
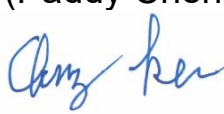


# MEASUREMENT REPORT

## FCC PART 15.247 WLAN 802.11b/g/n/VHT/ax

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**FCC ID:** 2ALJ3AP31X  
**Applicant:** HAN Networks Co., Ltd.  
**Application Type:** Certification  
**Product:** HAN Access Point  
**Model No.:** AP311  
**Brand Name:** HAN NETWORKS; HANNETWORKS  
**FCC Classification:** Digital Transmission System (DTS)  
**FCC Rule Part(s):** Part 15 Subpart C (Section 15.247)  
**Test Procedure(s):** ANSI C63.10-2013  
**Test Date:** August 24 ~ November 11, 2020

**Reviewed By:**   
(Paddy Chen)  
**Approved By:**   
(Chenz Ker)



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Taiwan) Co., Ltd.

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## Revision History

Report No.	Version	Description	Issue Date	Note
2010TW0002-U1	Rev. 01	Initial Report	11-12-2020	Valid

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### General Information

<b>Applicant:</b>	HAN Networks Co., Ltd.
<b>Applicant Address:</b>	101-A16, 1st Floor, Building 3, No.9 compound, Yongfeng Road, Haidian District, Beijing, P.R. China
<b>Manufacturer:</b>	HAN Networks Co., Ltd.
<b>Manufacturer Address:</b>	101-A16, 1st Floor, Building 3, No.9 compound, Yongfeng Road, Haidian District, Beijing, P.R. China
<b>Test Site:</b>	MRT Technology (Taiwan) Co., Ltd
<b>Test Site Address:</b>	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C)

### Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Fuxing Rd., Taoyuan, Taiwan ( R.O.C )

- MRT facility is a FCC registered (Reg. No. 291082 and 153292) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film.
- MRT facility is an IC registered (MRT Reg. No. 21723-1) test laboratory with the site description on file at Industry Canada.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (TAF) under the American Association for Laboratory Accreditation Program (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, Taiwan, EU and TELEC Rules.

TAF certificate here



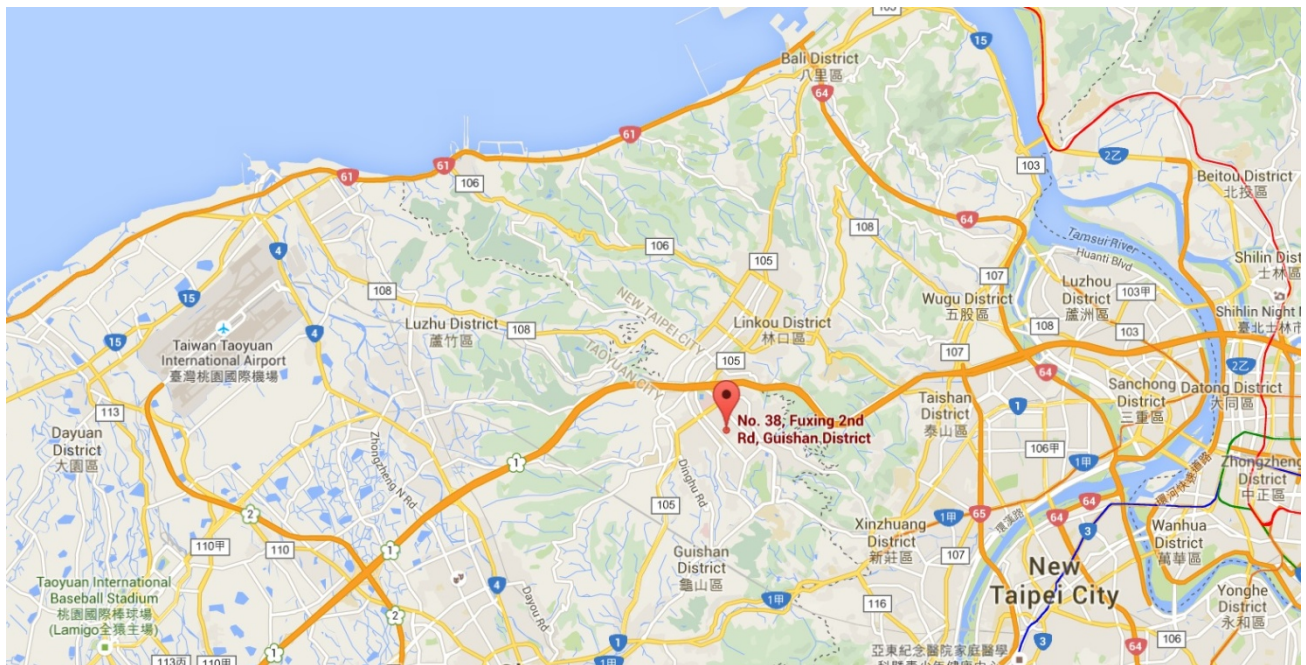
# 1. INTRODUCTION

## 1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada and Certification and Engineering Bureau.

## 1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



## 2. PRODUCT INFORMATION

### 2.1. Feature of Equipment under Test

Product Name:	HAN Access Point
Model No.:	AP311
Wi-Fi Specification:	802.11a/b/g/n/ac/ax
Bluetooth Specification:	v5.1 BLE only
Operating Temperature:	0 ~ 50 °C
Power Type:	PoE input or AC adapter input
Operating Environment:	Indoor Use
EUT Identification No.:	20200824Sample#01 (Conducted) 20200824Sample#02 (Radiated & AC conducted emission)

### 2.2. Product Specification Subjective to this Report

Frequency Range:	802.11b/g/n-HT20/VHT20/ax-HE20: 2412 ~ 2462 MHz 802.11n-HT40/VHT40/ax-HE40: 2422 ~ 2452 MHz
Channel Number:	802.11b/g/n-HT20/VHT20/ax-HE20: 11 802.11n-HT40/VHT40/ax-HE40: 7
Type of Modulation:	802.11b: DSSS; 802.11g/n/VHT: OFDM; 802.11ax: OFDMA
Data Rate:	802.11b: 1/2/5.5/11Mbps 802.11g: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 300Mbps 802.11VHT: up to 400Mbps 802.11ax: up to 573.5Mbps
Scan Antenna	
Frequency Range:	802.11b/g: 2412 ~ 2462 MHz
Channel Number:	802.11b/g: 11
Type of Modulation:	802.11b: DSSS; 802.11g: OFDM
Data Rate:	802.11b: 1/2/5.5/11Mbps; 802.11g: 6/9/12/18/24/36/48/54Mbps

Note: For other features of this EUT, test report will be issued separately.

### 2.3. Working Frequencies for this report

802.11b/g/n-HT20/VHT20/ax-HE20

Channel	Frequency	Channel	Frequency	Channel	Frequency
01	2412 MHz	02	2417 MHz	03	2422 MHz
04	2427 MHz	05	2432 MHz	06	2437 MHz
07	2442 MHz	08	2447 MHz	09	2452 MHz
10	2457 MHz	11	2462 MHz	--	--

802.11n-HT40/VHT40/ax-HE40

Channel	Frequency	Channel	Frequency	Channel	Frequency
03	2422 MHz	04	2427 MHz	05	2432 MHz
06	2437 MHz	07	2442 MHz	08	2447 MHz
09	2452 MHz	--	--	--	--



## 2.4. Description of Available Antennas

Antenna Type	Frequency Band (GHz)	Tx Paths	Bandwidth (MHz)	Max Peak Gain (dBi)		Directional Gain (dBi)		Beamforming Directional Gain (dBi)
				Ant 0	Ant 1	Power	PSD	
Wi-Fi Internal Antenna List (2.4GHz 2*2 MIMO, 5GHz 2*2 MIMO)								
PIFA Antenna	2412 ~ 2462	2	20, 40	3.20	3.30	3.30	6.31	6.26
	5150 ~ 5850	2	20, 40, 80	3.10	3.30	3.30	6.31	6.21
Bluetooth Internal Antenna								
Antenna Type		Frequency Band (GHz)			Max Peak Gain (dBi)			
PIFA Antenna		2400 ~ 2483.5			3.20			
Scan Antenna (1Tx)								
Antenna Type		Frequency Band (GHz)			Max Peak Gain (dBi)			
PIFA Antenna		2412 ~ 2462			3.20			
		5150 ~ 5250			3.30			
		5725~5850			3.30			

Note 1: The EUT supports Cyclic Delay Diversity (CDD) technology for 802.11a/b/g/n/ac/ax and Beam Forming technology for 802.11n/ac/ax.

Note 2: When the EUT supports Cyclic Delay Diversity (CDD) and it is correlated.

If all antennas have the same gain,  $G_{ANT}$ , Directional gain =  $G_{ANT} + \text{Array Gain}$ , where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,  
Array Gain =  $10 \log (N_{ANT} / N_{SS})$  dB = 3.01;
- For power measurements on IEEE 802.11 devices,  
Array Gain = 0 dB for  $N_{ANT} \leq 4$ ;

If antenna gains are not equal, Directional gain may be calculated by using the formulas applicable to equal gain antennas with  $G_{ANT}$  set equal to the gain of the antenna having the highest gain.

Note 3: The EUT also supports Beam Forming mode, and the Beam Forming support 802.11n/ac/ax, not include 802.11a/b/g. The directional gain =  $10 \cdot \log [(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}]$  dBi.

Note 4: Antenna type and antenna gain are provided by the manufacturer.

### 2.5. Description of Antenna RF Port

Antenna RF Port						
Software Control Port	2.4G RF Port		5G RF Port		Scan RF Port	BLE RF Port
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 0
						

## 2.6. Test Mode

Test Mode	Mode 1: Transmit by 802.11b (1Mbps)
	Mode 2: Transmit by 802.11g (6Mbps)
	Mode 3: Transmit by 802.11n-HT20 (MCS0)
	Mode 4: Transmit by 802.11n-HT40 (MCS0)
	Mode 5: Transmit by VHT20 (MCS0)
	Mode 6: Transmit by VHT40 (MCS0)
	Mode 7: Transmit by 802.11ax-HE20 (MCS0)
	Mode 8: Transmit by 802.11ax-HE40 (MCS0)

## 2.7. Test Software

The test utility software used during testing was “QSPR”, and the version was “v50-00186”.

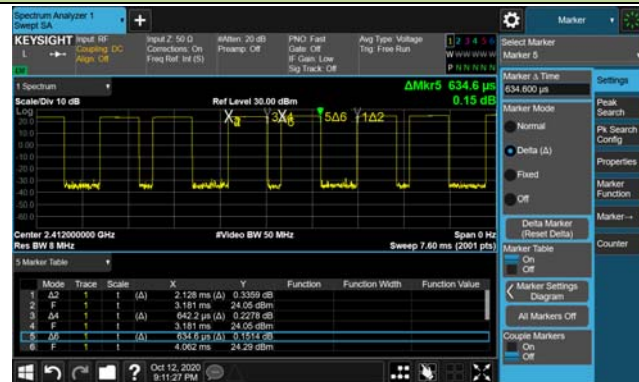
## 2.8. Duty Cycle

2.4GHz WLAN (DTS) operation is possible in 20MHz, and 40MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

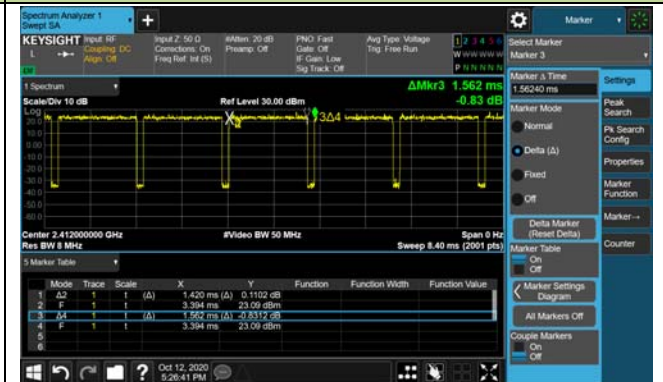
Test Mode	Duty Cycle	
	AP311	Scan Antenna
802.11b	60.0%	99.3%
802.11g	90.9%	96.0%
802.11n-HT20	95.8%	--
802.11n-HT40	90.0%	--
802.11VHT20	95.3%	--
802.11VHT40	94.9%	--
802.11ax-HE20	95.3%	--
802.11ax-HE40	94.0%	--

