

**ELECTROMAGNETIC EMISSIONS
COMPLIANCE REPORT**

Applicant: Handheld Group AB
Strandgatan 40, 531 60 Lidköping Sweden

Manufacturer: Handheld Group AB
Strandgatan 40, 531 60 Lidköping Sweden

Product Name: NAUTIZ X81

Brand Name: Handheld

Model No.: NX81-RF2-A00, NX81-RF0-A00

Model Difference: NX81-RF2-A00 has WWAN+WLAN,
NX81-RF0-A00 only has WLAN

Report Number: TERF2303000624E2

FCC ID YY3-142481

IC: 11695A-142481

Date of EUT Received: March 16, 2023

Date of Test: March 17, 2023~April 26, 2023

Issue Date: May 15, 2023

Approved By _____**Vito Pei****We hereby certify that:**

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.407, ISSED RSS-247.

The results of this report relate only to the sample identified in this report.

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Revision History					
Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2303000624E2	00	Original.	May 15, 2023	Yami Kuo	

Note:

- 1、The remark "*" indicates modification of the report upon requests from certification body.
- 2、Variant information of model numbers is provided by the applicant, test results of this report are applicable to the sample EUT(s) received.

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Contents

1	GENERAL INFORMATION	4
2	SYSTEM TEST CONFIGURATION	7
3	SUMMARY OF TEST RESULT	9
4	DESCRIPTION OF TEST MODES	10
5	MEASUREMENT UNCERTAINTY	12
6	MEASUREMENT EQUIPMENT USED	13
7	CONDUCTED EMISSION TEST	14
8	EMISSION BANDWIDTH MEASUREMENT	18
9	MAXIMUM CONDUCTED OUTPUT POWER MEASUREMENT	30
10	MAXIMUM POWER SPECTRAL DENSITY	40
11	UNDESIRABLE RADIATED EMISSION MEASUREMENT	49
12	TRANSMISSION IN THE ABSENCE OF DATA.....	123
13	ANTENNA REQUIREMENT	124

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	NAUTIZ X81
Brand Name:	Handheld
Model No.:	NX81-RF2-A00, NX81-RF0-A00
Model Difference:	NX81-RF2-A00 has WWAN+WLAN, NX81-RF0-A00 only has WLAN
Hardware Version:	R0.3
Firmware Version:	v001.06.00
EUT Series No.:	TE_SP_20230302243
Power Supply:	5 / 9 / 12 / 15 / 20Vdc from AC Adapter or 3.6Vdc from Lithium-ion Rechargeable Battery
Test Software (Name/Version)	default

1.2 Modulation & Data Rate

Modulation type:	64QAM, 16QAM, QPSK, BPSK for OFDM
	256QAM for OFDM in 802.11ac
Transition Rate:	802.11 a: 6 - 54 Mbps
	802.11 n_20MHz: up to 72.2 Mbps
	802.11 n_40MHz: up to 150 Mbps
	802.11 ac_20MHz: up to 86.7 Mbps
	802.11 ac_40MHz: up to 200 Mbps
	802.11 ac_80MHz: up to 433.3 Mbps

1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)
PRINT	5150~5250	-2.84
	5725~5825	2.00

Note:

1. Antenna information is provided by the applicant.

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1.4 FCC

Wi-Fi	Frequency Range	Channels	Rated Power(Avg) (dBm) (Worst Case)		Modulation Technology
a/ n_HT/ ac_VHT 20M	5180~5240	4	18.52	dBm	OFDM
	5745-5825	5	18.38	dBm	OFDM
n_HT/ ac_VHT 40M	5190~5230	2	18.27	dBm	OFDM
	5755-5795	2	18.15	dBm	OFDM
ac_VHT 80M	5210	1	14.44	dBm	OFDM
	5775	1	19.20	dBm	OFDM

1.5 ISED

Wi-Fi	Frequency Range	Channels	EIRP/Avg	Rated Power(EIRP/Avg) (dBm) (Worst Case)		Modulation Technology
a/ n_HT/ ac_VHT 20M	5180~5240	4	EIRP	15.68	dBm	OFDM
	5745-5825	5	Avg	18.38	dBm	OFDM
n_HT/ ac_VHT 40M	5190~5230	2	EIRP	15.43	dBm	OFDM
	5755-5795	2	Avg	18.15	dBm	OFDM
ac_VHT 80M	5210	1	EIRP	11.60	dBm	OFDM
	5775	1	Avg	19.20	dBm	OFDM

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1.6 Test Methodology of Applied Standards

FCC Part 15, Subpart E §15.407
 FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01
 FCC KDB 662911 D01 Multiple Transmitter Output v02r01
 FCC KDB 291074 D02 EMC Measurement v01
 RSS-247 issue 2 Feb. 2017
 RSS-Gen,issue 5 April, 2018
 ANSI C63.10:2013

1.7 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 2		
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
Conducted G				
Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.				

1.8 Special Accessories

There are no special accessories used while test was conducted.

1.9 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

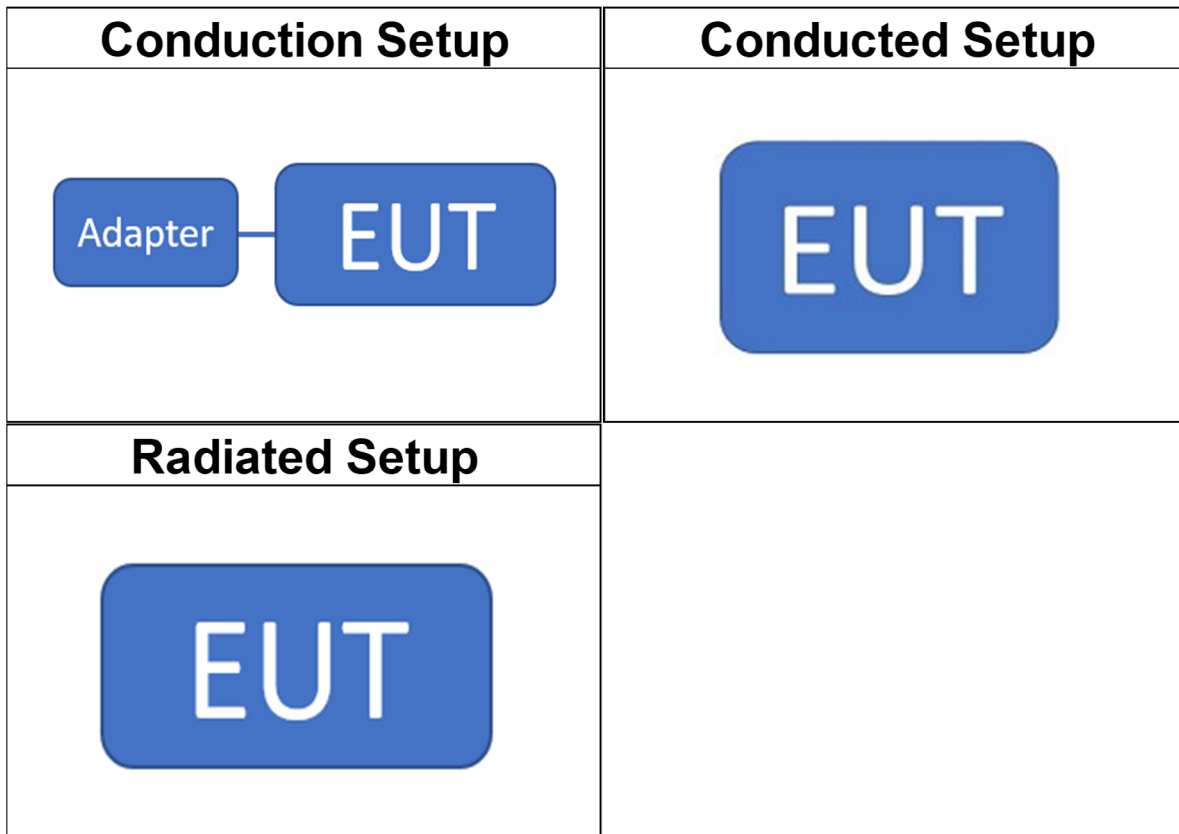
Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

2.5 Test Configuration



2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Adapter	CULLPOWER	TYPE-C45IC	N/A	N.C.R	N.C.R
USB Cable	Sheng Lintai	051-010003	N/A	N.C.R	N.C.R

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3 SUMMARY OF TEST RESULT

FCC Rules	ISED Rules	Description Of Test	Result
§15.207	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.407(e)	RSS-Gen §6.7 RSS-247 §6.2.4.1	Emission Bandwidth	Compliant
§15.407(a)	RSS-247 §6.2.1~ 4 (1)	Maximum Conducted Output Power	Compliant
§15.407(a)	RSS-247 §6.2.1~ 4 (1)	Power Spectral Density	Compliant
§15.205 §15.209 §15.407(b)	RSS-247 §6.2.1~ 4 (2)	Undesirable Radiated Emissions	Compliant
§15.407(c)	RSS-247 §6.4	Transmission in case of Absence of Information	Compliant
§15.203	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operating Frequencies

Operated band in 5150 MHz ~5250 MHz:

20 M		40 M		80 M	
CH	Freq (MHz)	CH	Freq (MHz)	CH	Freq (MHz)
36	5180	38	5190	42	5210
40	5200	46	5230		
44	5220				
48	5240				

Operated band in 5725 MHz ~5850 MHz:

20 M		40 M		80 M	
CH	Freq (MHz)	CH	Freq (MHz)	CH	Freq (MHz)
149	5745	151	5755	155	5775
153	5765	159	5795		
157	5785				
161	5805				
165	5825				

Note:

1. 5850~5895 MHz is not available for operation in Canada.

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case. The given UE is pre-scanned among below modes.

Modulation		Transmission Chain						Single Transmission Spatial	Multiple Transmission Spatial
v	802.11 a	v	Ch0	Ch1	Ch2	Ch3	v	1TX	1TX
v	802.11 n	v	Ch0	Ch1	Ch2	Ch3	v	1TX	1TX
v	802.11 ac	v	Ch0	Ch1	Ch2	Ch3	v	1TX	1TX
	802.11 ax		Ch0	Ch1	Ch2	Ch3		1TX	1TX

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4. Therefore, below summary is the modes of test configuration that yield the highest reading and generate the highest emission chosen to carry out the relevantly mandatory test items.

