

Test Report # 3584 A (WLAN 2.4 DTS)

Equipment Under Test: A700x Series Devices (A710x, A720x, A730x)

Requirement(s): FCC 15.247, FCC 15.207, FCC 15.209, RSS-247, RSS-GEN

Test Date(s): May 4th-20th, 2022; August 11, 2022

Prepared for: Honeywell International Inc.
Attn: Gretchen Bullen
9680 Old Bailes Road
Fort Mill, SC 29707

Report Issued by: Adam Alger, Laboratory Manager

Signature: 

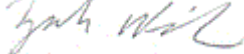
Date: 9/15/2022

Report Reviewed by: Adam Alger, Laboratory Manager

Signature: 

Date: 7/5/2022

Report Constructed by: Zach Wilson, EMC Engineer

Signature: 

Date: 6/29/2022

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Laird Connectivity Test Services in Review

The Laird Connectivity LLC 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



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

Company: Honeywell International Inc.	Page 3 of 49	Name: A700x Series Devices (A710x, A720x, A730x)
Report: TR3584 A		Model: TAP1010-02, TAP1020-02, TAP1030-02
Quote: NBO-01-2022-004630		Serial: Engineering Sample

1 TEST REPORT SUMMARY

During **May 4th-20th, August 11th, 2022** the Equipment Under Test (EUT), **A700x Series Devices (A710x, 720x, 730x)**, as provided by **Honeywell International Inc.** was tested to the following requirements **Federal Communications Commission and Innovation, Science and Economic Development Canada:**

DTS

Requirement	Description	Specification	Method	Result
FCC: 15.247 (a)(2) IC: RSS-247 5.2 (a)	Digital Modulation System 6 dB bandwidth	500 kHz	ANSI C63.10	Pass
FCC: 2.1049 IC: RSS-GEN 6.7	Occupied Bandwidth	Reported	ANSI C63.10	Pass
FCC: 15.247 (b)(3) IC: RSS-247 5.4 (d)	Maximum Conducted Average Output Power	30 dBm	ANSI C63.10	Pass
FCC: 15.247 (e) IC: RSS-247 5.2 (b)	Digital Modulation System Power Spectral Density	8 dBm / 3 kHz	ANSI C63.10	Pass
FCC: 15.247 (d) IC: RSS-247 5.5	RF Spurious Emissions at the Transmitter Antenna Terminal	20 dBc	ANSI C63.10	Pass
FCC: 15.247 (d) IC: RSS-GEN 8.10	Spurious Radiated Emissions in Restricted Bands	FCC 15.209 RSS-GEN 8.9	ANSI C63.10	Pass
FCC: 2.1055 (d) IC: RSS-GEN 6.11	Frequency Stability	Reported	ANSI C63.10	Pass

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	Honeywell International Inc.
Contact Person	Gretchen Bullen
Address	9680 Old Bailes Road Fort Mill, SC 29707

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	A700x Series Devices (A710x, 720x, 730x)
Model Number	TAP1010-02, TAP1020-02, TAP1030-02
Serial Number	Engineering Sample
FCC ID	HD5-TAP1000-02
IC ID	1693B-TAP100002

2.2 Product Description

The EUT is a handheld communication device consisting of the Laird SU60-SIPT WLAN 2.4/5 GHz and BLE/BT module. The EUT also contains the NXP PN7150BOHN/C110xx NFC radio. The EUT was powered by a 3.7 VDC battery. The WLAN operates in SISO mode only.

The EUT has three different models:

- o A710x - Contains the basic wireless functionality
- o A720x - Contains an end cap with two external proprietary connectors that add on the ability to connect a wired headset and a peripheral device such as a printer or scanner.
- o A730x - Contains an imager end cap that adds scanning functionality.

All models use identical radios and circuit boards in the “base unit” and the different A700x versions add additional (non-radio) capabilities through different, factory configurable “end caps”.

All conducted testing was completed on the A710x model. Radiated measurements completed for all three models.

