RF TEST REPORT

SIEMIC
A Bureau Veritas Group Company

Report No.: RF_FCC_IC_SL19011103-SEV-111R2_W58
Supersede Report No.:

Applicant	:	Trilliant Networks, Inc.
Product Name	:	SecureMesh WAN Connector
Model No.	:	CONN-2000
Test Standard	:	47 CFR 15.407 RSS 247 Issue 2, Feb 2017
Test Method	:	ANSI C63.10: 2013 RSS Gen Iss 5: April 2018 789033 D02 General UNII Test Procedures New Rules v01r02
FCC ID	:	TMB-CONN2000
IC	:	6028A-CONN2000
Dates of test	:	02/25/2019 - 03/22/2019
Issue Date	:	03/22/2019
Test Result	:	☒ Pass ☐ Fail
Equipment complied with the specification [X] Equipment did not comply with the specification [ ]		

This Test Report is Issued Under the Authority of:	
Gary Chou	
Gary Chou	**Chen Ge**
Test Engineer	Engineer Reviewer
This test report may be reproduced in full only **Test result presented in this test report is applicable to the tested sample only**	

Issued By:
SIEMIC Laboratories
775 Montague Expressway, Milpitas, 95035 CA

ilac-MRA
A2LA ACCREDITED
TESTING CERT # 2742-01

Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.

In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Accreditation Body	Scope
USA	FCC, A2LA	EMC, RF/Wireless, Telecom
Canada	IC, A2LA, NIST	EMC, RF/Wireless, Telecom
Taiwan	BSMI, NCC, NIST	EMC, RF, Telecom, Safety
Hong Kong	OFTA, NIST	RF/Wireless, Telecom
Australia	NATA, NIST	EMC, RF, Telecom, Safety
Korea	KCC/RRA, NIST	EMI, EMS, RF, Telecom, Safety
Japan	VCCI, JATE, TELEC, RFT	EMI, RF/Wireless, Telecom
Mexico	NOM, COFETEL, Caniety	Safety, EMC, RF/Wireless, Telecom
Europe	A2LA, NIST	EMC, RF, Telecom, Safety
Israel	MOC, NIST	EMC, RF, Telecom, Safety

Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & RED
Japan	MIC (RCB 208)	RF, Telecom
Hong Kong	OFTA (US002)	RF, Telecom

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1 Report Revision History

Report No.	Report Version	Description	Issue Date
RF_FCC_IC_SL19011103-SEV-111R2_W58	None	Original	03/22/2019

2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Trilliant Networks, Inc.
Product: SecureMesh WAN Connector
Model: CONN-2000

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

3 Customer information

FCC Applicant Name	Trilliant Networks
FCC Applicant Address	401 Harrison Oaks Blvd., Suite 300 Cary, NC 27513 USA
Manufacturer Name	Trilliant Networks
Manufacturer Address	401 Harrison Oaks Blvd., Suite 300 Cary, NC 27513 USA

IC Applicant Name	Trilliant Networks, Inc.
IC Applicant Address	610Rue Du Luxembourg Street, Granby QC J2J 2V2 Canada
Manufacturer Name	Trilliant Networks, Inc.
Manufacturer Address	610Rue Du Luxembourg Street, Granby QC J2J 2V2 Canada

4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	540430
IC Test Site No.	4842D
VCCI Test Site No.	A0133

5 Modification

Index	Item	Description	Note
-	-	-	-

6 EUT Information

6.1 EUT Description

Product Name	SecureMesh WAN Connector
Model No.	CONN-2000
Trade Name	Trilliant
Serial No.	FC00000002
Input Power	48VDC (PoE)
Date of EUT received	02/06/2019
Equipment Class/ Category	UNII
Port/Connectors	PoE, Ethernet

6.2 Radio Description

Radio Type	802.11a	802.11n20	802.11n40
Operating Frequency	5745-5825MHz	5745-5825MHz	5755-5795MHz
Modulation	OFDM (BPSK, QPSK, 16QAM, 64QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM)
Channel Spacing	20MHz	20MHz	40MHz
Number of Channels	4	4	2
Antenna Type	Panel Antenna		
Antenna Gain (Peak)	17.0 dBi (band 4)		
Antenna Connector Type	MMCX		
Note	This is a Outdoor device. 802.11n20/40 is 2x2 MIMO configuration. The 17 dBi antenna allows for point to point communication with another SecureMesh device. It connects internally to the 802.11n radio module and has no accessible external RF ports. 2.4GHz and 5GHz Radio transmit simultaneously		

EUT Power level setting :

Mode	Frequency	Power Setting
802.11-a	5745	26
802.11-a	5785	26
802.11-a	5825	26
802.11-n-20	5745	25
802.11-n-20	5785	25
802.11-n-20	5825	25
802.11-n-40	5755	25
802.11-n-40	5795	25

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	N17Q1	NXGNPAA0167300AA597600	Acer	N/A
2	POE Adapter	740-64214-001	N/A	Ruckus	-

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
1	EUT	RJ45	POE	RJ45	10	N/A	-
2	POE	RJ45	Laptop	RJ45	1	N/A	-

7.3 Test Software Description

Test Item	Software	Description
RF Testing	Putty	Set the EUT to transmit continuously in diferent test modes and channels

8 Test Summary

Test Item	Test standard		Test Method/Procedure	Pass / Fail
Restricted Band of Operation	FCC/IC	15.205 RSS 247 (2.2)	ANSI C63.4 – 2014 789033 D02 General UNII Test Procedures New Rules v01r02	☒ Pass ☐ N/A
AC Conducted Emissions Voltage	FCC/IC	15.207(a) RSS Gen Issue 4 (8.8)	ANSI C63.4 – 2014 RSS Gen Iss 5: April 2018	☒ Pass ☐ N/A

Test Item	Test standard		Test Method/Procedure	Pass / Fail
26 & 6 dB Emission Bandwidth	FCC	15.407 RSS 247	789033 D02 General UNII Test Procedures New Rules v01r02	☒ Pass ☐ N/A
99% Bandwidth	IC	RSS 247	RSS Gen Iss 5: April 2018	☒ Pass ☐ N/A
Maximum conducted Output Power	FCC/IC	15.407 RSS 247	789033 D02 General UNII Test Procedures New Rules v01r02	☒ Pass ☐ N/A
Power reduction (Antenna Gain > 6 dBi)	FCC/IC	15.407 RSS 247	789033 D02 General UNII Test Procedures New Rules v01r02	☒ Pass ☐ N/A
Band Edge and Radiated Spurious Emissions	FCC/IC	15.407 RSS 247	ANSI C63.4 – 2014 789033 D02 General UNII Test Procedures New Rules v01r02	☒ Pass ☐ N/A
Power Spectral Density	FCC/IC	15.407 RSS 247	789033 D02 General UNII Test Procedures New Rules v01r02	☒ Pass ☐ N/A
Frequency Stability	FCC/IC	15.407 RSS 247	789033 D02 General UNII Test Procedures New Rules v01r02	☐ Pass ☒ N/A
Transmit Power Control (TPC)	FCC/IC	15.407 RSS 247	789033 D02 General UNII Test Procedures New Rules v01r02	☐ Pass ☒ N/A
Remark	1. All measurement uncertainties are not taken into consideration for all presented test result. 2. The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual.			

9 Measurement Uncertainty

9.1 Radiated Emissions (30MHz to 1GHz)

The test is to measure the radiated emissions of the EUT.
Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- NSA Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Filter Insertion Loss	0.25	Normal	2	1	0.125
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.86605081
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
NSA Calibration	4.0	U-Shape	1.414	1	2.8288543
Combined Standard Uncertainty					3.0059131
Expanded Uncertainty (K=2)					**6.0118262**

The total derived measurement uncertainty is +/- 6.00 dB.

9.2 Radiated Emissions (1GHz to 40GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- VSWR Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.0692840
Cable Insertion Loss	0.21	Normal	2	1	0.1050000
Filter Insertion Loss	0.25	Normal	2	1	0.1250000
Antenna Factor	0.65	Normal	2	1	0.3250000
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.8660508
PRF Response	1.5	Rectangular	1.732	1	0.8660508
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
VSWR Calibration	2.0	U-Shape	1.414	1	1.4144272
Combined Standard Uncertainty					4.2363
Expanded Uncertainty (K=2)					**8.4726**

The total derived measurement uncertainty is +/- 8.47 dB.

9.3 RF conducted measurement

The test is to measure the RF output power from the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the Reference Level Uncertainty
- Uncertainty of variable attenuators
- Uncertainty of cables
- Uncertainty due to the mismatches

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Reference Level	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Attenuator	0.25	Normal	2	1	0.125
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.476087
Expanded Uncertainty (K=2)					**0.952174**

The total derived measurement uncertainty is +/- 0.95 dB.

10 Measurements, Examination and Derived Results

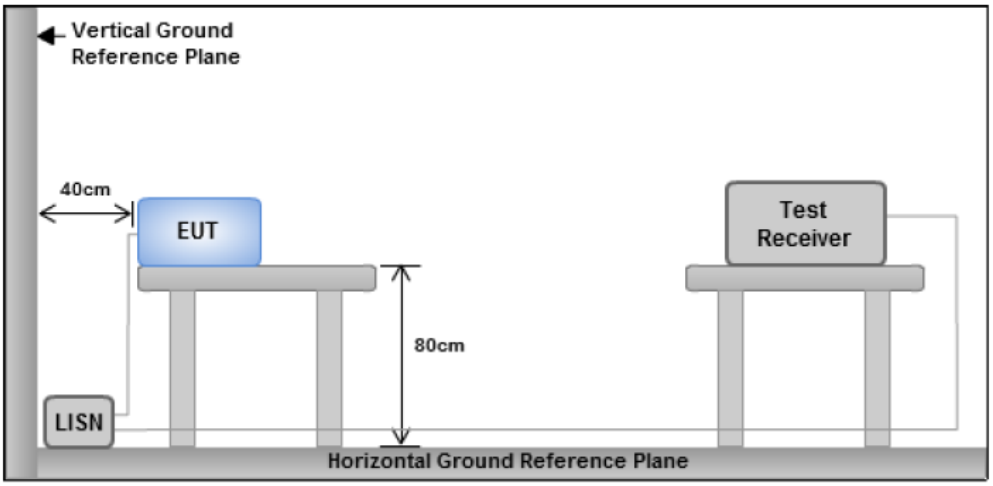
10.1 Antenna Requirement

Spec	Requirement	Applicable
§15.203	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. Antenna requirement must meet at least one of the following: a) Antenna must be permanently attached to the device. b) Antenna must use a unique type of connector to attach to the device. c) Device must be professionally installed. Installer shall be responsible for ensuring that the correct antenna is employed with the device.	☒
Remark	The EUT uses MMCX connector for antenna connection which meet the requirement.	
Result	☒ PASS ☐ FAIL	

10.2 Conducted Emissions

Conducted Emission Limit

Frequency ranges (MHz)	Limit (dBuV)	
	QP	Average
0.15 ~ 0.5	66 – 56	56 – 46
0.5 ~ 5	56	46
5 ~ 30	60	50

Spec	Item	Requirement	Applicable
FCC 15.207	a)	For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.	☒
Test Setup	 Note: 1. Support units were connected to second LISN. 2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes		
Procedure	- The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B. - The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains. - The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable. - All other supporting equipment was powered separately from another main supply.		
Remark	EUT was tested at 120VAC, 60Hz		
Result	☒ Pass ☐ Fail		

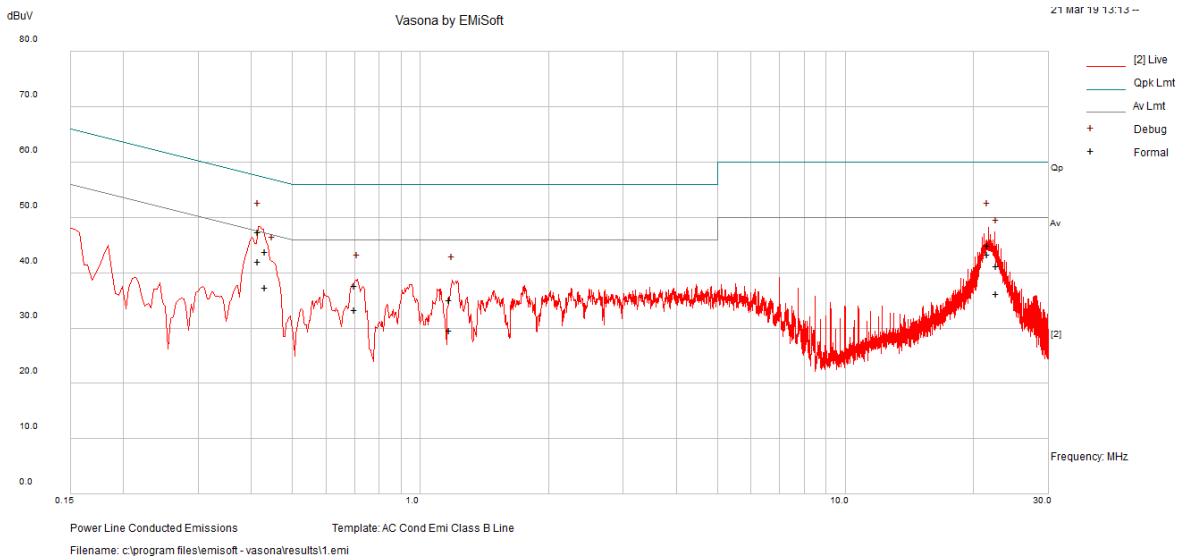
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Gary Chou at Conducted Emission test site.

Conducted Emission Test Results

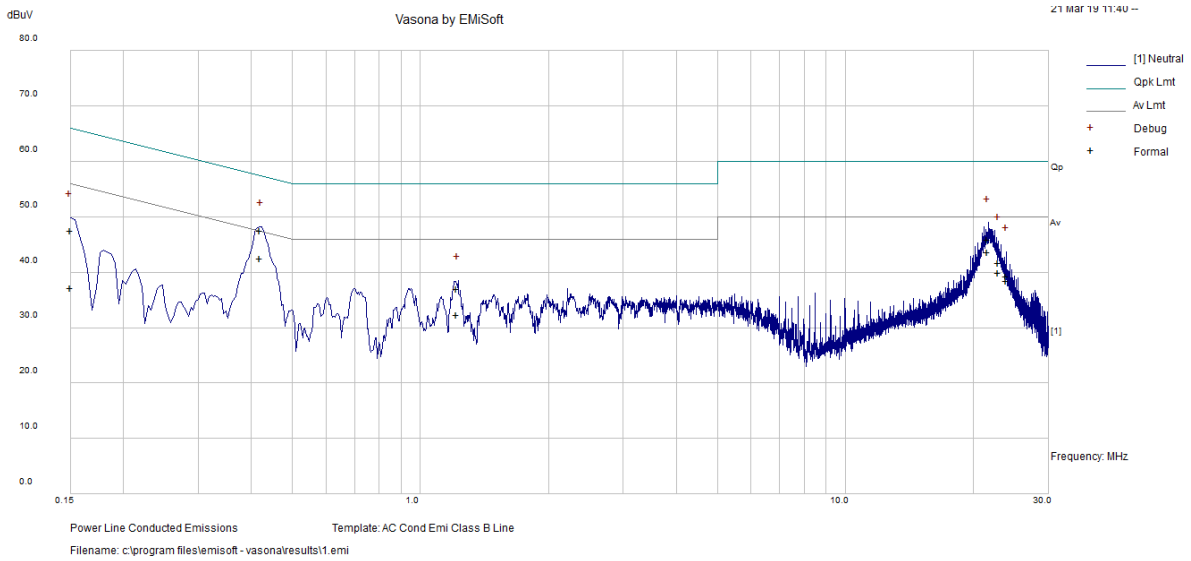
Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Gary Chou			
Test Date:	03/21/2019			
Remarks	Line			



