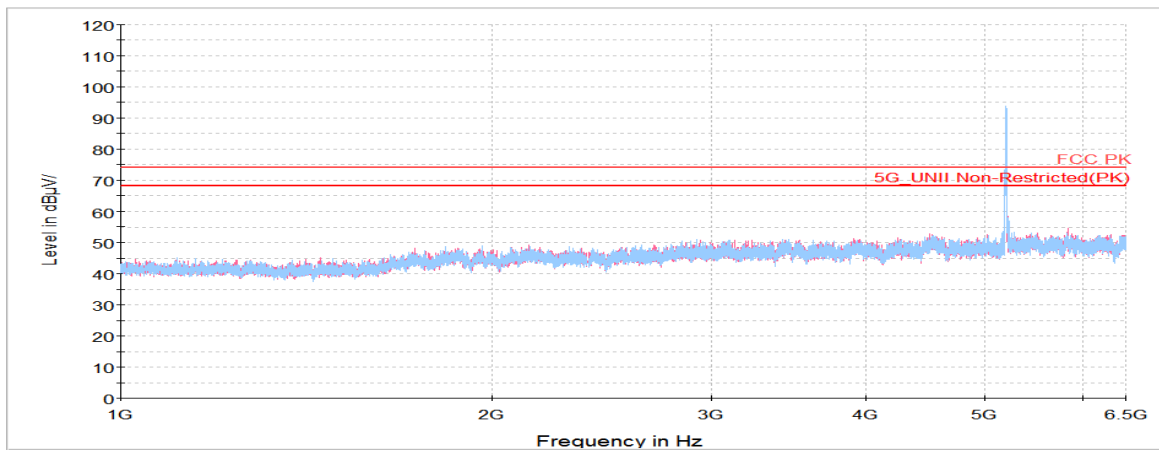
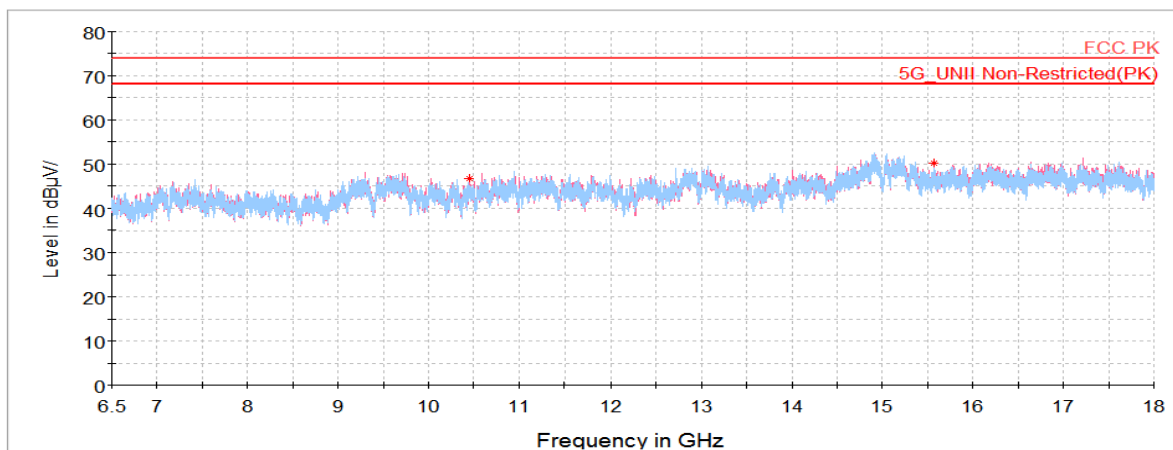
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KCTL**Middle Channel (5 200 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
10 447.02	V	58.73	37.65	-49.76	-	46.62	68.20	21.58
15 565.95 ¹⁾	V	55.76	39.97	-45.56	-	50.17	74.00	23.83
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 6.5 GHz**Horizontal/Vertical for 6.5 GHz ~ 18 GHz**

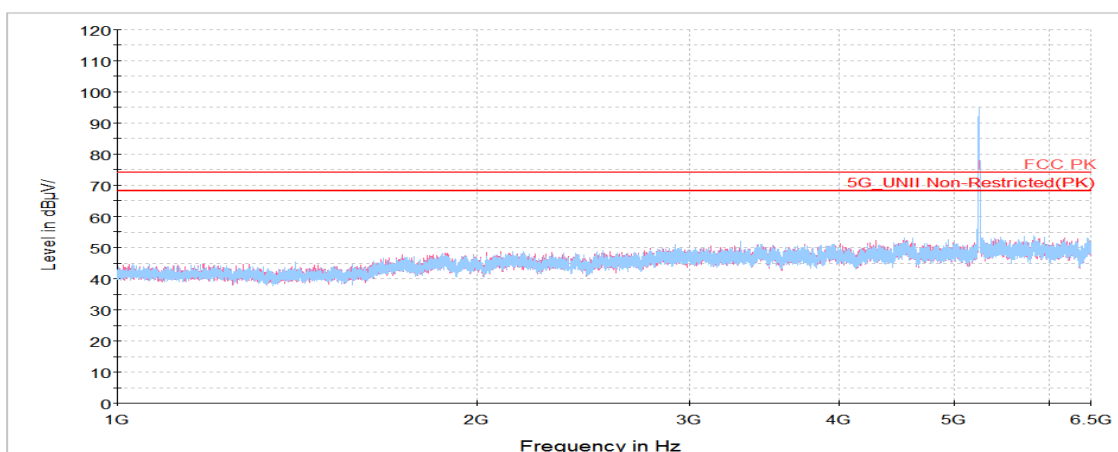
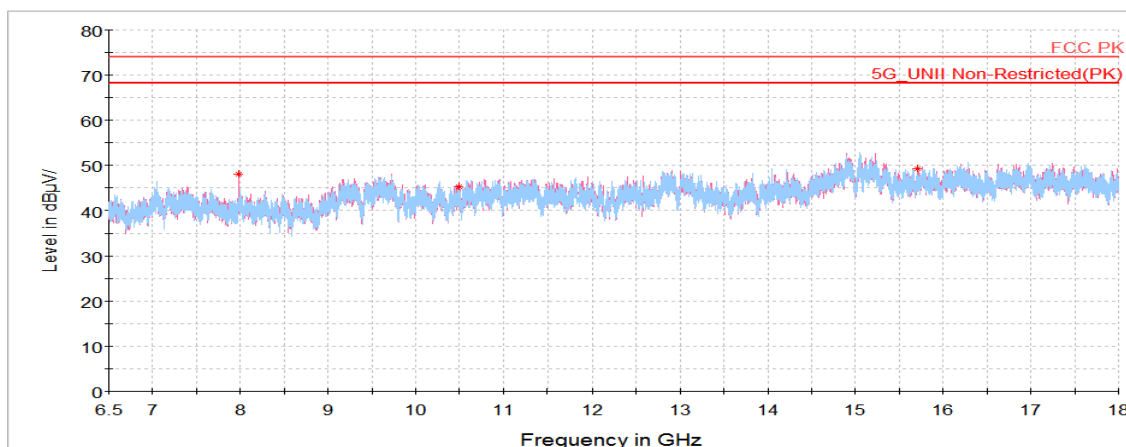
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KCTL**Highest Channel (5 240 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
7 987.09	V	63.14	35.59	-50.74	-	47.99	68.20	20.21
10 491.22	H	57.30	37.69	-49.78	-	45.21	74.00	28.79
15 701.44 ¹⁾	V	54.93	39.92	-45.66	-	49.19	74.00	24.81
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 6.5 GHz**Horizontal/Vertical for 6.5 GHz ~ 18 GHz**

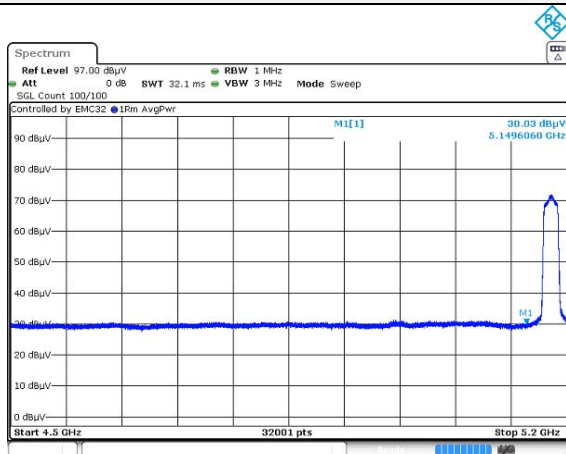
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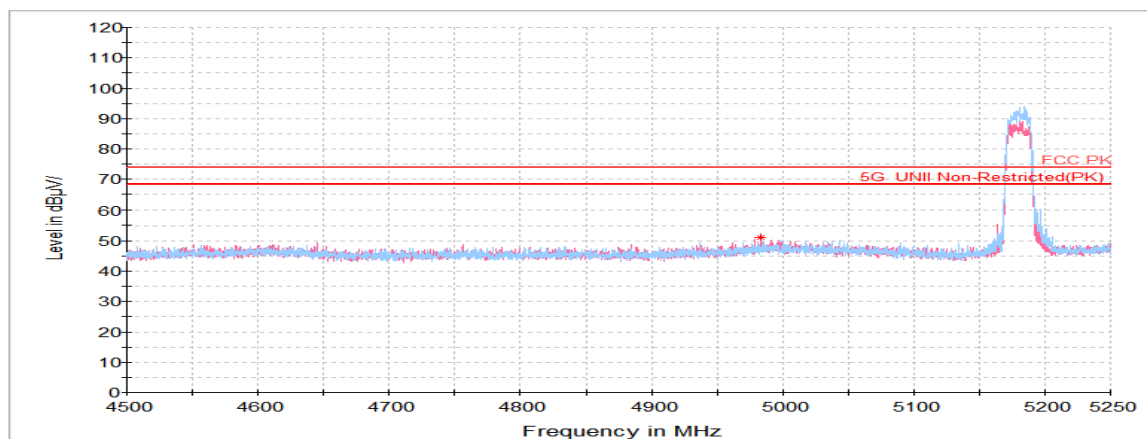
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KCTL**802.11n HT20 UNII 1****Lowest Channel (5 180 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
5 149.61 ¹⁾	V	43.36	34.17	-26.51	-	51.02	74.00	22.98
10 343.88	H	56.37	37.54	-49.70	-	44.21	68.20	23.99
10 922.11 ¹⁾	V	60.13	38.12	-49.26	-	48.99	74.00	25.01
15 556.25 ¹⁾	H	53.81	39.98	-45.55	-	48.24	74.00	25.76
Average Data								
5 149.61 ¹⁾	V	30.03	34.17	-26.51	0.32	38.01	54.00	15.99

Average data (5 149.61 MHz)

Blank

Horizontal/Vertical for Band-edge

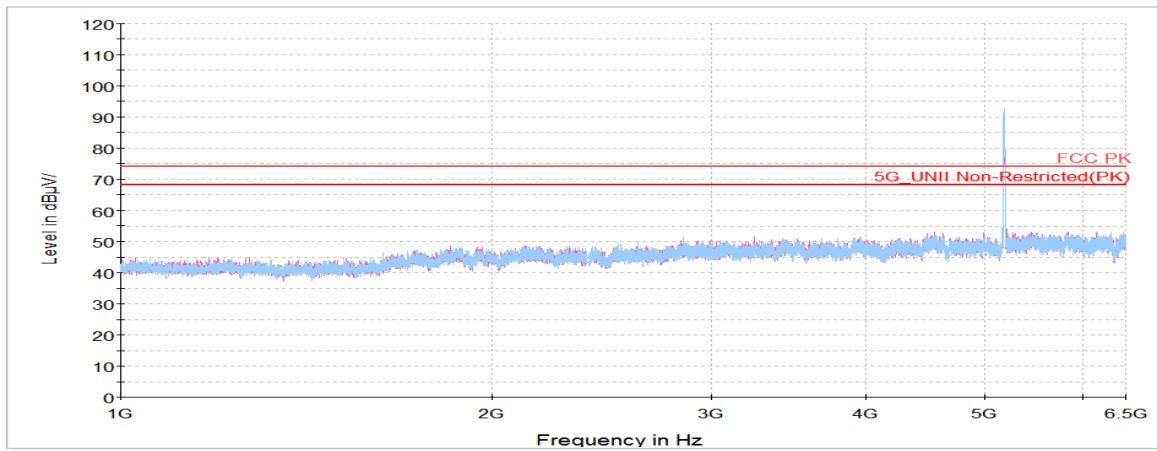
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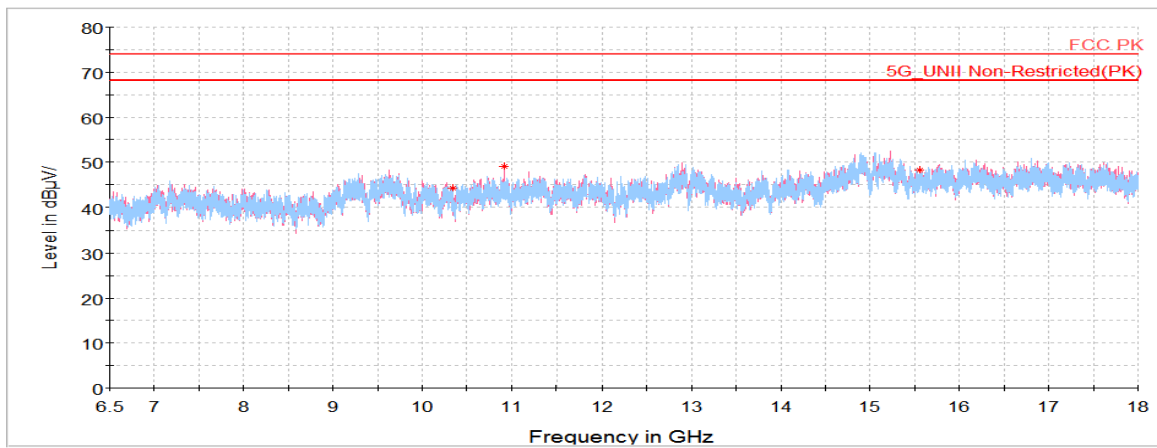
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



