

Avnet, Inc.

REVISED EMC TEST REPORT TO 105053-12

Secure Wi-Fi module
Model: AES-MS-MT3620-UFL-M-G Rev2

Tested to The Following Standards:

FCC Part 15 Subpart E Section(s)

15.207 & 15.407
(NII 5.15 – 5.25GHz)

Report No.: 105053-12A

Date of issue: February 8, 2023



Test Certificate # 803.01

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Avnet, Inc.
2211 S 47th Street
Phoenix, AZ 85034

Representatives: Avnet, Inc. - Brian Willess
F-Squared Laboratories - Karen Whipkey
Customer Reference Number: 5313

REPORT PREPARED BY:

Viviana Prado
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 105053

DATE OF EQUIPMENT RECEIPT:

July 13, 2021

DATE(S) OF TESTING:

July 13-29, 2021 and October 11, 2021
January 30, 2023

Revision History

Original: Testing of the Secure Wi-Fi module, Model: AES-MS-MT3620-UFL-M-G Rev2 to FCC Part 15 Subpart E Section(s) 15.207 & 15.407 (NII 5.15 – 5.25GHz).

Revision A: To add additional information and photo to the Output Power section.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.19

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	A-0136

*CKC's list of NIST designated countries can be found at: <https://standards.gov/cabs/designations.html>

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart E - 15.407 (NII)

Test Procedure	Description	Modifications	Results
15.215	Occupied Bandwidth	NA	Pass
15.407(a)(1)(iv)	Output Power	NA	Pass
15.407(a)(1)(iv)	Power Spectral Density	NA	Pass
15.407(a)(1)(i)	EIRP at >30° Elevation	NA	NA1
15.407(g)	Frequency Stability	NA	Pass
15.407(b)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	Pass

NA = Not Applicable

NA1 = Not applicable because the manufacturer declares the EUT is not an outdoor access point.

ISO/IEC 17025 Decision Rule

The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions

No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions

None

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Secure Wi-Fi module	Avnet, Inc.	AES-MS-MT3620-UFL-M-G Rev2	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Dell	Inspiron 15 3000	41436059078
PCB	Avnet Inc.	AES-MS-MT3620_Guard_PCB-RevA	4000242

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
Secure Wi-Fi module	Avnet, Inc.	AES-MS-MT3620-UFL-M-G Rev2	NA

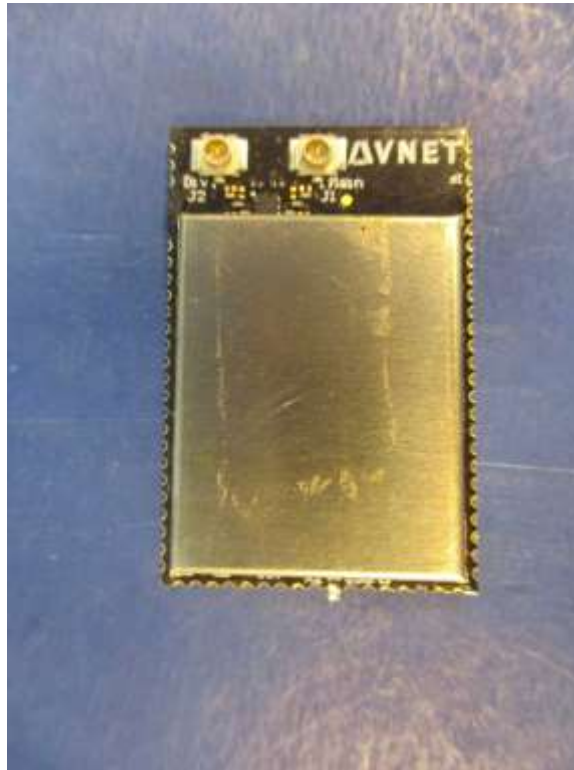
Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Dell	Inspiron 15 3000	41436059078
PCB	Avnet Inc.	AES-MS-MT3620_Guard_PCB-RevA	4000242
Power Supply	Extech Instruments	382225	P99250026

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Radio Module
Type of Wideband System:	802.11 n20
Operating Frequency Range:	5180-5240
Modulation Type(s):	MCS7, OFDM54M
Maximum Duty Cycle:	98%
Number of TX Chains:	1
Antenna Type(s) and Gain:	External, Patch, 2.7 dBi
Beamforming Type:	NA
Antenna Connection Type:	External Connector
Nominal Input Voltage:	3.3V DC
Firmware / Software used for Test:	Azure Sphere OS v20.07
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

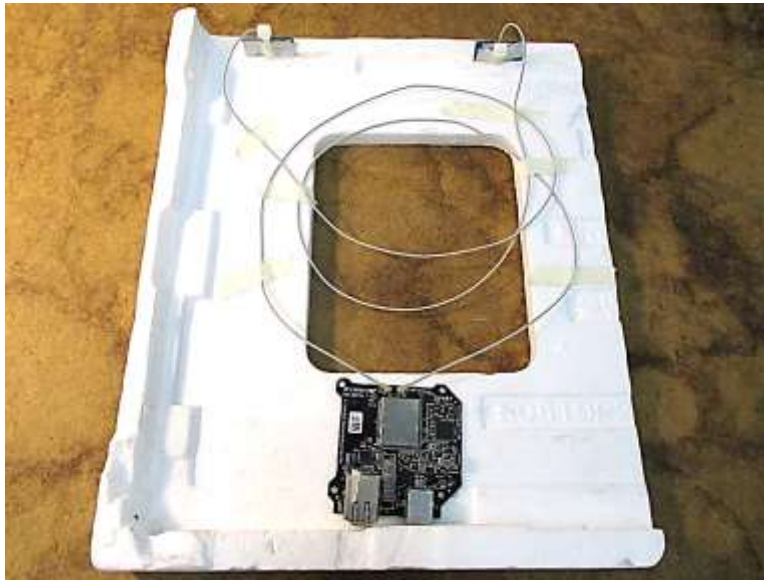
EUT Photo(s)



Support Equipment Photo(s)

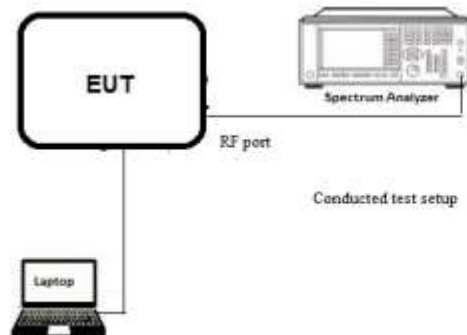
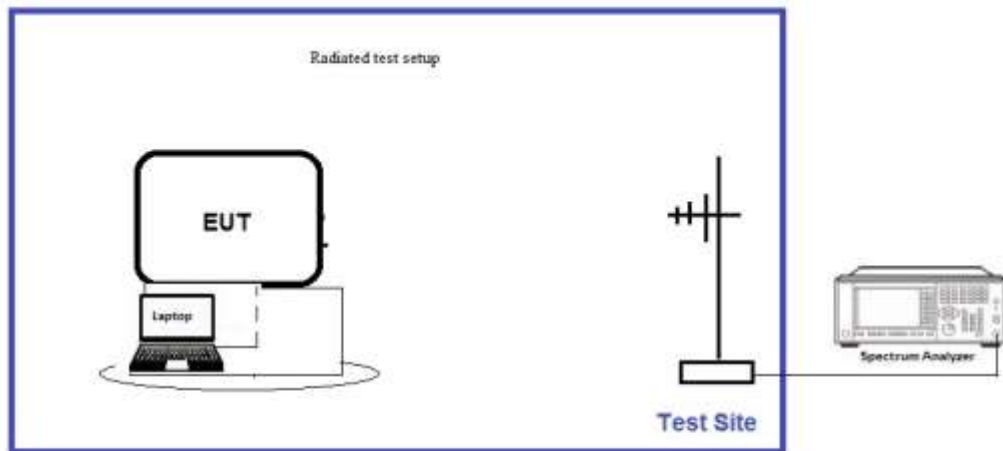


Laptop



Host

Block Diagram of Test Setup



FCC Part 15 Subpart E

15.215 Occupied Bandwidth

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013), KDB 789033 V02R01 December 14, 2017	Test Date(s):	7/13/2021
Configuration:	1		
Test Setup:	The EUT is installed on a support PCB which provide power and configuration interface for testing purposes. The Ethernet and USB-B port of the support PCB is not populated as the function of the PCB is to act as source of power and configuration only. A support laptop is connected to the PCB via micro-USB cable for configuration of the EUT. RF parameter evaluated at the antenna port J1. Power at antenna port J2 is verified. device does not transmit simultaneously from J1 and J2. Firmware power setting = 14		

Environmental Conditions			
Temperature (°C)	25.9	Relative Humidity (%):	54

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02762	Spectrum Analyzer	Agilent	E4446A	4/29/2020	4/29/2022
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	12/20/2019	12/20/2021
07655	Cable	Astro lab	32022-29094K-29094K-24TC	7/30/2020	7/30/2022

20dB Occupied Bandwidth

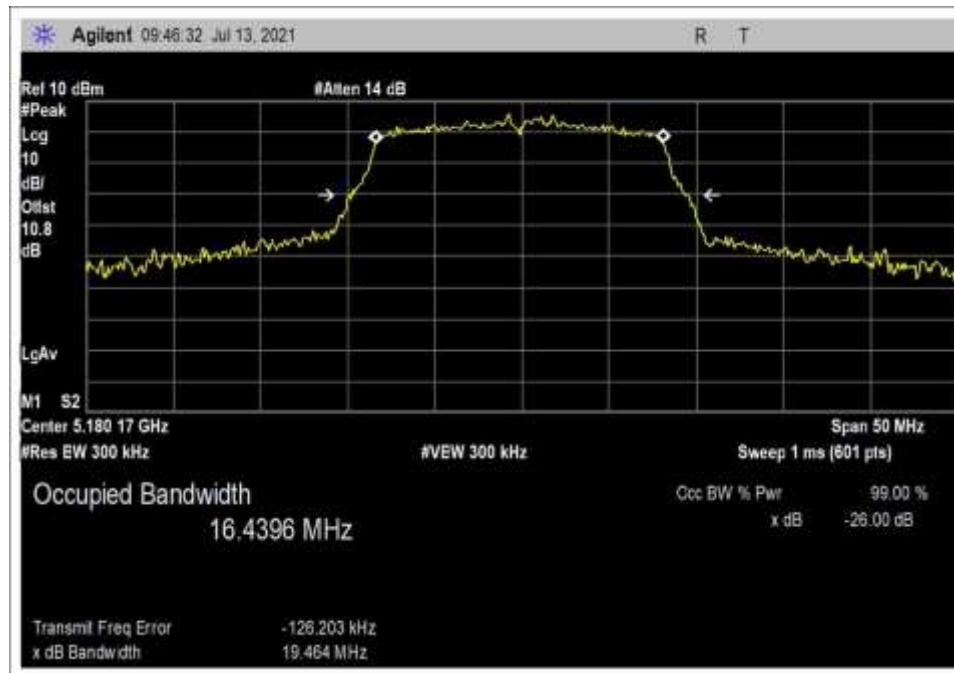
Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
5180	1	MCS7	19464	None	NA
5220	1	MCS7	19633		
5240	1	MCS7	19374		
5180	1	OFDM54M	19679	None	NA
5220	1	OFDM54M	19564		
5240	1	OFDM54M	19691		