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.416838	40.08	7.31	0.04	47.44	Quasi Peak	Line	57.51	-10.07	Pass
21.70577	35.57	8.97	0.49	45.03	Quasi Peak	Line	60	-14.97	Pass
0.431808	36.53	7.32	0.04	43.89	Quasi Peak	Line	57.22	-13.32	Pass
22.70448	31.8	9	0.51	41.31	Quasi Peak	Line	60	-18.69	Pass
0.702156	30.2	7.51	0.04	37.76	Quasi Peak	Line	56	-18.24	Pass
1.171792	27.28	7.73	0.05	35.05	Quasi Peak	Line	56	-20.95	Pass
0.416838	34.77	7.31	0.04	42.12	Average	Line	47.51	-5.39	Pass
21.70577	33.87	8.97	0.49	43.34	Average	Line	50	-6.66	Pass
0.431808	30.02	7.32	0.04	37.38	Average	Line	47.22	-9.83	Pass
22.70448	26.66	9	0.51	36.17	Average	Line	50	-13.83	Pass
0.702156	25.8	7.51	0.04	33.35	Average	Line	46	-12.65	Pass
1.171792	21.74	7.73	0.05	29.51	Average	Line	46	-16.49	Pass

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Gary Chou			
Test Date:	03/21/2019			
Remarks	Neutral			

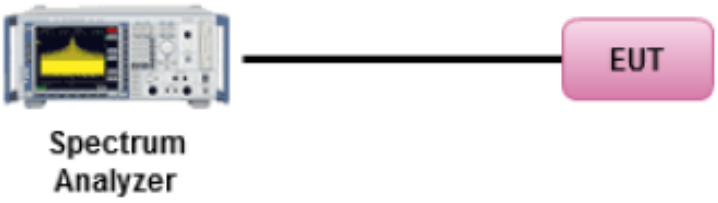


Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.419988	40.25	7.31	0.04	47.6	Quasi Peak	Neutral	57.45	-9.84	Pass
21.70434	36.5	8.97	0.49	45.97	Quasi Peak	Neutral	60	-14.03	Pass
22.95001	32.23	9	0.51	41.74	Quasi Peak	Neutral	60	-18.26	Pass
0.150386	40.43	7.11	0.05	47.59	Quasi Peak	Neutral	65.98	-18.38	Pass
23.94777	29.74	9	0.53	39.26	Quasi Peak	Neutral	60	-20.74	Pass
1.218132	29.29	7.74	0.05	37.08	Quasi Peak	Neutral	56	-18.92	Pass
0.419988	35.18	7.31	0.04	42.53	Average	Neutral	47.45	-4.92	Pass
21.70434	34.21	8.97	0.49	43.67	Average	Neutral	50	-6.33	Pass
22.95001	30.35	9	0.51	39.87	Average	Neutral	50	-10.13	Pass
0.150386	30.02	7.11	0.05	37.18	Average	Neutral	55.98	-18.8	Pass
23.94777	29.04	9	0.53	38.57	Average	Neutral	50	-11.43	Pass
1.218132	24.53	7.74	0.05	32.33	Average	Neutral	46	-13.67	Pass

10.3 26 dB Bandwidth & 6 dB Bandwidth

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.407 RSS 247	-	26 dB Emission BW: Report only for reference.	☐
	a) (2)	26 dB Emission BW: Report only for power limit calculation.	☐
	e)	Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.	☒

Test Setup				

Test Procedure	789033 D02 General UNII Test Procedures New Rules v01r02
	
	6 dB Minimum emission bandwidth measurement procedure (for 5.725-5.85 GHz)
	- Allow the trace to stabilize.
	- Use the spectrum analyzer built-in measurement function to determine the 6dB BW.
	  ○ Set RBW = 100 KHz
	  ○ Set VBW ≥ 3 x RBW
	  ○ Detector = Peak
	  ○ Trace mode = max hold
	  ○ Sweep = auto couple
	- Capture the plot.
	- Repeat above steps for different test channel and other modulation type.			

Test Date	02/26/2019	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	22ºC 38% 1020mbar
Remark	-			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes ☐ N/A
Test Plot ☒ Yes ☐ N/A

Test was done by Rachana Khanduri at RF test site.

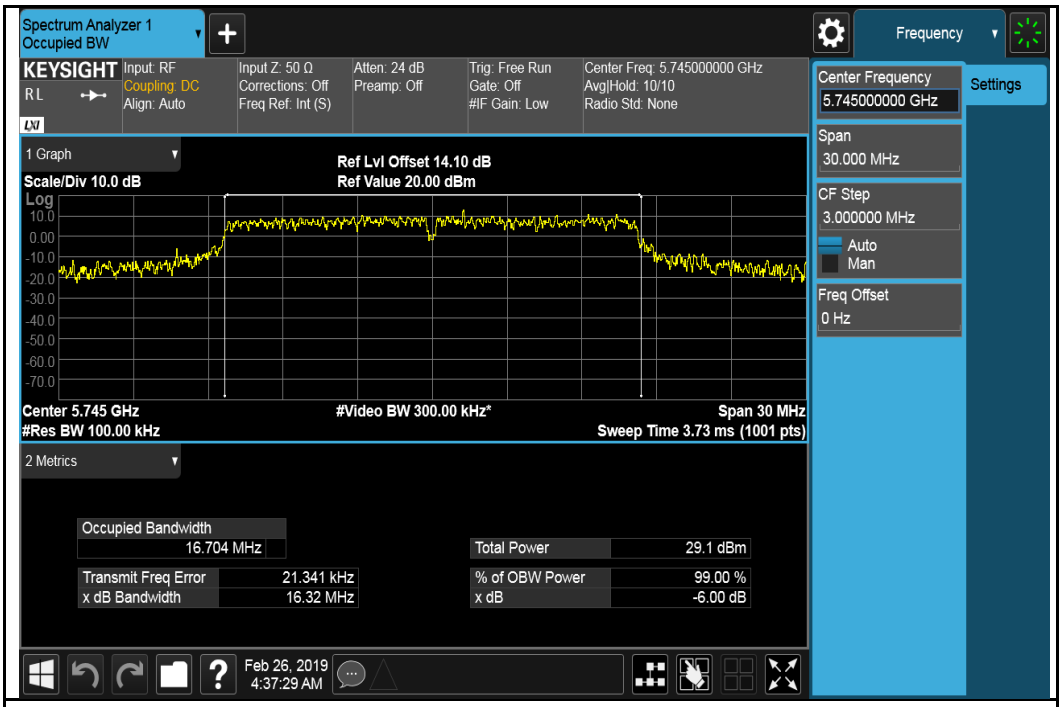
6dB Bandwidth measurement result for 5.8GHz

Type	Test mode	Freq (MHz)	CH	Result (MHz)	Limit (MHz)	Result
6dB BW	802.11a	5745	Low	16.32	≥0.5	Pass
		5785	Mid	16.39	≥0.5	Pass
		5825	High	16.31	≥0.5	Pass
	802.11n-20	5745	Low	17.57	≥0.5	Pass
		5785	Mid	17.20	≥0.5	Pass
		5825	High	17.61	≥0.5	Pass
	802.11n-40	5755	Low	35.70	≥0.5	Pass
		5795	High	35.11	≥0.5	Pass

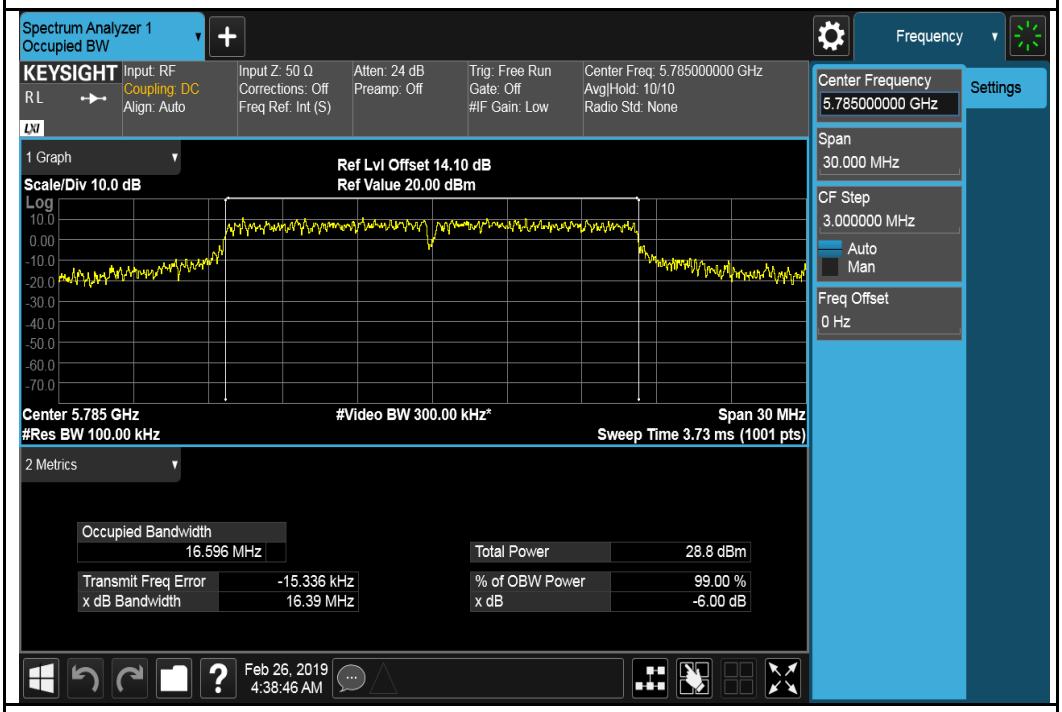
99% Bandwidth measurement result for 5.8GHz

Type	Test mode	Freq (MHz)	CH	Result (MHz)	Limit (MHz)	Result
99% OBW	802.11a	5745	Low	16.704	-	Pass
		5785	Mid	16.596	-	Pass
		5825	High	16.514	-	Pass
	802.11n-20	5745	Low	17.779	-	Pass
		5785	Mid	17.771	-	Pass
		5825	High	17.753	-	Pass
	802.11n-40	5755	Low	36.264	-	Pass
		5795	High	36.275	-	Pass

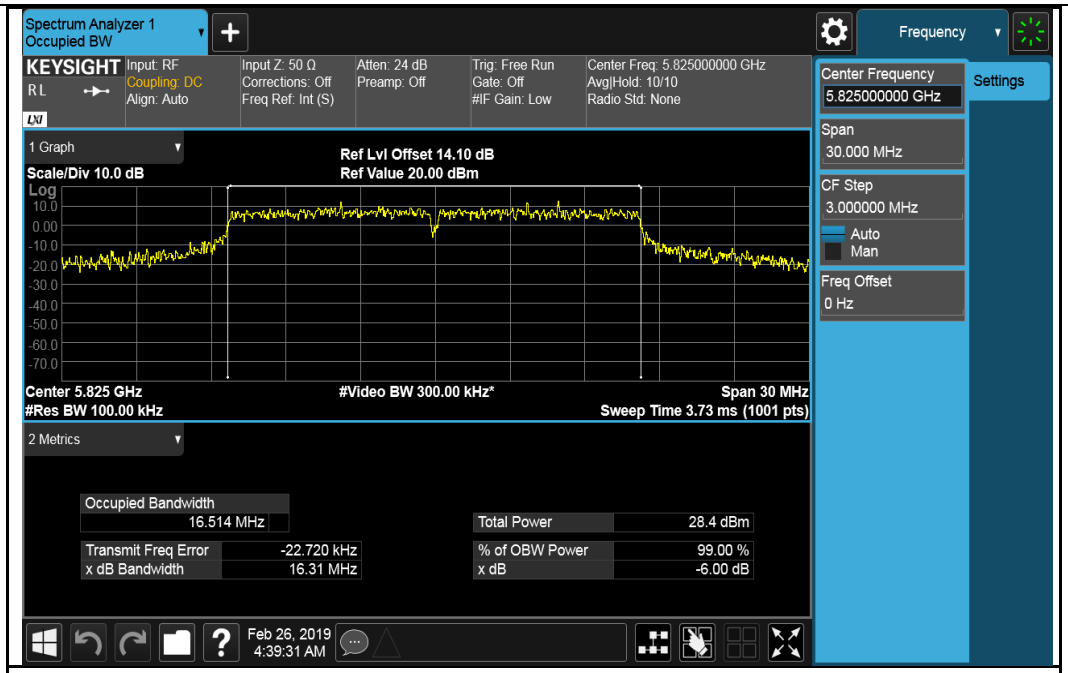
Occupied Bandwidth Test Plots
W58:



