



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.: KR24-SRF0093 Page (1) of (76)	 KCTL
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1. Client

◦ Name : DREAMUS COMPANY

◦ Address : 311, Gangnam-daero, Seocho-gu, Seoul, Republic of Korea

◦ Date of Receipt : 2024-01-24

2. Use of Report : Certification

3. Name of Product / Model : P1 / APP21

4. Manufacturer / Country of Origin : DREAMUS COMPANY / Korea

5. FCC ID : QDMAPP21

5. Date of Test : 2024-04-02 to 2024-05-09

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	Technical Manager
	Name : Hosung Lee 	Name : Harim Lee 

2024-05-21

Eurofins KCTL Co.,Ltd.

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REPORT REVISION HISTORY

Date	Revision	Page No
2024-05-21	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 : DREAMUS COMPANY
 Address : 311, Gangnam-daero, Seocho-gu, Seoul, Republic of Korea
 Manufacturer : DREAMUS COMPANY
 Address : 311, Gangnam-daero, 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 : P1
 Model : APP21
 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 WALN : 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 : FPCB Antenna
 Antenna gain : BT/BLE/2.4 GHz WALN : 0.78 dBi
 UNII-1 : 2.21 dBi
 UNII-3 : -0.08 dBi
 Frequency range : Bluetooth : 2 402 MHz ~ 2 480 MHz (BDR/EDR/BLE)
 2.4 GHz WALN : 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-106, TP-107(Conducted)
 TP-102(Radiated)
 Operation temperature : -10 °C ~ 50 °C

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
Li-ion Polymer Rechargeable Battery	Shenzhen Honcell Energy Company Limited	HCP494967PNFC	N/A	DC 3.8 V, 2700 mAh

2.2. 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
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

