



TEST REPORT



Report No. : KES-RF240944-R1
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■ FCC TEST REPORT

1. Client

- Name : TRUEN CO.,Ltd
- Address : 1309, Woolim e-BIZ Center 1, 28 Digital-ro 33-gil, Guro-gu, Seoul,
Republic of Korea

2. Sample Description

- Product item : Wireless Home Camera
- Model name : TCS-443P
- Manufacturer etc. : Shenzhen Gospell Smarthome Electronic Co., Ltd

3. Date of test : 2025.01.10 ~ 2025.01.23

4. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing

- Address : 473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea

5. Test method used : Part 15 Subpart E 15.407

6. Test result : PASS

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This laboratory is not accredited for the test results marked *.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by	Technical Manager
	Name : Gu-Bong, Kang (Signature)	Name : Yeong-Jun Cho (Signature)

[김구봉]2025/01/23

[조영준]2025/01/23

2025 . 01. 23.

KES Co., Ltd.

Accredited by KOLAS, Republic of KOREA



REPORT REVISION HISTORY

Date	Test Report No.	Revision History
2025.01.14	KES-RF240944	Initial
2025.01.23	KES-RF240944-R1	1. Corrected typo at Page 4, 7, 22. 2. Retested Power spectral density at UNII-3 band. 3. Added result at Page 68.

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Use of uncertainty of measurement for decisions on conformity (decision rule):

☒ No decision rule is specified by the standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty("simple acceptance" decision rule, previously known as "accuracy method").

☐ Other (to be specified, for example when required by the standard or client)



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1. General information

Applicant: TRUEN CO.,Ltd
Applicant address: 1309, Woolim e-BIZ Center 1, 28 Digital-ro 33-gil, Guro-gu,
Seoul, Republic of Korea
Test site: KES Co., Ltd.
Test site address: ☐ #3002, #3503, #3701, 40, Simin-daero365beon-gil,
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Republic of Korea
☒ 473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea
Test Facility: FCC Accreditation Designation No.: KR0100, Registration No.: 444148
FCC rule part(s): 15.407
FCC ID: 2AZK3-TSC-443P
Test device serial No.: ☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test: Wireless Home Camera
Frequency range & Number of channels: 2 412 MHz ~ 2 462 MHz (802.11b/g/n_HT20) : 11 ch
UNII-1 5 180 MHz ~ 5 240 MHz (802.11a/n_HT20) : 4 ch
UNII-3 5 745 MHz ~ 5 825 MHz (802.11a/n_HT20) : 5 ch
Model: TCS-443P
Modulation technique: DSSS, **OFDM**
Antenna specification: 2.4 GHz band FPCB Antenna // Peak gain: 3.94 dBi
UNII-1 band FPCB Antenna // Peak gain: 3.61 dBi
UNII-3 band FPCB Antenna // Peak gain: 3.77 dBi
Power source: DC 5 V
H/W version: 1.0
S/W version: 1.0

1.2. Test configuration

The **TRUEN CO.,Ltd // Wireless Home Camera // TCS-443P // FCC ID: 2AZK3-TSC-443P** was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.407
KDB 789033 D02 v02r01
ANSI C63.10-2013



Report No. : KES-RF240944-R1

1.3. Information about derivative model

N/A

1.4. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
-	-	-	-	-

1.5. Device modifications

N/A

1.6. Sample calculation

Where relevant, the following sample calculation is provided
For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator 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.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 2.43 + 20 = 22.43 \text{ (dB)}\end{aligned}$$

For Radiation test :

$$\text{Field strength level (dB}\mu\text{V/m)} = \text{Measured level (dB}\mu\text{V)} + \text{Antenna factor (dB)} + \text{Cable loss (dB)} - \text{Amplifier gain (dB)}$$

1.7. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.22 dB (SHIELD ROOM #6)
Uncertainty for Radiation emission test (include Fundamental emission)	Below 1 GHz	4.04 dB (SAC #6)
	Above 1 GHz	5.32 dB (SAC #5)
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		

1.8. Worst case data rate

1. Worst-case data rates were:

Mode	Data rate
802.11a	6 Mbps
802.11n_HT20	MCS0

**1.9. Frequency/channel operations**

Ch.	Frequency (MHz)	Mode
1	2 412	802.11b/g/n_HT20
.	.	.
6	2 437	802.11b/g/n_HT20
.	.	.
11	2 462	802.11b/g/n_HT20

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

802.11a/n_HT20 mode



2. Summary of tests

Section in FCC Part 15	Parameter	Test results
15.407(a)	26 dB bandwidth & 99 % bandwidth	Pass
15.407(e)	6 dB bandwidth	Pass
15.407(a)	Maximum conducted output power	Pass
15.407(a)	Power spectral density	Pass
15.407(g)	Frequency stability	Pass
15.205, 15.209, 15.407(b)	Radiated restricted band and emission	Pass
15.207(a)	AC power line conducted emissions	Pass
15.203	Antenna Requirement	Pass

Note.

- By the request of applicant, test is performed with power setting value below :

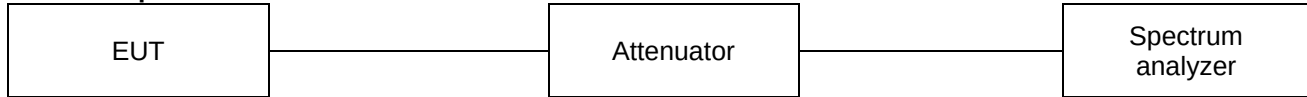
Mode	UNII-1		UNII-3	
	Frequency (MHz)	Setting value	Frequency (MHz)	Setting value
802.11a (6 Mbps)	5 180 ~ 5 240	Default	5 745 ~ 5 825	Default
802.11n_HT20 (MCS0)		Default		Default



3. Test results

3.1. 26 dB bandwidth & 99% Occupied Bandwidth

Test setup



Test procedure

26 dB bandwidth

KDB 789033 D02 v02r01– Section C.1

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 peak 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

KDB 789033 D02 v02r01– Section D

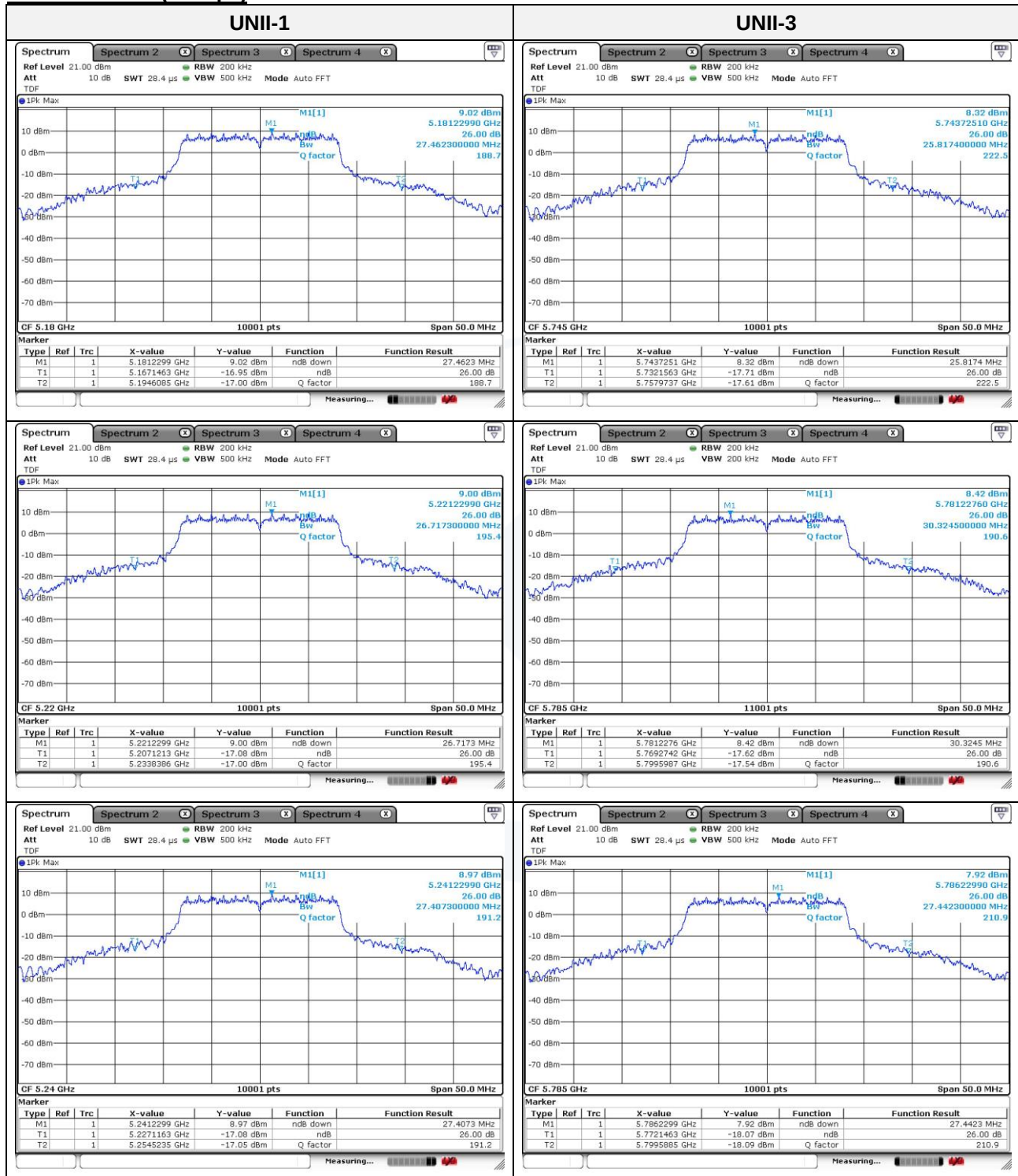
1. Set span = 1.5 times to 5.0 times the OBW.
2. Set RBW = 1% to 5% of the OBW
3. Set the VBW > 3 x RBW.
4. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak bandwidth function of the instrument (if available).
5. Use the 99% power bandwidth function of the instrument (if available).
6. 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.