99% Occupied Bandwidth

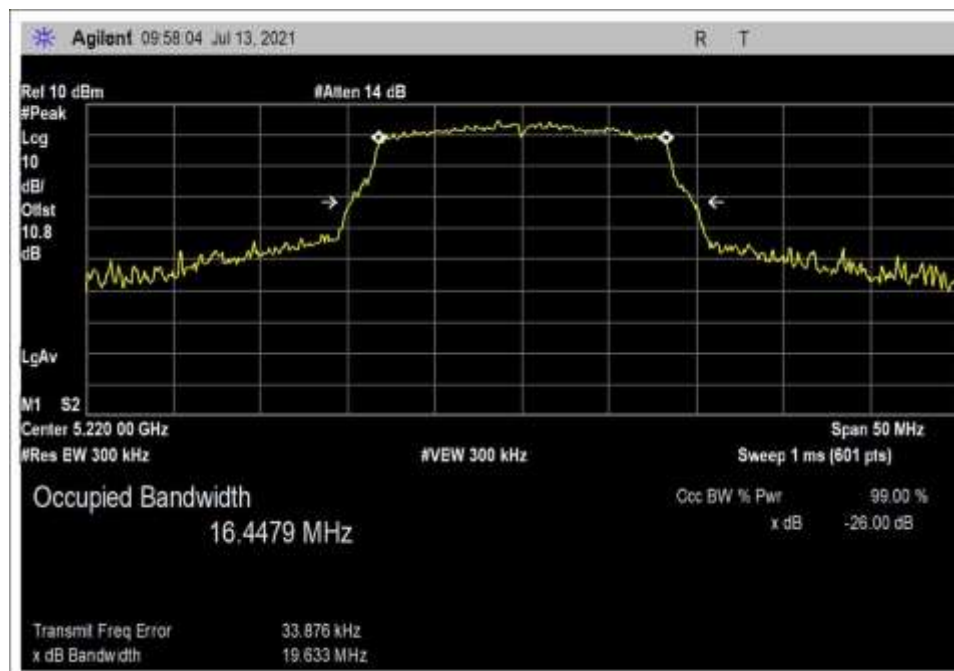
Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
5180	1	MCS7	16440	None	NA
5220	1	MCS7	16448		
5240	1	MCS7	16404		
5180	1	OFDM54M	16460	None	NA
5220	1	OFDM54M	16433		
5240	1	OFDM54M	16500		

Plot(s)

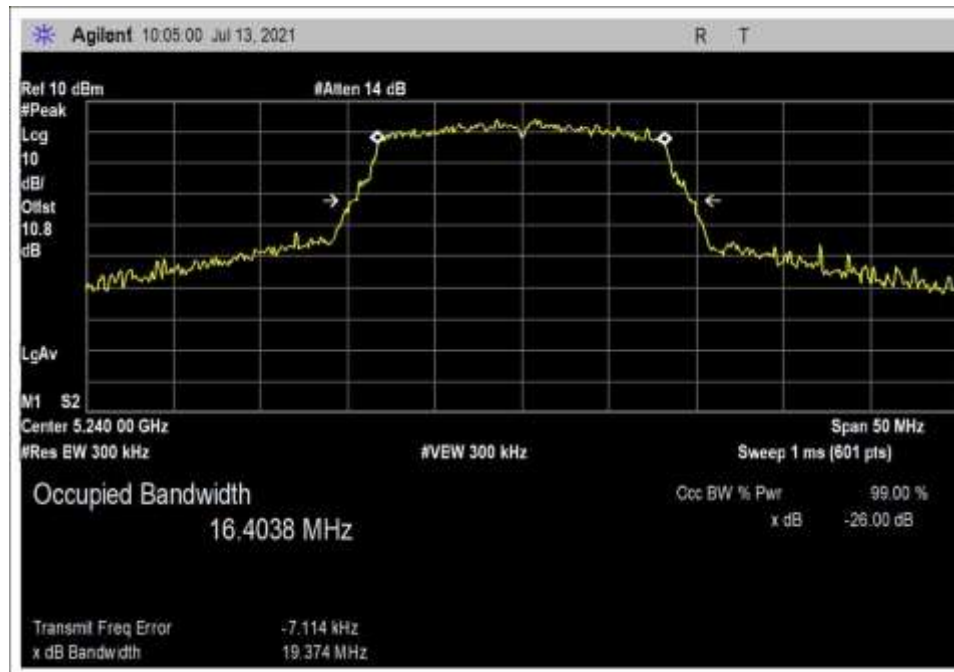
MCS7



Low Channel

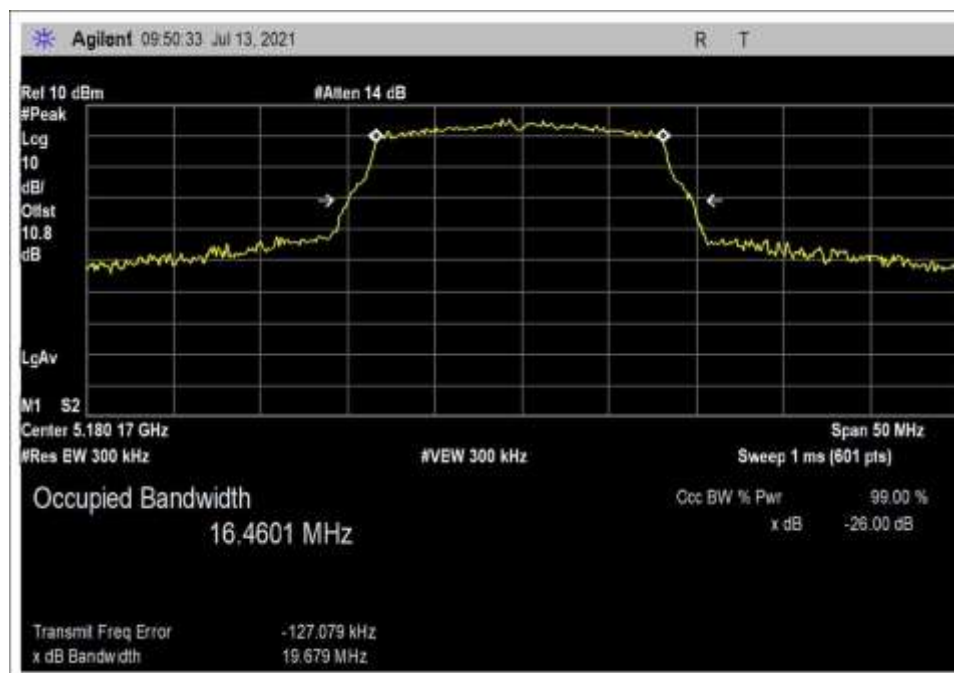


Middle Channel

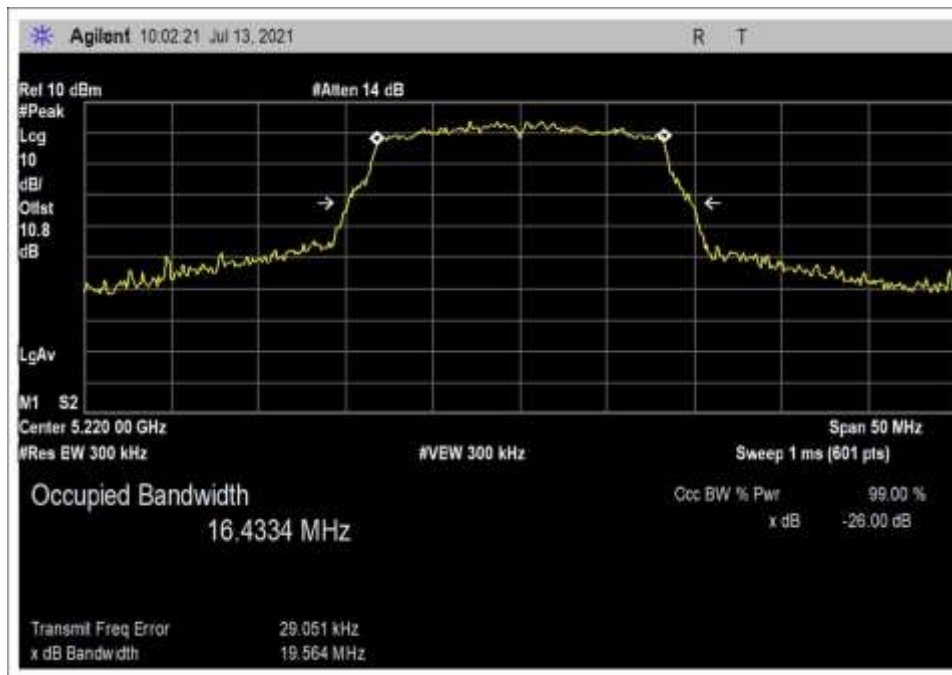


High Channel

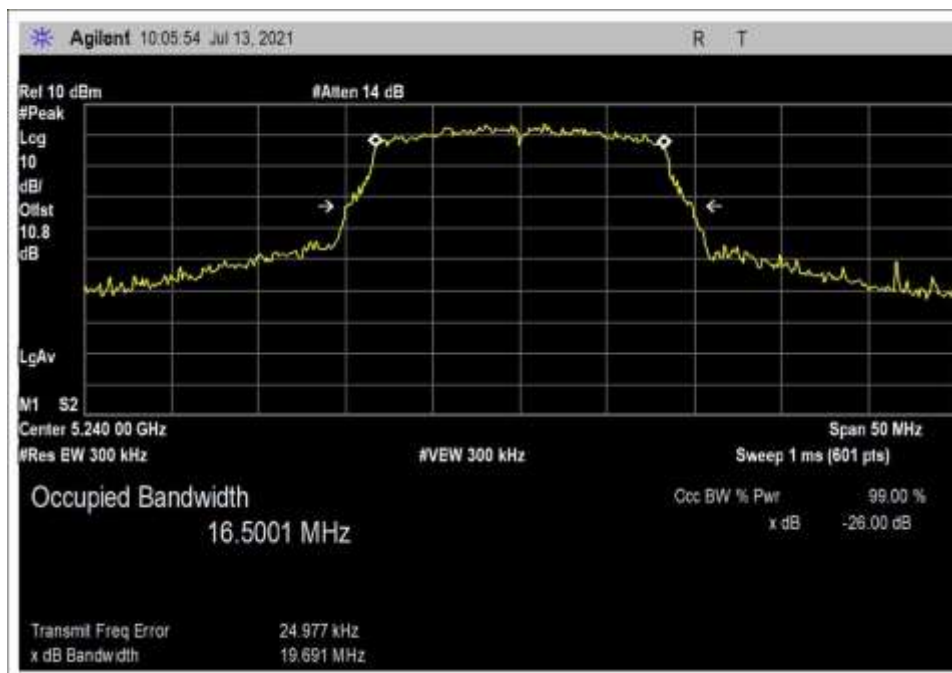
OFDM54M



Low Channel

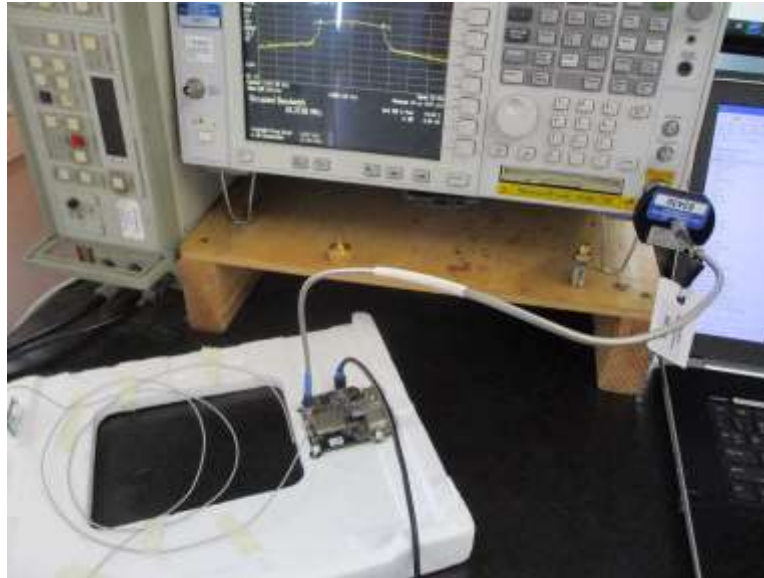


Middle Channel



High Channel

Test Setup Photo(s)



