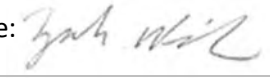
Test Report # 319295 B

Equipment Under Test:	KOLO Gen2 WiFi Module
Requirement(s):	FCC 15.407, FCC 15.207, FCC 15.209, RSS-247, RSS-GEN
Test Date(s):	October 16th, 2020 to June 17th, 2021
Prepared for:	Georgia Pacific Attn: Randall Duval 1915 Marathon Avenue Neenah, WI 54956

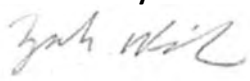
Report Issued by: Zach Wilson, EMC Engineer

Signature:  Date: 9/23/2021

Report Reviewed by: Adam Alger, Laboratory Manager

Signature:  Date: 8/3/2021

Report Constructed by: Zach Wilson, EMC Engineer

Signature:  Date: 7/19/2021

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Laird Connectivity Test Services in Review

The Laird Connectivity, Inc. laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted

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Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers

Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

1 TEST REPORT SUMMARY

During **October 16th, 2020 to June 17th, 2021** the Equipment Under Test (EUT), **KOLO Gen2 WiFi Module**, as provided by **Georgia Pacific** was tested to the following requirements **Federal Communications Commission and Innovation, Science and Economic Development Canada**:

Operation in the 5.15 – 5.25 GHz band

FCC	ISED Canada	Test Description	Measurement Procedure	Compliant
15.407 (a)(1)(iv)	RSS-247 Section 6.2.1	Power Limits	ANSI C63.10-2013 Section 12.3	Yes
15.407 (a)(1) (iv)	RSS-247 Section 6.2.1	Power Spectral Density	ANSI C63.10-2013 Section 12.5	Yes
15.407 (a)(5)	RSS-247 Section 6.2.1	26dB / 99% Bandwidth	ANSI C63.10-2013 Section 12.4	Yes
15.407 (b)(1)	RSS-247 Section 6.2.1	Undesirable emissions Limit	ANSI C63.10-2013 Section 12.7	Yes
15.407 (b)(i)	RSS-GEN	Spurious Emissions below 1GHz & AC Mains	ANSI C63.10-2013 Section 12.7	Yes
15.407 (b)(i)	RSS-GEN	Restricted Bands	ANSI C63.10-2013 Section 12.7	Yes
15.407 (g)	RSS-GEN	Frequency Stability	ANSI C63.10-2013 Section 6.8	Yes

Operation in the 5.25 – 5.35 GHz and 5.47 – 5.725 GHz bands

FCC	ISED Canada	Test Description	Measurement Procedure	Compliant
15.407 (a)(2)	RSS-247 Section 6.2.2 & 6.2.3	Power Limits	ANSI C63.10-2013 Section 12.3	Yes
15.407 (a)(2)	RSS-247 Section 6.2.2 & 6.2.3	Power Spectral Density	ANSI C63.10-2013 Section 12.5	Yes
15.407 (a)(5)	RSS-247 Section 6.2.2 & 6.2.3	26dB / 99% Bandwidth	ANSI C63.10-2013 Section 12.4	Yes
15.407 (b)(2) & (3)	RSS-247 Section 6.2.2 & 6.2.3	Undesirable emissions Limit	ANSI C63.10-2013 Section 12.7	Yes
15.407 (b)(6)	RSS-GEN	Spurious Emissions below 1GHz & AC Mains	ANSI C63.10-2013 Section 12.7	Yes
15.407 (b)(7)	RSS-GEN	Restricted Bands	ANSI C63.10-2013 Section 12.7	Yes
15.407 (g)	RSS-GEN	Frequency Stability	ANSI C63.10-2013 Section 6.8	Yes

Operation in the 5.725 – 5.85 GHz band

FCC	ISED Canada	Test Description	Measurement Procedure	Compliant
15.407 (a)(3)	RSS-247 Section 6.2.4	Power Limits	ANSI C63.10-2013 Section 12.3	Yes
15.407 (a)(3)	RSS-247 Section 6.2.4	Power Spectral Density	ANSI C63.10-2013 Section 12.5	Yes
15.407 (a)(5)	RSS-247 Section 6.2.4	26dB / 99% Bandwidth	ANSI C63.10-2013 Section 12.4	Yes
15.407 (b)(4)	RSS-247 Section 6.2.4	Undesirable emissions Limit	ANSI C63.10-2013 Section 12.7	Yes
15.407 (b)(6)	RSS-GEN	Spurious Emissions below 1GHz & AC Mains	ANSI C63.10-2013 Section 12.7	Yes
15.407 (b)(7)	RSS-GEN	Restricted Bands	ANSI C63.10-2013 Section 12.7	Yes
15.407 (g)	RSS-GEN	Frequency Stability	ANSI C63.10-2013 Section 6.8	Yes
15.407(e)	RSS-247 Section 6.2.4	Minimum 6dB bandwidth	ANSI C63.10-2013 Section 11.8	Yes

Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

Measurement Type	Rule
Emissions – Amplitude	Below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

2 CLIENT INFORMATION

Company Name	Georgia Pacific
Contact Person	Randall Duval
Address	1915 Marathon Avenue Neenah, WI 54956

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	KOLO Gen2 WiFi Module
Model Number	ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Serial Number	Engineering Sample
FCC ID	2AALY-530GP
IC ID	21620-530GP

2.2 Product Description

The 530GP is a module consisting of the Texas Instruments CC3135 WLAN 2.4/5 GHz and the Laird BL654 BLE module. The radios are not capable of simultaneous transmission. Multiple antenna options and model variants are available and listed below. The device is powered by 3.3VDC. The antenna port was terminated at 50Ω for radiated testing. The chip antenna version was tested for radiated emissions with emissions being lower than those produced by the terminated method.

Model Variants:

a. **HVIN ASM-0000001220:** This variant of the module has onboard Wi-Fi chip antenna on the PCB of the daughter card. No external antenna is used on this variant.

b. **HVIN ASM-0000001303:** This variant of the module has an onboard Wi-Fi chip antenna on the PCB of the daughter card and is identical to ASM-0000001220 other than the FFC cable connector on the PCB at position J7 being mounted vertically. No external antenna is used on this variant.

c. **HVIN ASM-0000000791:** This variant of the module has an external antenna connected to the Wi-Fi/BLE daughter card via u.FL connector on the daughter card. The antenna is mounted within the end device housing and is fully contained within the end device. The external antenna provides improved range for connectivity between the end device and the Wi-Fi access point.

d. **HVIN ASM-0000001327:** This variant of the module has an external antenna connected to the Wi-Fi/BLE daughter card via u.FL connector on the daughter card and is identical to ASM-0000000791 other than the FFC cable connector on the PCB at position J7 being mounted vertically.

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Channels and Data Rates

Channels	Protocol	Data Rate
UNII-1: 36, 40, 44, 48 UNII 2A: 52, 56, 64 UNII 2C: 100, 116, 140 UNII 3: 149, 157, 165	802.11a 802.11n HT20	6Mbps, 54Mbps MCS0, MCS7

2.6 Radio Programming

The WLAN radios were programmed using the Texas Instruments CC31XX/CC32XX Radio Tool v1.0.3.15.

2.7 Antennas

Radio	Antenna Type	Manufacturer	Model Number	Peak Gain (dBi)
WLAN 5	Chip	Yageo	ANT5320LL24R2455A	3.51
WLAN 5	Flexible (FlexPIFA)	Laird	001-0016	3.00

3 REFERENCES

Publication	Edition	Date
FCC CFR	-	2021
ANSI C63.10	-	2013
RSS-Gen	5	2018
RSS-247	2	2017
KDB 789033 D02	v02r01	2017

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

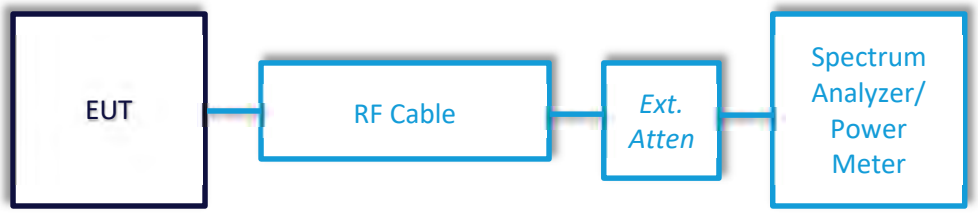
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



5.1.1 26dB/6dB Emission Bandwidth and 99% Occupied Bandwidth

Operator	Jon Dilley, Anthony Smith	**QA**	Shane Dock, Zach Wilson
Temperature	21.1°C	**R.H. %**	55%
Test Date	10/16/2020, 6/17/2021	**Location**	Conducted RF Bench
Requirement	FCC 15.407, RSS-247	**Method**	ANSI C63.10 §12.4.1 ANSI C63.10 §6.9.3

UNII 1, 2A, 2C Limits: Reported

UNII 3 Limits: 6dB EBW greater than 500kHz

Test Parameters

Frequency	5180, 5200, 5220, 5240, 5260, 5280, 5320, 5500, 5580, 5700, 5745, 5785, 5825 MHz	**Setup**	Conducted
RBW	26dB EBW/99% OBW: 200kHz 6dB EBW: 100kHz	**VBW**	26dB EBW/99% OBW: 620kHz 6dB EBW: 300kHz
Detector(s)	Max hold with peak detector	**Sweep Time**	Auto

Instrumentation

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Cable	Gore	EKD01D01048.0	5546519	2/3/2021	2/3/2022	Active Verification
2	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	7/14/2020	7/14/2021	Active Calibration

EUT Parameters

Input Power	5.9VDC	**Mode**	WLAN TX
Channels	36, 40, 44, 48, 52, 56, 64, 100, 116, 140, 149, 157, 165	**Data Rates**	802.11a: 6Mbps, 54Mbps 802.11n HT20: MCS0, MCS7

Data Tables

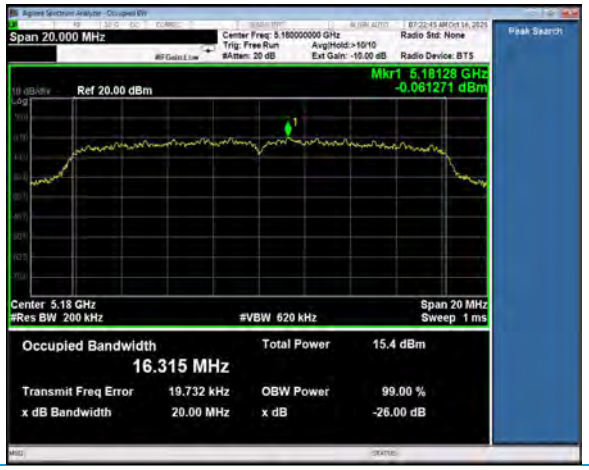
Protocol	Data Rate	Channel	26 dB BW (kHz)	99% OBW (kHz)
802.11a	6Mbps	36	20000.0	16485.0
802.11a	6Mbps	40	20000.0	16690.0
802.11a	6Mbps	44	20000.0	16672.0
802.11a	6Mbps	48	20000.0	16722.0
802.11a	6Mbps	52	20000.0	16836.0
802.11a	6Mbps	56	20000.0	16719.0
802.11a	6Mbps	64	20000.0	16355.0
802.11a	6Mbps	100	20000.0	16268.0
802.11a	6Mbps	116	20000.0	16653.0
802.11a	6Mbps	140	19810.0	16292.0
802.11a	54Mbps	36	20000.0	16410.0
802.11a	54Mbps	40	19990.0	16456.0
802.11a	54Mbps	44	20000.0	16528.0
802.11a	54Mbps	48	19970.0	16509.0
802.11a	54Mbps	52	19970.0	16602.0
802.11a	54Mbps	56	20000.0	16557.0
802.11a	54Mbps	64	20000.0	16604.0
802.11a	54Mbps	100	20000.0	16585.0
802.11a	54Mbps	116	19900.0	16522.0
802.11a	54Mbps	140	19850.0	16514.0

Protocol	Data Rate	Channel	99% OBW (kHz)	6dB EBW (kHz)	6dB EBW Limit (<kHz)	6 dB EBW Margin (kHz)
802.11a	6Mbps	149	16586.0	15120.0	500.0	14620.0
802.11a	6Mbps	157	16622.0	15150.0	500.0	14650.0
802.11a	6Mbps	165	16323.0	15150.0	500.0	14650.0
802.11a	54Mbps	149	16569.0	16500.0	500.0	16000.0
802.11a	54Mbps	157	16627.0	16440.0	500.0	15940.0
802.11a	54Mbps	165	16314.0	16470.0	500.0	15970.0

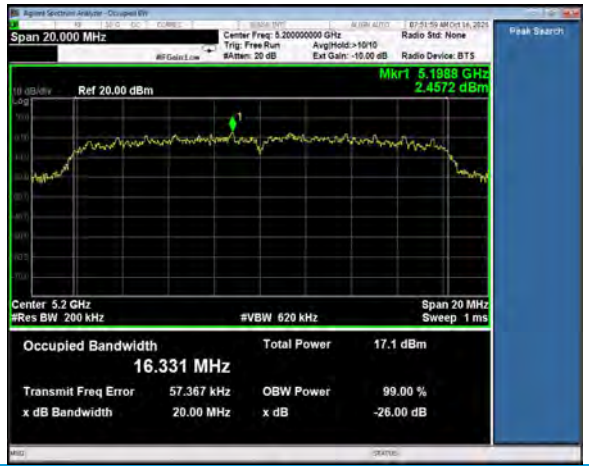
Protocol	Data Rate	Channel	26 dB BW (kHz)	99% OBW (kHz)
802.11n	MCS0	36	20000.0	17622.0
802.11n	MCS0	40	19930.0	17716.0
802.11n	MCS0	44	19950.0	17500.0
802.11n	MCS0	48	20000.0	17757.0
802.11n	MCS0	52	20000.0	17766.0
802.11n	MCS0	56	20000.0	17663.0
802.11n	MCS0	64	19880.0	17457.0
802.11n	MCS0	100	19980.0	17415.0
802.11n	MCS0	116	20000.0	17626.0
802.11n	MCS0	140	19980.0	17423.0
802.11n	MCS7	36	20000.0	17813.0
802.11n	MCS7	40	19930.0	17671.0
802.11n	MCS7	44	19940.0	17664.0
802.11n	MCS7	48	20000.0	17750.0
802.11n	MCS7	52	20000.0	17521.0
802.11n	MCS7	56	19920.0	17645.0
802.11n	MCS7	64	19900.0	17474.0
802.11n	MCS7	100	20000.0	17751.0
802.11n	MCS7	116	20000.0	17725.0
802.11n	MCS7	140	19950.0	17723.0

Protocol	Data Rate	Channel	99% OBW (kHz)	6dB EBW (kHz)	6dB EBW Limit (<kHz)	6 dB EBW Margin (kHz)
802.11n	MCS0	149	17583.0	15150.0	500.0	14650.0
802.11n	MCS0	157	17695.0	15150.0	500.0	14650.0
802.11n	MCS0	165	17487.0	15150.0	500.0	14650.0
802.11n	MCS7	149	17634.0	17430.0	500.0	16930.0
802.11n	MCS7	157	17704.0	17360.0	500.0	16860.0
802.11n	MCS7	165	17619.0	17380.0	500.0	16880.0

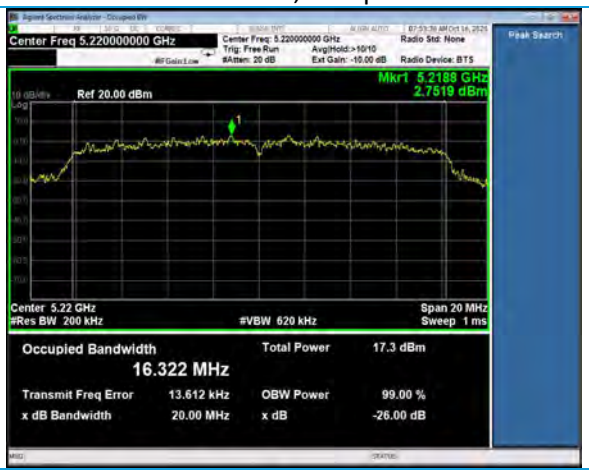
Plots



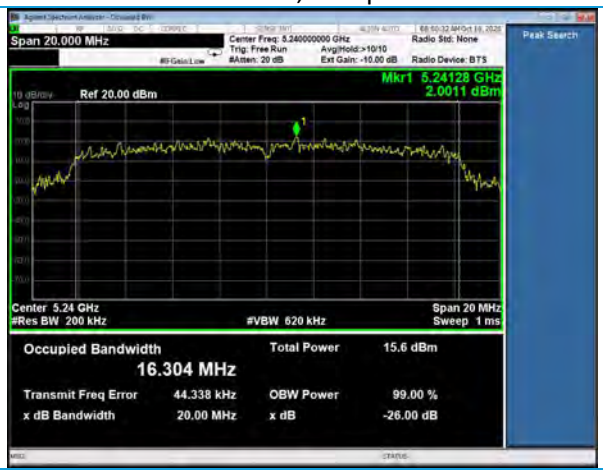
26 dB Emission Bandwidth, Channel 36
802.11a, 6Mbps