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

2.4 GHz WLAN Rates	
IEEE Standard	Data Rate
802.11b	1, 11 Mbps
802.11g	6, 54 Mbps
802.11n(20)	MCS0, MCS7
802.11n(40)	MCS0, MCS7

2.4 GHz WLAN Channels	
Channel	Freq. MHz
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

2.6 Radio Programming

The WLAN radios were programmed using the Laird Regulatory Tool v 9.32.0.6. BLE and BT radios were programmed using default HCI commands via the windows command prompt. The NFC radio was programmed using Honeywell's CBOB program V1.0.

2.7 Antennas

The device contains three antennas:

- Custom dual band PCB inverted F type antenna with a peak gain of
 - o +4.7 dBi in 2400-2484 MHz
 - o +6.4 dBi in 5150-5350 MHz
 - o +6.9 dBi in 5470-5725 MHz
 - o +7.3 dBi in 5725-5850 MHz
- Custom PCB inverted F type antenna with a peak gain of +0.2 dBi for the BT/BLE radios.
- Flex circuit magnetic loop antenna, P/N 1002403 for the NFC radio.

2.8 Simultaneous Transmission

The EUT radio combinations that are capable of simultaneous transmission are shown below:

- WLAN 5 GHz + BT/BLE + NFC
- WLAN 2.4 GHz + NFC

2.9 Power Settings

Default power tables used except for the following channels on 802.11b, all rates:

- Channels 3-9, power setting 14
- Channels 10-11, power setting 13

3 REFERENCES

Publication	Edition	Date	AMD 1	AMD 2
FCC CFR	-	2022	-	-
ANSI C63.10	-	2013	-	-
RSS-Gen	5	2018	2019	2021
RSS-247	2	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 $\pm$
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

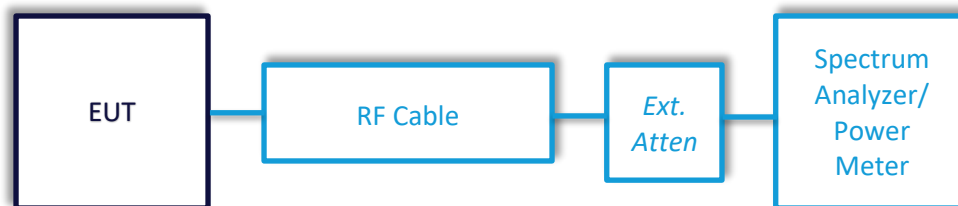
Parameter	ETSI U.C. $\pm$	U.C. $\pm$
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
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



Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960144	Cable	Gore	EKD01D010720	5800373	3/22/2022	3/22/2023	Active Verification
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	3/22/2022	3/22/2023	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/12/2022	4/12/2023	Active Calibration
EE 960090	Meter - RF Power	Anritsu	ML2495A	1335006	4/13/2022	4/13/2023	Active Calibration
EE 960091	Sensor - RF Power	Anritsu	MA2491A	1249277	4/13/2022	4/13/2023	Active Calibration

5.1.1 DTS Bandwidth (6dB)

Operator	Anthony Smith	QA	Zach Wilson
Temperature	21.6, 20.7, 22.2	R.H. %	35.6, 44.8, 54.2
Test Date	5/17/2022, 5/19/2022, 5/20/2022	Location	Conducted Bench
Requirement	FCC 15.247, RSS-247	Method	ANSI C63.10 §11.8.2

Limits: Bandwidth greater than 500 kHz

Test Parameters

Frequency	(20): 2412, 2437, 2462 MHz (40): 2422, 2442 MHz	Setup	Conducted
RBW	100 kHz	VBW	300 kHz
Detector(s)	Max hold with peak detector	Sweep Time	Auto