## Duty Cycle (T = Transmission Duration)

802.11b (T = 1.2768 ms)



802.11g (T = 1.420 ms)



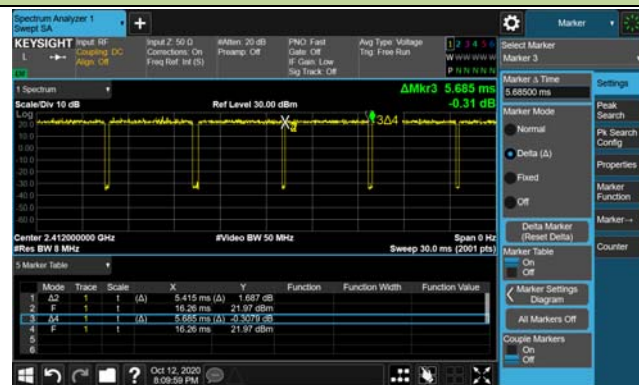
802.11n-HT20 (T = 5.430 ms)



802.11n-HT40 (T = 5.400 ms)

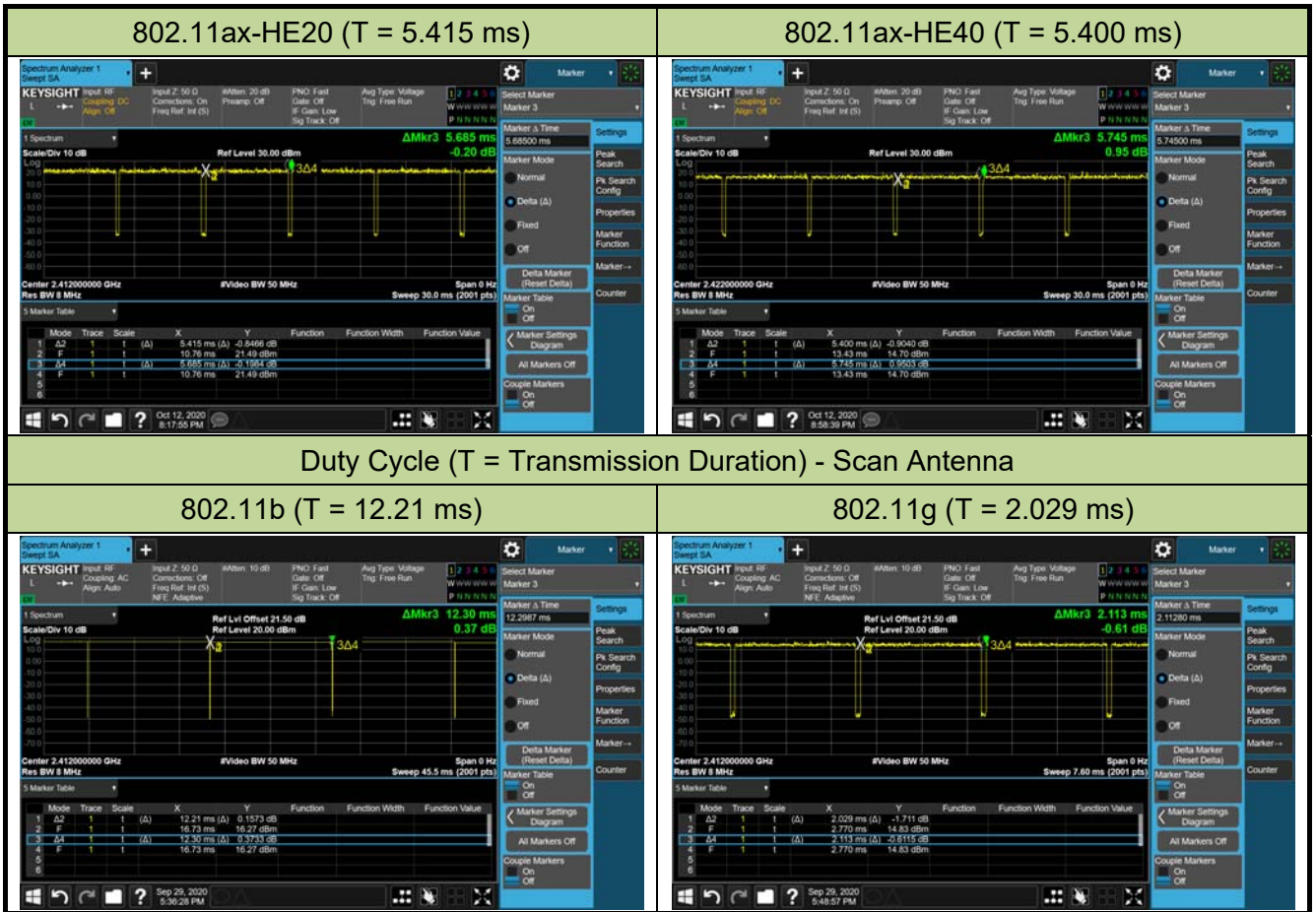


802.11VHT20 (T = 5.415 ms)



802.11VHT40 (T = 5.355 ms)



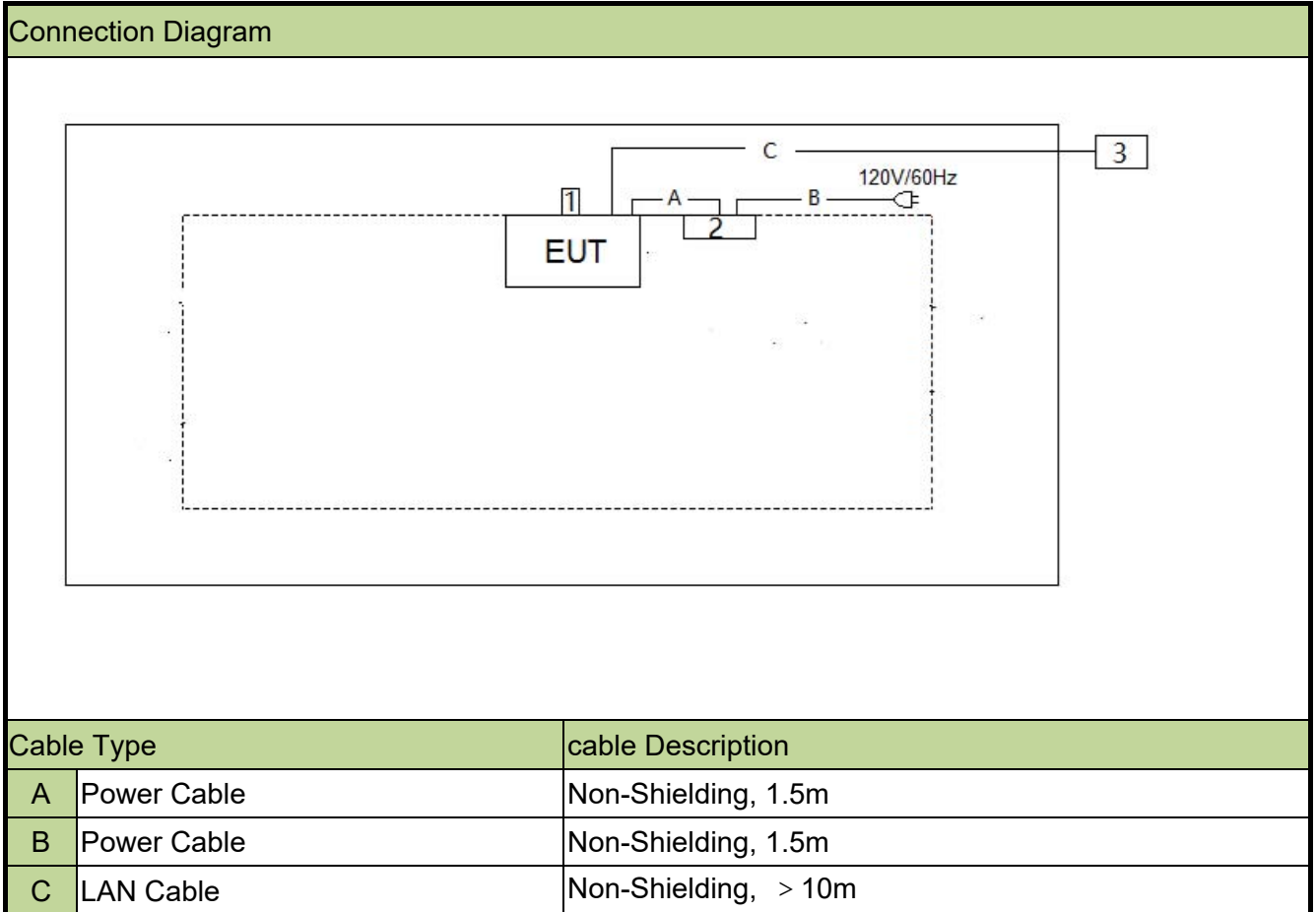


## 2.9. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

## 2.10. Configuration of Tested System

This device was tested per the guidance ANSI C63.10:2013 was used to reference the appropriate EUT setup for radiated emissions testing and AC line conducted testing.



## 2.11. Test System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Power Cord
1	USB Dongle	SanDisk	BL161025264V	N/A
2	AC Adapter	DELTA	ADP-30HR B	1WMD05S00T5
3	Notebook	ASUS	PRO45V	N/A

### 3. ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**

“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 antenna of the device is **permanently attached**.
- There are no provisions for connection to an external antenna.

**Conclusion:**

The unit complies with the requirement of §15.203.



#### 4. TEST EQUIPMENT CALIBRATION DATE

##### Radiated Disturbance :

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2021/10/5
Active Loop Antenna	SCHWARZBECK	FMZB 1519B	MRTTWA00002	1 year	2021/4/27
Broadband Hornantenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2021/4/24
Breitband Hornantenna	SCHWARZBECK	BBHA 9170	MRTTWA00004	1 year	2021/4/24
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2021/4/24
Broadband Amplifier	SCHWARZBECK	BBV 9721	MRTTWA00006	1 year	2021/4/24
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2021/3/24
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2021/3/25
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2021/10/14
EXA Signal Analyzer	KEYSIGHT	N9010B	MRTTWA00074	1 year	2021/7/14
Antenna Cable	HUBERSUHNER	SF106	MRTTWE00010	1 year	2021/6/16
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00032	1 year	2021/5/29
Cable	Rosnol	K1K50-UP0264-K1 K50-4M	MRTTWE00012	1 year	2021/6/21

##### Conducted Emissions :

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Two-Line V-Network	R&S	ENV216	MRTTWA00019	1 year	2021/3/26
Two-Line V-Network	R&S	ENV216	MRTTWA00020	1 year	2021/4/24
8-Wire ISN (T8-Cat6)	R&S	ENY81 CA6	MRTTWA00017	1 year	2021/5/25
8-Wire ISN (T8)	R&S	ENY81	MRTTWA00018	1 year	2021/5/25
8-Wire ISN	TESEQ	CDN ST08AS	MRTTWA00083	1 year	2021/9/2
EMI Test Receiver	R&S	ESR3	MRTTWA00045	1 year	2021/5/26
Conducted Cable	Rosnol	N1C50-RG400-B1C 50-500CM	MRTTWE00013	1 year	2021/6/21
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2021/5/28



## Conducted Test Equipment:

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00014	1 year	2021/4/24
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2021/3/26
Wideband Radio Communication Taster	R&S	CMW 500	MRTTWA00041	1 year	2021/1/7
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2021/10/14
EXA Signal Analyzer	KEYSIGHT	N9010B	MRTTWA00074	1 year	2021/7/14
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2021/3/24
Temperature & Humidity Chamber	TEN BILLION	TTH-B3UP	MRTTWA00036	1 year	2021/6/9
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2021/5/28

Software	Version	Function
e3	9.160520a	EMI Test Software

## 5. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k = 2$ .

<b>AC Conducted Emission Measurement</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): 150kHz~30MHz: 2.53dB
<b>Radiated Emission Measurement</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): 9kHz ~ 1GHz: 4.25dB 1GHz ~ 40GHz: 4.45dB
<b>Conducted Power</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 0.84$ dB
<b>Conducted Spurious Emission</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 2.65$ dB
<b>Occupied Bandwidth</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): 3.3%
<b>Temp. / Humidity</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 0.82^{\circ}\text{C}$ / $\pm 3\%$
<b>Frequency Error</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 78.4$ Hz

## 6. TEST RESULT

### 6.1. Summary

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	6dB Bandwidth	$\geq 500\text{kHz}$	Conducted	Pass	Section 7.2
15.247(b)(3)	Output Power	$\leq 30\text{dBm}$		Pass	Section 7.3
15.247(e)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$		Pass	Section 7.4
15.247(d)	Band Edge / Out-of-Band Emissions	$\leq 30\text{dBc}$ (Average)		Pass	Section 7.5
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 7.6 & 7.7
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.8

#### Notes:

- 1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 2) Output power test was verified over all data rates of each mode (data refers to operational description), and then choose the maximum power output (low data rate) for final test of each channel.
- 3) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
- 4) Test Items "6dB Bandwidth" & "Band Edge / Out-of-Band Emissions" have been assessed MIMO transmission, and showed the worst test data in this report.
- 5) The power setting of CDD & Beam-Forming mode are the same.