Limit

N/A

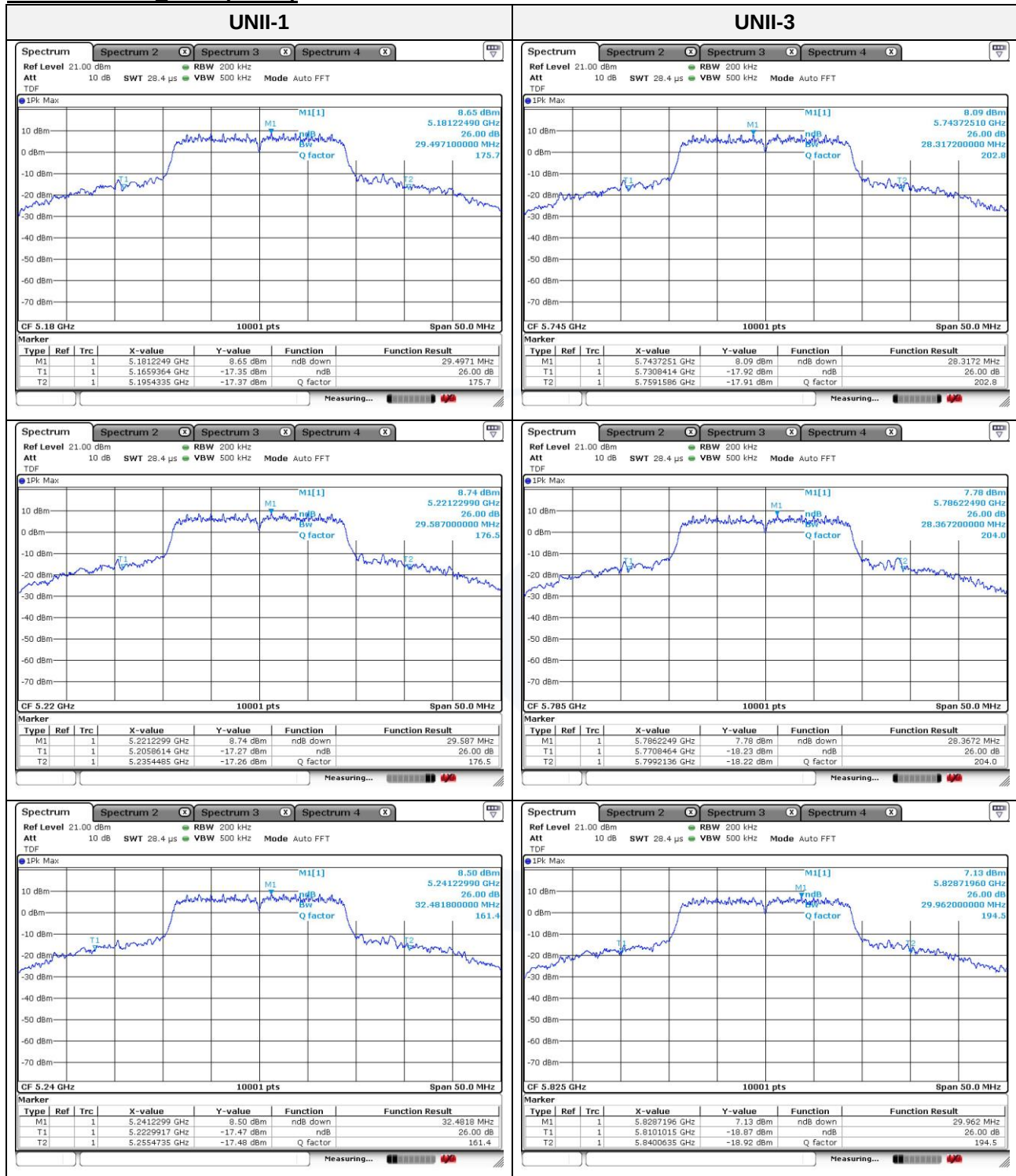
**Test results**

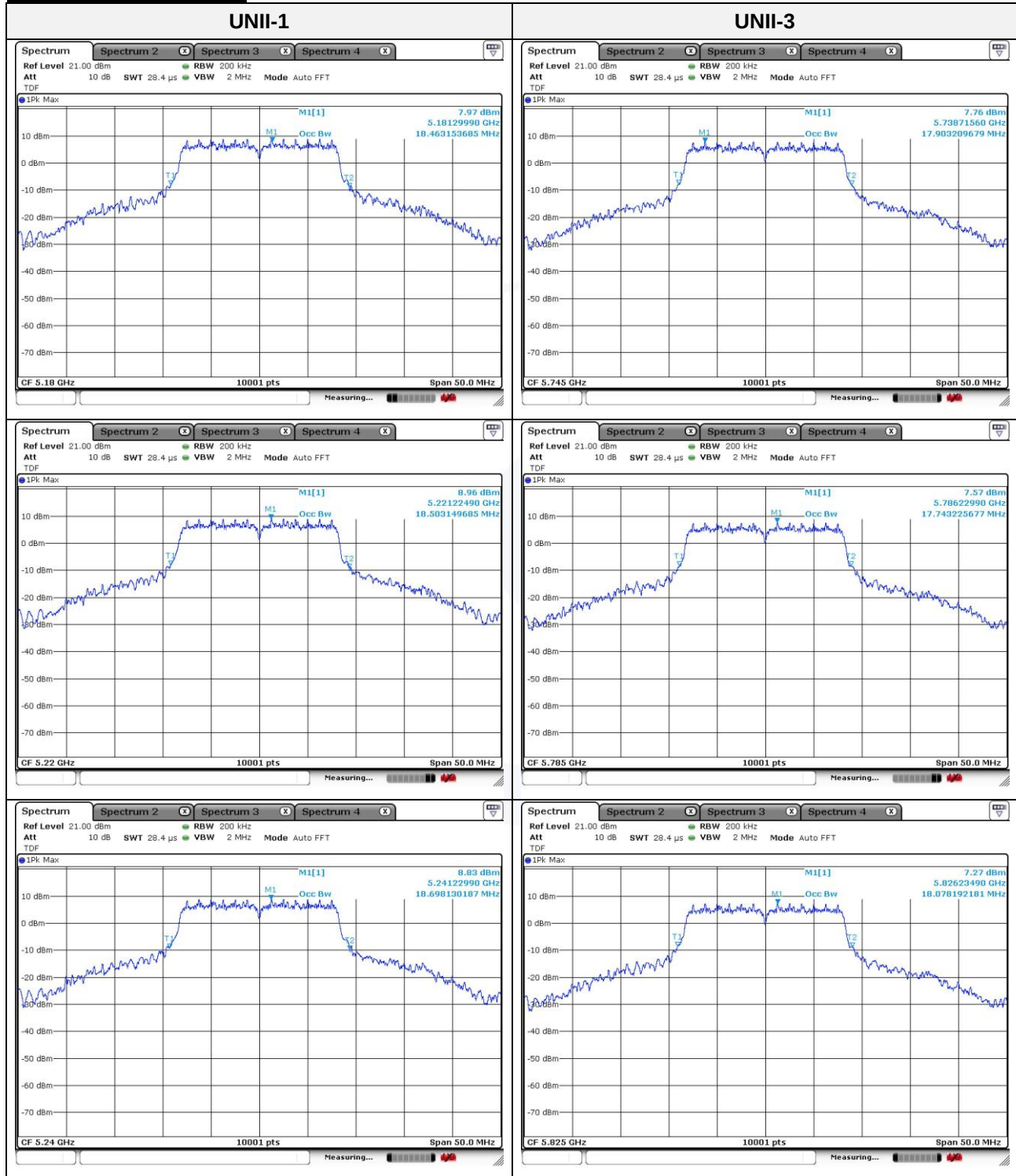
Band	Frequency(MHz)	Mode	26 dB bandwidth(MHz)	99 % bandwidth(MHz)
UNII-1	5 180	802.11a (6 Mbps)	27.46	18.46
	5 220		26.72	18.50
	5 240		27.41	18.70
UNII-3	5 745		25.82	17.90
	5 785		30.32	17.74
	5 825		27.44	18.08
UNII-1	5 180	802.11n_ HT20 (MCS0)	29.50	19.25
	5 220		29.59	19.29
	5 240		32.48	20.12
UNII-3	5 745		28.32	18.72
	5 785		28.37	19.19
	5 825		29.96	18.81