15.407(a)(1)(iv) Output Power

Test Setup/Conditions			
Test Location:	Brea Lab A & Bothell Bench	Test Engineer:	E. Wong & S. Pittsford
Test Method:	ANSI C63.10 (2013), KDB 789033 V02R01 December 14, 2017	Test Date(s):	7/13/2021 & 1/30/2023
Configuration:	1		
Test Setup:	The EUT is installed on a support PCB which provide power and configuration interface for testing purposes. The Ethernet and USB-B port of the support PCB is not populated as the function of the PCB is to act as source of power and configuration only. A support laptop is connected to the PCB via micro-USB cable for configuration of the EUT. RF parameter evaluated at the antenna port J1. Power at antenna port J2 is verified. device does not transmit simultaneously from J1 and J2. Firmware power setting = 14 Test performed using operational mode with the highest output power, representing worst case. Conducted power was remeasured on 1/30/2023. All measurements are within measurement uncertainty and device tolerances.		

Environmental Conditions			
Temperature (°C)	19-25	Relative Humidity (%):	34-55

Test Equipment 7/15/2021					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02762	Spectrum Analyzer	Agilent	E4446A	4/29/2020	4/29/2022
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	12/20/2019	12/20/2021
07655	Cable	Astro lab	32022-29094K-29094K-24TC	7/30/2020	7/30/2022

Test Equipment 1/30/2023					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03803	Spectrum Analyzer	Agilent	E4440A	2/23/2022	2/23/2024

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation / Ant Port	V _{Minimum} (dBm)	V _{Nominal} (dBm)	V _{Maximum} (dBm)	Max Deviation from V _{Nominal} (dB)
5180	MCS7	12.0	12.2	12.4	-0.2
5220	MCS7	11.7	11.9	12.1	-0.2
5240	MCS7	11.7	12.0	12.2	-0.3
5180	OFDM54M	11.0	11.7	11.9	-0.7
5220	OFDM54M	11.0	11.6	11.8	-0.6
5240	OFDM54M	11.1	11.6	11.8	-0.5

Parameter Definitions:

Measurements performed at input voltage according to manufacturer specification.

Parameter	Value
V _{Nominal} :	3.3
V _{Minimum} :	3.0
V _{Maximum} :	3.6

The manufacturer declares equipment voltage specification is 10% of nominal.

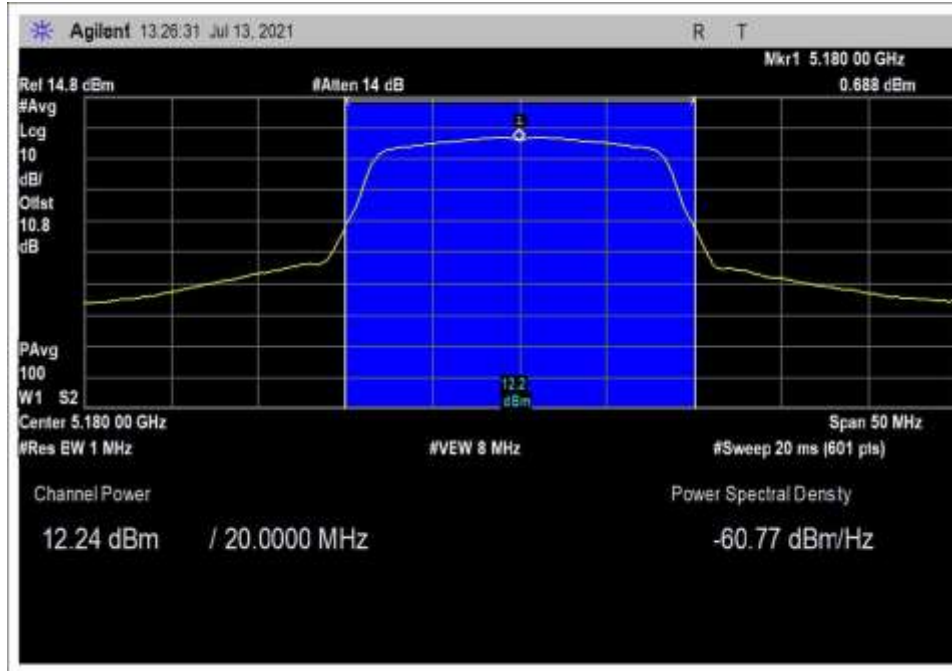
Test Data Summary - RF Conducted Measurement					
Measurement Option: AVGSA-1					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
5180	MCS7	Ext patch/ 2.7dBi	12.2	≤24	Pass
5220	MCS7	Ext patch/ 2.7dBi	11.9	≤24	Pass
5240	MCS7	Ext patch/ 2.7dBi	12.0	≤24	Pass
5180	OFDM54M	Ext patch/ 2.7dBi	11.7	≤24	Pass
5220	OFDM54M	Ext patch/ 2.7dBi	11.6	≤24	Pass
5240	OFDM54M	Ext patch/ 2.7dBi	11.6	≤24	Pass

For client devices access points using antennas in fixed point-to-point applications, the limit is calculated in accordance with 15.407(a)(1)(iv): For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

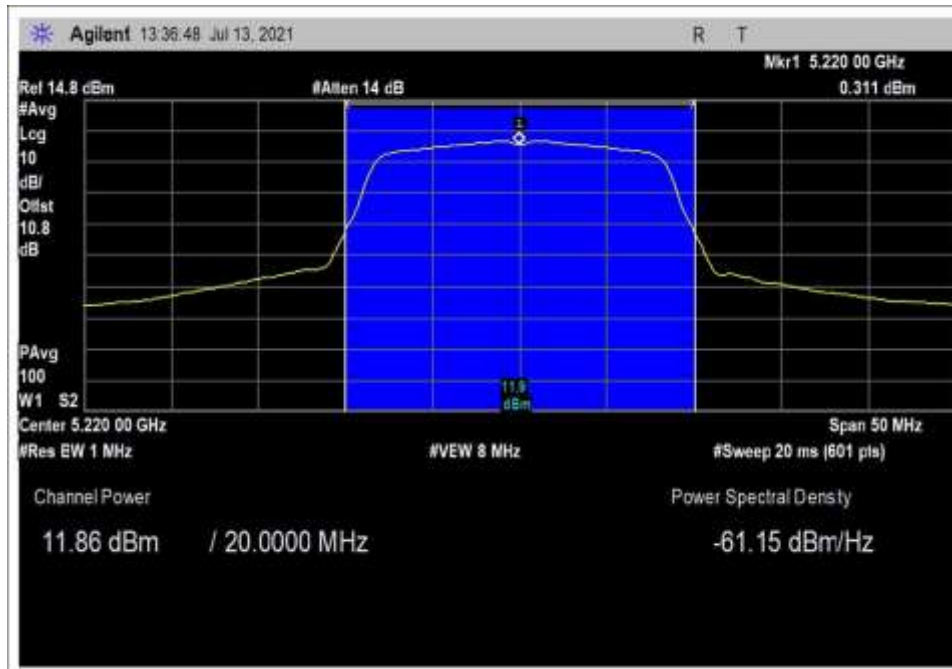
$$Limit = 24 - Roundup(G - 6)$$

Plot(s)