## 6.2. 6dB Bandwidth Measurement

### 6.2.1. Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

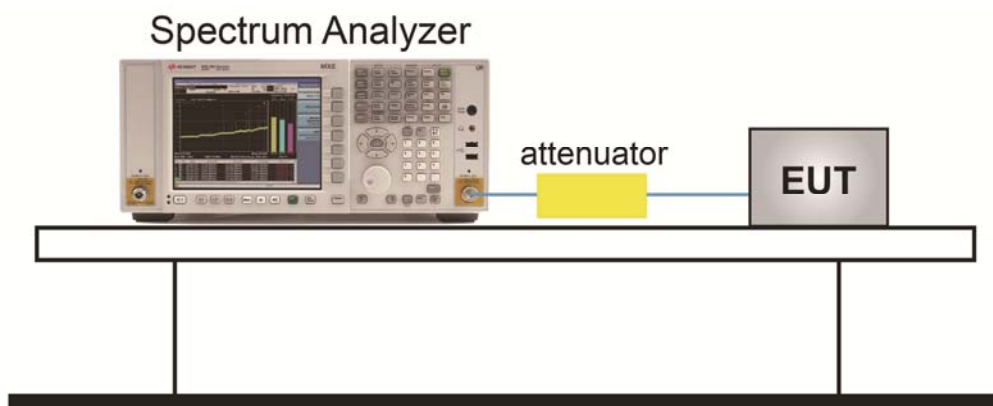
### 6.2.2. Test Procedure used

ANSI C63.10-2013 - Section 11.8.

### 6.2.3. Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to  $X = 6$ . The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3.  $VBW \geq 3 \times RBW$
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

### 6.2.4. Test Setup



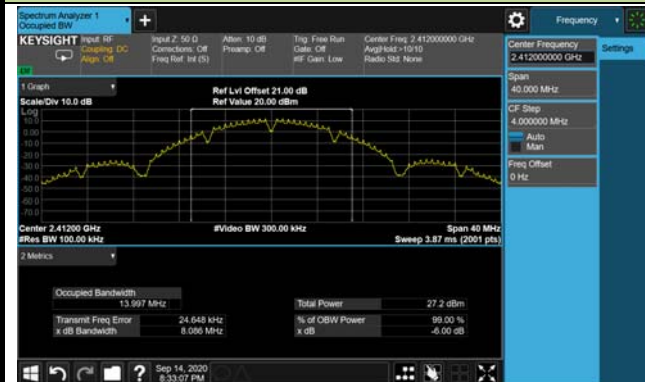
### 6.2.5. Test Result

Product	HAN Access Point	Temperature	23 ~ 25°C
Test Engineer	Kevin Ker	Relative Humidity	46 ~ 54%
Test Site	SR1	Test Date	2020/09/14
Model No.	AP311		

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Ant 0 / Ant 0 + 1						
802.11b	1Mbps	01	2412	8.09	≥ 0.5	Pass
802.11b	1Mbps	06	2437	8.09	≥ 0.5	Pass
802.11b	1Mbps	11	2462	8.56	≥ 0.5	Pass
802.11g	6Mbps	01	2412	15.37	≥ 0.5	Pass
802.11g	6Mbps	06	2437	15.82	≥ 0.5	Pass
802.11g	6Mbps	11	2462	15.89	≥ 0.5	Pass
802.11n-HT20	MCS0	01	2412	17.29	≥ 0.5	Pass
802.11n-HT20	MCS0	06	2437	16.66	≥ 0.5	Pass
802.11n-HT20	MCS0	11	2462	15.31	≥ 0.5	Pass
802.11n-HT40	MCS0	03	2422	35.12	≥ 0.5	Pass
802.11n-HT40	MCS0	06	2437	36.05	≥ 0.5	Pass
802.11n-HT40	MCS0	09	2452	36.34	≥ 0.5	Pass
VHT20	MCS0	01	2412	16.67	≥ 0.5	Pass
VHT20	MCS0	06	2437	17.30	≥ 0.5	Pass
VHT20	MCS0	11	2462	16.28	≥ 0.5	Pass
VHT40	MCS0	03	2422	35.70	≥ 0.5	Pass
VHT40	MCS0	06	2437	36.35	≥ 0.5	Pass
VHT40	MCS0	09	2452	36.00	≥ 0.5	Pass
802.11ax-HE20	MCS0	01	2412	18.57	≥ 0.5	Pass
802.11ax-HE20	MCS0	06	2437	18.53	≥ 0.5	Pass
802.11ax-HE20	MCS0	11	2462	18.62	≥ 0.5	Pass
802.11ax-HE40	MCS0	03	2422	37.12	≥ 0.5	Pass
802.11ax-HE40	MCS0	06	2437	37.54	≥ 0.5	Pass
802.11ax-HE40	MCS0	09	2452	37.81	≥ 0.5	Pass

### 802.11b 6dB Bandwidth

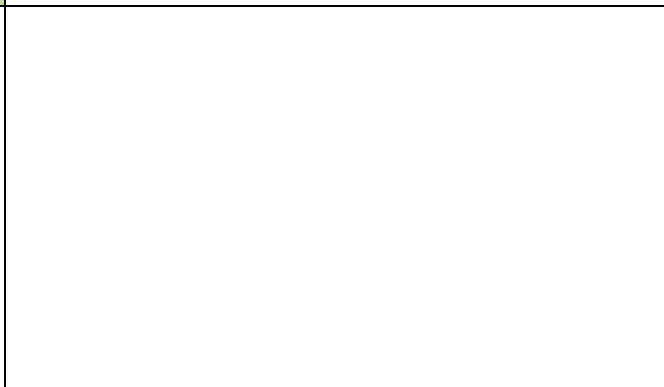
#### Channel 01 (2412MHz)



#### Channel 06 (2437MHz)



#### Channel 11 (2462MHz)

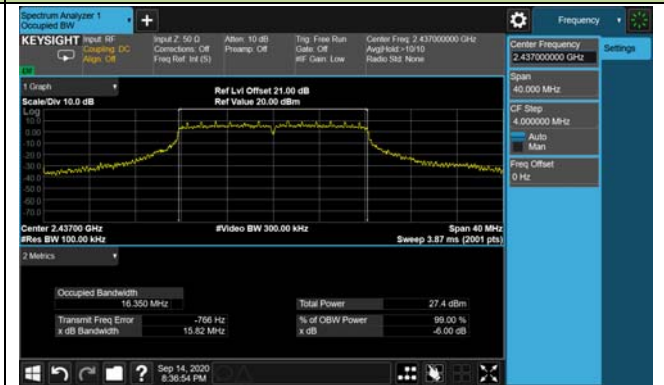


802.11g 6dB Bandwidth

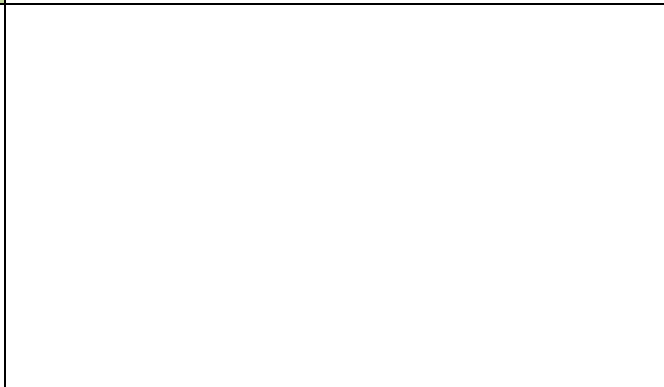
Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)



802.11n-HT20 6dB Bandwidth

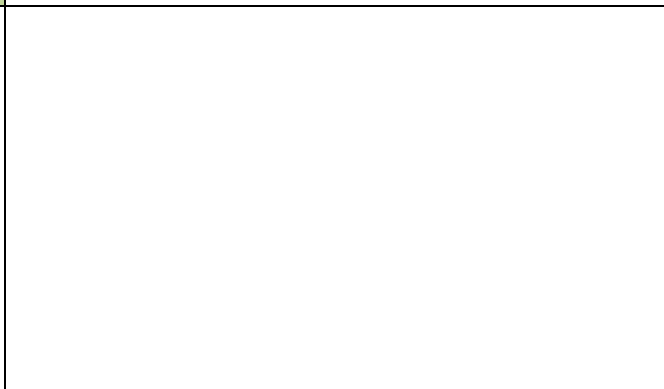
Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)





802.11n-HT40 6dB Bandwidth

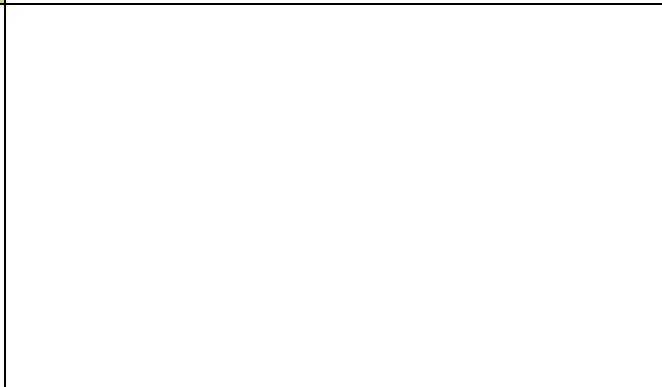
Channel 03 (2422MHz)