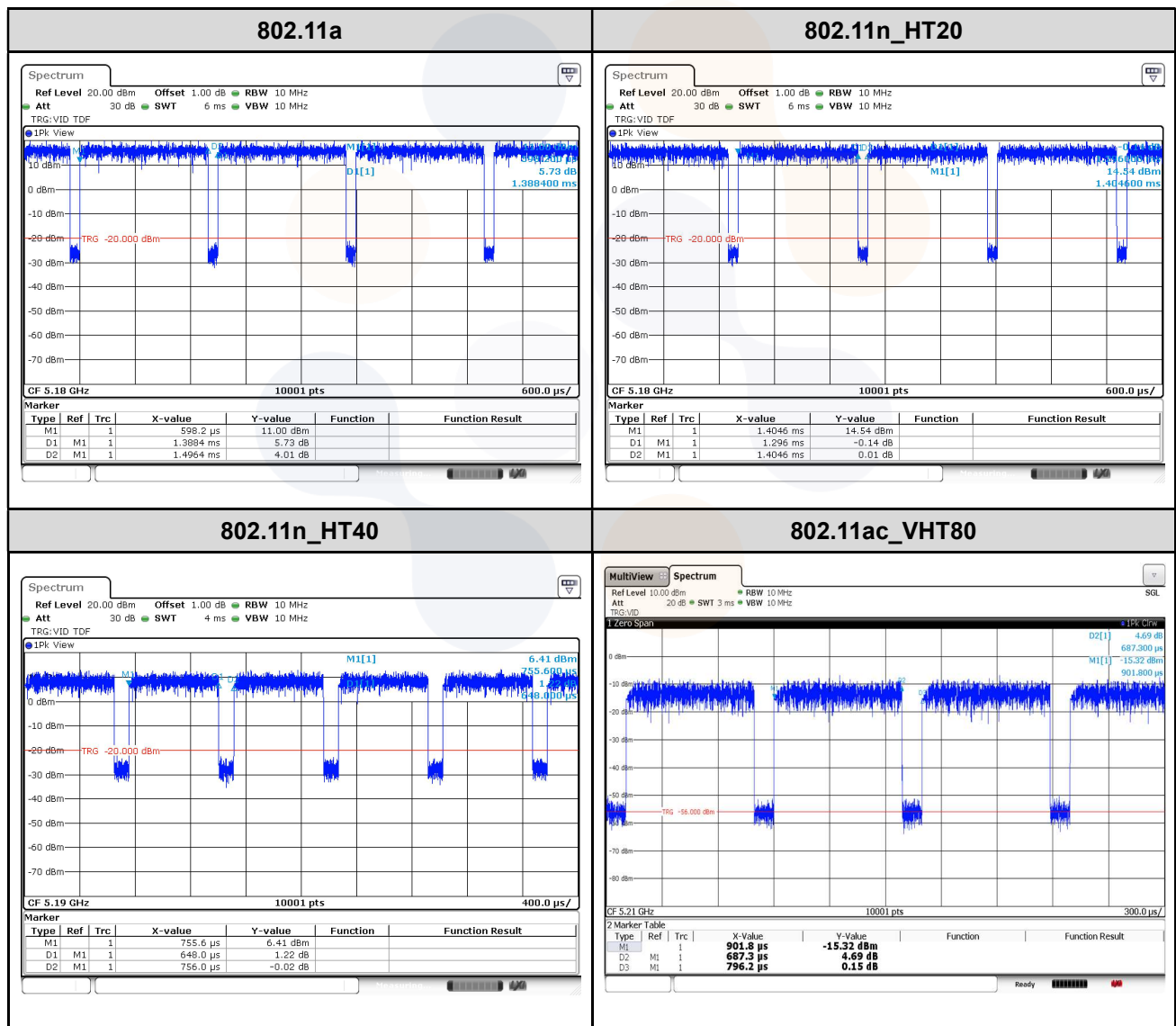
Table 2.2.3 802.11ac_VHT80 mode

2.3. Duty Cycle Factor

Test mode	Period (ms)	T _{on} time (ms)	Duty cycle		Duty cycle factor (dB)
			(Linear)	(%)	
802.11a	1.496 4	1.388 4	0.927 8	92.78	0.33
802.11n_HT20	1.404 6	1.296 0	0.922 7	92.27	0.35
802.11n_HT40	0.756 0	0.648 0	0.857 1	85.71	0.67
802.11ac_VHT80	0.796 2	0.687 3	0.863 2	86.32	0.64

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%



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 FPCB 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 **Y** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **Y** 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 emissions	1.3 dB	
Radiated spurious emissions	Below 30 MHz	2.3 dB
	30 MHz ~ 1 000 MHz	2.5 dB
	1 000 MHz ~ 18 000 MHz	4.7 dB
	Above 18 000 GHz	4.8 dB
Conducted emissions	150 kHz ~ 30 MHz	2.7 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	9.94	9 000	11.70
50	9.97	10 000	11.68
100	10.10	11 000	11.89
200	10.09	12 000	12.22
300	10.13	13 000	12.65
400	10.18	14 000	12.40
500	10.20	15 000	12.69
600	10.22	16 000	12..63
700	10.26	17 000	12.80
800	10.31	18 000	12.62
900	10.31	19 000	12.67
1 000	10.30	20 000	12.87
2 000	9.88	21 000	1.80
3 000	10.06	22 000	12.55
4 000	10.33	23 000	12.90
5 000	10.69	24 000	12.80
6 000	10.89	25 000	12.83
7 000	11.15	26 000	13.41
8 000	11.39	26 500	12.93

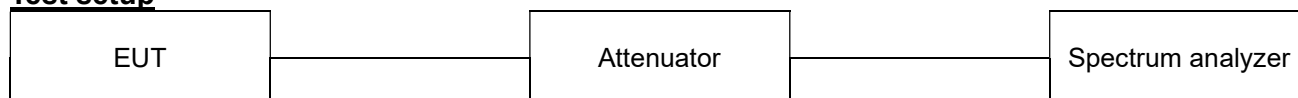
Note.

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 12.3.2.4

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

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Test settings

Used test method is Section E.3.a)

◆ KDB 789033 D02 v02r01

Section E.3.a)

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

- (i) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the following conditions 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.
- (ii) If the transmitter does not transmit continuously, measure the duty cycle, x , of the transmitter output signal as described in II.B.
- (iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
- (iv) 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%).