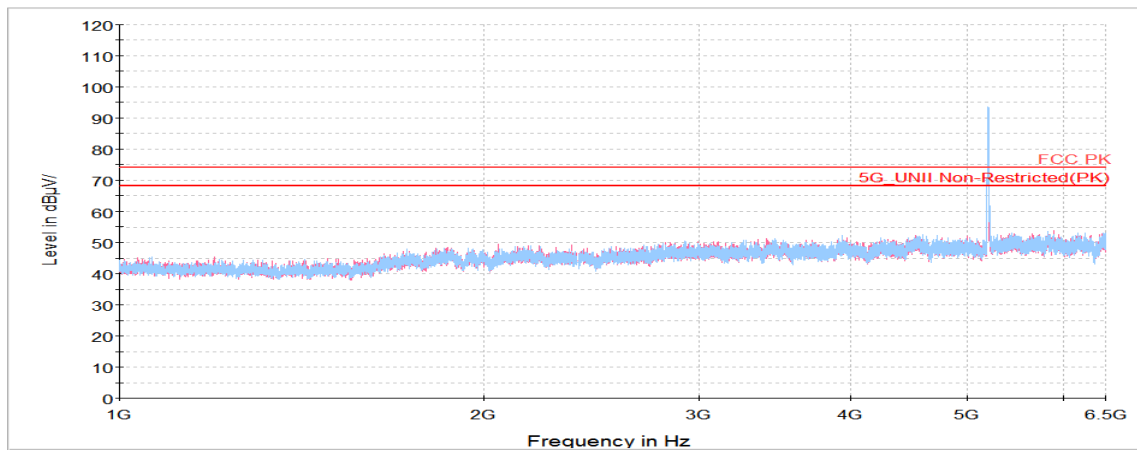
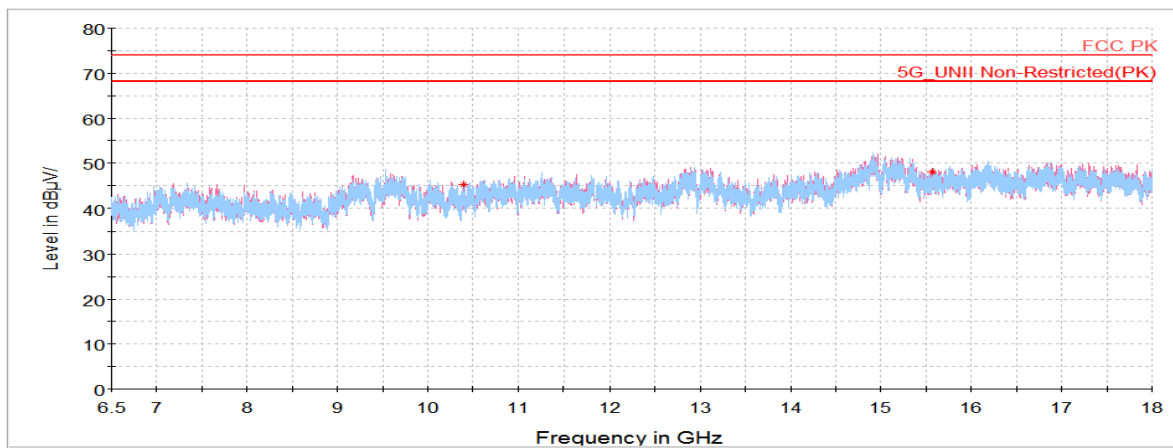
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KCTL**Middle Channel (5 200 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
10 393.83	V	57.38	37.59	-49.73	-	45.24	68.20	22.96
15 567.75 ¹⁾	H	53.72	39.97	-45.56	-	48.13	74.00	25.87
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 6.5 GHz**Horizontal/Vertical for 6.5 GHz ~ 18 GHz**

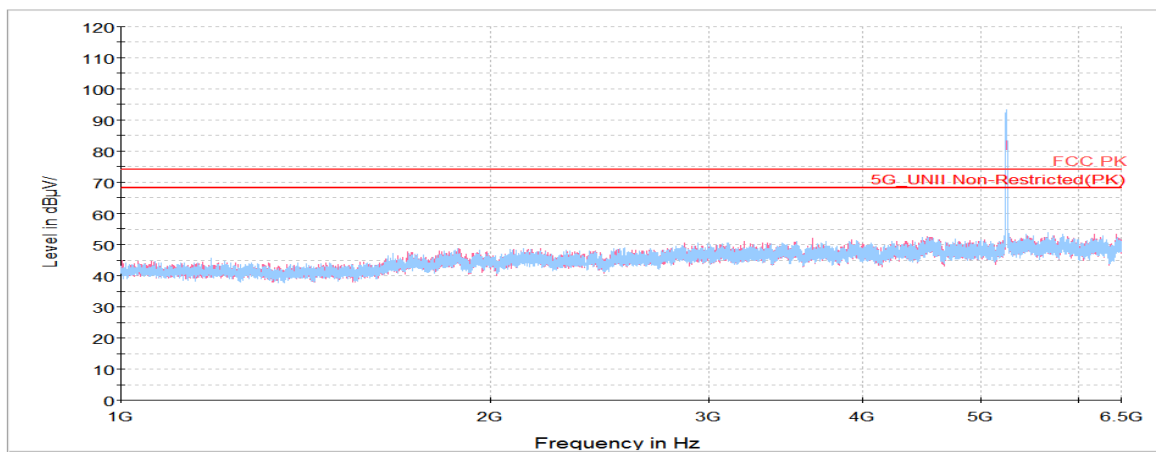
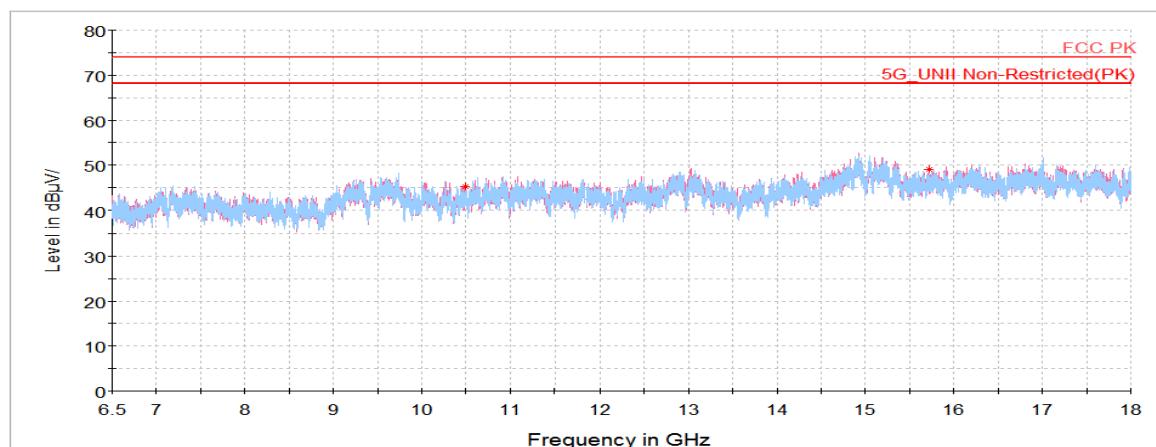
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KCTL**Highest Channel (5 240 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Peak data								
10 486.91	V	57.33	37.69	-49.78	-	45.24	68.20	22.96
15 727.31 ¹⁾	V	54.82	39.91	-45.68	-	49.05	74.00	24.95
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 6.5 GHz**Horizontal/Vertical for 6.5 GHz ~ 18 GHz**

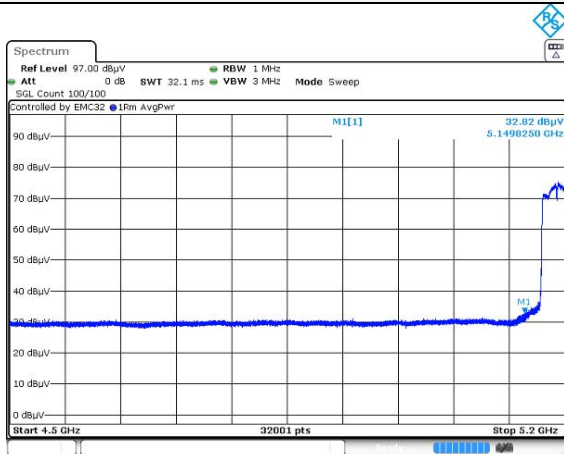
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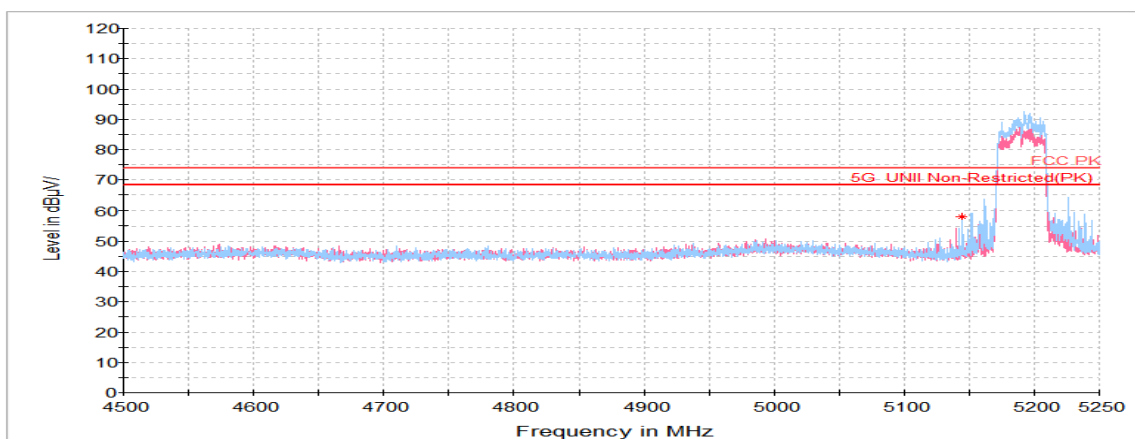
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KCTL**802.11n HT40 UNII 1****Lowest Channel (5 190 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
5 149.83 ¹⁾	H	50.06	34.17	-26.51	-	57.72	74.00	16.28
10 389.16	H	57.56	37.59	-49.73	-	45.42	68.20	22.78
15 574.22 ¹⁾	H	54.60	39.97	-45.57	-	49.00	74.00	25.00
Average Data								
5 149.83 ¹⁾	H	32.32	34.17	-26.51	0.62	40.60	54.00	13.40

Average data (5 149.83 MHz)

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Horizontal/Vertical for Band-edge

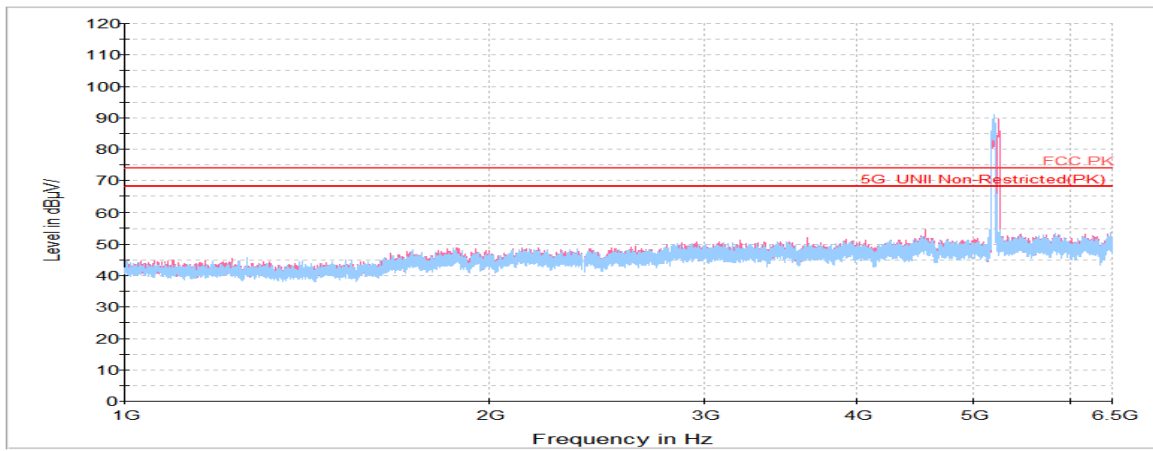
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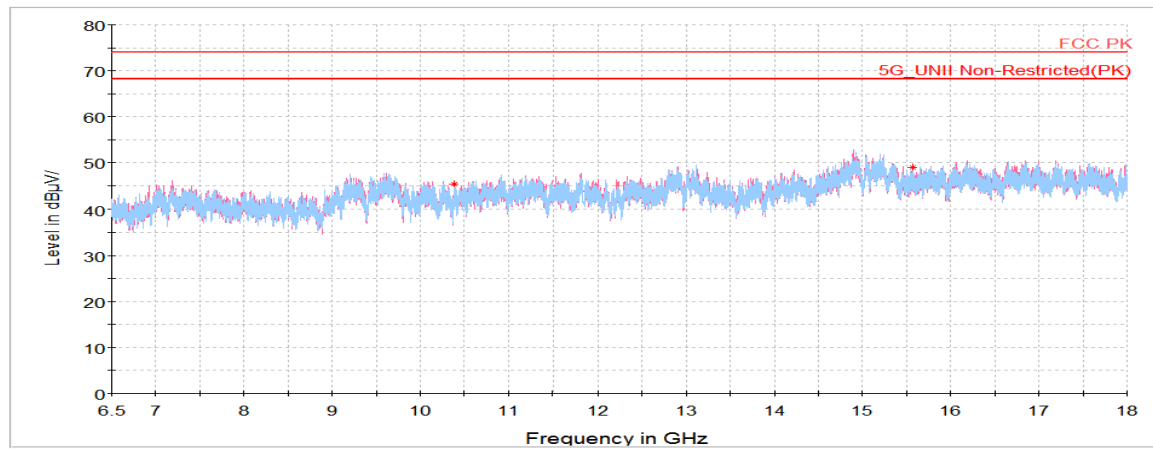
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