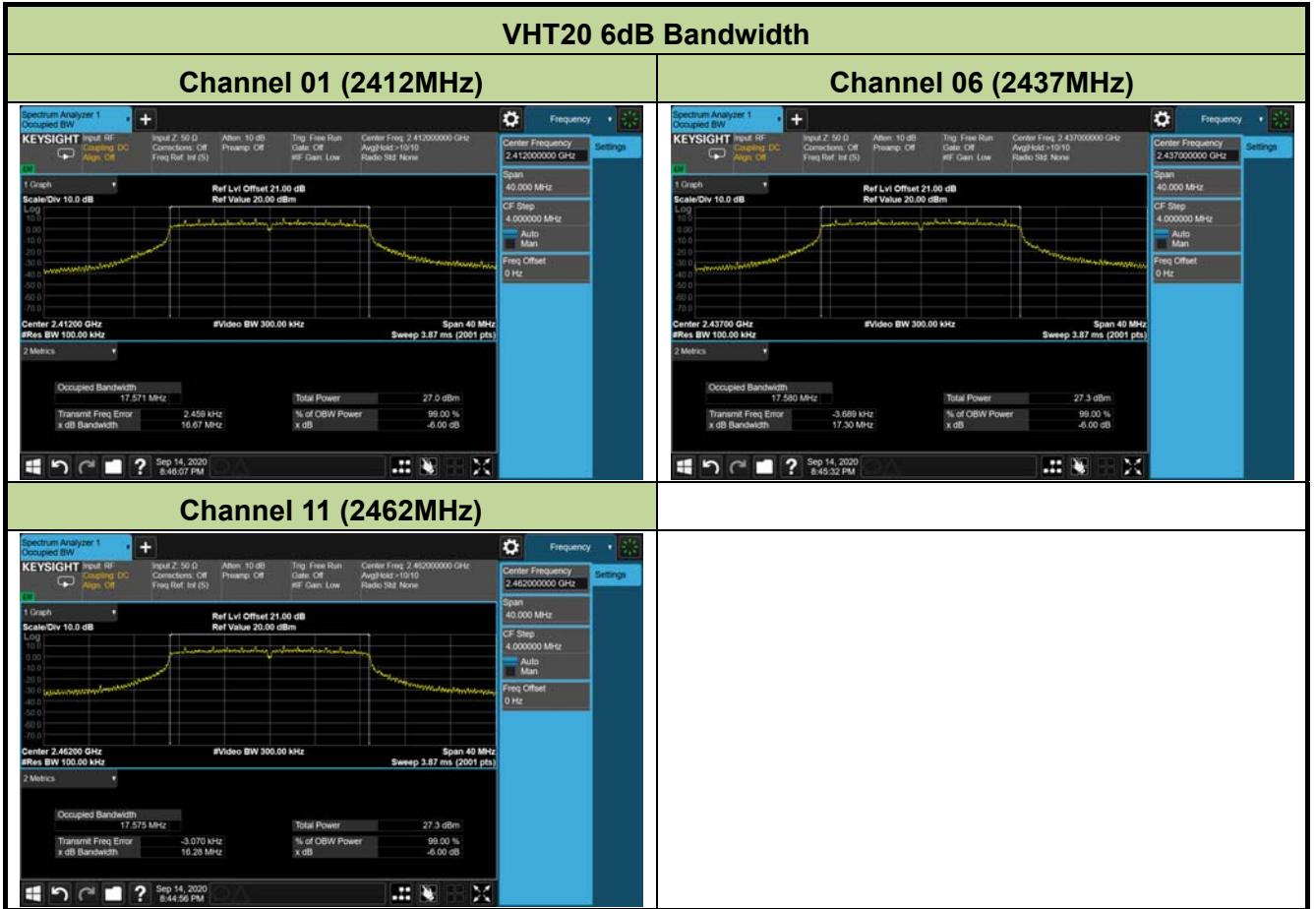


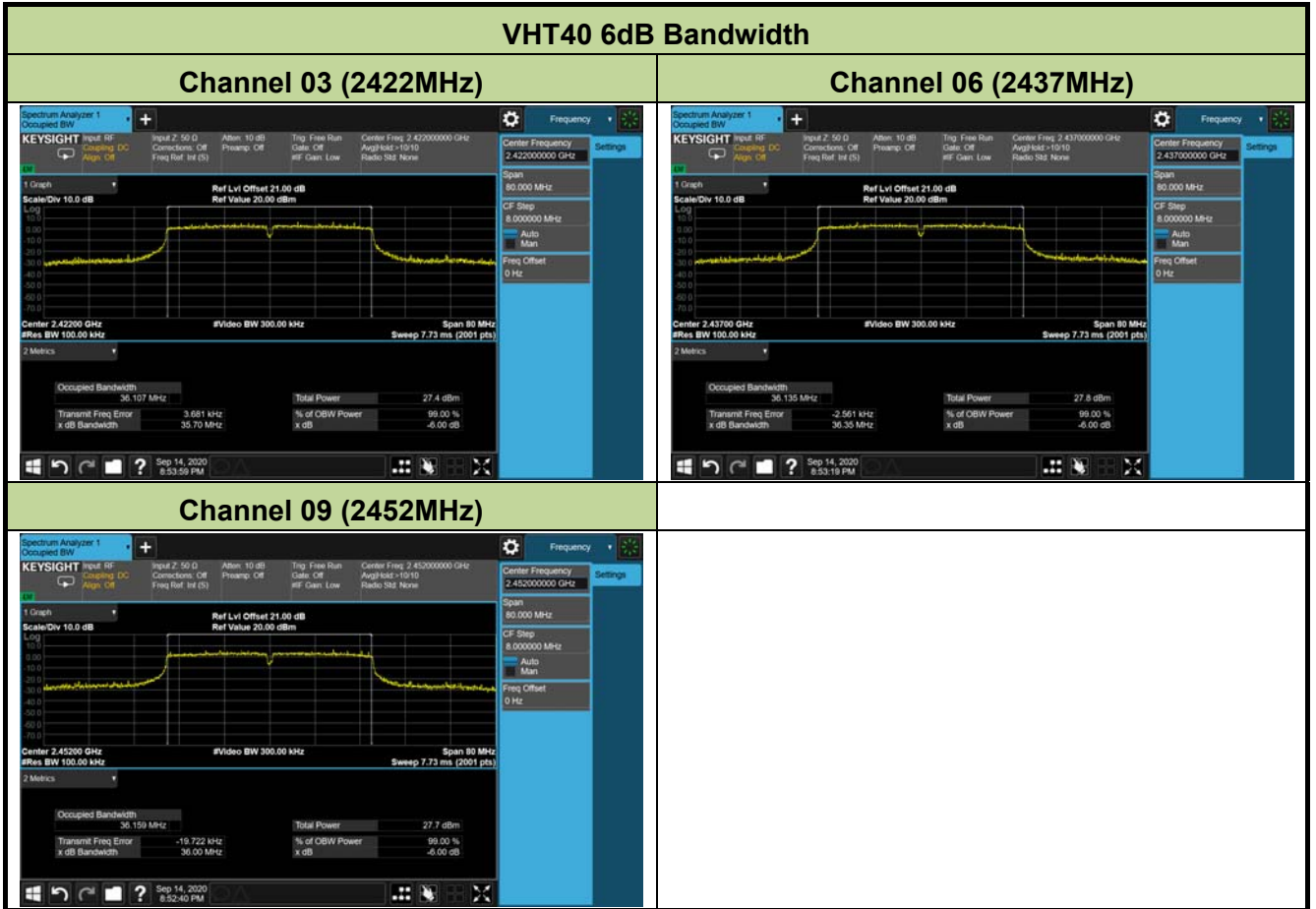
Channel 06 (2437MHz)



Channel 09 (2452MHz)







802.11ax-HE20 6dB Bandwidth

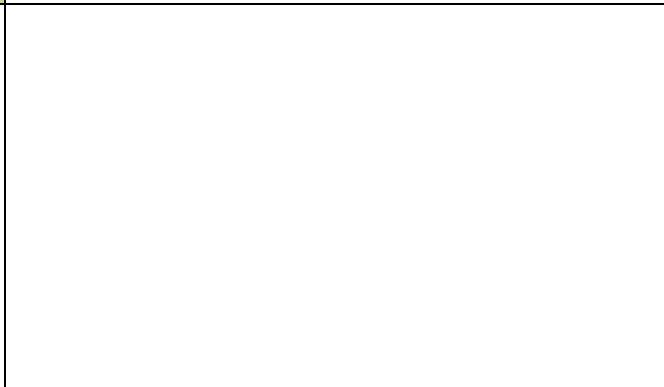
Channel 01 (2412MHz)



Channel 06 (2437MHz)

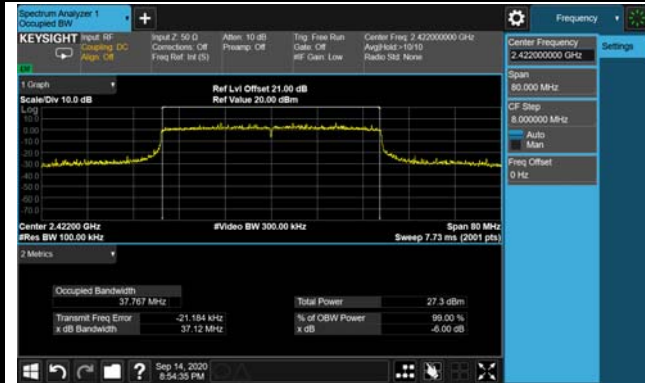


Channel 11 (2462MHz)

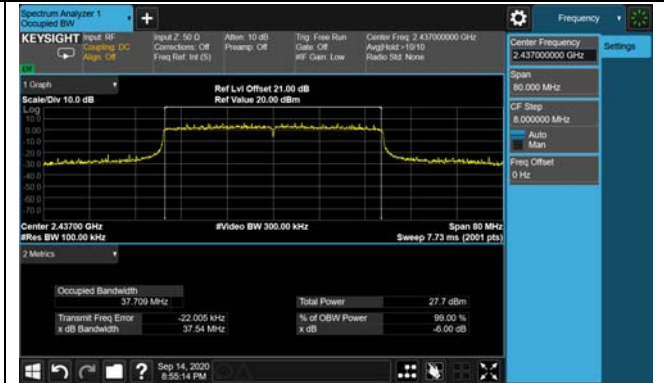


802.11ax-HE40 6dB Bandwidth

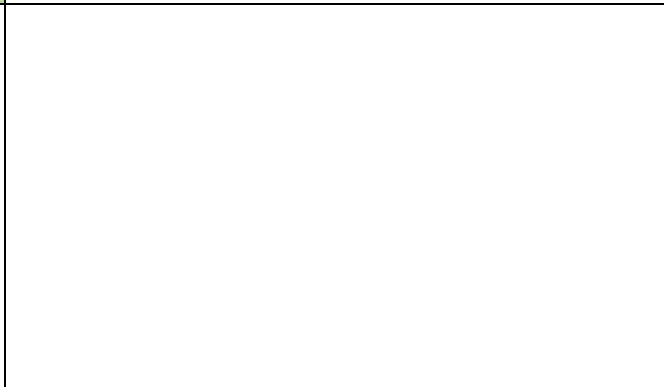
Channel 03 (2422MHz)



Channel 06 (2437MHz)

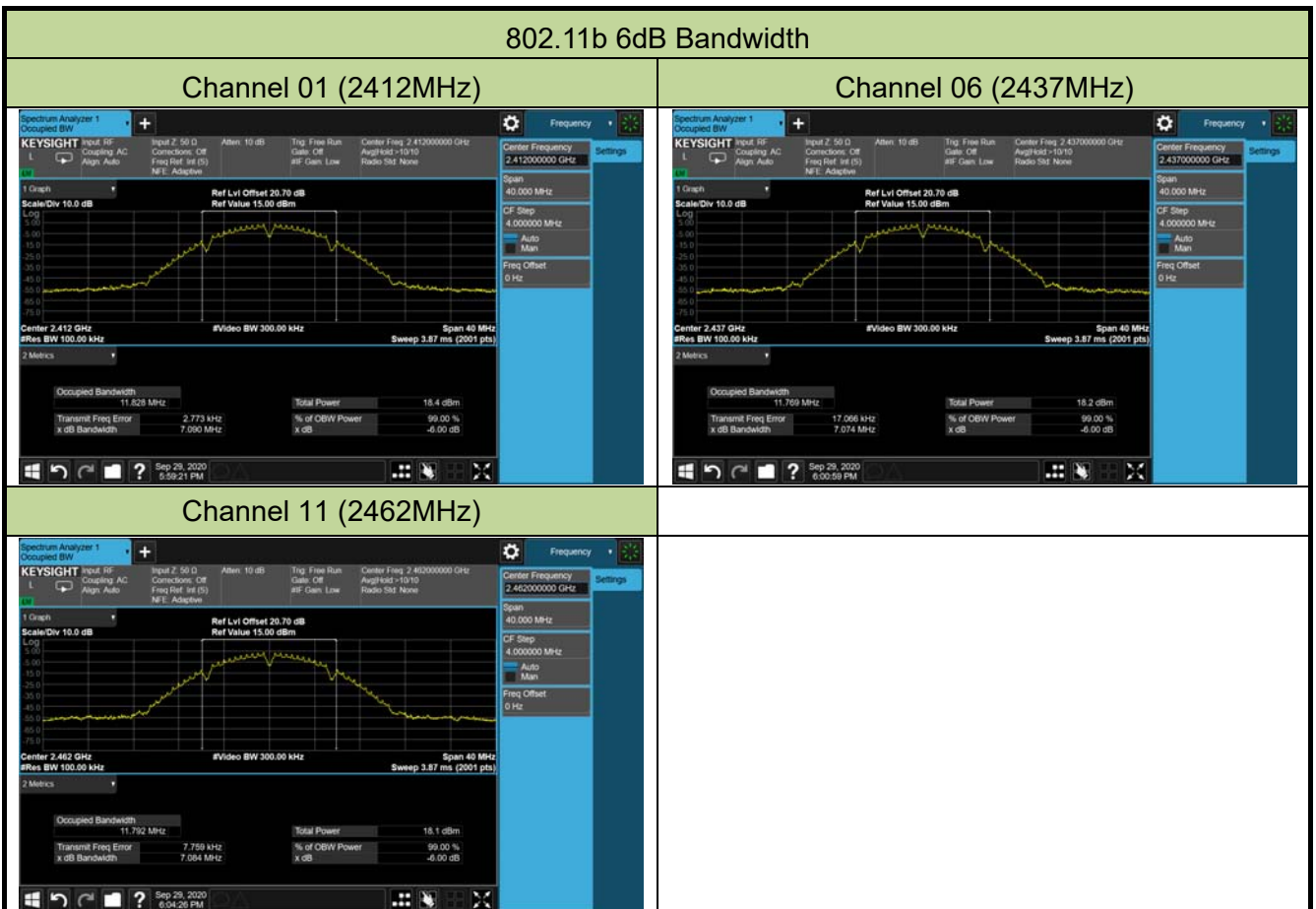


Channel 09 (2452MHz)