Test results

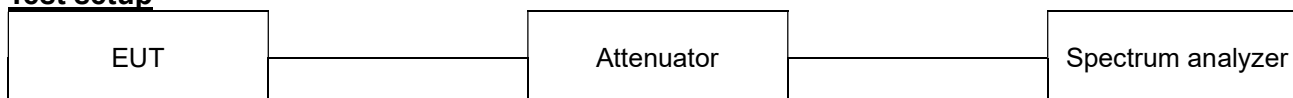
Test mode	Band	Frequency (MHz)	Measured power (dBm)	DCF (dB)	Conducted output power (dBm)	Conducted Power Limit (dBm)
					Average	
802.11a	UNII-1	5 180	5.54	0.33	5.87	23.98
		5 200	5.62		5.95	
		5 240	5.33		5.66	
	UNII-3	5 745	6.37		6.70	30.00
		5 785	6.46		6.79	
		5 825	6.43		6.76	
802.11n HT20	UNII-1	5 180	4.92	0.35	5.27	23.98
		5 200	5.01		5.36	
		5 240	5.18		5.53	
	UNII-3	5 745	7.15		7.50	30.00
		5 785	7.25		7.60	
		5 825	7.23		7.58	
802.11n HT40	UNII-1	5 190	6.51	0.67	7.18	23.01
		5 230	6.73		7.40	
	UNII-3	5 755	8.64		9.31	30.00
		5 795	8.79		9.46	
802.11ac VHT80	UNII-1	5 210	2.96	0.64	3.60	23.01
	UNII-3	5 775	10.47		11.11	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,

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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	-4.42	0.33	-4.09	11
		5 200	-5.27		-4.94	
		5 240	-4.71		-4.38	
802.11n HT20		5 180	-5.28	0.35	-4.93	
		5 200	-5.67		-5.32	
		5 240	-4.87		-4.52	
802.11n HT40		5 190	-6.60	0.67	-5.93	
		5 230	-6.35		-5.68	
802.11ac VHT80		5 210	-14.85	0.64	-14.21	

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	-6.62	0.33	-6.29	30
		5 785	-6.77		-6.44	
		5 825	-6.44		-6.11	
802.11n HT20		5 745	-5.59	0.35	-5.24	
		5 785	-6.17		-5.82	
		5 825	-6.20		-5.85	
802.11n HT40		5 755	-7.45	0.67	-6.78	
		5 795	-6.76		-6.09	
802.11ac VHT80		5 775	-9.55	0.64	-8.91	

Notes:

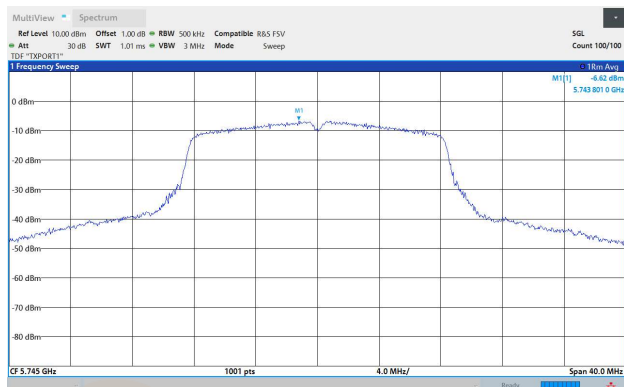
1. Maximum PSD calculation

- Maximum PSD = Measured PSD + DCF

UNII-1 / 802.11a / 5 180 MHz



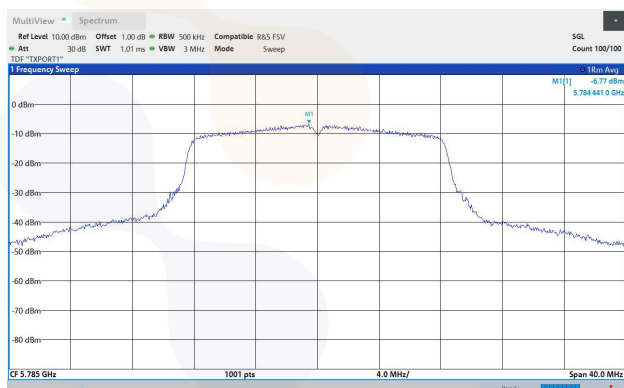
UNII-3 / 802.11a / 5 745 MHz



UNII-1 / 802.11a / 5 200 MHz



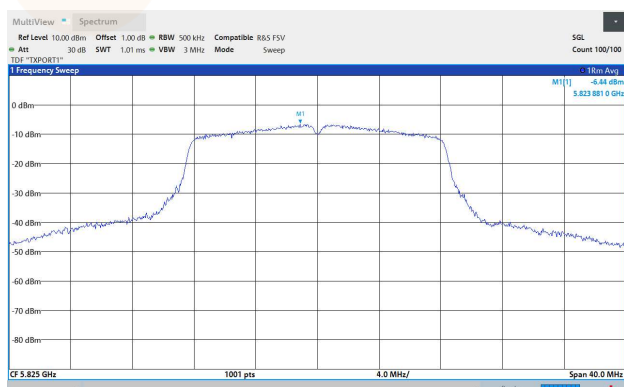
UNII-3 / 802.11a / 5 785 MHz



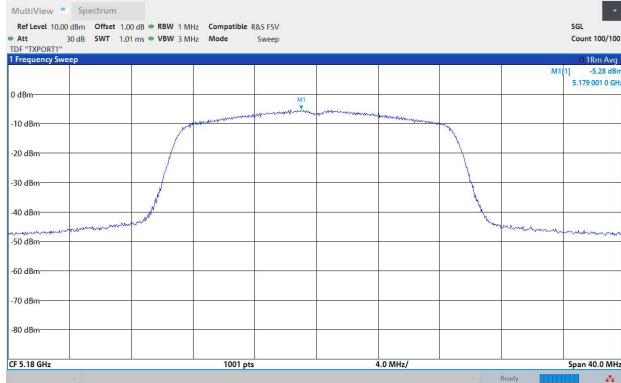
UNII-1 / 802.11a / 5 240 MHz



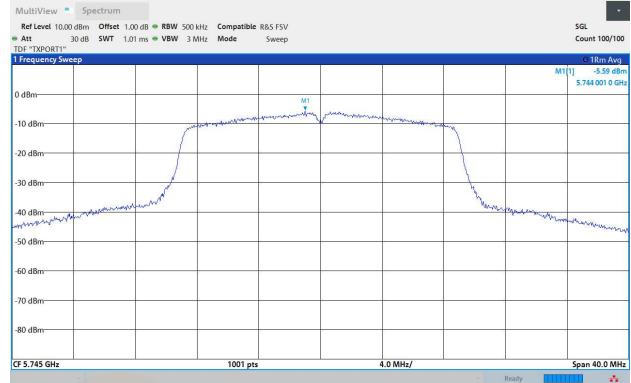
UNII-3 / 802.11a / 5 825 MHz



UNII-1 / 802.11n HT20 / 5 180 MHz



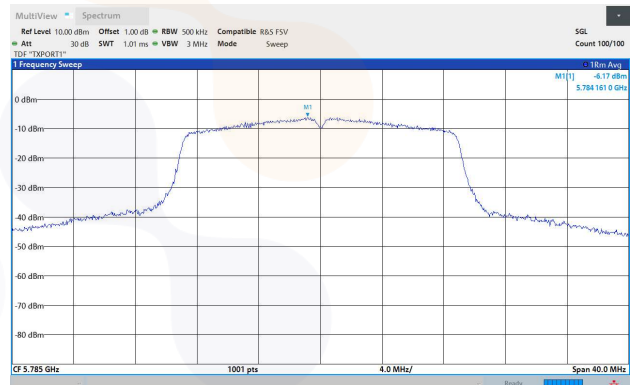
UNII-3 / 802.11n HT20 / 5 745 MHz