EUT Parameters

Input Power	3.7VDC Battery	Mode	WLAN Transmit
Channel	(20): 1, 6, 11 (40): 3, 7		

Data Table

IEE Standard	Data Rate	Channel Bandwidth (MHz)	Channel	6dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)
802.11b	1Mbps	20	1	10.1	0.5	9.6
802.11b	11Mbps	20	1	9.5	0.5	9.0
802.11g	6Mbps	20	1	16.6	0.5	16.1
802.11g	54Mbps	20	1	16.5	0.5	16.0
802.11n	MCS0	20	1	17.7	0.5	17.2
802.11n	MCS7	20	1	17.7	0.5	17.2
802.11b	1Mbps	20	6	10.0	0.5	9.5
802.11b	11Mbps	20	6	9.5	0.5	9.0
802.11g	6Mbps	20	6	16.5	0.5	16.0
802.11g	54Mbps	20	6	16.5	0.5	16.0
802.11n	MCS0	20	6	17.7	0.5	17.2
802.11n	MCS7	20	6	17.7	0.5	17.2
802.11b	1Mbps	20	11	10.1	0.5	9.6
802.11b	11Mbps	20	11	9.5	0.5	9.0
802.11g	6Mbps	20	11	16.5	0.5	16.0
802.11g	54Mbps	20	11	16.5	0.5	16.0
802.11n	MCS0	20	11	17.7	0.5	17.2
802.11n	MCS7	20	11	17.7	0.5	17.2
802.11n	MCS0	40	3	36.4	0.5	35.9
802.11n	MCS7	40	3	36.5	0.5	36.0
802.11n	MCS0	40	7	36.4	0.5	35.9
802.11n	MCS7	40	7	36.5	0.5	36.0

Plots



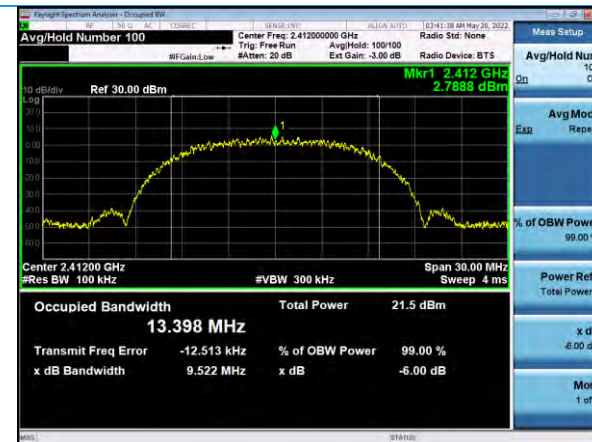
6 dB Bandwidth, Channel 1, 802.11b, 1Mbps



6 dB Bandwidth, Channel 6, 802.11b, 1 Mbps



6 dB Bandwidth, Channel 11, 802.11b, 1Mbps



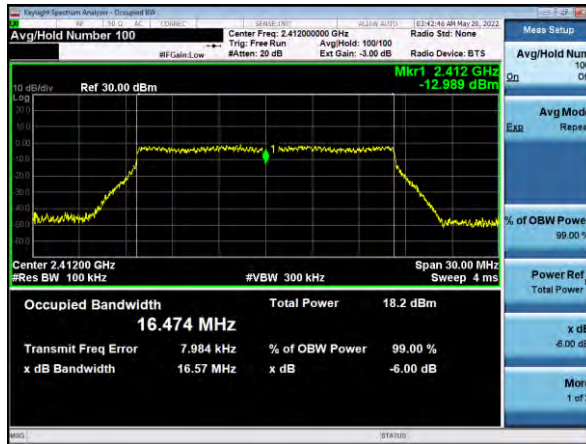
6 dB Bandwidth, Channel 1, 802.11b, 11Mbps