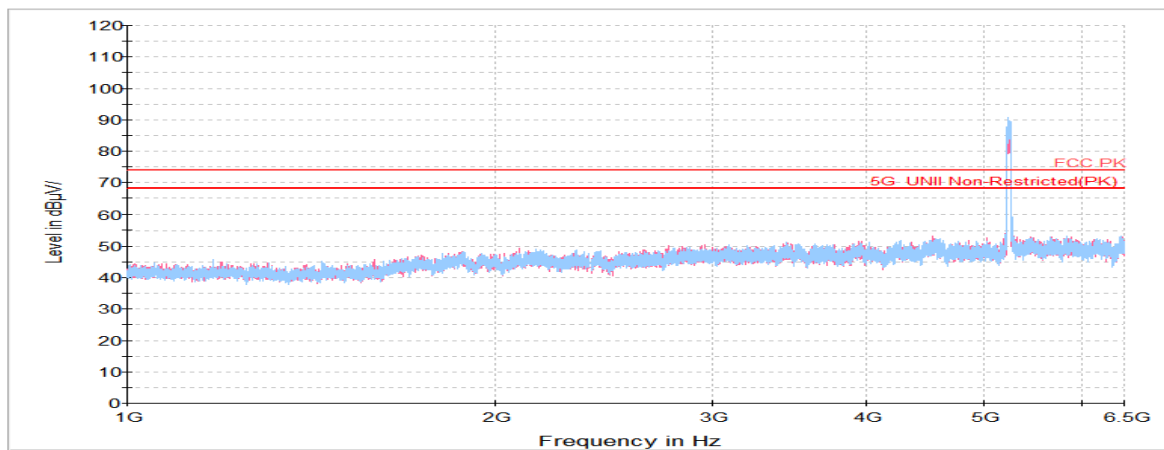
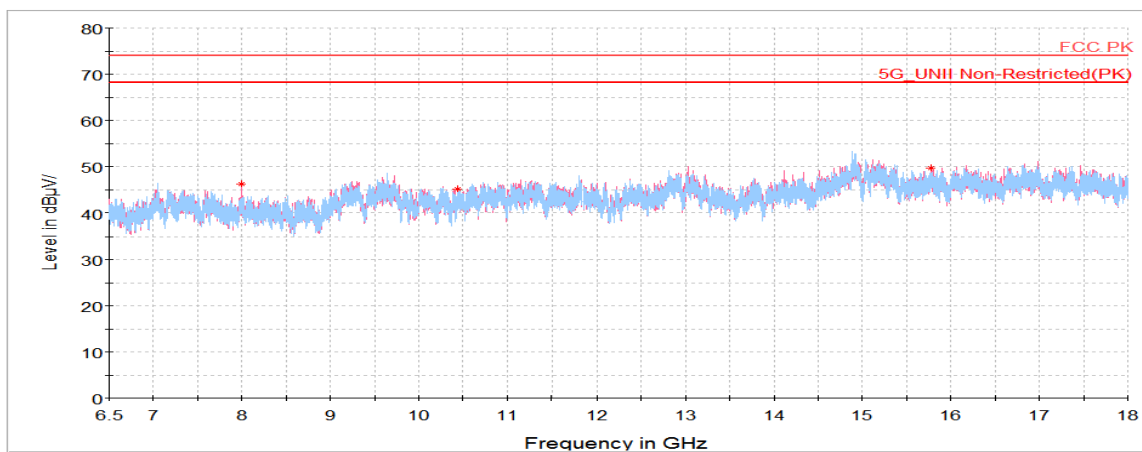
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KCTL**Highest Channel (5 230 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Peak data								
7 991.05	V	61.42	35.59	-50.74	-	46.27	68.20	21.93
10 435.16	H	57.16	37.64	-49.75	-	45.05	68.20	23.15
15 774.39 ¹⁾	V	55.43	39.89	-45.71	-	49.61	74.00	24.39
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 6.5 GHz**Horizontal/Vertical for 6.5 GHz ~ 18 GHz**

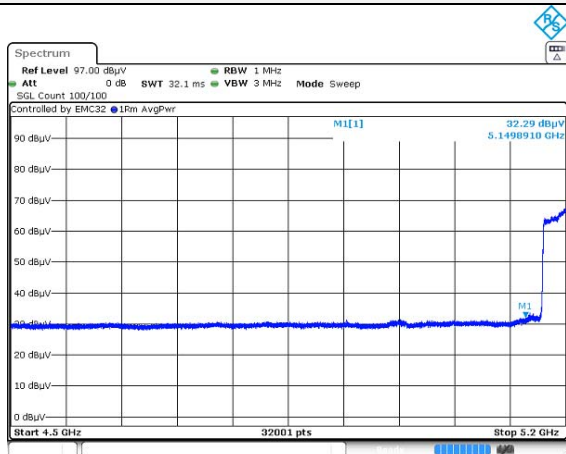
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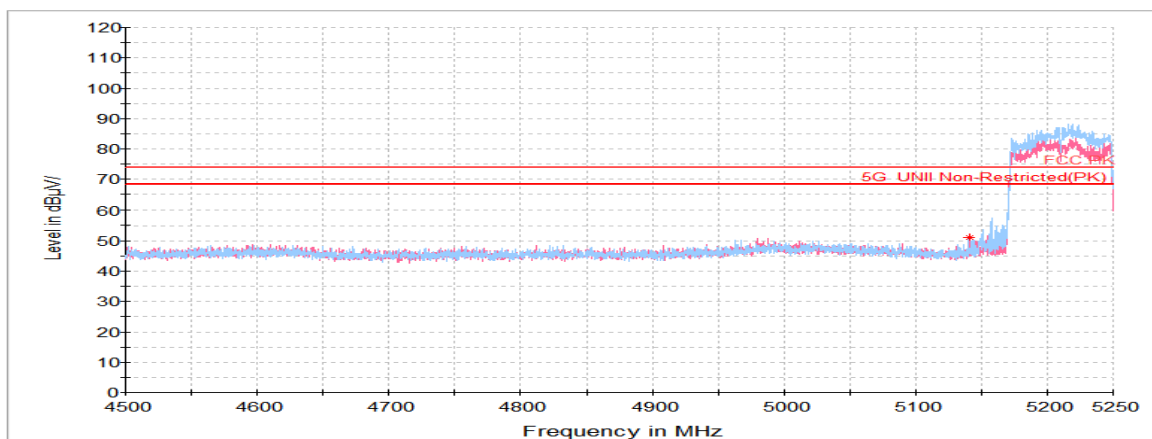
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KCTL**802.11ac VHT80 UNII 1****Channel (5 210 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
5 149.89 ¹⁾	V	43.53	34.15	-26.56	-	51.12	74.00	22.88
7 987.09	V	61.53	35.59	-50.74	-	46.38	68.20	21.82
10 276.31	V	58.49	37.48	-49.67	-	46.30	68.20	21.90
15 347.09	H	54.49	40.13	-44.19	-	50.43	68.20	17.77
Average Data								
5 149.89 ¹⁾	V	32.29	34.15	-26.56	1.53	41.41	54.00	12.59

Average data (5 149.89 MHz)

Blank

Horizontal/Vertical for Band-edge

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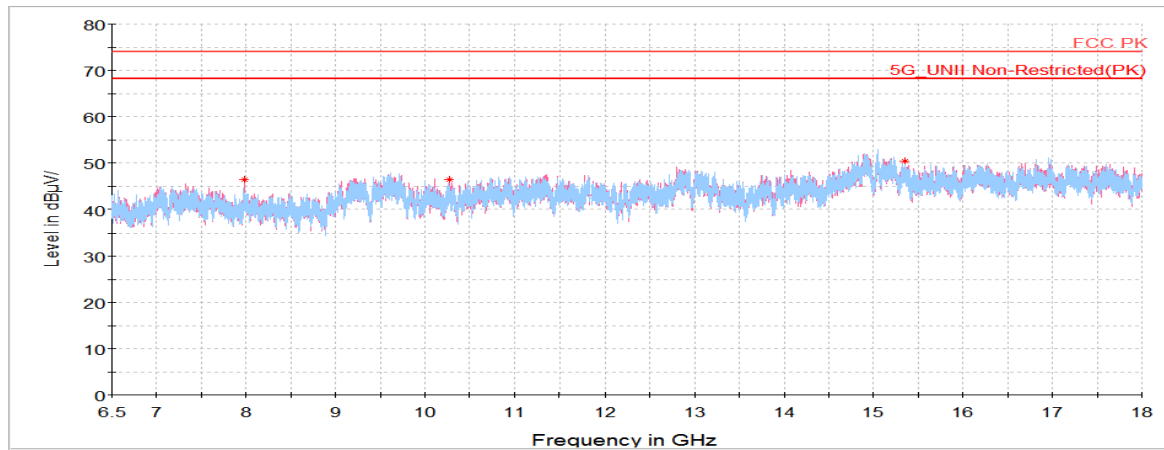
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



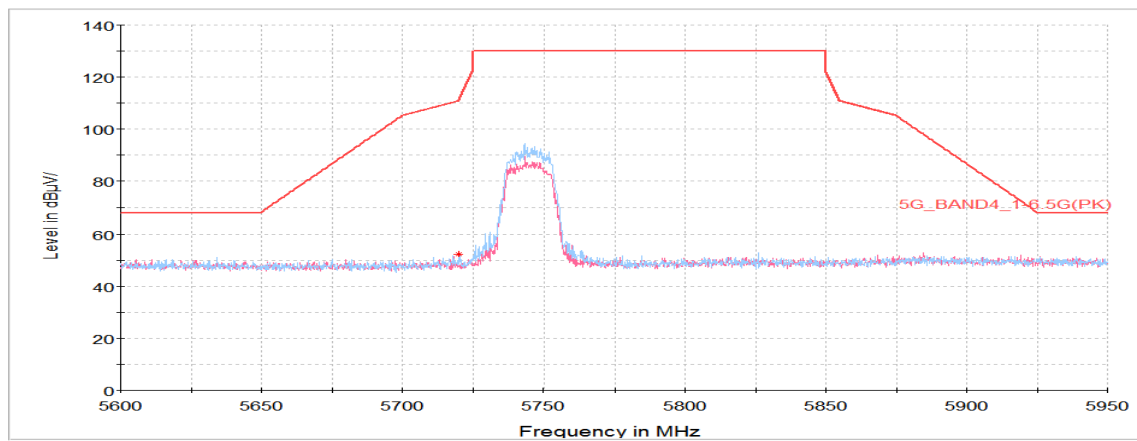
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KCTL**802.11a UNII 3****Lowest Channel (5 745 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
5 720.20	H	42.91	35.02	-25.64	-	52.29	68.20	15.91
11 485.97 ¹⁾	V	57.81	38.30	-49.30	-	46.81	74.00	27.19
17 244.95	V	56.60	40.55	-46.73	-	50.42	68.20	17.78
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for Band-edge

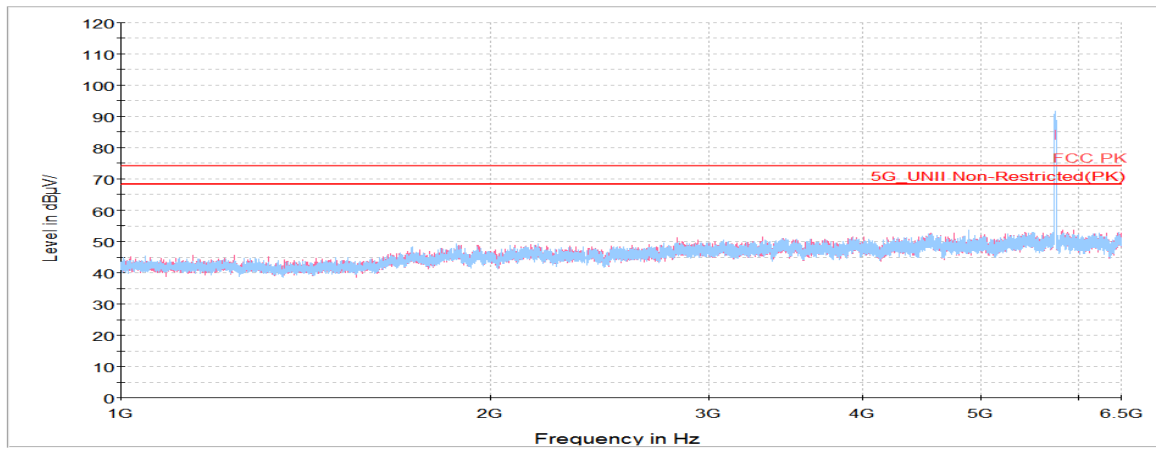
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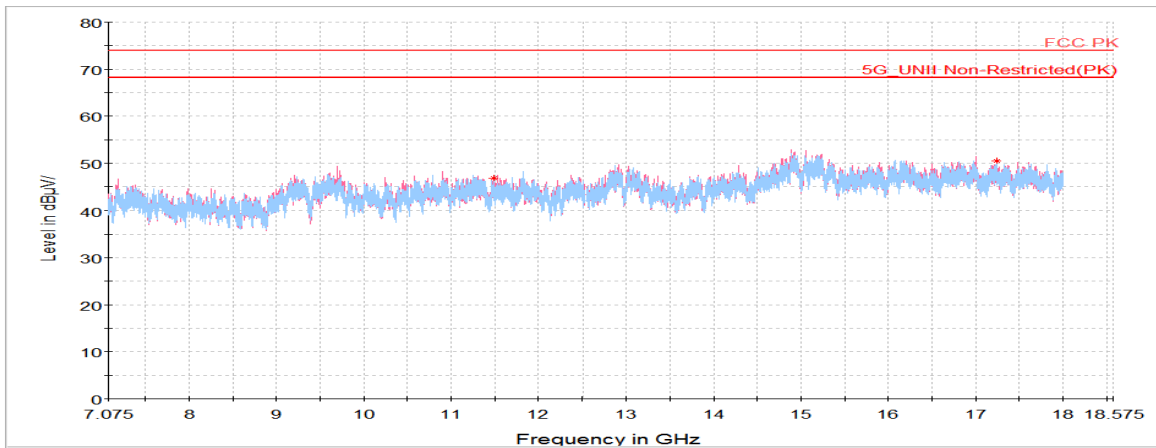
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



