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TEST REPORT

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1. Client

- Name : RNware Co., Ltd.
- Address : 3F, 37, Alphacity 1-ro 31-gil, Suseong-gu, Daegu, Republic of Korea
- Date of Receipt : 2019-02-07

2. Use of Report : -

3. Name of Product and Model : ANYSYNC 4K USB-C (Transmitter) / ANYSYNC-4KTU

4. Manufacturer and Country of Origin : RNware Co., Ltd. / Korea

5. FCC ID : 2ASNV-ANYSYNC-4KTU

6. Date of Test : 2019-05-01 to 2019-05-23

7. Test Standards : FCC Part 15 Subpart E, 15.407

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

Affirmation	Tested by Name : Myeonghwa Jang (Signature)	Technical Manager Name : Seungyong Kim (Signature)

2019-06-10

KCTL Inc.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc.

Report revision history

Date	Revision	Page No
2019-05-28	Initial report	-
2019-06-03	Updated	4, 6, 7, 21~23
2019-06-10	Updated accessory information and notes 1	5, 7

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1. General information

Client	:	RNware Co., Ltd.
Address	:	3F, 37, Alphacity 1-ro 31-gil, Suseong-gu, Daegu, Republic of Korea
Manufacturer	:	RNware Co., Ltd.
Address	:	3F, 37, Alphacity 1-ro 31-gil, Suseong-gu, Daegu, Republic of Korea
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-3327, G-198, C-3706, T-1849
		Industry Canada Registration No. : 8035A-2
		KOLAS No.: KT231

2. Device information

Equipment under test	:	ANYSYNC 4K USB-C (Transmitter)
Model	:	ANYSYNC-4KTU
Derivative model	:	ANYSYNC-WUTU
Frequency range	:	WIFI(802.11n HT20)_5 180 ㎒ ~ 5 240 ㎒ (UNII 1)
		5 745 ㎒ ~ 5 825 ㎒ (UNII 3)
Modulation technique	:	OFDM
Number of channels	:	WIFI(802.11n HT20)_4 ch (UNII 1)
		5 ch (UNII 3)
Power source	:	DC 3.7 V
Antenna specification	:	External - WiFi PCB Substrate Antenna
Antenna gain	:	5 150 ㎒ ~ 5 250 ㎒: 4.00 dBi
		5 725 ㎒ ~ 5 850 ㎒: 3.98 dBi
Software version	:	19.3.25
Hardware version	:	REV.5
Test device serial No.	:	N/A
Operation temperature	:	0 ℃ ~ 40 ℃

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2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
Li-ion Battery	Foshan Zhaoneng Battery Industrial Co., Ltd	ZN 754948	-	3.7V, 3500mAh, 12.95Wh
AC/DC Adapter	Samsung Electronics Co., Ltd	EP-TA21KBK	R37K6924GV5RT3	AC 100-240V 50-60Hz 0.50 A

2.2. Information about derivative model

The basic and derivative model are electrically identical.
The derivative models is only for the volume of memory.
(DDR4 512 MB x 2EA → DDR4 256 MB x 2EA)

2.3. Frequency/channel operations

This device contains the following capabilities:
802.11n HT20

UNII-1

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

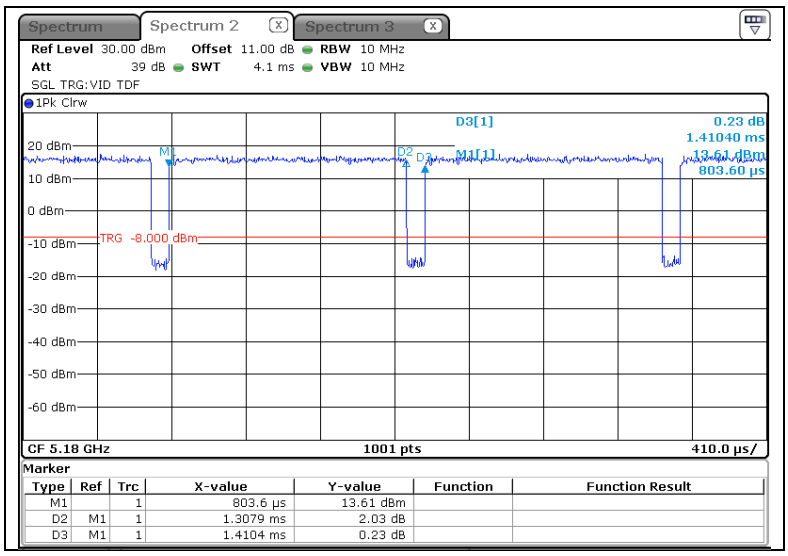
UNII-3

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

Table 2.3.1. 802.11n HT20 mode

2.4. Duty Cycle Correction Factor

- 802.11n HT20



Note1) : period : 1.41 ㎳, On time : 1.31 ㎳

Note2) : DCCF = 10 log(1 / x) = 10 log(1/0.93) = 0.33 ㏈, x = 1.31/1.41 = 0.93

Note3) : 802.11n HT20 is a continuous transmission (duty cycle <= 95 %)

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 Wi-Fi PCB Substrate Antenna of U Fl type(external antenna) on 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 & 99% Occupied bandwidth	Pass
15.407(e)	6 dB bandwidth	Pass
15.407(g)	Frequency stability	Pass
15.407(d), 15.205(a), 15.209(a)	Spurious emission	Pass
	Band-edge, restricted band	Pass
15.207(a)	Conducted emissions	Pass

Notes:

1. Device operates only in the 802.11n HT20 mode. The mode of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that X orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in X orientation
4. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013
   - KDB 789033 D02 v02r01
5. The worst-case data rate was:
   802.11n HT20 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 of 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	
Conducted RF power	1.76 dB	
Conducted spurious emissions	4.03 dB	
Radiated spurious emissions	9 kHz ~ 30 MHz:	2.28 dB
	30 MHz ~ 300 MHz	4.98 dB
	300 MHz ~ 1 000 MHz	5.14 dB
	1 GHz ~ 6 GHz	6.70 dB
	Above 6 GHz	6.60 dB
Conducted emissions	9 kHz ~ 150 kHz	3.66 dB
	150 kHz ~ 30 MHz	3.26 dB

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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 (㎒)	Factor(㏈)	Frequency (㎒)	Factor(㏈)
30	0.42	9 000	0.87
100	0.28	10 000	0.61
200	0.39	11 000	0.38
300	0.48	12 000	1.17
400	0.40	13 000	2.07
500	-0.54	14 000	2.10
600	0.53	15 000	1.43
700	0.60	16 000	1.79
800	0.67	17 000	1.75
900	0.71	18 000	2.39
1 000	0.68	19 000	2.59
2 000	0.98	20 000	2.11
3 000	1.06	21 000	2.80
4 000	1.60	22 000	1.36
5 000	1.85	23 000	2.12
6 000	2.23	24 000	2.69
7 000	0.59	25 000	2.74
8 000	0.69	26 000	2.87

Note.
Offset(㏈) = RF cable loss(㏈) + Attenuator(㏈) + EUT cable loss(㏈)

7. Test results

7.1. Maximum conducted output power

Test setup

EUT — Attenuator — Power sensor

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*
UNII-2C			250 mW or 11 dBm + 10logB*
UNII-3	√		1 W (30 dBm)

Notes:

FCC 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.3.a) or b)

Test settings

◆ 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 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

(ii) If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in II

(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%).

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(㎒)	Measured output power			Limit(dBm)
			Reading(dBm)	Duty Factor(dB)	Result(dBm)	
802.11n HT20	UNII-1	5 180	6.60	0.33	6.92	23.98
		5 200	6.53	0.33	6.86	
		5 240	7.09	0.33	7.41	
	UNII-3	5 745	6.22	0.33	6.54	30.00
		5 785	5.83	0.33	6.15	
		5 825	5.31	0.33	5.64	

Note.
1. Result(dB m) = Reading(dB m) + Duty Factor(dB)

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7.2. Maximum Power Spectral Density

Test setup

EUT	—	Attenuator	—	Spectrum analyzer

Limit

According to §15.407(a)

Band	EUT category		Limit
UNII-1		Outdoor access point	17dBm/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:

1. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall bereduced 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.

1. 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.)
2. serch function on the instrument to find the peak of the spectrum and record its value.
3. adjustments to the peak value of the spectrum, if applicable:

   a) 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.
   b) 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.
4. The result is the Maximum PSD over 1MHz reference bandwidth
5. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the preceding procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference

bandwidth specified in Section 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of RBWs less than 1MHz, 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≥1/T, where T is defined in II.B.I.a).
b) Set VBW≥3 RBW.
c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10 log (500 kHz /RBW) to the measured result, whereas RBW (<500 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 (1MHz/RBW) to the measured result, whereas RBW (< 1 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.

Note: 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 kHz is available on nearly all spectrum analyzers.