Product	AP311	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	52%
Test Site	SR1	Test Date	2020/09/29
Model No.	AP311 - Scan Antenna		

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11b	1Mbps	01	2412	7.09	≥ 0.5	Pass
802.11b	1Mbps	06	2437	7.07	≥ 0.5	Pass
802.11b	1Mbps	11	2462	7.08	≥ 0.5	Pass
802.11g	6Mbps	01	2412	16.35	≥ 0.5	Pass
802.11g	6Mbps	06	2437	16.33	≥ 0.5	Pass
802.11g	6Mbps	11	2462	16.36	≥ 0.5	Pass



802.11g 6dB Bandwidth

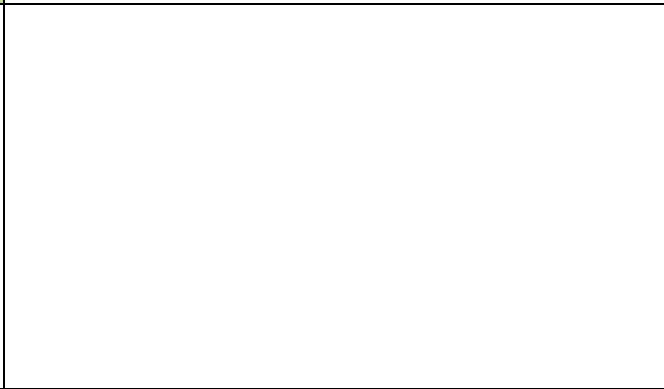
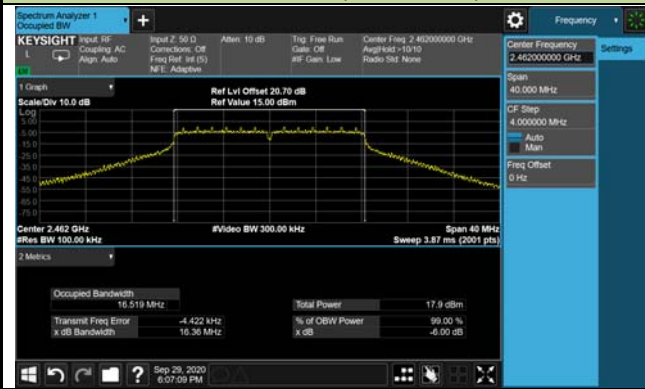
Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)



## 6.3. Output Power Measurement

### 6.3.1. Test Limit

The maximum out power shall be less 1 Watt (30dBm).

The conducted output power limit specified in paragraph FCC Part 15.247(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs FCC Part 15.247(b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 6.3.2. Test Procedure Used

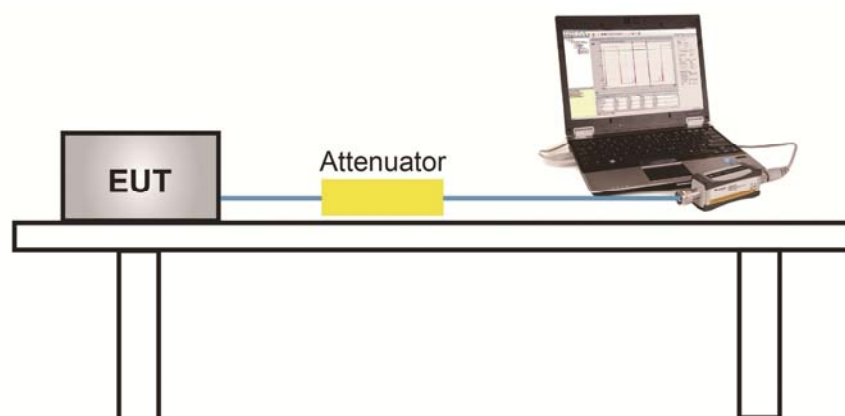
ANSI C63.10-2013 - Section 11.9.2.3

### 6.3.3. Test Setting

#### **Method AVGPM-G (Measurement using a gated RF average-reading 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 this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

### 6.3.4. Test Setup





### 6.3.5. Test Result of Output Power

Power output test was verified over all data rates of each mode shown as below, and then choose the maximum power output (gray marker) for final test of each channel.

Output power at various data rates for Ant 0 / Ant 0+1 port:

Test Mode	Bandwidth (MHz)	Channel No.	Frequency (MHz)	Data Rate/ MCS	Average Power (dBm)
802.11b	20	6	2437	1Mbps	19.93
				5.5Mbps	19.88
				11Mbps	19.79
802.11g	20	6	2437	6Mbps	19.82
				24Mbps	19.74
				54Mbps	19.66
802.11n	20	6	2437	MCS0	19.72
				MCS3	19.59
				MCS7	19.51
802.11n	40	6	2437	MCS0	16.95
				MCS3	16.84
				MCS7	16.75
VHT	20	6	2437	MCS0	19.73
				MCS4	19.62
				MCS9	19.55
VHT	40	6	2437	MCS0	17.03
				MCS4	16.88
				MCS9	16.80
802.11ax	20	6	2437	MCS0	19.78
				MCS5	19.68
				MCS11	19.56
802.11ax	40	6	2437	MCS0	17.03
				MCS5	16.91
				MCS11	16.84

Output power at various data rates for Scan Antenna:

Test Mode	Bandwidth (MHz)	Channel No.	Frequency (MHz)	Data Rate/ MCS	Average Power (dBm)
802.11b	20	6	2437	1Mbps	11.70
				5.5Mbps	11.60
				11Mbps	11.48
802.11g	20	6	2437	6Mbps	11.89
				24Mbps	11.78
				54Mbps	11.65

Product	HAN Access Point	Temperature	23 ~ 25°C
Test Engineer	Kevin Ker	Relative Humidity	44 ~ 52%
Test Site	SR1	Test Date	2020/09/14
Model No.	AP311		

Test Mode	Data Rate/MCS	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Total Average Power (dBm)	Limit (dBm)	Result
11b	1Mbps	01	2412	19.87	19.52	22.71	≤ 30.00	Pass
11b	1Mbps	06	2437	19.93	19.37	22.67	≤ 30.00	Pass
11b	1Mbps	11	2462	19.80	19.47	22.65	≤ 30.00	Pass
11g	6Mbps	01	2412	19.67	19.63	22.66	≤ 30.00	Pass
11g	6Mbps	06	2437	19.82	19.38	22.62	≤ 30.00	Pass
11g	6Mbps	11	2462	19.82	19.51	22.68	≤ 30.00	Pass
11n-HT20	MCS0	01	2412	19.53	19.33	22.44	≤ 30.00	Pass
11n-HT20	MCS0	06	2437	19.72	19.24	22.50	≤ 30.00	Pass
11n-HT20	MCS0	11	2462	19.66	19.36	22.52	≤ 30.00	Pass
11n-HT40	MCS0	03	2422	15.41	15.22	18.33	≤ 30.00	Pass
11n-HT40	MCS0	06	2437	16.95	16.84	19.91	≤ 30.00	Pass
11n-HT40	MCS0	09	2452	14.44	14.11	17.29	≤ 30.00	Pass
VHT20	MCS0	01	2412	18.51	18.35	21.44	≤ 30.00	Pass
VHT20	MCS0	06	2437	19.73	19.28	22.52	≤ 30.00	Pass
VHT20	MCS0	11	2462	17.13	16.79	19.97	≤ 30.00	Pass
VHT40	MCS0	03	2422	15.44	15.22	18.34	≤ 30.00	Pass
VHT40	MCS0	06	2437	17.03	16.73	19.89	≤ 30.00	Pass
VHT40	MCS0	09	2452	14.41	14.16	17.30	≤ 30.00	Pass
11ax-HE20	MCS0	01	2412	17.67	17.28	20.49	≤ 30.00	Pass
11ax-HE20	MCS0	06	2437	19.78	19.68	22.74	≤ 30.00	Pass
11ax-HE20	MCS0	11	2462	16.65	16.20	19.44	≤ 30.00	Pass
11ax-HE40	MCS0	03	2422	14.97	14.68	17.84	≤ 30.00	Pass
11ax-HE40	MCS0	06	2437	17.03	16.83	19.94	≤ 30.00	Pass
11ax-HE40	MCS0	09	2452	13.96	13.55	16.77	≤ 30.00	Pass

Note: Total Average Power (dBm) =  $10 \cdot \log_{10} [10^{(\text{Ant 0 Average Power} / 10)} + 10^{(\text{Ant 1 Average Power} / 10)}]$  (dBm).

Product	AP311	Temperature	23 ~ 25°C
Test Engineer	Kevin Ker	Relative Humidity	44 ~ 52%
Test Site	SR1	Test Date	2020/09/29
Model No.	AP311 Scan Antenna		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Peak Power (dBm)	Average Power (dBm)	Total Power (dBm)	Limit (dBm)	Result
11b	1Mbps	01	2412	14.69	11.67	16.45	≤ 30.00	Pass
11b	1Mbps	06	2437	14.77	11.70	16.51	≤ 30.00	Pass
11b	1Mbps	11	2462	14.43	11.41	16.19	≤ 30.00	Pass
11g	6Mbps	01	2412	16.31	11.79	17.62	≤ 30.00	Pass
11g	6Mbps	06	2437	16.47	11.89	17.77	≤ 30.00	Pass
11g	6Mbps	11	2462	16.12	11.34	17.37	≤ 30.00	Pass

## **6.4. Power Spectral Density Measurement**

### **6.4.1. Test Limit**

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

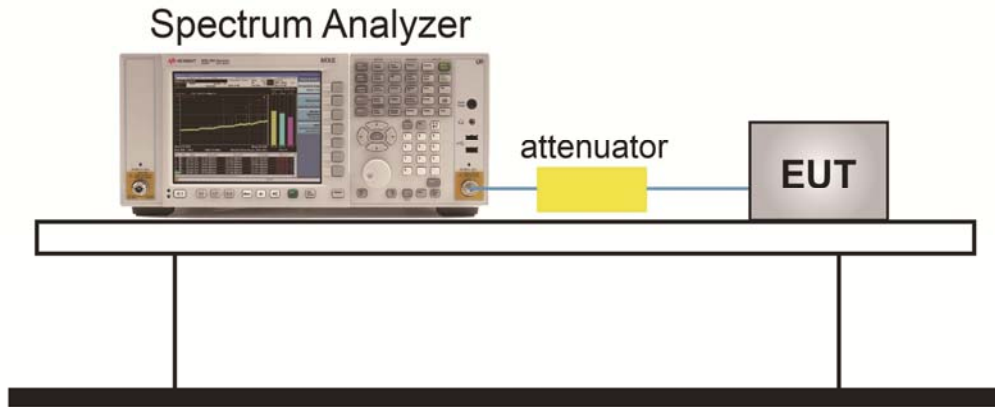
### **6.4.2. Test Procedure Used**

ANSI C63.10 Section 11.10.6

### **6.4.3. Test Setting**

1. Measure the duty cycle (x) of the transmitter output signal
2. Set instrument center frequency to DTS channel center frequency.
3. Set span to at least 1.5 times the OBW.
4. RBW = 10kHz
5. VBW = 30kHz
6. Detector = RMS
7. Ensure that the number of measurement points in the sweep  $\geq 2 \times \text{span}/\text{RBW}$ .
8. Sweep time = auto couple
9. Don't use sweep triggering. Allow sweep to "free run".
10. Employ trace averaging (RMS) mode over a minimum of 100 traces.
11. Use the peak marker function to determine the maximum amplitude level.
12. Add  $10 \log (1/x)$ , where x is the duty cycle measured in step (a), to the measured PSD to compute the average PSD during the actual transmission time.