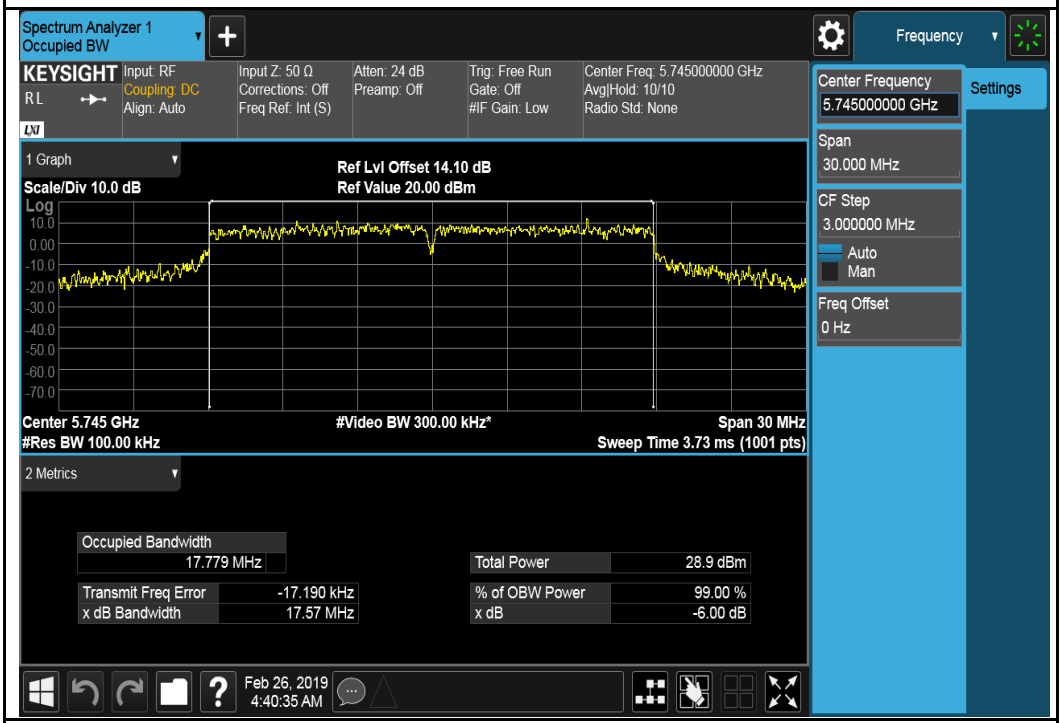
802.11a-5745MHz



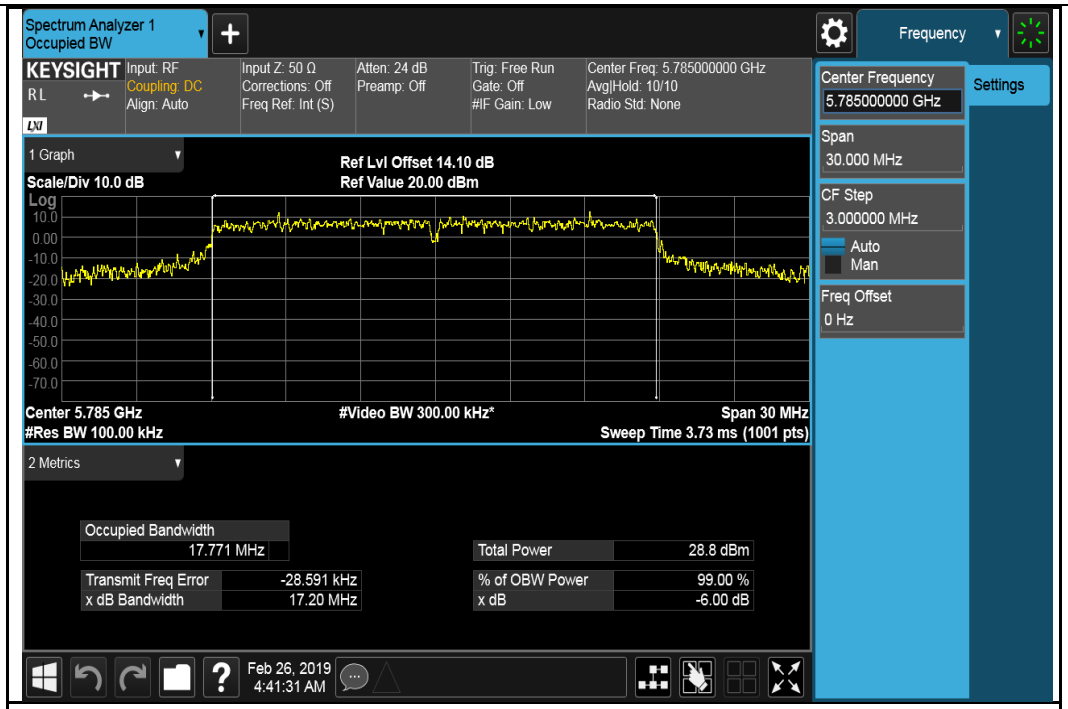
802.11a-5785MHz



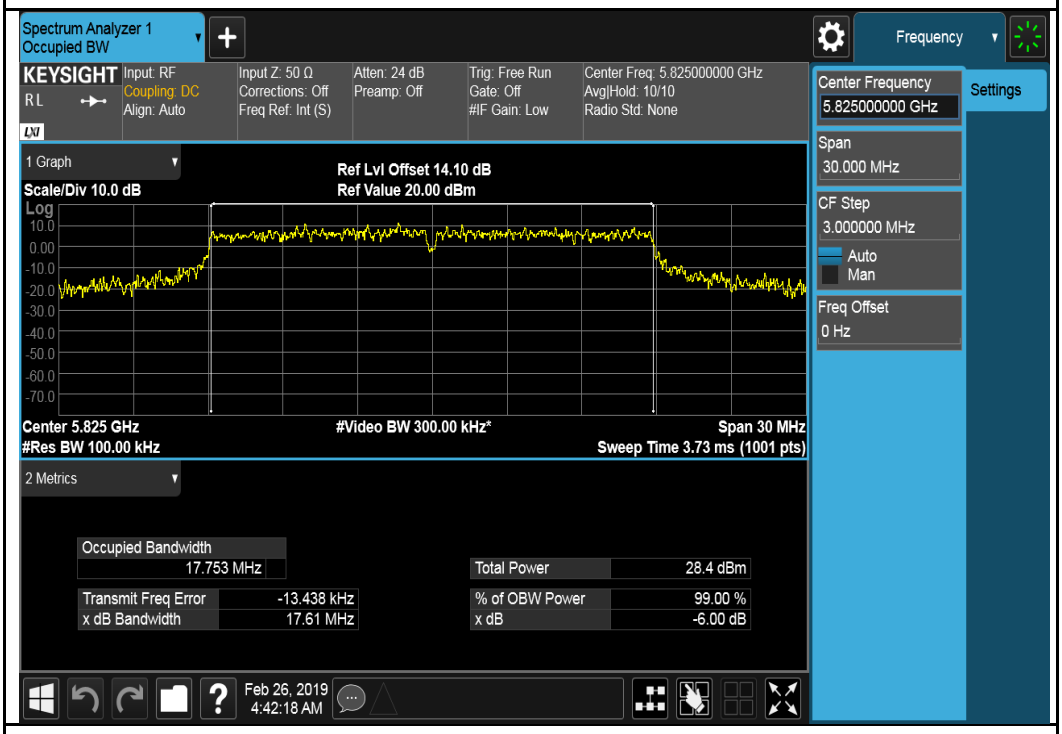
802.11a-5825MHz



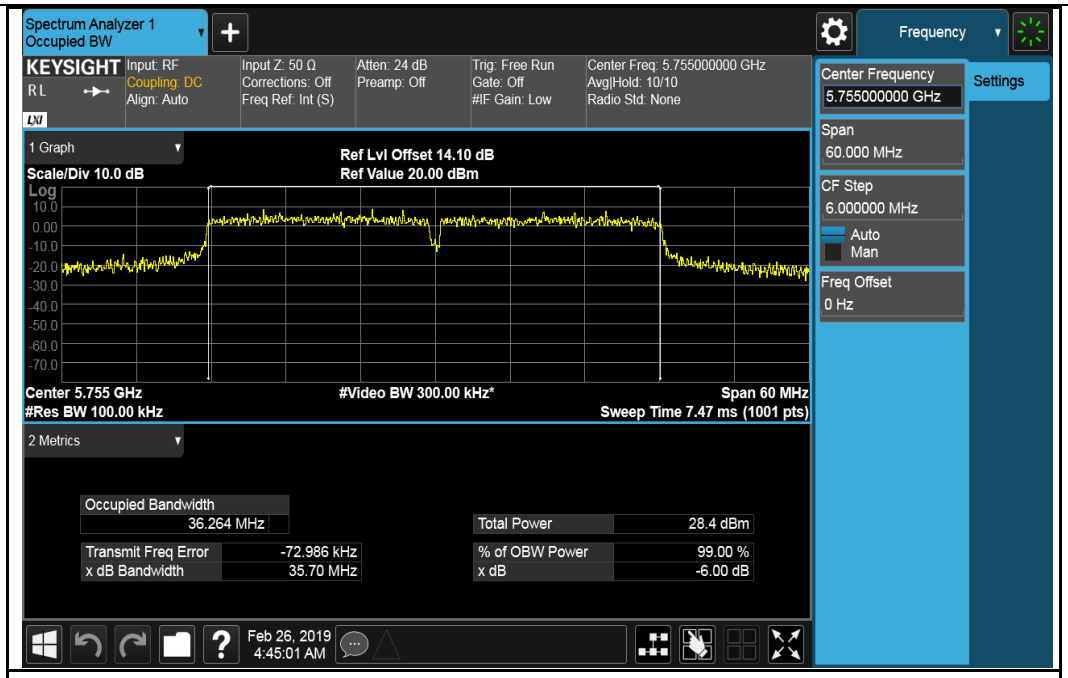
802.11n20-5745MHz



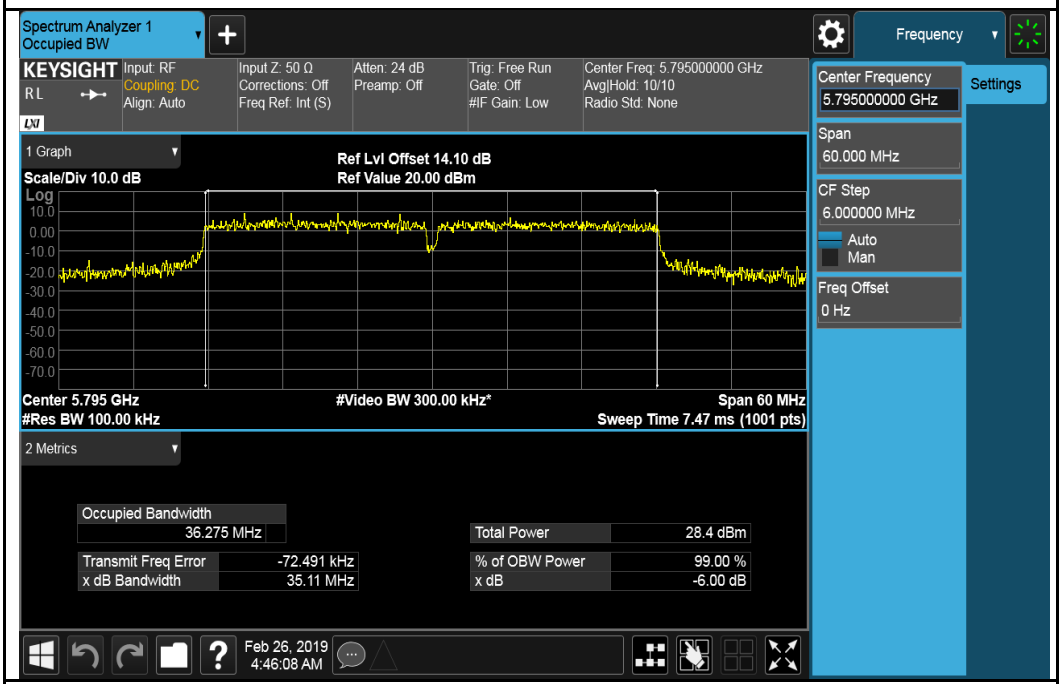
802.11n20-5785MHz



802.11n20-5825MHz



802.11n40-5755MHz

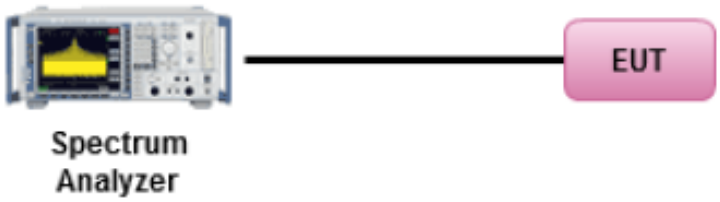


802.11n40-5795MHz

10.4 Output Power

Requirement(s):

Spec	Item	Requirement	Applicable
	a)(3)	For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.	☒

Test Setup				
Test Procedure	789033 D02 General UNII Test Procedures New Rules v01r02 Measurement using a Spectrum Analyzer or EMI Receiver (SA) Method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep): (i) Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal. (ii) Set RBW = 1 MHz (iii) Set VBW = 3 MHz (iv) Number of points in sweep ≥ 2 × span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.) (v) Sweep time = auto. (vi) Detector = power averaging (rms), if available. Otherwise, use sample detector mode. (vii) If transmit duty cycle < 98%, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run." (viii) Trace average at least 100 traces in power averaging (rms) mode. (ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.			
Test Date	02/26/2019	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	21°C 40% 1019mbar
Remark	The EUT has 2 antennas with 1 vertical and 1 horizontal, individual gain = 17dBi. EUT is pont to point, therefore, no limit adjustment is required. 802.11a is SISO and only 802.11n20/40 is 2x2 MIMO configuration.			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Rachana Khanduri at RF test site.

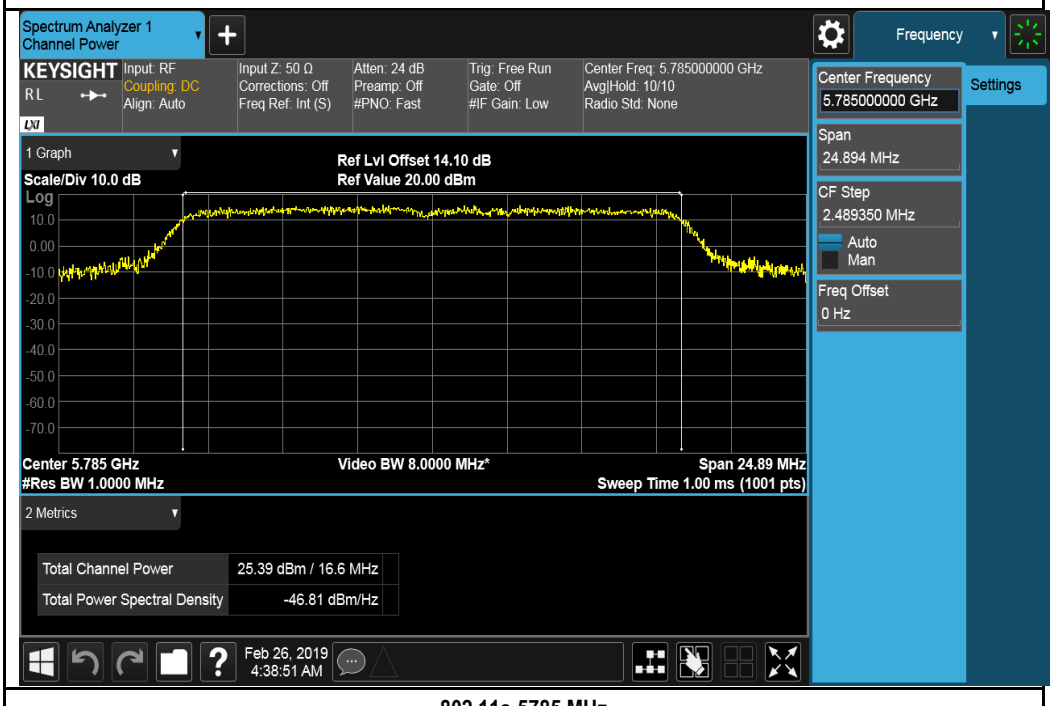
Output Power measurement result for 5.8GHz

Type	Test mode	Freq (MHz)	CH	Conducted Power (dBm)			Limit (dBm)	Result
				Chain0	Chain1	Combined Power		
Output power	802.11a	5745	Low	25.84	-	25.85	30	Pass
		5785	Mid	25.39	-	25.40	30	Pass
		5825	High	24.77	-	24.79	30	Pass
	802.11n-HT20	5745	Low	25.71	26.16	28.95	30	Pass
		5785	Mid	25.31	25.55	28.44	30	Pass
		5825	High	24.63	24.66	27.66	30	Pass
	802.11n-HT40	5755	Low	26.06	26.02	29.05	30	Pass
		5795	Mid	25.94	26.12	29.04	30	Pass

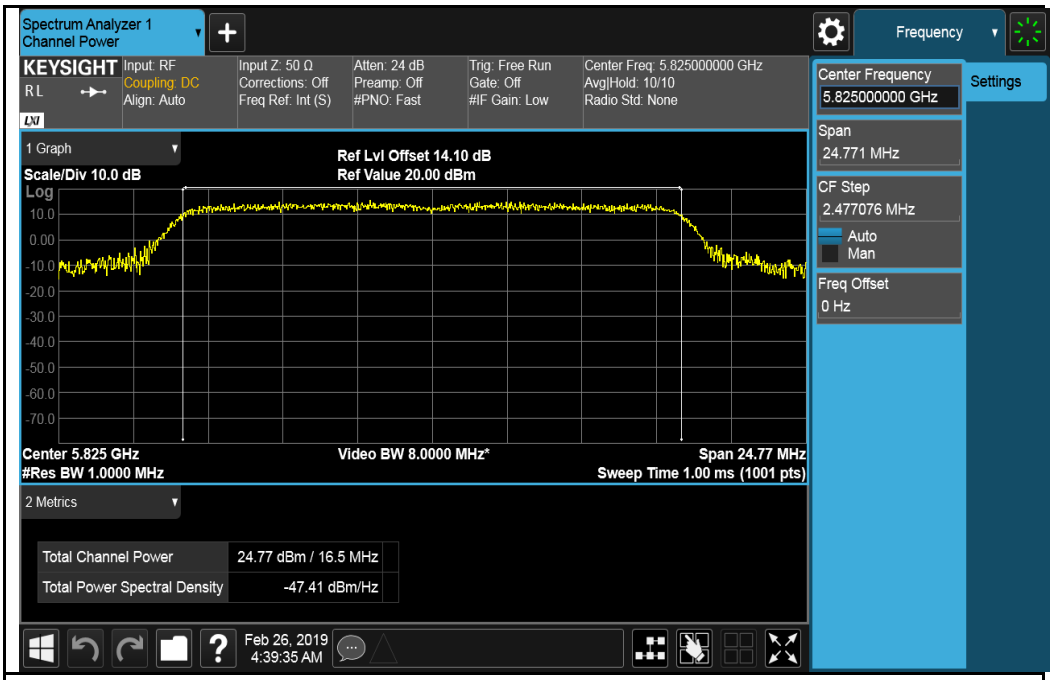
Test Plot for W58:

Chain 0:

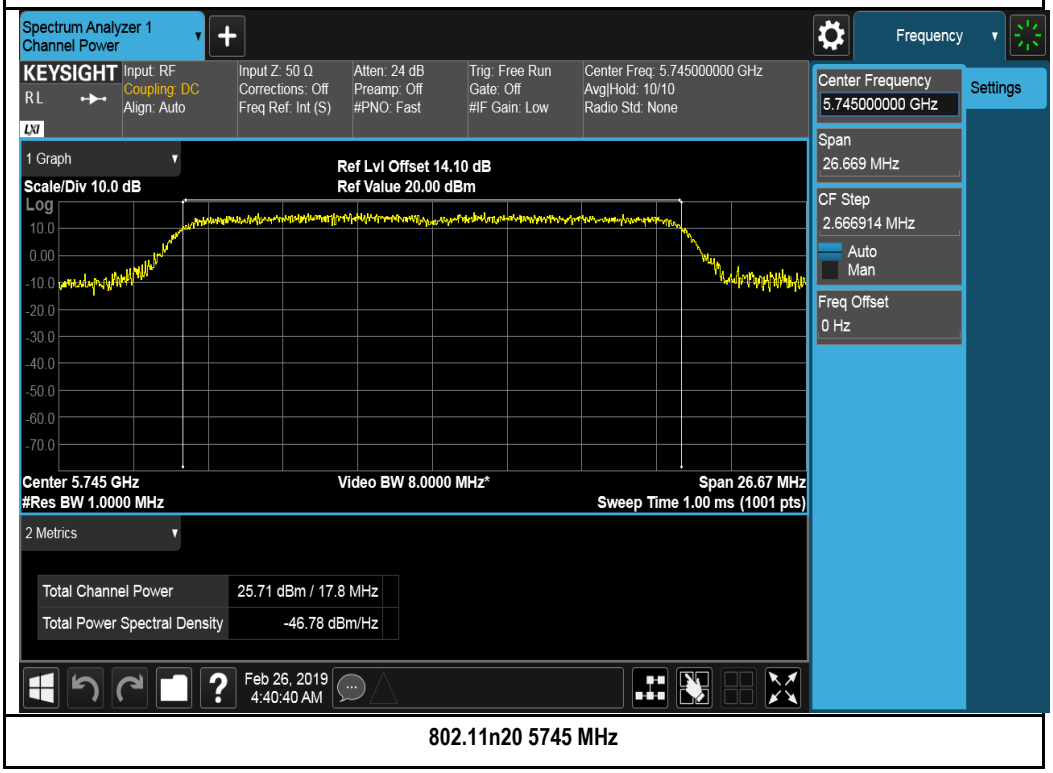
802.11a-5745MHz



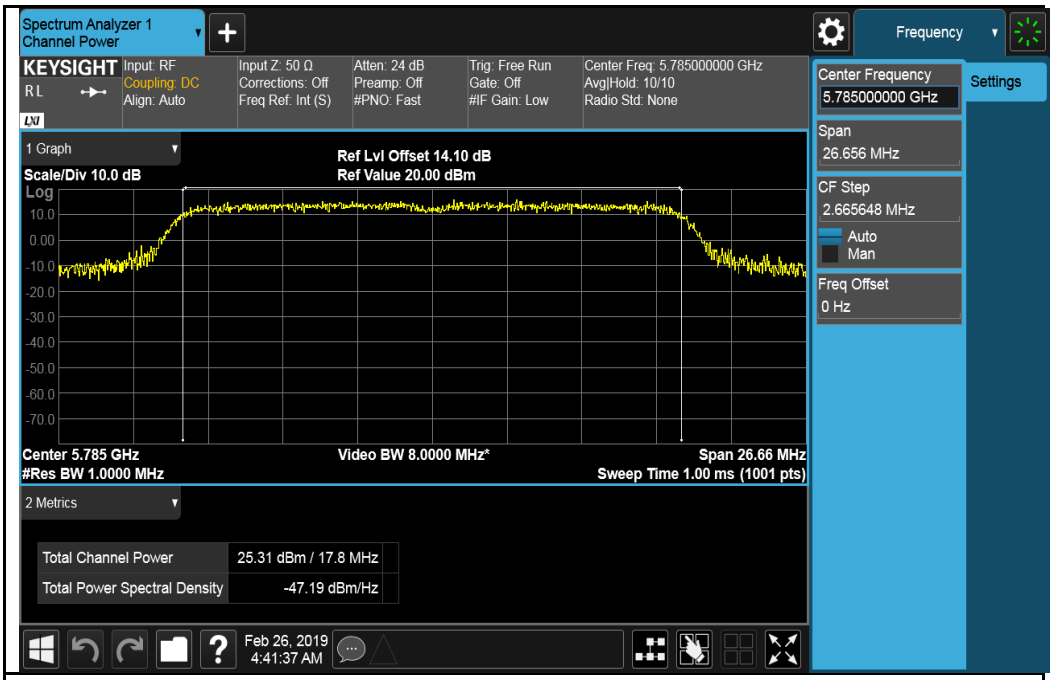
802.11a-5785 MHz



802.11a-5825 MHz



802.11n20 5745 MHz



802.11n20 5785 MHz

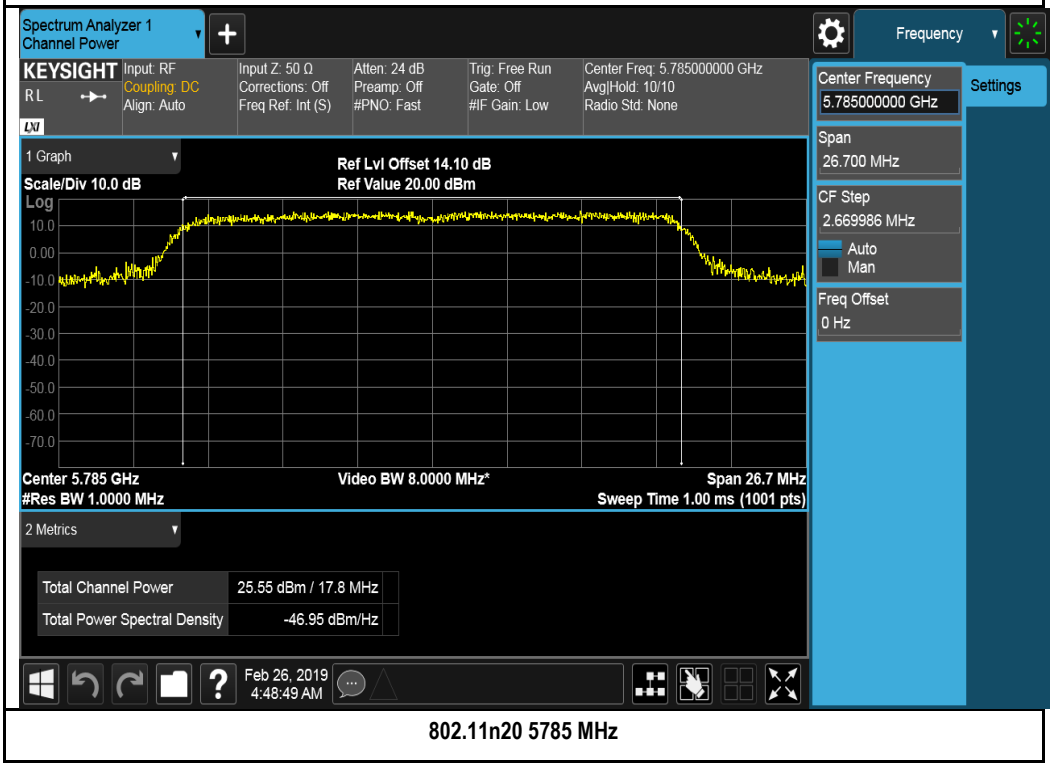
802.11n20 5825 MHz

802.11n40 5755 MHz

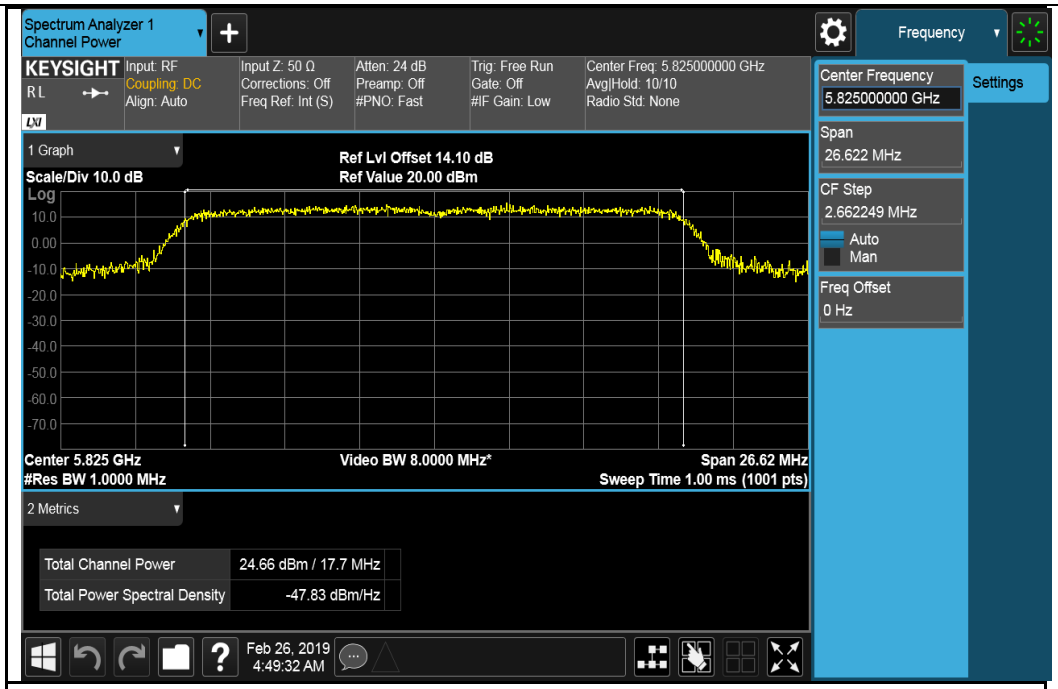
802.11n40 5795 MHz

Chain 1:

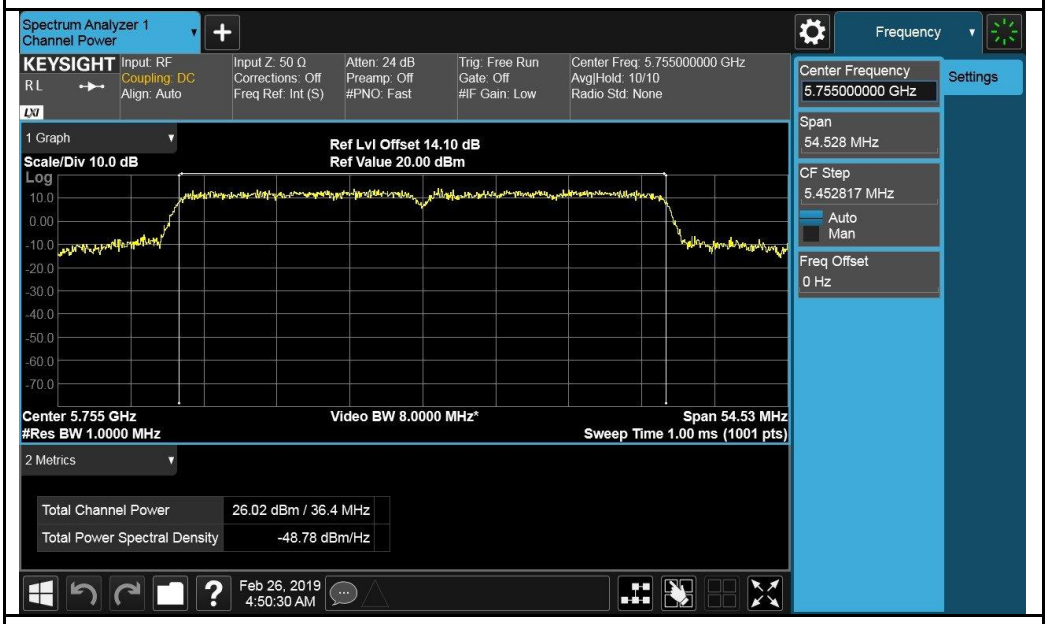
802.11n20 5745 MHz



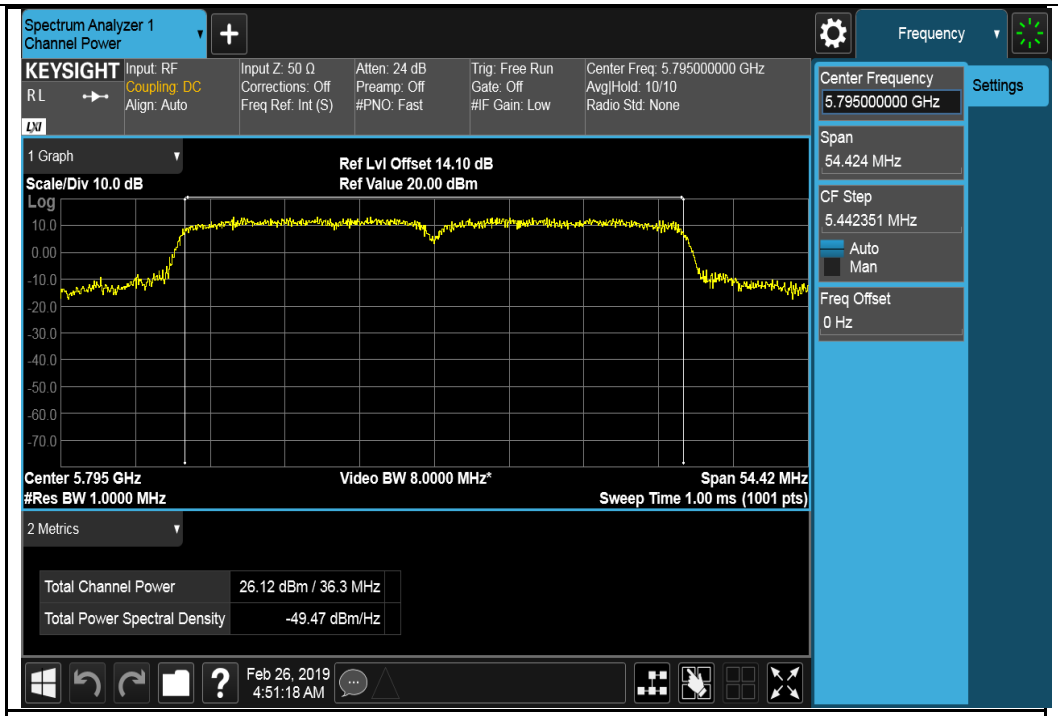
802.11n20 5785 MHz



802.11n20 5825 MHz



802.11n40 5755 MHz

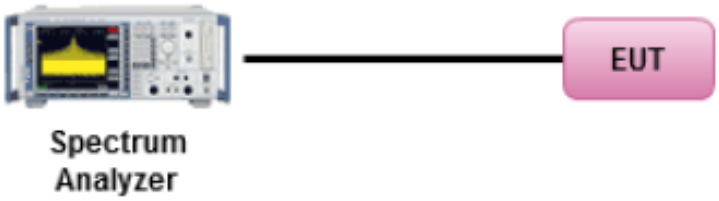


802.11n40 5795 MHz

10.5 Peak Spectral Density

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.407 RSS 247	a)(1)(i)	For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.	☐
	a)(3)	For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.	☒

Test Setup				
Test Procedure	789033 D02 General UNII Test Procedures New Rules v01r02, II.F. Method SA-1 Maximum spectral density measurement procedure - Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal. - Set RBW = 1 MHz - Set VBW ≥ 3 MHz - Detector = RMS. - Sweep time = auto couple. - Trace mode = max hold. - Trace average at least 100 traces in power averaging - Use the peak marker function to determine the maximum amplitude level within the RBW. Apply correction to the result if different RBW is used.			
Test Date	02/26/2019	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	22ºC 42% 1020mbar
Remark	The EUT has 2 antennas with 1 vertical and 1 horizontal, individual gain = 17dBi. 802.11a is SISO and only 802.11n20/40 is 2x2 MIMO configuration.			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

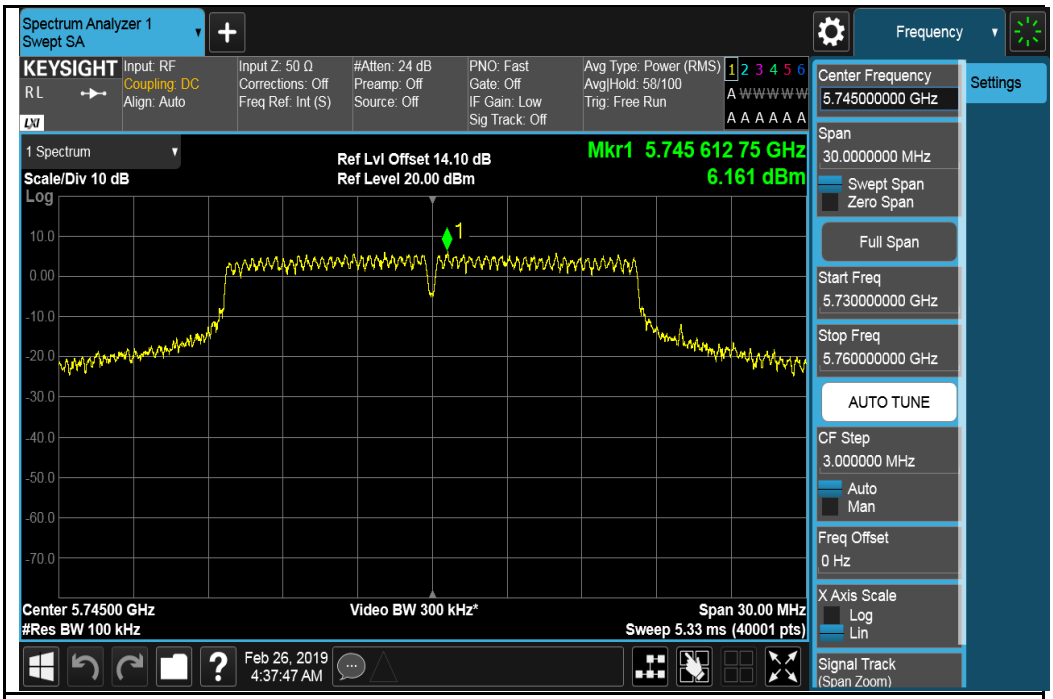
Test was done by Rachana Khanduri at RF test site.