Test results

UNII-1

Test mode	Frequency(㎒)	Peak Power Spectral Density			Limit (dBm/㎒)
		Reading(dBm)	Duty Factor (dB)	Result [1] (dBm)	
802.11n HT20	5 180	-3.55	0.22	-3.33	11.00
	5 200	-3.3	0.22	-3.08	
	5 240	-2.48	0.22	-2.26	

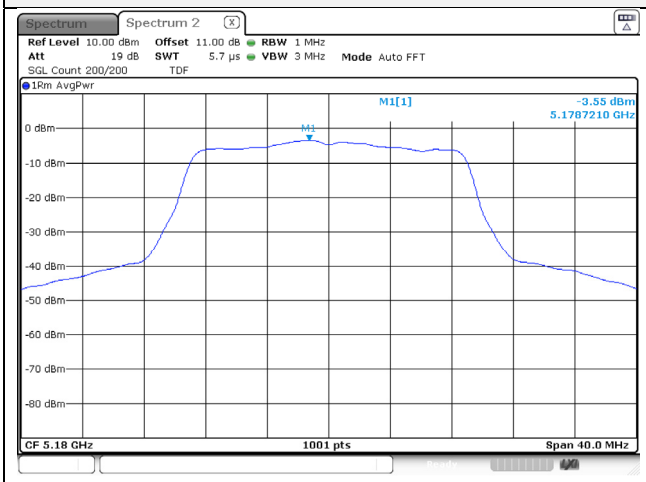
UNII-3

Test mode	Frequency(㎒)	Peak Power Spectral Density			Limit (dBm/500㎑)
		Reading(dBm)	Duty Factor (dB)	Result [1] (dBm)	
802.11n HT20	5 745	-6	0.22	-5.78	30.00
	5 785	-7.22	0.22	-7.00	
	5 825	-7.63	0.22	-7.41	

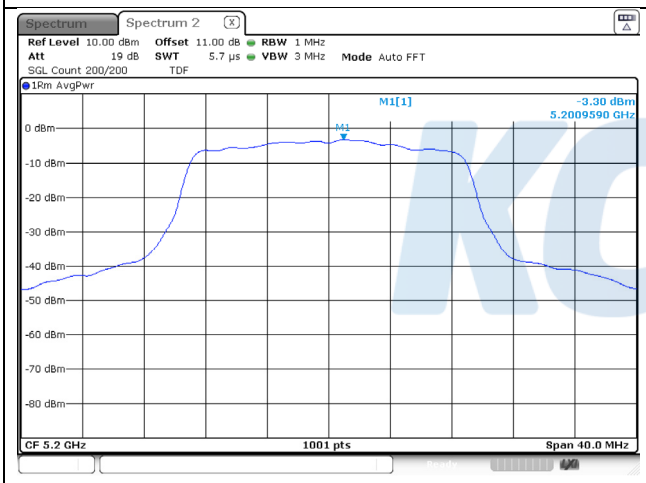
Note.
1. Result(dB m) = Reading(dB m) + Duty Factor(dB)

802.11n HT20

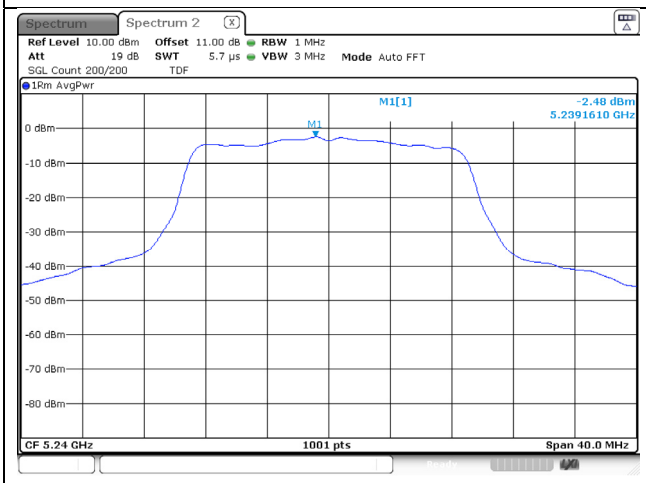
UNII-1



5 180 ㎒

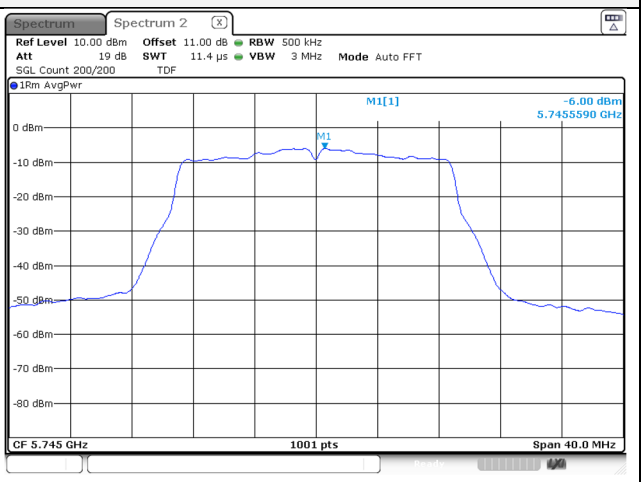


5 200 ㎒

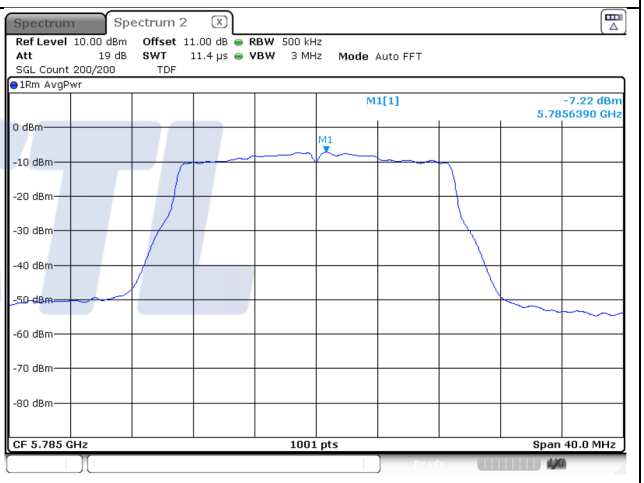


5 240 ㎒

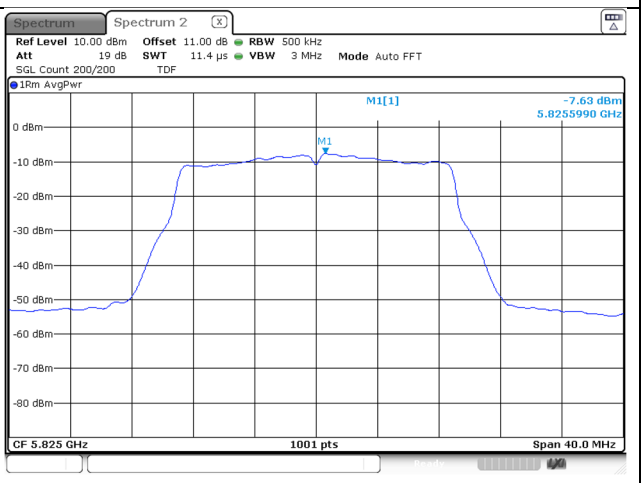
UNII-3



5 745 ㎒



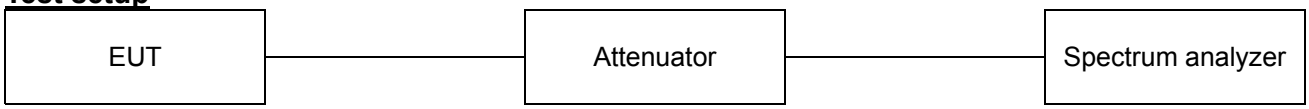
5 785 ㎒



5 825 ㎒

7.3. 26 dB Bandwidth & 99% Occupied Bandwidth

Test setup



Limit
N/A

Test procedure

26dBbandwidth
KDB 789033 D02 v02r01 - Section C.1

99% bandwidth
KDB 789033 D02 v02r01 - Section D

Test settings

1. 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%.

2. 99% Occupied Bandwidth

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1% to 5% of the OBW
4. Set VBW ≥ 3 x 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.

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Test results

26 dB bandwidth(㎒)

Test mode	Frequency(㎒)	26 dB bandwidth(㎒)
802.11n HT20_UNII-1	5 180	25.69
	5 200	21.38
	5 240	23.62

99 % bandwidth(㎒)

Test mode	Frequency(㎒)	99 % bandwidth(㎒)
802.11n HT20_UNII-1	5 240	18.22

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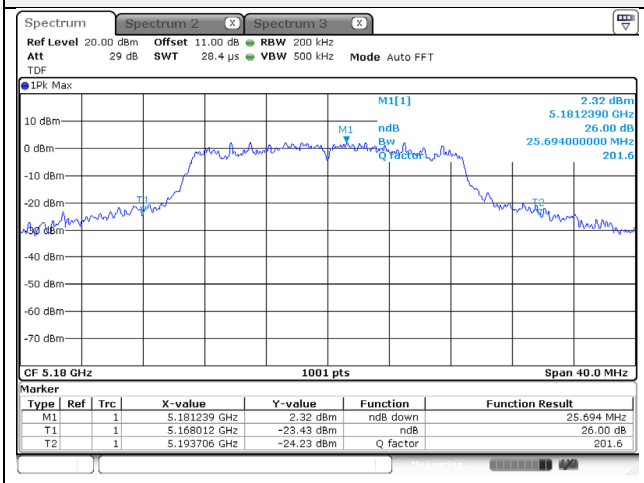
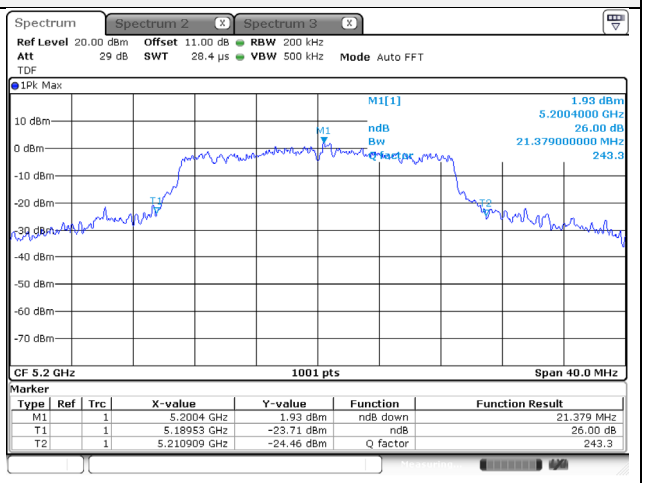
26 dB bandwidth(㎒)