CONDUCTED TEST						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11a	5180~5240	36,44,48	36,44,48	OFDM	6	ch0
	5745~5825	149,157,165	149,157,165			
802.11n_HT20	5180~5240	36,44,48	36,44,48	OFDM	MCS0	ch0
	5745~5825	149,157,165	149,157,165			
802.11n_HT40	5190~5230	38,46	38,46	OFDM	MCS0	ch0
	5755~5795	151,159	151,159			
802.11ac_VHT80	5210	42	42	OFDM	MCS0	ch0
	5775	155	155	OFDM	MCS0	ch0
RADIATED EMISSION TEST (BELOW 1 GHz)						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11a	5180~5240	36 to 48	44	OFDM	6	1TX
	5745~5825	149 to 165	157			
RADIATED EMISSION TEST (ABOVE 1 GHz)						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11a	5180~5240	36 to 48	36,44,48	OFDM	6	1TX
	5745~5825	149 to 165	149,157,165			
802.11n_HT20	5180~5240	36 to 48	36,44,48	OFDM	MCS0	1TX
	5745~5825	149 to 165	149,157,165			
802.11n_HT40	5190~5230	38 to 46	38,46	OFDM	MCS0	1TX
	5755~5795	151 to 159	151,159			
802.11ac_VHT80	5210	42	42	OFDM	MCS0	1TX
	5775	155	155			

Note:

The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.32 dB
Output Power measurement	+/- 1 dB
Emission Bandwidth	+/- 1.53 Hz
Undesignable radiated emission measurement	+/- 1.68 dB
Peak Power Density	+/- 2.16 dB
Temperature	+/- 0.7 °C
Humidity	+/- 3 %
DC / AC Power Source	+/- 1 %

Radiated Spurious Emission Measurement Uncertainty			
Polarization: Vertical	+/-	2.8 dB	9kHz~30MHz
	+/-	4.82 dB	30MHz - 1000MHz
	+/-	4.37 dB	1GHz - 18GHz
	+/-	4.21 dB	18GHz - 40GHz
Polarization: Horizontal	+/-	2.8 dB	9kHz~30MHz
	+/-	4.54 dB	30MHz - 1000MHz
	+/-	4.37 dB	1GHz - 18GHz
	+/-	4.21 dB	18GHz - 40GHz

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	SCHWARZBECK Mess-	NSLK8127	973	04/20/2023	04/19/2024
EMI Test Receiver	R&S	ESCI	101342	04/25/2023	04/24/2024
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2023	03/26/2024
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2023	03/26/2024
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071573	05/16/2022	05/15/2023
Power Meter	Anritsu	ML2496A	2138005	09/23/2022	09/22/2023
Power Sensor	Anritsu	MA2411B	1911395	09/23/2022	09/22/2023
Power Sensor	Anritsu	MA2411B	1911396	09/23/2022	09/22/2023
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R
Attenuator	Woken	WATT-218FS-10	RF18	11/16/2022	11/15/2023
Attenuator	Woken	WATT-218FS-10	RF19	11/16/2022	11/15/2023
DC Block	PASTERNAK	PE8210	RF157	11/16/2022	11/15/2023

6.3 Radiated Measurement

Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband	SCHWARZBECK	VULB 9168	1206	01/17/2023	01/16/2024
Horn Antenna	Schwarzbeck	BBHA9170	184	12/15/2022	12/14/2023
Horn Antenna	RF SPIN	DRH18-E	210105A18E	04/08/2022	05/07/2023
Loop Antenna	ETS.LINDGREN	6502	143303	05/06/2022	05/07/2023
3m Site NSA	SGS	966 chamber G	N/A	03/30/2023	03/29/2024
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/13/2022	07/14/2023
Pre-Amplifier	EMC Instruments	EMC18405SEE	980881	10/25/2022	10/24/2023
Pre-Amplifier	EMC Instruments	EMC330N	980781	03/15/2023	03/14/2024
Pre-Amplifier	EMC Instruments	EMC118A45SE	980815	03/15/2023	03/14/2024
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R
Coaxial Cable	EMC Instruments	EMCCFD400-NM-NM-8000-5000-2000	210216 、 210217 、 210218	03/15/2023	03/14/2024
Coaxial Cable	EMC Instruments	EMC104-SM-SM-8000-5000-5000	210219 、 210220 、 210221	03/15/2023	03/14/2024
Coaxial Cable	EMC Instruments	EMC105-NM-NM-5000-15000	210224 、 210306	03/15/2023	03/14/2024

NOTE: N.C.R refers to Not Calibrated Required.

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7 CONDUCTED EMISSION TEST

7.1 Standard Applicable

Frequency range within 150 kHz to 30 MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits (dBuV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

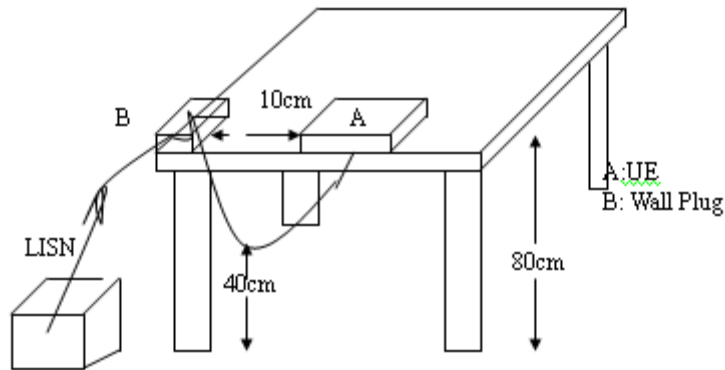
Note

- 1.The lower limit shall apply at the transition frequencies
- 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

7.2 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The LISN was connected with 120Vac/60Hz power source.

7.3 Test SET-UP



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7.4 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed.

7.5 Measurement Result

Note: Refer to next page for measurement data and plots.

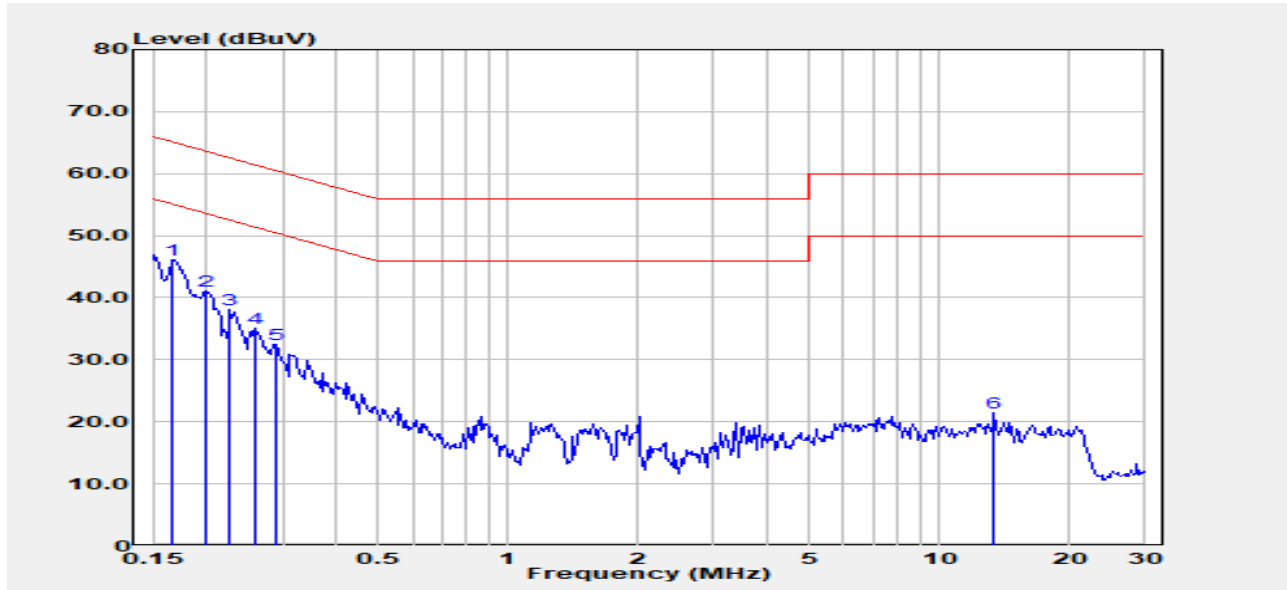
Note2: The * reveals the worst-case results that closest to the limit.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF2303000624E2	Test Site	:Conduction C
Test Mode	:Wifi 5G	Test Date	:2023-04-26
Power	:120V60Hz	Temp./Humi.	:23.4°C /64%
Probe	:L1	Engineer	:Temo Chen



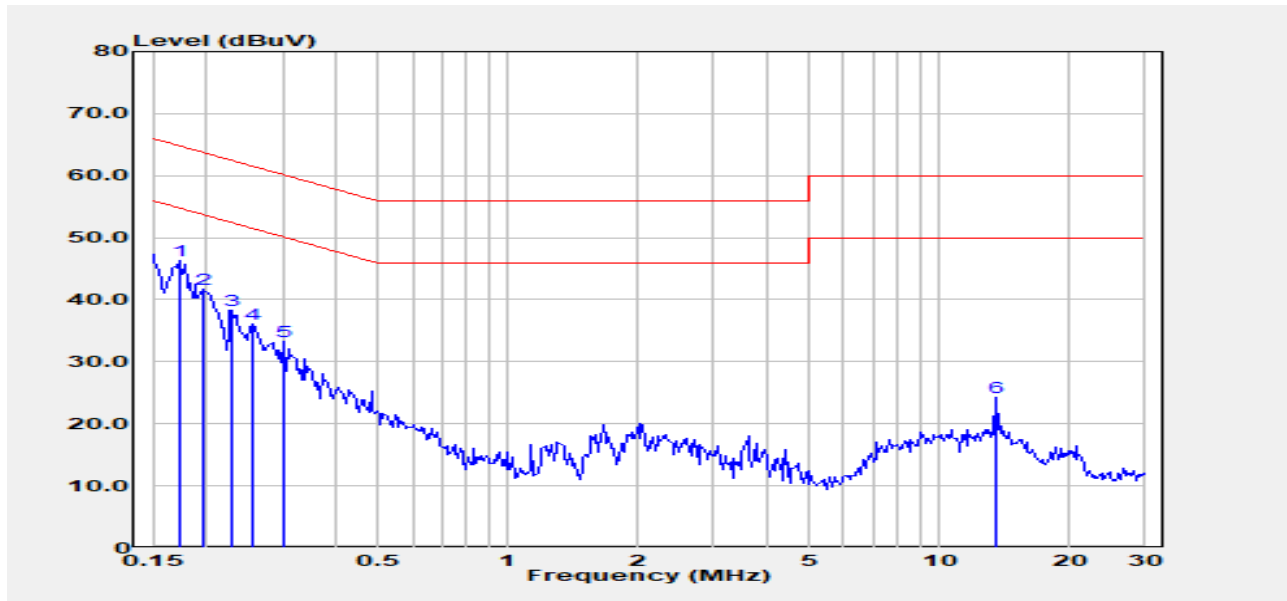
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.167	Peak	35.85	10.27	46.12	65.12	-19.00
0.200	Peak	30.80	10.27	41.07	63.62	-22.55
0.227	Peak	27.80	10.28	38.07	62.57	-24.50
0.260	Peak	24.83	10.28	35.12	61.42	-26.31
0.289	Peak	22.24	10.29	32.53	60.54	-28.01
13.408	Peak	10.66	10.75	21.41	60.00	-38.59