### 6.4.4. Test Setup



### 6.4.5. Test Result

Product	HAN Access Point	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	52%
Test Site	SR1	Test Date	2020/10/15~2020/10/19
Model No.	AP311		

Test Mode	Data Rate/MCS	Channel No.	Freq. (MHz)	Ant 0 AVGPDS (dBm / 10kHz)	Ant 1 AVGPDS (dBm / 10kHz)	Duty Cycle (%)	Total Peak PSD (dBm / 10kHz)	Limit (dBm / 3kHz)	Result
11b	1Mbps	01	2412	-6.67	-6.25	60.0	-1.23	≤ 7.69	Pass
11b	1Mbps	06	2437	-6.56	-6.78	60.0	-1.44	≤ 7.69	Pass
11b	1Mbps	11	2462	-6.18	-6.58	60.0	-1.15	≤ 7.69	Pass
11g	6Mbps	01	2412	-9.01	-8.85	90.9	-5.50	≤ 7.69	Pass
11g	6Mbps	06	2437	-8.27	-8.84	90.9	-5.12	≤ 7.69	Pass
11g	6Mbps	11	2462	-8.64	-9.24	90.9	-5.50	≤ 7.69	Pass
11n-HT20	MCS0	01	2412	-10.02	-9.89	95.8	-6.76	≤ 7.69	Pass
11n-HT20	MCS0	06	2437	-9.32	-9.92	95.8	-6.41	≤ 7.69	Pass
11n-HT20	MCS0	11	2462	-9.71	-9.76	95.8	-6.54	≤ 7.69	Pass
11n-HT40	MCS0	03	2422	-16.97	-17.10	90.0	-13.57	≤ 7.69	Pass
11n-HT40	MCS0	06	2437	-15.45	-15.37	90.0	-11.94	≤ 7.69	Pass
11n-HT40	MCS0	09	2452	-17.74	-18.21	90.0	-14.50	≤ 7.69	Pass
VHT20	MCS0	01	2412	-11.83	-11.26	95.3	-8.32	≤ 7.69	Pass
VHT20	MCS0	06	2437	-9.70	-9.60	95.3	-6.43	≤ 7.69	Pass
VHT20	MCS0	11	2462	-12.68	-12.65	95.3	-9.45	≤ 7.69	Pass
VHT40	MCS0	03	2422	-17.11	-16.93	94.9	-13.78	≤ 7.69	Pass
VHT40	MCS0	06	2437	-15.41	-15.30	94.9	-12.12	≤ 7.69	Pass
VHT40	MCS0	09	2452	-17.87	-18.32	94.9	-14.85	≤ 7.69	Pass
11ax-HE20	MCS0	01	2412	-13.20	-13.01	95.3	-9.88	≤ 7.69	Pass
11ax-HE20	MCS0	06	2437	-10.92	-10.59	95.3	-7.53	≤ 7.69	Pass
11ax-HE20	MCS0	11	2462	-14.06	-14.13	95.3	-10.88	≤ 7.69	Pass
11ax-HE40	MCS0	03	2422	-18.50	-18.32	94.0	-15.13	≤ 7.69	Pass
11ax-HE40	MCS0	06	2437	-16.97	-16.87	94.0	-13.64	≤ 7.69	Pass
11ax-HE40	MCS0	09	2452	-19.63	-19.40	94.0	-16.23	≤ 7.69	Pass

Note: When EUT duty cycle < 98%, Total AVGPDS =  $10 \cdot \log \{ 10^{(\text{Ant 0 AVGPDS}/10)} + 10^{(\text{Ant 1 AVGPDS}/10)} \} + 10 \cdot \log (1/\text{duty cycle})$ .

802.11b PSD - Ant 0 / Ant 0 + 1

Channel 01 (2412MHz)



Channel 06 (2437MHz)



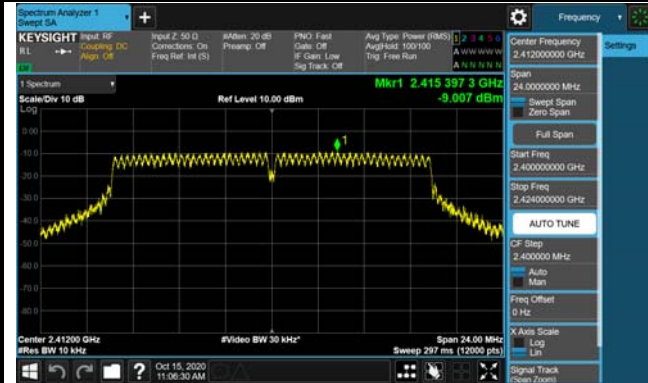
Channel 11 (2462MHz)



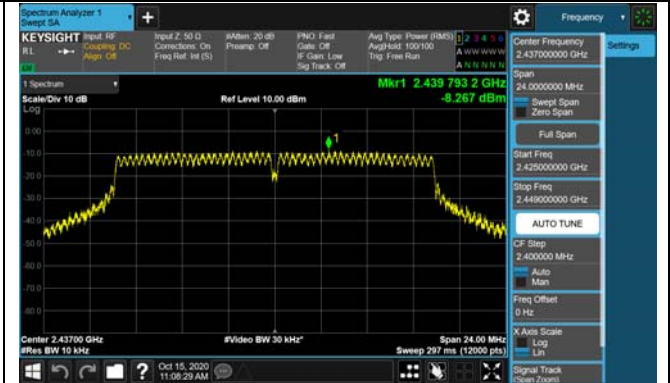


802.11g PSD - Ant 0 / Ant 0 + 1

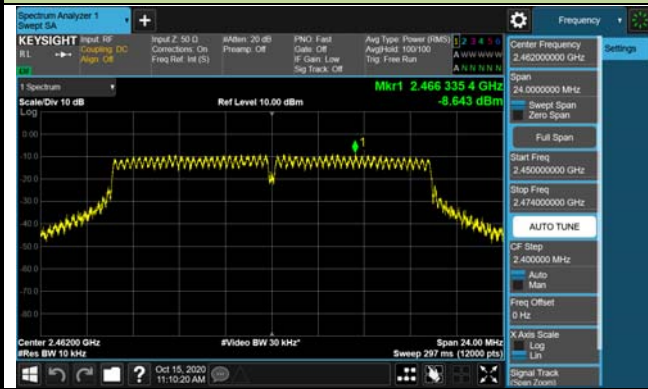
Channel 01 (2412MHz)



Channel 06 (2437MHz)

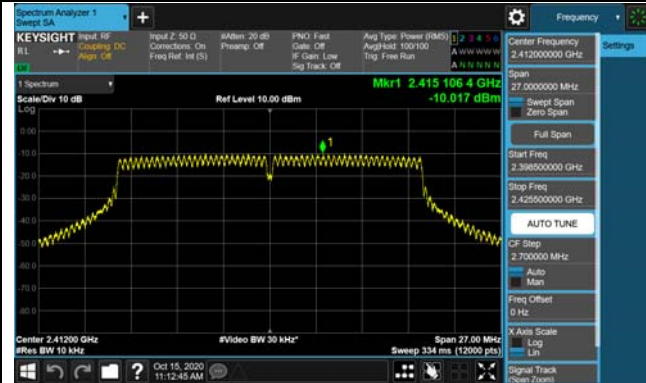


Channel 11 (2462MHz)

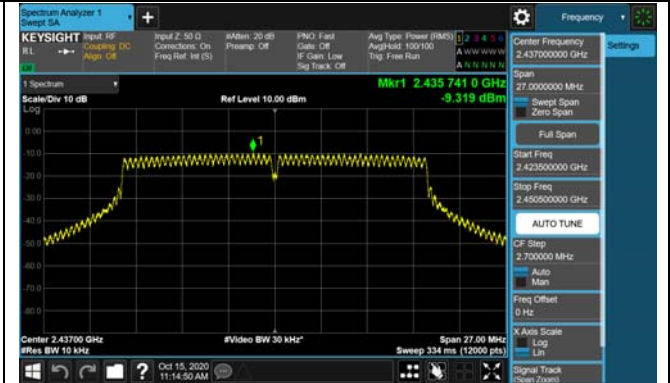


802.11n-HT20 PSD - Ant 0 / Ant 0 + 1

Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)

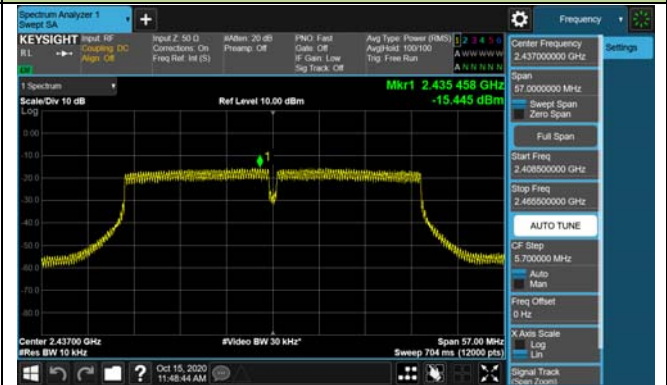


802.11n-HT40 PSD - Ant 0 / Ant 0 + 1

Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)

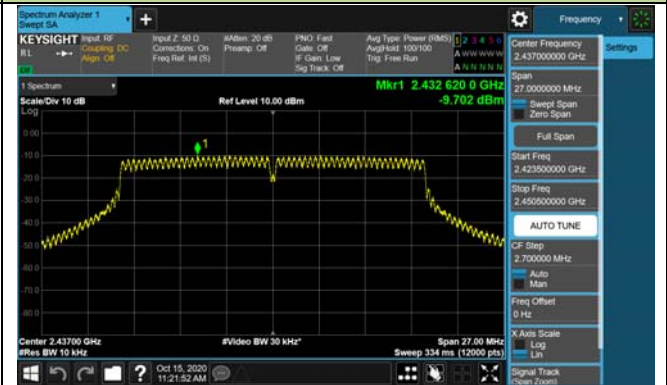


VHT20 PSD - Ant 0 / Ant 0 + 1

Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)



VHT40 PSD - Ant 0 / Ant 0 + 1

Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)



802.11ax-HE20 PSD - Ant 0 / Ant 0 + 1

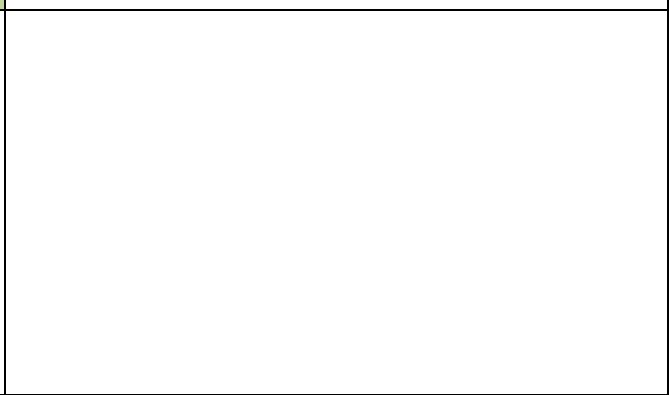
Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)



802.11ax-HE40 PSD - Ant 0 / Ant 0 + 1

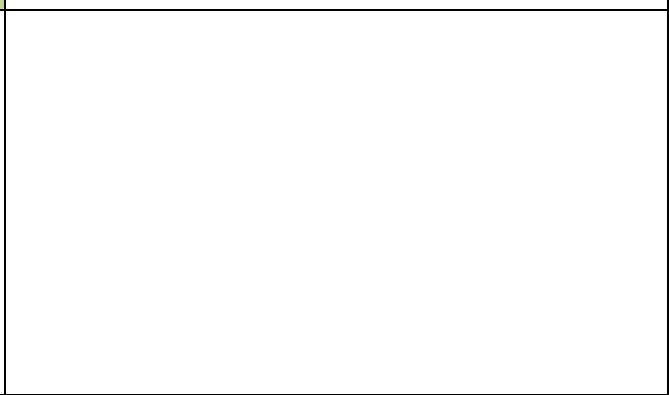
Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)





802.11b PSD - Ant 1 / Ant 0 + 1

Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)