26 dB Emission Bandwidth, Channel 40
802.11a, 6Mbps



26 dB Emission Bandwidth, Channel 44
802.11a, 6Mbps



26 dB Emission Bandwidth, Channel 48
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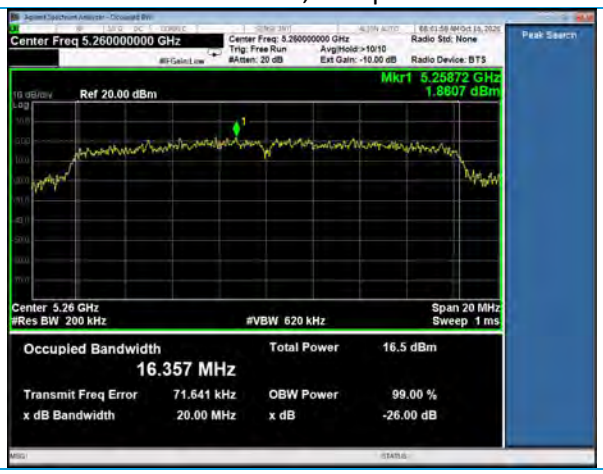
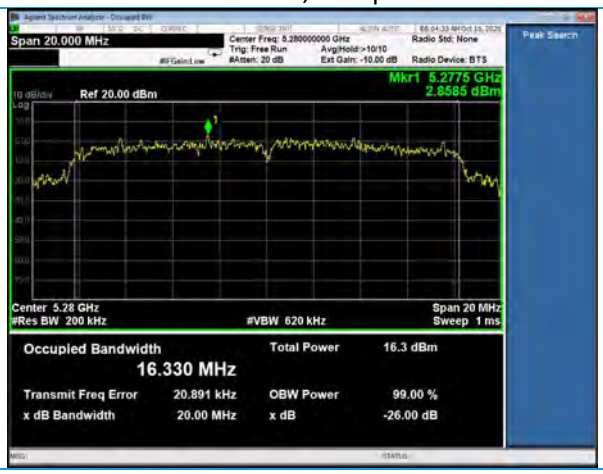
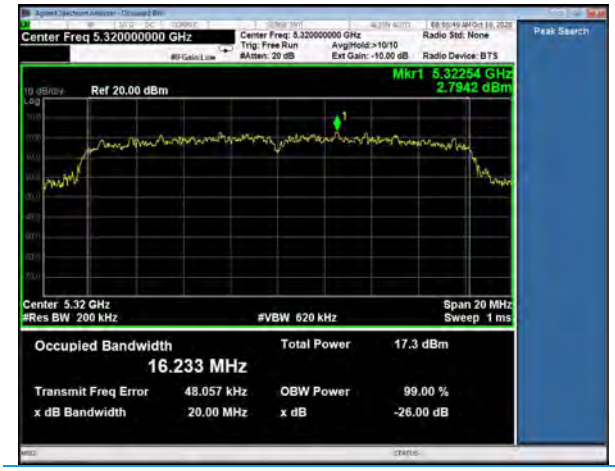


26 dB Emission Bandwidth, Channel 52
802.11a, 6Mbps

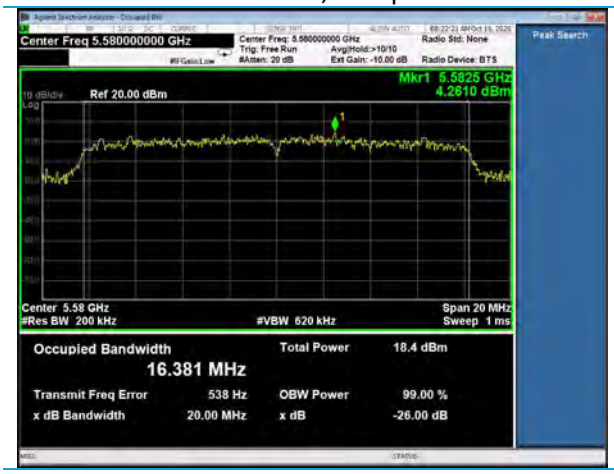


26 dB Emission Bandwidth, Channel 56
802.11a, 6Mbps



26 dB Emission Bandwidth, Channel 64
802.11a, 6Mbps

26 dB Emission Bandwidth, Channel 100
802.11a, 6Mbps



26 dB Emission Bandwidth, Channel 116
802.11a, 6Mbps

26 dB Emission Bandwidth, Channel 140
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 36
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 40
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 44
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 48
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 52
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 56
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 64
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 100
802.11a, 6Mbps

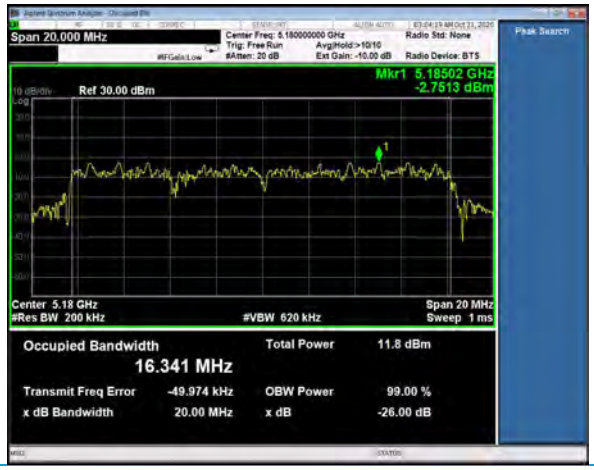
99% Occupied Bandwidth, Channel 116
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 140
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 149
802.11a, 6Mbps

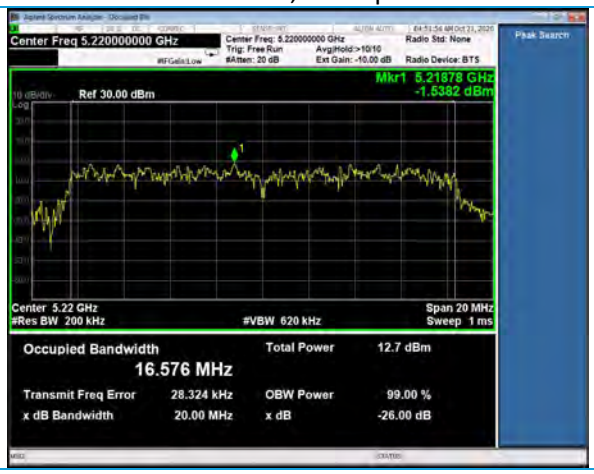
99% Occupied Bandwidth, Channel 157
802.11a, 6Mbps

99% Occupied Bandwidth, Channel 165
802.11a, 6Mbps



26 dB Emission Bandwidth, Channel 36
802.11a, 54Mbps

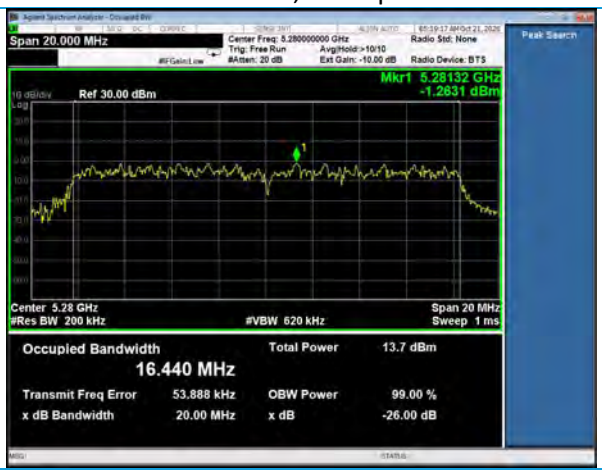
26 dB Emission Bandwidth, Channel 40
802.11a, 54Mbps



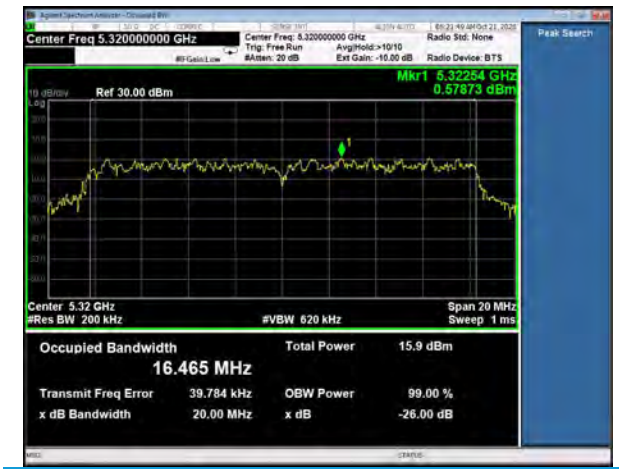
26 dB Emission Bandwidth, Channel 44
802.11a, 54Mbps

26 dB Emission Bandwidth, Channel 48
802.11a, 54Mbps

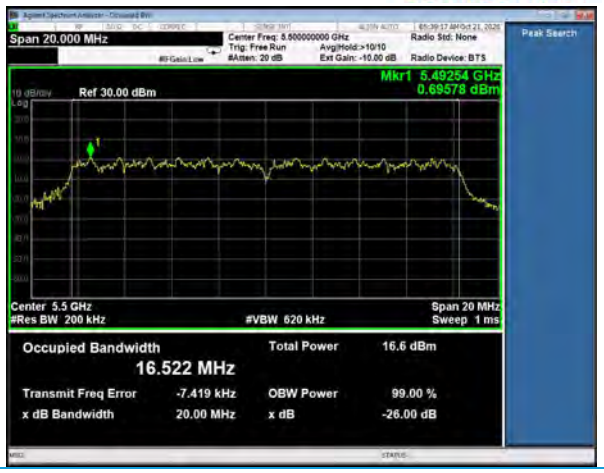
26 dB Emission Bandwidth, Channel 52
802.11a, 54Mbps



26 dB Emission Bandwidth, Channel 56
802.11a, 54Mbps



26 dB Emission Bandwidth, Channel 64
802.11a, 54Mbps



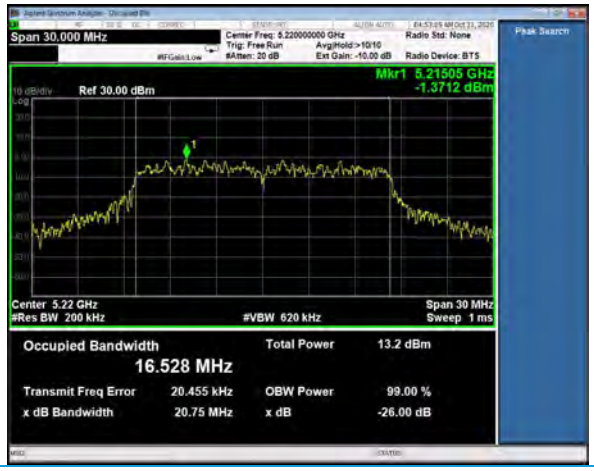
26 dB Emission Bandwidth, Channel 100
802.11a, 54Mbps

26 dB Emission Bandwidth, Channel 116
802.11a, 54Mbps

26 dB Emission Bandwidth, Channel 140
802.11a, 54Mbps

99% Occupied Bandwidth, Channel 36
802.11a, 54Mbps

99% Occupied Bandwidth, Channel 40
802.11a, 54Mbps



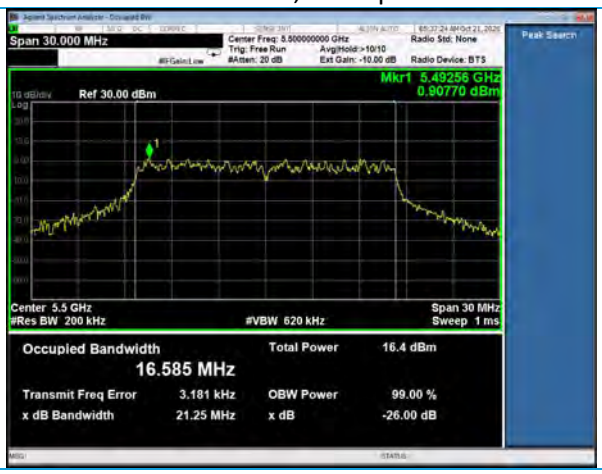
99% Occupied Bandwidth, Channel 44
802.11a, 54Mbps

99% Occupied Bandwidth, Channel 48
802.11a, 54Mbps

99% Occupied Bandwidth, Channel 52
802.11a, 54Mbps

99% Occupied Bandwidth, Channel 56
802.11a, 54Mbps

99% Occupied Bandwidth, Channel 64
802.11a, 54Mbps



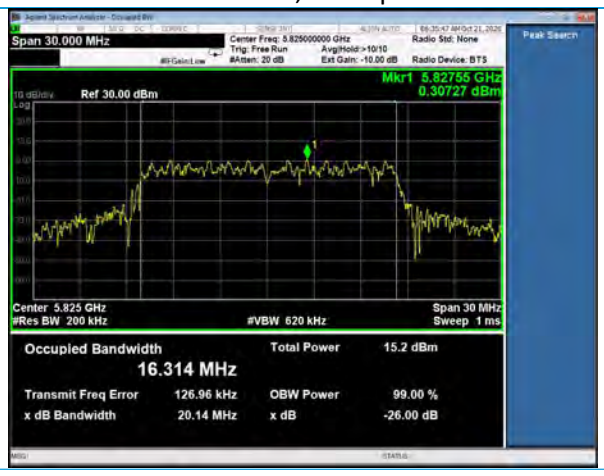
99% Occupied Bandwidth, Channel 100
802.11a, 54Mbps

99% Occupied Bandwidth, Channel 116
802.11a, 54Mbps

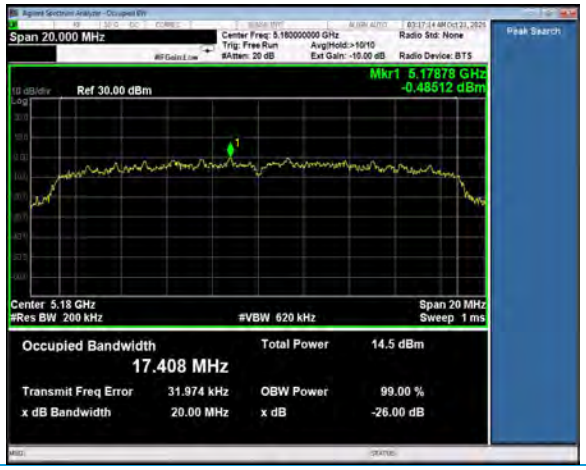
99% Occupied Bandwidth, Channel 140
802.11a, 54Mbps

99% Occupied Bandwidth, Channel 149
802.11a, 54Mbps

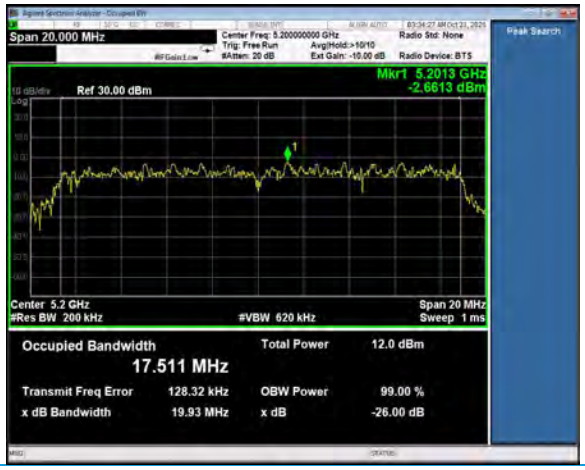
99% Occupied Bandwidth, Channel 157
802.11a, 54Mbps



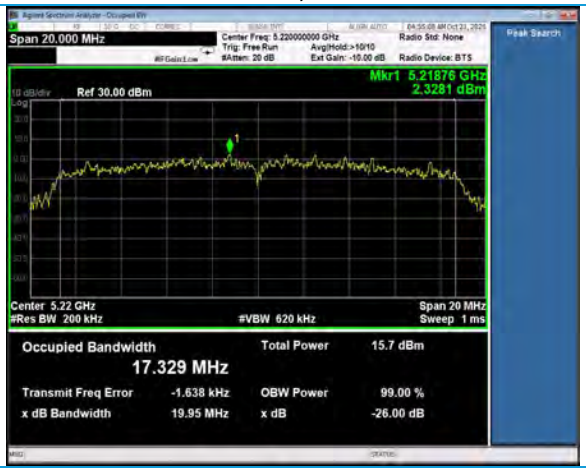
99% Occupied Bandwidth, Channel 165
802.11a, 54Mbps



26 dB Emission Bandwidth, Channel 36
802.11n, MCS0

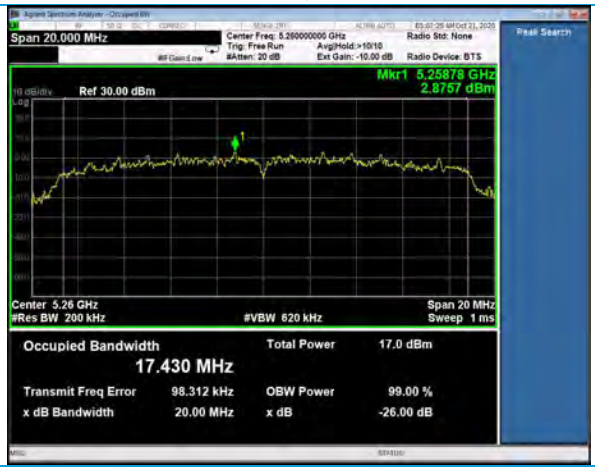


26 dB Emission Bandwidth, Channel 40
802.11n, MCS0

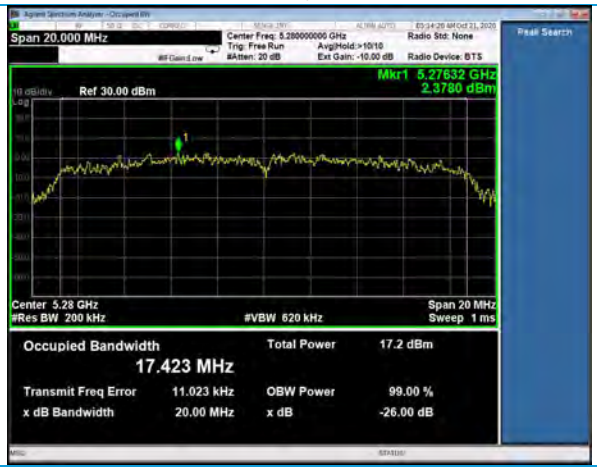


26 dB Emission Bandwidth, Channel 44
802.11n, MCS0

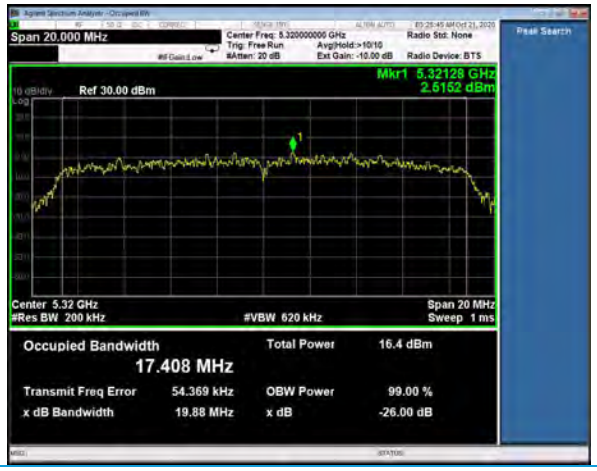
26 dB Emission Bandwidth, Channel 48
802.11n, MCS0