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Report Number	:TERF2303000624E2	Test Site	:Conduction C
Test Mode	:Wifi 5G	Test Date	:2023-04-26
Power	:120V60Hz	Temp./Humi.	:23.4°C /64%
Probe	:N	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.172	Peak	35.99	10.28	46.27	64.86	-18.59
0.195	Peak	31.44	10.27	41.71	63.80	-22.09
0.229	Peak	28.04	10.27	38.31	62.48	-24.17
0.255	Peak	25.90	10.28	36.18	61.60	-25.42
0.302	Peak	22.93	10.28	33.22	60.19	-26.98
13.551	Peak	13.46	10.71	24.17	60.00	-35.83

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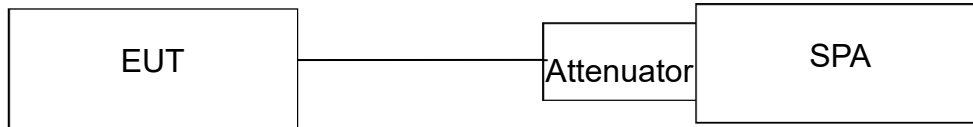
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8 EMISSION BANDWIDTH MEASUREMENT

8.1 Standard Applicable

There is no limit bandwidth for U-NII-1, U-NII-2-A and U-NII-2-C.
The minimum of 6dB Bandwidth measurement is 0.5 MHz for U-NII-3.

8.2 Test Setup



8.3 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the Antenna port to the spectrum analyzer.
 - 3.a. 26dB Band width Measurement: Set the spectrum analyzer as 1% of emission BW
Sweep=auto,
Detector = Peak,
Trace Mode = Max Hold,
Manually readjust RBW until the RBW/EBW ratio is 1% based on EBW as observed on the result of pre-sequence measurement.
 - 3.b. Mark the peak frequency and -26dB (upper and lower) frequency.
4. Repeat the procedures as list above until all test default channels (low, middle, and high) are completed.
5. Minimum Emission Bandwidth for the band 5.725-5.850GHz.
 - a. Set the spectrum analyzer as
RBW = 100 kHz,
VBW = 3*RBW,
Span = large enough to capture all products of the modulation process,
Detector=Peak,
Sweep=auto
 - b. Mark the peak frequency and -6dB (upper and lower) frequency.
6. For 99% Bandwidth: Set the spectrum analyzer as
RBW = 1%,
VBW = 3*RBW,
Span = large enough to capture all products of the modulation process,
Detector=Sample,
Sweep=auto.
7. Turn on the 99% bandwidth function, max reading.
8. Repeat above procedures until all frequency of interest measured was complete.

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8.4 Measurement Result

8.4.1 FCC Occupied Bandwidth

802.11a_Ch0

Freq. (MHz)	26dB BW (MHz)	Offset	10 Log (B) (dB)
5180	25.83	11.67	14.120
5220	22.27	11.67	13.480
5240	19.51	11.67	12.900

802.11a_Ch0

Freq. (MHz)	6dB BW (MHz)	Offset	10 Log (B) (dB)
5745	14.67	11.67	11.660
5785	14.56	11.67	11.630
5825	15.19	11.67	11.820

802.11a_Ch0

Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5240	5248.234815	< 5250
5745	5736.813017	> 5725

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802.11n_HT20_Ch0

Freq. (MHz)	26dB BW (MHz)	Offset	10 Log (B) (dB)
5180	24.17	11.67	13.830
5220	22.42	11.67	13.510
5240	21.60	11.67	13.340

802.11n_HT20_Ch0

Freq. (MHz)	6dB BW (MHz)	Offset	10 Log (B) (dB)
5745	13.34	11.67	11.250
5785	17.14	11.67	12.340
5825	13.84	11.67	11.410

802.11n_HT20_Ch0

Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5240	5248.794123	< 5250
5745	5736.217285	> 5725

802.11n_HT40_Ch0

Freq. (MHz)	26dB BW (MHz)	Offset	10 Log (B) (dB)
5190	40.31	11.67	16.050
5230	48.33	11.67	16.840

802.11n_HT40_Ch0

Freq. (MHz)	6dB BW (MHz)	Offset	10 Log (B) (dB)
5755	35.16	11.67	15.460
5795	35.12	11.67	15.460

802.11n_HT40_Ch0

Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5230	5248.000748	< 5250
5755	5737.053540	> 5725

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802.11ac_VHT80_Ch0

Freq. (MHz)	26dB BW (MHz)	Offset	10 Log (B) (dB)
5210	80.16	11.67	19.040

802.11ac_VHT80_Ch0

Freq. (MHz)	6dB BW (MHz)	Offset	10 Log (B) (dB)
5775	75.22	11.67	18.760

802.11ac_VHT80_Ch0

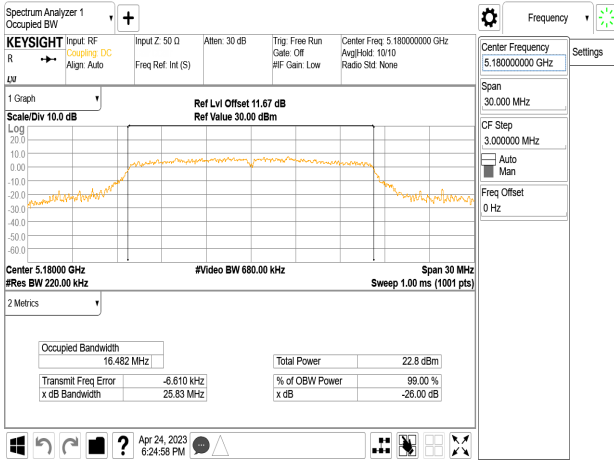
Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5210	5247.597561	< 5250
5775	5737.395147	> 5725

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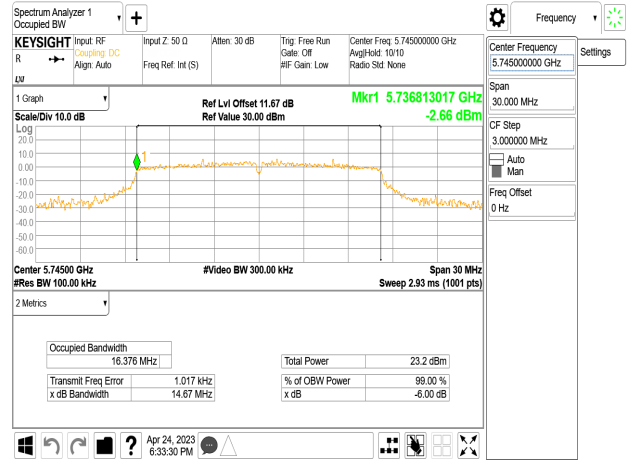
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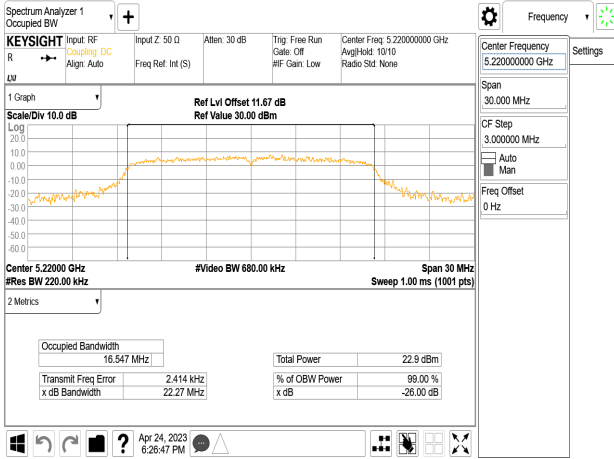
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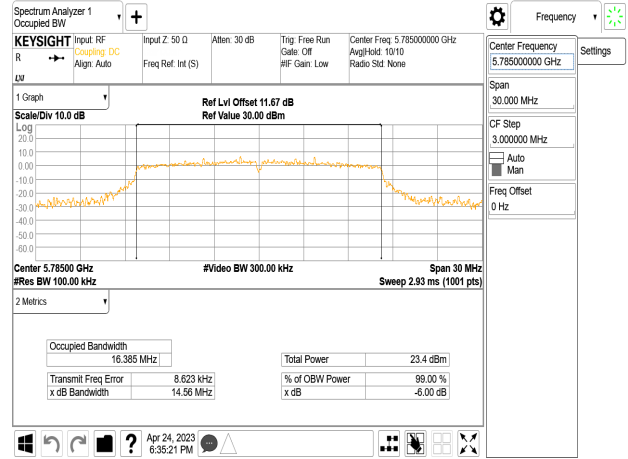
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802.11a_20MHz_Chain0_5220MHz



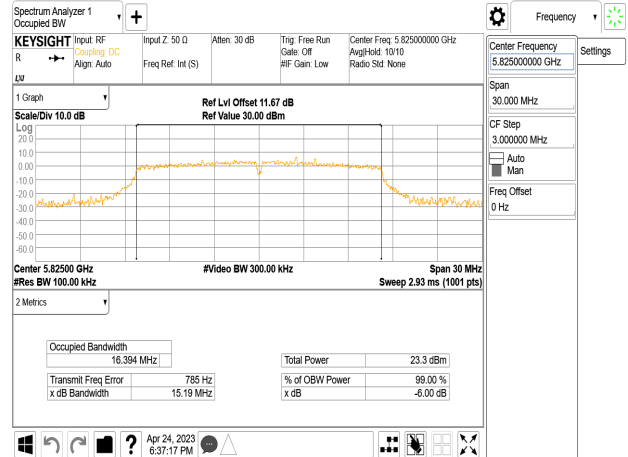
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802.11a_20MHz_Chain0_5240MHz