PSD measurement result for 5.8GHz:

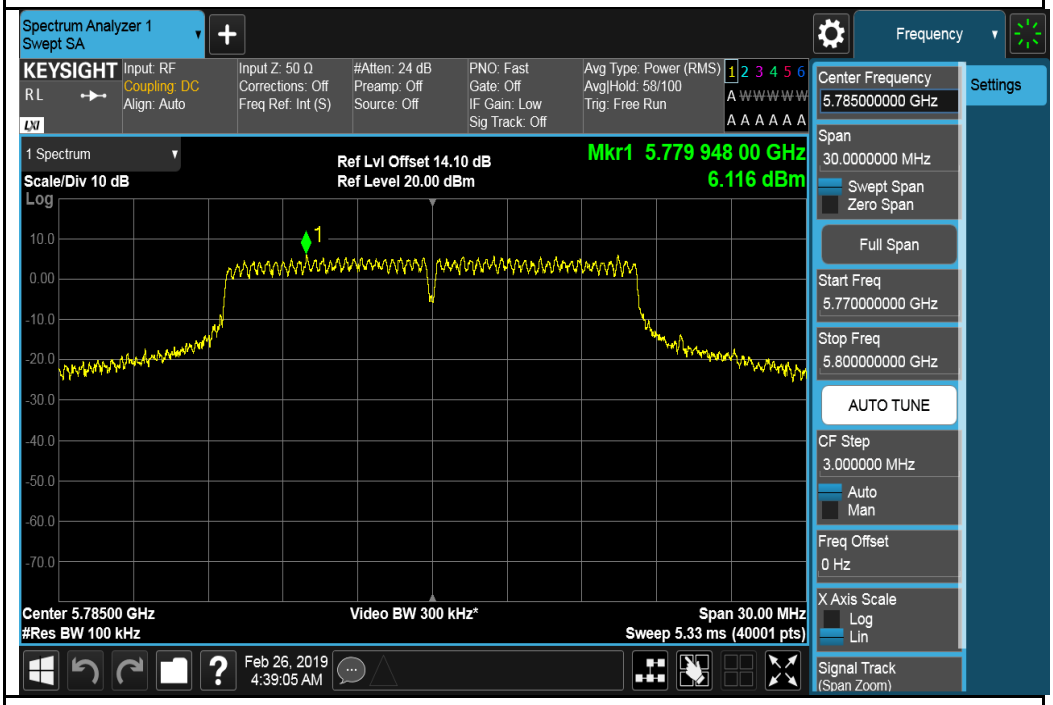
Test mode	Freq (MHz)	CH	Conducted PSD (dBm/MHz)			Correction factor (dB)	Total (dBm/500kHz)	Limit (dBm/500kHz)	Result
			Chain0	Chain1	Combined Power				
802.11a	5745	Low	6.16	-	7.10	6.99	14.09	30	Pass
	5785	Mid	6.12	-	7.07	6.99	14.06	30	Pass
	5825	High	5.19	-	6.34	6.99	13.33	30	Pass
802.11n-HT20	5745	Low	5.73	6.48	9.13	6.99	16.12	30	Pass
	5785	Mid	5.97	6.04	9.02	6.99	16.01	30	Pass
	5825	High	5.08	5.25	8.18	6.99	15.17	30	Pass
802.11n-HT40	5755	Low	2.77	3.54	6.18	6.99	13.17	30	Pass
	5795	High	2.93	2.81	5.88	6.99	12.87	30	Pass
Note	BW correction factor = 10log(500kHz/RBW), RBW was set to 100kHz during test.								

Test Plot for W58:

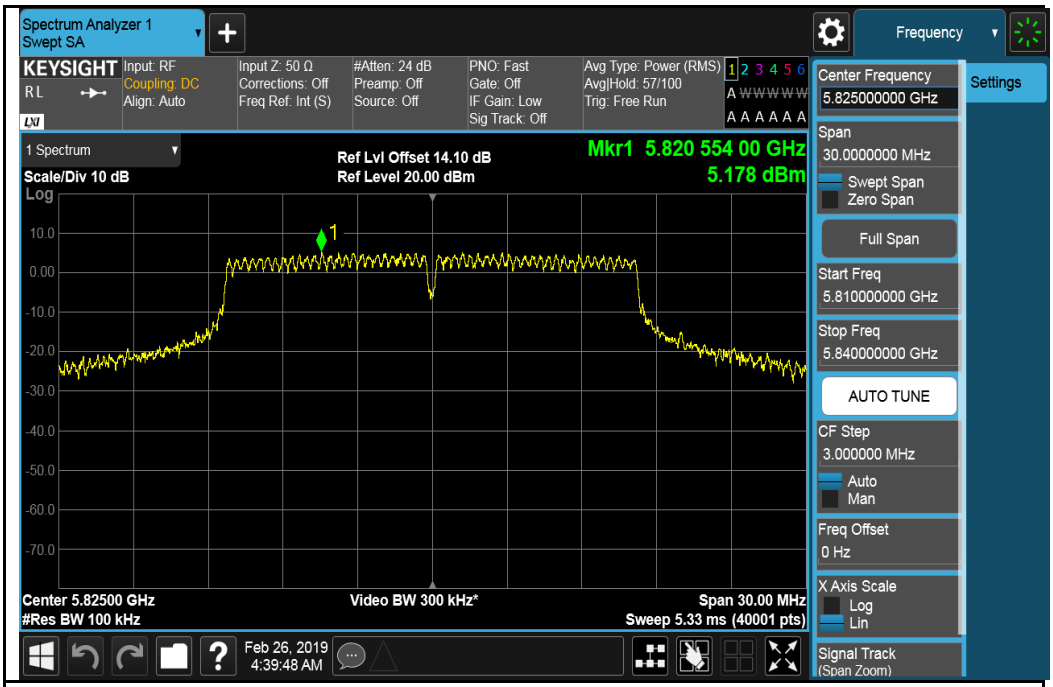
Chain 0:



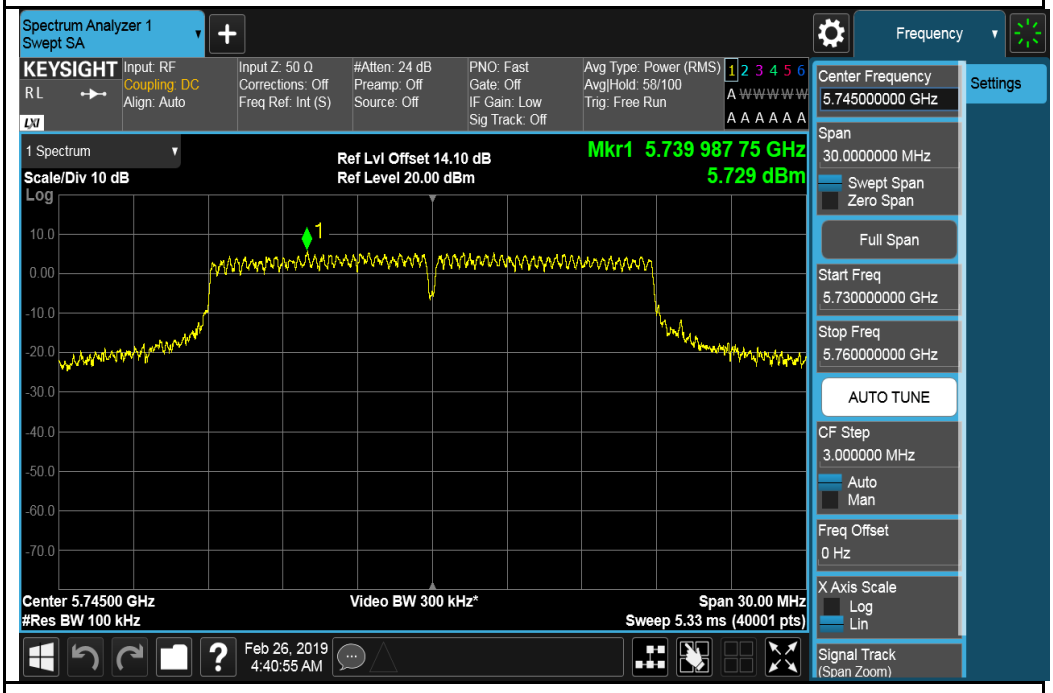
802.11a-5745MHz



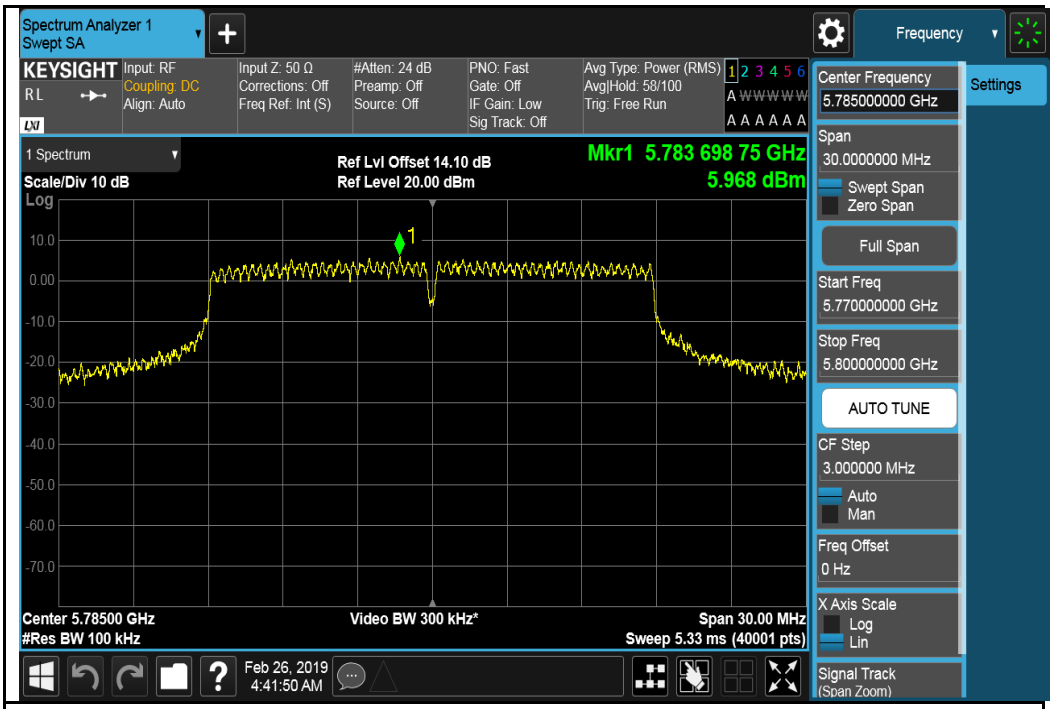
802.11a-5785 MHz



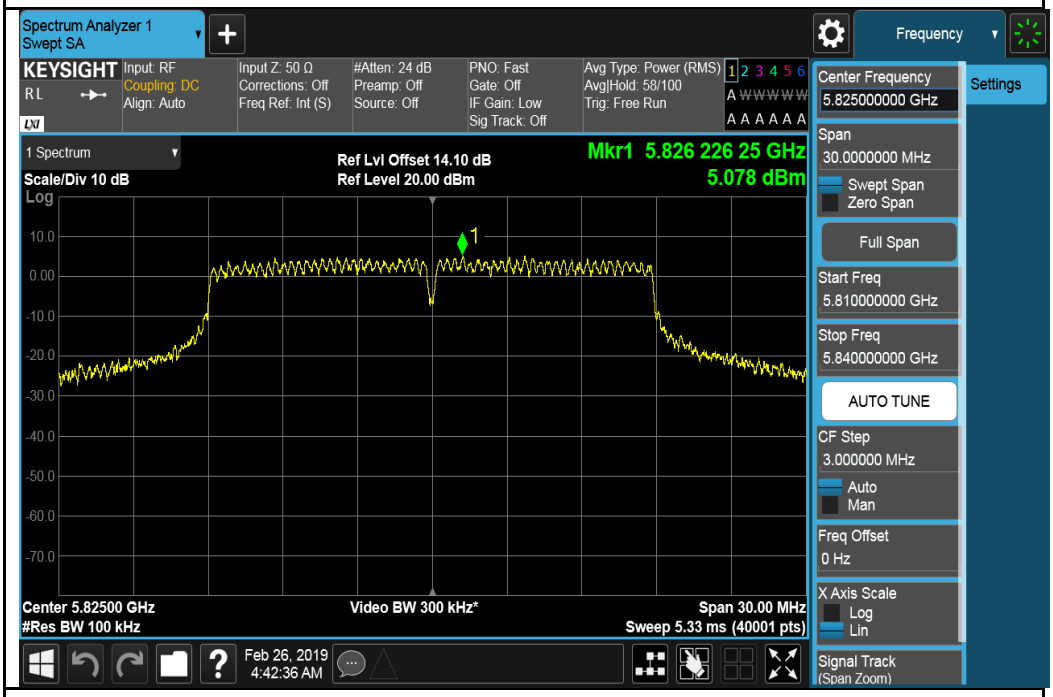
802.11a-5825 MHz



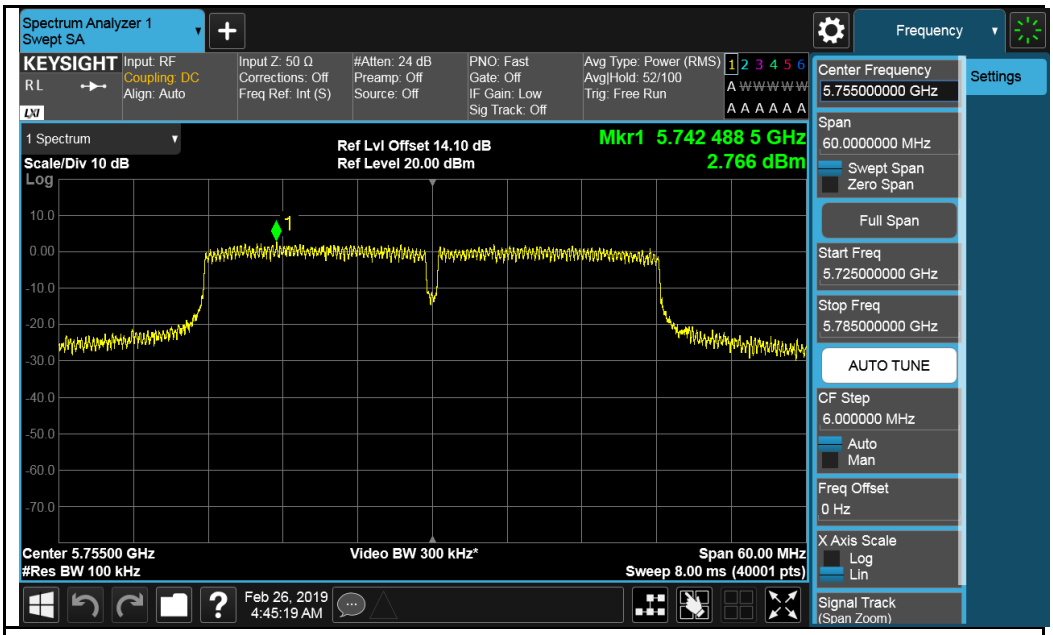
802.11n20 5745 MHz



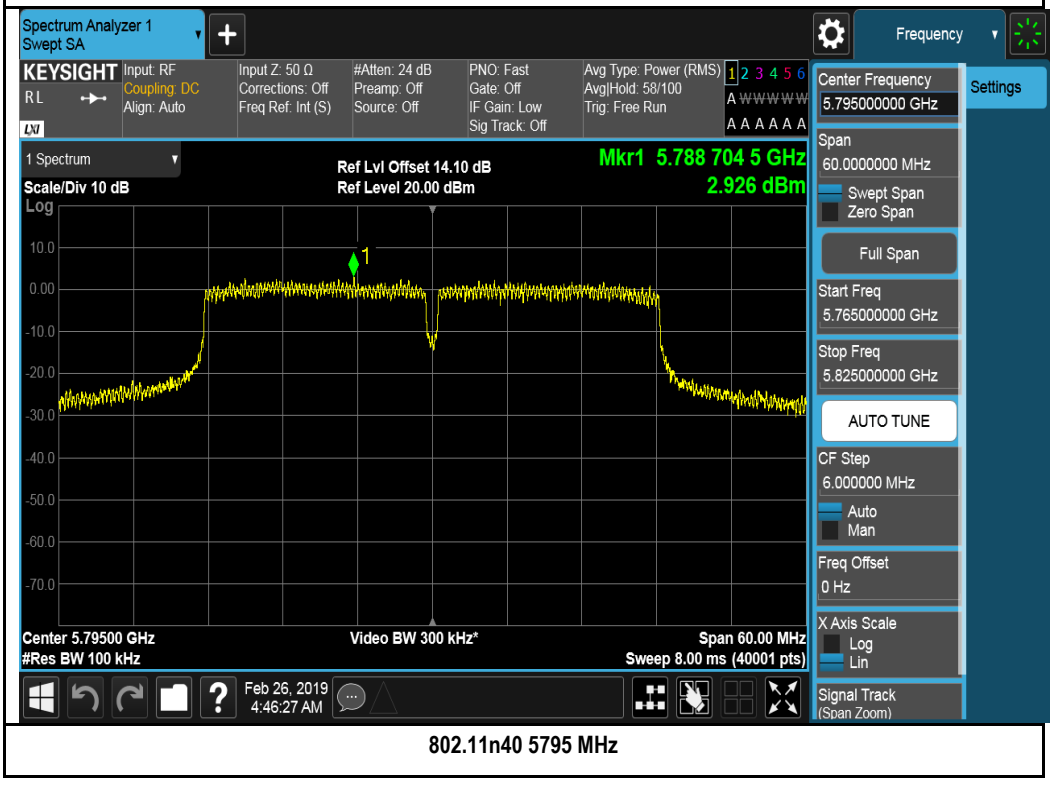
802.11n20 5785 MHz



802.11n20 5825 MHz

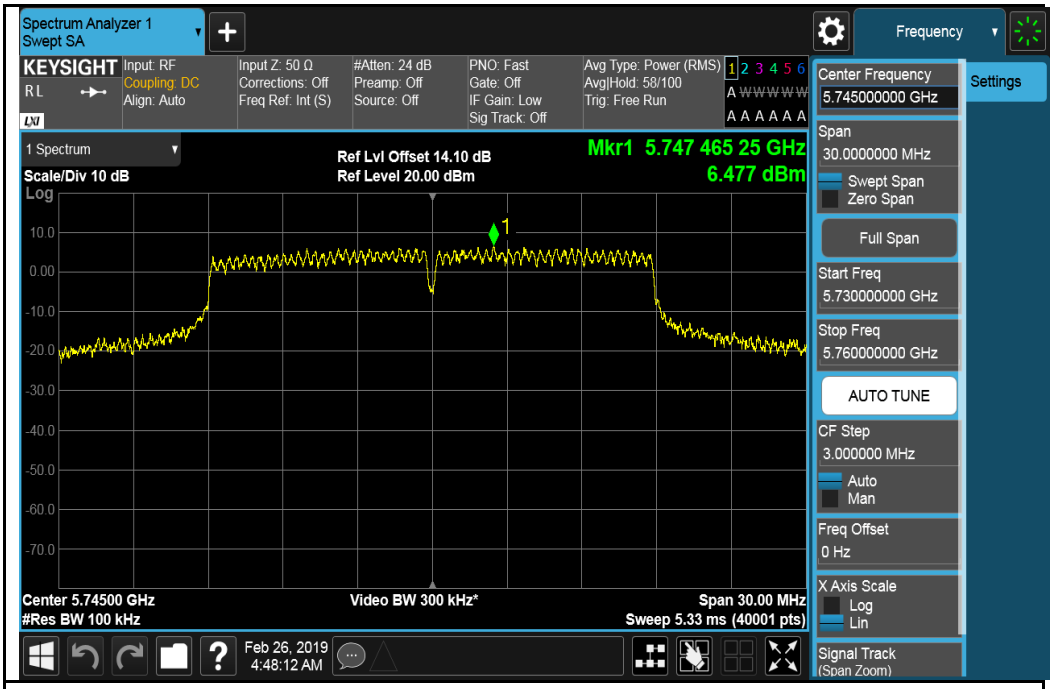


802.11n40 5755 MHz



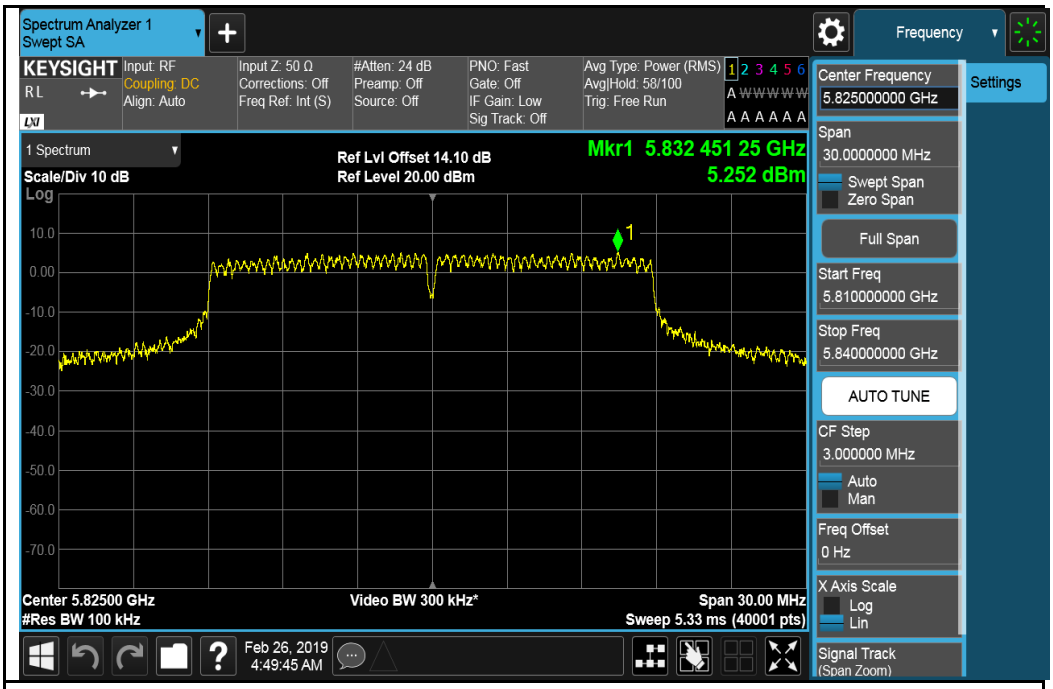
802.11n40 5795 MHz

Chain 1:



802.11n20 5745 MHz

802.11n20 5785 MHz



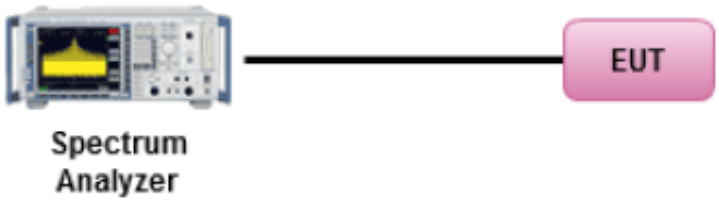
802.11n20 5825 MHz

802.11n40 5755 MHz

802.11n40 5795 MHz

10.6 Band Edge and Emission Mask Measurement

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§ RSS 247	(4)	For transmitters operating in the 5.725-5.825 GHz band: all emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.	☒
Test Setup			
Procedure	789033 D02 General UNII Test Procedures New Rules v01r02, II.F. Method SA-1 Band Edge measurement: - For average emissions measurements, follow the procedures described in section II.G.6., "Procedures for Average Unwanted Emissions Measurements above 1000 MHz", except for the following changes: - Set RBW=100kHz - Set VBW=300kHz - Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.		
Remark	-		
Result	☒ Pass ☐ Fail		

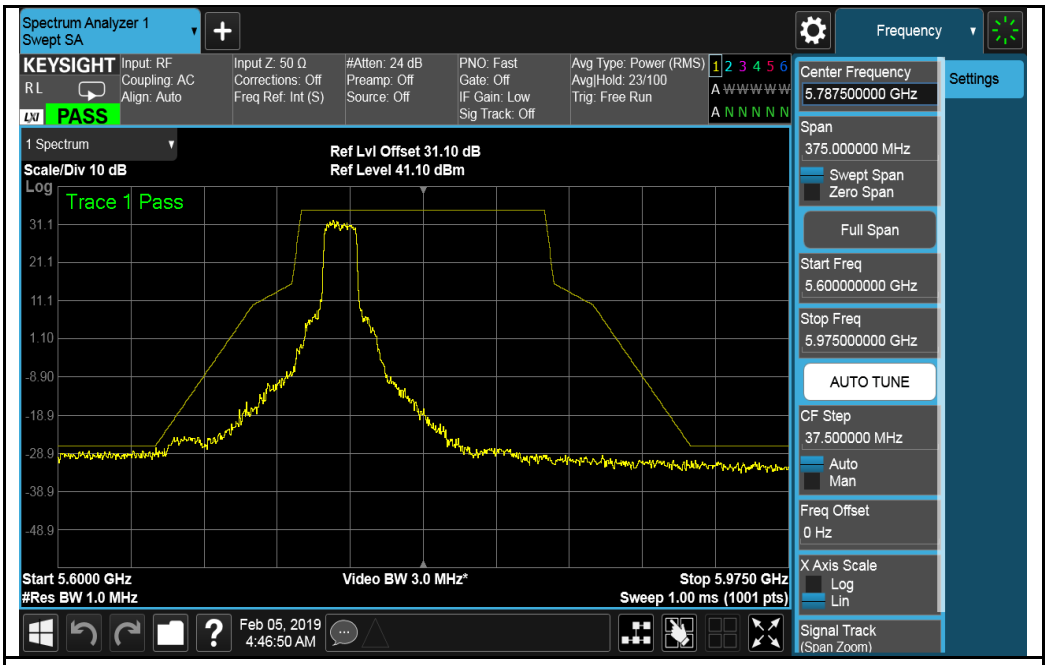
Test Data ☐ Yes (See below) ☒ N/A

Test Plot ☒ Yes (See below) ☐ N/A

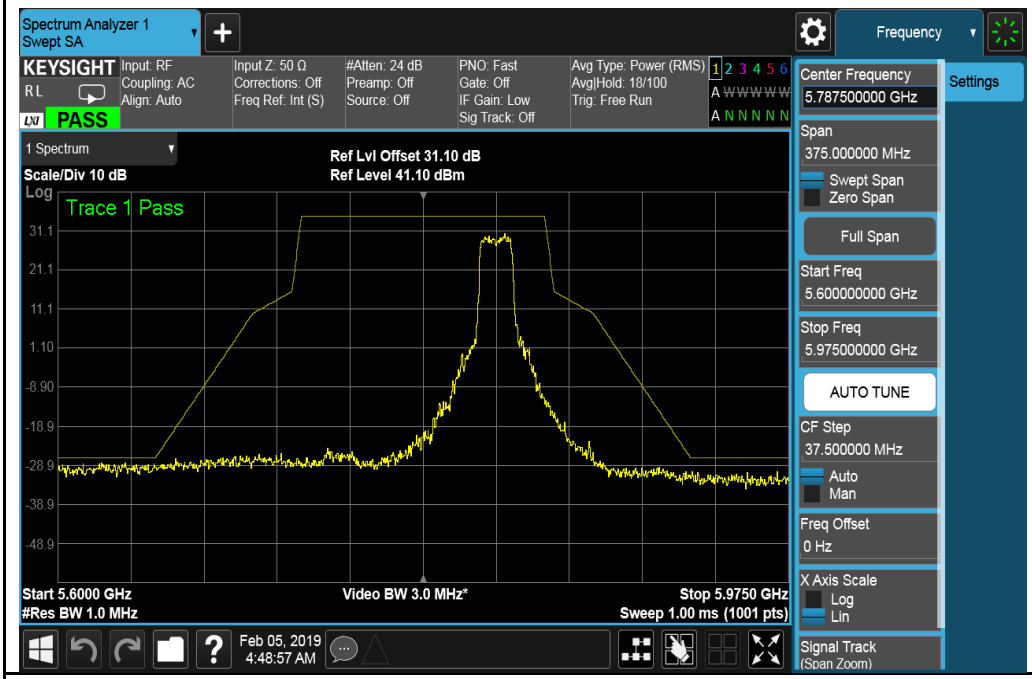
Test was done by Rachana Khanduri at RF test site.