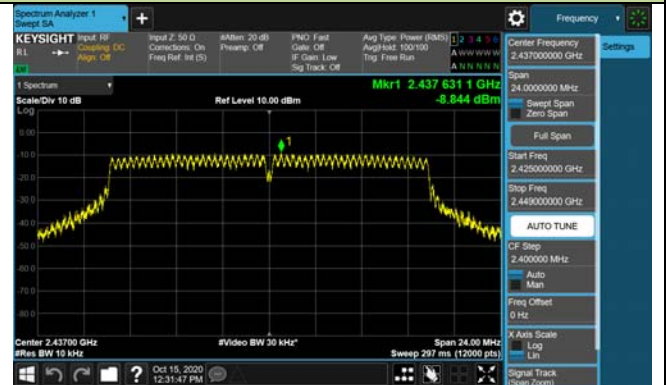


802.11g PSD - Ant 1 / Ant 0 + 1

Channel 01 (2412MHz)



Channel 06 (2437MHz)

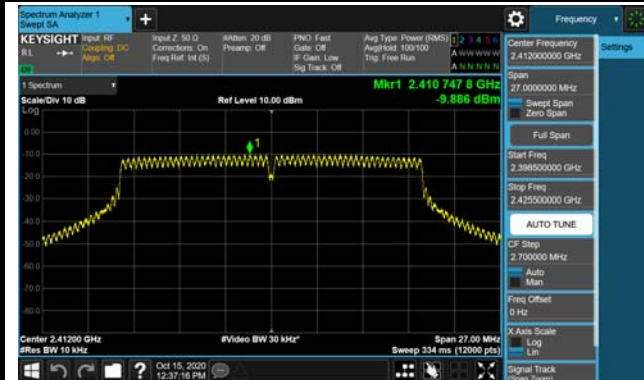


Channel 11 (2462MHz)

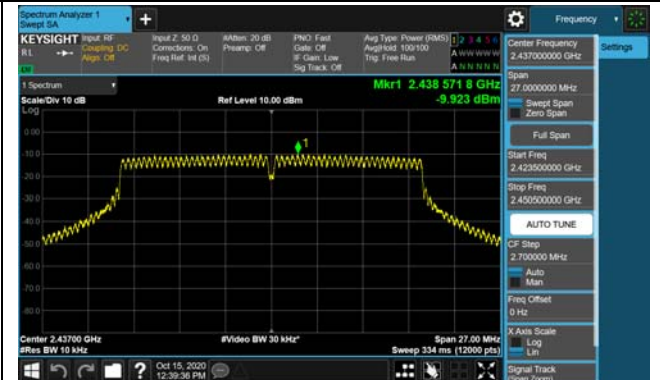


802.11n-HT20 PSD - Ant 1 / Ant 0 + 1

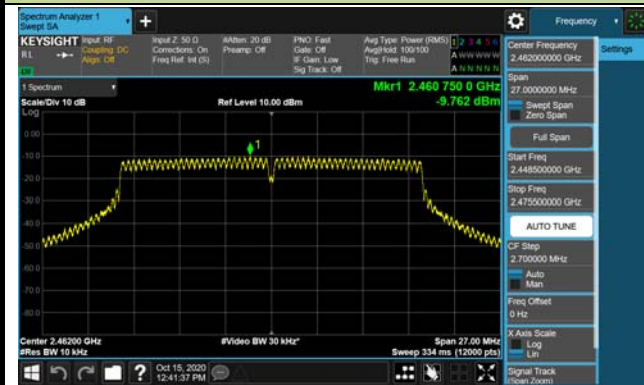
Channel 01 (2412MHz)



Channel 06 (2437MHz)

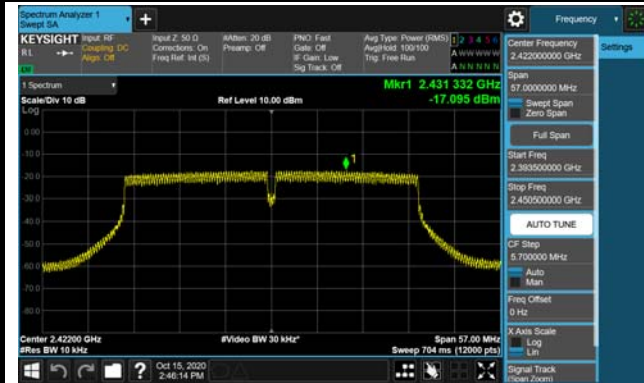


Channel 11 (2462MHz)



802.11n-HT40 PSD - Ant 1 / Ant 0 + 1

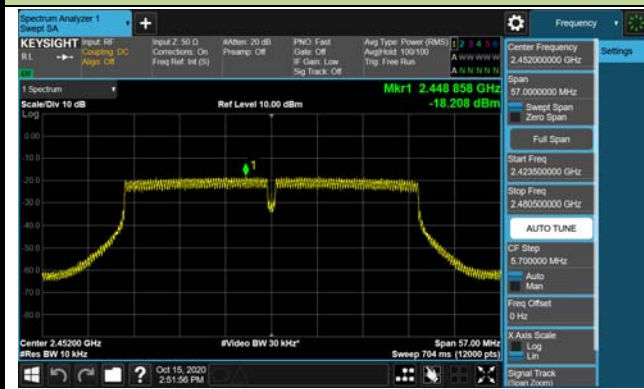
Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)

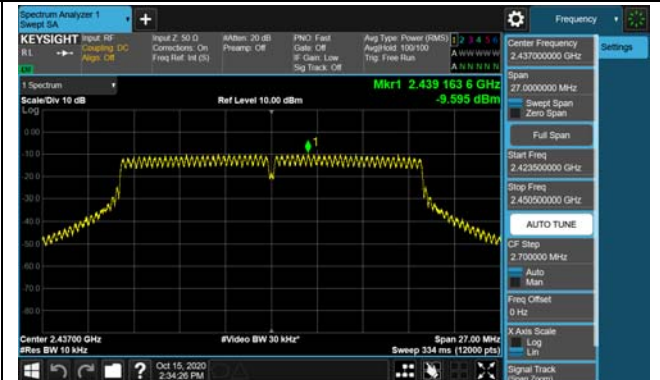


VHT20 PSD - Ant 1 / Ant 0 + 1

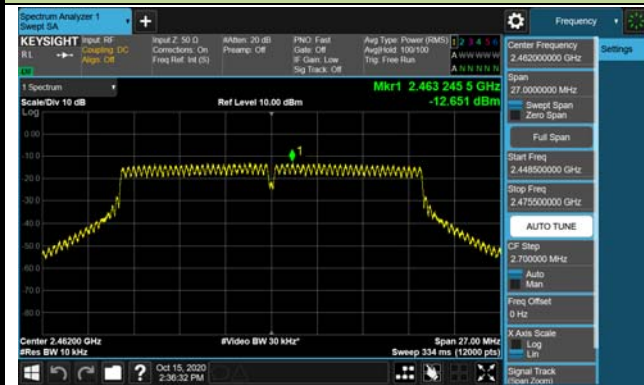
Channel 01 (2412MHz)



Channel 06 (2437MHz)

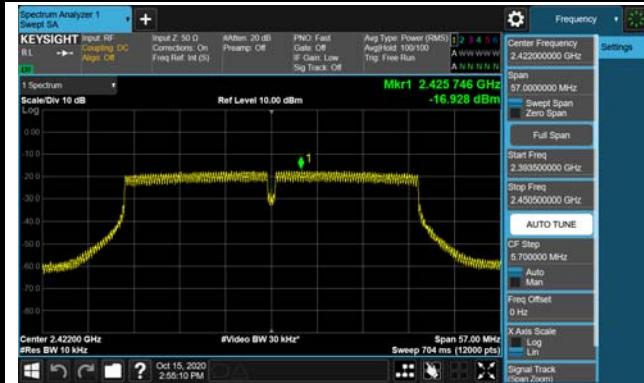


Channel 11 (2462MHz)

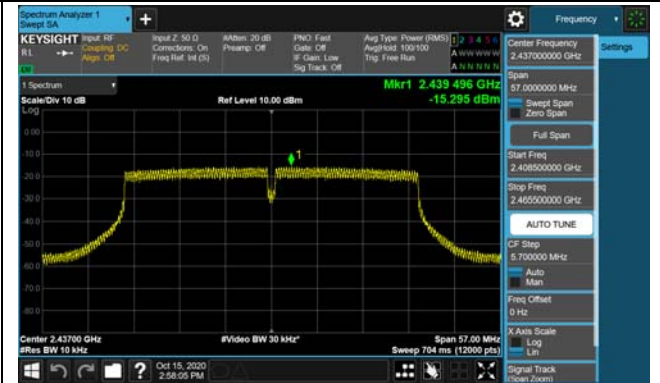


VHT40 PSD - Ant 1 / Ant 0 + 1

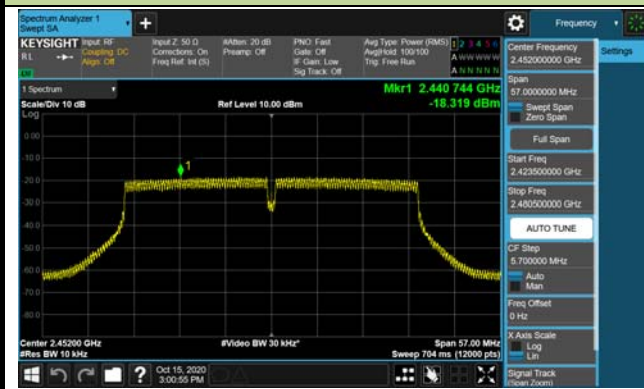
Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)



802.11ax-HE20 PSD - Ant 1 / Ant 0 + 1

Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)



802.11ax-HE40 PSD - Ant 1 / Ant 0 + 1

Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)



Product	AP311	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	52%
Test Site	SR1	Test Date	2020/10/15~2020/10/19
Model No.	Scan Antenna		

Test Mode	Data Rate	Channel No.	Freq. (MHz)	Ant 0 AVGPDS (dBm/10kHz)	Duty Cycle (%)	Total AVGPDS (dBm/10kHz)	Limit (dBm/3kHz)	Result
11b	1Mbps	01	2412	-13.26	99.3%	-13.26	≤ 8.00	Pass
11b	1Mbps	06	2437	-13.63	99.3%	-13.63	≤ 8.00	Pass
11b	1Mbps	11	2462	-13.61	99.3%	-13.61	≤ 8.00	Pass
11g	6Mbps	01	2412	-17.71	96.0%	-17.53	≤ 8.00	Pass
11g	6Mbps	06	2437	-17.89	96.0%	-17.71	≤ 8.00	Pass
11g	6Mbps	11	2462	-18.19	96.0%	-18.01	≤ 8.00	Pass

Note: When EUT duty cycle < 98%, Total AVGPDS = Ant 0 AVGPDS (dBm/10kHz) + 10\*log (1/duty cycle).



802.11b PSD - Ant 0

Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)



802.11g PSD - Ant 0

Channel 01 (2412MHz)



Channel 06 (2437MHz)



Channel 11 (2462MHz)



## **6.5. Conducted Band Edge and Out-of-Band Emissions**

### **6.5.1. Test Limit**

The limit for out-of-band spurious emissions at the band edge is 30dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth per the PSD procedure.