802.11a_20MHz_Chain0_5825MHz

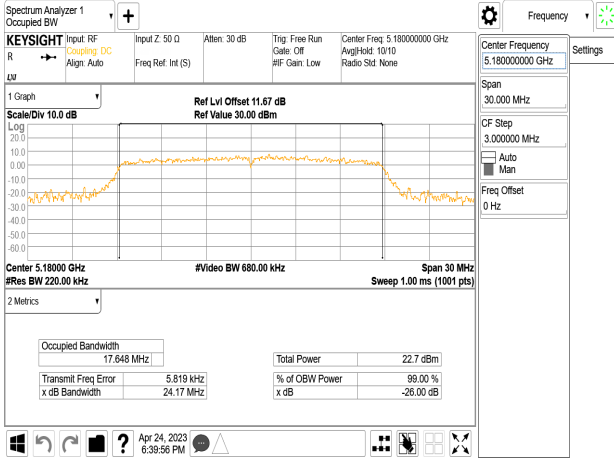


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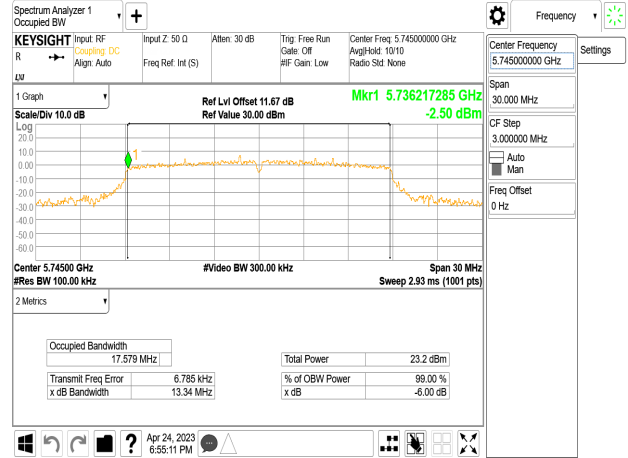
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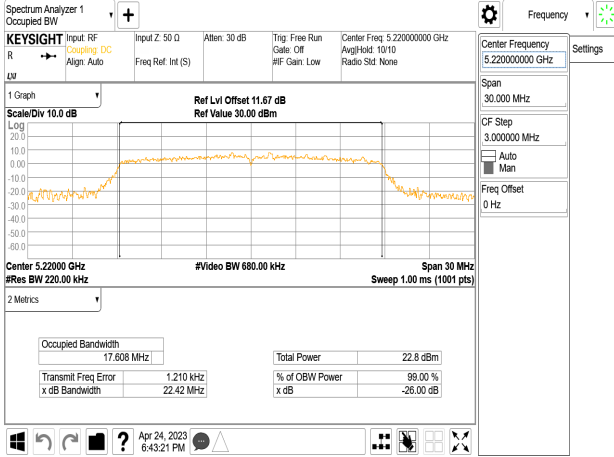
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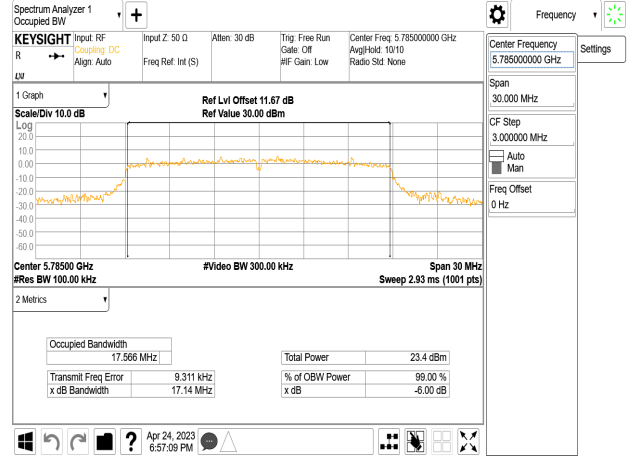
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802.11n_20MHz_Chain0_5220MHz



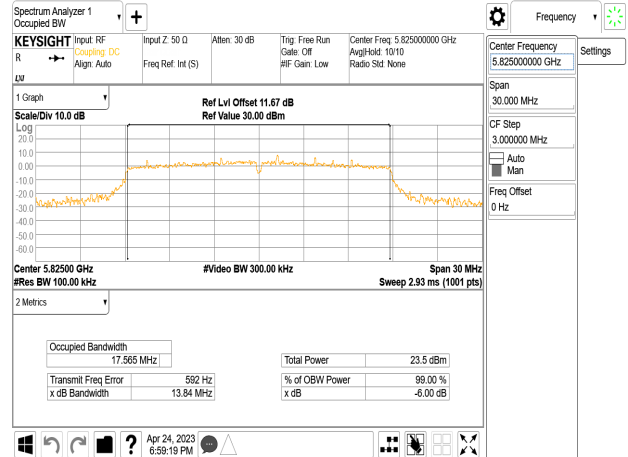
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802.11n_20MHz_Chain0_5240MHz



802.11n_20MHz_Chain0_5825MHz

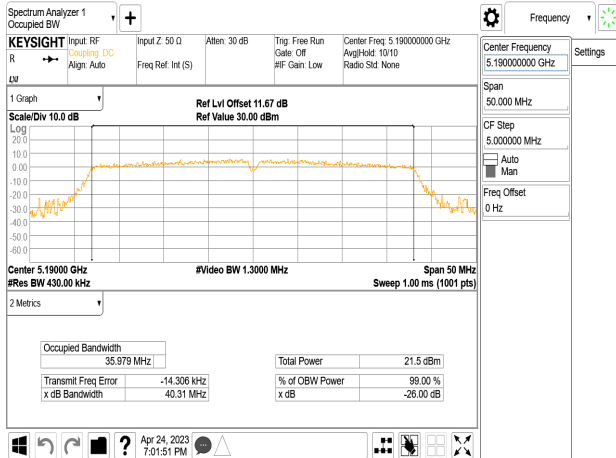


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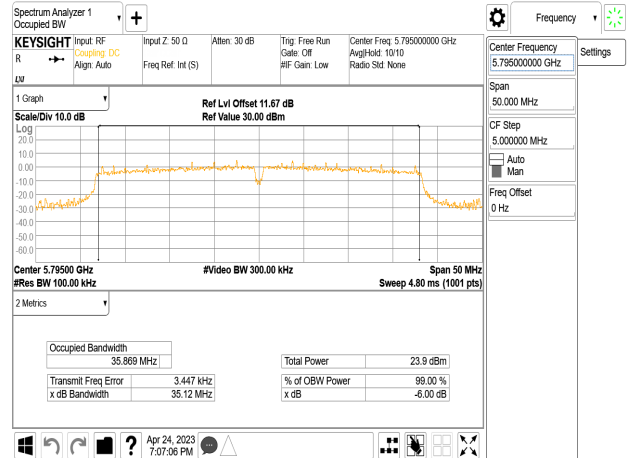
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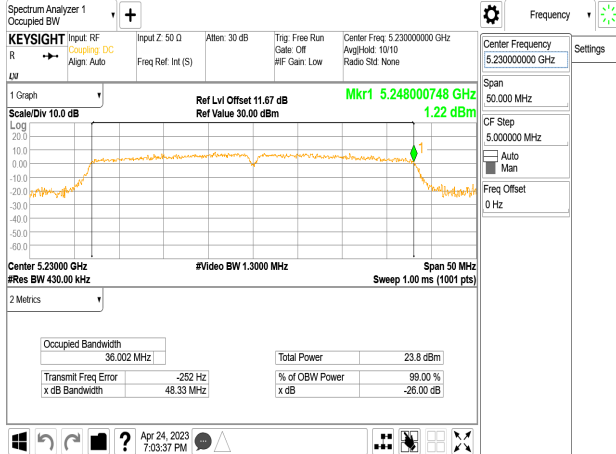
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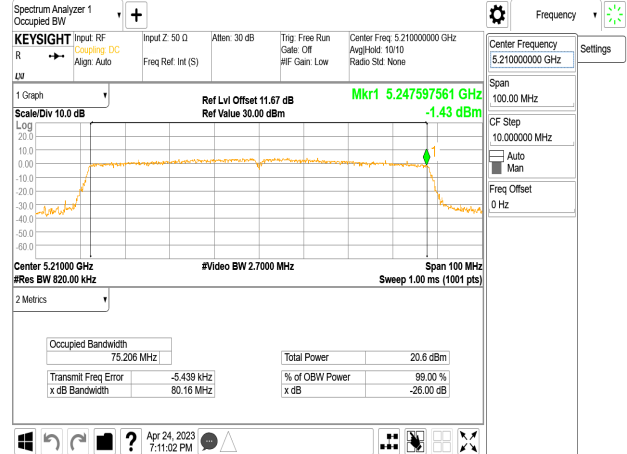
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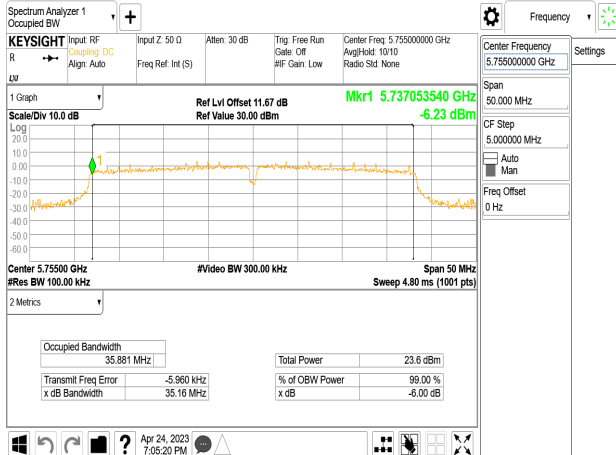
802.11n_40MHz_Chain0_5230MHz



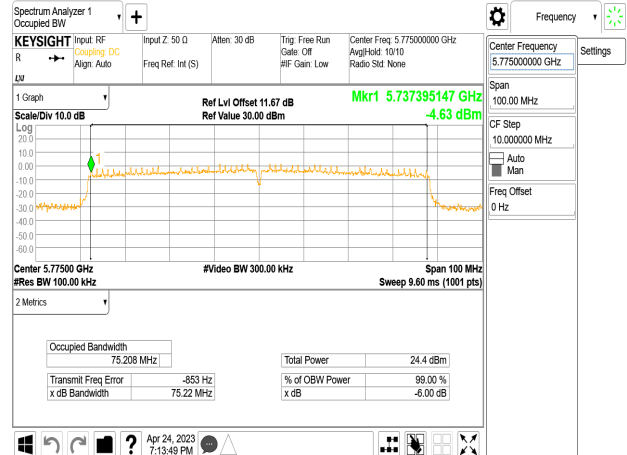
802.11ac_80MHz_Chain0_5210MHz



802.11n_40MHz_Chain0_5755MHz



802.11ac_80MHz_Chain0_5775MHz



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8.4.2 ISED Occupied Bandwidth

802.11a_Ch0

Frequency (MHz)	99% BW (MHz)	10 Log (B) (dB)
5180	16.488	12.170
5220	16.435	12.160
5240	16.471	12.170

802.11a_Ch0

Frequency (MHz)	99% BW (MHz)	6dB BW (MHz)
5745	16.481	15.980
5785	16.480	16.090
5825	16.457	15.920