**26 dB bandwidth****Mode : 802.11a (6 Mbps)**



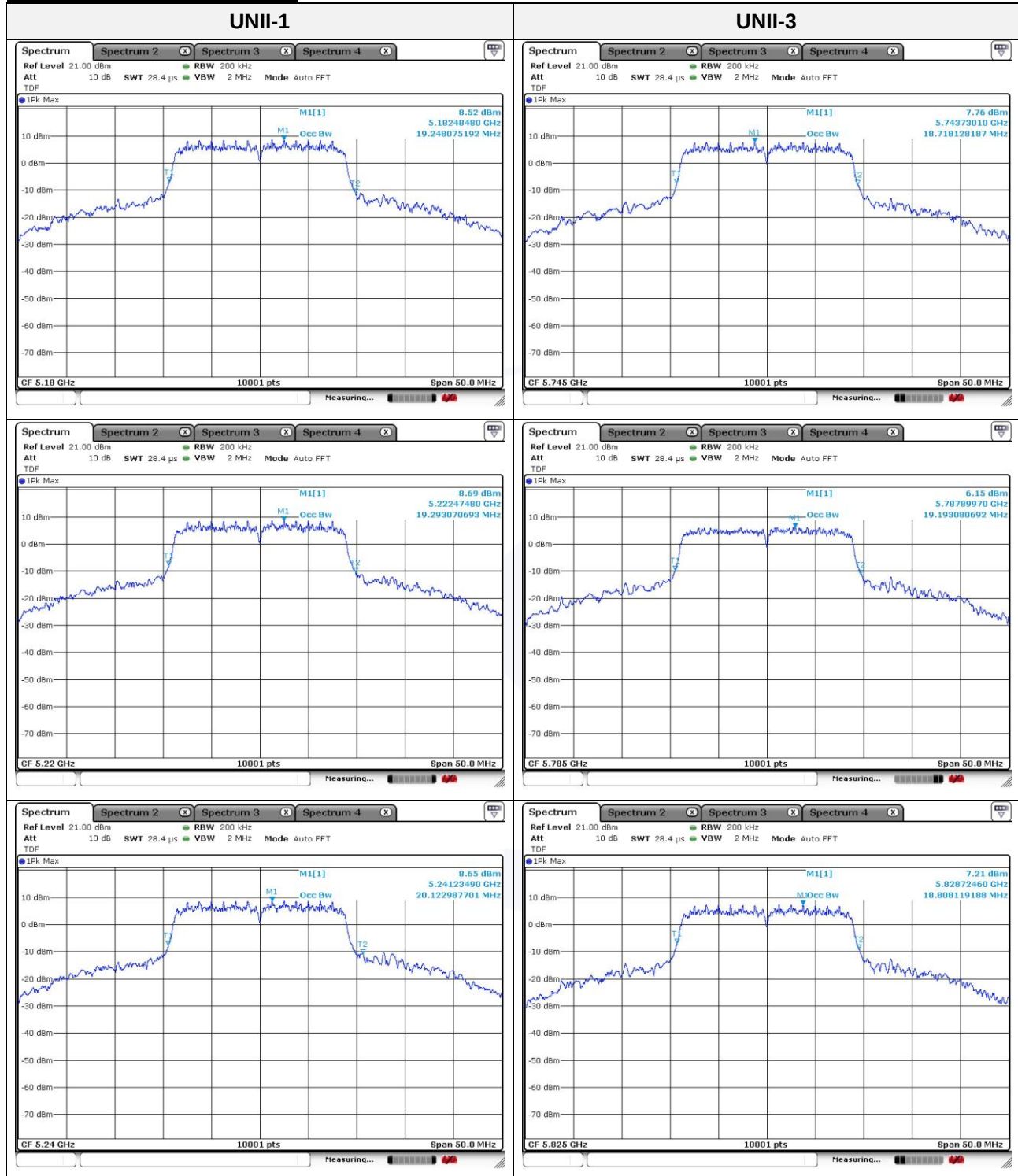
Mode : 802.11n HT20 (MCS0)



**99% bandwidth****Mode : 802.11a (6 Mbps)**



Mode : 802.11n HT20 (MCS0)



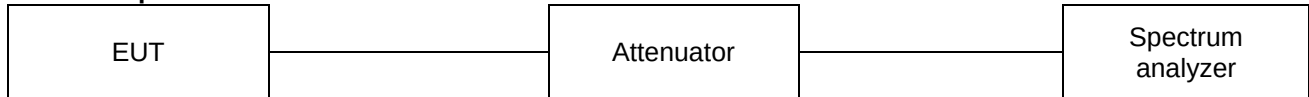


3.2. 6 dB bandwidth

Test procedure

KDB 789033 D02 v02r01– Section C.2

Test setup



Section C.2

1. Set RBW = 100 kHz
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = peak.
4. Sweep = auto couple.
5. Allow the trace to stabilize
6. 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.

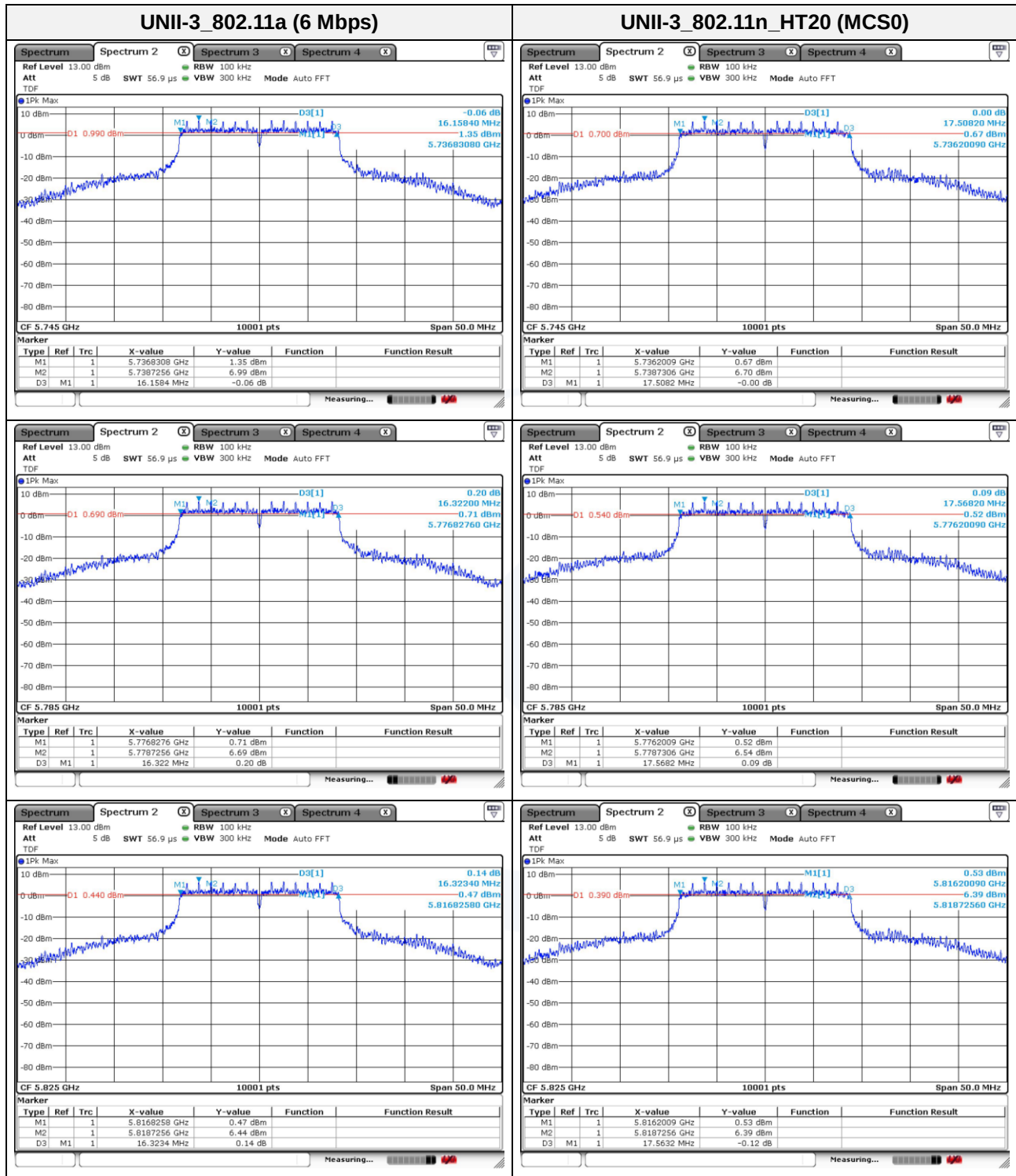
Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

**Test results**

Band	Frequency(MHz)	Mode	6 dB bandwidth(MHz)
UNII-3	5 745	802.11a (6 Mbps)	16.16
	5 785		16.32
	5 825		16.32
	5 745	802.11n_HT20 (MCS0)	17.51
	5 785		17.57
	5 825		17.56







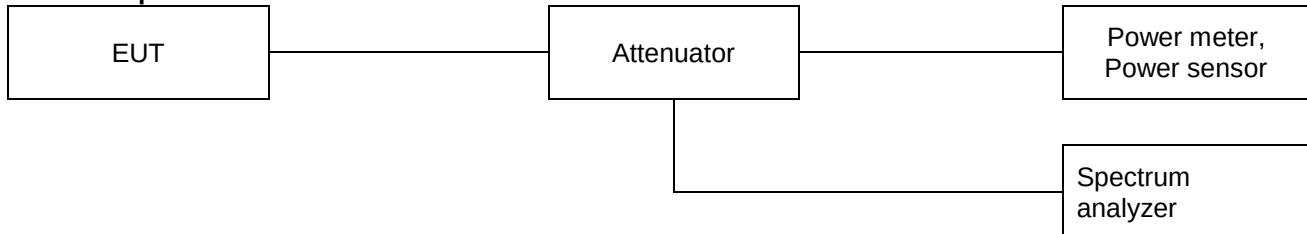
3.3. Maximum conducted output power

Test procedure

KDB 789033 D02 v02r01– Section E.3.a) or b)

Used test method is Section E.3.b)

Test setup



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 section 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 %).

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.