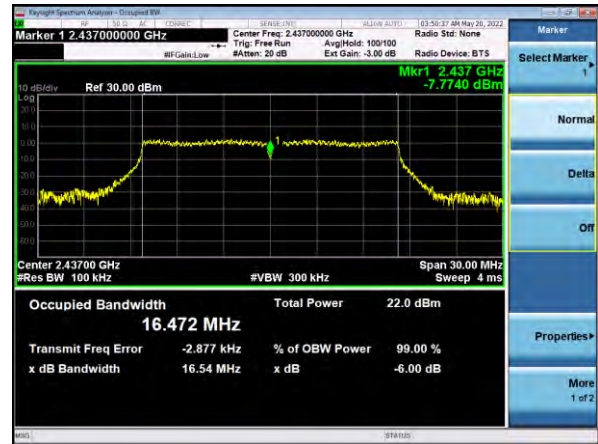
6 dB Bandwidth, Channel 6, 802.11b, 11Mbps



6 dB Bandwidth, Channel 11, 802.11b, 11Mbps



6 dB Bandwidth, Channel 1, 802.11g, 6Mbps



6 dB Bandwidth, Channel 6, 802.11g, 6Mbps



6 dB Bandwidth, Channel 11, 802.11g, 6Mbps



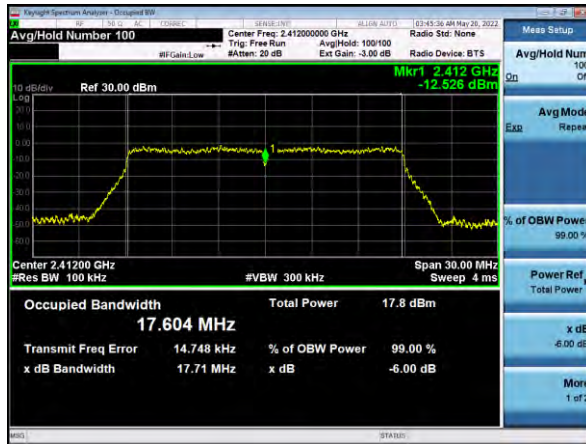
6 dB Bandwidth, Channel 1, 802.11g, 54Mbps



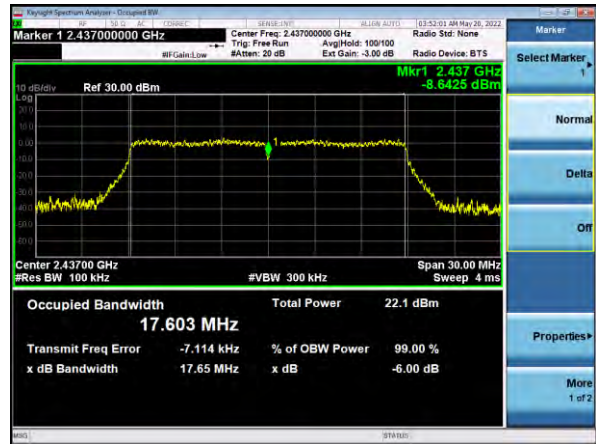
6 dB Bandwidth, Channel 6, 802.11g, 54Mbps



6 dB Bandwidth, Channel 11, 802.11g, 54Mbps



6 dB Bandwidth, Channel 1, 802.11n, MCS0



6 dB Bandwidth, Channel 6, 802.11n, MCS0



6 dB Bandwidth, Channel 11, 802.11n, MCS0



6 dB Bandwidth, Channel 1, 802.11n, MCS7



6 dB Bandwidth, Channel 6, 802.11n, MCS7



6 dB Bandwidth, Channel 11, 802.11n, MCS7



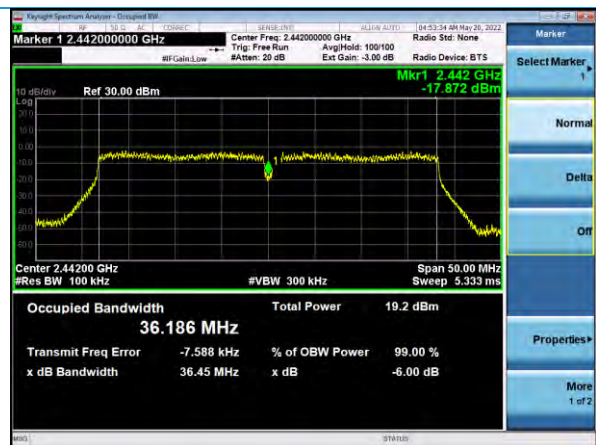
6 dB Bandwidth, Channel 3, 802.11n (40), MCS0