802.11n_HT20_Ch0

Frequency (MHz)	99% BW (MHz)	10 Log (B) (dB)
5180	17.607	12.460
5220	17.608	12.460
5240	17.607	12.460

802.11n_HT20_Ch0

Frequency (MHz)	99% BW (MHz)	6dB BW (MHz)
5745	17.614	17.110
5785	17.603	16.950
5825	17.605	16.930

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802.11n_HT40_Ch0

Frequency (MHz)	99% BW (MHz)	10 Log (B) (dB)
5190	35.944	15.560
5230	35.992	15.560

802.11n_HT40_Ch0

Frequency (MHz)	99% BW (MHz)	6dB BW (MHz)
5755	35.975	34.600
5795	35.984	35.490

802.11ac_VHT80_Ch0

Frequency (MHz)	99% BW (MHz)	10 Log (B) (dB)
5210	75.203	18.760

802.11ac_VHT80_Ch0

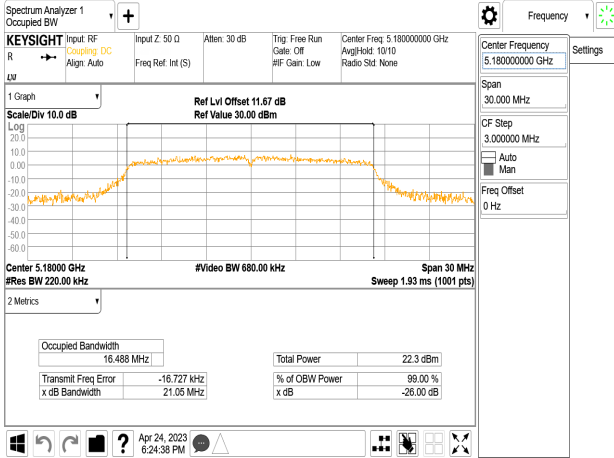
Frequency (MHz)	99% BW (MHz)	6dB BW (MHz)
5775	75.272	75.600

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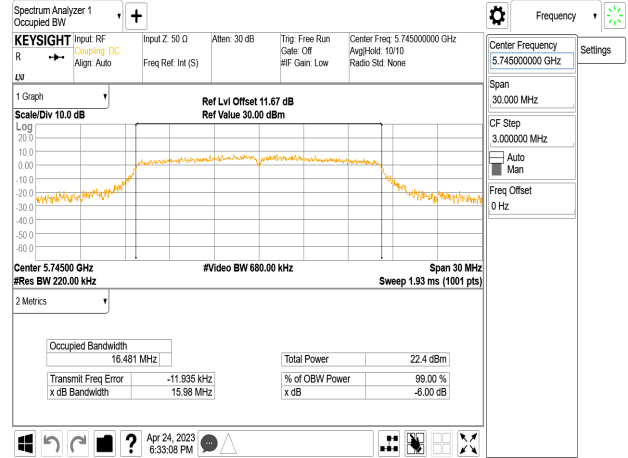
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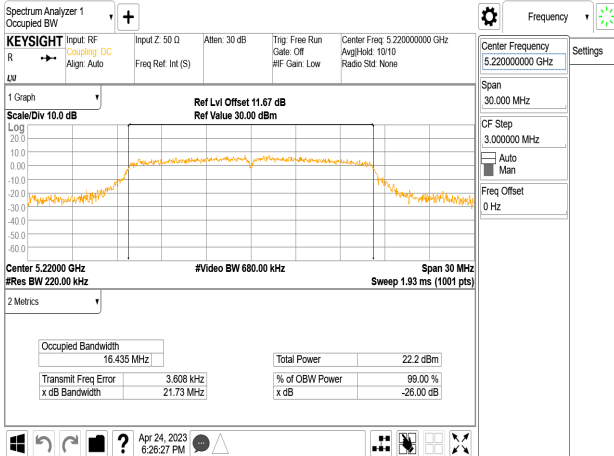
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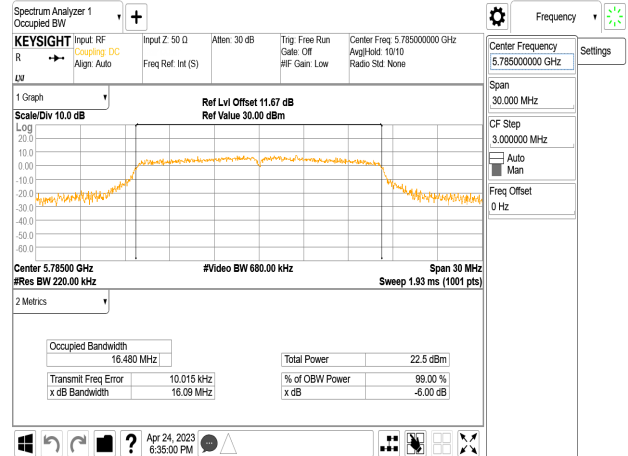
802.11a_20MHz_Chain0_5745MHz



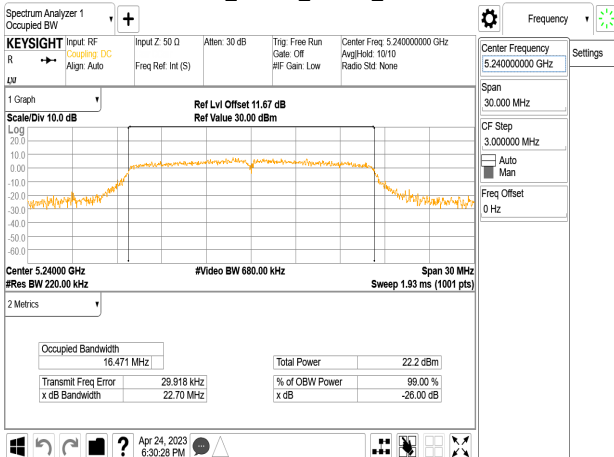
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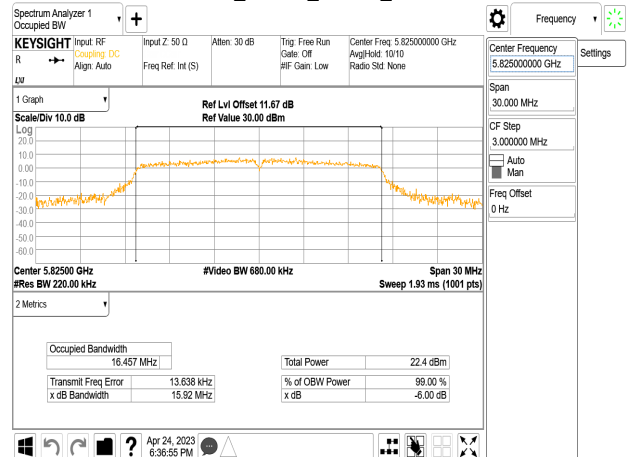
802.11a_20MHz_Chain0_5785MHz



802.11a_20MHz_Chain0_5240MHz



802.11a_20MHz_Chain0_5825MHz

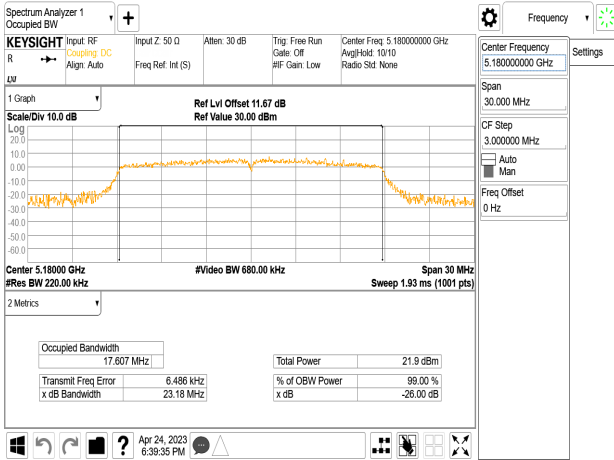


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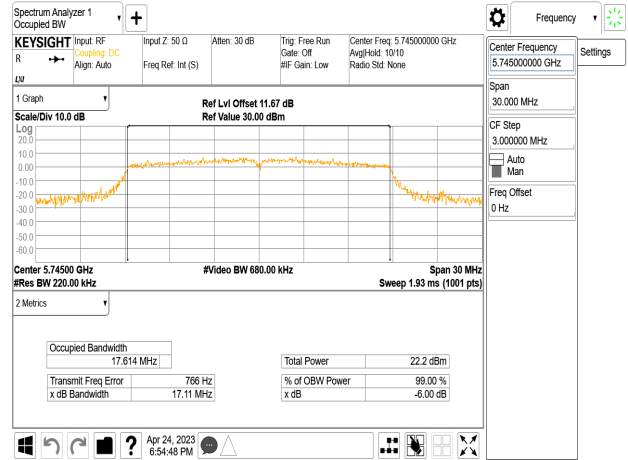
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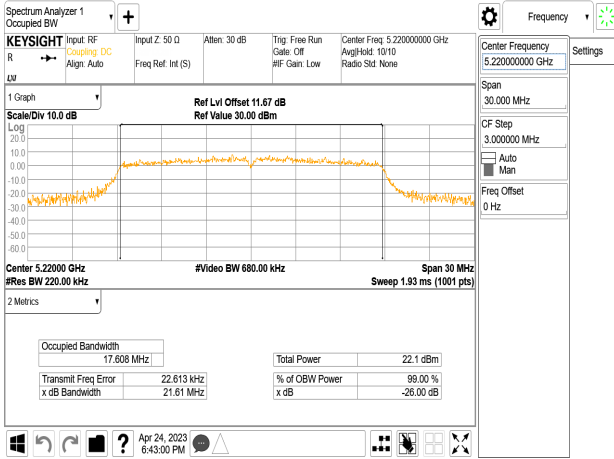
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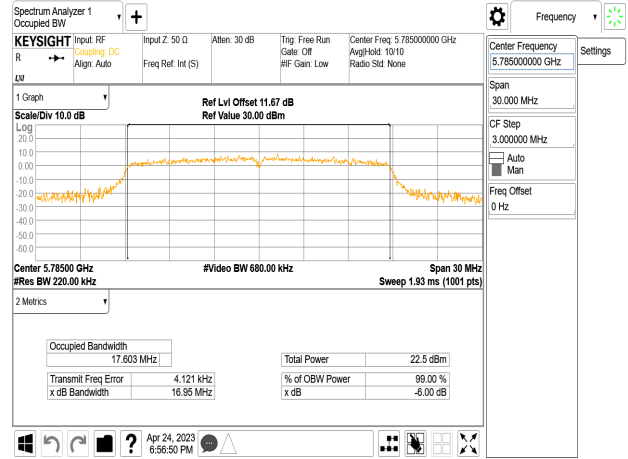
802.11n_20MHz_Chain0_5745MHz