Test Plot for W58:

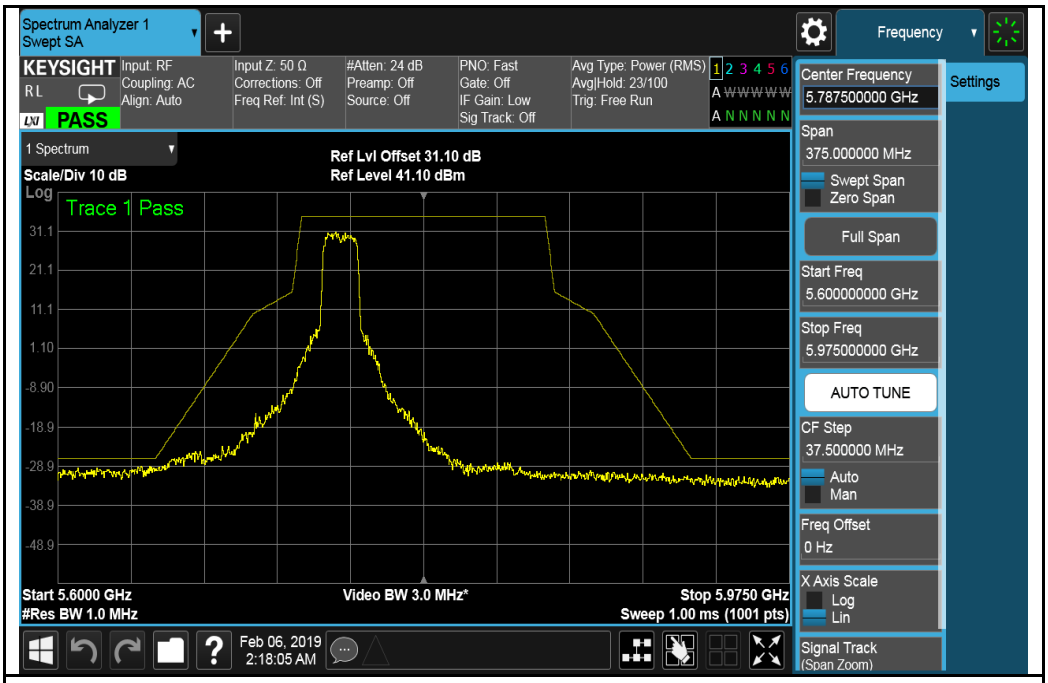
Chain 0:



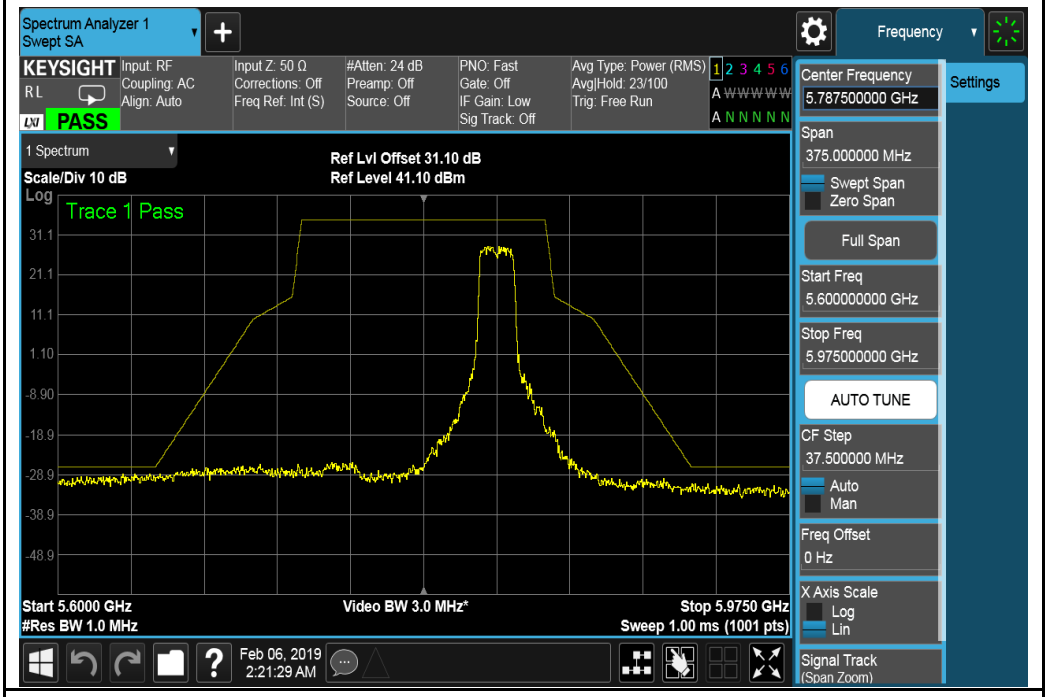
802.11a-5745MHz



802.11a-5825 MHz



802.11n20-5745 MHz

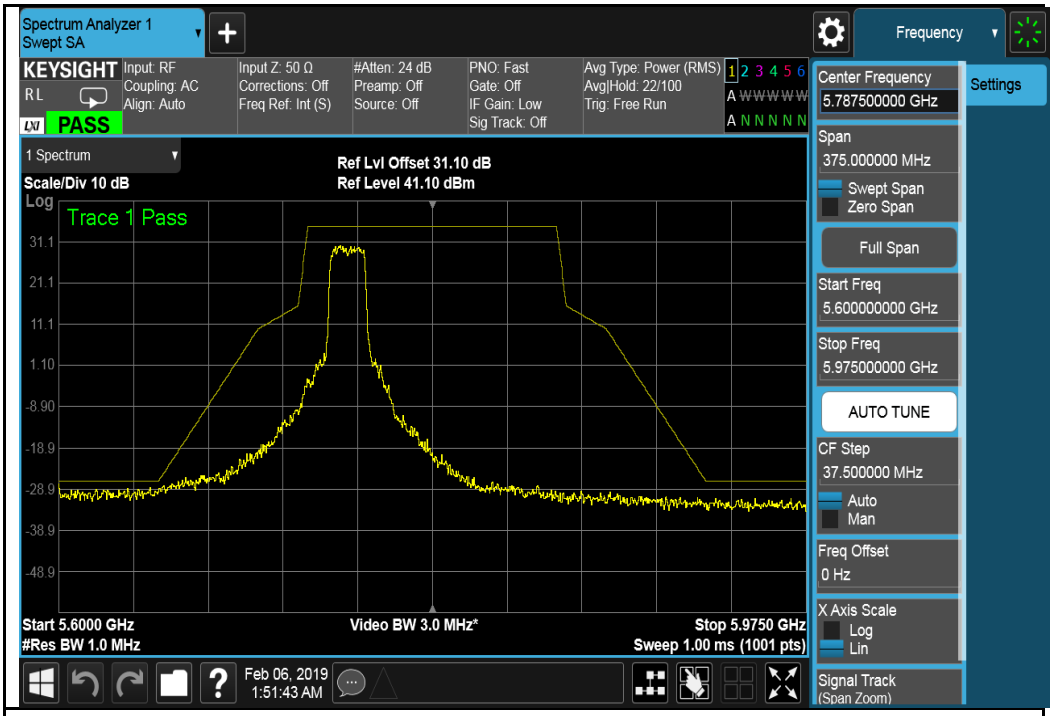


802.11n20-5825 MHz

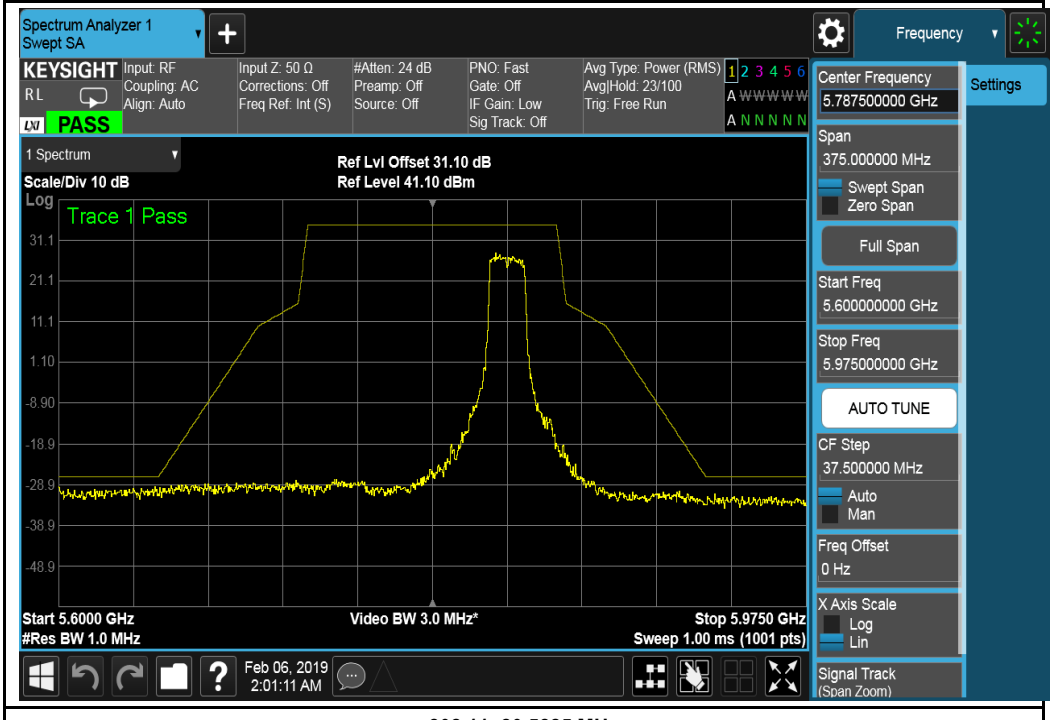
802.11n40 5755 MHz

802.11n40 5795 MHz

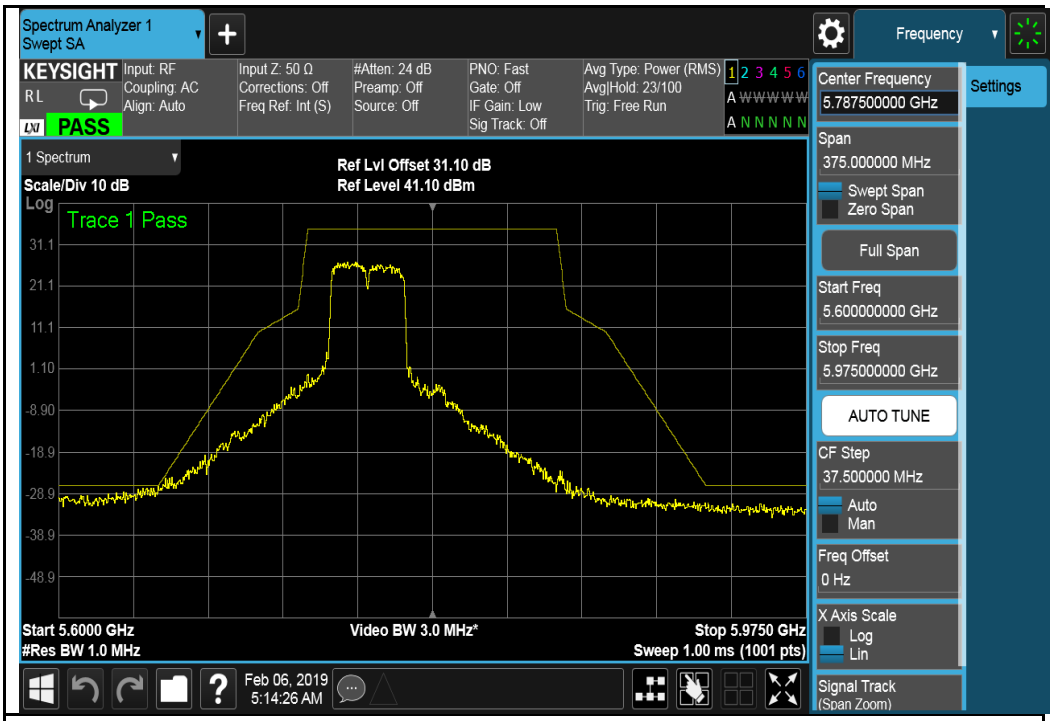
Chain 1:



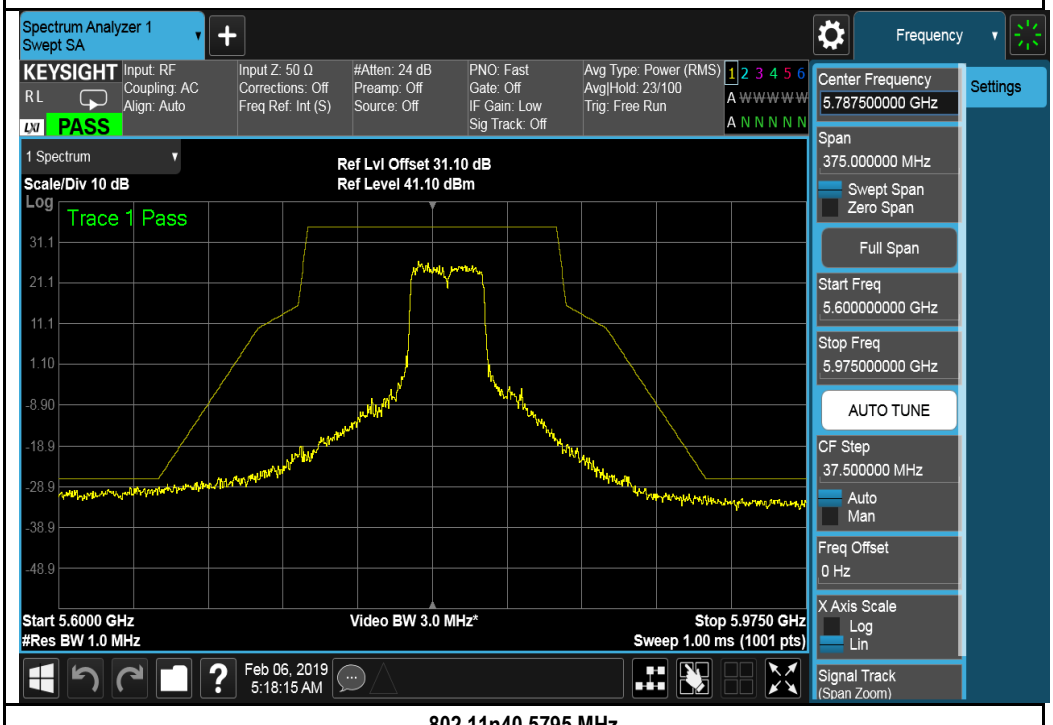
802.11n20 5745 MHz



802.11n20 5825 MHz



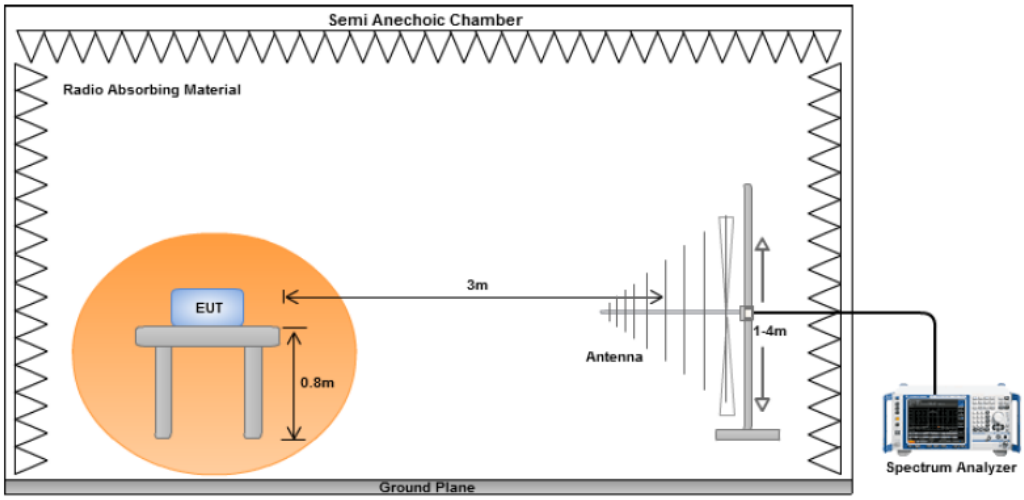
802.11n40 5755 MHz



802.11n40 5795 MHz

10.7 Radiated Emissions below 1GHz

Requirement(s):

<table>
<tr><th>Spec</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td>47CFR§
15.407(b)
15.209 (a)
RSS GEN</td><td>Except higher limit as specified elsewhere in other section, the emissions from the low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges
<table>
<tr><th>Frequency range (MHz)</th><th>Field Strength (uV/m)</th></tr>
<tr><td>30 – 88</td><td>100</td></tr>
<tr><td>88 – 216</td><td>150</td></tr>
<tr><td>216 960</td><td>200</td></tr>
<tr><td>Above 960</td><td>500</td></tr>
</table></td><td>☒</td></tr>
<tr><td>Test Setup</td><td colspan="2"> 
</td></tr>
<tr><td>Procedure</td><td colspan="2">1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
b. The EUT was then rotated to the direction that gave the maximum emission.
c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. A Quasi-peak measurement was then made for that frequency point.
4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.</td></tr>
<tr><td>Remark</td><td colspan="2">The EUT was scanned up to 1GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case.</td></tr>
<tr><td>Result</td><td colspan="2">☒ Pass ☐ Fail</td></tr>
</table>

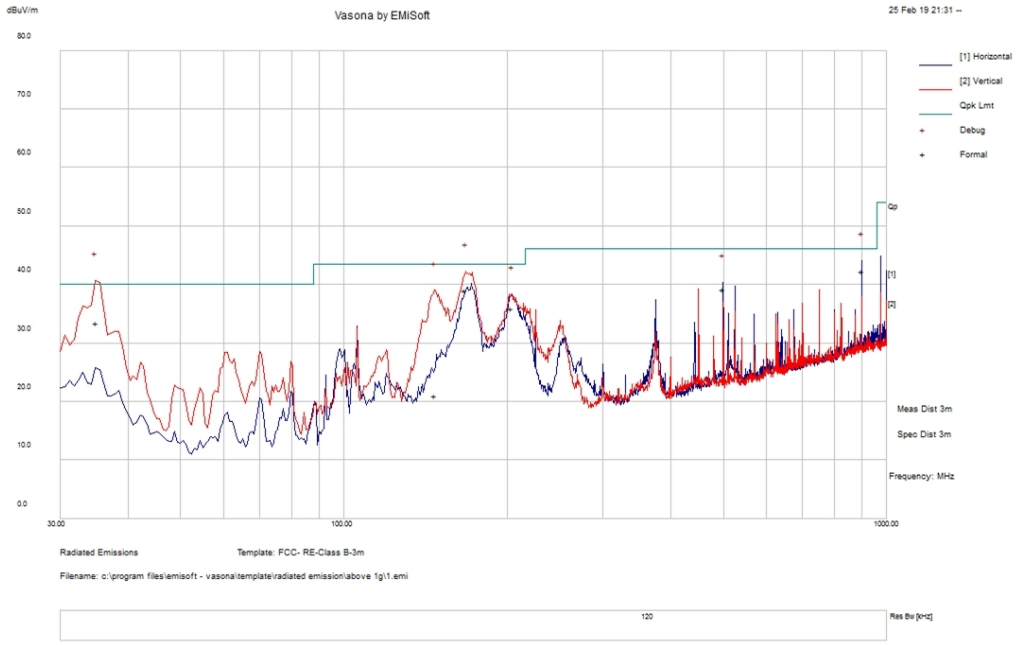
Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Gary Chou at 10m chamber.