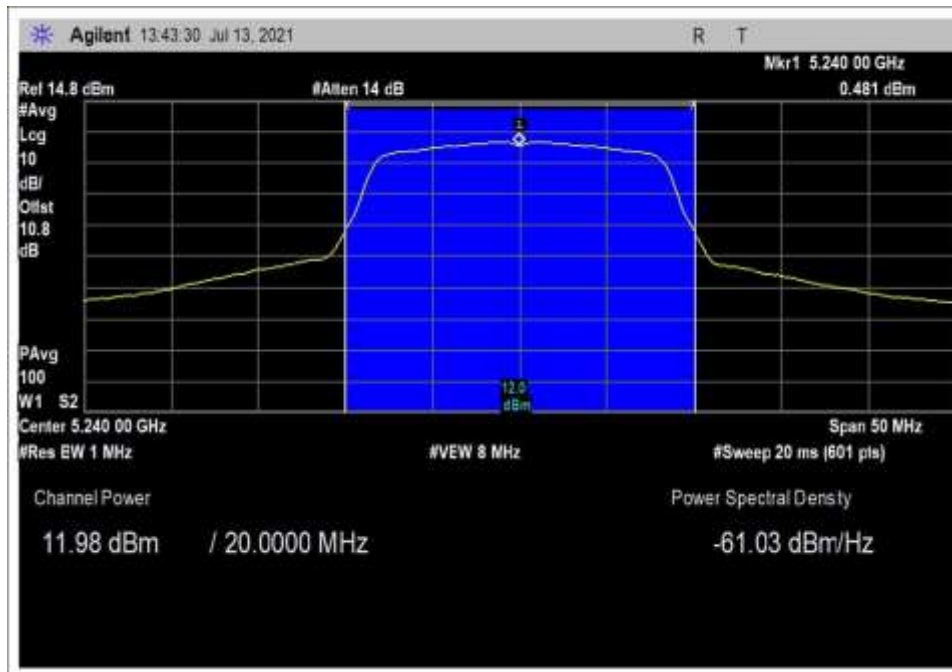
MCS7



Low Channel

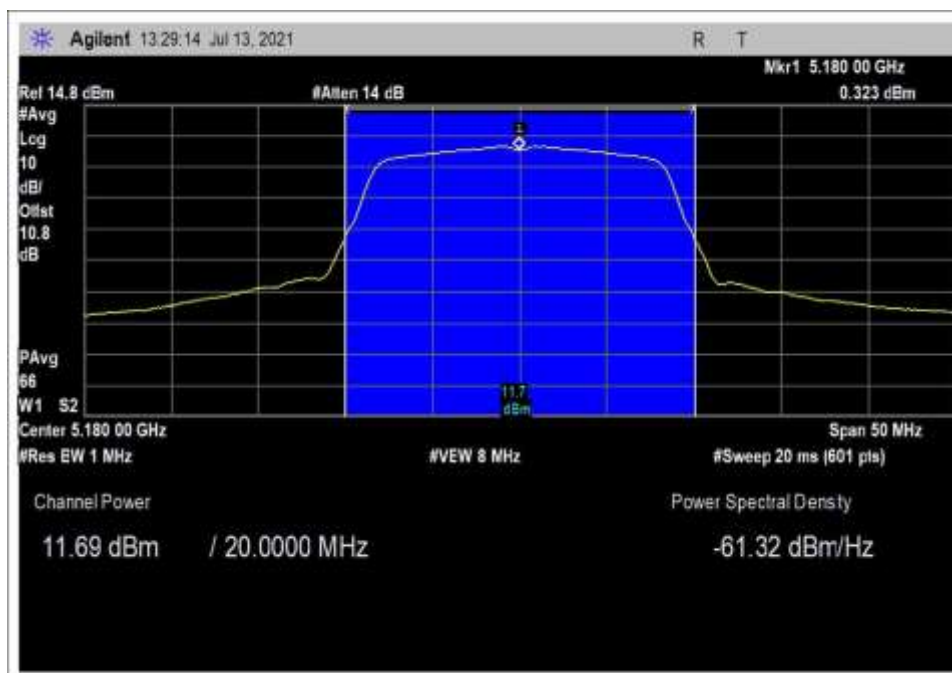


Middle Channel

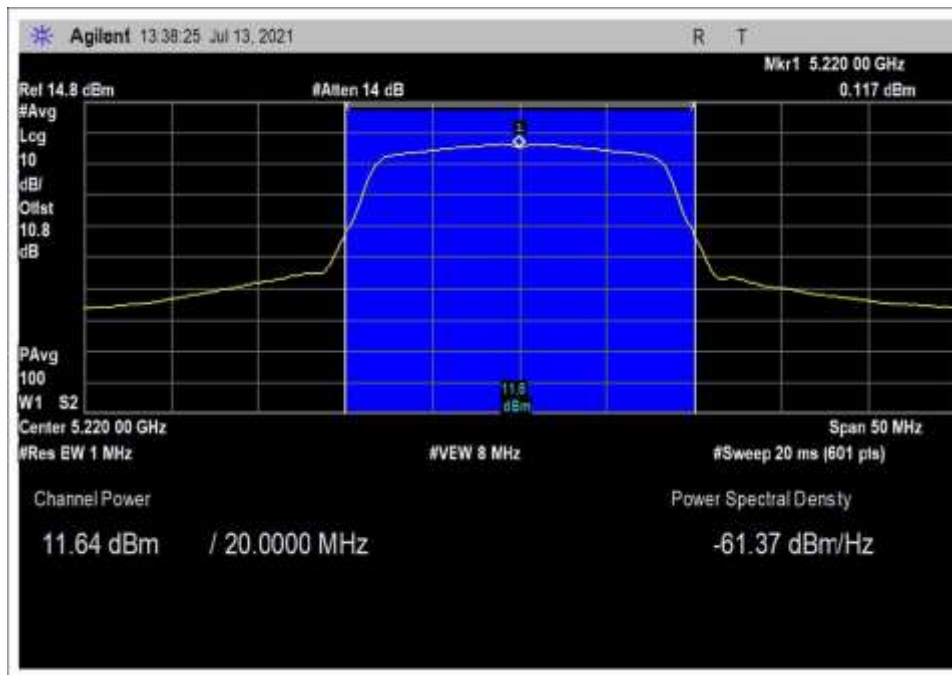


High Channel

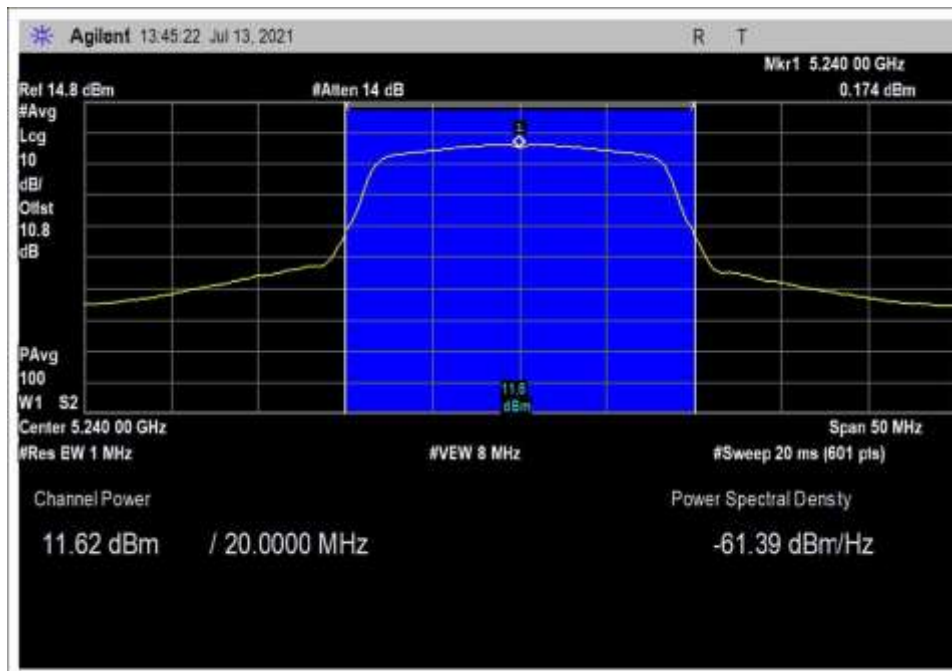
OFDM54M



Low Channel

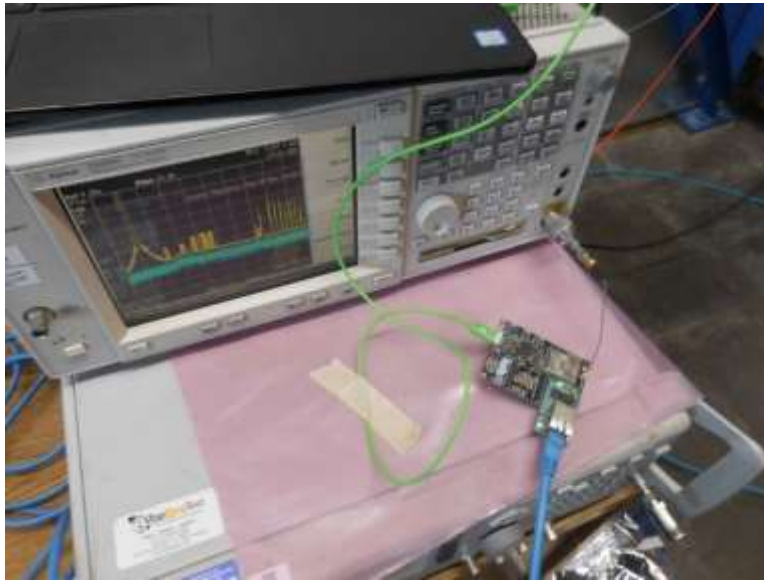


Middle Channel

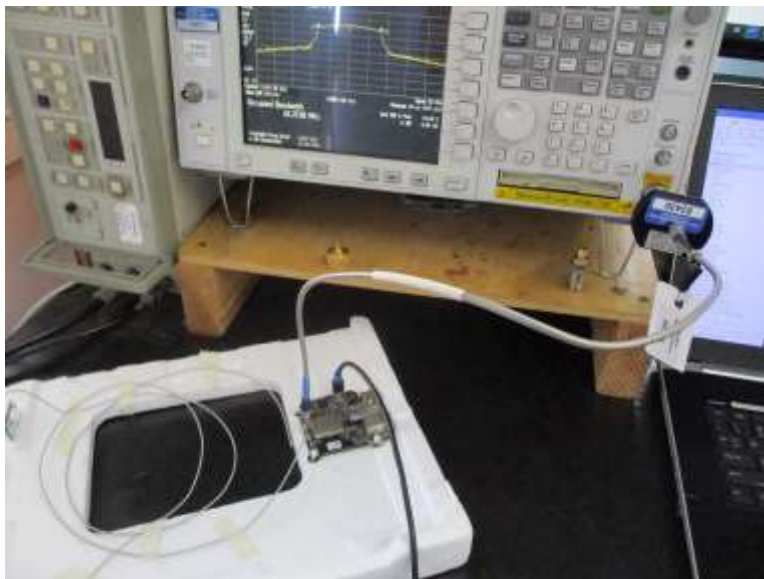


High Channel

Test Setup Photo(s)



Power Setup



Antenna Port

15.407(a)(1)(iv) Power Spectral Density

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013), KDB 789033 V02R01 December 14, 2017	Test Date(s):	7/14/2021
Configuration:	1		
Test Setup:	The EUT is installed on a support PCB which provide power and configuration interface for testing purposes. The Ethernet and USB-B port of the support PCB is not populated as the function of the PCB is to act as source of power and configuration only. A support laptop is connected to the PCB via micro-USB cable for configuration of the EUT. RF parameter evaluated at the antenna port J1. Power at antenna port J2 is verified. device does not transmit simultaneously from J1 and J2. Firmware power setting = 14		

Environmental Conditions			
Temperature (°C)	26	Relative Humidity (%):	57

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02762	Spectrum Analyzer	Agilent	E4446A	4/29/2020	4/29/2022
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	12/20/2019	12/20/2021
07655	Cable	Astro lab	32022-29094K-29094K-24TC	7/30/2020	7/30/2022

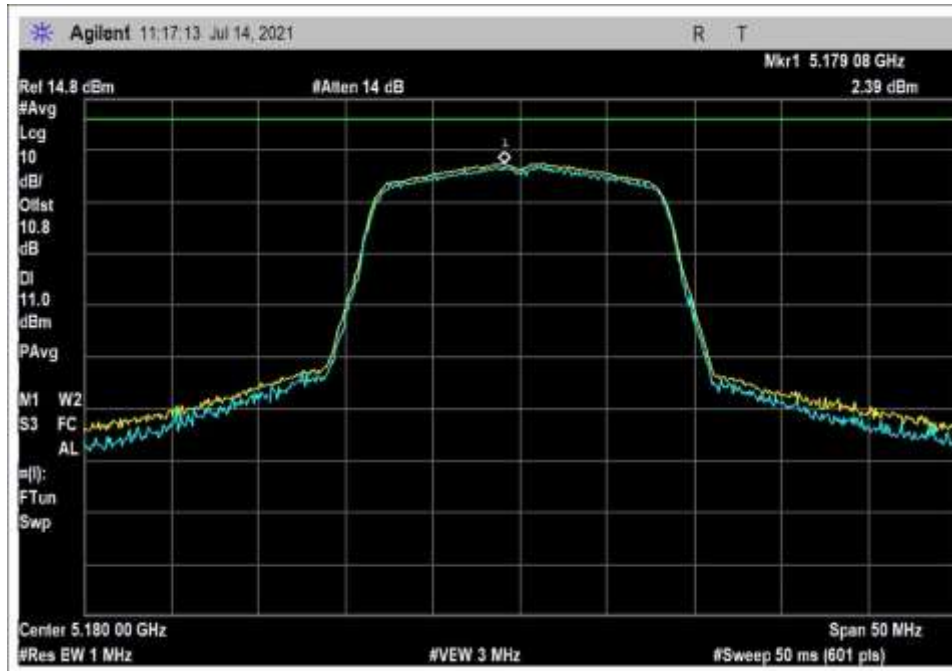
Test Data Summary - RF Conducted Measurement					
Measurement Option: AVGSA-1					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm/MHz)	Limit (dBm/MHz)	Results
5180	MCS7	Ext patch/ 2.7dBi	2.4	≤ 11	Pass
5220	MCS7	Ext patch/ 2.7dBi	2.1	≤ 11	Pass
5240	MCS7	Ext patch/ 2.7dBi	2.3	≤ 11	Pass
5180	OFDM54M	Ext patch/ 2.7dBi	2.2	≤ 11	Pass
5220	OFDM54M	Ext patch/ 2.7dBi	1.7	≤ 11	Pass
5240	OFDM54M	Ext patch/ 2.7dBi	2.2	≤ 11	Pass