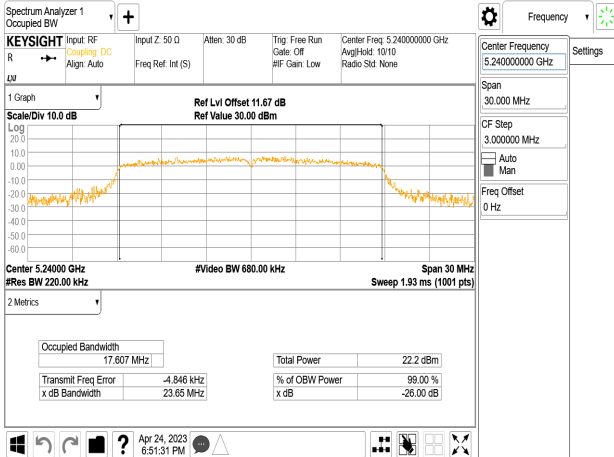
802.11n_20MHz_Chain0_5220MHz



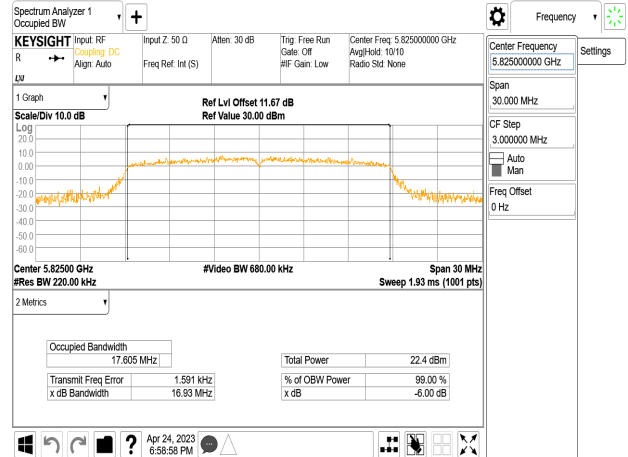
802.11n_20MHz_Chain0_5785MHz



802.11n_20MHz_Chain0_5240MHz



802.11n_20MHz_Chain0_5825MHz

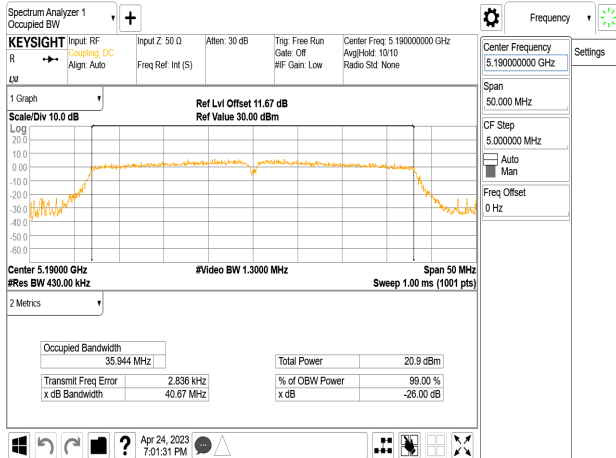


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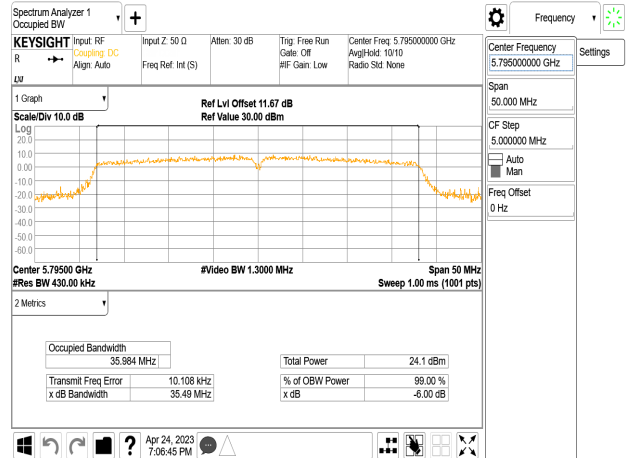
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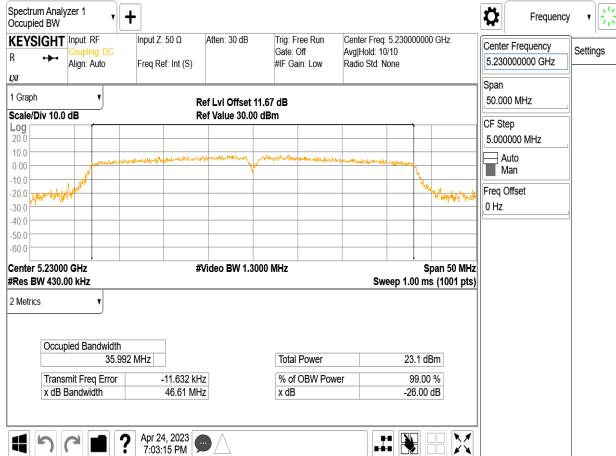
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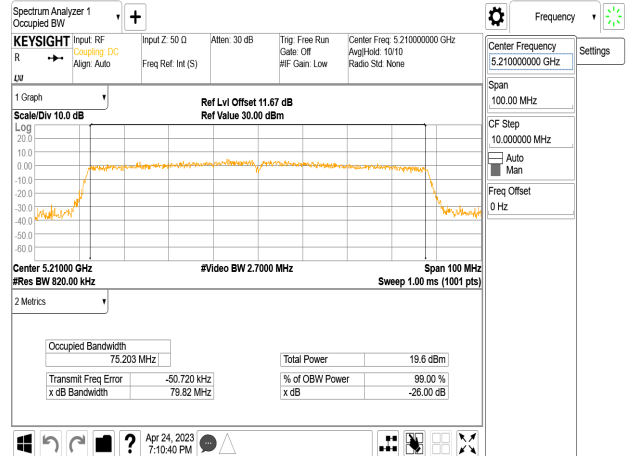
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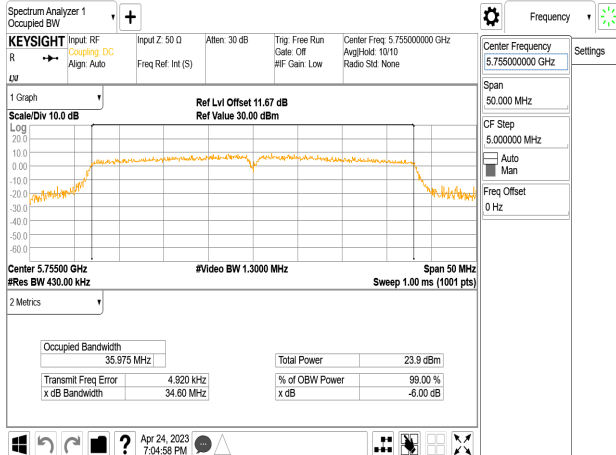
802.11n_40MHz_Chain0_5230MHz



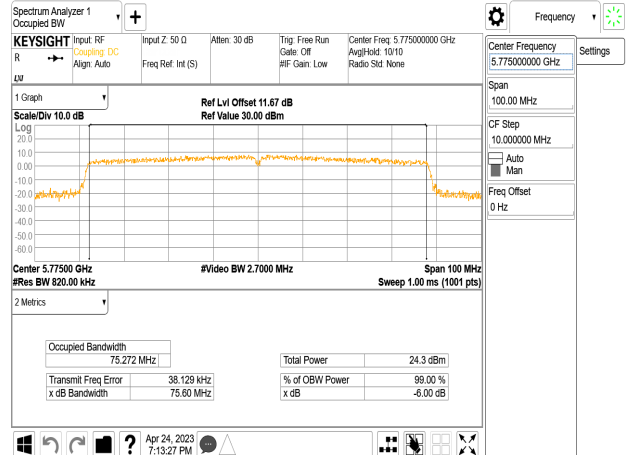
802.11ac_80MHz_Chain0_5210MHz



802.11n_40MHz_Chain0_5755MHz



802.11ac_80MHz_Chain0_5775MHz



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9 MAXIMUM CONDUCTED OUTPUT POWER MEASUREMENT

9.1 Standard Applicable

9.1.1 Duty Cycle

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

9.1.2 Output Power

Band	EUT CATEGORY		e-CRF Title 47 §15.407			
			Conducted Output Power	EIRP	TPC	Antenna Directional Gain Requirements
U-NII-1		Fixed point-to-point	1 Watt(30dBm)	Not required	Not required	23dBi
		Out door AP	1 Watt(30dBm)	Elevation angle above 30 degrees 125mW (21dBm)	Not required	6dBi
		Indoor AP	1 Watt(30dBm)	Not required	Not required	6dBi
	V	Other	250mW(23.98dBm)	Not required	Not required	6dBi
U-NII-2A		Other	250mW(23.98dBm) or 11dBm+10 log B	Not required	When EIRP >500mW At least 6dB below EIRP 1W (30dBm)	6dBi
U-NII-2C		Other	250mW(23.98dBm) or 11dBm+10 log B	Not required		6dBi
U-NII-3	V	Other	1 Watt(30dBm)	Not required	Not required	6dBi
		Fixed point-to-point	1 Watt(30dBm)	Not required	Not required	Not required
U-NII-4		Indoor AP (a channel spans 5725~5850 and 5850~5895MHz)	Not required	36dBm	Not required	Not required
		indoor client (a channel spans 5725~5850 and 5850~5895MHz)	Not required	30dBm	Not required	Not required
		subordinate device	Not required	36dBm	Not required	Not required

1. If transmitting antennas of directional gain greater than the antenna requirements column, the Maximum transmit power shall be reduced by the amount in dB that the direction-al gain of the antenna.

2. For the 10 log B, B is the 26 dB emission bandwidth.

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FREQUENCY BAND (MHz)	EUT CATEGORY		RSS-247 §6.2.1~6.2.4		
			EIRP	Conducted Output Power	TPC
5150~5250		OEM devices installed in vehicles	30 mW or 1.76 + 10 log10B	N/A	At least 3dB below 30mW EIRP
	V	Other device	200 mW or 10 + 10 log10B dBm	N/A	N/A
5250~5350		OEM devices installed in vehicles	30 mW or 1.76 + 10 log10B	N/A	At least 3dB below 30mW EIRP
		Other device	1.0 W or 17 + 10 log10B dBm	250 mW or 11 +10 log10B	EIRP >500mW, at least 6dB below 1W EIRP
		Outdoor Fixed with EIRP>200mW	-13 dBW/MHz for 0° ≤ θ < 8° -13 -0.716 (θ-8) dBW/MHz for 8° ≤ θ < 40° -35.9 -1.22 (θ-40) dBW/MHz for 40° ≤ θ ≤ 45° -42 dBW/MHz for θ > 45°	N/A	EIRP >500mW, at least 6dB below 1W EIRP
5470-5600 and 5650-5725		All	1.0 W or 17 + 10 log10B dBm	250 mW or 11 +10 log10B	EIRP >500mW, at least 6dB below 1W EIRP
5725~5850	V	All	N/A	1 W	N/A

1 For equipment operating in the band 5725-5850 MHz, If transmitting antennas of directional gain greater than 6 dBi are used, the Maximum transmit power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. For the 10 log B, B is the 99% emission bandwidth.