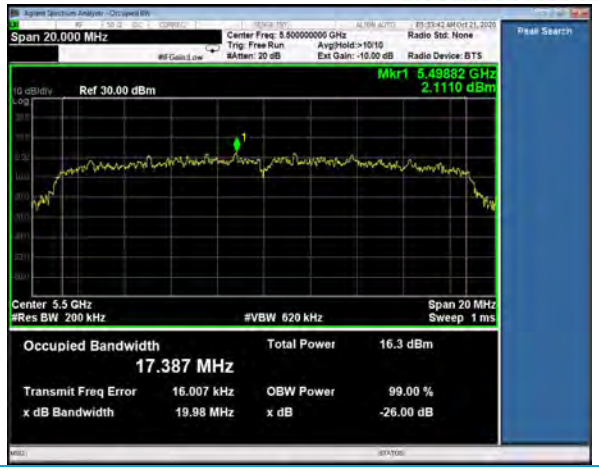
26 dB Emission Bandwidth, Channel 52
802.11n, MCS0



26 dB Emission Bandwidth, Channel 56
802.11n, MCS0



26 dB Emission Bandwidth, Channel 64
802.11n, MCS0



26 dB Emission Bandwidth, Channel 100
802.11n, MCS0

26 dB Emission Bandwidth, Channel 116
802.11n, MCS0

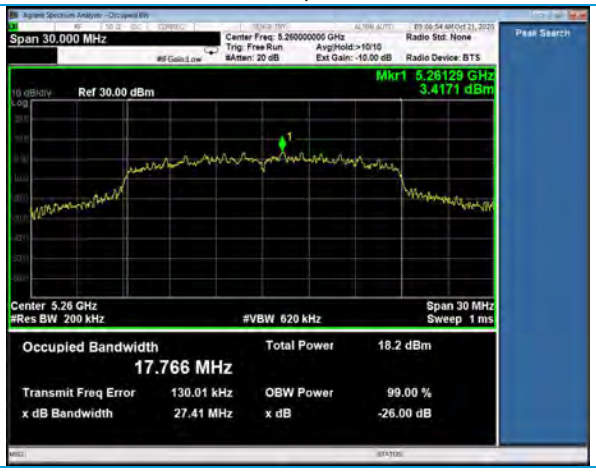
26 dB Emission Bandwidth, Channel 140
802.11n, MCS0

99% Occupied Bandwidth, Channel 36
802.11n, MCS0

99% Occupied Bandwidth, Channel 40
802.11n, MCS0

99% Occupied Bandwidth, Channel 44
802.11n, MCS0

99% Occupied Bandwidth, Channel 48
802.11n, MCS0



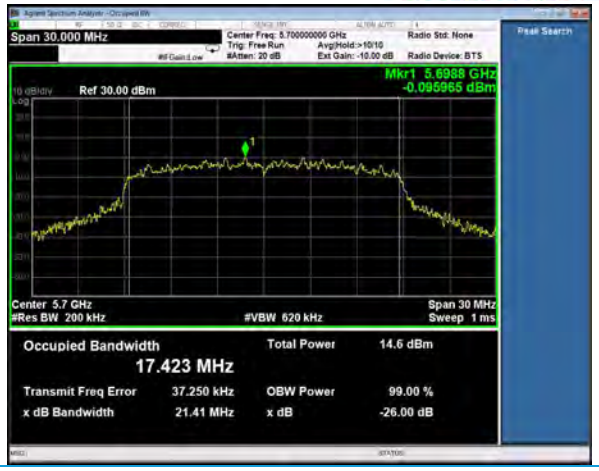
99% Occupied Bandwidth, Channel 52
802.11n, MCS0

99% Occupied Bandwidth, Channel 56
802.11n, MCS0

99% Occupied Bandwidth, Channel 64
802.11n, MCS0

99% Occupied Bandwidth, Channel 100
802.11n, MCS0

99% Occupied Bandwidth, Channel 116
802.11n, MCS0

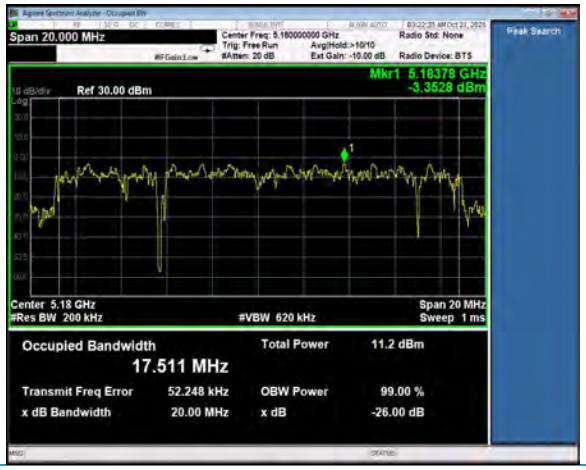


99% Occupied Bandwidth, Channel 140
802.11n, MCS0

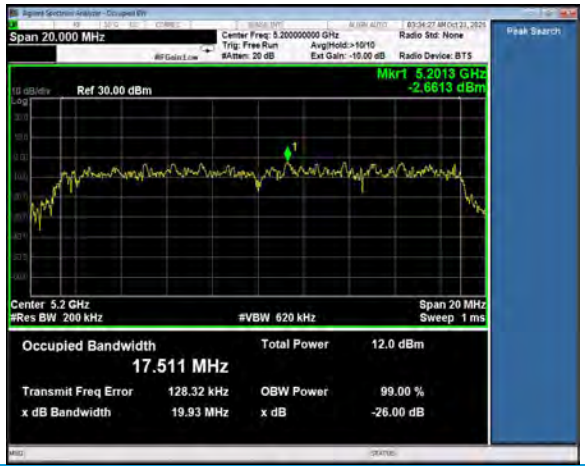
99% Occupied Bandwidth, Channel 149
802.11n, MCS0

99% Occupied Bandwidth, Channel 157
802.11n, MCS0

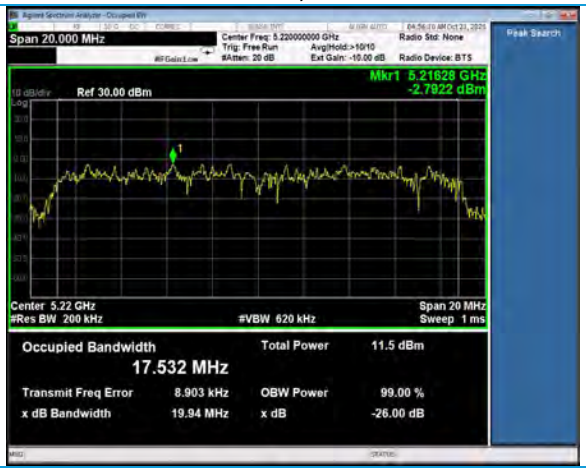
99% Occupied Bandwidth, Channel 165
802.11n, MCS0



26 dB Emission Bandwidth, Channel 36
802.11n, MCS7

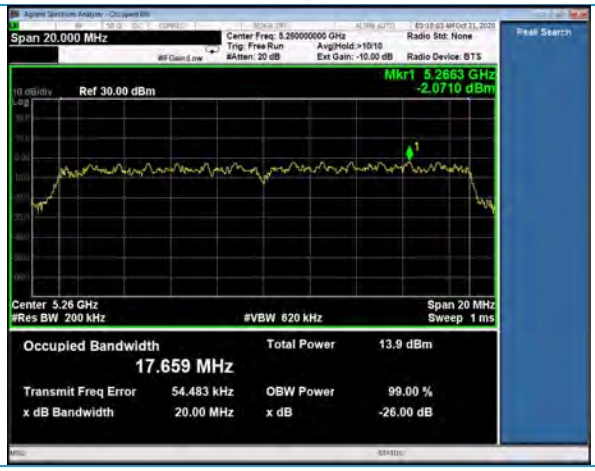


26 dB Emission Bandwidth, Channel 40
802.11n, MCS7

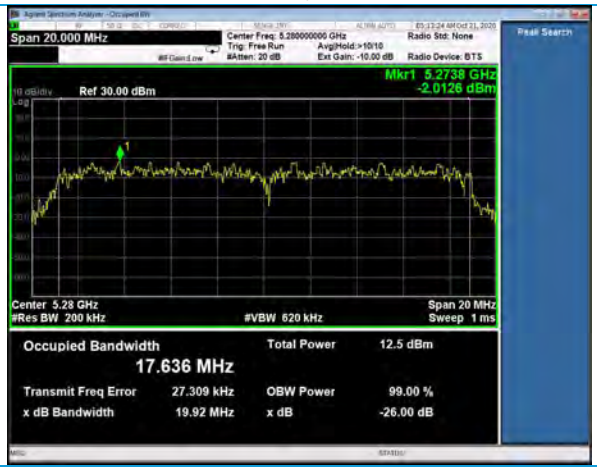


26 dB Emission Bandwidth, Channel 44
802.11n, MCS7

26 dB Emission Bandwidth, Channel 48
802.11n, MCS7

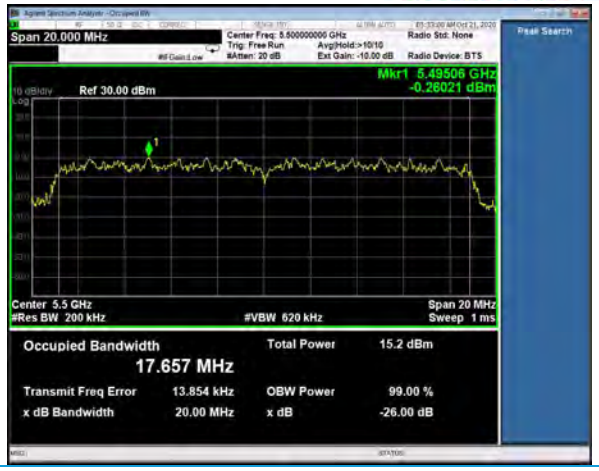


26 dB Emission Bandwidth, Channel 52
802.11n, MCS7

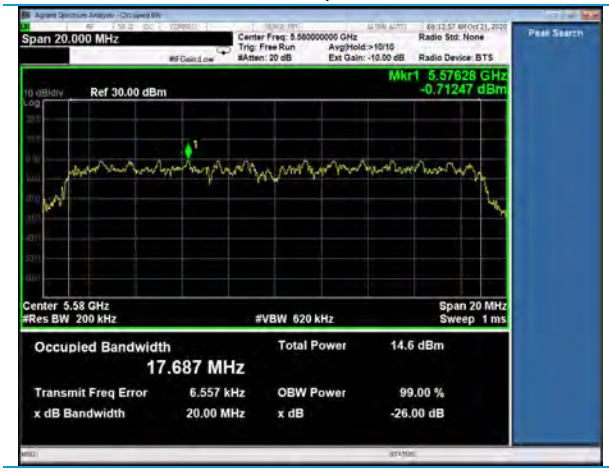


26 dB Emission Bandwidth, Channel 56
802.11n, MCS7

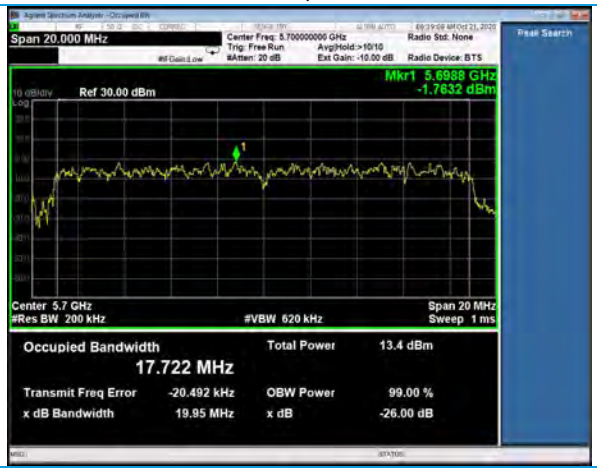
26 dB Emission Bandwidth, Channel 64
802.11n, MCS7



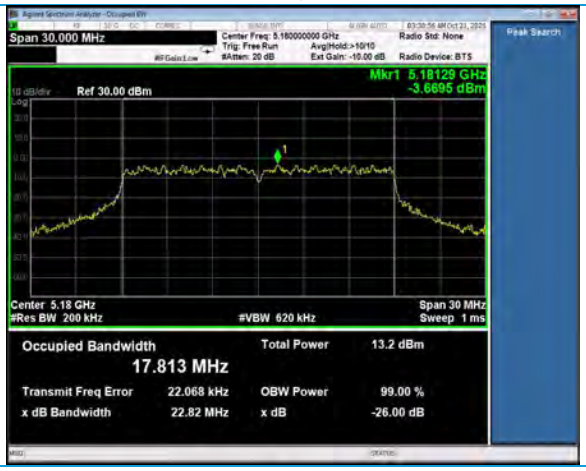
26 dB Emission Bandwidth, Channel 100
802.11n, MCS7



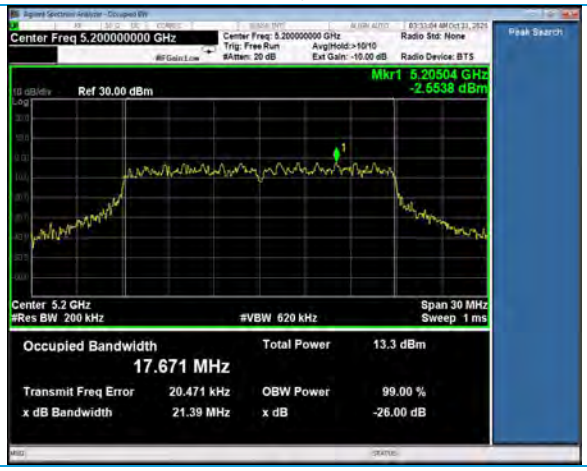
26 dB Emission Bandwidth, Channel 116
802.11n, MCS7



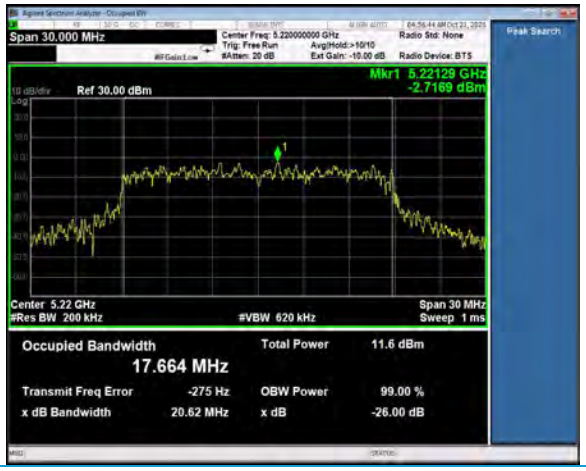
26 dB Emission Bandwidth, Channel 140
802.11n, MCS7



99% Occupied Bandwidth, Channel 36
802.11n, MCS7



99% Occupied Bandwidth, Channel 40
802.11n, MCS7

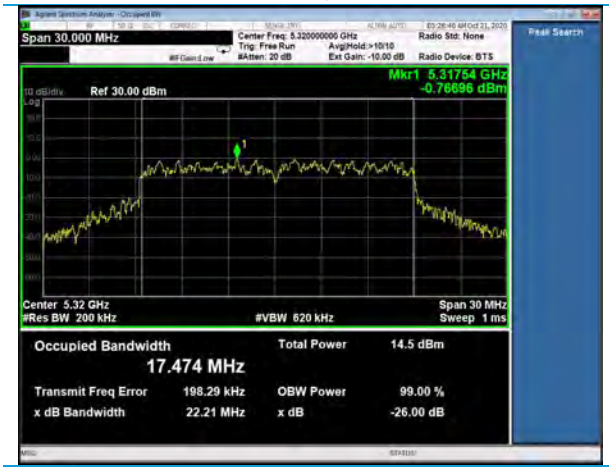


99% Occupied Bandwidth, Channel 44
802.11n, MCS7

99% Occupied Bandwidth, Channel 48
802.11n, MCS7

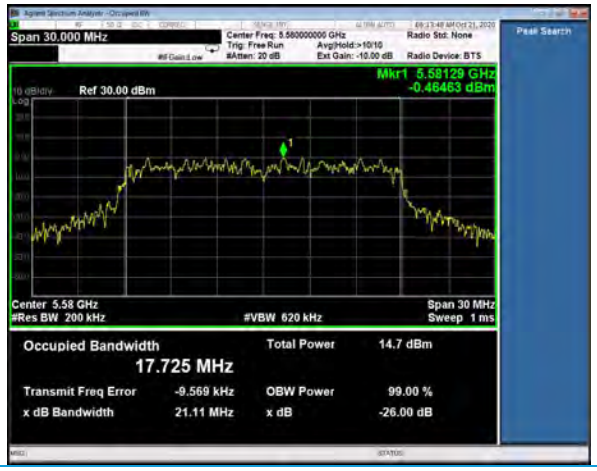
99% Occupied Bandwidth, Channel 52
802.11n, MCS7

99% Occupied Bandwidth, Channel 56
802.11n, MCS7



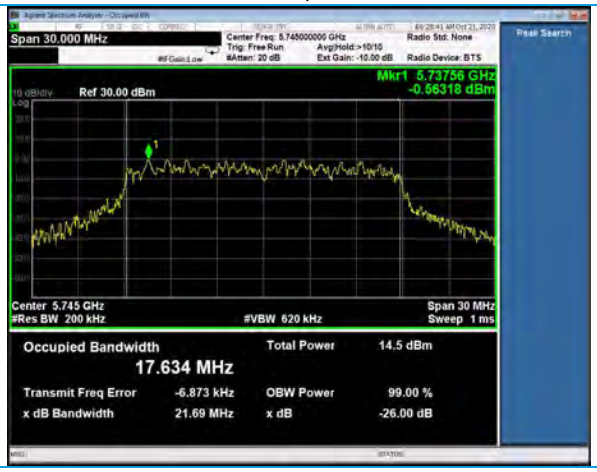
99% Occupied Bandwidth, Channel 64
802.11n, MCS7