6 dB Bandwidth, Channel 7, 802.11n (40), MCS0



6 dB Bandwidth, Channel 3, 802.11n (40), MCS7



6 dB Bandwidth, Channel 7, 802.11n (40), MCS7

5.1.2 99% Bandwidth

Operator	Anthony Smith	QA	Zach Wilson
Temperature	21.6, 20.7, 22.2	R.H. %	35.6, 44.8, 54.2
Test Date	5/17/2022, 5/19/2022, 5/20/2022	Location	Conducted Bench
Requirement	15.1049, RSS-GEN	Method	ANSI C63.10 §6.9.3

Limits: Reported

Test Parameters

Frequency	(20): 2412, 2437, 2462 MHz (40): 2422, 2442 MHz	Setup	Conducted
RBW	300 kHz	VBW	1 MHz, 1.2 MHz
Detector(s)	Max hold with peak detector	Sweep Time	Auto

EUT Parameters

Input Power	3.7VDC Battery	Mode	WLAN TX
Channel	(20): 1, 6, 11 (40): 3, 7		

Data Table

IEE Standard	Data Rate	Channel Bandwidth (MHz)	Channel	99% OBW (MHz)
802.11b	1Mbps	20	1	13.5
802.11b	11Mbps	20	1	13.4
802.11g	6Mbps	20	1	16.8
802.11g	54Mbps	20	1	16.6
802.11n	MCS0	20	1	17.7
802.11n	MCS7	20	1	17.7
802.11b	1Mbps	20	6	13.5
802.11b	11Mbps	20	6	13.4
802.11g	6Mbps	20	6	16.8
802.11g	54Mbps	20	6	16.7
802.11n	MCS0	20	6	17.7
802.11n	MCS7	20	6	17.7
802.11b	1Mbps	20	11	13.4
802.11b	11Mbps	20	11	13.3
802.11g	6Mbps	20	11	16.8
802.11g	54Mbps	20	11	16.6
802.11n	MCS0	20	11	17.7
802.11n	MCS7	20	11	17.7
802.11n	MCS0	40	3	36.1
802.11n	MCS7	40	3	36.2
802.11n	MCS0	40	7	36.1
802.11n	MCS7	40	7	36.2

Plots



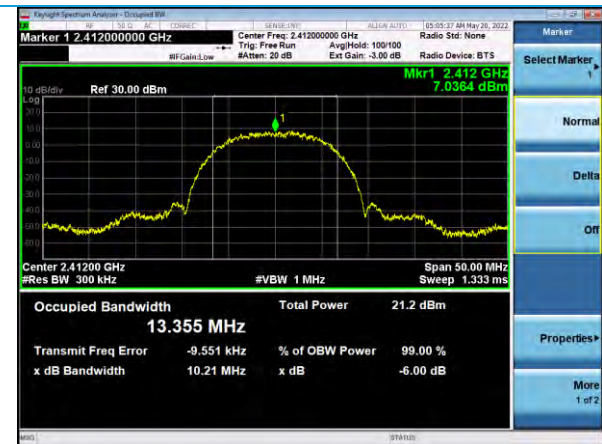
99% Bandwidth, Channel 1, 802.11b, 1Mbps