For client devices the limit is calculated in accordance with 15.407(a)(1)(iv):

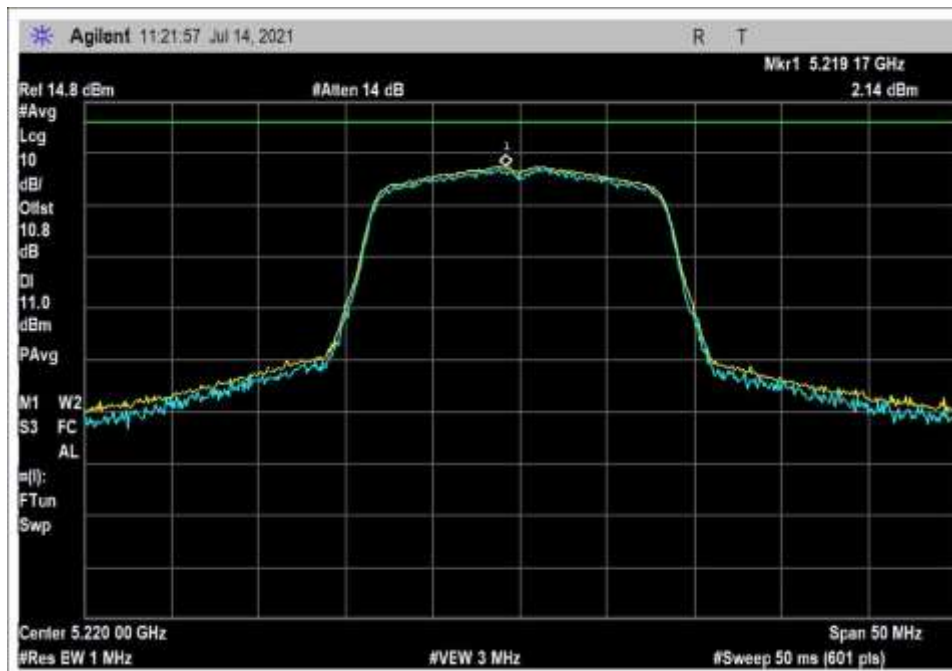
$$\text{Limit} = 11 - \text{Roundup}(G - 6)$$

Plot(s)

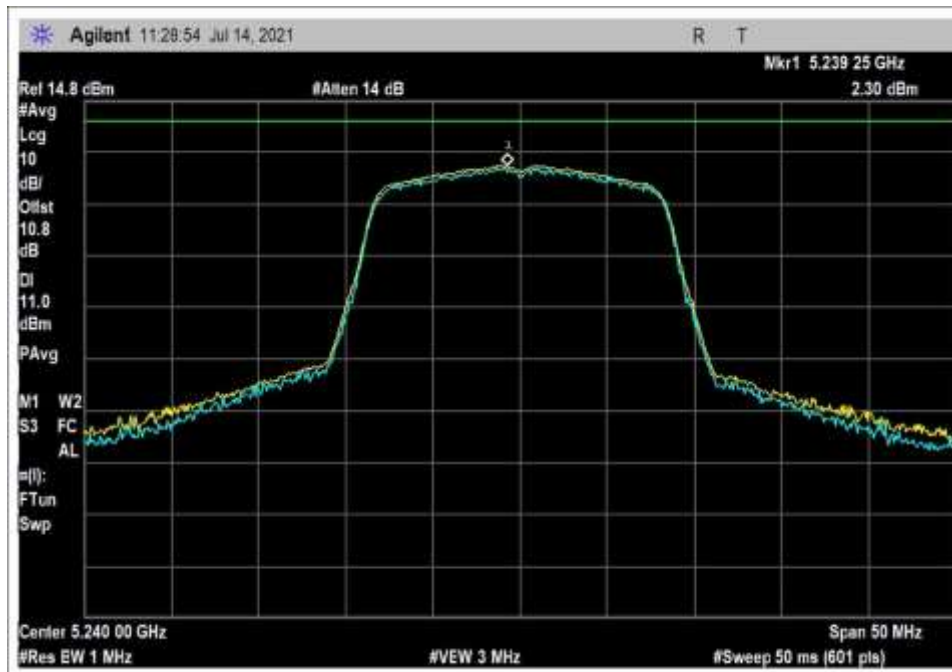
MCS7



Low Channel

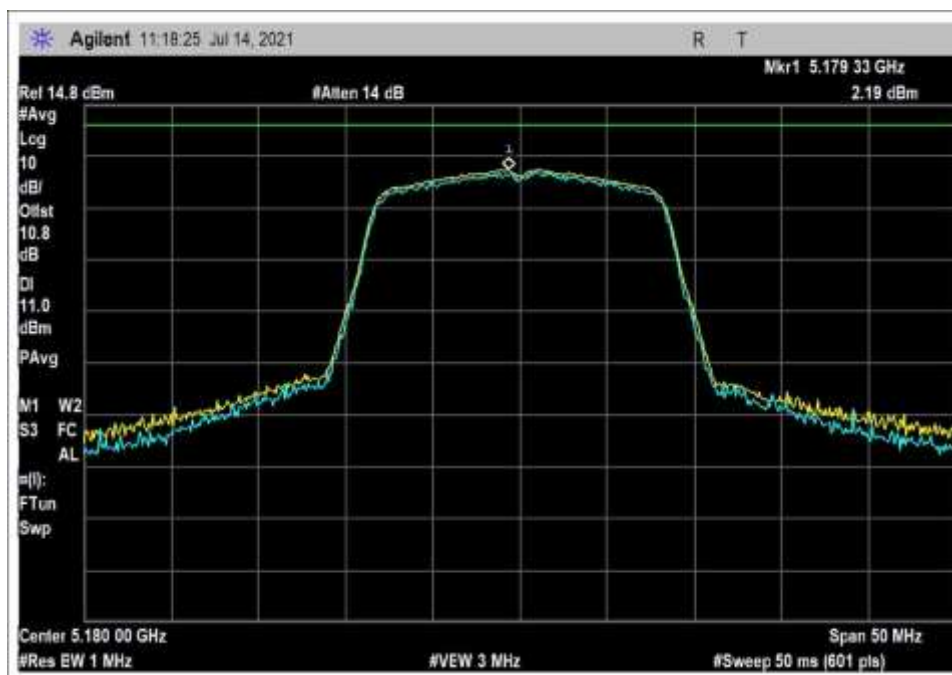


Middle Channel

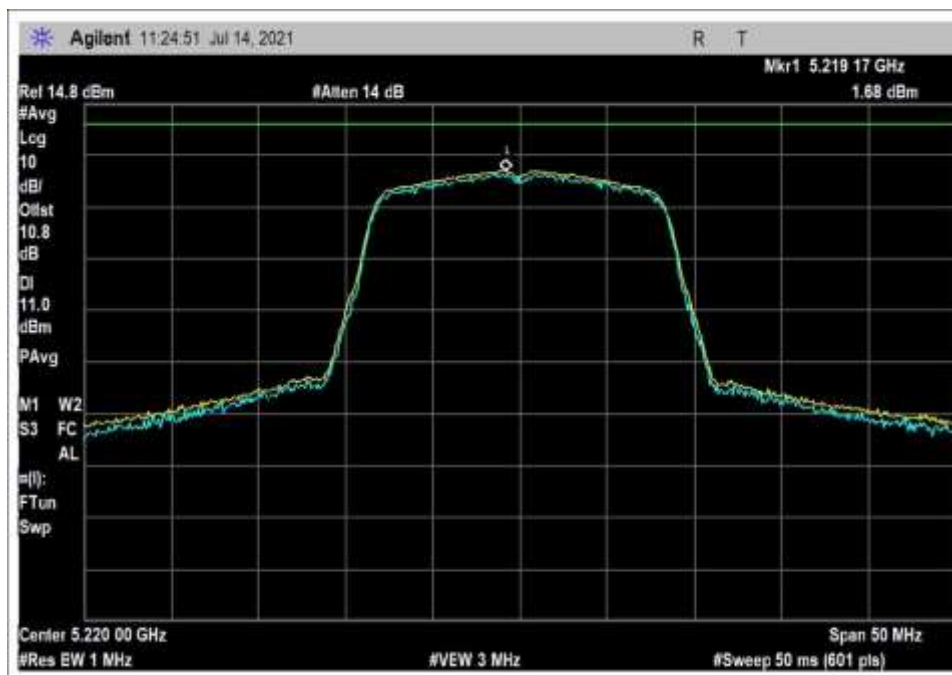


High Channel

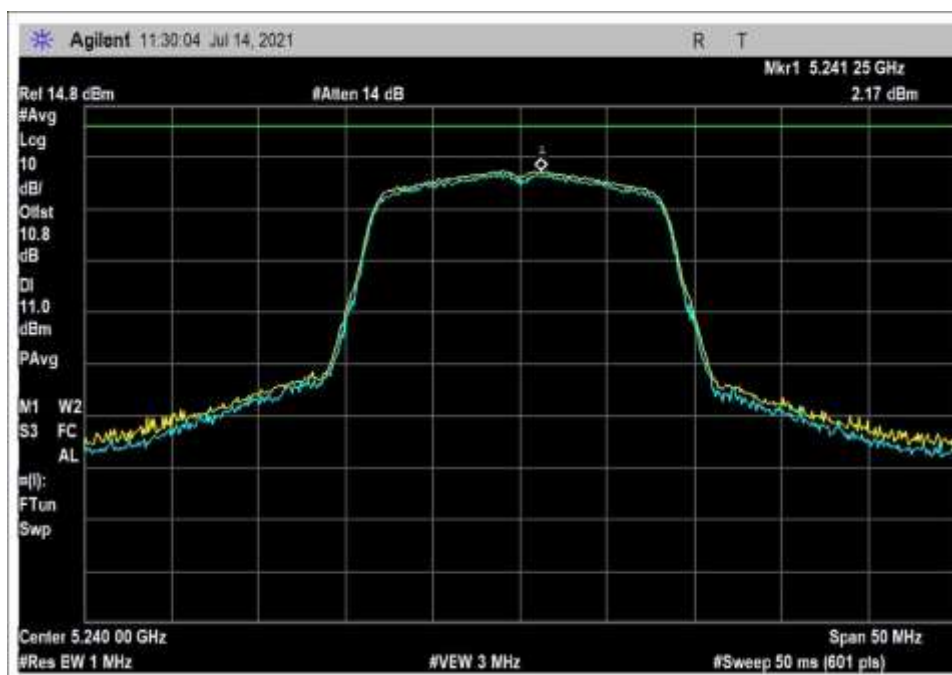
OFDM54M



Low Channel

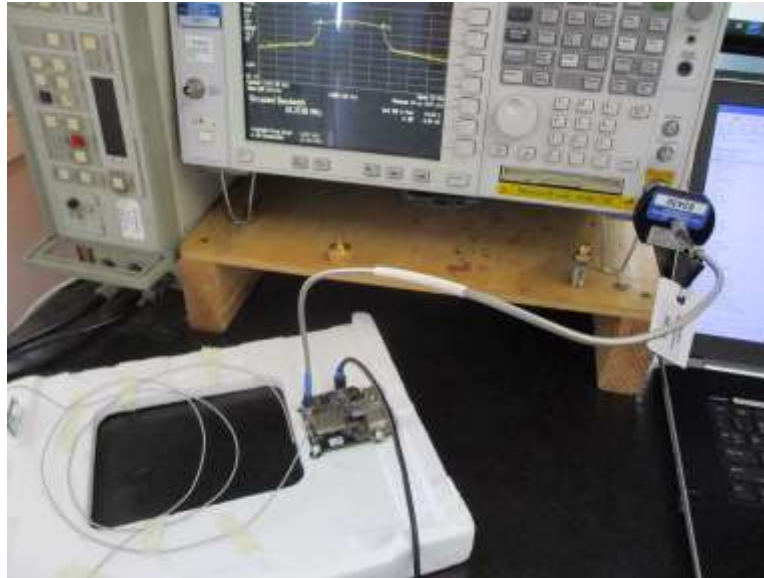


Middle Channel



High Channel

Test Setup Photo(s)



15.407(g) Frequency Stability

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013), KDB 789033 V02R01 December 14, 2017	Test Date(s):	7/27/2021
Configuration:	2		
Test Setup:	EUT is set in temperature chamber. Evaluation performed at antenna port. Reference to FI and FH of radiated Bandedge plot. Voltage variation was performed along with 15.31(e) no drift were detected.		