99% Occupied Bandwidth, Channel 100
802.11n, MCS7



99% Occupied Bandwidth, Channel 116
802.11n, MCS7

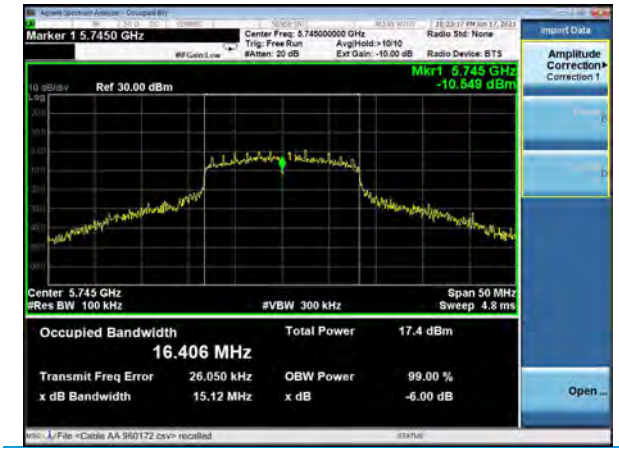
99% Occupied Bandwidth, Channel 140
802.11n, MCS7



99% Occupied Bandwidth, Channel 149
802.11n, MCS7

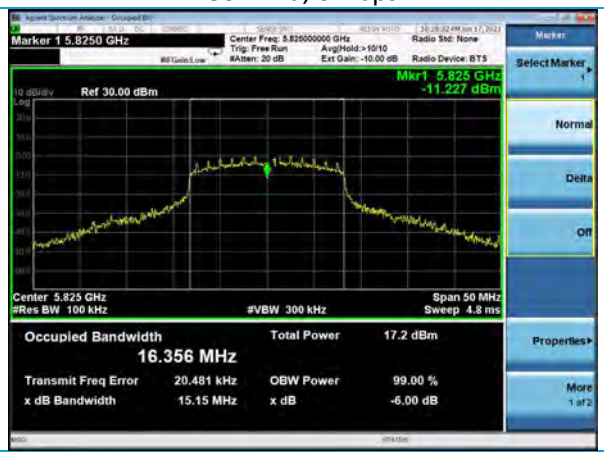
99% Occupied Bandwidth, Channel 157
802.11n, MCS7

99% Occupied Bandwidth, Channel 165
802.11n, MCS7

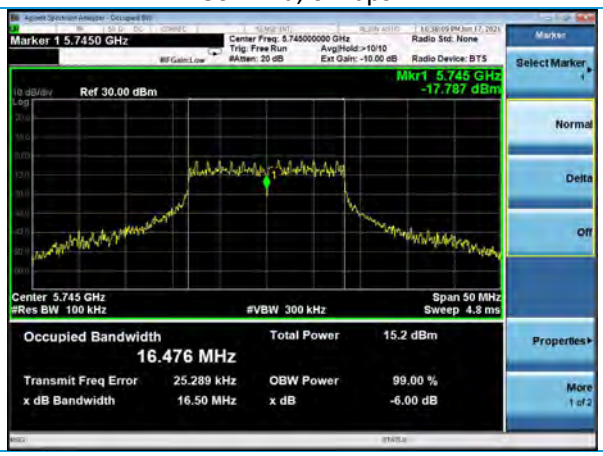


6 dB Emission Bandwidth, Channel 149
802.11a, 6Mbps

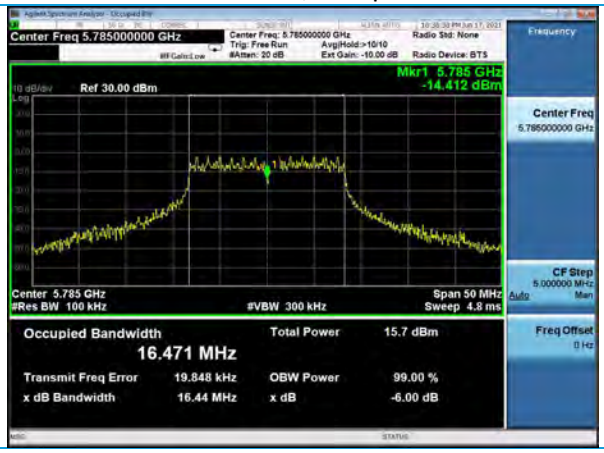
6 dB Emission Bandwidth, Channel 157
802.11a, 6Mbps



6 dB Emission Bandwidth, Channel 165
802.11a, 6Mbps

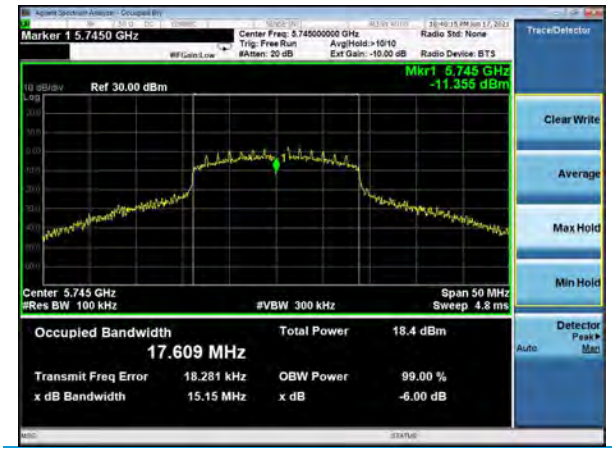


6 dB Emission Bandwidth, Channel 149
802.11a, 54Mbps



6 dB Emission Bandwidth, Channel 157
802.11a, 54Mbps

6 dB Emission Bandwidth, Channel 165
802.11a, 54Mbps



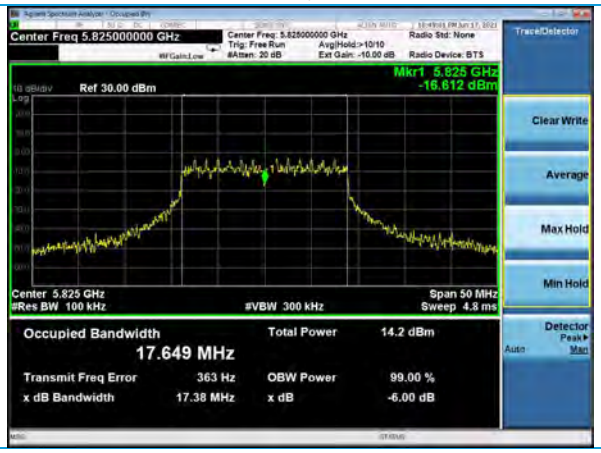
6 dB Emission Bandwidth, Channel 149
802.11n, MCS0

6 dB Emission Bandwidth, Channel 157
802.11n, MCS0

6 dB Emission Bandwidth, Channel 165
802.11n, MCS0

6 dB Emission Bandwidth, Channel 149
802.11n, MCS7

6 dB Emission Bandwidth, Channel 157
802.11n, MCS7



6 dB Emission Bandwidth, Channel 165
802.11n, MCS7

5.1.3 Fundamental Emission Output Power

Operator	Jon Dilley	**QA**	Shane Dock
Temperature	21.1°C	**R.H. %**	55%
Test Date	10/12/2020	**Location**	Conducted RF Bench
Requirement	FCC 15.407, RSS-247	**Method**	ANSI C63.10 §12.3.2.4 SA-2

Limits

Band	ISED Output Power Limit (dBm)	FCC Output Power Limit (dBm)
UNII 1	23.0	24.0
UNII 2A	24.0	24.0
UNII 2C	24.0	24.0
UNII 3	30.0	30.0

Test Parameters

Frequency	5180, 5200, 5220, 5240, 5260, 5280, 5320, 5500, 5580, 5700, 5745, 5785, 5825 MHz	**Setup**	Conducted
RBW	1 MHz	**VBW**	3 MHz
Detector(s)	RMS	**Sweep Time**	Auto
Number of Traces	100	**Correction Factor Example Calculation**	10LOG(1/D), where D=duty cycle

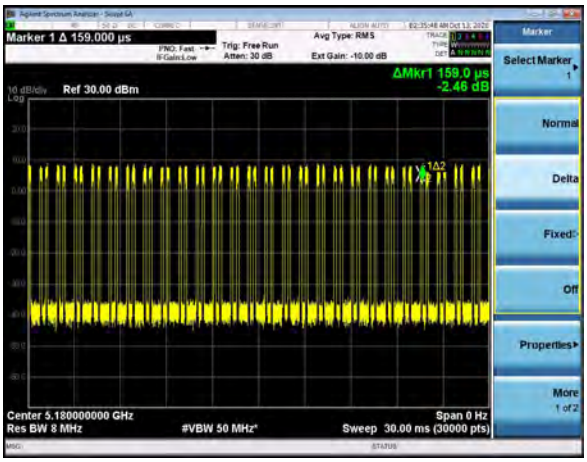
Instrumentation

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Cable	Gore	EKD01D01048.0	5546519	2/3/2021	2/3/2022	Active Verification
2	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	7/14/2020	7/14/2021	Active Calibration

EUT Parameters

Input Power	5.9VDC	**Mode**	WLAN TX
Channels	36, 40, 44, 48, 52, 56, 64, 100, 116, 140, 149, 157, 165	**Data Rates**	802.11a: 6Mbps, 54Mbps 802.11n HT20: MCS0, MCS7

802.11a, 6Mbps, Duty Cycle



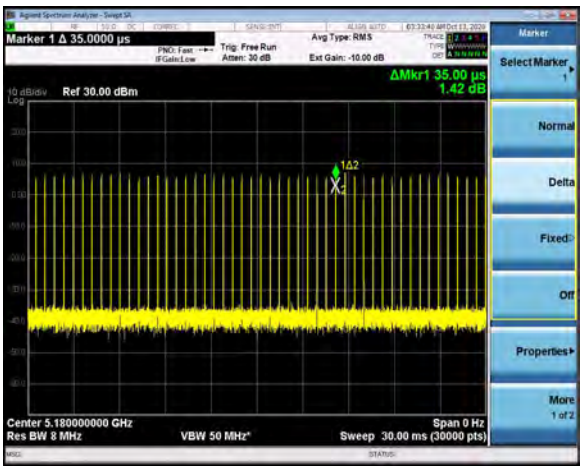
On Time = 320µs

Observation Period = 1119µs

Constant Duty Cycle = 29%

Duty Cycle Correction Factor = 5.4 dB

802.11a, 54Mbps, Duty Cycle



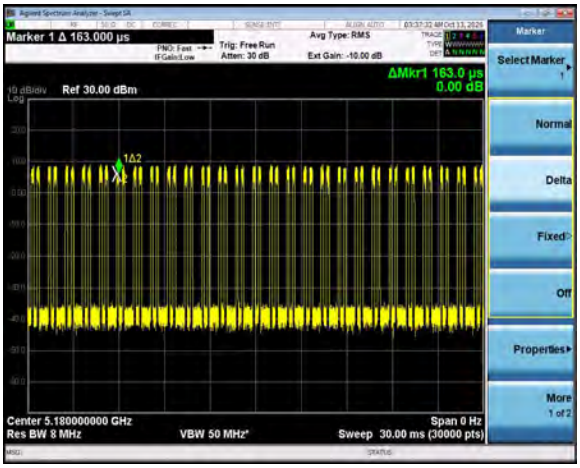
On Time = 35µs

Observation Period = 620µs

Constant Duty Cycle = 0.6%

Duty Cycle Correction Factor = 12.5 dB

802.11n, MCS0, Duty Cycle



On Time = 326µs

Observation Period = 1126µs

Constant Duty Cycle = 29%

Duty Cycle Correction Factor = 5.4 dB

802.11n, MCS7, Duty Cycle

On Time = 50µs

Observation Period = 654µs

Constant Duty Cycle = 0.8%

Duty Cycle Correction Factor = 11.2 dB

Data Tables

Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Conducted Output Power (dBm)	Output Power Limit (dBm)	Margin (dB)
802.11a	6Mbps	36	4.1	5.4	9.5	23.0	13.5
802.11a	6Mbps	40	5.9	5.4	11.3	23.0	11.7
802.11a	6Mbps	44	6.0	5.4	11.4	23.0	11.6
802.11a	6Mbps	48	5.6	5.4	11.0	23.0	12.0
802.11a	6Mbps	52	6.3	5.4	11.7	24.0	12.3
802.11a	6Mbps	56	6.5	5.4	11.9	24.0	12.1
802.11a	6Mbps	64	6.4	5.4	11.8	24.0	12.2
802.11a	6Mbps	100	6.2	5.4	11.6	24.0	12.4
802.11a	6Mbps	116	8.3	5.4	13.7	24.0	10.3
802.11a	6Mbps	140	3.4	5.4	8.8	24.0	15.2
802.11a	6Mbps	149	7.6	5.4	13.0	30.0	17.0
802.11a	6Mbps	157	8.6	5.4	14.0	30.0	16.0
802.11a	6Mbps	165	6.4	5.4	11.8	30.0	18.2

Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Conducted Output Power (dBm)	Output Power Limit (dBm)	Margin (dB)
802.11a	54Mbps	36	-4.2	12.5	8.3	23.0	14.7
802.11a	54Mbps	40	-3.6	12.5	8.9	23.0	14.1
802.11a	54Mbps	44	-3.3	12.5	9.2	23.0	13.8
802.11a	54Mbps	48	-4.2	12.5	8.3	23.0	14.7
802.11a	54Mbps	52	-2.8	12.5	9.7	24.0	14.3
802.11a	54Mbps	56	-3.2	12.5	9.3	24.0	14.7
802.11a	54Mbps	64	-1.2	12.5	11.3	24.0	12.7
802.11a	54Mbps	100	-1.1	12.5	11.4	24.0	12.6
802.11a	54Mbps	116	-1.7	12.5	10.8	24.0	13.2
802.11a	54Mbps	140	-3.3	12.5	9.2	24.0	14.8
802.11a	54Mbps	149	-1.5	12.5	11.0	30.0	19.0
802.11a	54Mbps	157	-0.7	12.5	11.8	30.0	18.2
802.11a	54Mbps	165	-1.5	12.5	11.0	30.0	19.0

Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Conducted Output Power (dBm)	Output Power Limit (dBm)	Margin (dB)
802.11n	MCS0	36	4.2	5.4	9.6	23.0	13.4
802.11n	MCS0	40	5.9	5.4	11.3	23.0	11.7
802.11n	MCS0	44	6.1	5.4	11.5	23.0	11.5
802.11n	MCS0	48	5.4	5.4	10.8	23.0	12.2
802.11n	MCS0	52	6.4	5.4	11.8	24.0	12.2
802.11n	MCS0	56	6.9	5.4	12.3	24.0	11.7
802.11n	MCS0	64	6.6	5.4	12.0	24.0	12.0
802.11n	MCS0	100	5.9	5.4	11.3	24.0	12.7
802.11n	MCS0	116	8.4	5.4	13.8	24.0	10.2
802.11n	MCS0	140	3.3	5.4	8.7	24.0	15.3
802.11n	MCS0	149	7.8	5.4	13.2	30.0	16.8
802.11n	MCS0	157	8.6	5.4	14.0	30.0	16.0
802.11n	MCS0	165	6.3	5.4	11.7	30.0	18.3

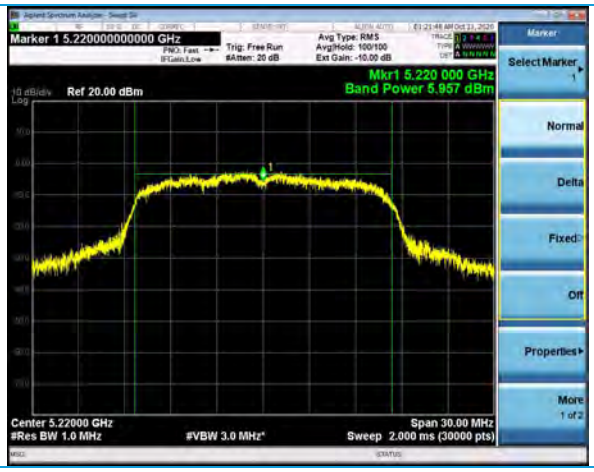
Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Conducted Output Power (dBm)	Output Power Limit (dBm)	Margin (dB)
802.11n	MCS7	36	-4.1	11.2	7.1	23.0	15.9
802.11n	MCS7	40	-3.3	11.2	7.9	23.0	15.1
802.11n	MCS7	44	-3.2	11.2	8.0	23.0	15.0
802.11n	MCS7	48	-3.6	11.2	7.6	23.0	15.4
802.11n	MCS7	52	-2.9	11.2	8.3	24.0	15.7
802.11n	MCS7	56	-2.5	11.2	8.7	24.0	15.3
802.11n	MCS7	64	-1.0	11.2	10.2	24.0	13.8
802.11n	MCS7	100	-0.7	11.2	10.5	24.0	13.5
802.11n	MCS7	116	-1.0	11.2	10.2	24.0	13.8
802.11n	MCS7	140	-2.1	11.2	9.1	24.0	14.9
802.11n	MCS7	149	-1.3	11.2	9.9	30.0	20.1
802.11n	MCS7	157	-0.9	11.2	10.3	30.0	19.7
802.11n	MCS7	165	-1.5	11.2	9.7	30.0	20.3

Plots

802.11a, 1Mbps

Output Power, Channel 36, 802.11a, 6Mbps

Output Power, Channel 40, 802.11a, 6Mbps



Output Power, Channel 44, 802.11a, 6Mbps

Output Power, Channel 48, 802.11a, 6Mbps

Output Power, Channel 52, 802.11a, 6Mbps

Output Power, Channel 56, 802.11a, 6Mbps

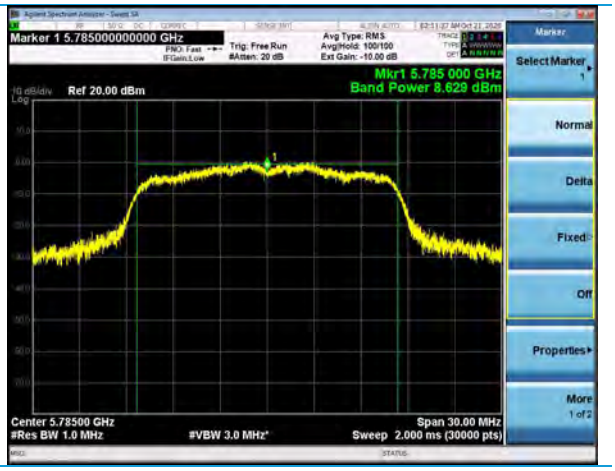
Output Power, Channel 64, 802.11a, 6Mbps