### **6.5.2. Test Procedure Used**

ANSI C63.10 Section 11.11

### **6.5.3. Test Setting**

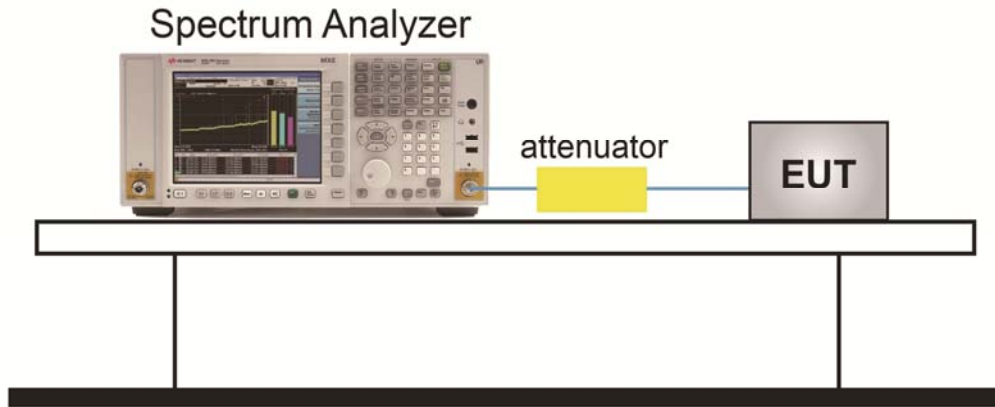
#### **Reference level measurement**

1. Set instrument center frequency to DTS channel center frequency
2. Set the span to  $\geq 1.5$  times the DTS bandwidth
3. Set the RBW = 100 kHz
4. Set the VBW  $\geq 3 \times$  RBW
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Allow trace to fully stabilize

#### **Emission level measurement**

1. Set the center frequency and span to encompass frequency range to be measured
2. RBW = 100kHz
3. VBW = 300kHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

### 6.5.4. Test Setup



### 6.5.5. Test Result

Product	HAN Access Point	Temperature	23 ~ 25°C
Test Engineer	Kevin Ker	Relative Humidity	48 ~ 54%
Test Site	SR1	Test Date	2020/10/15
Model No.	AP311		

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	Limit	Result
11b	1Mbps	01	2412	30dBc	Pass
11b	1Mbps	06	2437	30dBc	Pass
11b	1Mbps	11	2462	30dBc	Pass
11g	6Mbps	01	2412	30dBc	Pass
11g	6Mbps	06	2437	30dBc	Pass
11g	6Mbps	11	2462	30dBc	Pass
11n-HT20	MCS0	01	2412	30dBc	Pass
11n-HT20	MCS0	06	2437	30dBc	Pass
11n-HT20	MCS0	11	2462	30dBc	Pass
11n-HT40	MCS0	03	2422	30dBc	Pass
11n-HT40	MCS0	06	2437	30dBc	Pass
11n-HT40	MCS0	09	2452	30dBc	Pass
VHT20	MCS0	01	2412	30dBc	Pass
VHT20	MCS0	06	2437	30dBc	Pass
VHT20	MCS0	11	2462	30dBc	Pass
VHT40	MCS0	03	2422	30dBc	Pass
VHT40	MCS0	06	2437	30dBc	Pass
VHT40	MCS0	09	2452	30dBc	Pass
11ax-HE20	MCS0	01	2412	30dBc	Pass
11ax-HE20	MCS0	06	2437	30dBc	Pass
11ax-HE20	MCS0	11	2462	30dBc	Pass
11ax-HE40	MCS0	03	2422	30dBc	Pass
11ax-HE40	MCS0	06	2437	30dBc	Pass
11ax-HE40	MCS0	09	2452	30dBc	Pass

802.11b Out-of-Band Emissions - Ant 0 / Ant 0 + 1

Channel 01 (2412MHz)

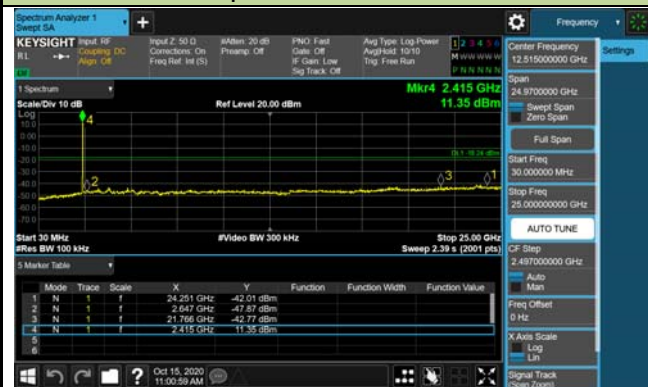
100kHz PSD reference Level



Low Band Edge



Spurious Emission



Channel 06 (2437MHz)

100kHz PSD reference Level



Spurious Emission



Channel 11 (2462MHz)

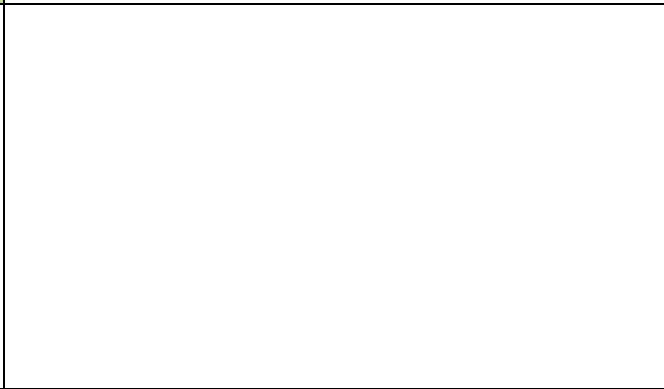
100kHz PSD reference Level



High Band Edge



Spurious Emission





## 802.11g Out-of-Band Emissions- Ant 0 / Ant 0 + 1

## Channel 01 (2412MHz)

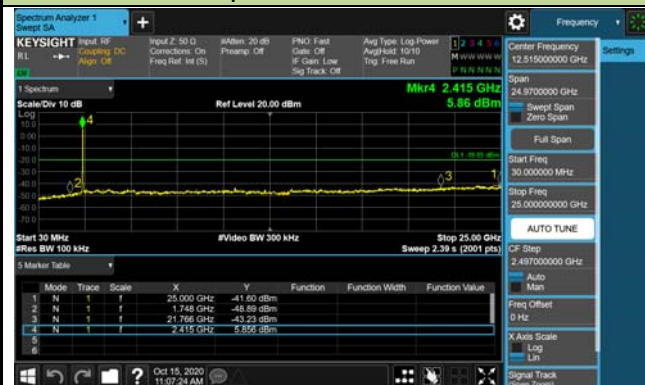
## 100kHz PSD reference Level



## Low Band Edge



## Spurious Emission



## Channel 06 (2437MHz)

## 100kHz PSD reference Level



## Spurious Emission





Channel 11 (2462MHz)

100kHz PSD reference Level



High Band Edge



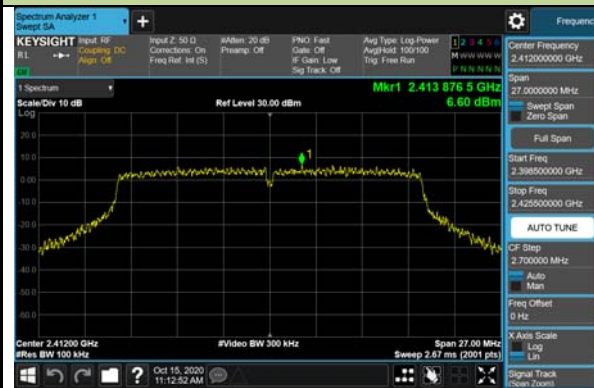
Spurious Emission



802.11n-HT20 Out-of-Band Emissions- Ant 0 / Ant 0 + 1

Channel 01 (2412MHz)

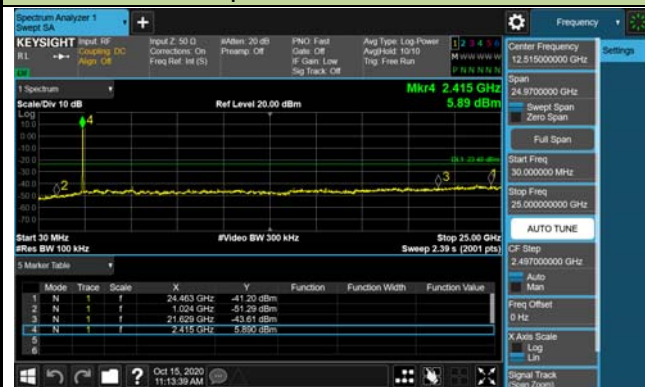
100kHz PSD reference Level



Low Band Edge

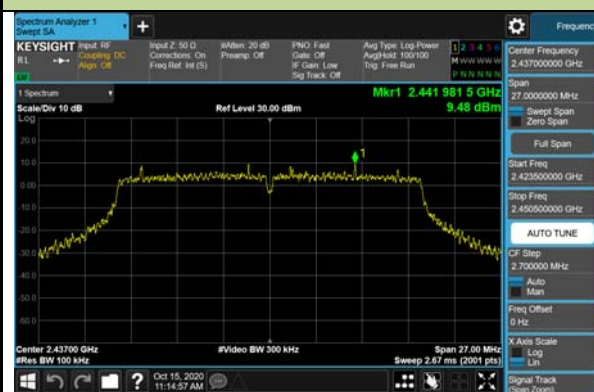


Spurious Emission



Channel 06 (2437MHz)

100kHz PSD reference Level



Spurious Emission



Channel 11 (2462MHz)

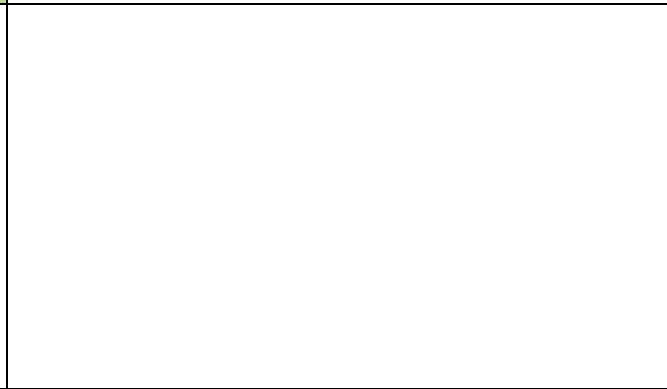
100kHz PSD reference Level



High Band Edge



Spurious Emission



802.11n-HT40 Out-of-Band Emissions- Ant 0 / Ant 0 + 1

Channel 03 (2422MHz)

100kHz PSD reference Level



Low Band Edge



Spurious Emission



Channel 06 (2437MHz)

100kHz PSD reference Level



Spurious Emission



Channel 09 (2452MHz)

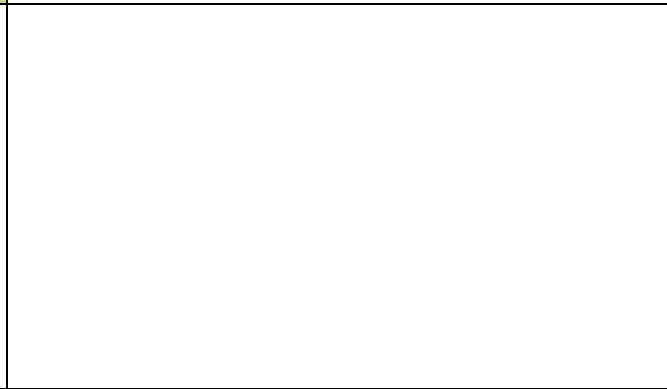
100kHz PSD reference Level



High Band Edge



Spurious Emission

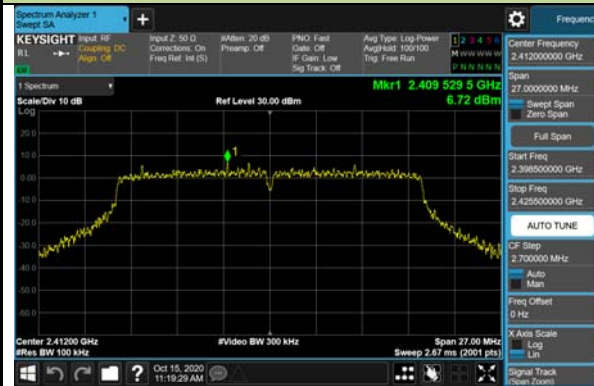




### VHT20 Out-of-Band Emissions- Ant 0 / Ant 0 + 1

#### Channel 01 (2412MHz)

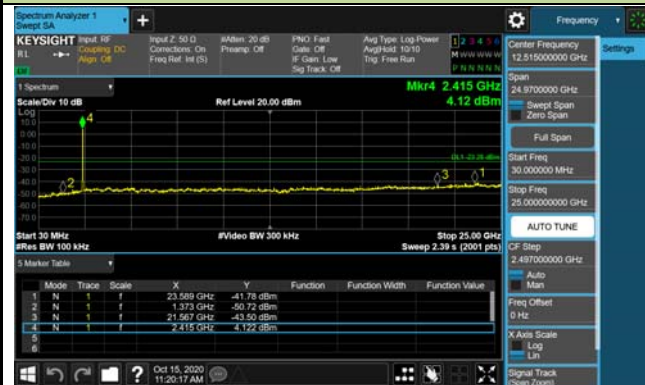
##### 100kHz PSD reference Level



##### Low Band Edge



##### Spurious Emission



#### Channel 06 (2437MHz)

##### 100kHz PSD reference Level



##### Spurious Emission