Environmental Conditions			
Temperature (°C)	25.4	Relative Humidity (%):	60

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02762	Spectrum Analyzer	Agilent	E4446A	4/29/2020	4/29/2022
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	12/20/2019	12/20/2021
07655	Cable	Astro lab	32022-29094K-29094K-24TC	7/30/2020	7/30/2022
05947	Thermometer	Fluke	51	4/28/2020	4/28/2022
01878	Temperature chamber	Thermotron Corp.	S 1.2 Mini-Max	3/30/2021	3/30/2023

Test Data Summary					
Declared Temperature Range: -40 - +85. °C					
Temperature (°C)	Voltage	Low Frequency (MHz)	High Frequency (MHz)	Limit (MHz)	Results
-40	V _{Nominal}	5150.59	5264.92	All emissions remain within 5150-5250 (Fh limit at 5350)	Pass
-20	V _{Nominal}	5150.75	5264.92		
-10	V _{Nominal}	5150.67	5264.92		
0	V _{Nominal}	5150.50	5264.92		
10	V _{Nominal}	5150.59	5265.00		
20	V _{Minimum}	5150.50	5265.00		
20	V _{Nominal}	5150.50	5265.00		
20	V _{Maximum}	5150.50	5265.00		
30	V _{Nominal}	5150.59	5275.00		
40	V _{Nominal}	5150.59	5265.00		
50	V _{Nominal}	5150.75	5264.92		
80	V _{Nominal}	5150.84	5264.84		
Nominal Frequency:		5150.50	5265.00		

Note Listed Nominal frequency is where the limit intersects the signal.

Parameter Definitions:

Measurements performed at input voltage according to manufacturer specification.

Parameter	Value
V _{Nominal} :	3.3Vdc
V _{Minimum} :	3.0Vdc
V _{Maximum} :	3.6Vdc

Test Setup Photo(s)



15.407(b) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA • 714 993 6112
 Customer: **Avnet Inc.**
 Specification: **15.407(b) / 15.209 Radiated Spurious Emissions**
 Work Order #: **105053** Date: 7/21/2021
 Test Type: **Radiated Scan** Time: 10:52:24
 Tested By: E. Wong Sequence#: 7
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Placed on a Styrofoam block, the EUT seeking single modular approval is installed on a support PCB which provide power and configuration interface for testing purposes. The Ethernet and USB-B port of the support PCB is not populated as the function of the PCB is to act as source of power and configuration only.

A support laptop is connected to the PCB via micro-USB cable for configuration of the EUT.

Frequency range: 5150-5250 MHz

UNII1 TX freq: 5180MHz ch36, 5220MHz ch44, 5240MHz ch48

Protocol: OFDM54M, MCS7

Firmware power setting: 14dBm.

Worse case Protocol: MCS7

Frequency range of measurement = 9 kHz- 40GHz.

9 kHz -150 kHz;RBW=200 Hz,VBW=600 Hz;150 kHz-30 MHz;RBW=9 kHz,VBW=27 kHz;30 MHz-1000 MHz;RBW=120 kHz,VBW=360 kHz,1000 MHz-40000 MHz;RBW=1MHz,VBW=3 MHz.

Test environment conditions:

Temperature: 25.3C

Relative Humidity: 58%

Pressure: 98.9kPa

Site A

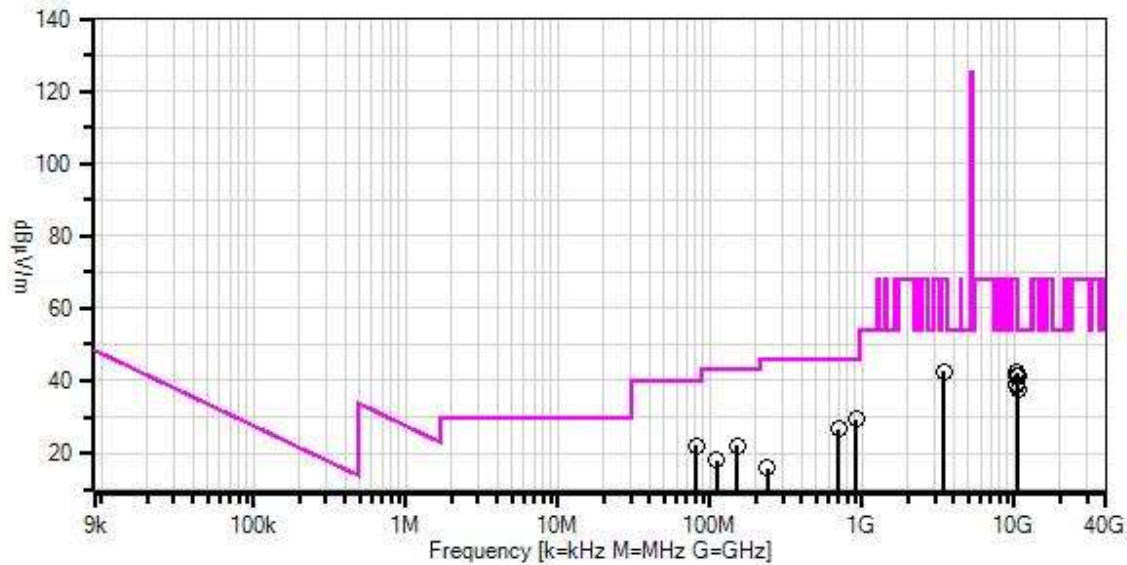
ANSI C63.10-2013.

KDB 789033 D02 General U-NII Test Procedures New Rules v02r01 December 14, 2017

Emission profile of the EUT rotated along the three orthogonal axes was investigated, worse case report.

Note -27dBm/MHz eirp = 68.2dVuV/m@3m

Avnet, Inc WO#: 105053 Sequence#: 7 Date: 7/21/2021
15.407(b) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



— Readings
× QP Readings
▼ Ambient
— 1 - 15.407(b) / 15.209 Radiated Spurious Emissions
○ Peak Readings
* Average Readings
Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	4/29/2020	4/29/2022
T2	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T3	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
T4	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T5	ANP06360	Cable	L1-PNMM-48	8/8/2019	8/8/2021
T6	AN02755	High Pass Filter	11SH10-6000/T18000-O/O	4/9/2020	4/9/2022
	AN03367	Horn Antenna	62-GH-62-25.	8/1/2019	8/1/2021
	AN01413	Horn Antenna	84125-80008	10/19/2020	10/19/2022
	ANP07658	Cable	32022-29094K-29094K-24TC	7/30/2020	7/30/2022
T7	AN00851	Biconilog Antenna	CBL6111C	4/14/2020	4/14/2022
T8	ANP05505	Attenuator	NAT-6	5/26/2021	5/26/2023
T9	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/21/2020	12/21/2022
T10	AN00309	Preamp	8447D	12/24/2019	12/24/2021
T11	ANP05050	Cable	RG223/U	12/24/2020	12/24/2022
	AN00314	Loop Antenna	6502	4/13/2020	4/13/2022
	AN03158A	Horn Antenna	GH-28-25	8/15/2019	8/15/2021

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7 T11	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	10439.300M	38.5	+0.0 +7.6 +0.0	+38.3 +0.5 +0.0	+1.0 +0.0 +0.0	-36.1 +0.0	+0.0	49.8	54.0 Band1_M_Y	-4.2	Horiz
2	10481.000M	37.7	+0.0 +7.6 +0.0	+38.3 +0.5 +0.0	+1.0 +0.0 +0.0	-36.2 +0.0	+0.0	48.9	54.0 Band1_H_Y	-5.1	Horiz
3	10363.000M	37.2	+0.0 +7.6 +0.0	+38.3 +0.5 +0.0	+1.1 +0.0 +0.0	-36.0 +0.0	+0.0	48.7	54.0 Band1_L_Y	-5.3	Vert
4	10358.300M	35.3	+0.0 +7.6 +0.0	+38.3 +0.5 +0.0	+1.1 +0.0 +0.0	-36.0 +0.0	+0.0	46.8	54.0 Band1_L_Y	-7.2	Horiz
5	3453.333M	48.9	+0.0 +3.9 +0.0	+31.2 +0.0 +0.0	+0.6 +0.0 +0.0	-38.2 +0.0	+0.0	46.4	54.0 non intentional	-7.6	Horiz
6	10432.700M	34.9	+0.0 +7.6 +0.0	+38.3 +0.5 +0.0	+1.0 +0.0 +0.0	-36.1 +0.0	+0.0	46.2	54.0 Band1_M_Y	-7.8	Vert
7	10481.000M	33.8	+0.0 +7.6 +0.0	+38.3 +0.5 +0.0	+1.0 +0.0 +0.0	-36.2 +0.0	+0.0	45.0	54.0 Band1_H_Y	-9.0	Vert
8	913.500M	20.6	+0.0 +0.0 +5.8	+0.0 +0.0 -27.1	+0.0 +23.3 +0.5	+0.0 +6.3	+0.0	29.4	46.0	-16.6	Horiz
9	81.300M	34.9	+0.0 +0.0 +1.5	+0.0 +0.0 -28.1	+0.0 +7.7 +0.1	+0.0 +6.1	+0.0	22.2	40.0	-17.8	Vert
10	696.750M	21.7	+0.0 +0.0 +4.9	+0.0 +0.0 -27.2	+0.0 +20.8 +0.3	+0.0 +6.2	+0.0	26.7	46.0	-19.3	Horiz
11	150.000M	30.5	+0.0 +0.0 +2.1	+0.0 +0.0 -28.0	+0.0 +11.2 +0.2	+0.0 +6.1	+0.0	22.1	43.5	-21.4	Horiz
12	110.600M	27.2	+0.0 +0.0 +1.8	+0.0 +0.0 -28.0	+0.0 +10.7 +0.1	+0.0 +6.1	+0.0	17.9	43.5	-25.6	Vert
13	238.300M	23.0	+0.0 +0.0 +2.7	+0.0 +0.0 -27.9	+0.0 +11.8 +0.2	+0.0 +6.1	+0.0	15.9	46.0	-30.1	Vert