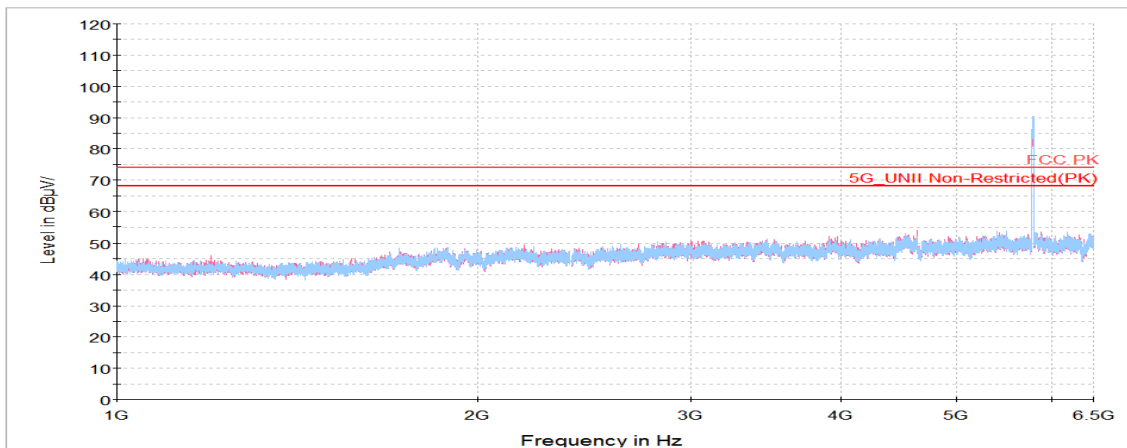
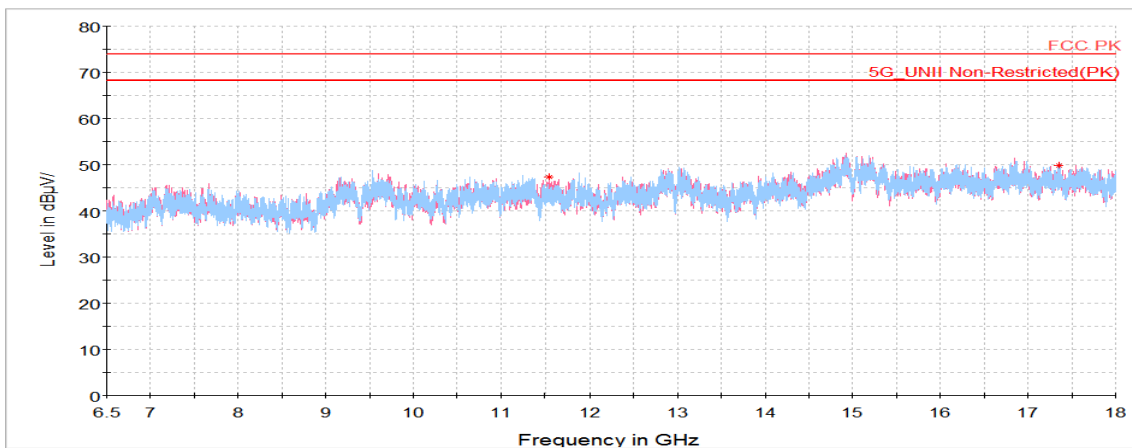
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KCTL**Middle Channel (5 785 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
11 552.81 ¹⁾	V	58.18	38.34	-49.35	-	47.17	74.00	26.83
17 357.44	H	56.05	40.49	-46.76	-	49.78	68.20	18.42
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 6.5 GHz**Horizontal/Vertical for 6.5 GHz ~ 18 GHz**

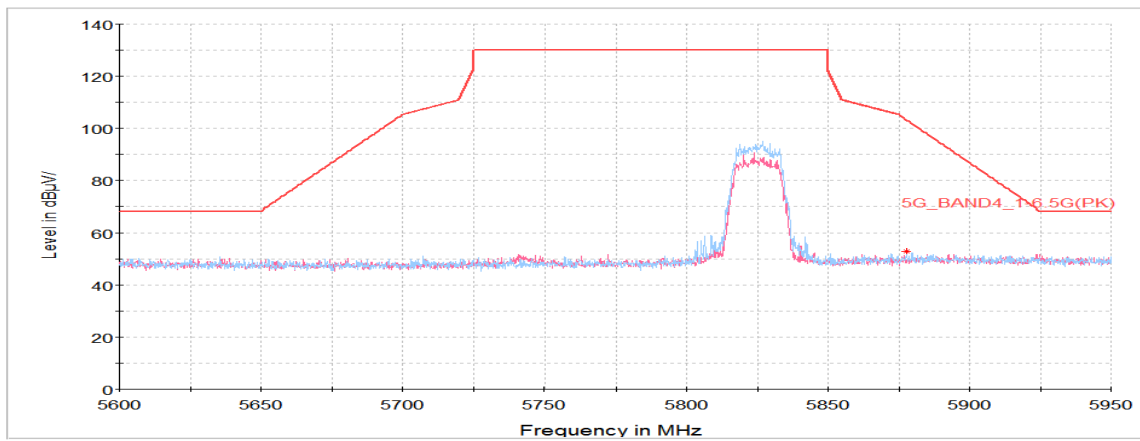
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KCTL**Highest Channel (5 825 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
5 877.81	H	41.46	35.18	-23.72	-	52.92	68.20	15.28
11 676.44 ¹⁾	V	58.13	38.44	-49.45	-	47.12	74.00	26.88
17 527.78	V	56.10	40.81	-46.85	-	50.06	68.20	18.14
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for Band-edge

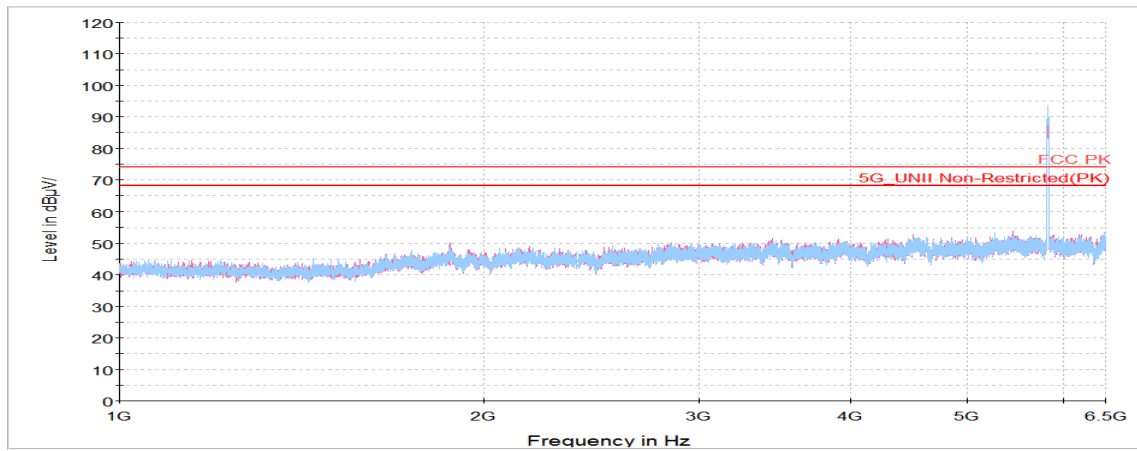
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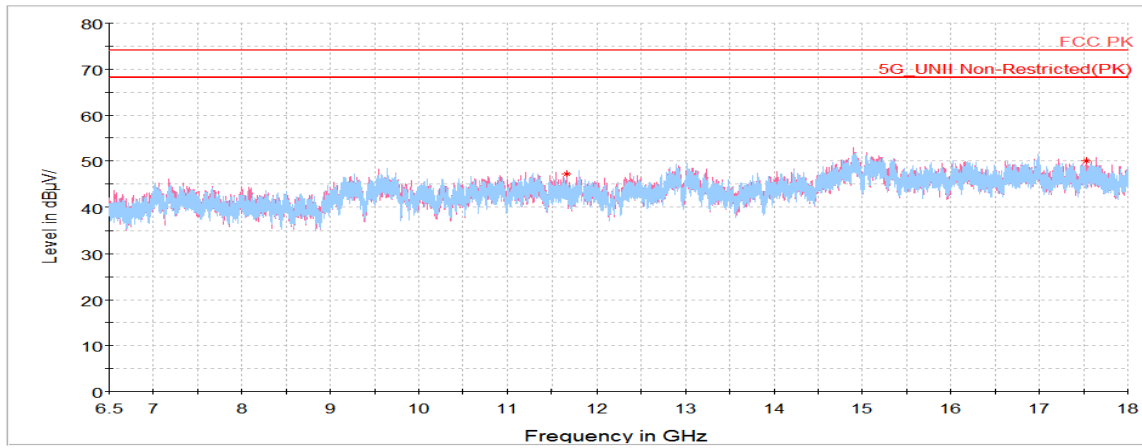
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



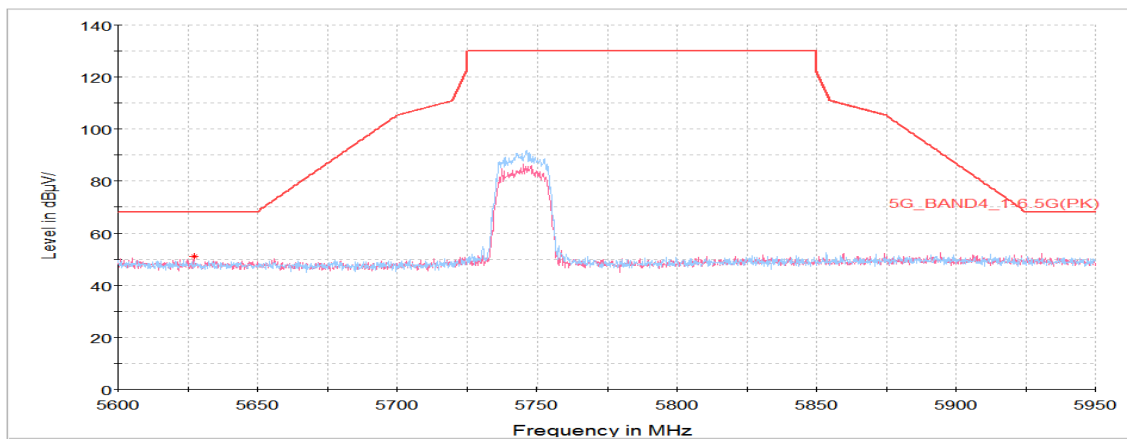
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KCTL**802.11n HT20 UNII 3****Lowest Channel (5 745 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
5 627.22	V	41.81	34.93	-25.47	-	51.27	68.20	16.93
11 462.97 ¹⁾	V	57.14	38.29	-49.29	-	46.14	74.00	27.86
17 216.92	H	55.70	40.57	-46.72	-	49.55	68.20	18.65
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for Band-edge