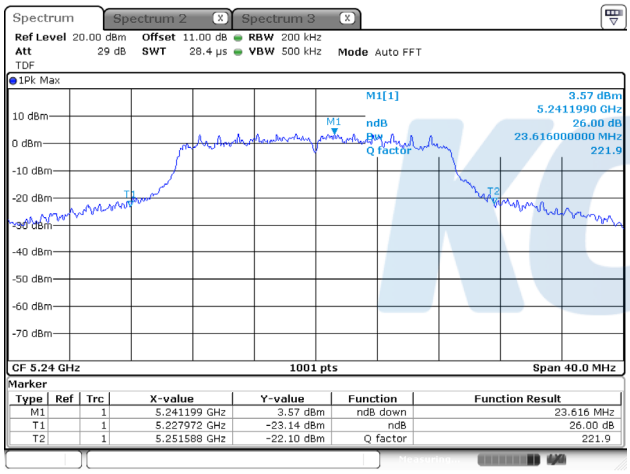
UNII-1



5 180 ㎒



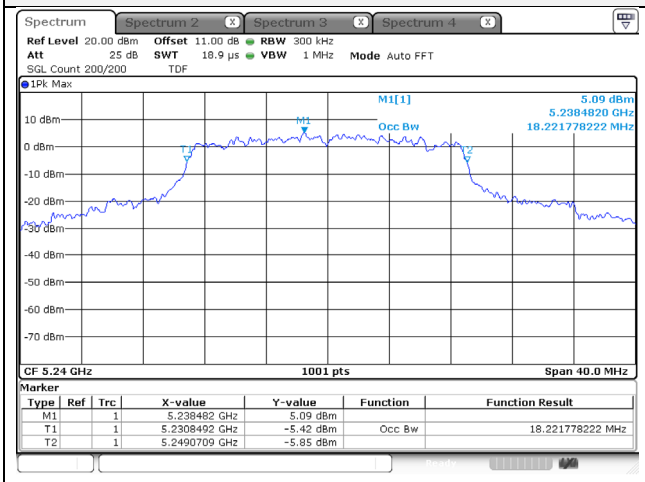
5 200 ㎒



5 240 ㎒

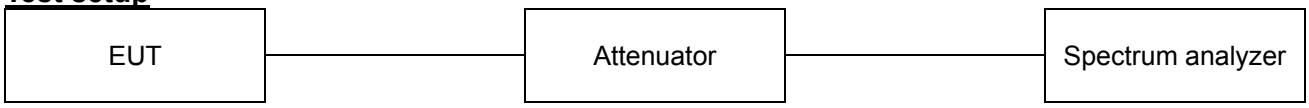
Blank

99 % bandwidth(㎒)

UNII-1	
	Blank
5 240 ㎒	

7.4. 6 dB Bandwidth

Test setup



Limit

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

Test procedure

KDB 789033 D02 v02r01 - Section C.2

Test settings

2. Minimum Emission Bandwidth for the band 5.725−5.85 ㎓

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

1. Set RBW = 100 ㎑.
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 ㏈ relative to the maximum level measured in the fundamental emission.

Test results

Test mode	Frequency (㎒)	Measured Bandwidth (㎒)
11n HT20	5 745	17.58
	5 785	17.58
	5 825	17.54

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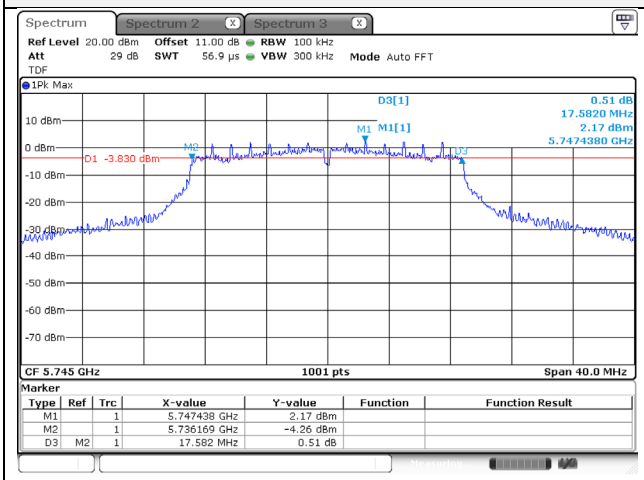
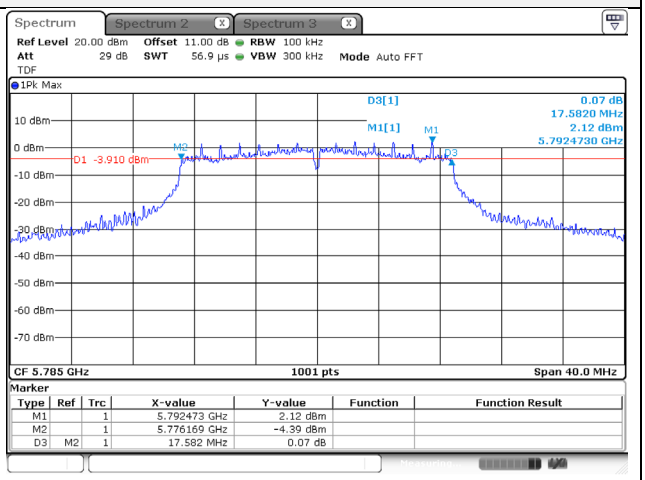
6 dB bandwidth

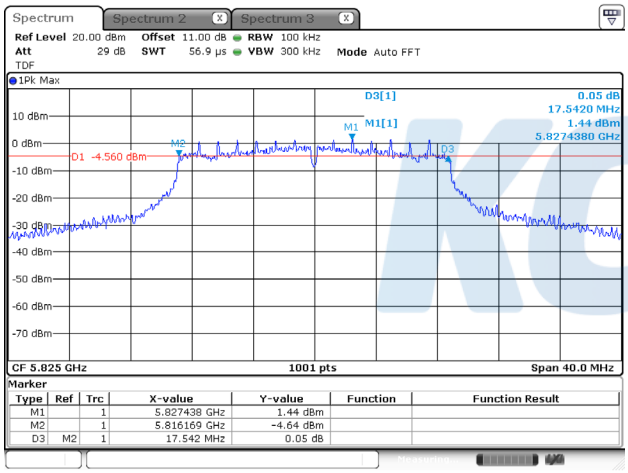
802.11n HT20



5 745 MHz



5 785 MHz

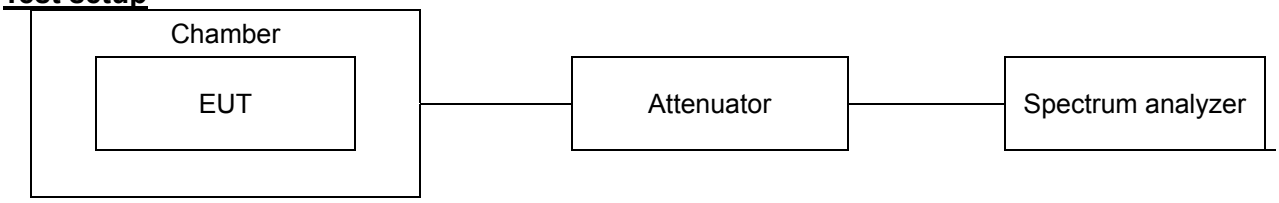


5 825 MHz

Blank

7.5. Frequency Stability

Test setup



Limit

N/A

Test procedure

ANSI C63.10-2013, clause 6.8.1

Test settings

The frequency stability of the carrier frequency of the intentional radiator shall be maintained all conditions of normal operation as specified in the users manual. The frequency stability shall be maintained over a temperature variation of specified in the users manual at normal supply voltage, and over a variation in the primary supply voltage of specified in the users manual of the rated supply voltage at a temperature of 20 °C. For equipment that is capable only of operating from a battery, the frequency stability tests shall be performed using a new battery without any further requirement to vary supply voltage.

1. The EUT was placed inside the environmental test chamber.
2. The temperature was incremented by 10 °C intervals from lowest temperature.
3. Each increase step of temperature measured the frequency.
4. The test temperature was set 20°C and the supply voltage was then adjusted on the EUT from 85 % to 115% and the frequency record.
5. While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

Test results

Test mode : UNII-1

Frequency(㎐) : 5 180 000 000

Voltage [%]	Voltage [V]	TEMP [℃]	Maintaining time	Measure frequency [㎐]	Frequency deviation [㎐]	Deviation [%]
100	3.70	20	Startup	5179 972 777	-272 23.00	-0.000 53
			2 minutes	5179 968 482	-315 18.00	-0.000 61
			5 minutes	5179 966 983	-330 17.00	-0.000 64
			10 minutes	5179 967 932	-320 68.00	-0.000 62
		0	Startup	5179 959 891	-401 09.00	-0.000 77
			2 minutes	5179 956 447	-435 53.00	-0.000 84
			5 minutes	5179 955 057	-449 43.00	-0.000 87
			10 minutes	5179 954 044	-459 56.00	-0.000 89
		10	Startup	5179 989 757	-102 43.00	-0.000 20
			2 minutes	5179 990 596	-940 4.00	-0.000 18
			5 minutes	5179 991 696	-830 4.00	-0.000 16
			10 minutes	5179 992 217	-778 3.00	-0.000 15
		25	Startup	5179 985 165	-148 35.00	-0.000 29
			2 minutes	5179 945 575	-544 25.00	-0.001 05
			5 minutes	5179 974 076	-259 24.00	-0.000 50
			10 minutes	5179 968 681	-313 19.00	-0.000 60
		30	Startup	5179 972 959	-270 41.00	-0.000 52
			2 minutes	5179 971 710	-282 90.00	-0.000 55
			5 minutes	5179 969 412	-305 88.00	-0.000 59
			10 minutes	5179 960 771	-392 29.00	-0.000 76
		40	Startup	5179 969 212	-307 88.00	-0.000 59
			2 minutes	5179 960 821	-391 79.00	-0.000 76
			5 minutes	5179 960 122	-398 78.00	-0.000 77
			10 minutes	5179 971 610	-283 90.00	-0.000 55
		50	Startup	5179 973 223	-267 77.00	-0.000 52
			2 minutes	5179 966 530	-334 70.00	-0.000 65
			5 minutes	5179 964 332	-356 68.00	-0.000 69
			10 minutes	5179 968 561	-314 39.00	-0.000 61
85	3.15	20	Startup	5179 970 080	-299 20.00	-0.000 58
			2 minutes	5179 967 683	-323 17.00	-0.000 62
			5 minutes	5179 970 729	-292 71.00	-0.000 57
			10 minutes	5179 967 982	-320 18.00	-0.000 62
115	4.26	20	Startup	5179 968 831	-311 69.00	-0.000 60
			2 minutes	5179 967 633	-323 67.00	-0.000 62
			5 minutes	5179 967 083	-329 17.00	-0.000 64
			10 minutes	5179 968 032	-319 68.00	-0.000 62