Band Edge

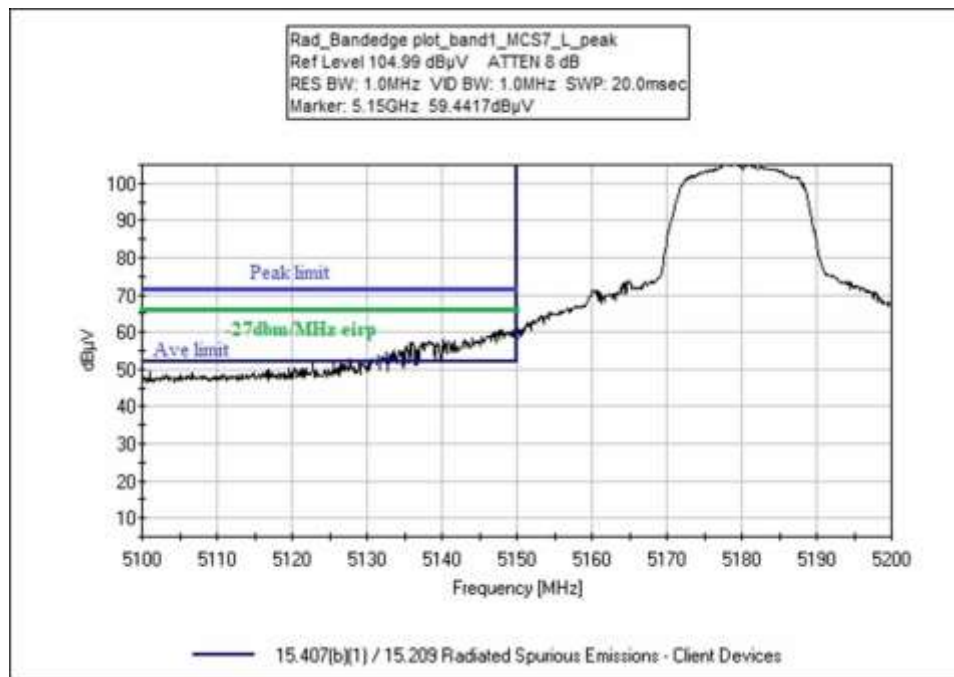
Band Edge Summary

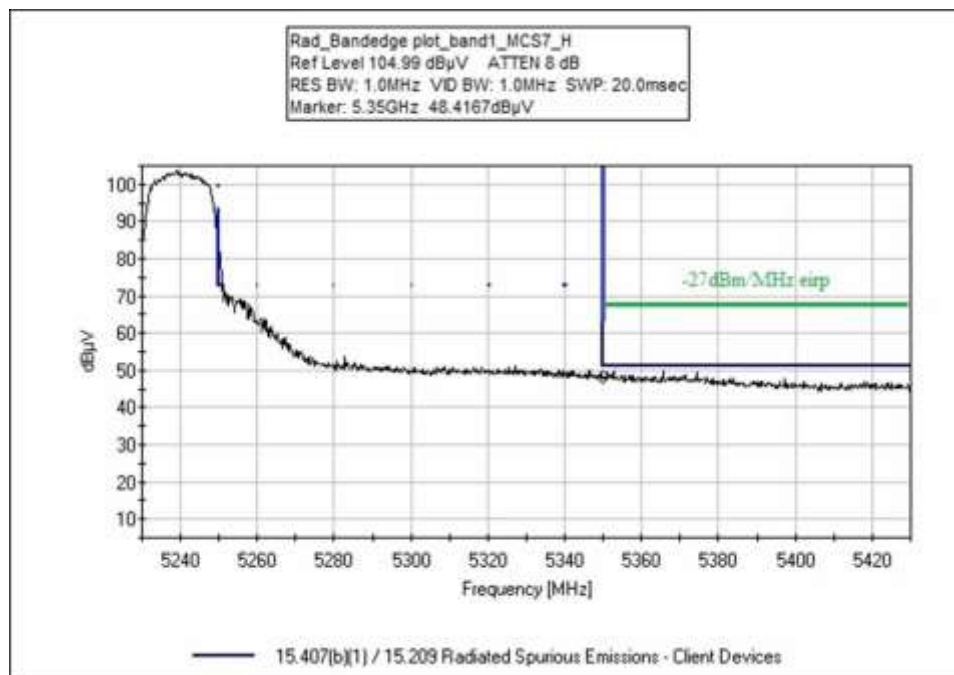
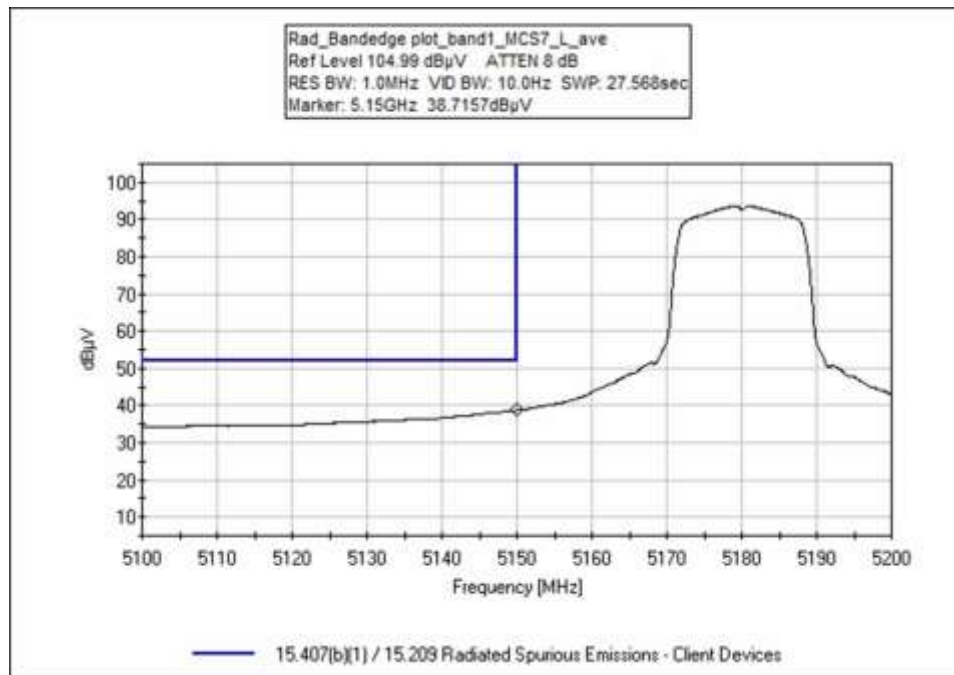
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
5150*	MCS7	Ext patch/ 2.7dBi	40.7 Av	< 54.0 Av	Pass
5150*	MCS7	Ext patch/ 2.7dBi	60.7 Pk	< 74.0 Pk	Pass
5150	MCS7	Ext patch/ 2.7dBi	60.7 Pk	< 68.2 Pk	Pass
5350	MCS7	Ext patch/ 2.7dBi	51.1 Pk	< 68.2 Pk	Pass
5350*	MCS7	Ext patch/ 2.7dBi	51.1 Pk	< 54.0 Av	Pass

*Restricted band edge

Note -27dBm/MHz eirp = 68.2dVuV/m@3m

Band Edge Plots





Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA • 714 993 6112
 Customer: **Avnet Inc.**
 Specification: **15.407(b)(1) / 15.209 Radiated Spurious Emissions**
 Work Order #: **105053** Date: 10/11/2021
 Test Type: **Radiated Scan** Time: 19:14:13
 Tested By: E. Wong Sequence#: 7
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Placed on a Styrofoam block, the EUT seeking single modular approval is installed on a support PCB which provide power and configuration interface for testing purposes. The Ethernet and USB-B port of the support PCB is not populated as the function of the PCB is to act as source of power and configuration only.

A support laptop is connected to the PCB via micro-USB cable for configuration of the EUT.

Frequency range: 5150-5250 MHz

UNII1 TX frequency: 5180MHz ch36, 5220MHz ch44, 5240MHz ch48

Protocol: OFDM54M, MCS7

Firmware power setting: 14dBm.

Worse case Protocol tested MCS7

Test environment conditions:

Temperature: 25.3C

Relative Humidity: 58%

Pressure: 98.9kPa

Site A

ANSI C63.10-2013

KDB 789033 D02 General U-NII Test Procedures New Rules v02r01 December 14, 2017

Emission profile of the EUT rotated along the three orthogonal axes was investigated, worse case report.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	4/29/2020	4/29/2022
T2	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T3	ANP07246	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
T4	AN00786	Preamplifier	83017A	5/20/2020	5/20/2022
T5	ANP06360	Cable	L1-PNMNM-48	9/30/2021	9/30/2023

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V/m	dB μ V/m	dB	Ant
1	5350.000M	48.4	+0.0 +5.2	+34.0	+0.7	-37.2	+0.0	51.1	54.0 Band1_Bandedge_ H_Y	-2.9	Horiz
2	5150.000M Ave	38.7	+0.0 +5.0	+33.7	+0.7	-37.4	+0.0	40.7	54.0 Band1_Bandedge_L _Y	-13.3	Horiz
^	5150.000M	58.7	+0.0 +5.0	+33.7	+0.7	-37.4	+0.0	60.7	54.0 Band1_Bandedge_L _Y	+6.7	Horiz

Test Setup Photo(s)



Below 1GHz



Below 1GHz



Above 1GHz



Above 1GHz



X Axis



Y Axis



Y Axis, 5GHz



Y Axis, 5GHz



Z Axis

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA • 714 993 6112
 Customer: **Avnet, Inc.**
 Specification: **15.207 AC Mains - Average**
 Work Order #: **105053** Date: 7/26/2021
 Test Type: **Conducted Emissions** Time: 17:36:20
 Tested By: E. Wong Sequence#: 8
 Software: EMITest 5.03.20 120/60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Placed on the test bench, the EUT seeking single modular approval is installed on a support PCB which provide power and configuration interface for testing purposes. The Ethernet and USB-B port of the support PCB is not populated as the function of the PCB is to act as source of power and configuration only.

A support laptop is connected to the PCB via micro-USB cable for configuration of the EUT.

Frequency range: 5150-5250 MHz

UNII1 ch36, 5220MHz ch44,

Protocol: OFDM54M, MCS7

Firmware power setting: 14dBm.

Worse case Protocol tested MCS7

Frequency range of measurement = 150kHz- 30MHz.

150 kHz-30 MHz;RBW=9 kHz,VBW=30kHz

AC conducted emission perform at AC main of support DC power supply. 3.3 Vdc supplied to the EUT.