**Limit**

Band	EUT Category		Limit
UNII-1		Outdoor access point	1 W (30 dBm)
	✓	Indoor access point	
		Fixed point-to-point access point	
		Mobile and portable client device	250 mW(23.97 dBm)
UNII-2A			250 mW or 11 dBm + 10logB*
UNII-2C			250 mW or 11 dBm + 10logB*
UNII-3	✓		1 W (30 dBm)

Note.

1. Limit B is the 26 dB emission bandwidth.



Test results

Band	Frequency (MHz)	Mode	Detector mode	Ant Gain (dBi)	Output power (dBm)	Limit (dBm)
UNII-1	5 180	802.11a (6 Mbps)	AV	3.61	17.28	30.00
	5 220		AV		17.24	
	5 240		AV		17.22	
UNII-3	5 745		AV	3.77	15.77	30.00
	5 785		AV		15.91	
	5 825		AV		15.74	
UNII-1	5 180	802.11n _HT20 (MCS0)	AV	3.61	17.16	30.00
	5 220		AV		17.16	
	5 240		AV		17.12	
UNII-3	5 745		AV	3.77	16.03	30.00
	5 785		AV		15.82	
	5 825		AV		15.68	

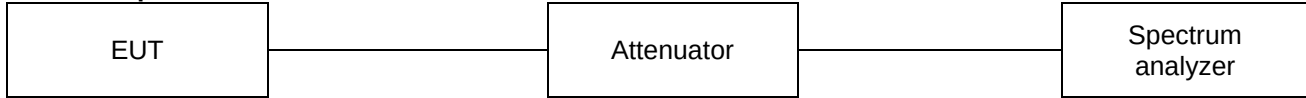


3.4. Power spectral density

Test procedure

KDB 789033 D02 v02r01 – Section F

Test setup



Section F

1. Create an average power spectrum for the EUT operating mode being tested by following the instructions in section 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. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
3. Make the following 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 step 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 1 MHz 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 above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 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 a 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 section 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.

Note.

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

**Limit**

Band	EUT Category		Limit
UNII-1		Outdoor access point	17 dBm/MHz
	✓	Indoor access point	
		Fixed point-to-point access point	
		Mobile and portable client device	11 dBm/MHz
UNII-2A			11 dBm/MHz
UNII-2C			11 dBm/MHz
UNII-3	✓		30 dBm/500 kHz

Note.

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 be reduced by the amount in dB that the directional gain of the antenna exceed 6 dBi.



Test results

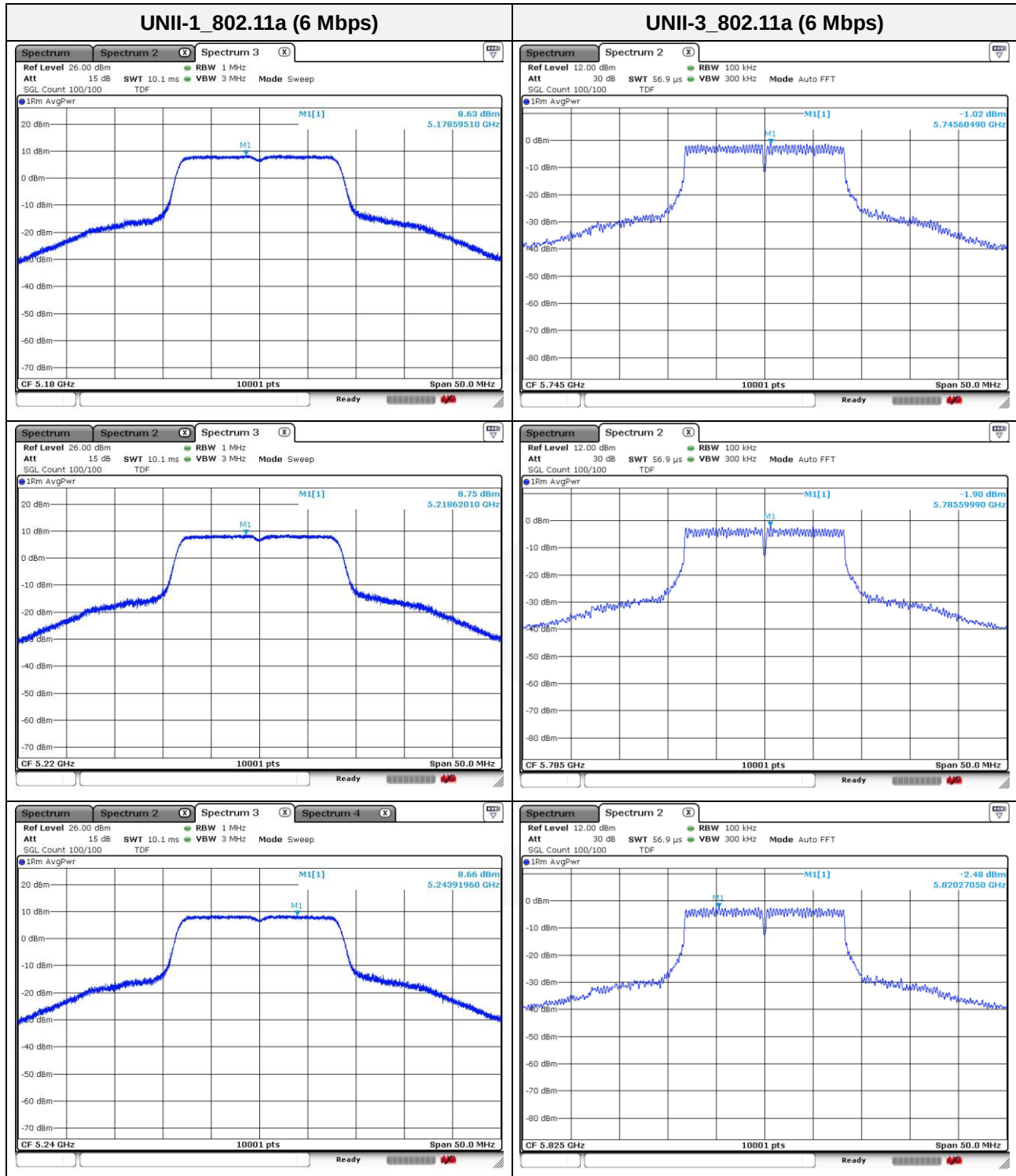
Mode	Frequency (MHz)	Band	PSD (dBm/MHz)	RBWF Note1	DCF Note2	Sum Note3	Limit
802.11a (6 Mbps)	5 180	UNII-1	8.63	-	0.18	8.81	17.00 (dB m/MHz)
	5 220		8.75			8.93	
	5 240		8.66			8.84	
	5 745	UNII-3	-1.02	6.99	0.22	6.19	30.00 (dBm/500 kHz)
	5 785		-1.90			5.31	
	5 825		-2.48			4.73	
802.11n_ HT20 (MCS0)	5 180	UNII-1	8.31	-	-	8.49	17.00 (dB m/MHz)
	5 220		8.42			8.60	
	5 240		8.24			8.42	
	5 745	UNII-3	-1.93	6.99	-	5.28	30.00 (dBm/500 kHz)
	5 785		-2.24			4.97	
	5 825		-2.22			4.99	

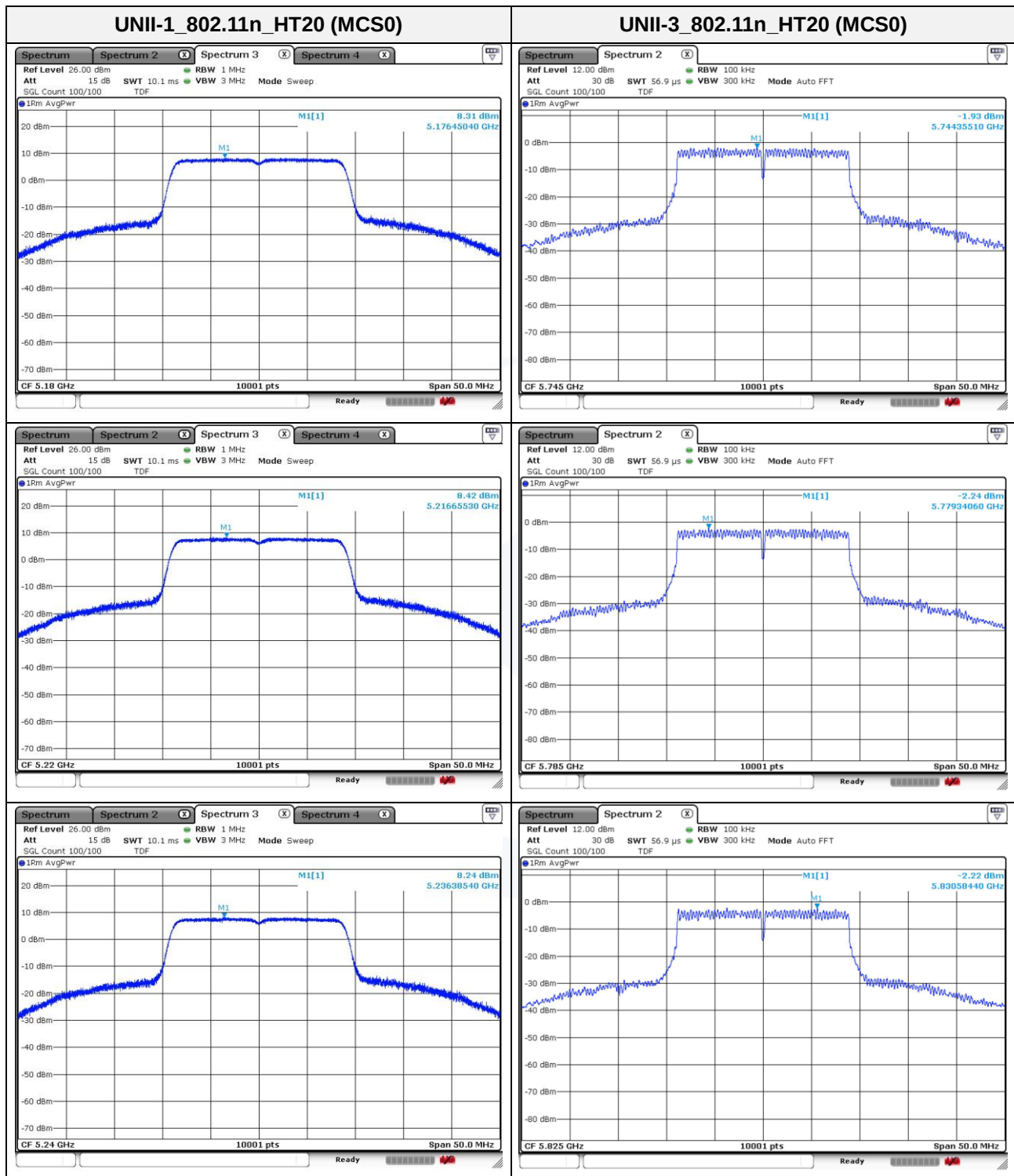
Note.