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Test mode : UNII-3

Frequency(Hz) : 5 745 000 000

Voltage [%]	Voltage [V]	TEMP [℃]	Maintaining time	Measure frequency [Hz]	Frequency deviation [Hz]	Deviation [%]
100	3.70	20	Startup	5744 985 758	-142 42.00	-0.000 25
			2 minutes	5744 986 597	-134 03.00	-0.000 23
			5 minutes	5744 985 584	-144 16.00	-0.000 25
			10 minutes	5744 985 555	-144 45.00	-0.000 25
		0	Startup	5744 947 350	-526 50.00	-0.000 92
			2 minutes	5744 946 915	-530 85.00	-0.000 92
			5 minutes	5744 946 481	-535 19.00	-0.000 93
			10 minutes	5744 946 539	-534 61.00	-0.000 93
		10	Startup	5744 994 009	-599 1.00	-0.000 10
			2 minutes	5744 994 819	-518 1.00	-0.000 09
			5 minutes	5744 995 369	-463 1.00	-0.000 08
			10 minutes	5744 996 788	-321 2.00	-0.000 06
		25	Startup	5744 969 176	-308 24.00	-0.000 54
			2 minutes	5744 970 653	-293 47.00	-0.000 51
			5 minutes	5744 970 855	-291 45.00	-0.000 51
			10 minutes	5744 970 624	-293 76.00	-0.000 51
		30	Startup	5744 963 852	-361 48.00	-0.000 63
			2 minutes	5744 959 713	-402 87.00	-0.000 70
			5 minutes	5744 959 221	-407 79.00	-0.000 71
			10 minutes	5744 958 902	-410 98.00	-0.000 72
		40	Startup	5744 959 331	-406 69.00	-0.000 71
			2 minutes	5744 956 958	-430 42.00	-0.000 75
			5 minutes	5744 956 668	-433 32.00	-0.000 75
			10 minutes	5744 956 755	-432 45.00	-0.000 75
		50	Startup	5744 967 060	-329 40.00	-0.000 57
			2 minutes	5744 948 650	-513 50.00	-0.000 89
			5 minutes	5744 947 984	-520 16.00	-0.000 91
			10 minutes	5744 947 579	-524 21.00	-0.000 91
85	3.15	20	Startup	5744 975 484	-245 16.00	-0.000 43
			2 minutes	5744 968 132	-318 68.00	-0.000 55
			5 minutes	5744 966 656	-333 44.00	-0.000 58
			10 minutes	5744 960 838	-391 62.00	-0.000 68
115	4.26	20	Startup	5744 961 069	-389 31.00	-0.000 68
			2 minutes	5744 960 780	-392 20.00	-0.000 68
			5 minutes	5744 961 272	-387 28.00	-0.000 67
			10 minutes	5744 960 635	-393 65.00	-0.000 69

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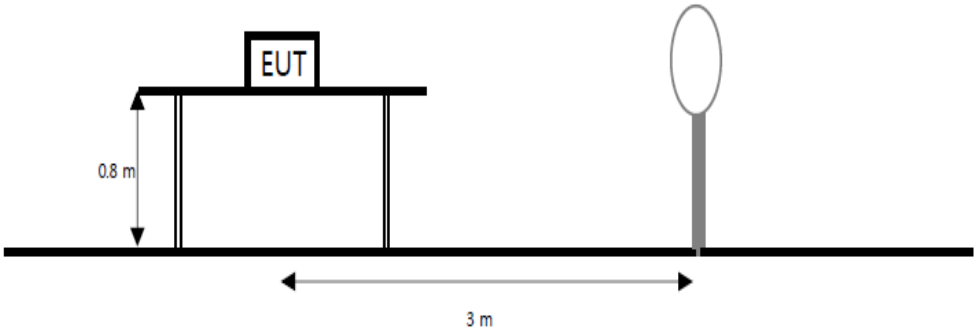
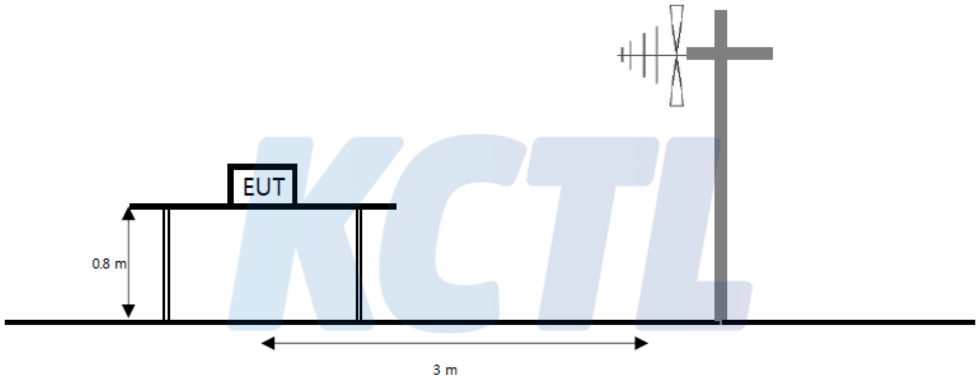
7.6. Spurious Emission, Band Edge and Restricted bands

Test setup

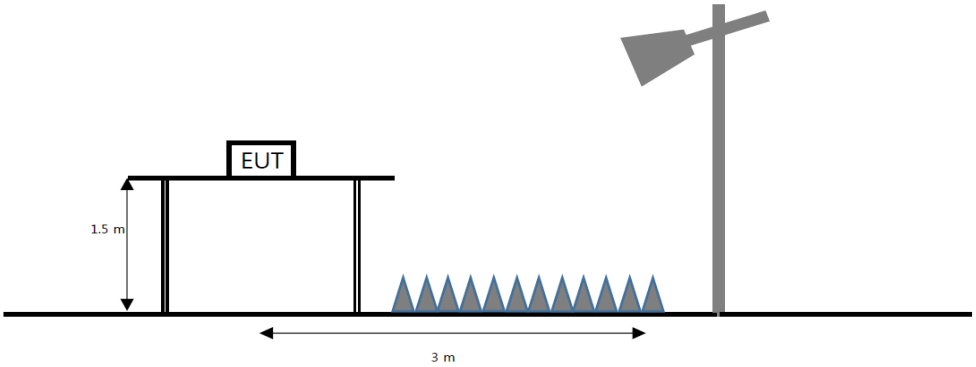
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions



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



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ 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 (μV/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., Section15.231 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 25	2 483.5 – 2 500	17.7 - 21.4
8.376 25 - 8.386 75		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 ㎓ band: All emissions outside of the 5.15-5.35 ㎓ band shall not exceed an e.i.r.p. of −27 ㏈m/㎒.

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

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Test procedure

ANSI C63.10-2013
KDB 789033 D2 v02r01 – Section G

Test settings

Peak field strength measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in table
3. VBW ≥ (3×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 ㎑ to 150 ㎑	200 ㎐ to 300 ㎐
0.15 ㎒ to 30 ㎒	9 ㎑ to 10 ㎑
30 ㎒ to 1 000 ㎒	100 ㎑ to 120 ㎑
> 1 000 ㎒	1 ㎒

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 ≥ 98%), then the average emission levels shall be measured using the following method (with EUT transmitting continuously):

1. RBW = 1 ㎒ (unless otherwise specified).
2. VBW ≥ (3×RBW).
3. Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (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 ㏈ averaging shall not be used.
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces.

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

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±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 ㎒ (unless otherwise specified).
4. VBW ≥ [3 × RBW].
5. Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (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 ≥ 98%) rather than turning ON and OFF with with the transmit cycle, then no duty cycle correction is required for that emission.

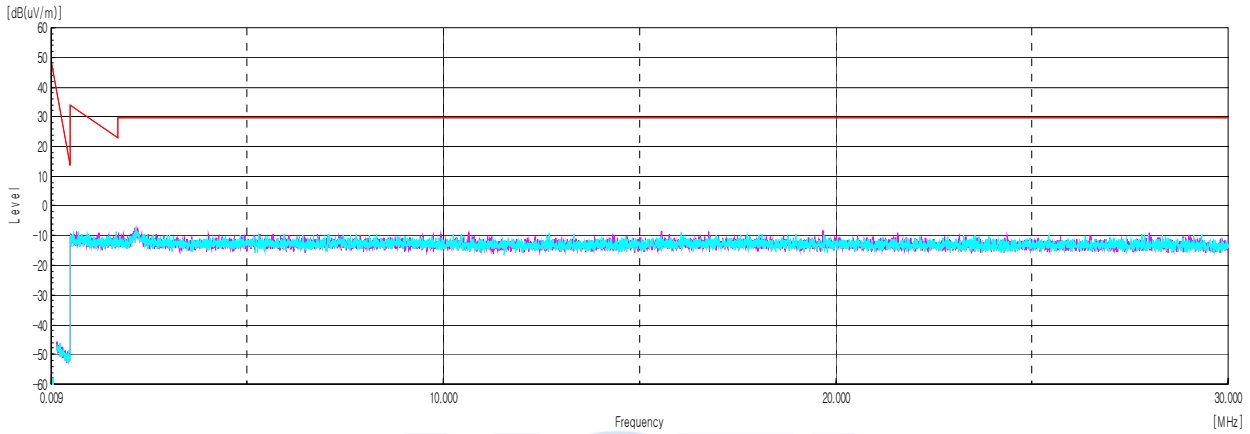
Notes:

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(≥1/T) for Average detection (AV) at frequency above 1 GHz. (where T = pulse width)
2. *f* <30 MHz, extrapolation factor of 40 dB/decade of distance. F_d = 40log(D_m/Ds)
   f ≥30 MHz, extrapolation factor of 20 dB/decade of distance. F_d = 20log(D_m/Ds)
   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) mean is 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.