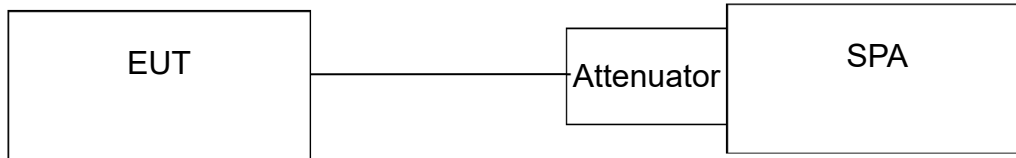
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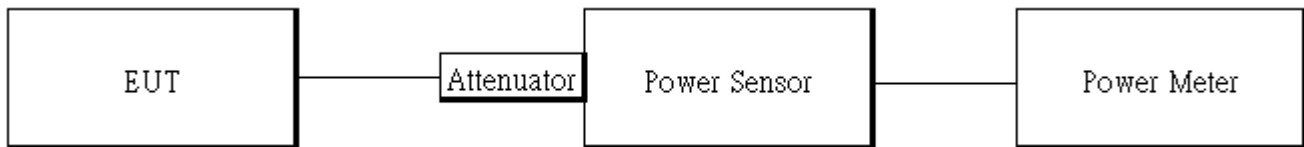
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9.2 Test Setup

9.2.1 Duty Cycle



9.2.2 Output Power



9.3 Measurement Procedure

9.3.1 Duty Cycle Measurements

1. Set span = Zero
2. RBW = 8MHz
3. VBW = 8MHz,
4. Detector = Peak

9.3.2 Output Power Measurements

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter
4. Power Meter is used as the auxiliary test equipment to conduct the output power measurement.
5. Record the max. reading and add $10 \log(1/\text{duty cycle})$.
6. Repeat above procedures until all frequency (low, middle, and high channel) measured were complete.

The antenna gain is not greater than 6 dBi. Therefore, reduction of power is not required.

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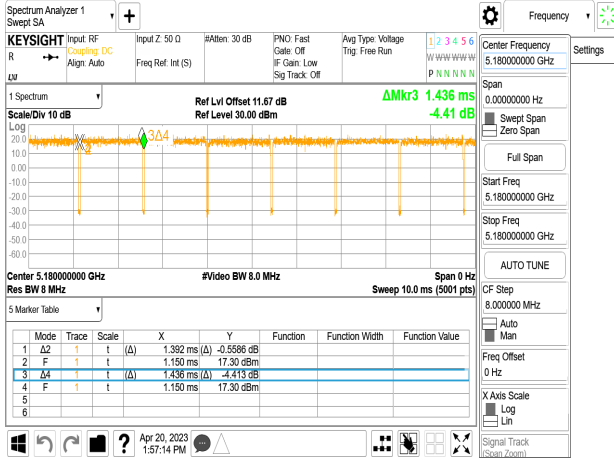
9.4 Duty Cycle Measurement Result

Mode	Duty Cycle (%) =Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
802.11a	96.94	0.13	0.72	1.00
802.11n_20	96.73	0.14	0.77	1.00
802.11ac_20	96.61	0.15	0.76	1.00
802.11n_40	93.64	0.29	1.54	2.00
802.11ac_40	93.68	0.28	1.53	2.00
802.11ac_80	88.04	0.55	3.09	4.00

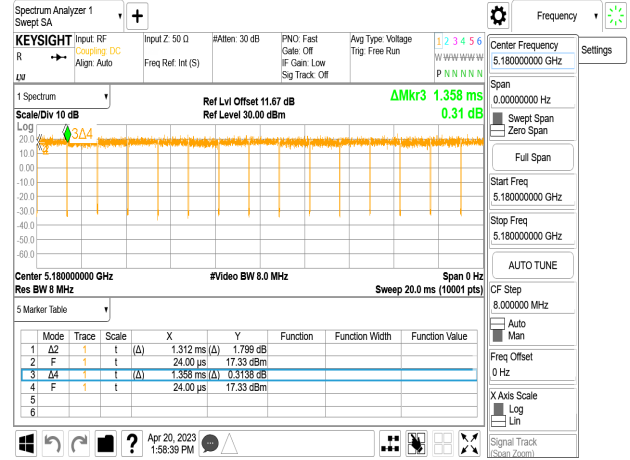
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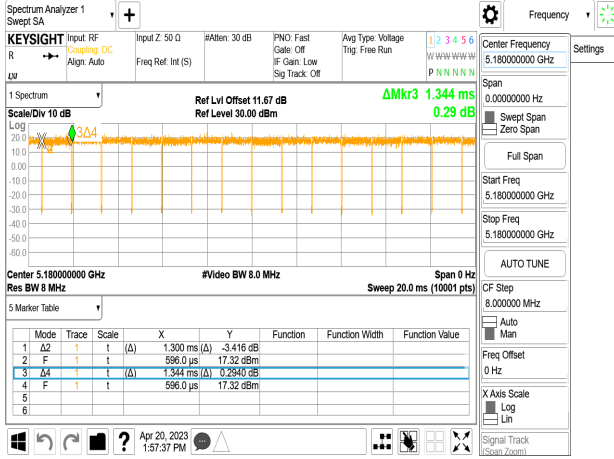
802.11a_20MHz_Chain0_5180MHz



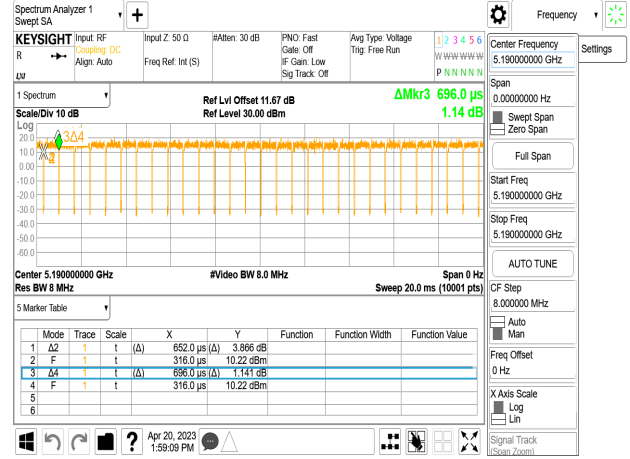
802.11ac_20MHz_Chain0_5180MHz



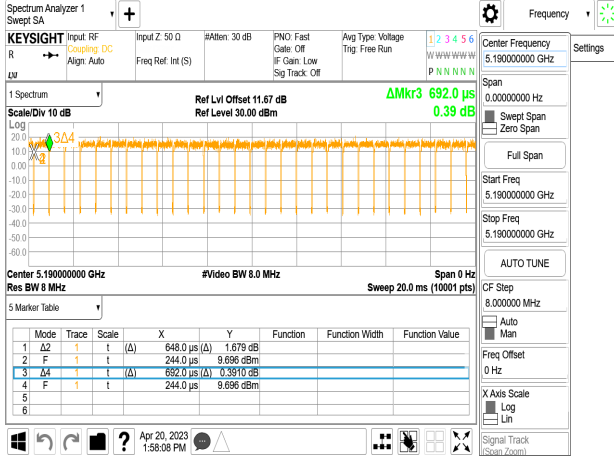
802.11n_20MHz_Chain0_5180MHz



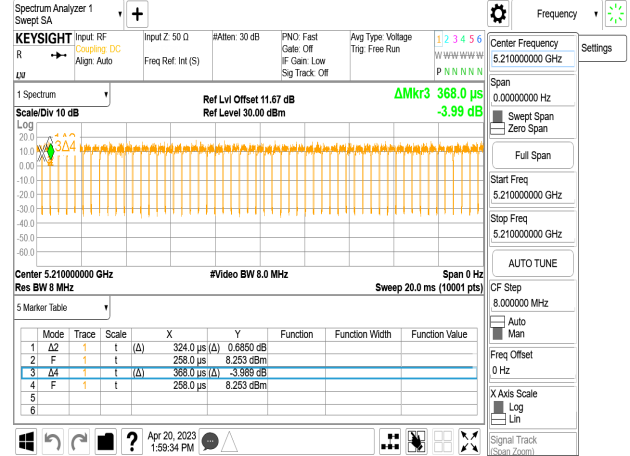
802.11ac_40MHz_Chain0_5190MHz



802.11n_40MHz_Chain0_5190MHz



802.11ac_80MHz_Chain0_5210MHz



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9.5 Output Power Measurement Result

9.5.1 FCC Output power

802.11a_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	6	20	18.52	71.203	23.98	PASS
44	5220	6	20	18.50	70.876	23.98	PASS
48	5240	6	20	18.48	70.550	23.98	PASS
149	5745	6	20	18.38	68.944	30	PASS
157	5785	6	20	18.27	67.220	30	PASS
165	5825	6	20	18.34	68.312	30	PASS

802.11n_HT20_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	MCS0	20	18.29	67.521	23.98	PASS
44	5220	MCS0	20	18.35	68.460	23.98	PASS
48	5240	MCS0	20	18.43	69.733	23.98	PASS
149	5745	MCS0	20	18.28	67.366	30	PASS
157	5785	MCS0	20	18.23	66.595	30	PASS
165	5825	MCS0	20	18.24	66.748	30	PASS

802.11n_HT40_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
38	5190	MCS0	17.5	15.90	38.863	23.98	PASS
46	5230	MCS0	20	18.27	67.072	23.98	PASS
151	5755	MCS0	20	18.10	64.497	30	PASS
159	5795	MCS0	20	18.15	65.244	30	PASS

802.11ac_VHT20_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	MCS0	20	18.27	67.139	23.98	PASS
44	5220	MCS0	20	18.35	68.388	23.98	PASS
48	5240	MCS0	20	18.42	69.499	23.98	PASS
149	5745	MCS0	20	18.22	66.371	30	PASS
157	5785	MCS0	20	18.16	65.460	30	PASS
165	5825	MCS0	20	18.19	65.914	30	PASS