- UNII-1 = $10\log(1 \text{ MHz}/1 \text{ MHz}) = 0$
UNII-3 = $10\log(500 \text{ kHz} / 100 \text{ kHz}) = 6.99$
- Refer to the page 34 on this report.
- Sum(dBm) = PSD(dBm) + RBWF + Duty correction factor (dB)



Test results





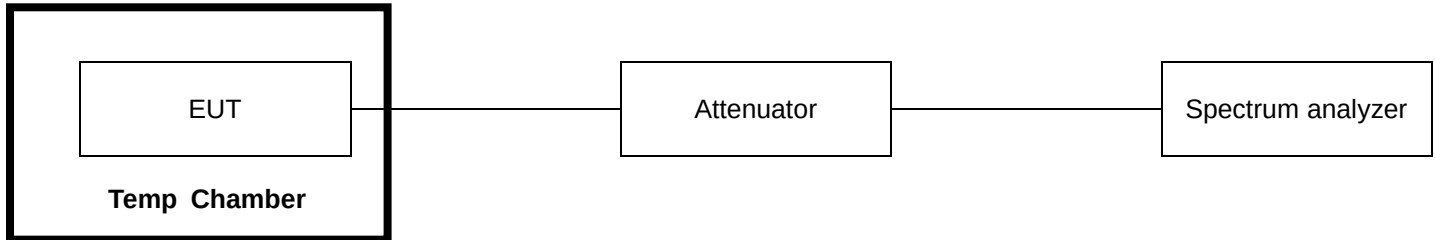


3.5. Frequency Stability

Test procedure

ANSI C63.10-2013, clause 6.8.1

Test setup



1. The EUT was placed inside the environmental test chamber and powered by nominal AC voltage.
2. Turn the EUT on and couple its output to a spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.
7. 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.

Limit

N/A

**Test results**

Mode: UNII-1

Operating frequency: 5 180 MHz

Test voltage (%)	Test voltage (V)	Temperature (°C)	Maintaining time	Measure frequency (MHz)	Frequency deviation (Hz)	Deviation (%)
100 %	DC 5.00	-10.0	Startup	5 180.007 500	7 500	0.000 14
			2 minutes	5 180.005 500	5 500	0.000 11
			5 minutes	5 180.012 000	12 000	0.000 23
			10 minutes	5 180.005 500	5 500	0.000 11
100 %		0.0	Startup	5 180.015 000	15 000	0.000 29
			2 minutes	5 180.013 500	13 500	0.000 26
			5 minutes	5 180.012 000	12 000	0.000 23
			10 minutes	5 180.011 500	11 500	0.000 22
100 %		10.0	Startup	5 179.990 000	-10 000	-0.000 19
			2 minutes	5 179.992 500	-7 500	-0.000 14
			5 minutes	5 179.995 000	-5 000	-0.000 10
			10 minutes	5 179.989 000	-11 000	-0.000 21
100 %		20.0	Startup	5 179.985 000	-15 000	-0.000 29
			2 minutes	5 179.986 500	-13 500	-0.000 26
			5 minutes	5 179.986 000	-14 000	-0.000 27
			10 minutes	5 179.983 000	-17 000	-0.000 33
100 %		25.1	Startup	5 179.982 500	-17 500	-0.000 34
			2 minutes	5 179.982 000	-18 000	-0.000 35
			5 minutes	5 179.985 000	-15 000	-0.000 29
			10 minutes	5 179.988 000	-12 000	-0.000 23
100 %		30.0	Startup	5 179.972 500	-27 500	-0.000 53
			2 minutes	5 179.975 000	-25 000	-0.000 48
			5 minutes	5 179.976 000	-24 000	-0.000 46
			10 minutes	5 179.978 500	-21 500	-0.000 42
100 %		40.0	Startup	5 179.965 000	-35 000	-0.000 68
			2 minutes	5 179.967 000	-33 000	-0.000 64
			5 minutes	5 179.960 000	-40 000	-0.000 77
			10 minutes	5 179.963 000	-37 000	-0.000 71
100 %		50.0	Startup	5 179.982 500	-17 500	-0.000 34
			2 minutes	5 179.985 000	-15 000	-0.000 29
			5 minutes	5 179.986 000	-14 000	-0.000 27
			10 minutes	5 179.988 500	-11 500	-0.000 22
85 %	DC 4.25	25.1	Startup	5 179.986 000	-14 000	-0.000 27
			2 minutes	5 179.985 500	-14 500	-0.000 28
			5 minutes	5 179.987 500	-12 500	-0.000 24
			10 minutes	5 179.987 000	-13 000	-0.000 25
115 %	DC 5.75	25.1	Startup	5 179.985 000	-15 000	-0.000 29
			2 minutes	5 179.978 000	-22 000	-0.000 42
			5 minutes	5 179.978 500	-21 500	-0.000 42
			10 minutes	5 179.981 500	-18 500	-0.000 36



Mode: UNII-3

Operating frequency: 5 745 MHz

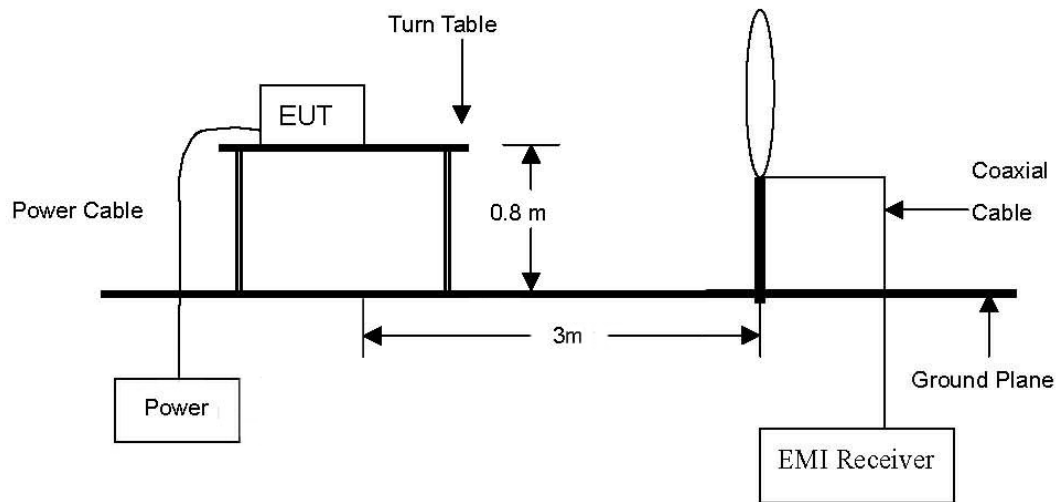
Test voltage (%)	Test voltage (V)	Temperature (°C)	Maintaining time	Measure frequency (MHz)	Frequency deviation (Hz)	Deviation (%)
100 %	DC 5.00	-10.0	Startup	5 745.017 500	17 500	0.000 30
			2 minutes	5 745.015 500	15 500	0.000 27
			5 minutes	5 745.016 000	16 000	0.000 28
			10 minutes	5 745.013 000	13 000	0.000 23
100 %		0.0	Startup	5 744.997 500	-2 500	-0.000 04
			2 minutes	5 744.996 500	-3 500	-0.000 06
			5 minutes	5 744.994 500	-5 500	-0.000 10
			10 minutes	5 744.997 500	-2 500	-0.000 04
100 %		10.0	Startup	5 744.980 000	-20 000	-0.000 35
			2 minutes	5 744.985 000	-15 000	-0.000 26
			5 minutes	5 744.983 000	-17 000	-0.000 30
			10 minutes	5 744.984 000	-16 000	-0.000 28
100 %		20.0	Startup	5 744.990 000	-10 000	-0.000 17
			2 minutes	5 744.990 000	-10 000	-0.000 17
			5 minutes	5 744.987 500	-12 500	-0.000 22
			10 minutes	5 744.987 000	-13 000	-0.000 23
100 %		25.1	Startup	5 744.960 000	-40 000	-0.000 70
			2 minutes	5 744.965 000	-35 000	-0.000 61
			5 minutes	5 744.970 000	-30 000	-0.000 52
			10 minutes	5 744.967 000	-33 000	-0.000 57
100 %		30.0	Startup	5 744.990 000	-10 000	-0.000 17
			2 minutes	5 744.988 000	-12 000	-0.000 21
			5 minutes	5 744.985 000	-15 000	-0.000 26
			10 minutes	5 744.992 500	-7 500	-0.000 13
100 %		40.0	Startup	5 744.972 500	-27 500	-0.000 48
			2 minutes	5 744.978 000	-22 000	-0.000 38
			5 minutes	5 744.976 000	-24 000	-0.000 42
			10 minutes	5 744.978 500	-21 500	-0.000 37
100 %		50.0	Startup	5 744.990 000	-10 000	-0.000 17
			2 minutes	5 744.985 000	-15 000	-0.000 26
			5 minutes	5 744.986 500	-13 500	-0.000 23
			10 minutes	5 744.987 500	-12 500	-0.000 22
85 %	DC 4.25	25.1	Startup	5 744.967 000	-33 000	-0.000 57
			2 minutes	5 744.966 000	-34 000	-0.000 59
			5 minutes	5 744.964 000	-36 000	-0.000 63
			10 minutes	5 744.960 000	-40 000	-0.000 70
115 %	DC 5.75	25.1	Startup	5 744.960 000	-40 000	-0.000 70
			2 minutes	5 744.962 500	-37 500	-0.000 65
			5 minutes	5 744.964 000	-36 000	-0.000 63
			10 minutes	5 744.965 000	-35 000	-0.000 61