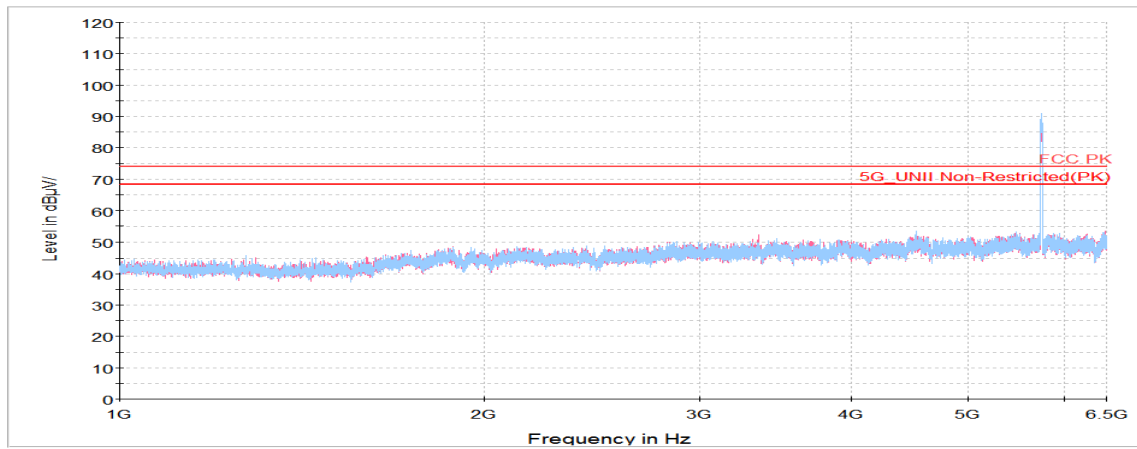
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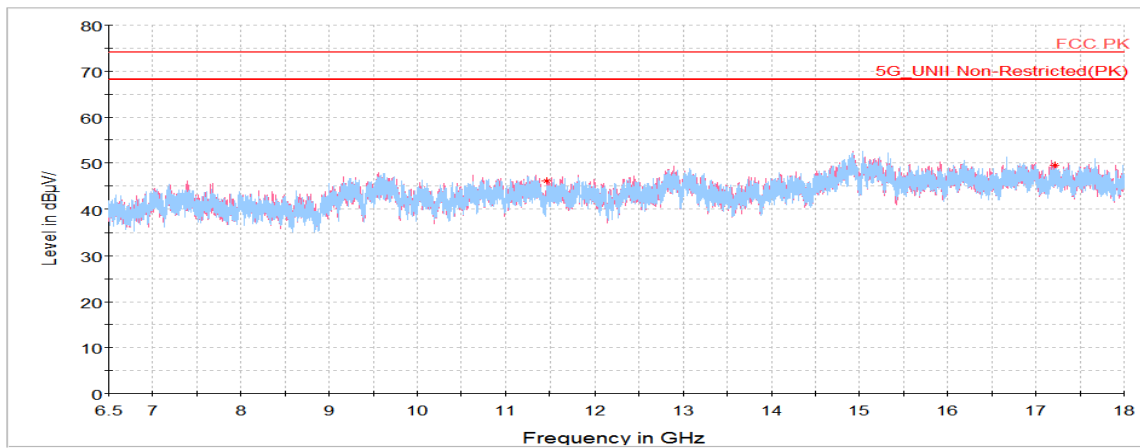
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



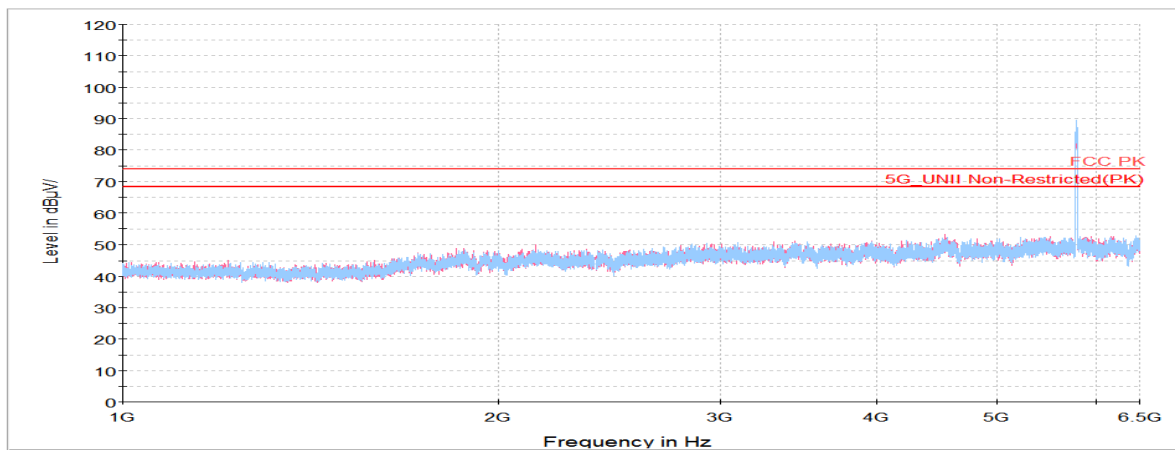
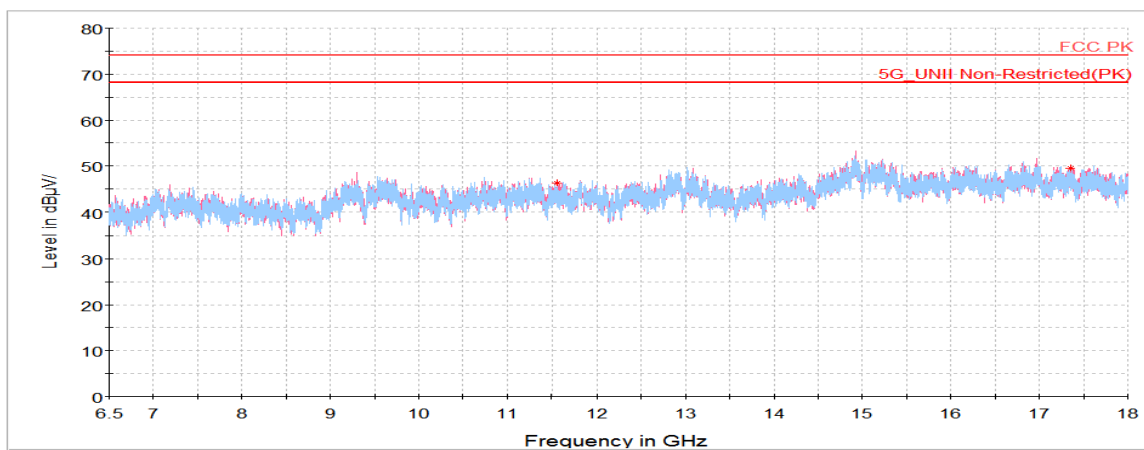
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KCTL**Middle Channel (5 785 MHz)**

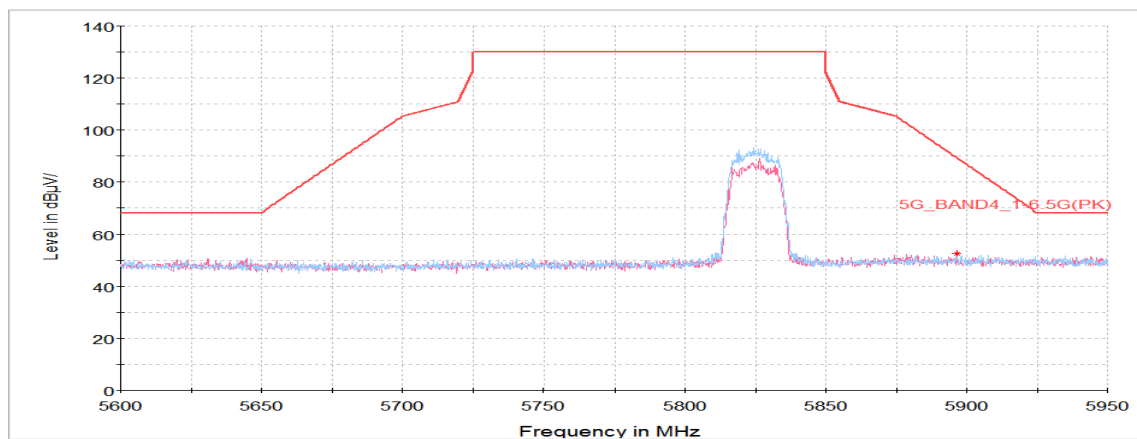
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
11 557.84 ¹⁾	H	57.19	38.35	-49.35	-	46.19	74.00	27.81
17 360.31	V	55.81	40.48	-46.76	-	49.53	68.20	18.67
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 6.5 GHz**Horizontal/Vertical for 6.5 GHz ~ 18 GHz**

Highest Channel (5 825 MHz)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
5 896.38	H	41.16	35.20	-23.63	-	52.73	68.20	15.47
11 645.89 ¹⁾	H	58.62	38.42	-49.42	-	47.62	74.00	26.38
11 824.14 ¹⁾	H	59.75	38.56	-49.56	-	48.75	74.00	25.25
17 182.06	V	58.55	40.59	-46.71	-	52.43	68.20	15.77
17 485.38	H	55.85	40.41	-46.79	-	49.47	68.20	18.73
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for Band-edge



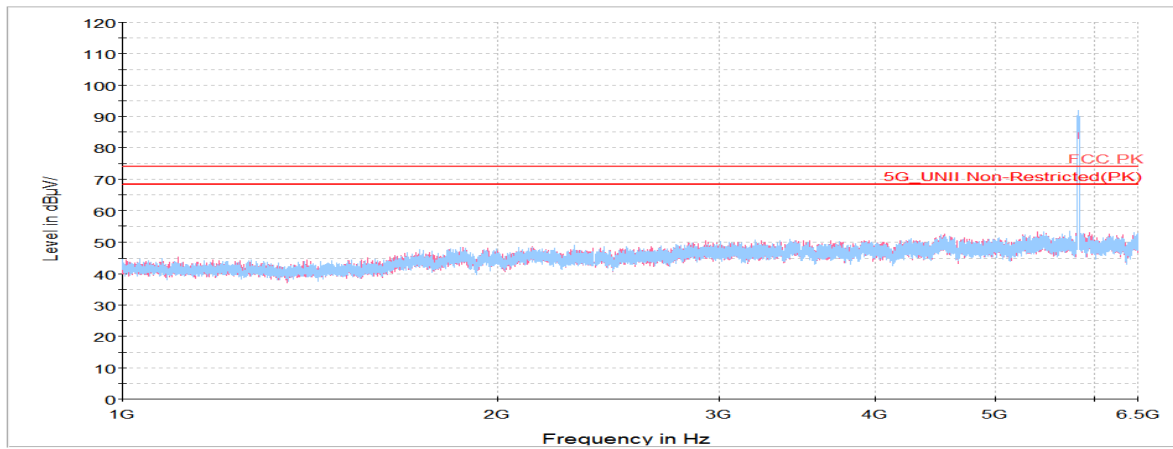
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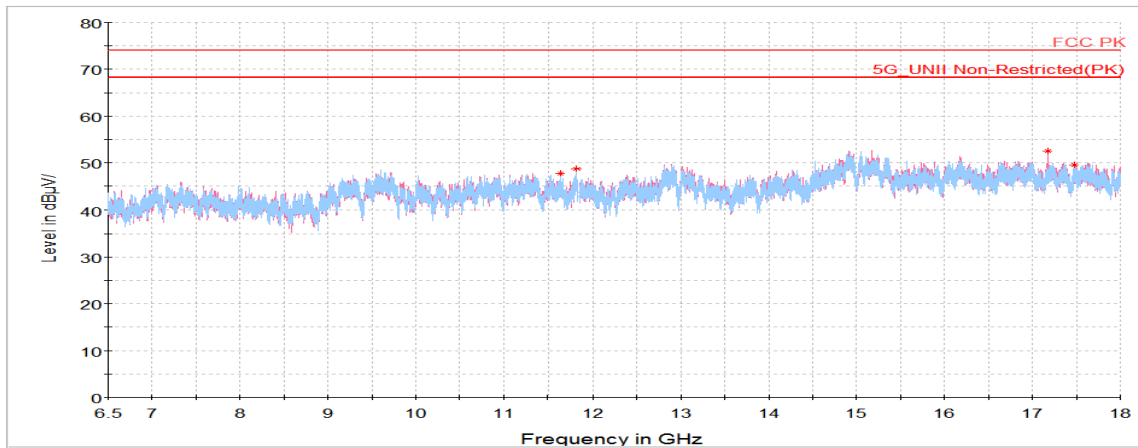
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz

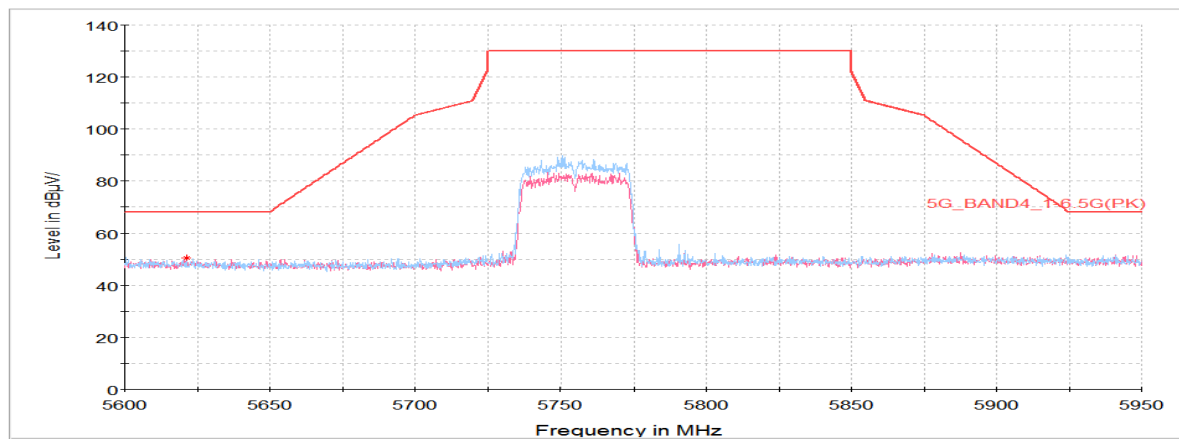


802.11n HT40 UNII 3

Lowest Channel (5 755 MHz)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
5 621.38	V	41.00	34.92	-25.42	-	50.50	68.20	17.70
7 992.48	V	61.92	35.60	-50.75	-	46.77	68.20	21.43
11 480.94 ¹⁾	V	57.90	38.30	-49.30	-	46.90	74.00	27.10
17 239.56	H	56.17	40.56	-46.73	-	50.00	68.20	18.20
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for Band-edge