Output Power, Channel 100, 802.11a, 6Mbps

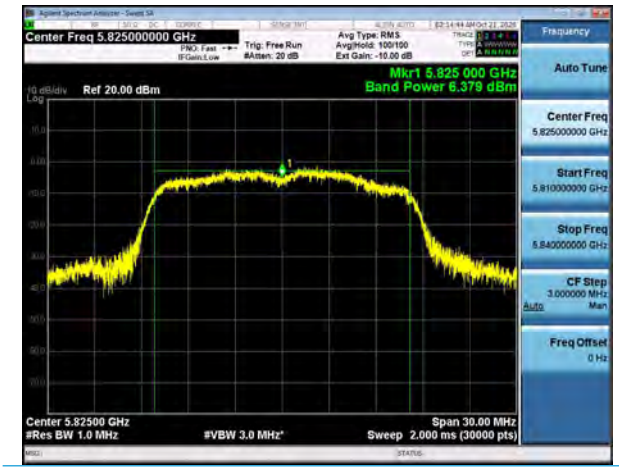
Output Power, Channel 116, 802.11a, 6Mbps

Output Power, Channel 140, 802.11a, 6Mbps

Output Power, Channel 149, 802.11a, 6Mbps

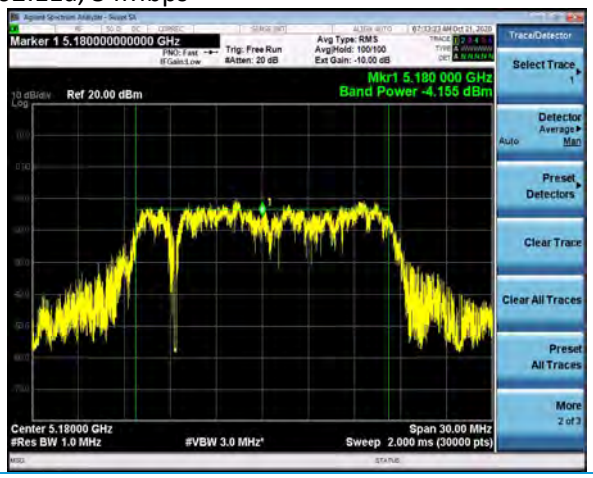


Output Power, Channel 157, 802.11a, 6Mbps

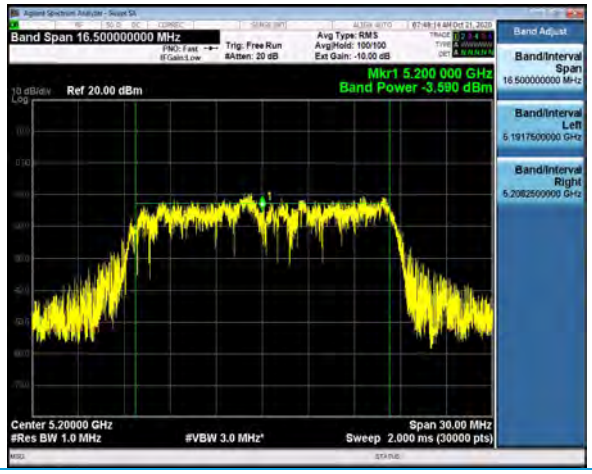


Output Power, Channel 165, 802.11a, 6Mbps

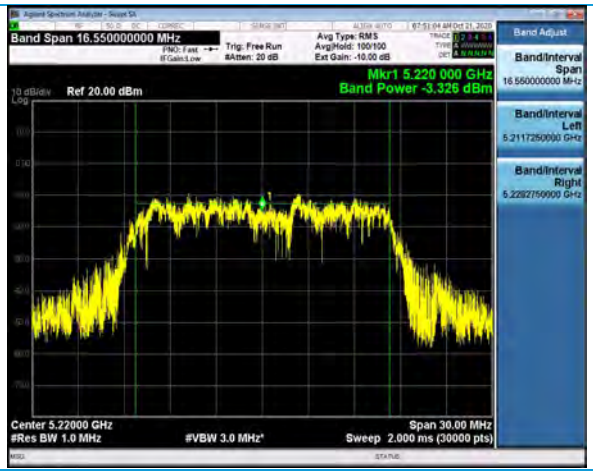
802.11a, 54Mbps



Output Power, Channel 36, 802.11a, 54Mbps

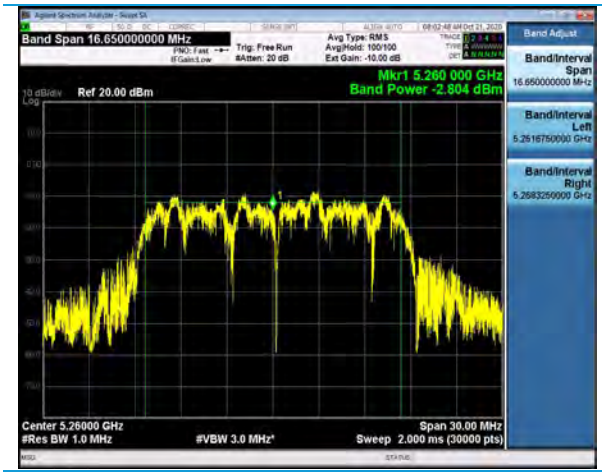


Output Power, Channel 40, 802.11a, 54Mbps



Output Power, Channel 44, 802.11a, 54Mbps

Output Power, Channel 48, 802.11a, 54Mbps

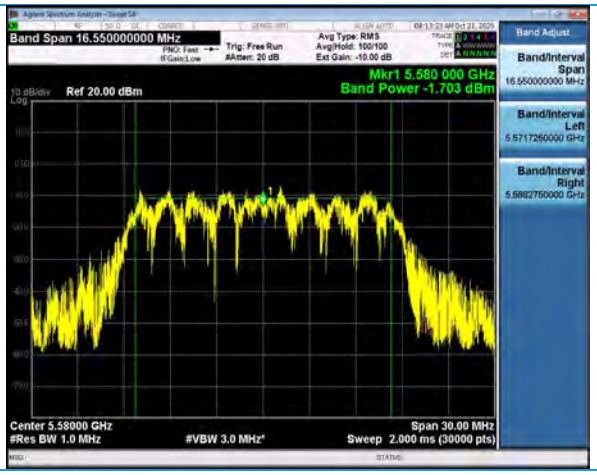


Output Power, Channel 52, 802.11a, 54Mbps

Output Power, Channel 56, 802.11a, 54Mbps

Output Power, Channel 64, 802.11a, 54Mbps

Output Power, Channel 100, 802.11a, 54Mbps



Output Power, Channel 116, 802.11a, 54Mbps

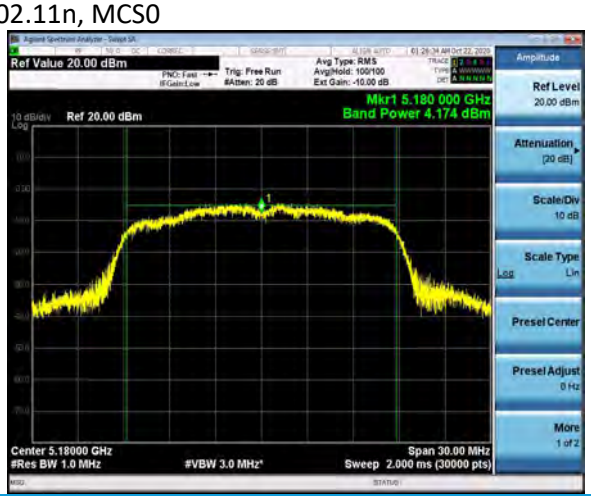
Output Power, Channel 140, 802.11a, 54Mbps

Output Power, Channel 149, 802.11a, 54Mbps

Output Power, Channel 157, 802.11a, 54Mbps

Output Power, Channel 165, 802.11a, 54Mbps

802.11n, MCS0



Output Power, Channel 36, 802.11n, MCS0

Output Power, Channel 40, 802.11n, MCS0

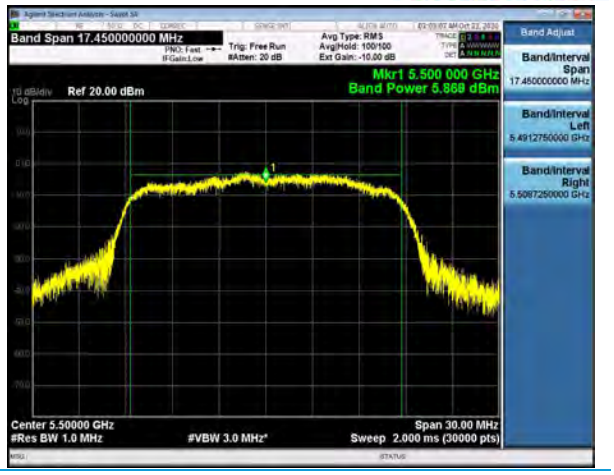
Output Power, Channel 44, 802.11n, MCS0

Output Power, Channel 48, 802.11n, MCS0

Output Power, Channel 52, 802.11n, MCS0

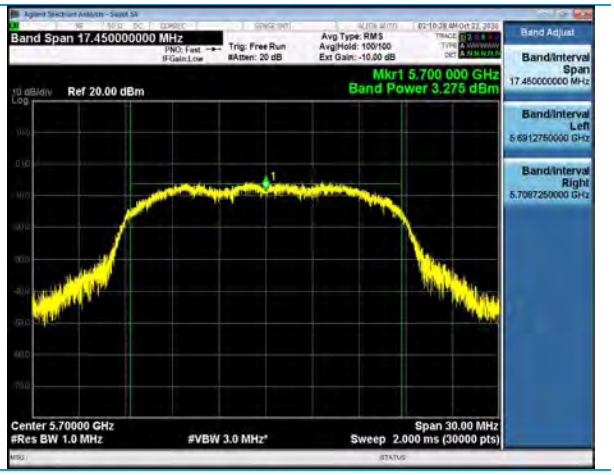
Output Power, Channel 56, 802.11n, MCS0

Output Power, Channel 64, 802.11n, MCS0



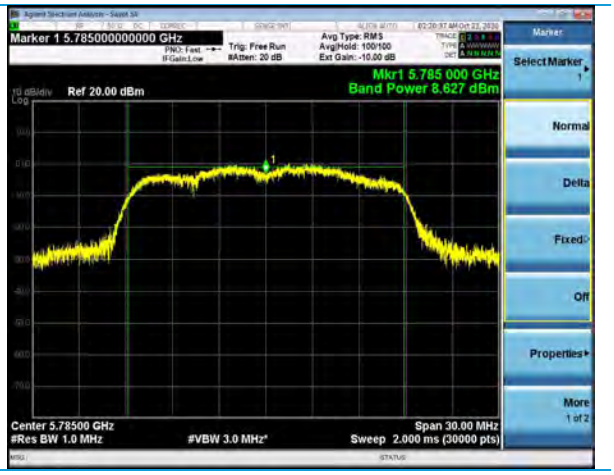
Output Power, Channel 100, 802.11n, MCS0

Output Power, Channel 116, 802.11n, MCS0

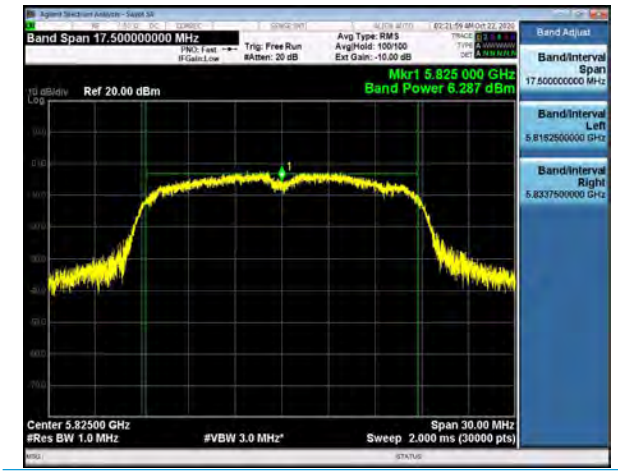


Output Power, Channel 140, 802.11n, MCS0

Output Power, Channel 149, 802.11n, MCS0

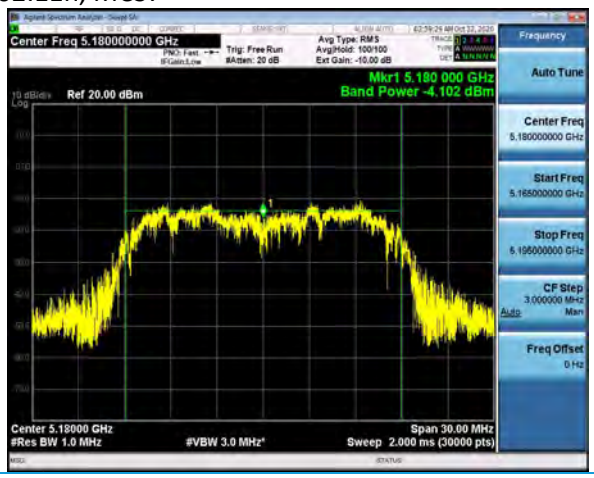


Output Power, Channel 157, 802.11n, MCS0

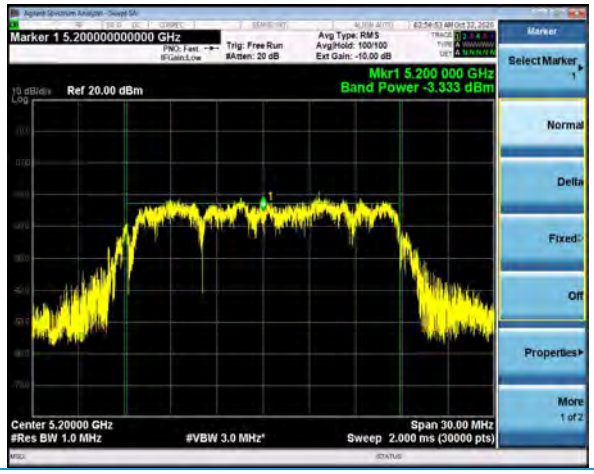


Output Power, Channel 165, 802.11n, MCS0

802.11n, MCS7



Output Power, Channel 36, 802.11n, MCS7



Output Power, Channel 40, 802.11n, MCS7

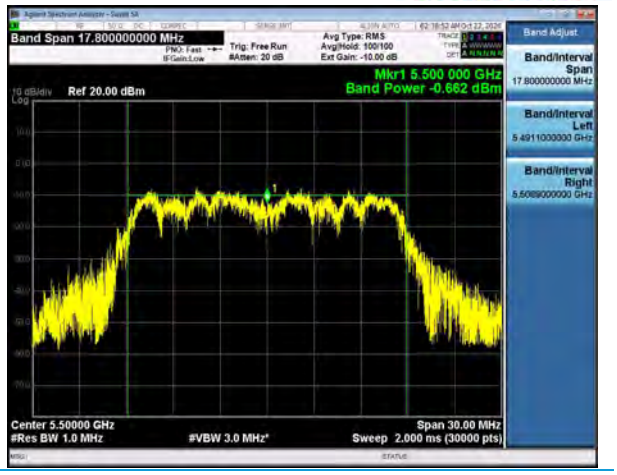
Output Power, Channel 44, 802.11n, MCS7

Output Power, Channel 48, 802.11n, MCS7

Output Power, Channel 52, 802.11n, MCS7

Output Power, Channel 56, 802.11n, MCS7

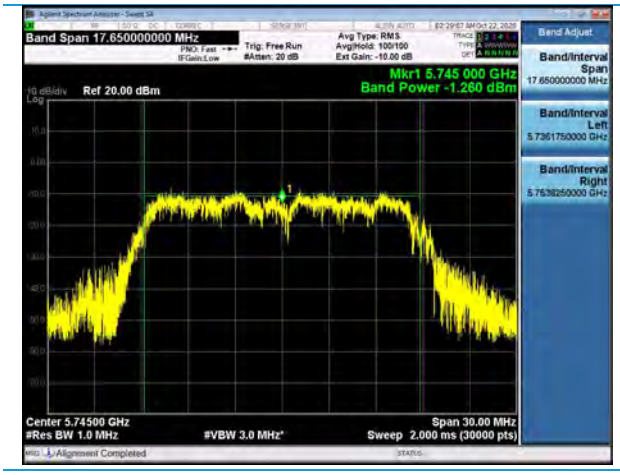
Output Power, Channel 64, 802.11n, MCS7



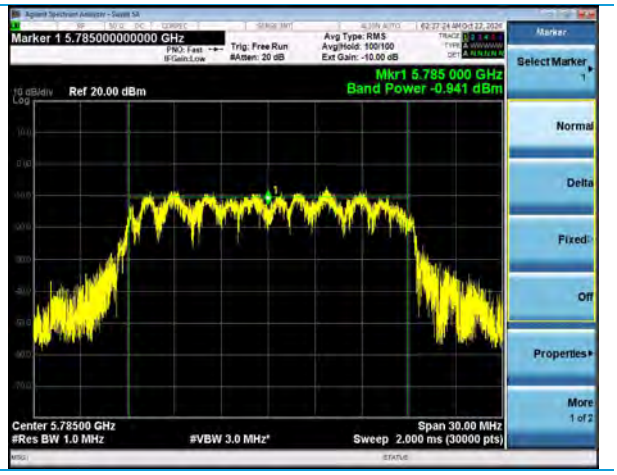
Output Power, Channel 100, 802.11n, MCS7

Output Power, Channel 116, 802.11n, MCS7

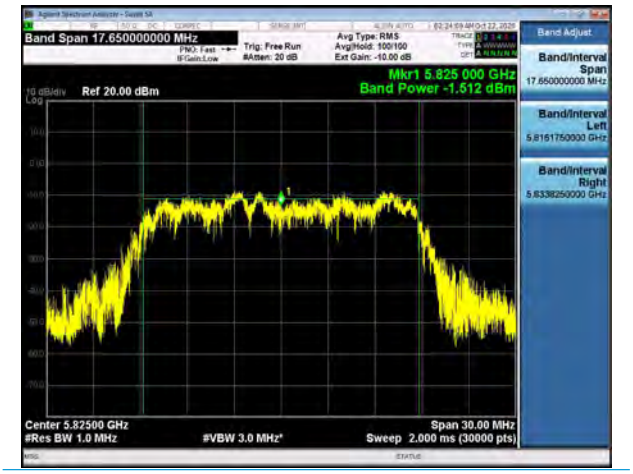
Output Power, Channel 140, 802.11n, MCS7