99% Bandwidth, Channel 6, 802.11b, 1Mbps



99% Bandwidth, Channel 11, 802.11b, 1Mbps



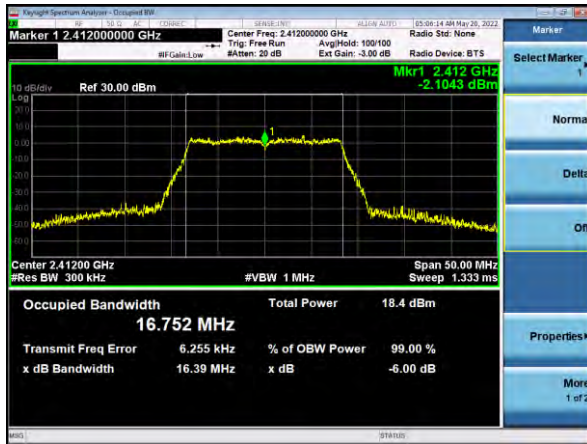
99% Bandwidth, Channel 1, 802.11b, 11Mbps



99% Bandwidth, Channel 6, 802.11b, 11Mbps



99% Bandwidth, Channel 11, 802.11b, 11Mbps



99% Bandwidth, Channel 1, 802.11g, 6Mbps



99% Bandwidth, Channel 6, 802.11g, 6Mbps



99% Bandwidth, Channel 11, 802.11g, 6Mbps



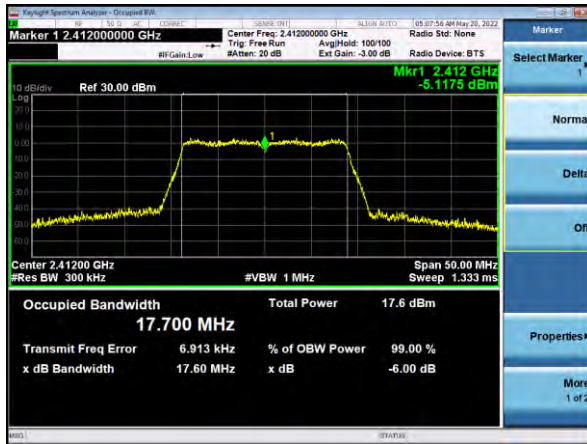
99% Bandwidth, Channel 1, 802.11g, 54Mbps



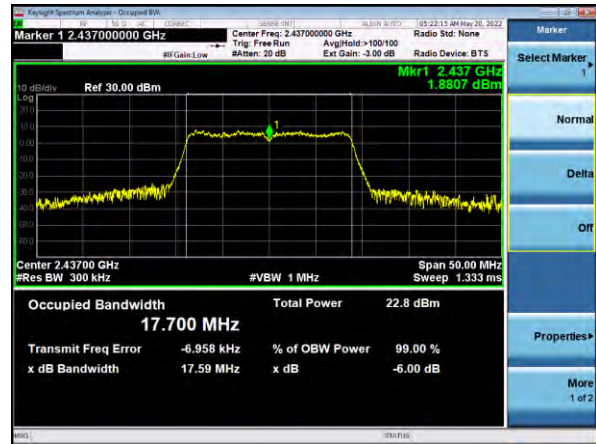
99% Bandwidth, Channel 6, 802.11g, 54Mbps



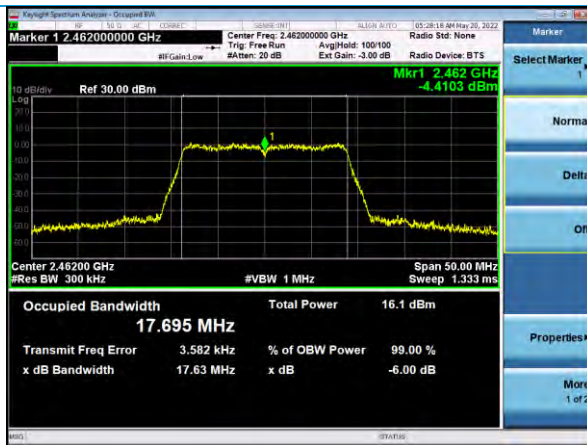
99% Bandwidth, Channel 11, 802.11g, 54Mbps