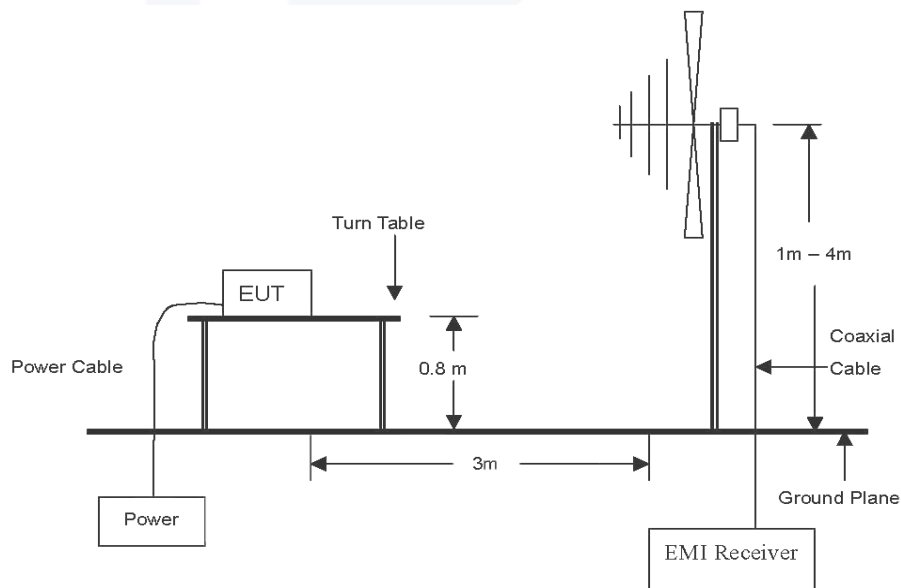
3.6. Radiated restricted band and emissions

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.

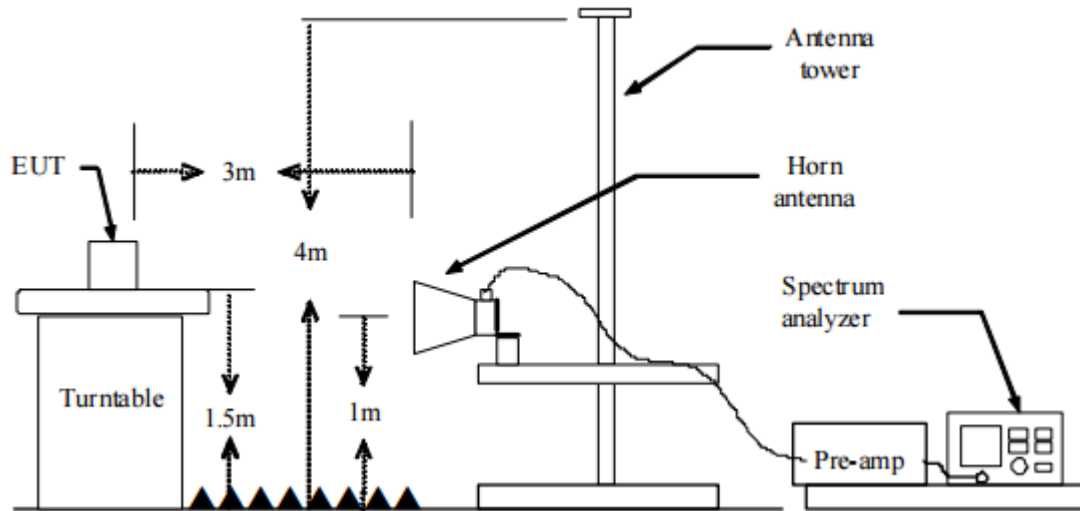


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.





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.



Test procedure

Radiated emissions from the EUT were measured according to the dictates in section 11.11 & 11.12 of ANSI C63.10-2013.

Test procedure below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel, ground parallel and perpendicular of the antenna are set to make the measurement. It was determined that parallel was worst-case orientation; therefore, all final radiated testing was performed with the EUT in parallel.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum hold mode.

Test procedure above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground for 30 MHz-1 GHz and 1.5 meters for above 1 GHz at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The antenna is a bi-log antenna, a horn antenna, and its height are varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
5. Spectrum analyzer settings for $f < 1$ GHz:
 - ① Span = wide enough to fully capture the emission being measured
 - ② RBW = 120 kHz
 - ③ VBW $\geq$ RBW
 - ④ Detector = quasi peak
 - ⑤ Sweep time = auto
 - ⑥ Trace = max hold



6. Spectrum analyzer settings for $f \geq 1$ GHz: Peak

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW ≥ 3 MHz
- ④ Detector = peak
- ⑤ Sweep time = auto
- ⑥ Trace = max hold
- ⑦ Trace was allowed to stabilize

7. Spectrum analyzer settings for $f \geq 1$ GHz: Average

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW $\geq 3 \times$ RBW
- ④ Detector = RMS, 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.
- ⑤ 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 in order to use linear voltage averaging. Log or dB averaging shall not be used.
- ⑥ Sweep = auto
- ⑦ Trace = max hold
- ⑧ Perform a trace average of at least 100 traces.
- ⑨ A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (RMS) mode was used in step ⑤, then the applicable correction factor is $10 \log(1/x)$, where x is the duty cycle.
 - 2) If linear voltage averaging mode was used in step ⑤, then the applicable correction factor is $20 \log(1/x)$, where x is the duty cycle.
 - 3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

**Note.**

- $f < 30$ MHz, extrapolation factor of 40 dB/decade of distance. $F_d = 40\log(D_m/D_s)$
 $f \geq 30$ MHz, extrapolation factor of 20 dB/decade of distance. $F_d = 20\log(D_m/D_s)$
 Where:
 F_d = Distance factor in dB
 D_m = Measurement distance in meters
 D_s = Specification distance in meters
- Field strength(dB μ V/m) = Level(dB μ V/m) + CF (dB) + or DCF(dB)
- Margin(dB) = Limit(dB μ V/m) - Field strength(dB μ V/m)
- Emissions below 18 GHz were measured at a 3 meter test distance while emissions above 18 GHz were measured at a 1 meter test distance with the application of a distance correction factor.
- 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.
- The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
- 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.

Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated (μ V/m)
0.009 ~ 0.490	300	2400/F(kHz)
0.490 ~ 1.705	30	24000/F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**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., Sections 15.231 and 15.241.



According to 15.407(b), (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:

- (1) 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.
- (2) 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.
- (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of –27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band:
 - i) 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.
 - ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.
- (5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
- (6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.
- (7) The provisions of §15.205 apply to intentional radiators operating under this section.
- (8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.



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Duty cycle

Regarding to KDB 789033 D02 v02r01, B)2)b), the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below.

Set RBW $\geq$ OBW if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$, where T is defined in II.B.1.a), and the number of sweep points across duration T exceeds 100.

For the band 5.150-5.250 GHz

Test mode	T _{on} time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
802.11a	1.40	1.46	0.96	95.89	0.18
802.11n_HT20	5.09	5.15	0.99	98.83	-