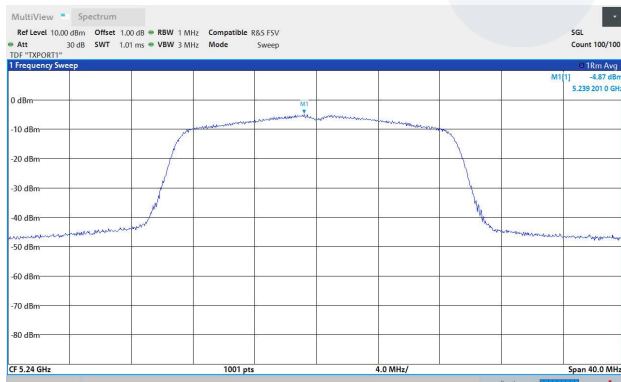
UNII-1 / 802.11n HT20 / 5 200 MHz



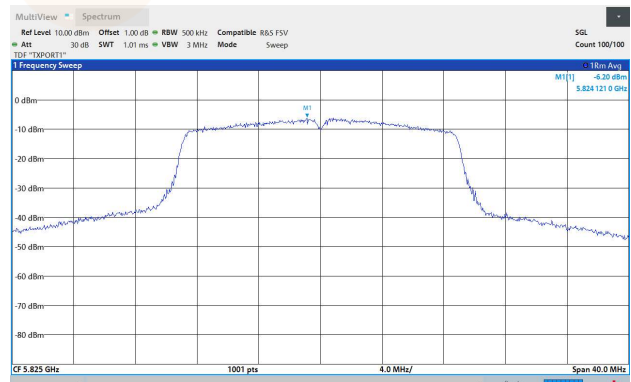
UNII-3 / 802.11n HT20 / 5 785 MHz



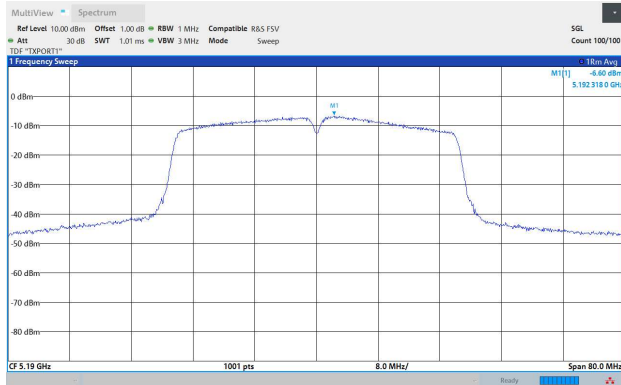
UNII-1 / 802.11n HT20 / 5 240 MHz



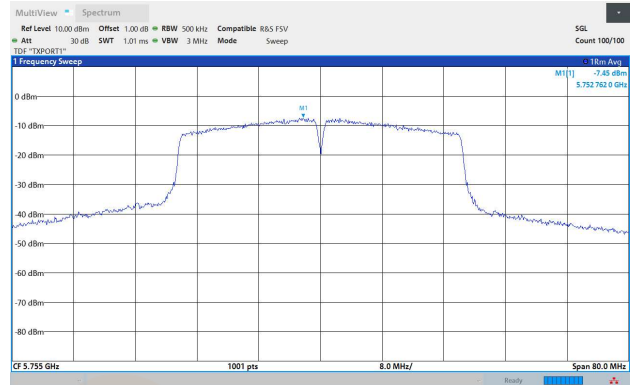
UNII-3 / 802.11n HT20 / 5 825 MHz



UNII-1 / 802.11n HT40 / 5 190 MHz



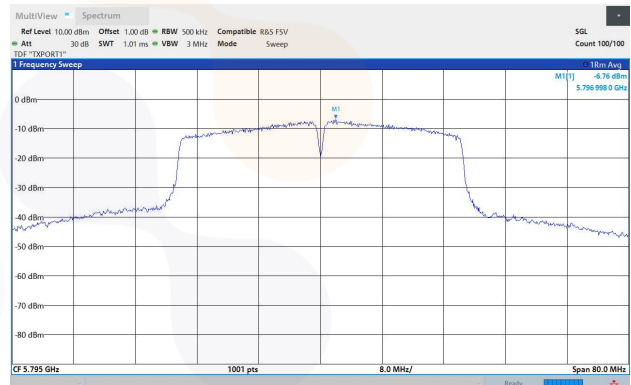
UNII-3 / 802.11n HT40 / 5 755 MHz



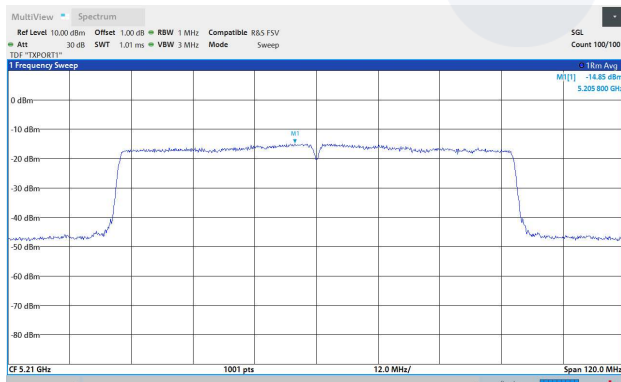
UNII-1 / 802.11n HT40 / 5 230 MHz



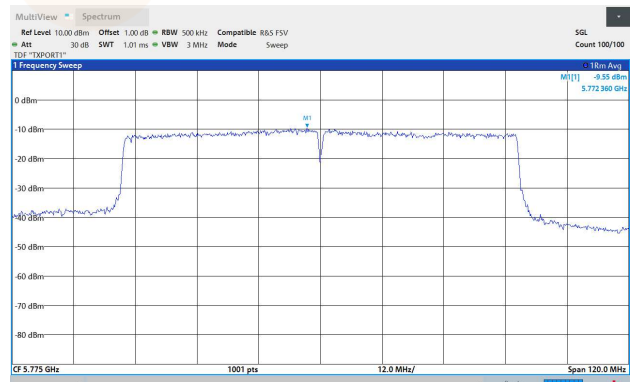
UNII-3 / 802.11n HT40 / 5 795 MHz



UNII-1 / 802.11ac VHT80 / 5 210 MHz