Test results (Below 30 ㎒) – Worst case: 802.11n HT20_UNII-1 Highest frequency

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

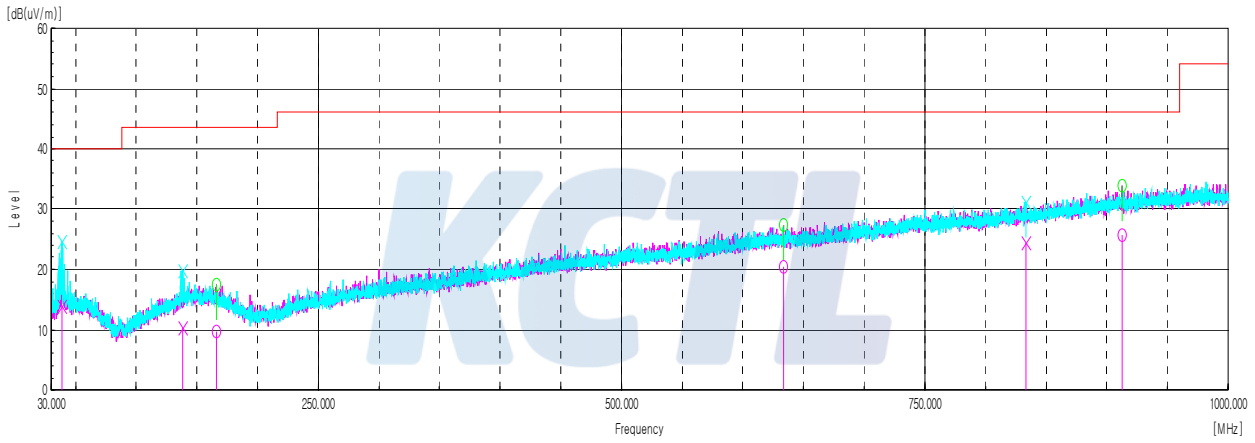
Horizontal/Vertical



Test results (Below 1 000 ㎒) – Worst case: 802.11n HT20_UNII-1 Highest frequency

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Quasi peak data								
38.85	V	26.40	18.17	-30.83	-	13.74	40.00	26.26
138.28	V	21.30	18.66	-29.57	-	10.39	43.50	33.11
166.41	H	20.20	18.62	-29.22	-	9.60	43.50	33.90
633.34	H	20.70	26.20	-26.36	-	20.54	46.00	25.46
833.28	V	20.90	28.57	-25.06	-	24.41	46.00	21.59
912.34	H	20.50	29.58	-24.33	-	25.75	46.00	20.25

Horizontal/Vertical

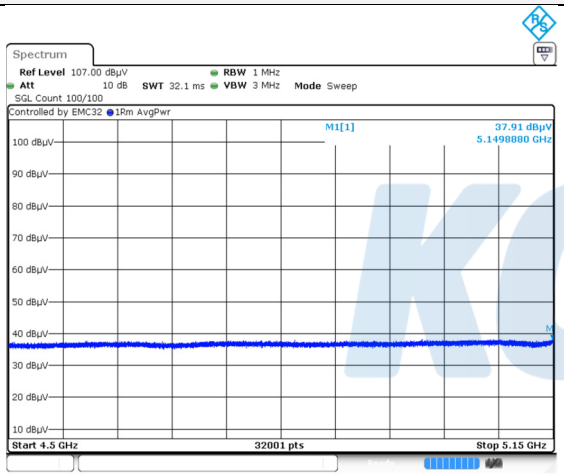


Test results (Above 1 000 ㎒)
802.11n HT20 UNII-1

Lowest Channel (5 180 ㎒)

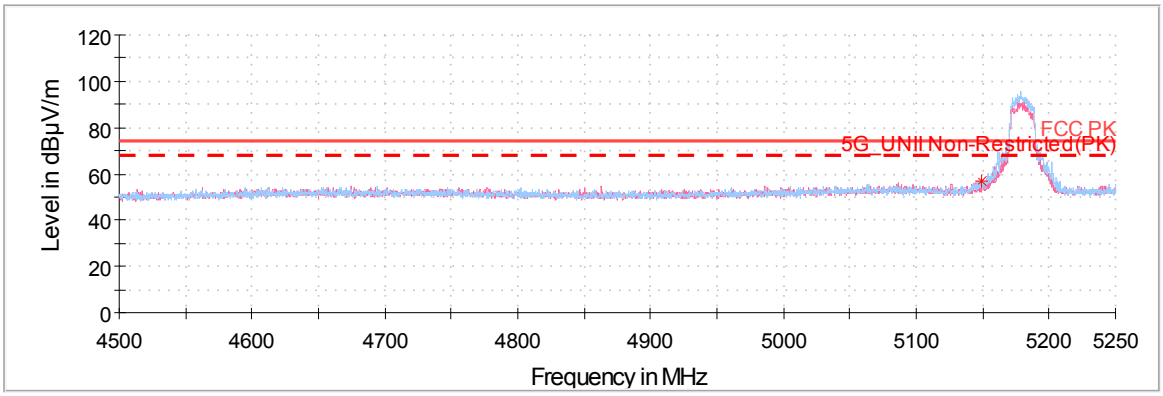
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 361.84	H	58.78	37.32	-52.5	-	43.60	68.20	24.60
15 542.23[1)]	V	53.79	40.02	-48.82	-	44.99	74.00	29.01
Average Data								
5 149.89[1)]	H	37.91	34.08	-28.14	0.33	44.18	54.00	9.82

Horizontal/Vertical for Average data

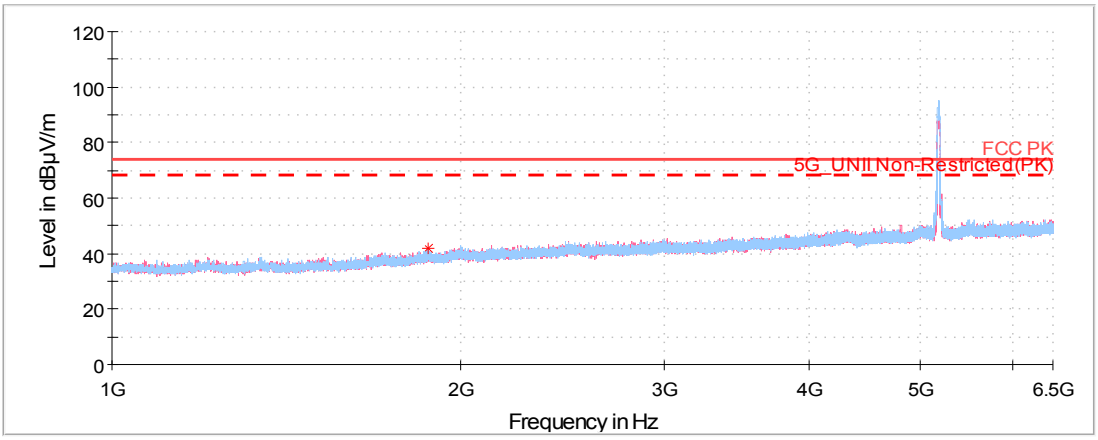


Blank

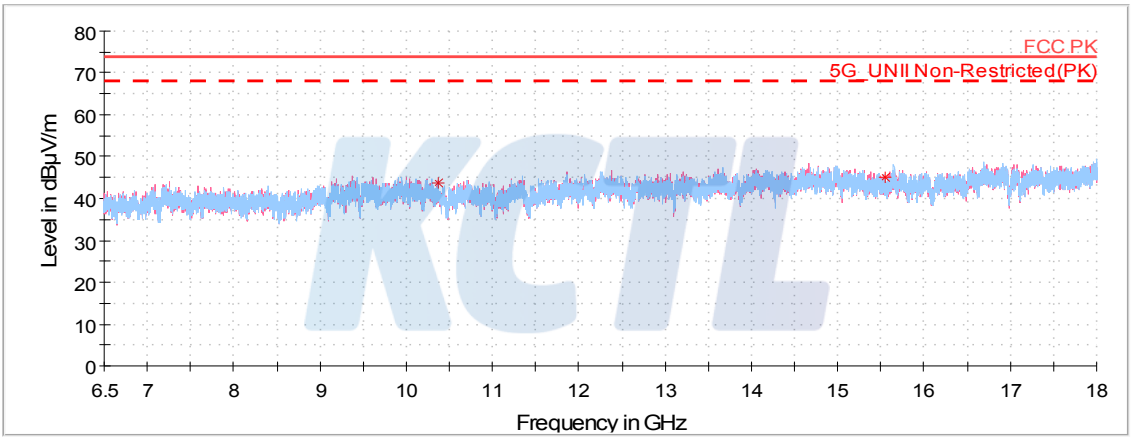
Horizontal/Vertical for Band-edge



Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

Middle Channel (5 200 ㎒)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 397.06	V	58.05	37.34	-52.56	-	42.83	68.20	25.37
12 196.09[1)]	V	61.15	39.04	-51.14	-	49.05	74.00	24.95
15 597.94[1)]	V	56.40	40.04	-48.91	-	47.53	74.00	26.47
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

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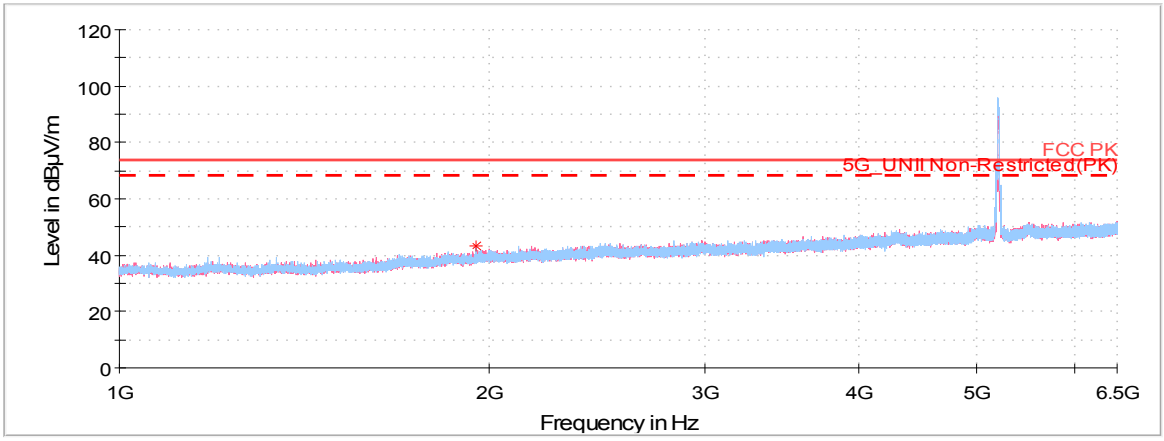
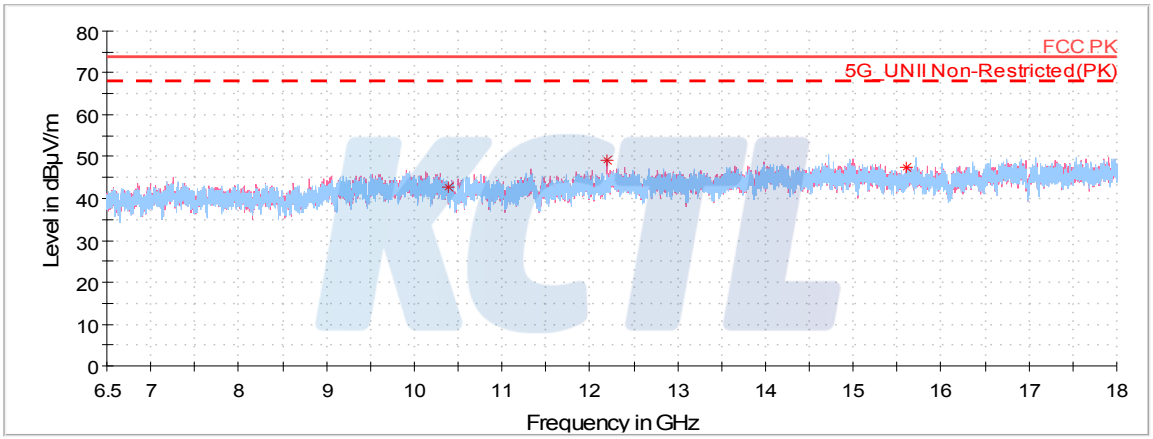
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