Output Power, Channel 149, 802.11n, MCS7



Output Power, Channel 157, 802.11n, MCS7



Output Power, Channel 165, 802.11n, MCS7

5.1.4 Maximum Power Spectral Density

Operator	Jon Dilley, Anthony Smith	**QA**	Shane Dock, Zach Wilson
Temperature	21.1°C – 22.7°C	**R.H. %**	53%-55%
Test Date	10/12/2020, 6/18/2021, 6/21/2021	**Location**	Conducted RF Bench
Requirement	FCC 15.247, RSS-247	**Method**	ANSI C63.10 §12.5

Limits

UNII 1: 10.0dBm/MHz

UNII 2A/2C: 11.0dBm/MHz

UNII 3: 30dBm/500kHz

Test Parameters

Frequency	5180, 5200, 5220, 5240, 5260, 5280, 5320, 5500, 5580, 5700, 5745, 5785, 5825 MHz	**Setup**	Conducted
RBW	UNII-1, UNII-2a/2c: 1MHz UNII-3: 100kHz	**VBW**	UNII-1, UNII-2a/2c: 3MHz UNII-3: 300kHz
Detector(s)	RMS, Peak Search	**Sweep Time**	Auto
Number of Traces	100	**Correction Factor Example Calculation**	10LOG(1/D), where D=duty cycle

Instrumentation

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Cable	Gore	EKD01D01048.0	5546519	2/3/2021	2/3/2022	Active Verification
2	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	7/14/2020	7/14/2021	Active Calibration

EUT Parameters

Input Power	5.9VDC	**Mode**	WLAN TX
Channels	36, 40, 44, 48, 52, 56, 64, 100, 116, 140, 149, 157, 165	**Data Rates**	802.11a: 6Mbps, 54Mbps 802.11n HT20: MCS0, MCS7

Data Tables

Protocol	Data Rate	Channel	Measured PSD (dBm)	Duty Cycle Correction Factor (dB)	Conducted PSD (dBm)	PSD Limit (dBm)	Margin (dB)
802.11a	6Mbps	36	-5.0	5.4	0.4	10.0	9.6
802.11a	6Mbps	40	-2.9	5.4	2.5	10.0	7.5
802.11a	6Mbps	44	-2.9	5.4	2.5	10.0	7.5
802.11a	6Mbps	48	-4.0	5.4	1.4	10.0	8.6
802.11a	6Mbps	52	-2.8	5.4	2.6	11.0	8.4
802.11a	6Mbps	56	-2.7	5.4	2.7	11.0	8.3
802.11a	6Mbps	64	-2.9	5.4	2.5	11.0	8.5
802.11a	6Mbps	100	-3.1	5.4	2.3	11.0	8.7
802.11a	6Mbps	116	-1.2	5.4	4.2	11.0	6.8
802.11a	6Mbps	140	-6.6	5.4	-1.2	11.0	12.2
802.11a	6Mbps	149	-9.5	5.4	-4.1	30.0	34.1
802.11a	6Mbps	157	-7.6	5.4	-2.2	30.0	32.2
802.11a	6Mbps	165	-10.9	5.4	-5.5	30.0	35.5

Protocol	Data Rate	Channel	Measured PSD (dBm)	Duty Cycle Correction Factor (dB)	Conducted PSD (dBm)	PSD Limit (dBm)	Margin (dB)
802.11a	54Mbps	36	-12.8	12.5	-0.3	10.0	10.3
802.11a	54Mbps	40	-12.8	12.5	-0.3	10.0	10.3
802.11a	54Mbps	44	-12.2	12.5	0.3	10.0	9.7
802.11a	54Mbps	48	-12.1	12.5	0.4	10.0	9.6
802.11a	54Mbps	52	-11.5	12.5	1.0	11.0	10.0
802.11a	54Mbps	56	-11.5	12.5	1.0	11.0	10.0
802.11a	54Mbps	64	-9.4	12.5	3.1	11.0	7.9
802.11a	54Mbps	100	-10.3	12.5	2.2	11.0	8.8
802.11a	54Mbps	116	-10.3	12.5	2.2	11.0	8.8
802.11a	54Mbps	140	-12.8	12.5	-0.3	11.0	11.3
802.11a	54Mbps	149	-15.6	12.5	-3.1	30.0	33.1
802.11a	54Mbps	157	-14.4	12.5	-1.9	30.0	31.9
802.11a	54Mbps	165	-15.9	12.5	-3.4	30.0	33.4

Protocol	Data Rate	Channel	Measured PSD (dBm)	Duty Cycle Correction Factor (dB)	Conducted PSD (dBm)	PSD Limit (dBm)	Margin (dB)
802.11n	MCS0	36	-5.8	5.4	-0.4	10.0	10.4
802.11n	MCS0	40	-3.9	5.4	1.5	10.0	8.5
802.11n	MCS0	44	-2.6	5.4	2.8	10.0	7.2
802.11n	MCS0	48	-2.9	5.4	2.5	10.0	7.5
802.11n	MCS0	52	-1.9	5.4	3.5	11.0	7.5
802.11n	MCS0	56	-2.8	5.4	2.6	11.0	8.4
802.11n	MCS0	64	-3.4	5.4	2.0	11.0	9.0
802.11n	MCS0	100	-2.8	5.4	2.6	11.0	8.4
802.11n	MCS0	116	-1.4	5.4	4.0	11.0	7.0
802.11n	MCS0	140	-6.2	5.4	-0.8	11.0	11.8
802.11n	MCS0	149	-9.4	5.4	-4.0	30.0	34.0
802.11n	MCS0	157	-7.3	5.4	-1.9	30.0	31.9
802.11n	MCS0	165	-10.5	5.4	-5.1	30.0	35.1

Protocol	Data Rate	Channel	Measured PSD (dBm)	Duty Cycle Correction Factor (dB)	Conducted PSD (dBm)	PSD Limit (dBm)	Margin (dB)
802.11n	MCS7	36	-11.5	11.2	-0.3	10.0	10.3
802.11n	MCS7	40	-13.3	11.2	-2.1	10.0	12.1
802.11n	MCS7	44	-13.0	11.2	-1.8	10.0	11.8
802.11n	MCS7	48	-11.7	11.2	-0.5	10.0	10.5
802.11n	MCS7	52	-12.4	11.2	-1.2	11.0	12.2
802.11n	MCS7	56	-11.5	11.2	-0.3	11.0	11.3
802.11n	MCS7	64	-10.7	11.2	0.5	11.0	10.5
802.11n	MCS7	100	-9.1	11.2	2.1	11.0	8.9
802.11n	MCS7	116	-10.5	11.2	0.7	11.0	10.3
802.11n	MCS7	140	-12.1	11.2	-0.9	11.0	11.9
802.11n	MCS7	149	-16.4	11.2	-5.2	30.0	35.2
802.11n	MCS7	157	-14.7	11.2	-3.5	30.0	33.5
802.11n	MCS7	165	-16.5	11.2	-5.3	30.0	35.3