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802.11ac_VHT40_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
38	5190	MCS0	17.5	15.87	38.668	23.98	PASS
46	5230	MCS0	20	18.21	66.276	23.98	PASS
151	5755	MCS0	20	18.06	64.026	30	PASS
159	5795	MCS0	20	18.09	64.469	30	PASS

802.11ac_VHT80_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
42	5210	MCS0	15.5	14.44	27.818	23.98	PASS
155	5775	MCS0	20	19.20	83.238	30	PASS

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9.5.2 ISED Conducted output power and EIRP

802.11a_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
149	5745	18.38	68.944	30	PASS
157	5785	18.27	67.220	30	PASS
165	5825	18.34	68.312	30	PASS

802.11n_HT20_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
149	5745	18.28	67.366	30	PASS
157	5785	18.23	66.595	30	PASS
165	5825	18.24	66.748	30	PASS

802.11n_HT40_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
151	5755	18.10	64.497	30	PASS
159	5795	18.15	65.244	30	PASS

802.11ac_VHT20_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
149	5745	18.22	66.371	30	PASS
157	5785	18.16	65.460	30	PASS
165	5825	18.19	65.914	30	PASS

802.11ac_VHT40_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
151	5755	18.06	64.026	30	PASS
159	5795	18.09	64.469	30	PASS

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802.11ac_VHT80_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
155	5775	19.20	83.238	30	PASS

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802.11a_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	18.52	-2.84	15.68	36.983	22.17	PASS
44	5220	18.50	-2.84	15.66	36.813	22.16	PASS
48	5240	18.48	-2.84	15.64	36.644	22.17	PASS

802.11n_HT20_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	18.29	-2.84	15.45	35.075	22.46	PASS
44	5220	18.35	-2.84	15.51	35.563	22.46	PASS
48	5240	18.43	-2.84	15.59	36.224	22.46	PASS

802.11n_HT40_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	REQUIRED LIMIT (dBm)	RESULT
38	5190	15.90	-2.84	13.06	20.230	23.01	PASS
46	5230	18.27	-2.84	15.43	34.914	23.01	PASS

802.11ac_VHT20_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	18.27	-2.84	15.43	34.914	22.46	PASS
44	5220	18.35	-2.84	15.51	35.563	22.46	PASS
48	5240	18.42	-2.84	15.58	36.141	22.46	PASS

802.11ac_VHT40_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	REQUIRED LIMIT (dBm)	RESULT
38	5190	15.87	-2.84	13.03	20.091	23.01	PASS
46	5230	18.21	-2.84	15.37	34.435	23.01	PASS

802.11ac_VHT80_Ch0

CH	Frequency (MHz)	TOTAL POWER (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	REQUIRED LIMIT (dBm)	RESULT
42	5210	14.44	-2.84	11.60	14.454	23.01	PASS

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10 MAXIMUM POWER SPECTRAL DENSITY

10.1 Standard Applicable

Operation Bands	EUT CATEGORY		e-CRF Title 47 §15.407 Power Spectral Density	Antenna Directional Gain Requirements
U-NII-1		Outdoor Access Point (Master)	1. 17dBm / MHz 2. EIRP<=125mW(21dBm) at any elevation angle > 30°	6dBi
		Indoor Access Point (Master)	17dBm / MHz	6dBi
		Fixed point-to-point Access Point	17dBm / MHz	23dBi
	V	Client device	11dBm / MHz	6dBi
U-NII-2A		All	11dBm / MHz	6dBi
U-NII-2C		All	11dBm / MHz	6dBi
U-NII-3	V	All	30dBm / 500kHz	6dBi
U-NII-4		Indoor AP	20dBm / MHz e.i.r.p.	Not required
		indoor client	14dBm / MHz e.i.r.p.	Not required
		subordinate device	20dBm / MHz e.i.r.p.	Not required
If transmitting antennas of directional gain greater than the antenna requirements column, the Maximum transmit power shall be reduced by the amount in dB that the directional gain of the antenna.				

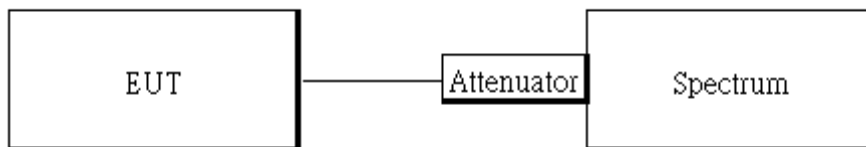
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FREQUENCY BAND (MHz)	EUT CATEGORY		RSS-247 §6.2.1~6.2.4	
			EIRP Density	Power Density
5150~5250		OEM devices installed in vehicles	N/A	N/A
	V	Other device	10 dBm/MHz	N/A
5250~5350		OEM devices installed in vehicles	N/A	N/A
		Other device	N/A	11 dBm/MHz
5725~5850	V	All	N/A	30 dBm/500kHz

For equipment operating in the band 5725-5850 MHz, If transmitting antennas of directional gain greater than 6 dBi are used, the Maximum transmit power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

10.2 Test Setup



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10.3 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to Spectrum.
4. **For U-NII1, U-NII-2A, U-NII-2C Band:**
Set RBW=1MHz, VBW=3MHz, where span is enough to capture the entire bandwidth, Sweep time = Auto (1001 pts), Detector = power averaging (rms), if available. Otherwise, use sample detector mode, traces 100 sweeps of video averaging. (SA-2 with the omission of procedure x, the integration with 26dB EBW bandwidth)
For U-NII-3 Band:
Set RBW=300kHz, VBW=1MHz, where span is enough to capture the entire bandwidth, Sweep time = Auto, detector = RMS or sample, traces 100 sweeps of video averaging.
In addition, measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10 \log(500 \text{ kHz/RBW})$ to the measured result.
5. Use the cursor on spectrum to peak search the highest level of trace
6. Record the max. reading and add $10 \log(1/\text{duty cycle})$.
7. Repeat above procedures until all default test channel (low, middle, and high) was complete.

The antenna gain is not greater than 6 dBi. Therefore, reduction of power is not required.

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10.4 Measurement Result

POWER DENSITY 802.11a MODE						
Frequency (MHz)	Ch0 meas PSD (dBm/MHz)	Duty Factor (dB)	Maxmum Corr'd PSD(dBm/MHz)		Limit	Margin (dB)
5180	8.50	0.13	8.63		11.00 dBm/MHz	-2.37
5220	8.40	0.13	8.53		11.00 dBm/MHz	-2.47
5240	8.11	0.13	8.24		11.00 dBm/MHz	-2.76
Frequency (MHz)	Ch0 meas PSD (dBm/300kHz)	Duty Factor (dB)	10log (500kHz/RBW) Factor(dB)	Maxmum Corr'd PSD (dBm/500kHz)	Limit	Margin (dB)
5745	3.68	0.13	2.22	6.03	30.00 dBm/500kHz	-23.97
5785	3.97	0.13	2.22	6.32	30.00 dBm/500kHz	-23.68
5825	4.17	0.13	2.22	6.52	30.00 dBm/500kHz	-23.48
POWER DENSITY 802.11n HT20 MODE						
Frequency (MHz)	Ch0 meas PSD (dBm/MHz)	Duty Factor (dB)	Maxmum Corr'd PSD(dBm/MHz)		Limit	Margin (dB)
5180	7.93	0.14	8.07		11.00 dBm/MHz	-2.93
5220	7.99	0.14	8.13		11.00 dBm/MHz	-2.87
5240	7.74	0.14	7.88		11.00 dBm/MHz	-3.12
Frequency (MHz)	Ch0 meas PSD (dBm/300kHz)	Duty Factor (dB)	10log (500kHz/RBW) Factor(dB)	Maxmum Corr'd PSD (dBm/500kHz)	Limit	Margin (dB)
5745	3.39	0.14	2.22	5.75	30.00 dBm/500kHz	-24.25
5785	3.74	0.14	2.22	6.10	30.00 dBm/500kHz	-23.90
5825	4.09	0.14	2.22	6.45	30.00 dBm/500kHz	-23.55
POWER DENSITY 802.11n HT40 MODE						
Frequency (MHz)	Ch0 meas PSD (dBm/MHz)	Duty Factor (dB)	Maxmum Corr'd PSD(dBm/MHz)		Limit	Margin (dB)
5190	2.10	0.29	2.39		11.00 dBm/MHz	-8.61
5230	4.42	0.29	4.71		11.00 dBm/MHz	-6.30
Frequency (MHz)	Ch0 meas PSD (dBm/300kHz)	Duty Factor (dB)	10log (500kHz/RBW) Factor(dB)	Maxmum Corr'd PSD (dBm/500kHz)	Limit	Margin (dB)
5755	0.38	0.29	2.22	2.89	30.00 dBm/500kHz	-27.11
5795	0.50	0.29	2.22	3.01	30.00 dBm/500kHz	-26.99

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POWER DENSITY 802.11ac VHT80 MODE						
Frequency (MHz)	Ch0 meas PSD (dBm/MHz)	Duty Factor (dB)	Maxmum Corr'd PSD(dBm/MHz)		Limit	Margin (dB)
5210	-2.79	0.55	-2.24		11.00 dBm/MHz	-13.24
Frequency (MHz)	Ch0 meas PSD (dBm/300kHz)	Duty Factor (dB)	10log (500kHz/RBW) Factor(dB)	Maxmum Corr'd PSD (dBm/500kHz)	Limit	Margin (dB)
5775	-2.83	0.55	2.22	-0.06	30.00 dBm/500kHz	-30.06

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EIRP spectral density 802.11a MODE					
Freq. (MHz)	PSD (dBm)	Ant. Gain (dBi)	EIRP PSD (dBm)	Limit (dBm)	Margin (dB)
5180	8.63	-2.84	5.79	10	-4.21
5220	8.53	-2.84	5.69	10	-4.31
5240	8.24	-2.84	5.40	10	-4.60
EIRP spectral density 802.11n HT20 MODE					
Freq. (MHz)	PSD (dBm)	Ant. Gain (dBi)	EIRP PSD (dBm)	Limit (dBm)	Margin (dB)
5180	8.07	-2.84	5.23	10	-4.77
5220	8.13	-2.84	5.29	10	-4.71
5240	7.88	-2.84	5.04	10	-4.96
EIRP spectral density 802.11n HT40 MODE					
Freq. (MHz)	PSD (dBm)	Ant. Gain (dBi)	EIRP PSD (dBm)	Limit (dBm)	Margin (dB)
5190	2.39	-2.84	-0.45	10	-10.45
5230	4.71	-2.84	1.87	10	-8.14
EIRP spectral density 802.11ac VHT80 MODE					
Freq. (MHz)	PSD (dBm)	Ant. Gain (dBi)	EIRP PSD (dBm)	Limit (dBm)	Margin (dB)
5210	-2.24	-2.84	-5.08	10	-15.08

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