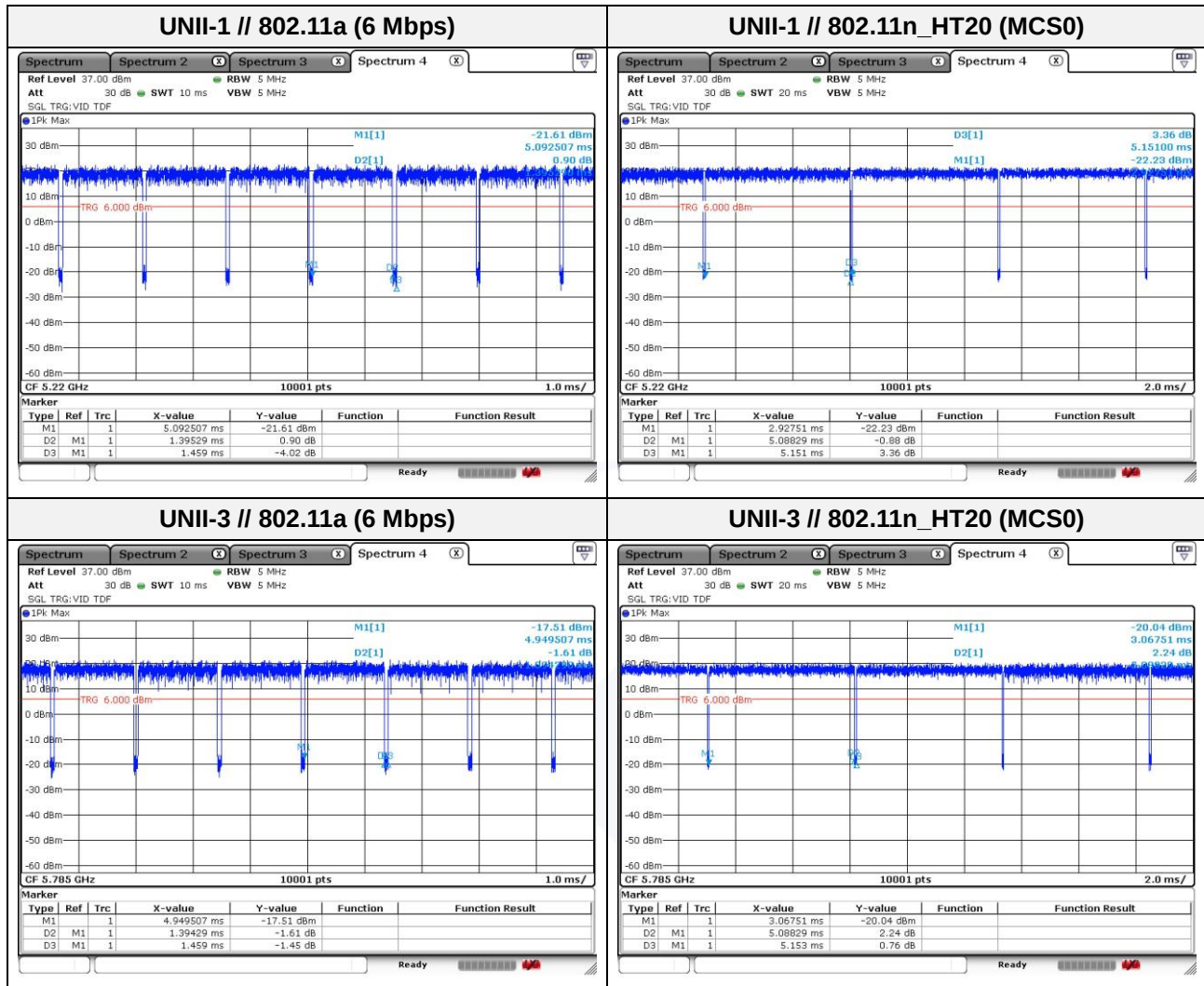
For the band 5.725-5.85 GHz

Test mode	T _{on} time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
802.11a	1.39	1.46	0.95	95.21	0.22
802.11n_HT20	5.09	5.15	0.99	98.83	-

Note:

Duty cycle (Linear) = T_{on} time/Period

DCF(Duty cycle correction factor (dB)) = $10\log(1/\text{duty cycle})$

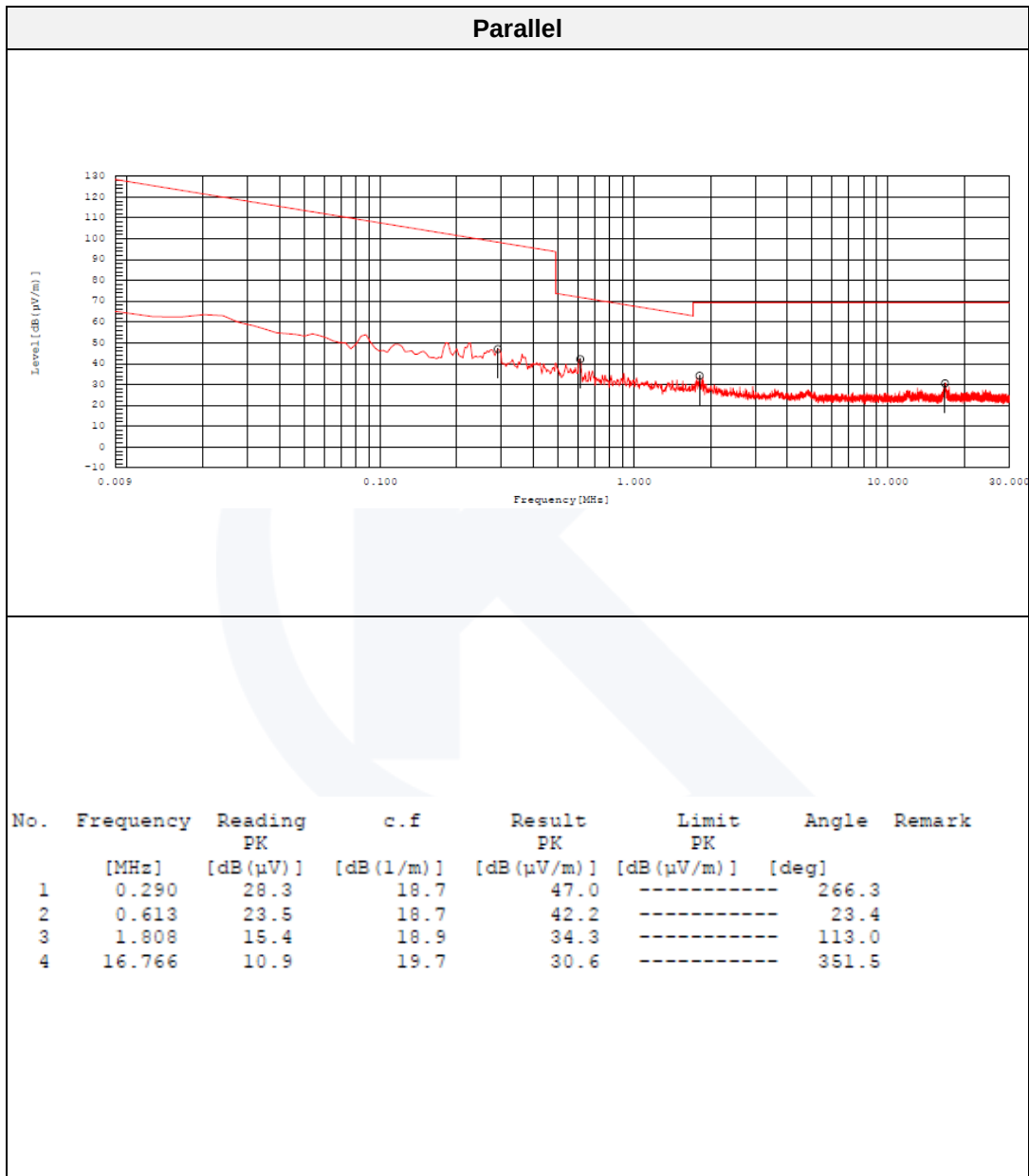


Note.

1. Tested with the maximum duty that can be set on the EUT.

**Test results (Below 30 MHz)**

Band UNII-1
Mode 802.11a (6 Mbps)
Distance of measurement: 3 meter
Channel 36 (Worst Case)

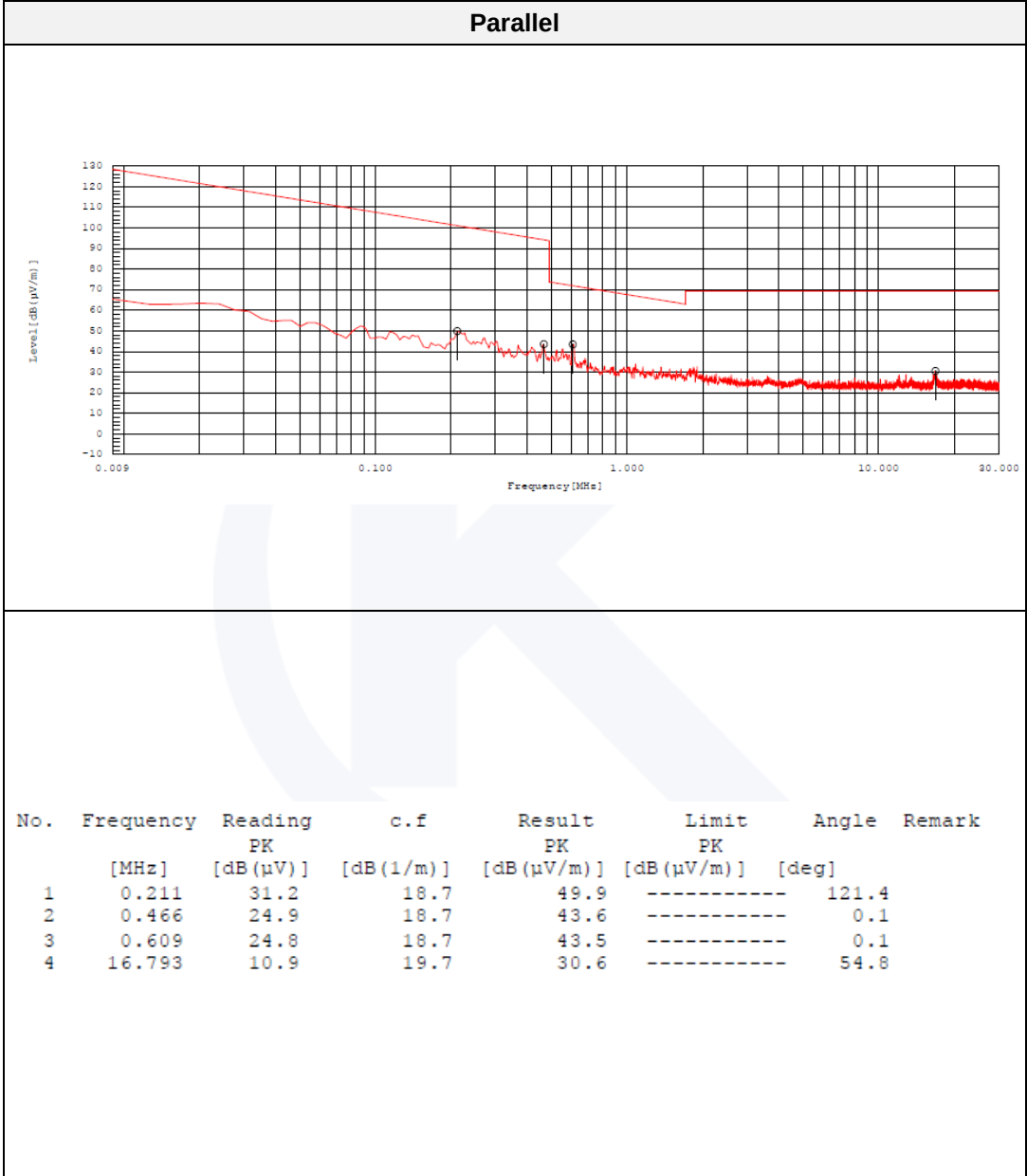


Note.