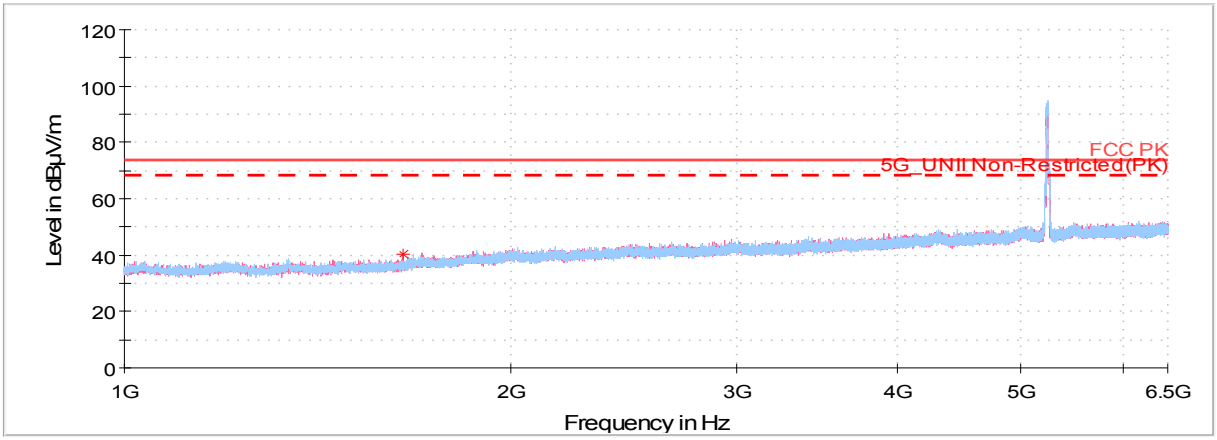


Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

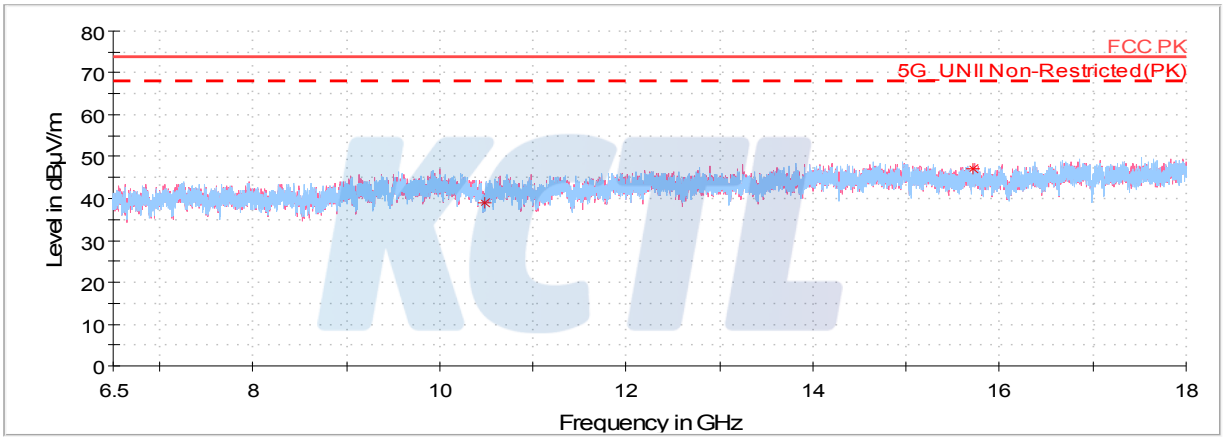
Highest Channel (5 240 ㎒)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 481.52	V	54.27	37.39	-52.69	-	38.97	68.20	29.23
15 721.20[1)]	V	56.20	40.09	-49.13	-	47.16	74.00	26.84
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

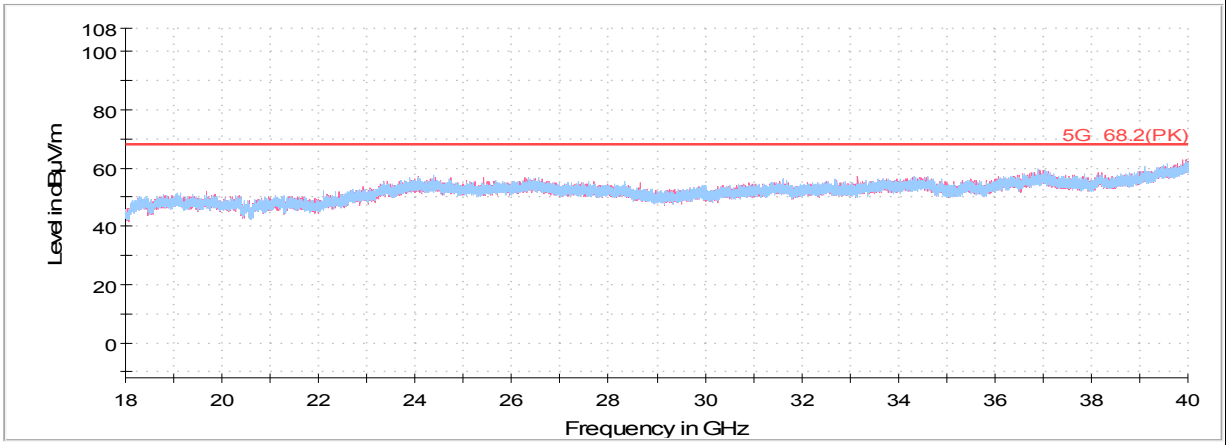
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

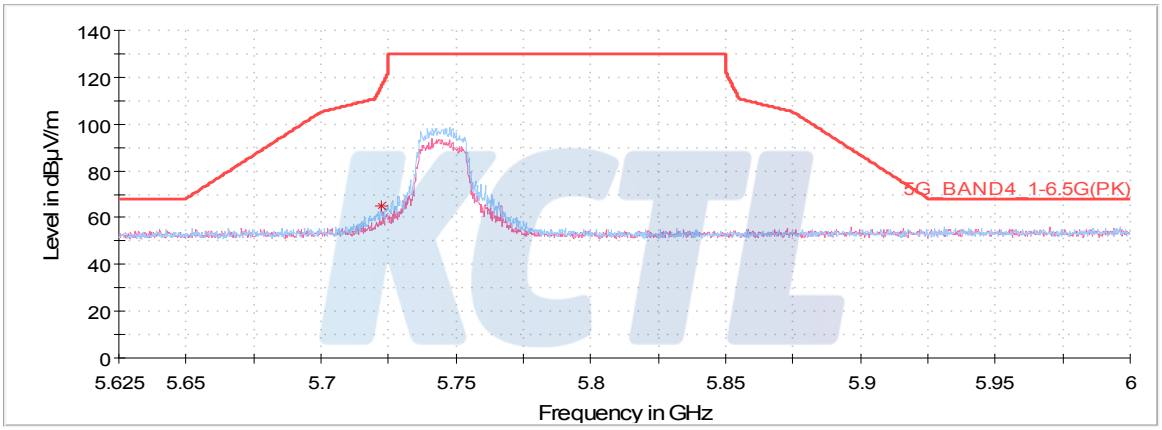


802.11n HT20 UNII-3

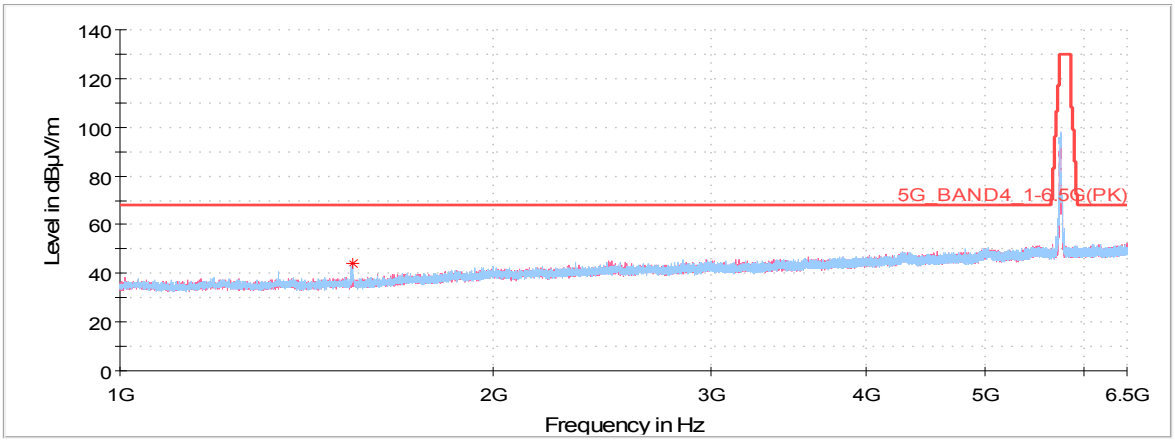
Lowest Channel (5 745 ㎒)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 722.09	H	57.69	34.77	-27.29	-	65.17	115.57	50.40
11 490.64[1)]	V	55.06	38.19	-51.5	-	41.75	74.00	32.25
17 236.33	H	58.48	41.79	-48.63	-	51.64	68.20	16.56
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