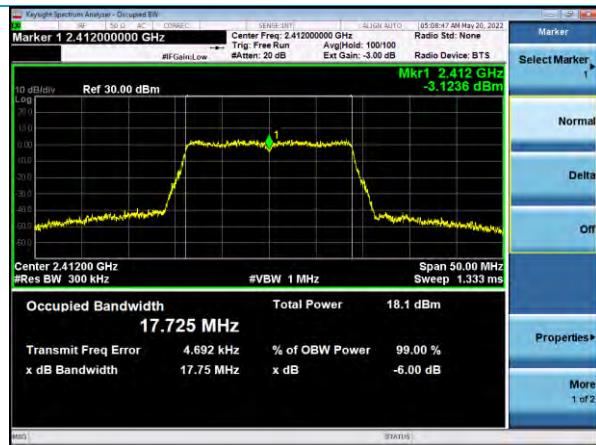
99% Bandwidth, Channel 1, 802.11n, MCS0



99% Bandwidth, Channel 6, 802.11n, MCS0



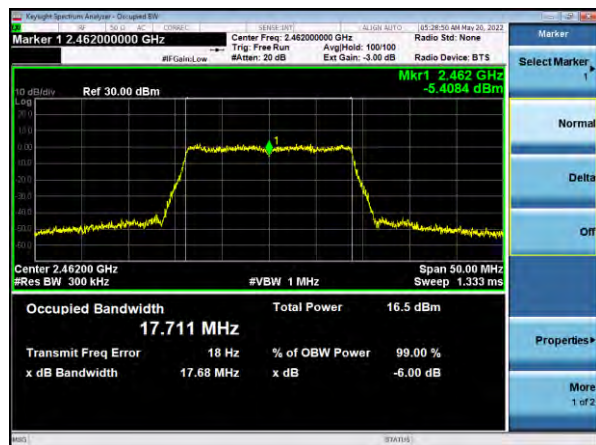
99% Bandwidth, Channel 11, 802.11n, MCS0



99% Bandwidth, Channel 1, 802.11n, MCS7



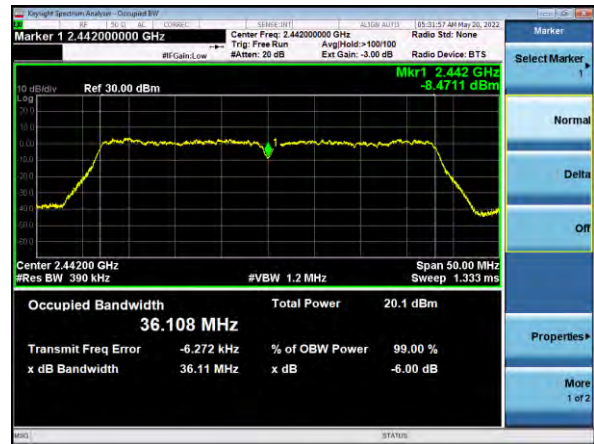
99% Bandwidth, Channel 6, 802.11n, MCS7



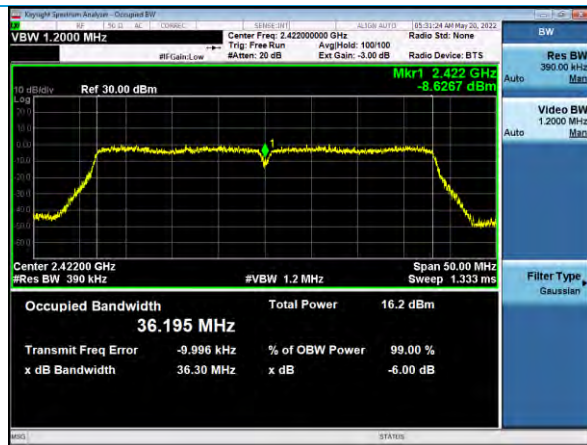
99% Bandwidth, Channel 11, 802.11n, MCS7