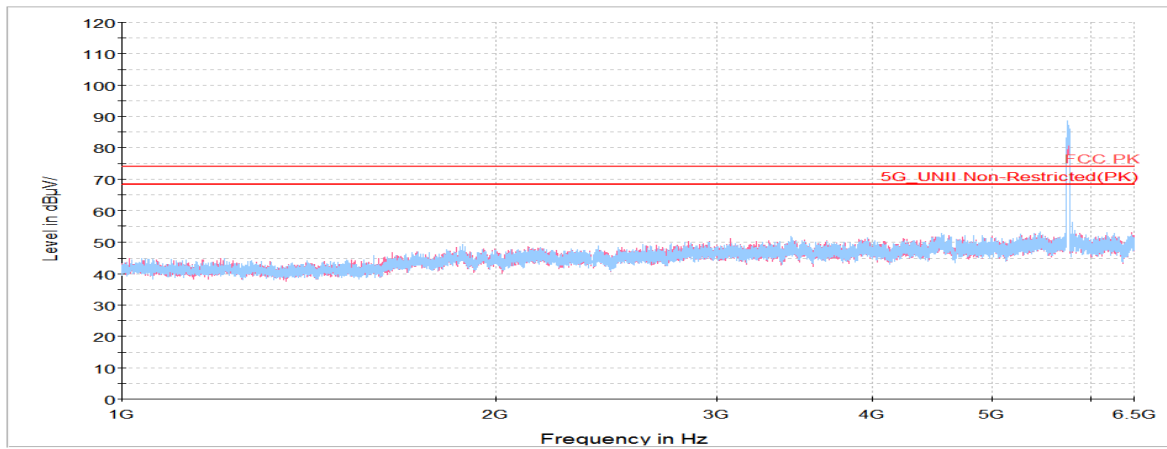
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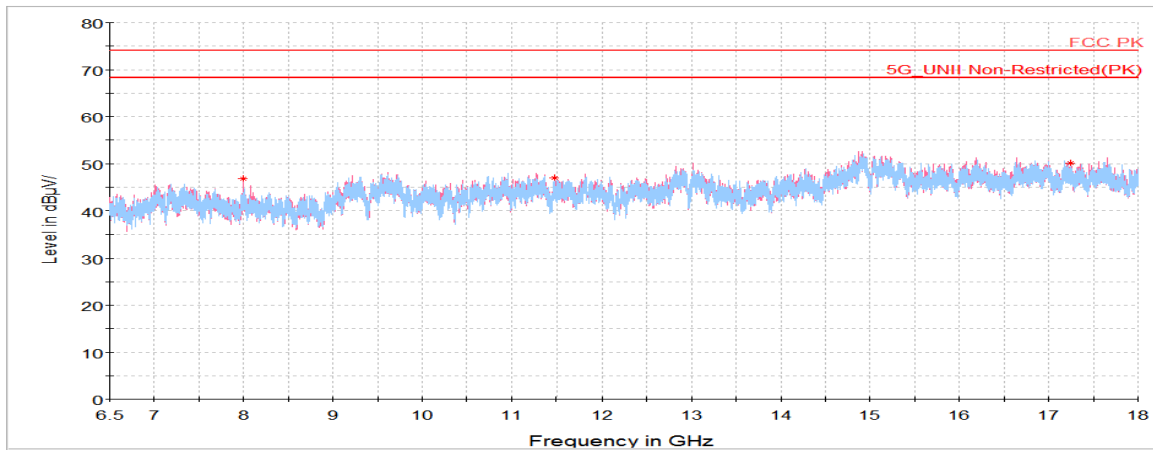
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



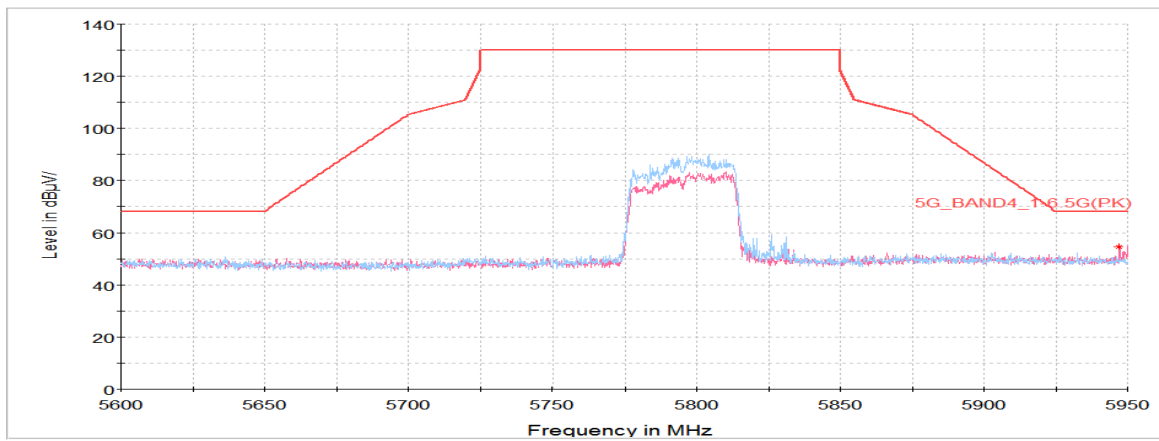
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**Highest Channel (5 795 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB($\mu V/m$))	(dB($\mu V/m$))	(dB)
Peak data								
5 947.08	V	43.56	35.25	-24.16	-	54.65	68.20	13.55
11 552.09 ¹⁾	H	57.53	38.34	-49.35	-	46.52	74.00	27.48
17 376.84	H	55.67	40.47	-46.76	-	49.38	68.20	18.82
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for Band-edge

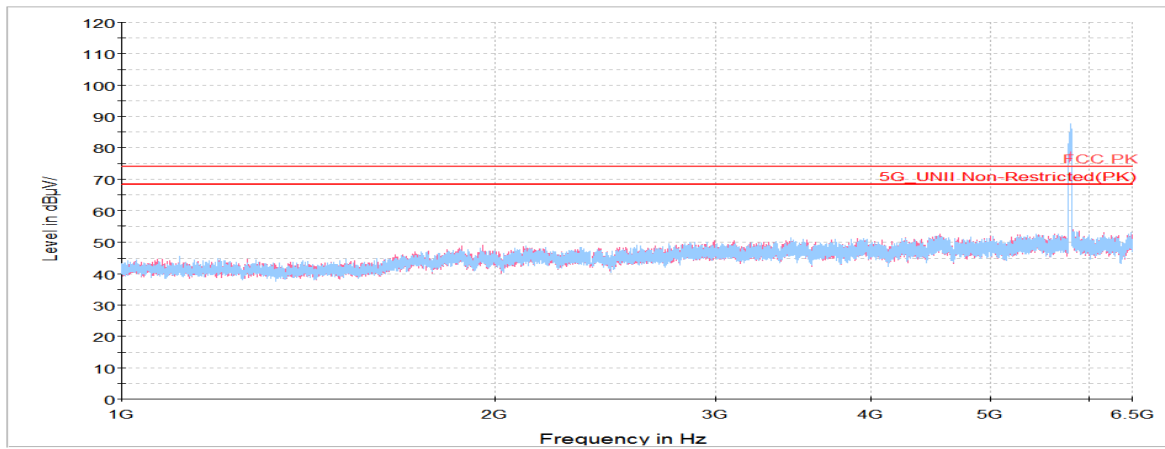
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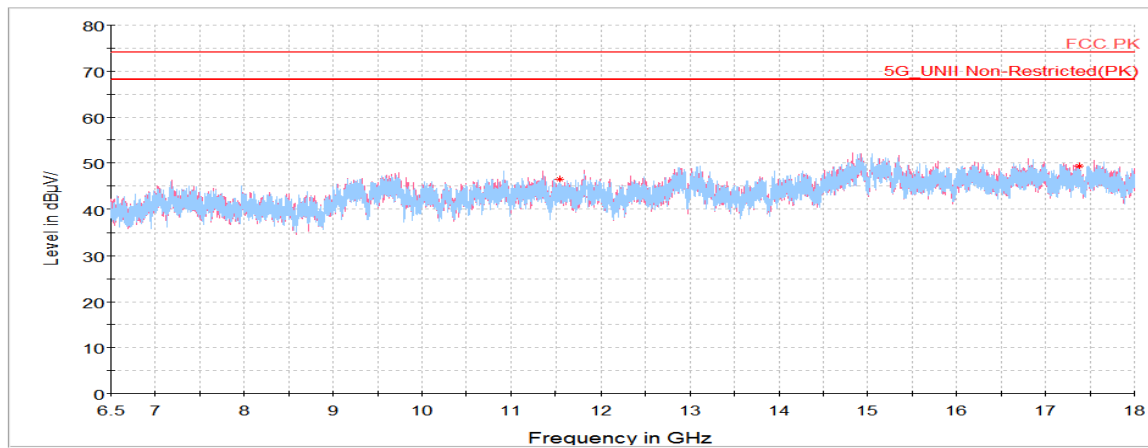
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



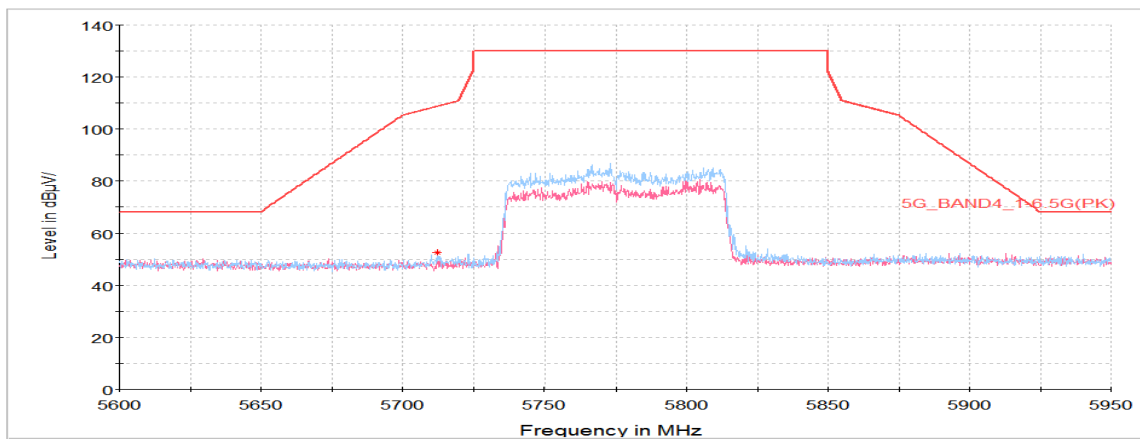
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KCTL**802.11ac VHT80 UNII 3****Channel (5 775 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Peak data								
5 712.30	H	43.32	35.01	-25.79	-	52.54	68.20	15.66
11 537.72 ¹⁾	H	58.79	38.33	-49.34	-	47.78	74.00	26.22
17 293.83	H	56.56	40.52	-46.74	-	50.34	68.20	17.86
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for Band-edge

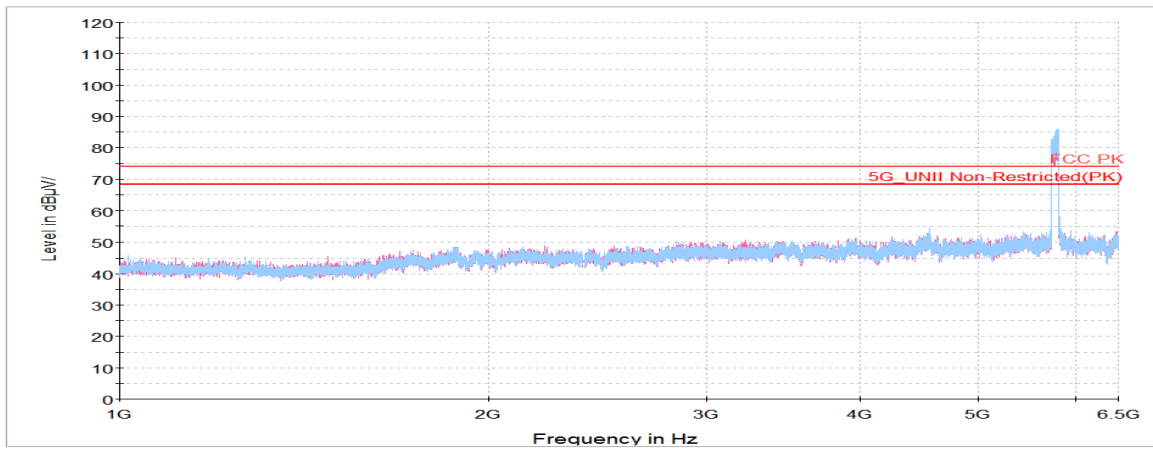
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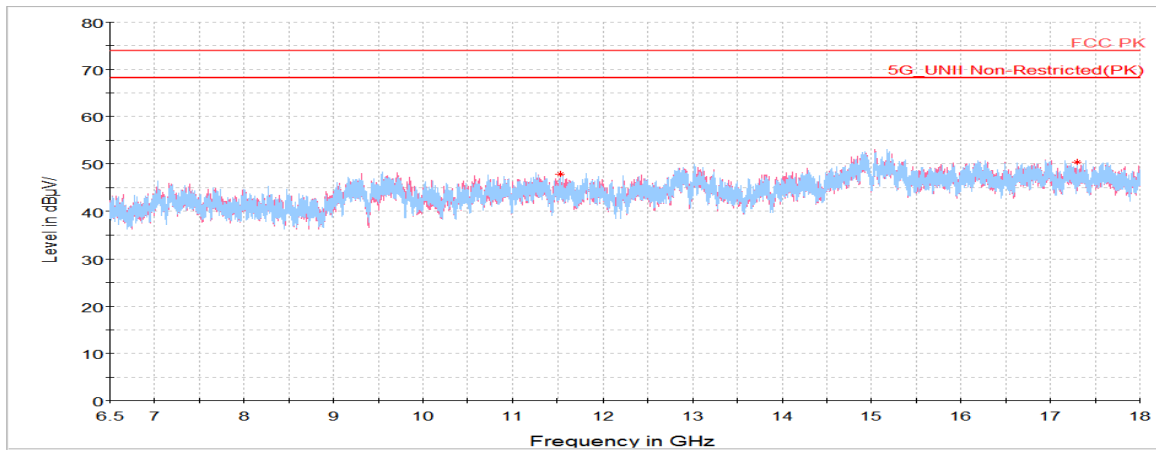
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Horizontal/Vertical for 1 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