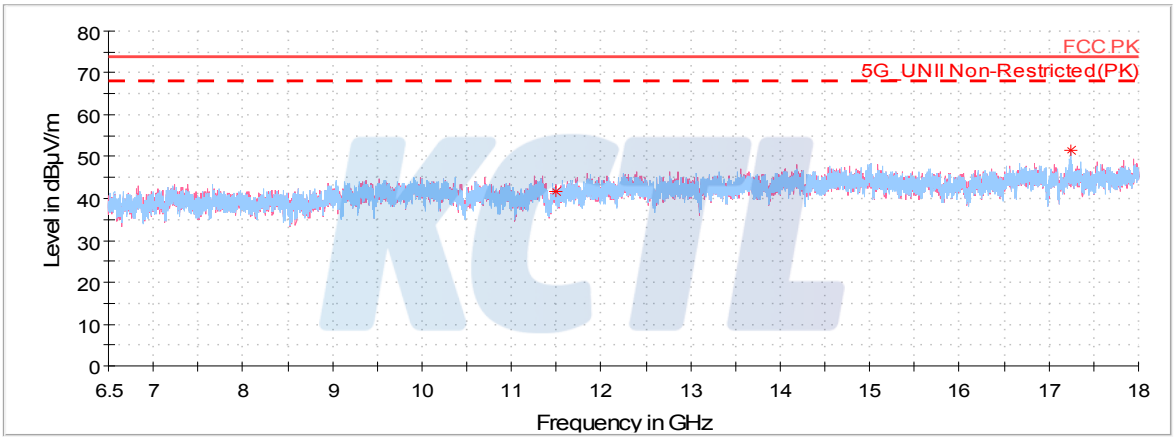
Horizontal/Vertical for Band-edge



Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



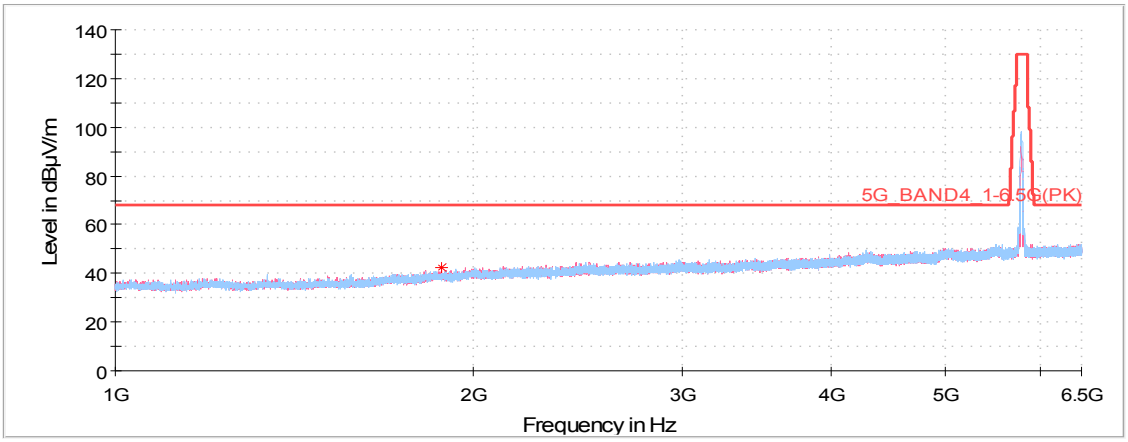
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

Middle Channel (5 785 ㎒)

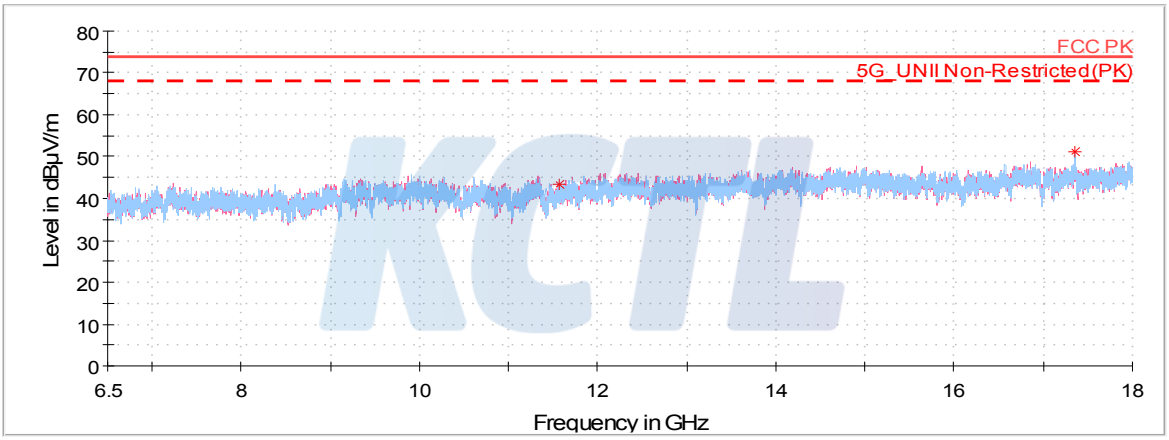
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 571.50[1)]	H	56.53	38.29	-51.43	-	43.39	74.00	30.61
17 353.84	H	57.99	41.84	-48.65	-	51.18	68.20	17.02
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

KCTL

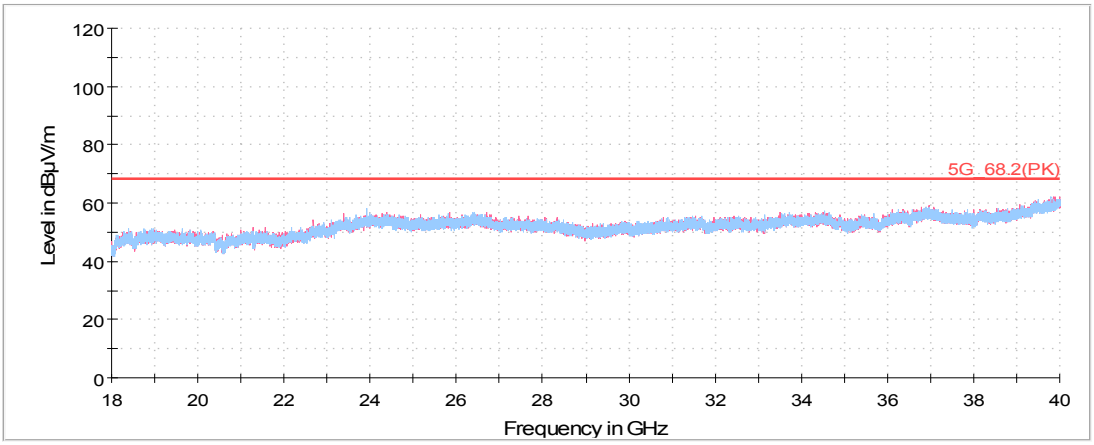
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



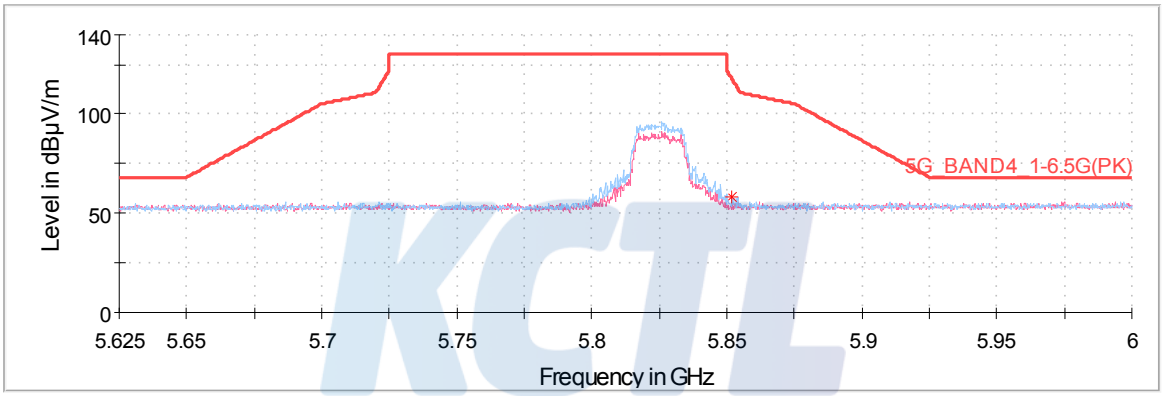
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



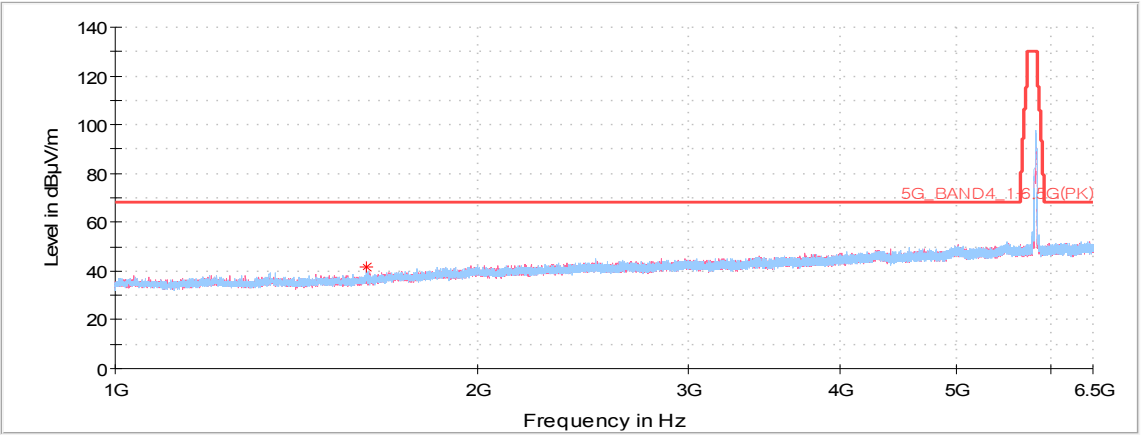
Highest Channel (5 825 ㎒)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 851.86	H	50.45	34.92	-27.18	-	58.19	117.96	59.77
11 646.97[1)]	V	56.18	38.38	-51.38	-	43.18	74.00	30.82
17 476.03	H	53.31	41.89	-48.68	-	46.52	68.20	21.68
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