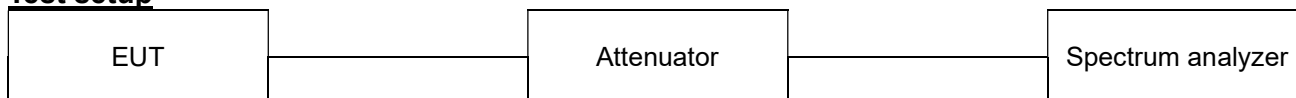


UNII-3 / 802.11ac VHT80 / 5 775 MHz



7.3. 26 dB Bandwidth

Test setup



Limit

N/A

Test procedure

ANSI C63.10-2013 Section 12.4

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

Test results

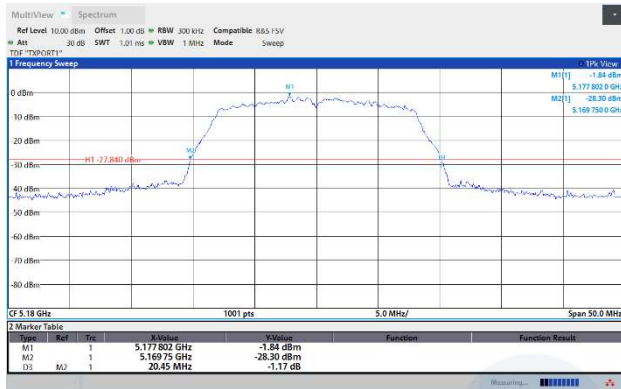
Test mode	Band	Frequency(MHz)	26 dB bandwidth (MHz)	99 % bandwidth (MHz)
802.11a	UNII-1	5 180	20.45	16.77
		5 200	20.45	16.81
		5 240	20.40	16.79
802.11n HT20		5 180	20.35	17.59
		5 200	20.45	17.61
		5 240	20.35	17.59
802.11n HT40		5 190	41.10	36.06
		5 230	41.00	36.07
11ac VHT80		5 210	82.80	75.78