Test environment conditions:

Temperature: 25.3°C

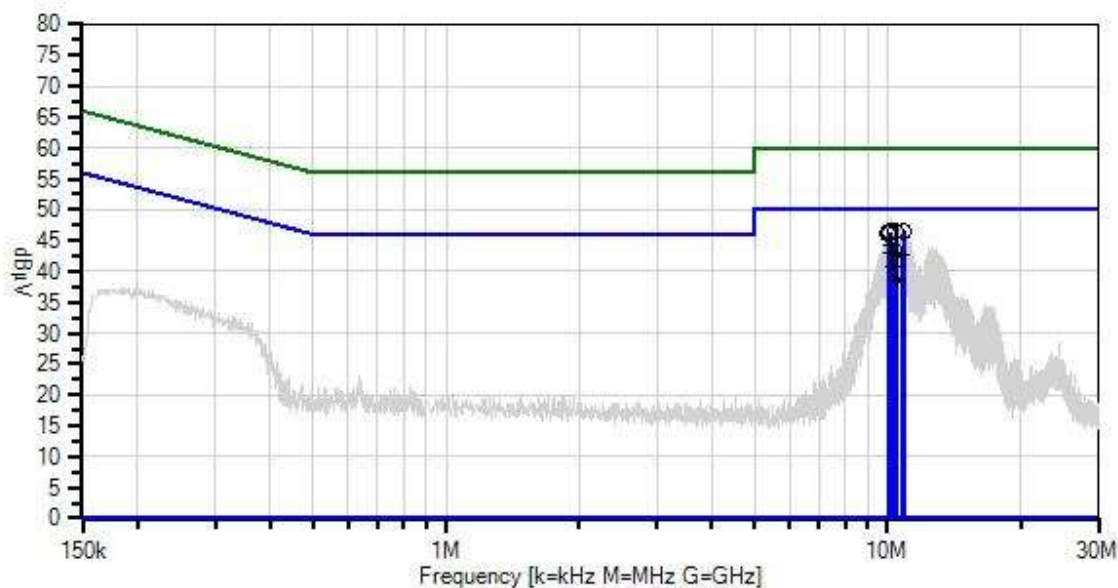
Relative Humidity: 58%

Pressure: .9kPa

Site A

ANSI C63.10-2013

Avnet, Inc W/O#: 105053 Sequence#: 8 Date: 7/26/2021
15.207 AC Mains - Average Test Lead: 120/60Hz L1-Line



— Sweep Data
× QP Readings
Software Version: 5.03.20

— Readings
* Average Readings
— 1 - 15.207 AC Mains - Average

○ Peak Readings
▼ Ambient
— 2 - 15.207 AC Mains - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	4/29/2020	4/29/2022
T1	AN02610	High Pass Filter	HE9615-150K-50-720B	10/22/2019	10/22/2021
T2	ANP07338	Cable	2249-Y-240	12/24/2019	12/24/2021
T3	ANP07545	Attenuator	SA18N10W-06	1/4/2021	1/4/2023
T4	AN00969A	50uH LISN-Line (dB)	3816/2NM	7/27/2020	7/27/2022
	AN00969A	50uH LISN-Return (dB)	3816/2NM	7/27/2020	7/27/2022

Measurement Data:

Reading listed by margin.

Test Lead: L1-Line

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	10.860M	40.1	+0.2	+0.3	+5.7	+0.2	+0.0	46.5	50.0	-3.5	L1-Li
2	10.427M	39.9	+0.2	+0.3	+5.7	+0.3	+0.0	46.4	50.0	-3.6	L1-Li
3	10.139M	39.9	+0.2	+0.3	+5.7	+0.3	+0.0	46.4	50.0	-3.6	L1-Li
4	10.049M	39.7	+0.2	+0.3	+5.7	+0.3	+0.0	46.2	50.0	-3.8	L1-Li
5	10.094M	39.7	+0.2	+0.3	+5.7	+0.3	+0.0	46.2	50.0	-3.8	L1-Li
6	10.238M	37.9	+0.2	+0.3	+5.7	+0.3	+0.0	44.4	50.0	-5.6	L1-Li
Ave											
^	10.238M	40.6	+0.2	+0.3	+5.7	+0.3	+0.0	47.1	50.0	-2.9	L1-Li
8	10.193M	36.4	+0.2	+0.3	+5.7	+0.3	+0.0	42.9	50.0	-7.1	L1-Li
Ave											
^	10.193M	42.1	+0.2	+0.3	+5.7	+0.3	+0.0	48.6	50.0	-1.4	L1-Li
10	10.761M	36.3	+0.2	+0.3	+5.7	+0.2	+0.0	42.7	50.0	-7.3	L1-Li
Ave											
^	10.761M	40.8	+0.2	+0.3	+5.7	+0.2	+0.0	47.2	50.0	-2.8	L1-Li
12	10.337M	34.2	+0.2	+0.3	+5.7	+0.3	+0.0	40.7	50.0	-9.3	L1-Li
Ave											
^	10.337M	40.4	+0.2	+0.3	+5.7	+0.3	+0.0	46.9	50.0	-3.1	L1-Li
14	10.481M	32.0	+0.2	+0.3	+5.7	+0.3	+0.0	38.5	50.0	-11.5	L1-Li
Ave											
^	10.481M	40.2	+0.2	+0.3	+5.7	+0.3	+0.0	46.7	50.0	-3.3	L1-Li



Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA • 714 993 6112
 Customer: **Avnet, Inc.**
 Specification: **15.207 AC Mains - Average**
 Work Order #: **105053** Date: 7/26/2021
 Test Type: **Conducted Emissions** Time: 17:41:29
 Tested By: E. Wong Sequence#: 9
 Software: EMITest 5.03.20 120/60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Placed on the test bench, the EUT seeking single modular approval is installed on a support PCB which provide power and configuration interface for testing purposes. The Ethernet and USB-B port of the support PCB is not populated as the function of the PCB is to act as source of power and configuration only.

A support laptop is connected to the PCB via micro-USB cable for configuration of the EUT.

Frequency range **5150-5250 MHz**

UNII1 ch36, 5220MHz ch44,

Protocol: OFDM54M, MCS7

Firmware power setting: 14dBm.

Worse case Protocol tested MCS7

Frequency range of measurement = 150kHz- 30MHz.

150 kHz-30 MHz;RBW=9 kHz,VBW=30kHz

AC conducted emission perform at AC main of support DC power supply. 3.3 Vdc supplied to the EUT.

Test environment conditions:

Temperature: 25.3°C

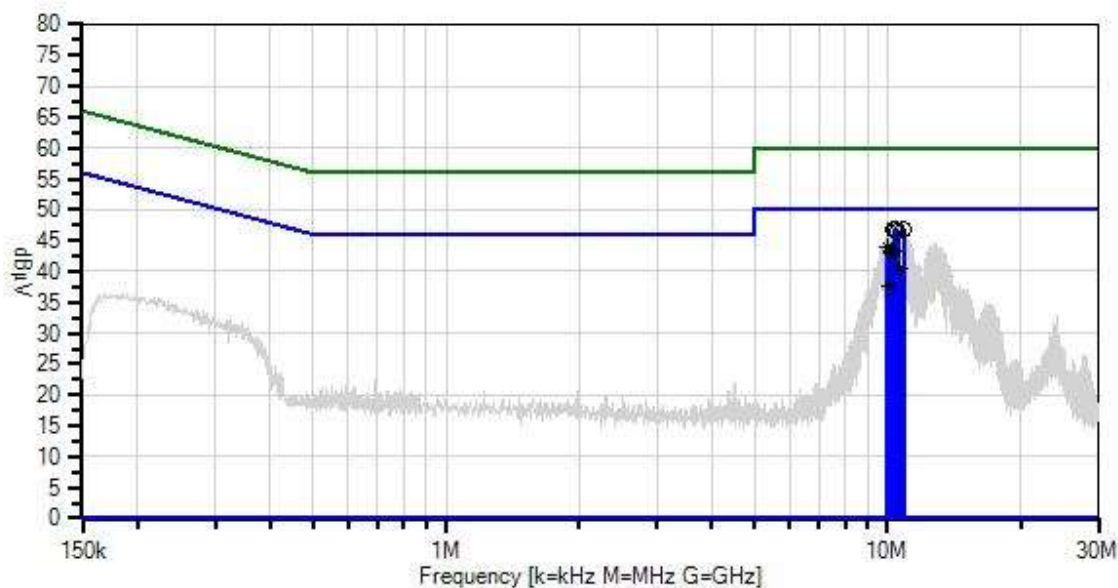
Relative Humidity: 58%

Pressure: 98.9kPa

Site A

ANSI C63.10-2013

Avnet, Inc W/O#: 105053 Sequence#: 9 Date: 7/26/2021
15.207 AC Mains - Average Test Lead: 120/60Hz L2-Neutral



— Sweep Data
× QP Readings
Software Version: 5.03.20

— Readings
* Average Readings
— 1 - 15.207 AC Mains - Average

○ Peak Readings
▼ Ambient
— 2 - 15.207 AC Mains - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	4/29/2020	4/29/2022
T1	AN02610	High Pass Filter	HE9615-150K-50-720B	10/22/2019	10/22/2021
T2	ANP07338	Cable	2249-Y-240	12/24/2019	12/24/2021
T3	ANP07545	Attenuator	SA18N10W-06	1/4/2021	1/4/2023
	AN00969A	50uH LISN-Line (dB)	3816/2NM	7/27/2020	7/27/2022
T4	AN00969A	50uH LISN-Return (dB)	3816/2NM	7/27/2020	7/27/2022

Measurement Data:

Reading listed by margin.

Test Lead: L2-Neutral

#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V	Spec dB μ V	Margin dB	Polar Ant
1	10.337M	40.4	+0.2	+0.3	+5.7	+0.3	+0.0	46.9	50.0	-3.1	L2-Ne
2	10.427M	40.4	+0.2	+0.3	+5.7	+0.3	+0.0	46.9	50.0	-3.1	L2-Ne
3	10.860M	40.3	+0.2	+0.3	+5.7	+0.2	+0.0	46.7	50.0	-3.3	L2-Ne
4	10.526M	40.2	+0.2	+0.3	+5.7	+0.2	+0.0	46.6	50.0	-3.4	L2-Ne
5	10.001M	37.6	+0.2	+0.3	+5.7	+0.3	+0.0	44.1	50.0	-5.9	L2-Ne
Ave											
^	10.004M	40.9	+0.2	+0.3	+5.7	+0.3	+0.0	47.4	50.0	-2.6	L2-Ne
7	10.283M	36.7	+0.2	+0.3	+5.7	+0.3	+0.0	43.2	50.0	-6.8	L2-Ne
Ave											
^	10.283M	41.7	+0.2	+0.3	+5.7	+0.3	+0.0	48.2	50.0	-1.8	L2-Ne
9	10.193M	36.6	+0.2	+0.3	+5.7	+0.3	+0.0	43.1	50.0	-6.9	L2-Ne
Ave											
^	10.193M	40.6	+0.2	+0.3	+5.7	+0.3	+0.0	47.1	50.0	-2.9	L2-Ne
11	10.670M	34.2	+0.2	+0.3	+5.7	+0.2	+0.0	40.6	50.0	-9.4	L2-Ne
Ave											
^	10.670M	40.7	+0.2	+0.3	+5.7	+0.2	+0.0	47.1	50.0	-2.9	L2-Ne
13	10.148M	31.1	+0.2	+0.3	+5.7	+0.3	+0.0	37.6	50.0	-12.4	L2-Ne
Ave											
^	10.148M	40.8	+0.2	+0.3	+5.7	+0.3	+0.0	47.3	50.0	-2.7	L2-Ne

Test Setup Photo(s)



SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k=2$. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in $\text{dB}\mu\text{V}/\text{m}$, the spectrum analyzer reading in $\text{dB}\mu\text{V}$ was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	($\text{dB}\mu\text{V}$)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	($\text{dB}\mu\text{V}/\text{m}$)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.