Radiated Emission Test Results (Below 1GHz)

Test specification	below 1GHz			
Environmental Conditions:	Temp (°C):	26	Result	Pass
	Humidity (%)	47		
	Atmospheric (mbar):	1020		
Mains Power:	120VAC, 60Hz			
Tested by:	Gary Chou			
Test Date:	02/25/2019			
Remarks:	802.11n40, 5755MHz			

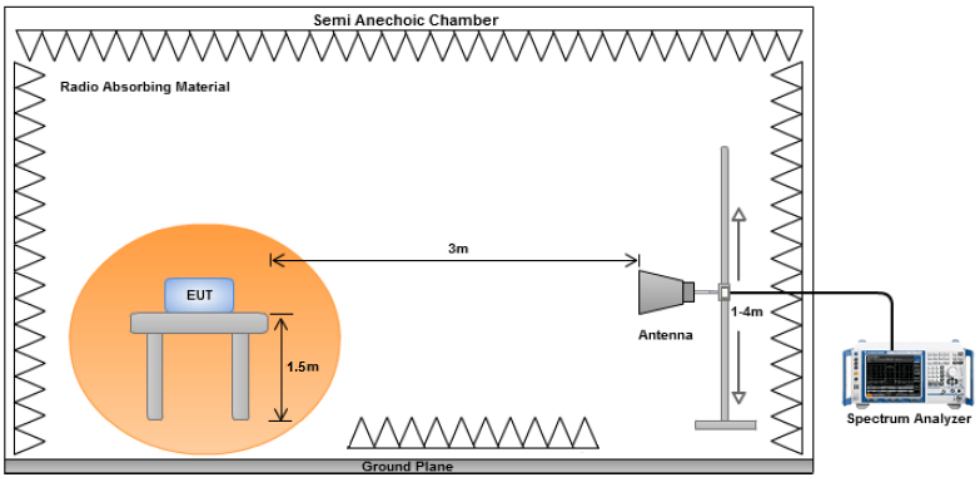


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
34.97125	38.85	11.2	-16.52	33.53	Quasi Max	V	108	249	40	-6.47	Pass
167.4244	50.41	12.33	-23.62	39.13	Quasi Max	V	175	9	43.5	-4.37	Pass
900.0247	39.7	15.95	-13.28	42.37	Quasi Max	H	107	234	46	-3.63	Pass
146.9696	32.26	12.2	-23.37	21.1	Quasi Max	H	105	279	43.5	-22.41	Pass
203.8534	47.54	12.66	-24.27	35.94	Quasi Max	H	120	120	43.5	-7.56	Pass
500.0131	43.32	14.17	-18.27	39.22	Quasi Max	H	118	101	46	-6.78	Pass

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case.

10.8 Radiated Spurious Emissions above 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.407 RSS 247	(1)	For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.	☐
	(2)	For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.	☐
	(3)	For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.	☐
	(4)	For transmitters operating in the 5.725-5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of -27 dBm/MHz.	☒
	(5)	Restricted band, emission must also comply with the radiated emission limits specified in 15.209	☒
Test Setup			
Procedure	1. The EUT was switched on and allowed to warm up to its normal operating condition. 2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. b. The EUT was then rotated to the direction that gave the maximum emission. c. Finally, the antenna height was adjusted to the height that gave the maximum emission. 3. An average measurement was then made for that frequency point. 4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.		
Remark	The EUT was scanned up to 40GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case.		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A
Test Plot ☐ Yes (See below) ☐ N/A

Test was done by Gary Chou at 10m chamber.

Radiated Emission Test Results (Above 1GHz)

1GHz-40GHz – 802.11a – 5745MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
7012.26	51.27	5.08	-7.81	48.54	Peak Max	H	264	296	74	-25.46	Pass
11490.54	55.04	6.07	-2.79	58.32	Peak Max	V	227	41	74	-15.68	Pass
13834.72	47.42	7.18	-1.69	52.91	Peak Max	H	161	155	74	-21.09	Pass
7012.26	37.82	5.08	-7.81	35.09	Average Max	H	264	296	54	-18.91	Pass
11490.54	41.71	6.07	-2.79	44.99	Average Max	V	227	41	54	-9.01	Pass
13834.72	34.08	7.18	-1.69	39.57	Average Max	H	161	155	54	-14.43	Pass

1GHz-40GHz - 802.11a– 5785MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
7891.31	50.61	5.34	-7.13	48.82	Peak Max	H	264	295	74	-25.18	Pass
11569.93	54.35	6.13	-2.68	57.8	Peak Max	H	225	43	74	-16.2	Pass
13070.20	46.57	6.93	-1.75	51.75	Peak Max	H	167	157	74	-22.25	Pass
7891.31	37.35	5.34	-7.13	35.56	Average Max	V	264	295	54	-18.44	Pass
11569.93	41.27	6.13	-2.68	44.72	Average Max	V	225	43	54	-9.28	Pass
13070.20	33.3	6.93	-1.75	38.48	Average Max	H	167	157	54	-15.52	Pass

1GHz-40GHz - 802.11a - 5825MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
7315.81	52.37	5.15	-7.66	49.86	Peak Max	V	273	304	74	-24.14	Pass
11650.91	55.38	6.2	-2.52	59.06	Peak Max	V	234	47	74	-14.94	Pass
13444.18	46.62	7.04	-1.61	52.05	Peak Max	V	166	162	74	-21.95	Pass
7315.81	39.03	5.15	-7.66	36.52	Average Max	V	273	304	54	-17.48	Pass
11650.91	41.67	6.2	-2.52	45.35	Average Max	H	234	47	54	-8.65	Pass
13444.18	32.79	7.04	-1.61	38.22	Average Max	H	166	162	54	-15.78	Pass

1GHz-40GHz – 802.11n-20M – 5745MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
7113.50	41.48	5.12	-0.29	46.31	Peak Max	H	273	302	74	-27.69	Pass
11490.88	45	6.07	2.64	53.71	Peak Max	H	231	46	74	-20.29	Pass
13311.56	46.06	7.01	4.56	57.63	Peak Max	H	164	159	74	-16.37	Pass
7113.50	24.38	5.12	-0.29	29.21	Average Max	V	273	302	54	-24.79	Pass
11490.88	27.49	6.07	2.64	36.2	Average Max	H	231	46	54	-17.8	Pass
13311.56	28.81	7.01	4.56	40.38	Average Max	H	164	159	54	-13.62	Pass

1GHz-40GHz - 802.11n-20M– 5785MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
7795.61	41.08	5.26	-0.32	46.02	Peak Max	H	266	304	74	-27.98	Pass
11569.34	44.39	6.13	2.75	53.27	Peak Max	V	234	42	74	-20.73	Pass
13192.95	46.52	6.98	4.44	57.94	Peak Max	H	162	161	74	-16.06	Pass
7795.61	23.97	5.26	-0.32	28.91	Average Max	V	266	304	54	-25.09	Pass
11569.34	26.94	6.13	2.75	35.82	Average Max	V	234	42	54	-18.18	Pass
13192.95	29.39	6.98	4.44	40.81	Average Max	V	162	161	54	-13.19	Pass

1GHz-40GHz - 802.11n-20M - 5825MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
7547.15	41.88	5.15	-0.41	46.62	Peak Max	V	270	303	74	-27.38	Pass
11650.67	45.38	6.2	2.93	54.51	Peak Max	V	225	48	74	-19.49	Pass
13424.99	46.6	7.03	4.56	58.19	Peak Max	H	163	157	74	-15.81	Pass
7547.15	24.73	5.15	-0.41	29.47	Average Max	V	270	303	54	-24.53	Pass
11650.67	27.82	6.2	2.93	36.95	Average Max	H	225	48	54	-17.05	Pass
13424.99	28.73	7.03	4.56	40.32	Average Max	H	163	157	54	-13.68	Pass

1GHz-40GHz – 802.11n-40M – 5755MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
7634.79	42.05	5.18	-0.35	46.88	Peak Max	V	268	298	74	-27.12	Pass
11509.25	45.24	6.08	2.66	53.98	Peak Max	H	229	47	74	-20.02	Pass
13963.22	47.56	7.26	4.85	59.67	Peak Max	V	163	155	74	-14.33	Pass
7634.79	24.34	5.18	-0.35	29.17	Average Max	H	268	298	54	-24.83	Pass
11509.25	27.58	6.08	2.66	36.32	Average Max	V	229	47	54	-17.68	Pass
13963.22	30.47	7.26	4.85	42.58	Average Max	V	163	155	54	-11.42	Pass

1GHz-40GHz - 802.11n-40M– 5795MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
7179.30	41.38	5.14	-0.31	46.21	Peak Max	H	272	303	74	-27.79	Pass
11590.50	46.19	6.15	2.79	55.13	Peak Max	H	230	46	74	-18.87	Pass
13783.74	46.47	7.14	4.53	58.14	Peak Max	V	170	162	74	-15.86	Pass
7179.30	23.96	5.14	-0.31	28.79	Average Max	V	272	303	54	-25.21	Pass
11590.50	29.05	6.15	2.79	37.99	Average Max	V	230	46	54	-16.01	Pass
13783.74	29.17	7.14	4.53	40.84	Average Max	H	170	162	54	-13.16	Pass

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Conducted Emissions						
EMI Test Receiver	ESIB 40	100179	08/28/2018	1 Year	8/28/2019	☑
Transient Limiter (9kHz - 100MHz)	EM-7600-5	106	01/10/2019	1 Year	5/26/2019	☑
LISN (9kHz - 30MHz)	3816/2NM	214372	9/27/2018	1 Year	9/27/2019	☑
Radiated Emissions						
50GHz Spectrum Analyzer	N9030B (PXA)	MY57140374	01/25/2019	1 Year	01/25/2020	☑
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	03/09/2018	2 Year	03/09/2020	☑
Horn Antenna (1-18GHz)	3115	10SL0059	01/26/2018	2 Year	01/26/2020	☑
RF Pre-Amplifier (9kHz - 6.5GHz)	LPA-6-30	11170601	07/23/2018	1 Year	07/23/2019	☑
Pre-Amplifier (1-26.5GHz)	8449B	3008A00715	05/06/2018	1 Year	05/06/2019	☑
RF Conducted Measurement						
Spectrum Analyzer	N9010A	MY50210206	01/18/2018	2 Year	01/18/2020	☑
MXG Signal Generator	N5182A	MY47071065	08/10/2018	1 Year	08/10/2019	☑

Annex B. SIEMIC Accreditation

Accreditations	Document	Scope / Remark
ISO 17025 (A2LA)		Please see the documents for the detailed scope
ISO Guide 65 (A2LA)		Please see the documents for the detailed scope
TCB Designation		A1, A2, A3, A4, B1, B2, B3, B4, C
FCC DoC Accreditation		FCC Declaration of Conformity Accreditation
FCC Site Registration		3 meter site
FCC Site Registration		10 meter site
IC Site Registration		3 meter site
IC Site Registration		10 meter site
EU NB		**Radio & Telecommunications Terminal Equipment:** EN45001 – EN ISO/IEC 17025
		Electromagnetic Compatibility: EN45001 – EN ISO/IEC 17025
Singapore iDA CB(Certification Body)		Phase I, Phase II
Vietnam MIC CAB Accreditation		Please see the document for the detailed scope
Hong Kong OFCA		**(Phase II)** OFCA Foreign Certification Body for Radio and Telecom
		(Phase I) Conformity Assessment Body for Radio and Telecom
Industry Canada CAB		**Radio:** Scope A – All Radio Standard Specification in Category I
		Telecom: CS-03 Part I, II, V, VI, VII, VIII

Japan Recognized Certification Body Designation		**Radio**: A1. Terminal equipment for purpose of calling **Telecom**: B1. Specified radio equipment specified in Article 38-2, Paragraph 1, Item 1 of the Radio Law
Korea CAB Accreditation		**EMI:** KCC Notice 2008-39, RRL Notice 2008-3: CA Procedures for EMI KN22: Test Method for EMI **EMS:** KCC Notice 2008-38, RRL Notice 2008-4: CA Procedures for EMS KN24, KN61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11: Test Method for EMS
		Radio: RRL Notice 2008-26, RRL Notice 2008-2, RRL Notice 2008-10, RRL Notice 2007-49, RRL Notice 2007-20, RRL Notice 2007-21, RRL Notice 2007-80, RRL Notice 2004-68
		Telecom: President Notice 20664, RRL Notice 2007-30, RRL Notice 2008-7 with attachments 1, 3, 5, 6; President Notice 20664, RRL Notice 2008-7 with attachment 4
Taiwan NCC CAB Recognition		LP0002, PSTN01, ADSL01, ID0002, IS6100, CNS14336, PLMN07, PLMN01, PLMN08
Taiwan BSMI CAB Recognition		CNS 13438
Japan VCCI		R-3083: Radiation 3 meter site C-3421: Main Ports Conducted Interference Measurement T-1597: Telecommunication Ports Conducted Interference Measurement
Australia CAB Recognition		**EMC:** AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4
		Radio communications: AS/NZS 4281, AS/NZS 4268, AS/NZS 4280.1, AS/NZS 4280.2, AS/NZS 4295, AS/NZS 4582, AS/NZS 4583, AS/NZS 4769.1, AS/NZS 4769.2, AS/NZS 4770, AS/NZS 4771
		Telecommunications: AS/ACIF S002:05, AS/ACIF S003:06, AS/ACIF S004:06 AS/ACIF S006:01, AS/ACIF S016:01, AS/ACIF S031:01, AS/ACIF S038:01, AS/ACIF S040:01, AS/ACIF S041:05, AS/ACIF S043.2:06, AS/ACIF S60950.1
Australia NATA Recognition		AS/ACIF S002, AS/ACIF S003, AS/ACIF S004, AS/ACIF S006, AS/ACIF S016,AS/ACIF S031, AS/ACIF S038, AS/ACIF S040, AS/ACIF S041, AS/ACIF S043.2