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

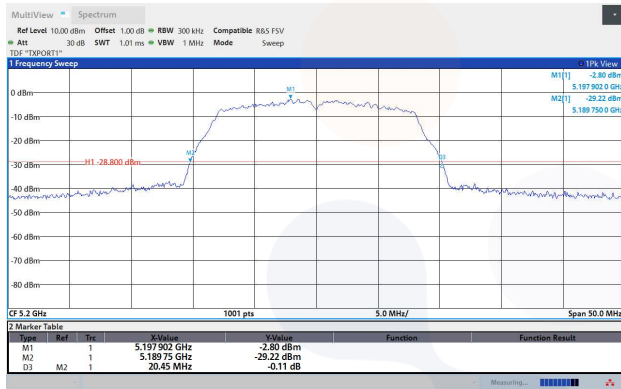
UNII-1 / 802.11a / 5 180 MHz



UNII-1 / 802.11n HT20 / 5 180 MHz



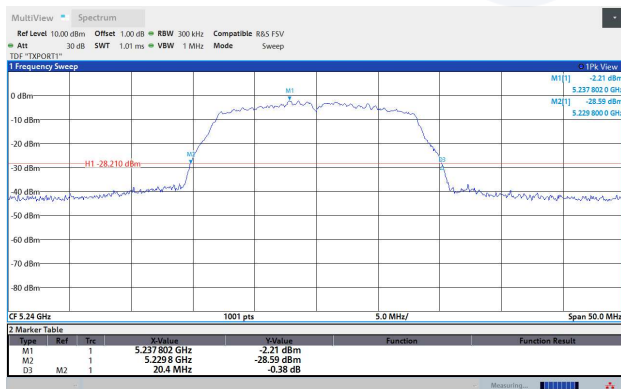
UNII-1 / 802.11a / 5 200 MHz



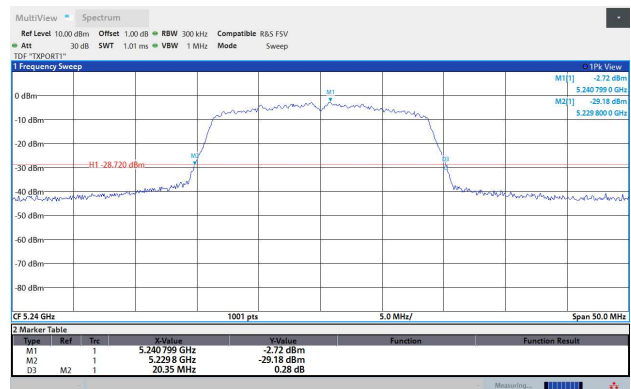
UNII-1 / 802.11n HT20 / 5 200 MHz



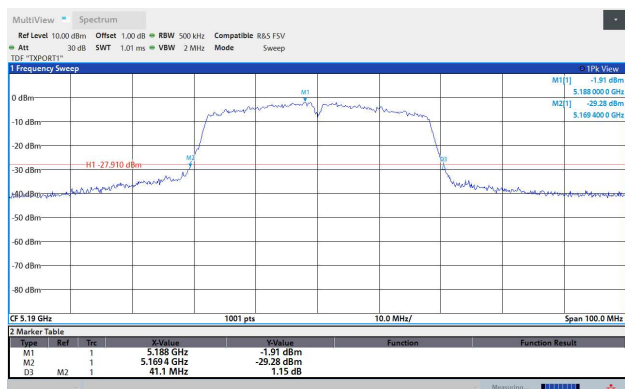
UNII-1 / 802.11a / 5 240 MHz



UNII-1 / 802.11n HT20 / 5 240 MHz



UNII-1 / 802.11n HT40 / 5 190 MHz



UNII-1 / 802.11ac VHT80 / 5 210 MHz