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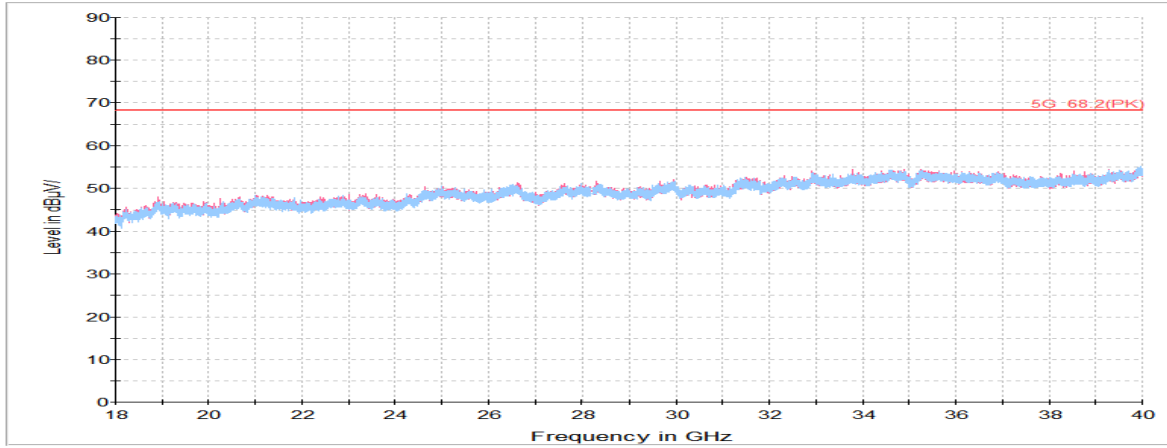
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Test results (Above 18 GHz) – Worst case: 802.11ac VHT80_UNII 1_5 210 MHz

Horizontal/Vertical for 18 GHz ~ 40 GHz



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

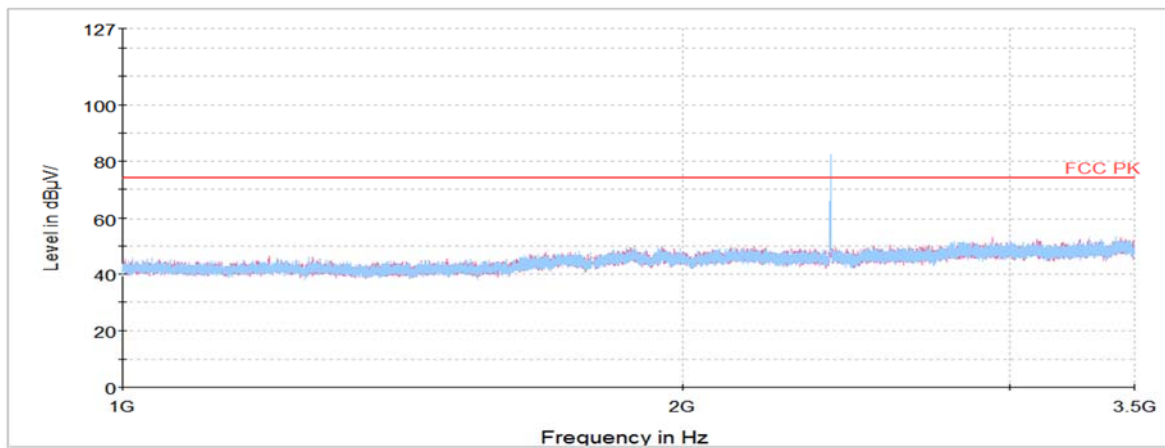
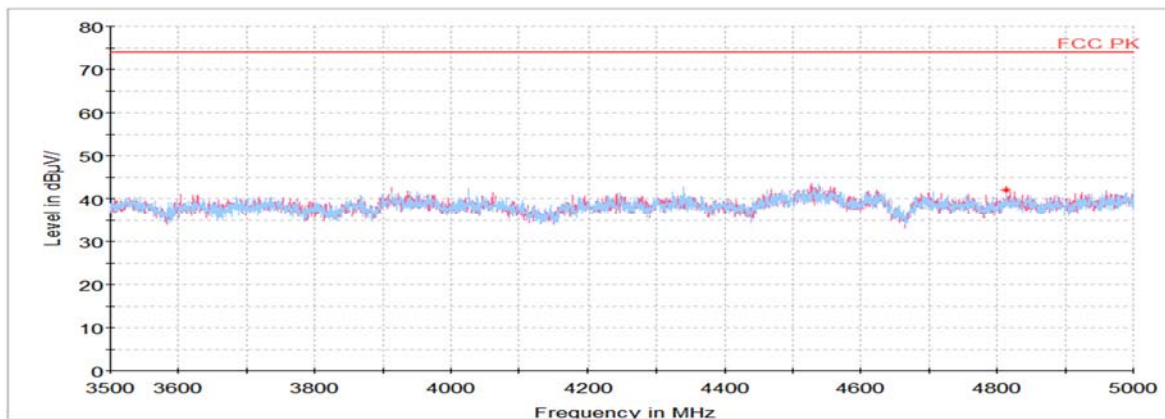
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KCTL**Simultaneous condition****802.11ac VHT80 (5 210 MHz) + BT_BDR(DH5)(2 402 MHz)**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
4 814.06 ¹⁾	V	61.30	33.79	-53.10	-	41.99	74.00	32.01
10 486.19	V	58.32	37.69	-49.78	-	46.23	68.20	21.97
15 042.34	H	54.09	40.19	-41.56	-	52.72	68.20	15.48
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 3.5 GHz**Horizontal/Vertical for 3.5 GHz ~ 5 GHz**

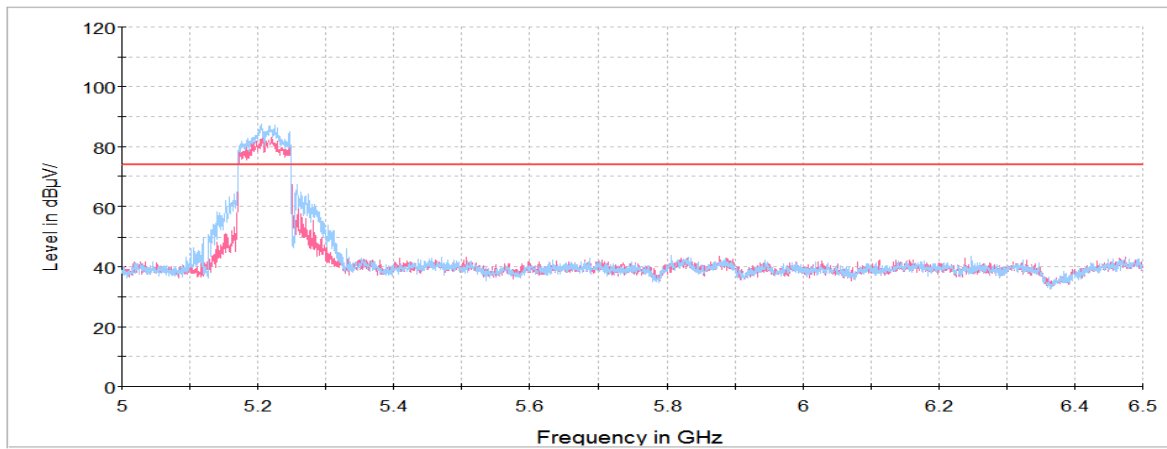
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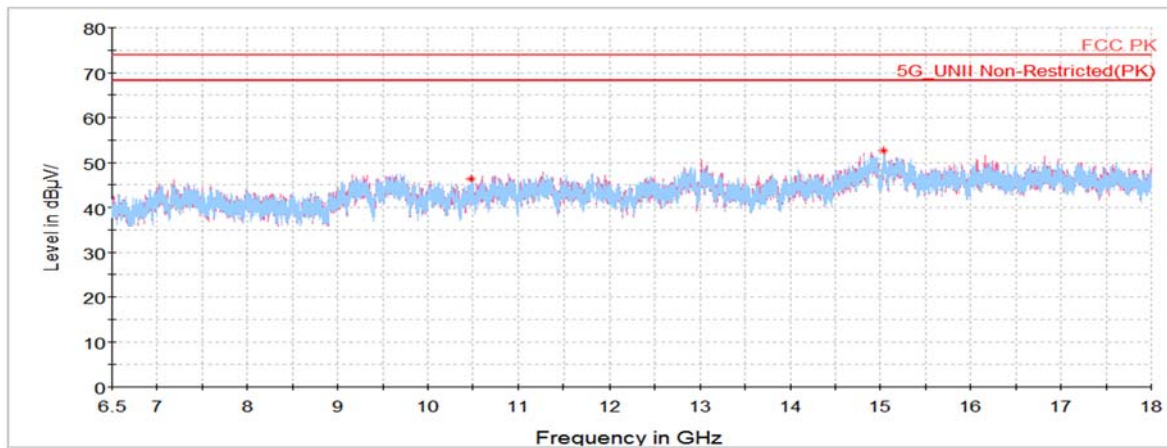
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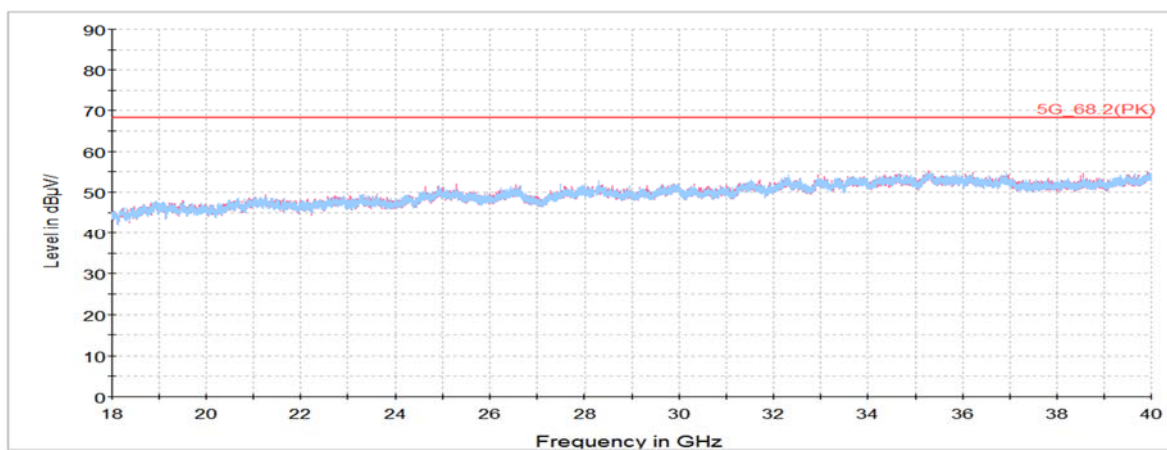
Horizontal/Vertical for 5 GHz ~ 6.5 GHz