Plots

802.11a, 6Mbps

PSD, Channel 36, 802.11a, 6Mbps

PSD, Channel 40, 802.11a, 6Mbps

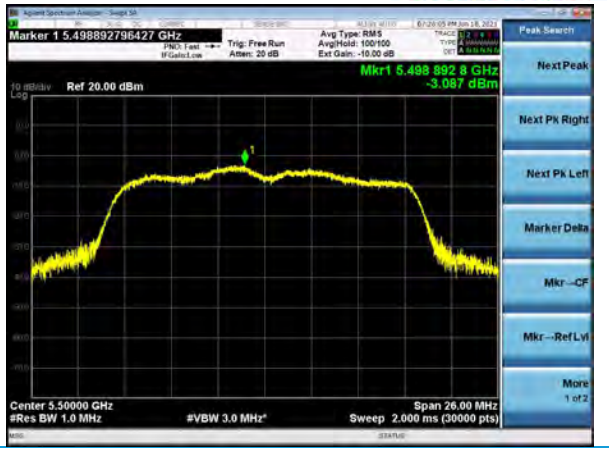
PSD, Channel 44, 802.11a, 6Mbps

PSD, Channel 48, 802.11a, 6Mbps

PSD, Channel 52, 802.11a, 6Mbps

PSD, Channel 56, 802.11a, 6Mbps

PSD, Channel 64, 802.11a, 6Mbps



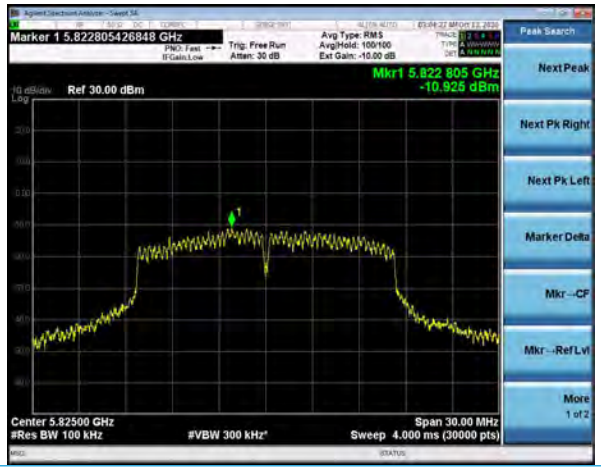
PSD, Channel 100, 802.11a, 6Mbps

PSD, Channel 116, 802.11a, 6Mbps

PSD, Channel 140, 802.11a, 6Mbps

PSD, Channel 149, 802.11a, 6Mbps

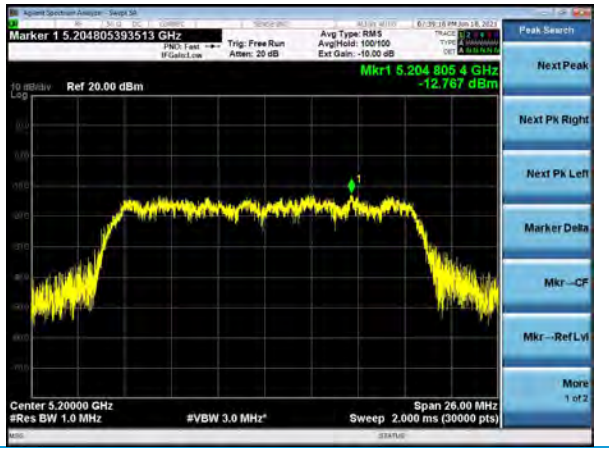
PSD, Channel 157, 802.11a, 6Mbps



PSD, Channel 165, 802.11a, 6Mbps

802.11a, 54Mbps

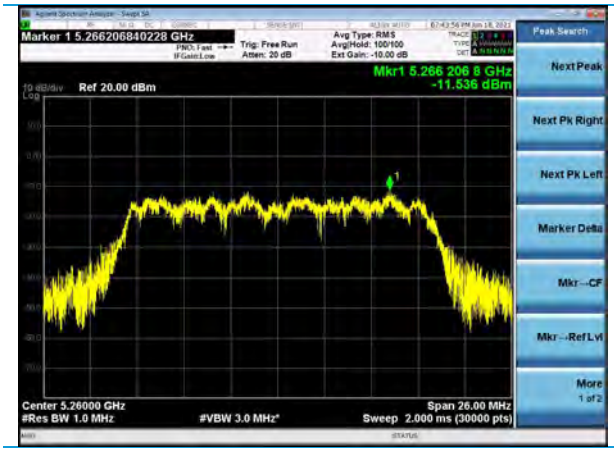
PSD, Channel 36, 802.11a, 54Mbps



PSD, Channel 40, 802.11a, 54Mbps

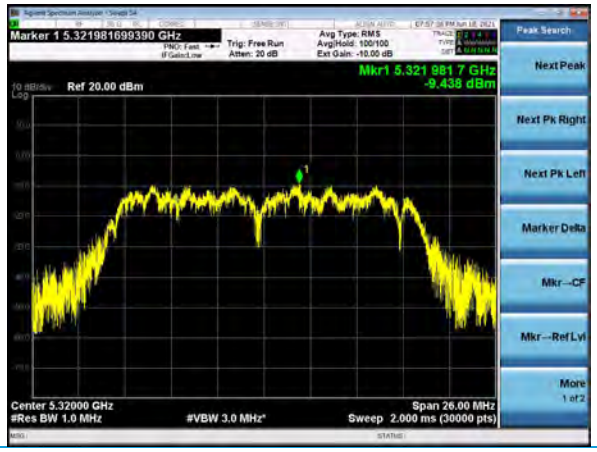
PSD, Channel 44, 802.11a, 54Mbps

PSD, Channel 48, 802.11a, 54Mbps

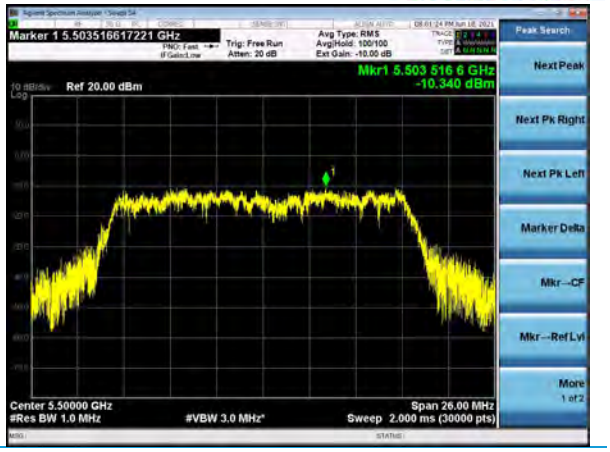


PSD, Channel 52, 802.11a, 54Mbps

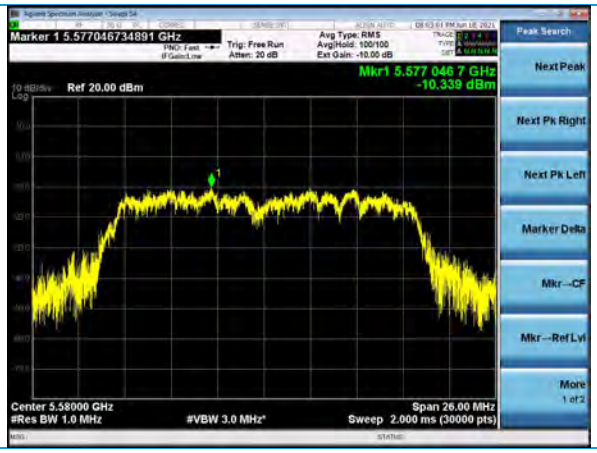
PSD, Channel 56, 802.11a, 54Mbps



PSD, Channel 64, 802.11a, 54Mbps

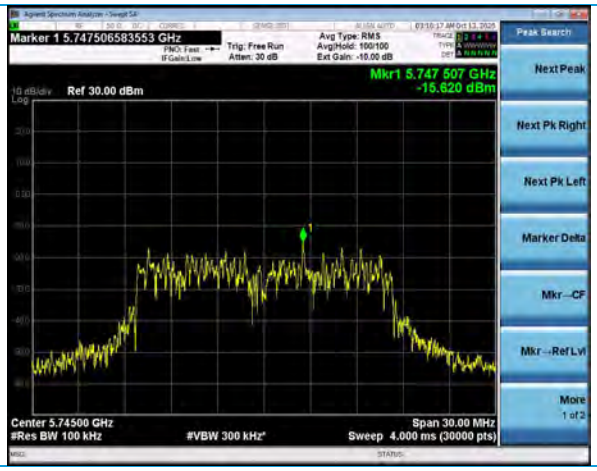


PSD, Channel 100, 802.11a, 54Mbps

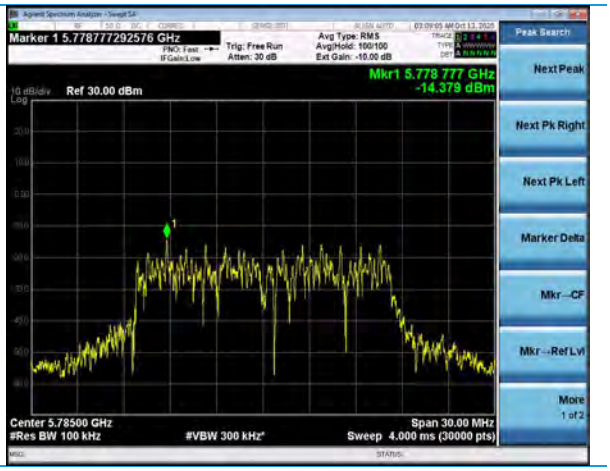


PSD, Channel 116, 802.11a, 54Mbps

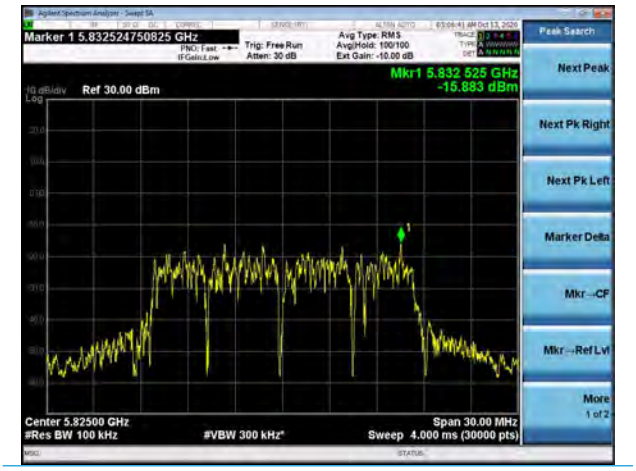
PSD, Channel 140, 802.11a, 54Mbps



PSD, Channel 149, 802.11a, 54Mbps



PSD, Channel 157, 802.11a, 54Mbps



PSD, Channel 165, 802.11a, 54Mbps

802.11n, MCS0

PSD, Channel 36, 802.11n, MCS0

PSD, Channel 40, 802.11n, MCS0

PSD, Channel 44, 802.11n, MCS0

PSD, Channel 48, 802.11n, MCS0

PSD, Channel 52, 802.11n, MCS0

PSD, Channel 56, 802.11n, MCS0

PSD, Channel 64, 802.11n, MCS0

PSD, Channel 100, 802.11n, MCS0

PSD, Channel 116, 802.11n, MCS0

PSD, Channel 140, 802.11n, MCS0

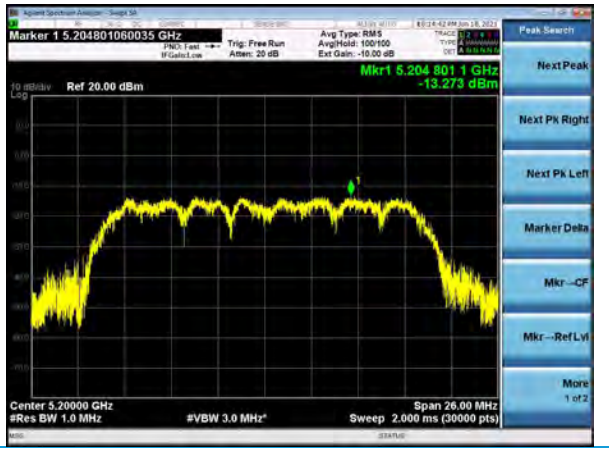
PSD, Channel 149, 802.11n, MCS0

PSD, Channel 157, 802.11n, MCS0

PSD, Channel 165, 802.11n, MCS0

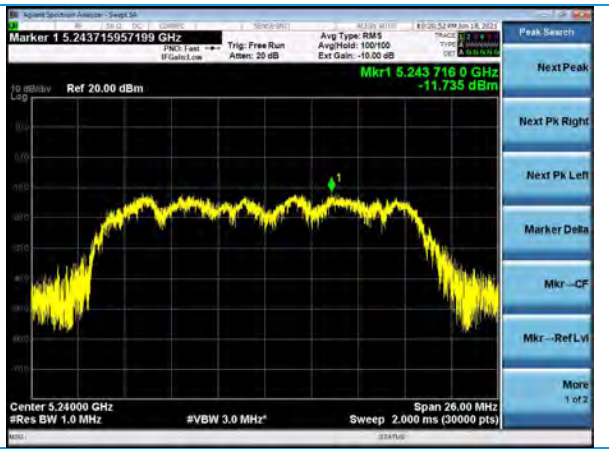
802.11n, MCS7

PSD, Channel 36, 802.11n, MCS7

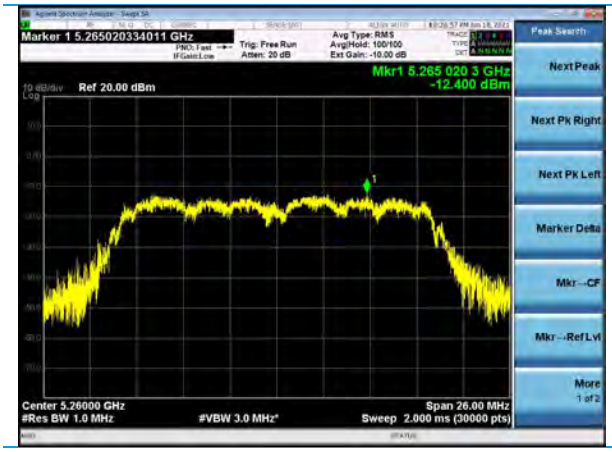


PSD, Channel 40, 802.11n, MCS7

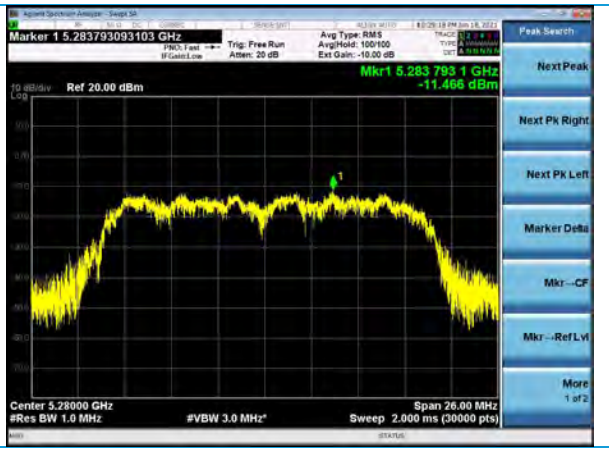
PSD, Channel 44, 802.11n, MCS7



PSD, Channel 48, 802.11n, MCS7



PSD, Channel 52, 802.11n, MCS7

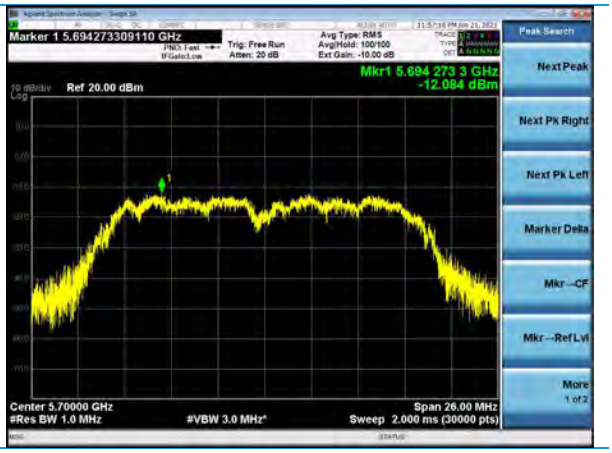


PSD, Channel 56, 802.11n, MCS7

PSD, Channel 64, 802.11n, MCS7

PSD, Channel 100, 802.11n, MCS7

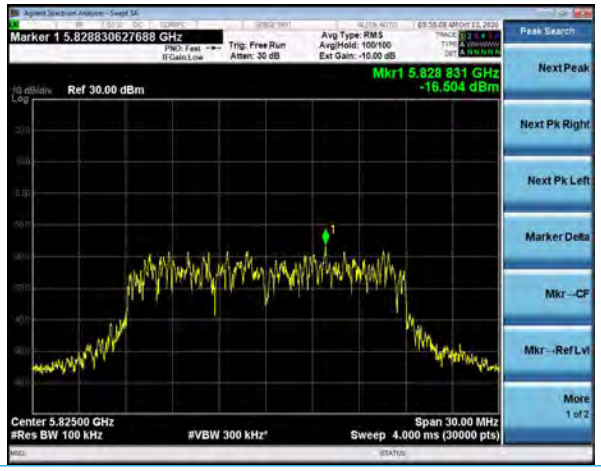
PSD, Channel 116, 802.11n, MCS7



PSD, Channel 140, 802.11n, MCS7

PSD, Channel 149, 802.11n, MCS7

PSD, Channel 157, 802.11n, MCS7



PSD, Channel 165, 802.11n, MCS7

5.1.5 Frequency Stability

Operator	Anthony Smith	QA	Adam Alger
Temperature	21.9°C	R.H. %	38.30%
Test Date	5/6/2021	Location	Conducted RF Bench
Requirement	FCC 15.1055 (d) (1)	Method	ANSI C63.10 §6.8.2

Limits: Reported

Test Parameters

Frequency	5180 MHz	Setup	Conducted
RBW	3 MHz	VBW	50 MHz

Instrumentation

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Cable	Gore	EKD01D01048.0	5546519	2/3/2021	2/3/2022	Active Verification
2	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	7/14/2020	7/14/2021	Active Calibration

EUT Parameters

Input Power	5.1, 5.9, 6.9 VDC	Mode	WLAN TX CW
Channel	36		

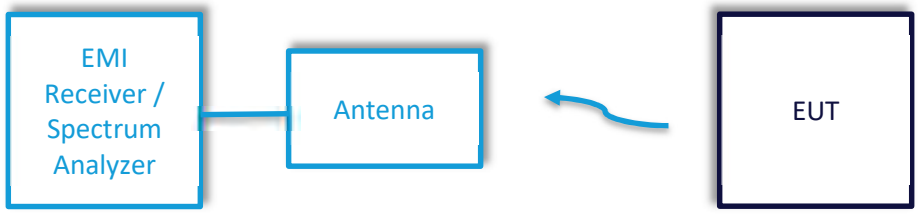
Data Table

Protocol	Data Rate	Channel	5.1 VDC Freq. (Hz)	5.9 VDC Freq. (Hz)	6.8 VDC Freq. (Hz)	Deviation (Hz)
802.11a	6Mbps	36	5179994337.3	5180003478.0	5179997198.5	9140.7

5.2 Radiated Emissions

Description of Measurement	The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values. The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.
Example Calculations	Measurement (dBµV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBµV/m) Margin (dB) = Limit (dBµV/m) - Corrected Reading (dBµV/m) Example at 4000 MHz: Reading = 40 dBµV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBµV/m Average Limit = 20 log (500) = 54 dBµV/m Margin = 54 dBµV/m - 50.8 dBµV/m = 3.2 dB

Block Diagram



5.2.1 Radiated Emissions

Operator	Braden Smith, Jon Dilley	**QA**	Anthony Smith
Temperature	22.3 to 24.0°C	**R.H. %**	25.70 to 29.4%
Test Date	11/11/2020 to 12/1/2020	**Location**	Chamber 5, Chamber 3
Requirement	FCC 15.407, RSS-GEN, FCC 15.209	**Method**	ANSI C63.10

Limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(4) For transmitters operating solely in the 5.725-5.850 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

-27dBm = 68.23 dBµV/m @ 3m

Test Parameters

Frequency	30-40000 MHz	**Distance**	3m
Detector(s)	Max hold with peak detector for plots. Quasi peak detector for measurements below 1 GHz. Peak detector for measurements above 1 GHz. Average measurements taken with a reduced VBW of (see data table below).	**Table height**	150cm
RBW	Below 1 GHz: 120 kHz Above 1 GHz: 1 MHz	**VBW**	Below 1 GHz: 1.2 MHz Above 1 GHz Peak: 3 MHz Above 1 GHz Avg: see data table
Example Calculation	Radiated Limit @ 3m dBµV/m= 95.23 dBµV/m – (conducted limit dBm)		

EUT Parameters

Input Power	5.9 VDC via DC Power Supply	Mode	WLAN TX Modulated
Channel	36, 44, 48, 52, 56, 64, 100, 116, 140, 149, 157, 165	Data Rate	6Mbps for spurious, all rates for Band Edges
Notes	Antenna port terminated with a 50Ω u.fl-SMA termination.		

Instrumentation

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	EE 960203	Analyzer - EMI Receiver	Keysight	N9038A	MY56400072	7/14/2020	7/14/2021	Active Calibration
2	AA 960195	Antenna - Log Periodic	A.H. Systems, Inc	SAS-512-2	557	7/24/2020	7/24/2021	Active Calibration
3	AA 960194	Antenna - Biconical	A.H. Systems, Inc	SAS-540	780	9/21/2020	9/22/2021	Active Calibration
4	LSC-500	Cable	Chamber 5 Emissi	-	-	9/14/2020	9/14/2021	Active Verification
5	AA 960007	Antenna - Double Ridge Horn	EMCO	3115	9311-4138	9/21/2020	9/21/2021	Active Calibration
6	LSC-300	Cable	Chamber 3 Emissi	-	-	8/9/2020	8/9/2021	Active Verification
7	AA 960158	Antenna - Double Ridge Horn	ETS Lindgren	3117	109300	12/27/2019	12/27/2020	Active Calibration
8	EE 960159	Antenna - Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	691801732	12/27/2019	12/27/2020	Active Calibration
9	AA 960176	Cable	A.H. Systems, Inc	SAC-26G-6	395	12/9/2019	12/9/2020	Active Verification
10	AA 960153	Filter - High Pass 2.4 GHz	KWM	HPF-L-14186	7272-04	7/16/2020	7/16/2021	Active Calibration
11	AA 960161	Filter - Highpass 5 GHz	K&L Microwave	11SH10-8000	2	7/16/2020	7/16/2021	Active Calibration
12	EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	7/13/2020	7/13/2021	Active Calibration
13	AA 960171	Cable	A.H. Systems, Inc	SAC-26G-6	386	12/9/2019	12/9/2020	Active Verification

On Times and Average VBW Used

Data Rate	On Time	Ave VBW
6Mbps	160 us	6.3 kHz
54Mbps	36 us	28.2 kHz
MCS0	164 us	6.2 kHz
MCS7	50 us	20 kHz

Data Tables

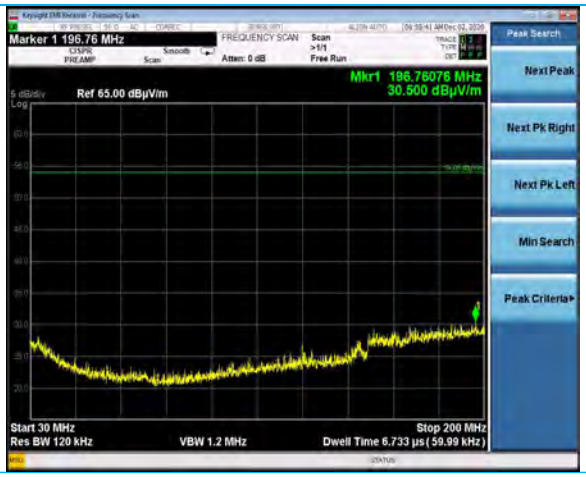
Frequency (MHz)	Orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)
70.2	Vertical	Horizontal	100	0	16.4	40.0	23.6
88.0	Vertical	Horizontal	100	0	21.8	40.0	18.2
112.8	Vertical	Horizontal	100	0	24.7	43.5	18.8
114.6	Vertical	Horizontal	150	0	22.1	43.5	21.4
136.8	Vertical	Horizontal	150	0	31.4	43.5	12.1
164.5	Vertical	Horizontal	150	0	26.8	43.5	16.7

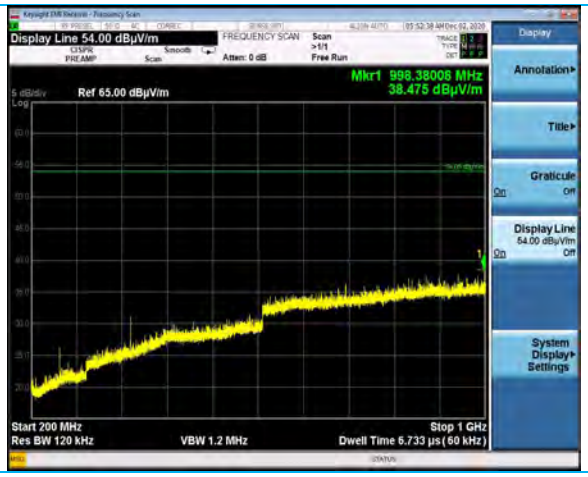
Frequency	EUT Orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Peak Reading (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Channel	Data Rate
5402.2	Flat	Vertical	230	286	54.8	68.2	13.4	64	6Mbps
5372.2	Flat	Vertical	230	286	54.4	68.2	13.8	64	54Mbps
5453.0	Flat	Vertical	230	286	53.8	68.2	14.4	64	MCS0
5391.3	Flat	Vertical	230	286	53.7	68.2	14.5	64	MCS7
5402.9	Flat	Vertical	230	286	53.4	68.2	14.8	100	6Mbps
5442.1	Flat	Vertical	230	286	53.5	68.2	14.7	100	54Mbps
5456.4	Flat	Vertical	230	286	52.8	68.2	15.4	100	MCS0
5405.3	Flat	Vertical	230	286	53.4	68.2	14.8	100	MCS7

Frequency	EUT Orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)	Channel	Data Rate
5403.2	Flat	Vertical	230	286	44.4	54.0	9.6	64	6Mbps
5437.7	Flat	Vertical	230	286	47.1	54.0	6.9	64	54Mbps
5442.5	Flat	Vertical	230	286	43.9	54.0	10.1	64	MCS0
5361.3	Flat	Vertical	230	286	45.8	54.0	8.2	64	MCS7
5447.5	Flat	Vertical	230	286	43.8	54.0	10.2	100	6Mbps
5441.1	Flat	Vertical	230	286	47.1	54.0	6.9	100	54Mbps
5373.6	Flat	Vertical	230	286	44.1	54.0	9.9	100	MCS0
5445.1	Flat	Vertical	230	286	45.5	54.0	8.5	100	MCS7

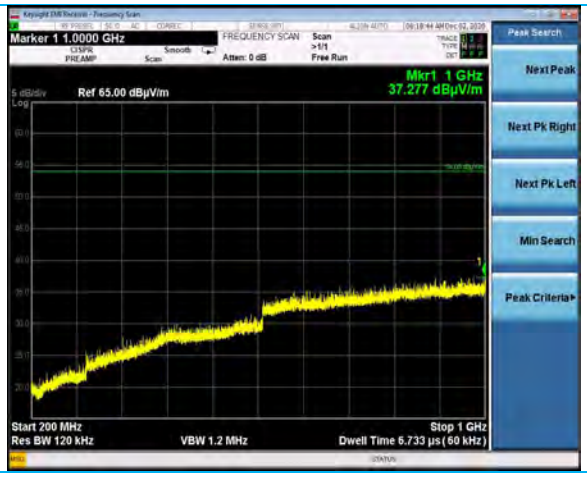
Frequency (MHz)	EUT Orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)	Peak Reading (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	Channel
8288.0	Vertical	Horizontal	248.2	44.8	42.1	54.0	11.9	47.4	68.2	20.8	36
8352.0	Vertical	Horizontal	100.0	110.5	44.3	54.0	9.7	48.2	68.2	20.0	44
8384.0	Vertical	Horizontal	100.0	108.8	45.0	54.0	9.0	48.7	68.2	19.5	48
8415.9	Vertical	Horizontal	100.0	111.3	44.4	54.0	9.6	48.6	68.2	19.6	52
8448.0	Vertical	Horizontal	100.8	109.0	44.3	54.0	9.7	48.0	68.2	20.2	56
9120.0	Vertical	Horizontal	100.0	119.0	45.1	54.0	8.9	49.8	68.2	18.4	140
9192.0	Vertical	Horizontal	104.5	115.5	46.1	54.0	7.9	50.6	68.2	17.6	149
9320.0	Side	Vertical	103.0	186.0	42.6	54.0	11.4	47.5	68.2	20.7	165
9320.0	Vertical	Vertical	148.0	109.3	43.2	54.0	10.8	48.4	68.2	19.8	165
9320.0	Side	Horizontal	105.3	69.3	43.0	54.0	11.0	47.4	68.2	20.8	165
9320.0	Flat	Horizontal	100.0	40.3	43.3	54.0	10.7	48.1	68.2	20.1	165
9320.0	Flat	Vertical	100.0	54.5	44.4	54.0	9.6	48.9	68.2	19.3	165
9320.0	Vertical	Horizontal	100.0	121.5	45.2	54.0	8.8	50.1	68.2	18.1	165
10640.0	Vertical	Horizontal	241.7	349.8	50.0	54.0	4.0	58.8	68.2	9.4	64
11000.3	Vertical	Horizontal	291.3	345.0	46.2	54.0	7.8	56.7	68.2	11.5	100
11160.1	Vertical	Horizontal	250.0	344.3	49.0	54.0	5.0	58.4	68.2	9.8	116
11399.6	Vertical	Horizontal	277.1	342.0	37.9	54.0	16.1	47.6	68.2	20.6	140
11491.8	Vertical	Horizontal	249.9	334.3	42.5	54.0	11.5	52.2	68.2	16.0	149
11572.1	Vertical	Horizontal	250.0	48.5	46.5	54.0	7.5	55.8	68.2	12.4	157
11646.3	Side	Vertical	238.0	0.0	41.7	54.0	12.3	52.2	68.2	16.0	165
11647.9	Side	Horizontal	247.3	0.0	39.8	54.0	14.2	48.9	68.2	19.3	165
11648.0	Vertical	Vertical	250.0	8.0	38.4	54.0	15.6	48.4	68.2	19.8	165
11648.8	Flat	Horizontal	362.5	270.0	39.3	54.0	14.7	48.4	68.2	19.8	165
11650.8	Flat	Vertical	300.0	0.0	39.0	54.0	15.0	48.1	68.2	20.1	165
11651.7	Vertical	Horizontal	247.9	355.5	41.8	54.0	12.2	51.7	68.2	16.5	165