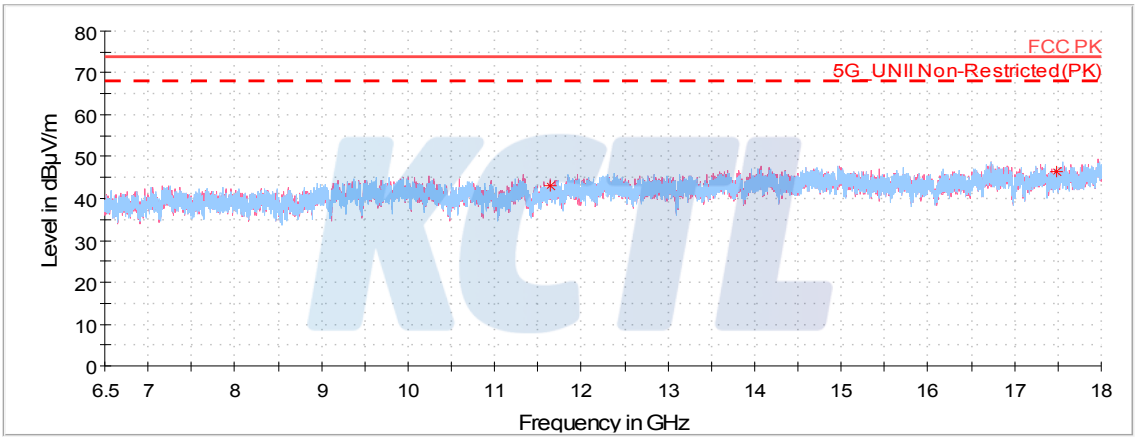
Horizontal/Vertical for Band-edge



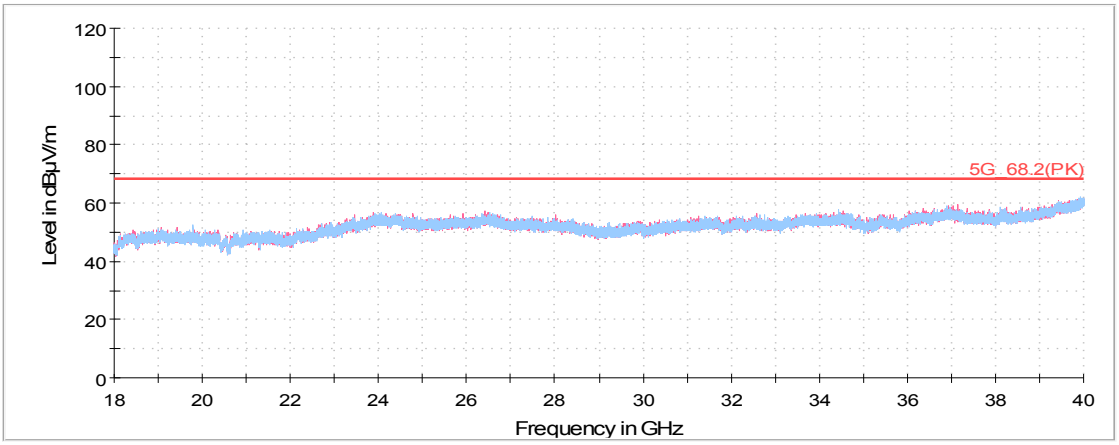
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

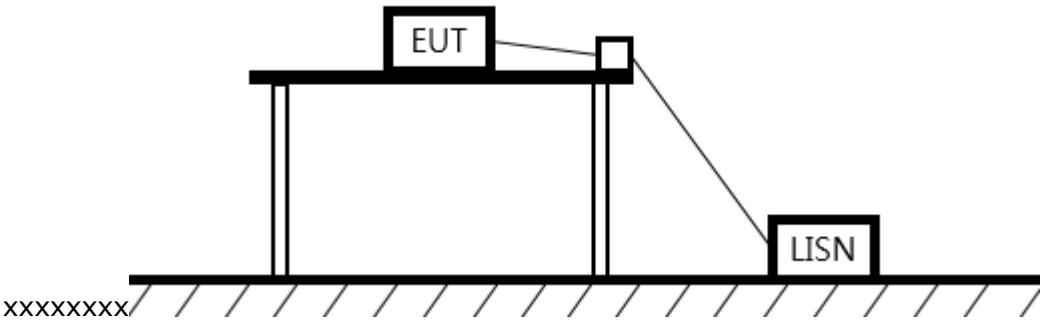


Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



7.7. AC Conducted emission

Test setup



Limit

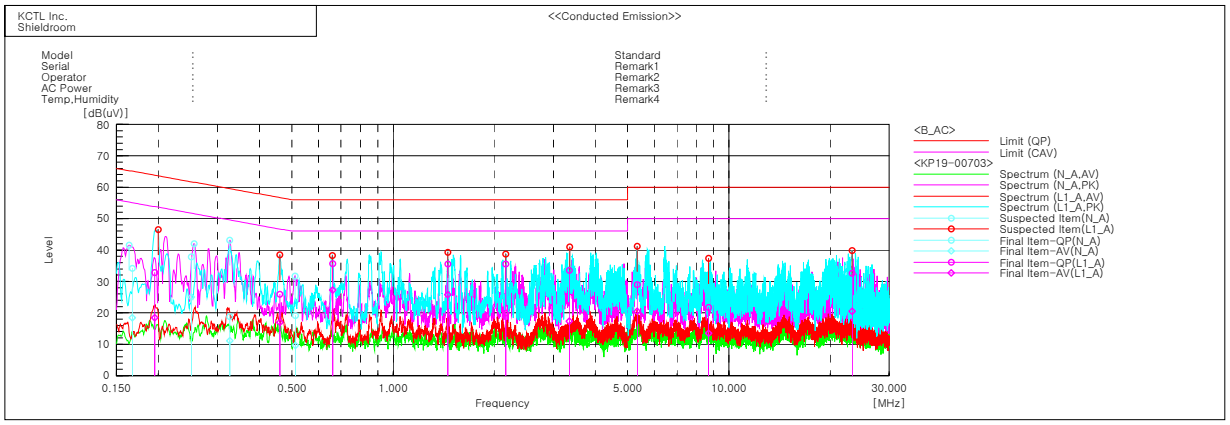
According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/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 (㎒)	Conducted limit (dBμV/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 ㎝ in which is located 40 ㎝ 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 50Ω/50μH LISN, which is an input transducer to a spectrum analyzer or an EMI/Field Intensity ㅡ 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 ㎒ to 30 ㎒.
5. The measurements were made with the detector set to peak amplitude within a bandwidth of 10 ㎑ or to quasi-peak and average within a bandwidth of 9 ㎑. The EUT was in transmitting mode during the measurements.

Test results



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	0.16731	23.9	8.2	10.2	34.1	18.4	65.1	55.1	31.0	36.7
2	0.2511	28.0	15.3	9.8	37.8	25.1	61.7	51.7	23.9	26.6
3	0.32597	8.9	1.2	9.9	18.8	11.1	59.6	49.6	40.8	38.5
4	0.5124	9.1	-0.4	10.0	19.1	9.6	56.0	46.0	36.9	36.4

--- 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	0.19509	22.9	8.4	10.0	32.9	18.4	63.8	53.8	30.9	35.4
2	0.45992	16.0	7.0	9.9	25.9	16.9	56.7	46.7	30.8	29.8
3	0.6615	25.8	17.4	9.9	35.7	27.3	56.0	46.0	20.3	18.7
4	1.45574	25.8	16.0	9.8	35.6	25.8	56.0	46.0	20.4	20.2
5	2.16492	25.8	10.2	9.8	35.6	20.0	56.0	46.0	20.4	26.0
6	3.35105	23.6	7.4	9.9	33.5	17.3	56.0	46.0	22.5	28.7
7	5.33441	19.0	10.5	10.0	29.0	20.5	60.0	50.0	31.0	29.5
8	8.69531	11.5	3.3	10.2	21.7	13.5	60.0	50.0	38.3	36.5
9	23.29658	21.6	9.5	11.0	32.6	20.5	60.0	50.0	27.4	29.5

8. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R & S	FSV30	100914	19.09.10
Spectrum Analyzer	R & S	FSV40	100988	20.01.04
ATTENUATOR	Wideband Power Sensor	NRP-Z81	102398	20.01.25
ATTENUATOR	HP	8491A	29738	20.01.04
EMI TEST RECEIVER	R & S	ESCI	100732	19.08.23
Bi-Log Antenna	SCHWARZBECK	VULB 9168	583	21.05.04
Amplifier	SONOMA INSTRUMENT	310N	284608	19.08.23
COAXIAL FIXED ATTENUATOR	Agilent	8491B-003	2708A18758	20.05.04
Horn antenna	ETS.lindgren	3116	00086632	20.02.15
Horn antenna	ETS.lindgren	3117	161225	20.05.22*
AMPLIFIER	L-3 Narda-MITEQ	AMF-7D-01001800 -22-10P	2003683	20.02.21
AMPLIFIER	L-3 Narda-MITEQ	JS44-18004000-33 -8P	2000997	19.08.02
AMPLIFIER	L-3 Narda-MITEQ	AFS5-00101800-25-S-5	2054571	20.02.21
Broadband PreAmplifier	SCHWARZBECK	BBV9718	216	19.08.01
LOOP Antenna	R & S	HFH2-Z2	100355	20.08.24
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	-
TWO-LINE V - NETWORK	R & S	ENV216	101584	20.04.05
EMI TEST RECEIVER	R & S	ESCI	101408	19.08.23
Highpass Filter	WT	WT-A1699-HS	WT160411002	20.05.14*
Vector Signal Generator	R & S	SMBV100A	257566	20.01.04
Signal Generator	R & S	SMR40	100007	20.05.13
Cable Assembly	RadiAll	2301761768000PJ	1724.659	-
Cable Assembly	gigalane	RG-400	-	-
Cable Assembly	HUER+SUHNER	SUCOFLEX 104	MY4342/4	-

*The equipment was used after finished calibration.

End of test report

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