1. No spurious emission were detected under 30 MHz, Above data is peak result.



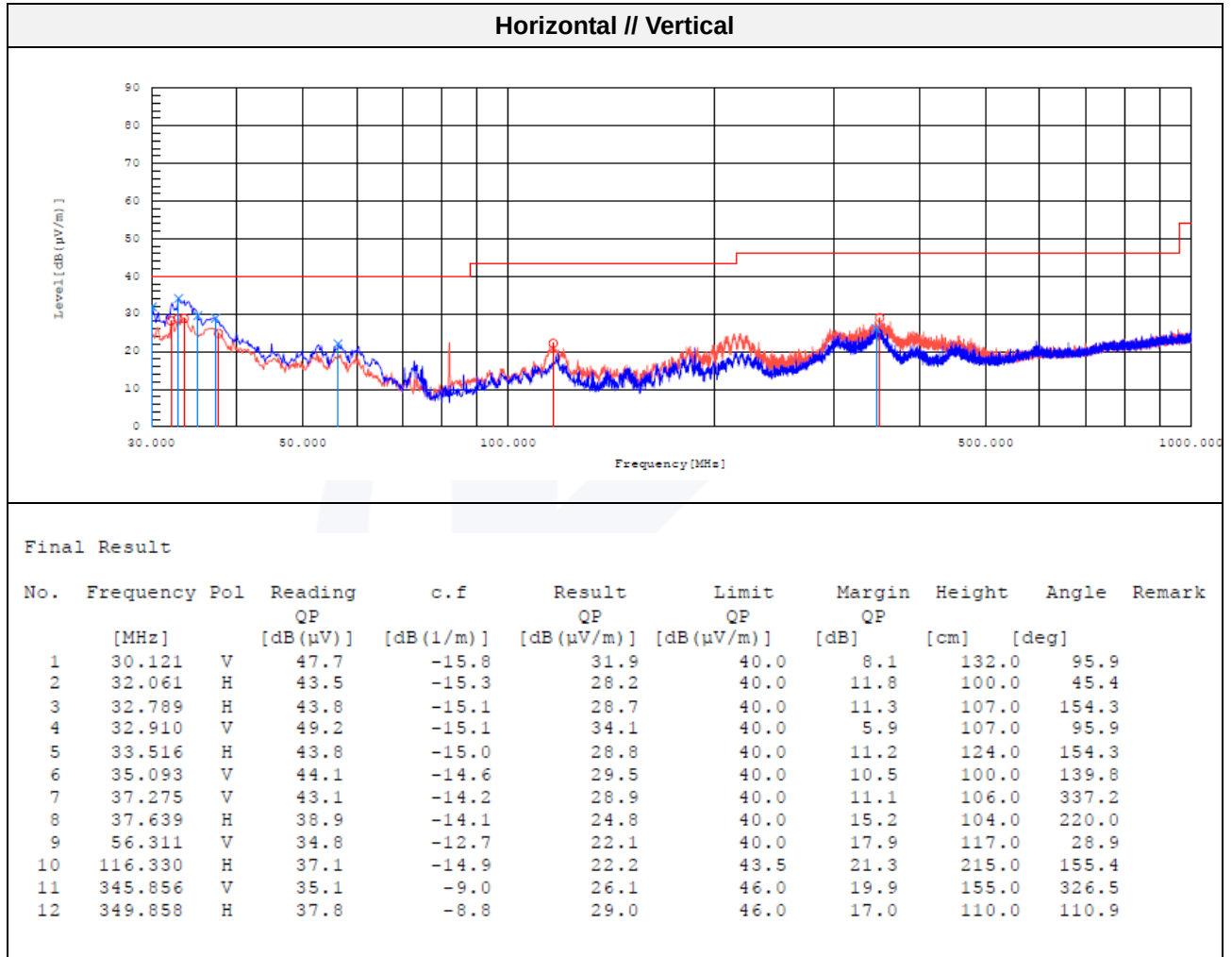
Band UNII-3
Mode 802.11n_HT20 (MCS0)
Distance of measurement: 3 meter
Channel 149 (Worst Case)



Note.
1. No spurious emission were detected under 30 MHz, Above data is peak result.

**Test results (Below 1 000 MHz)**

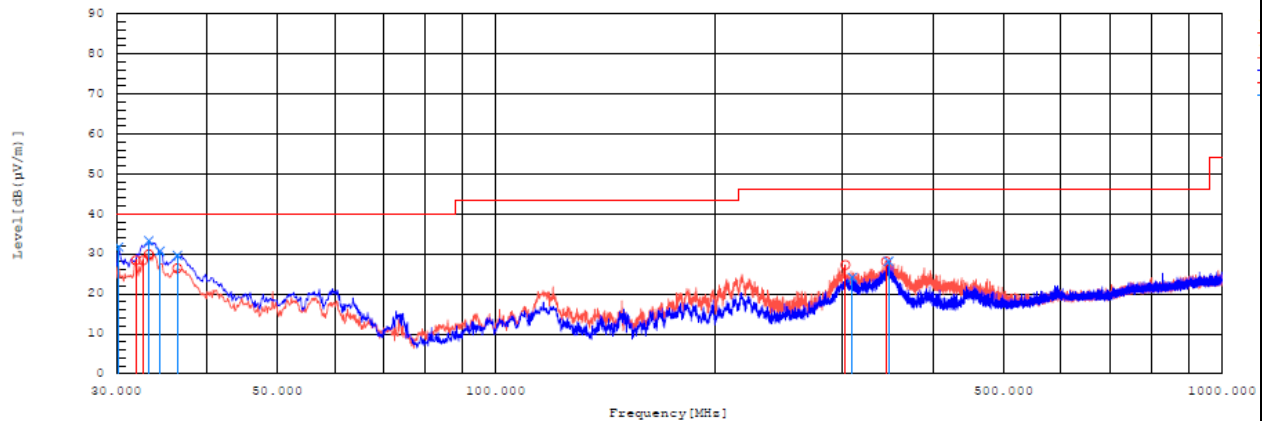
Band UNII-1
Mode 802.11a (6 Mbps)
Distance of measurement: 3 meter
Channel 36 (Worst Case)





Band UNII-3
Mode 802.11n_HT20 (MCS0)
Distance of measurement: 3 meter
Channel 149 (Worst Case)

Horizontal // Vertical



Final Result

No.	Frequency [MHz]	Pol	Reading QP [dB(μV)]	c.f [dB(1/m)]	Result QP [dB(μV/m)]	Limit QP [dB(μV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	30.243	V	47.5	-15.8	31.7	40.0	8.3	104.0	22.6	
2	31.940	H	43.7	-15.3	28.4	40.0	11.6	124.0	315.1	
3	32.667	H	43.6	-15.2	28.4	40.0	11.6	103.0	295.2	
4	33.274	H	44.9	-15.0	29.9	40.0	10.1	100.0	249.1	
5	33.274	V	48.3	-15.0	33.3	40.0	6.7	107.0	27.4	
6	34.486	V	45.5	-14.8	30.7	40.0	9.3	135.0	22.6	
7	36.426	H	40.7	-14.3	26.4	40.0	13.6	110.0	114.6	
8	36.426	V	43.9	-14.3	29.6	40.0	10.4	103.0	198.8	
9	302.813	H	37.9	-10.7	27.2	46.0	18.8	100.0	183.3	
10	309.966	V	34.5	-10.4	24.1	46.0	21.9	153.0	160.8	
11	344.765	H	37.1	-9.0	28.1	46.0	17.9	110.0	71.4	
12	347.311	V	37.0	-8.9	28.1	46.0	17.9	153.0	269.4	

**Test results (Above 1 000 MHz)**

Mode: 802.11a (6 Mbps)

Distance of measurement: 3 meter

Channel: 36

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 060.74	43.92	Peak	V	-10.32	-	33.60	74.00	40.40
1 170.73	43.67	Peak	H	-9.63	-	34.04	74.00	39.96

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5 143.38	51.84	Peak	H	6.39	-	58.23	74.00	15.77
5 143.38	34.38	Average	H	6.39	0.18	40.95	54.00	13.05
5 144.24	47.51	Peak	V	6.39	-	53.90	74.00	20.10
5 148.36	47.11	Peak	V	6.39	-	53.50	74.00	20.50
5 150.00	50.23	Peak	H	6.39	-	56.62	74.00	17.38
5 150.00	36.36	Average	H	6.39	0.18	42.93	54.00	11.07