Horizontal/Vertical for 6.5 GHz ~ 18 GHz



Horizontal/Vertical for 18 GHz ~ 40 GHz



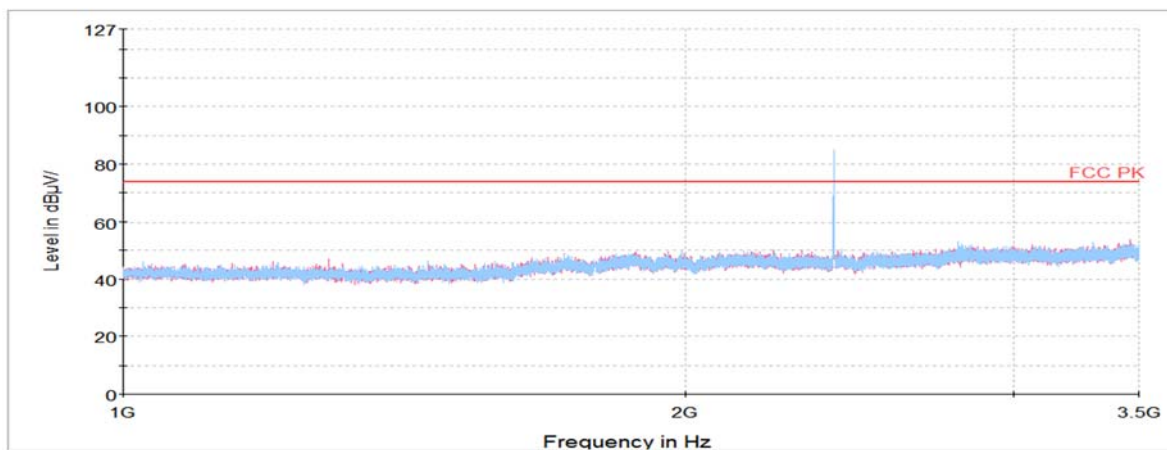
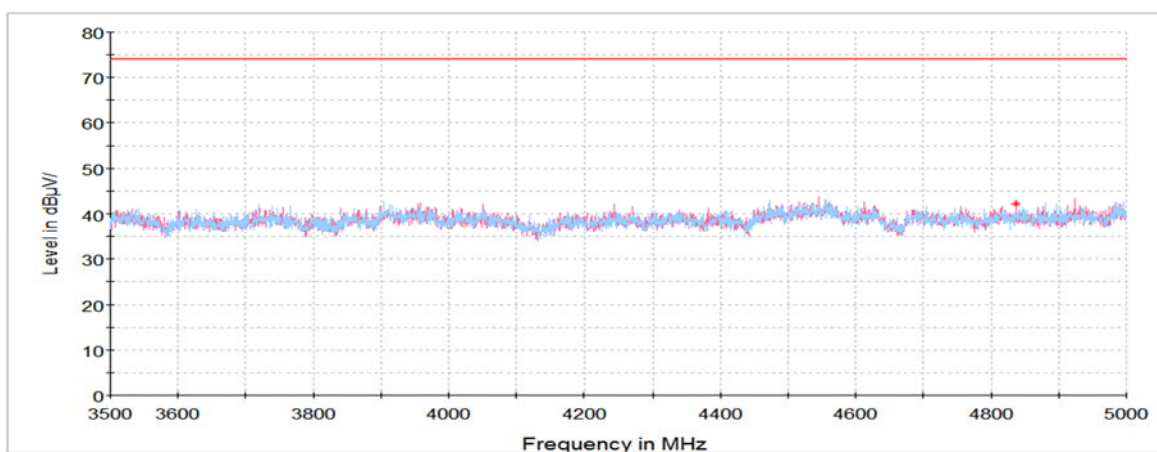
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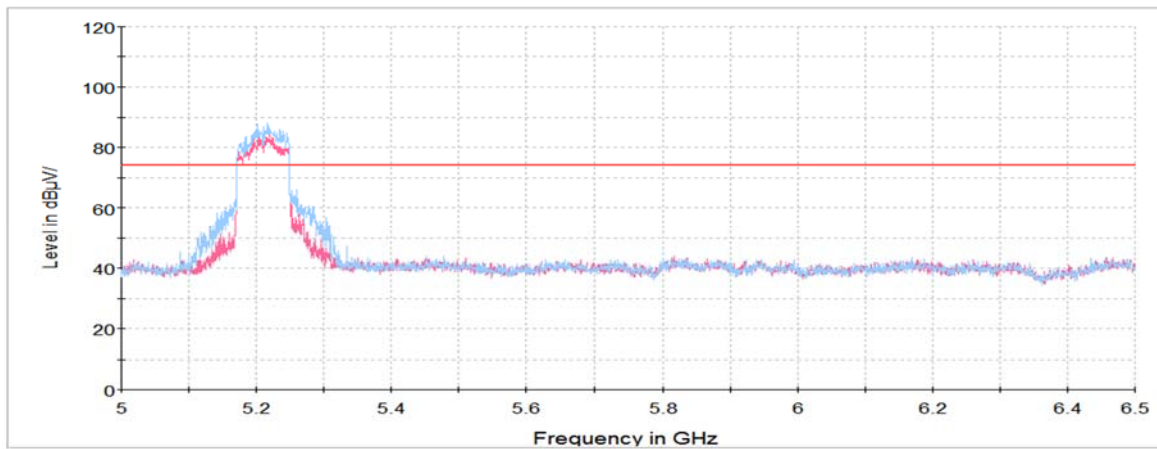
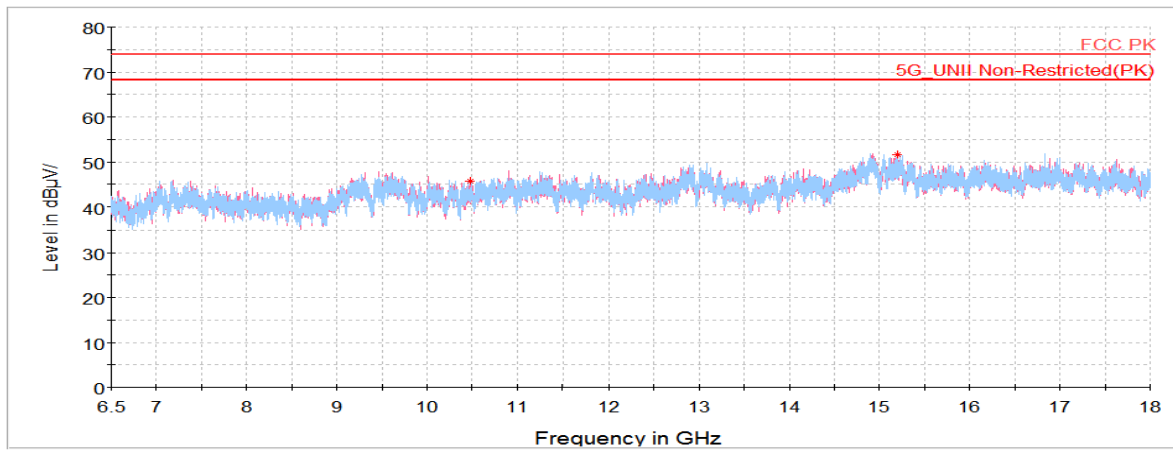
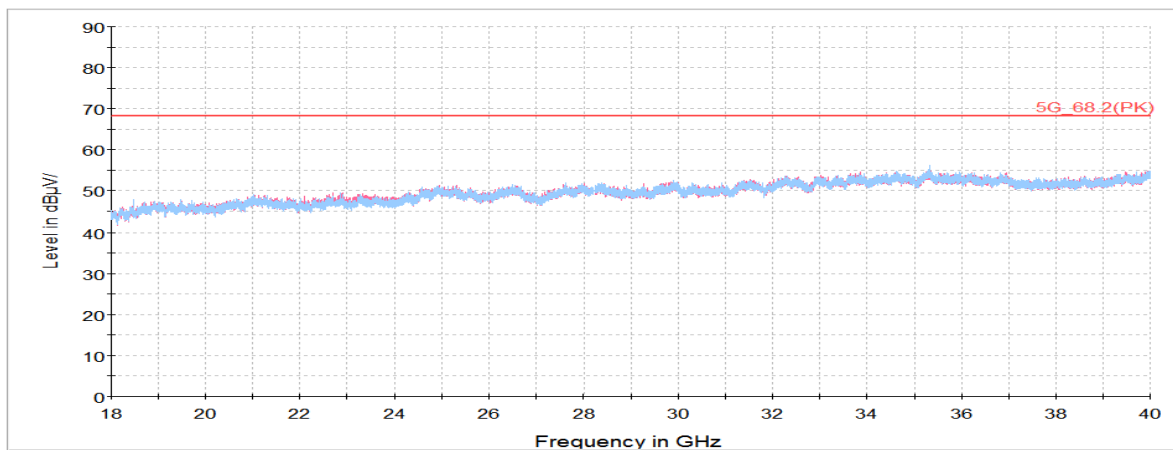
65, Sinwon-ro, Yeongtong-gu,
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KCTL**802.11ac VHT80 (5 210 MHz) + BLE_1M Bits/s, 37 Packet (2 402 MHz)**

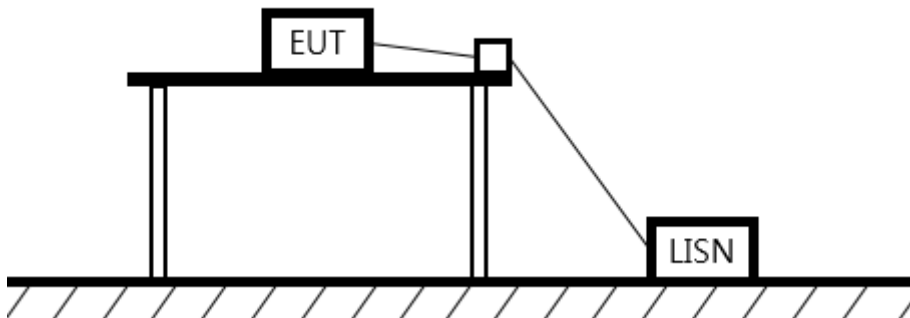
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
4 836.72 ¹⁾	V	61.46	33.80	-53.12	-	42.14	74.00	31.86
10 476.13	V	57.82	37.68	-49.77	-	45.73	68.20	22.47
15 195.08	V	54.24	40.16	-42.88	-	51.52	68.20	16.68
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Horizontal/Vertical for 1 GHz ~ 3.5 GHz**Horizontal/Vertical for 3.5 GHz ~ 5 GHz**

Horizontal/Vertical for 5 GHz ~ 6.5 GHz**Horizontal/Vertical for 6.5 GHz ~ 18 GHz****Horizontal/Vertical for 18 GHz ~ 40 GHz**

7.6. AC Conducted emission

Test setup



Limit

According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted limit (dB μ V/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

Measurement procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω /50 μ H LISN, which is an input transducer to a spectrum analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to peak amplitude within a bandwidth of 10 kHz or to quasi-peak and average within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

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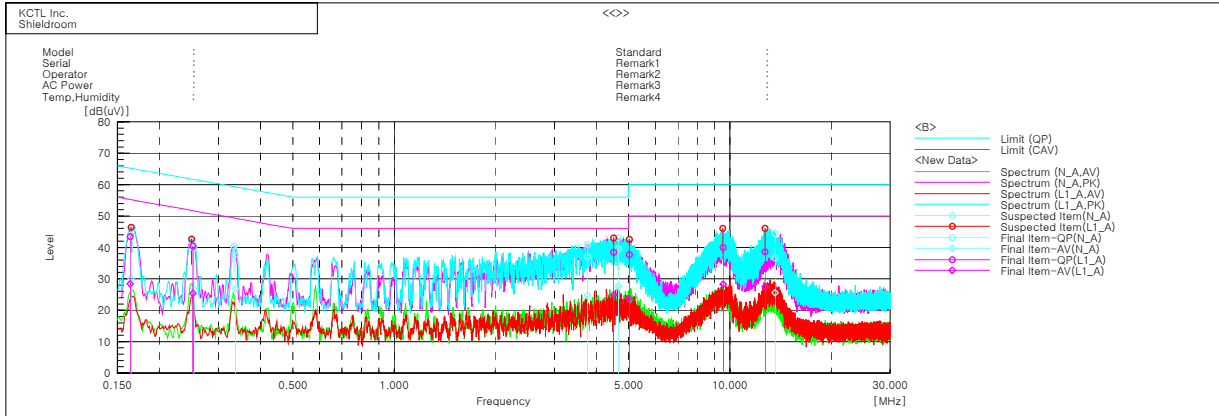
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Test results

Worst case: 802.11a_UNII 1_5 180 MHz



Final Result

--- N_A Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.16455	33.9	20.1	10.0	43.9	30.1	65.2	55.2	21.3	25.1
2	0.25352	30.2	17.1	9.7	39.9	26.8	61.6	51.6	21.7	24.8
3	0.33713	27.8	17.0	9.8	37.6	26.8	59.3	49.3	21.7	22.5
4	3.76304	27.2	15.0	9.8	37.0	24.8	56.0	46.0	19.0	21.2
5	4.64961	29.6	17.7	9.9	39.5	27.6	56.0	46.0	16.5	18.4
6	13.61384	26.4	15.3	10.3	36.7	25.6	60.0	50.0	23.3	24.4

--- L1_A Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.16372	33.4	18.4	10.0	43.4	28.4	65.3	55.3	21.9	26.9
2	0.25223	30.6	15.6	9.7	40.3	25.3	61.7	51.7	21.4	26.4
3	4.50688	28.6	15.0	9.9	38.5	24.9	56.0	46.0	17.5	21.1
4	5.02122	27.8	13.9	9.9	37.7	23.8	60.0	50.0	22.3	26.2
5	9.53922	29.9	18.2	10.1	40.0	28.3	60.0	50.0	20.0	21.7
6	12.71411	28.3	17.2	10.3	38.6	27.5	60.0	50.0	21.4	22.5

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8. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV30	101437	22.07.27
Spectrum Analyzer	R&S	FSW26	101353	22.04.01
Attenuator	API Inmet	40AH2W-10	13	22.05.11
Power Sensor	R&S	NRP-Z81	1137.9009.02-106223-bB	22.05.11
Attenuator	R&S	DNF Dämpfungsglied 10 dB in N-50 Ohm	31211	22.05.11
Signal Generator	R&S	SMB100A	176206	22.01.20
Spectrum Analyzer	R&S	FSV40	100989	21.12.23
EMI TEST RECEIVER	R&S	ESCI3	101408	22.03.05
Bi-Log Antenna	AMETEK	CBL 6112D	55545	23.01.14
Amplifier	SONOMA INSTRUMENT	310N	284608	22.08.19
COAXIAL FIXED ATTENUATOR	Agilent	8491B-003	2708A18758	22.04.23
Horn antenna	ETS.lindgren	3117	155787	21.10.28
Horn antenna	ETS.lindgren	3116	86635	22.05.17
Attenuator	API Inmet	40AH2W-10	12	22.05.11
Broadband PreAmplifier	SCHWARZBECK	BBV9718	216	22.07.27
AMPLIFIER	L-3 Narda-MITEQ	AMF-7D-01001800-22-10P	2003683	22.08.19
AMPLIFIER	L-3 Narda-MITEQ	JS44-18004000-33-8P	2000996	22.01.21
LOOP Antenna	R&S	HFH2-Z2	100355	22.08.21
Antenna Mast	Innco Systems	MA4640-XP-ET	-	-
Turn Table	Innco Systems	DT2000	79	-
Antenna Mast	Innco Systems	MA4000-EP	303	-
Turn Table	Innco Systems	DT2000	79	-
High pass Filter	Wainwright Instruments GmbH	WHKX6.5/18G-8SS	2	22.05.11
Highpass Filter	WT	WT-A1699-HS	WT160411002	22.05.10
TWO-LINE V - NETWORK	R&S	ENV216	101358	22.04.05
EMI TEST RECEIVER	R&S	ESCI	100001	22.04.14
Vector Signal Generator	R&S	SMBV100A	257566	22.07.09

End of test report