Plots

	
30-200 MHz, Horizontal Antenna, Vertical EUT Channel 36, 802.11a 6Mbps	30-200 MHz, Vertical Antenna, Vertical EUT Channel 36, 802.11a 6Mbps



200-1000 MHz, Horizontal Antenna, Vertical EUT
Channel 165, 802.11a 6Mbps



200-1000 MHz, Vertical Antenna, Vertical EUT
Channel 165, 802.11a 6Mbps

1000-4500 MHz, Horizontal Antenna, Flat EUT
Channel 48, 802.11a 6Mbps

1000-4500 MHz, Vertical Antenna, Flat EUT
Channel 48, 802.11a 6Mbps

1000-5150 MHz, Horizontal Antenna, Flat EUT
Channel 64, 802.11a 6Mbps

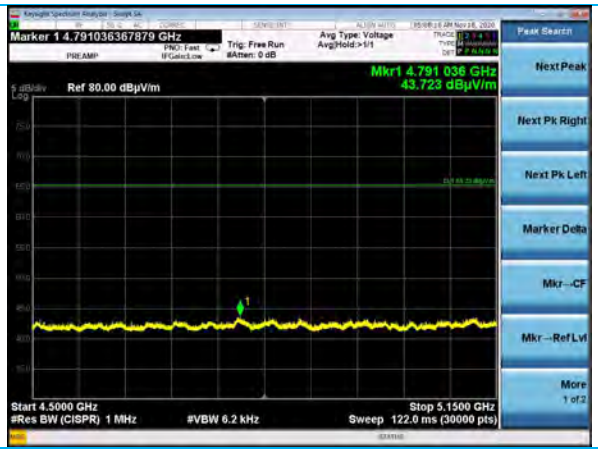
1000-5150 MHz, Vertical Antenna, Flat EUT
Channel 64, 802.11a 6Mbps

1000-5350 MHz, Horizontal Antenna, Flat EUT
Channel 140, 802.11a 6Mbps

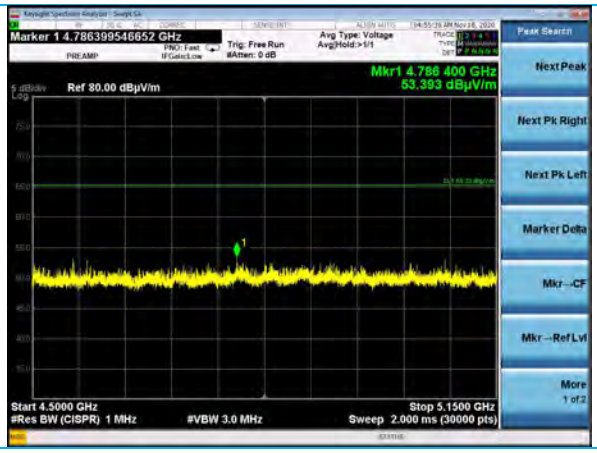
1000-5350 MHz, Vertical Antenna, Flat EUT
Channel 140, 802.11a 6Mbps

1000-5650 MHz, Horizontal Antenna, Flat EUT
Channel 165, 802.11a 6Mbps

1000-5650 MHz, Vertical Antenna, Flat EUT
Channel 165, 802.11a 6Mbps

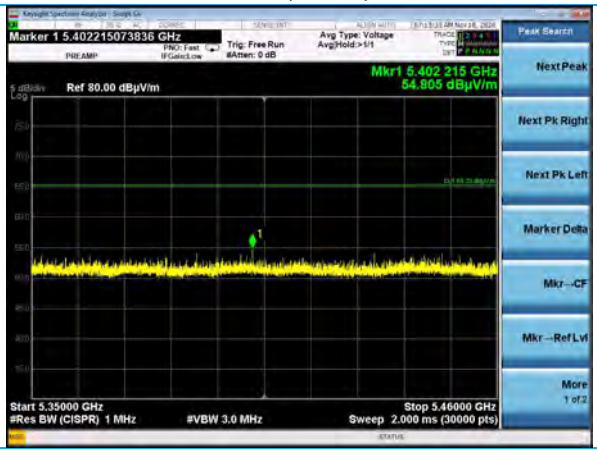


4500-5150 MHz, Vertical Antenna, Flat EUT
Channel 36, MCS0, Average



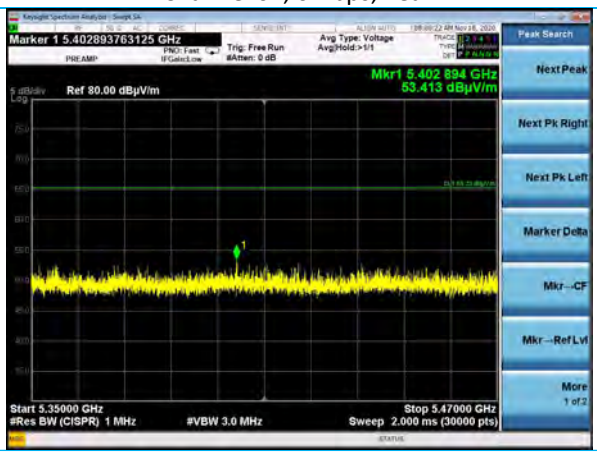
4500-5150 MHz, Vertical Antenna, Flat EUT
Channel 36, MCS0, Peak

5350-5460 MHz, Vertical Antenna, Flat EUT
Channel 64, 6Mbps, Average

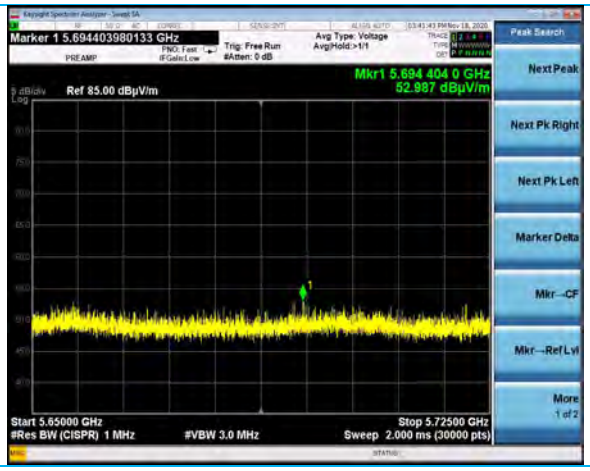


5350-5460 MHz, Vertical Antenna, Flat EUT
Channel 64, 6Mbps, Peak

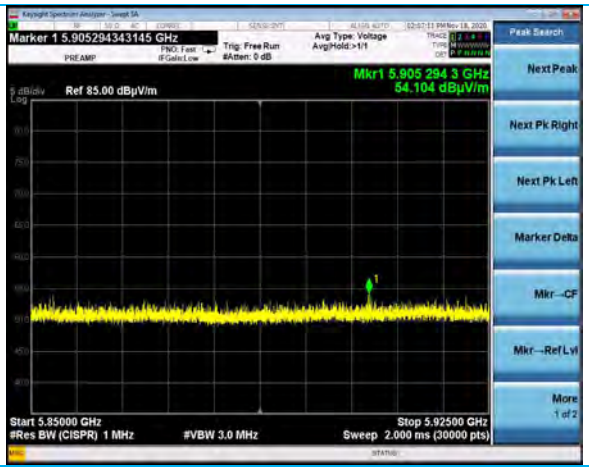
5350-5460 MHz, Vertical Antenna, Flat EUT
Channel 100, 6Mbps, Average



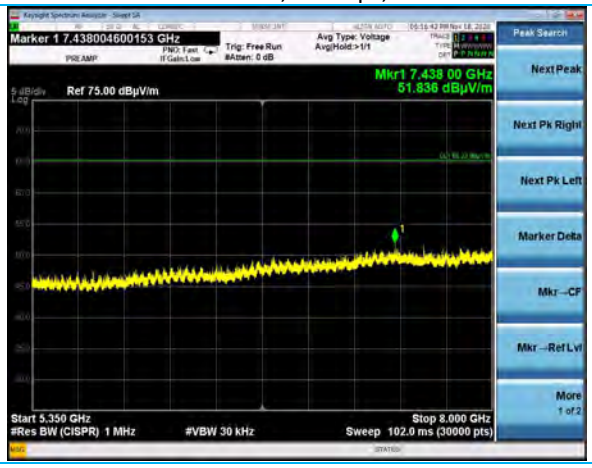
5350-5470 MHz, Vertical Antenna, Flat EUT
Channel 100, 6Mbps, Peak



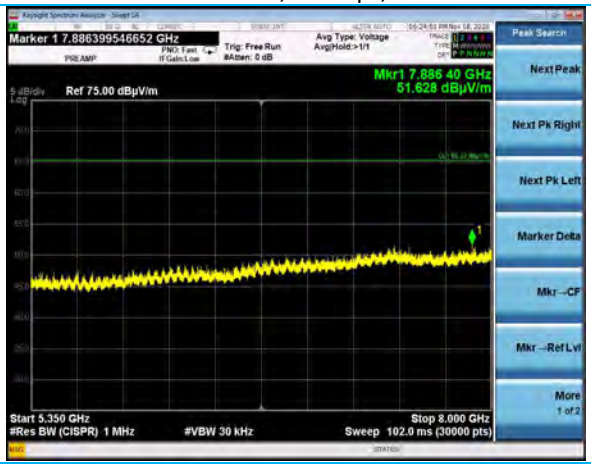
5650-5725 MHz, Vertical Antenna, Flat EUT
Channel 149, 54Mbps, Peak



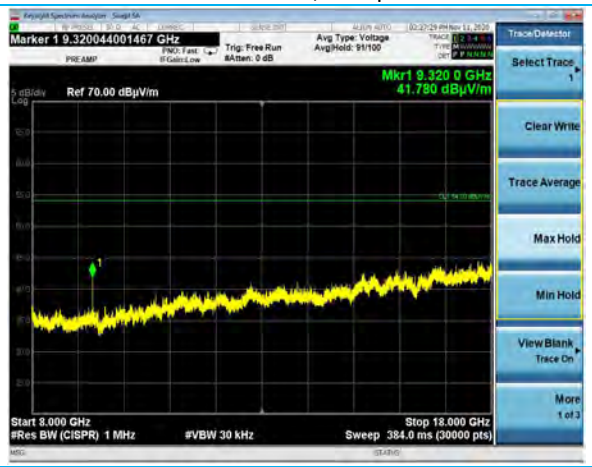
5850-5925 MHz, Vertical Antenna, Flat EUT
Channel 165, 54Mbps, Peak



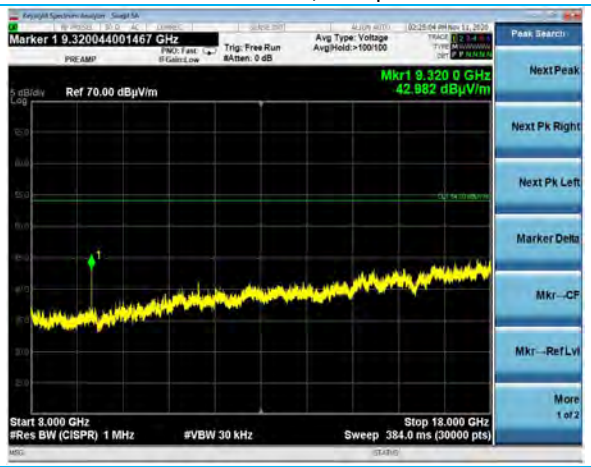
5350-8000 MHz, Horizontal Antenna, Flat EUT
Channel 48, 6Mbps



5350-8000 MHz, Vertical Antenna, Flat EUT
Channel 48, 6Mbps



8-18 GHz, Horizontal Antenna, Flat EUT
Channel 165, 6Mbps

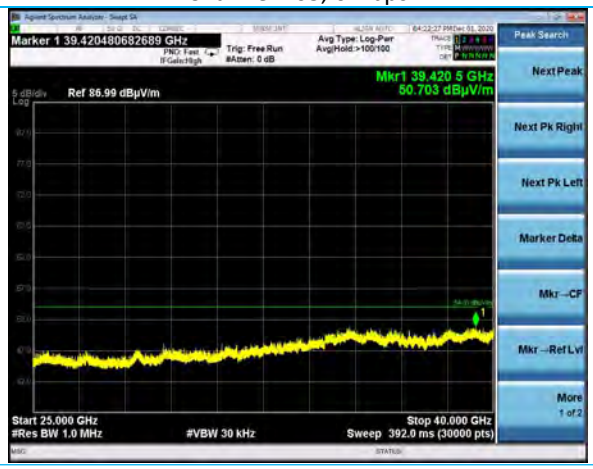


8-18 GHz, Vertical Antenna, Flat EUT
Channel 165, 6Mbps

18-25 GHz, Horizontal Antenna, Vertical EUT
Channel 165, 6Mbps

18-25 GHz, Vertical Antenna, Vertical EUT
Channel 165, 6Mbps

25-40 GHz, Horizontal Antenna, Vertical EUT
Channel 165, 6Mbps

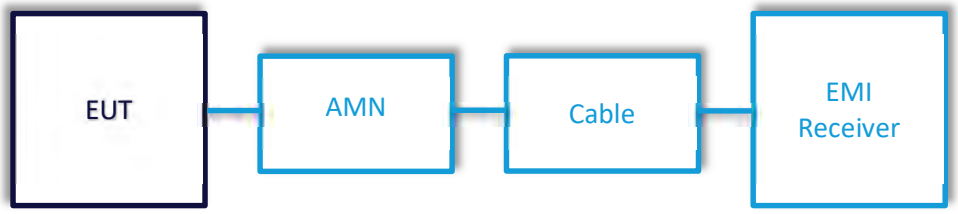


25-40 GHz, Vertical Antenna, Vertical EUT
Channel 165, 6Mbps

5.3 AC Mains Conducted Emissions

	A line impedance stabilization network (LISN) or artificial mains network (AMN) allows the emissions of the power supply conductors to be measured while isolating the EUT from the supply mains.
Description of Measurement	The AMN, cable, and other necessary measurement system correction factors are loaded onto the EMI receiver when the measurements are performed. The data is gathered and reported as the corrected values. Maximum emissions are determined with a peak max hold trace then measurements at a selection of the highest points are made with quasi-peak and average detectors. Results are recorded and compared to limit for each line. (e.g. line and neutral)
Example Calculations	Measurement (dBµV) + Cable factor (dB) + Other (dB) = Corrected Reading (dBµV) Margin (dB) = Limit (dBµV) - Corrected Reading (dBµV)

Block Diagram



5.3.1 AC Mains Conducted Emissions

Operator	Jon Dilley	**QA**	Shane Dock
Temperature	21.8°C	**R.H. %**	20.60%
Test Date	12/16/2020	**Location**	Conducted Bench Area
Requirement	FCC 15.207, RSS-GEN	**Method**	ANSI C63.10

Limits:

Frequency (MHz)	Quasi-peak Limit (dBµV)	Average Limit (dBµV)
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

Test Parameters

Frequency	0.15-30 MHz	**Distance**	40cm from VGP
Detector(s)	Max hold with peak detector for plots. Quasi peak and average detectors for final measurement.	**Table height**	80cm
RBW	9 kHz	**VBW**	90 kHz

Instrumentation

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	EE 960089	LISN	COM-POWER	LI-215A	191943	7/13/2020	7/13/2021	Active Calibration
2	EE 960088	Analyzer - EMI Receiver	Agilent	N9038A	MY51210138	7/14/2020	7/14/2021	Active Calibration
3	LSC-202	Cable	Micro-Coax	UFB311A-0-1440-70L	64639 224071-004	12/9/2020	12/9/2021	Active Verification

EUT Parameters

Input Power	5.9VDC via Wall Wart	**Mode**	WLAN TX
Channel	165	**Data Rate**	6Mbps
Notes	No difference in emission when channels/data rates are changed.		

Data Table

Line	Frequency (MHz)	Quasi-Peak Reading (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Channel
1	0.355	49.1	58.8	9.7	34.5	48.8	14.3	165
1	0.459	45.4	56.7	11.3	28.7	46.7	18.0	165
1	0.653	42.3	56.0	13.7	27.5	46.0	18.5	165
2	0.356	44.1	58.8	14.7	30.4	48.8	18.4	165
2	0.662	38.3	56.0	17.7	26.5	46.0	19.5	165
2	1.445	34.7	56.0	21.3	22.1	46.0	23.9	165

Plots

Line 1, Channel 165

Line 2, Channel 165

6 REVISION HISTORY

Version	Date	Notes	Person
0	7/19/2021	Initial Draft	Zach Wilson
1	7/29/2021	Revised per internal review	Zach Wilson
2	9/23/2021	Revised per TCB review	Zach Wilson

END OF REPORT