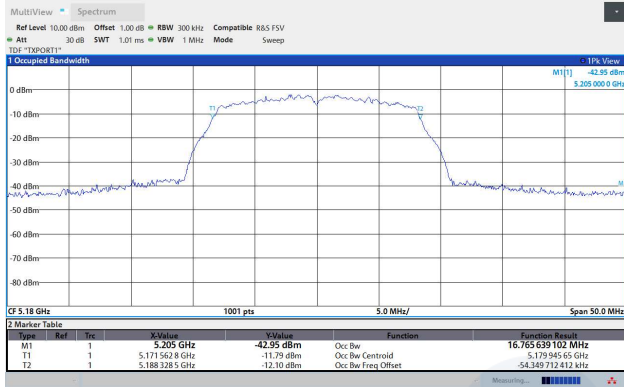
UNII-1 / 802.11n HT40 / 5 230 MHz



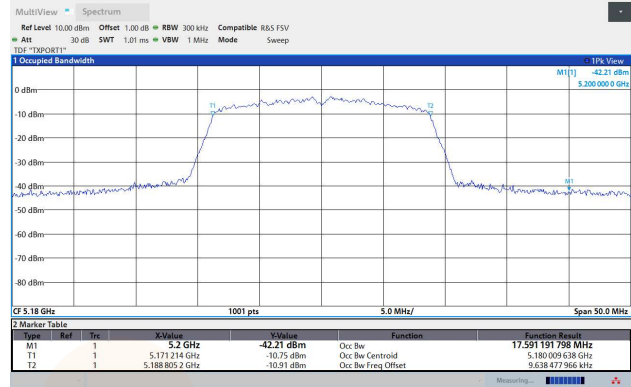
Blank

99% bandwidth

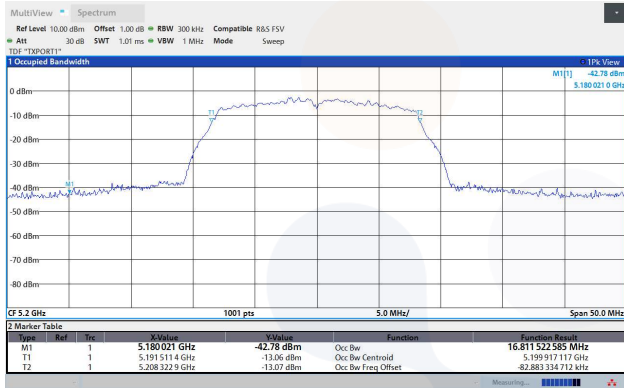
UNII-1 / 802.11a / 5 180 MHz



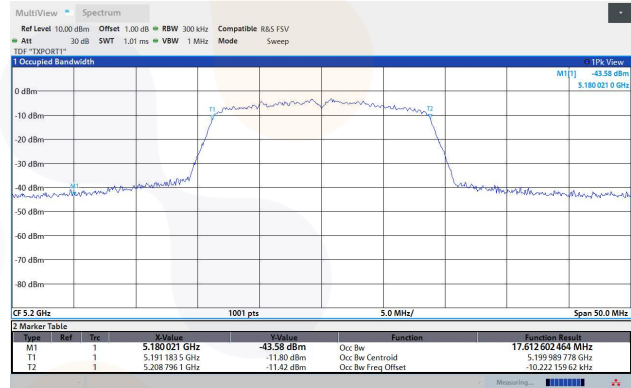
UNII-1 / 802.11n HT20 / 5 180 MHz



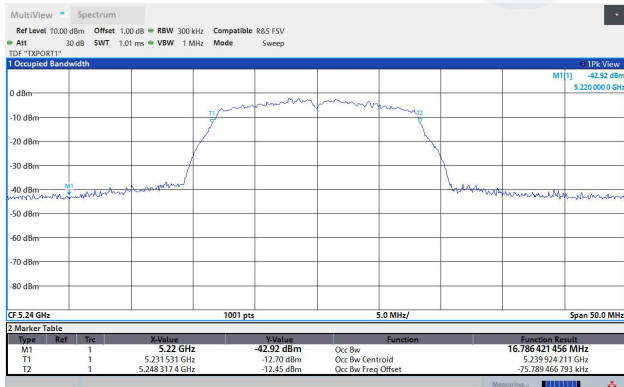
UNII-1 / 802.11a / 5 200 MHz



UNII-1 / 802.11n HT20 / 5 200 MHz



UNII-1 / 802.11a / 5 240 MHz



UNII-1 / 802.11n HT20 / 5 240 MHz