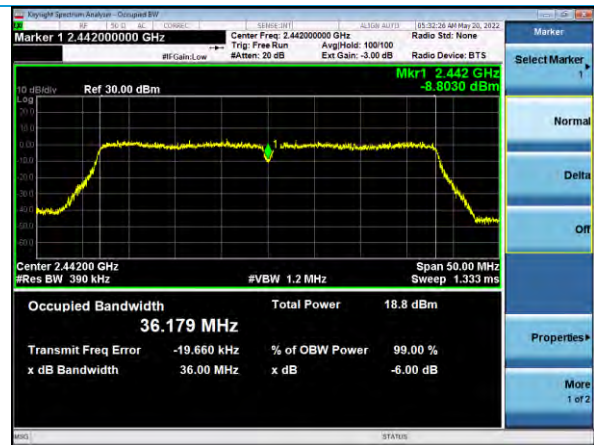
99% Bandwidth, Channel 3, 802.11n(40), MCS0



99% Bandwidth, Channel 7, 802.11n(40), MCS0



99% Bandwidth, Channel 3, 802.11n(40), MCS7



99% Bandwidth, Channel 7, 802.11n(40), MCS7

5.1.3 Fundamental Emission Output Power

Operator	Anthony Smith	QA	Adam Alger
Temperature	21.7° C	R.H. %	47.4
Test Date	8/11/2022	Location	Conducted Bench
Requirement	FCC 15.247, RSS-247	Method	ANSI C63.10 §11.9.2.3.1 AVGPM

Limits: 30dBm = 1W

Test Parameters

Frequency	(20): 2412, 2437, 2462 MHz (40): 2422, 2442 MHz	Setup	Conducted
Detector	RMS	Measurement Device	Power Meter

EUT Parameters

Input Power	3.7VDC Battery
Channel	(20): 1, 6, 11 (40): 3, 7

Data Table

IEEE Standard	Data Rate	Channel Bandwidth (MHz)	Channel	Average Output Power (dBm)	Average Output Power Limit (dBm)	Margin (dB)
802.11b	1	20	1	15.8	30.0	14.2
802.11b	1	20	6	17.5	30.0	12.5
802.11b	1	20	11	16.5	30.0	13.5
802.11b	11	20	1	15.6	30.0	14.4
802.11b	11	20	6	17.5	30.0	12.5
802.11b	11	20	11	16.5	30.0	13.5
802.11g	6	20	1	13.5	30.0	16.5
802.11g	6	20	6	17.4	30.0	12.6
802.11g	6	20	11	13.6	30.0	16.4
802.11g	54	20	1	13.5	30.0	16.5
802.11g	54	20	6	15.5	30.0	14.5
802.11g	54	20	11	13.6	30.0	16.4
802.11n	mcs0	20	1	12.8	30.0	17.2
802.11n	mcs0	20	6	17.7	30.0	12.3
802.11n	mcs0	20	11	11.8	30.0	18.2
802.11n	mcs7	20	1	12.8	30.0	17.2
802.11n	mcs7	20	6	15.7	30.0	14.3
802.11n	mcs7	20	11	11.8	30.0	18.2
802.11n	mcs0	40	3	10.6	30.0	19.4
802.11n	mcs0	40	7	14.6	30.0	15.4
802.11n	mcs7	40	3	10.7	30.0	19.3
802.11n	mcs7	40	7	13.6	30.0	16.4

5.1.4 Maximum Power Spectral Density

Operator	Anthony Smith	QA	Zach Wilson
Temperature	21.6, 20.7, 22.2	R.H. %	35.6, 44.8, 54.2
Test Date	5/17/2022, 5/19/2022, 5/20/2022	Location	Conducted Bench
Requirement	FCC 15.247, RSS-247	Method	ANSI C63.10 §11.10.3 AVGPDS-1

Limits: 8dBm/3kHz

Test Parameters

Frequency	(20): 2412, 2437, 2462 MHz (40): 2422, 2442 MHz	Setup	Conducted
RBW	100 kHz	VBW	300 kHz
Detector(s)	RMS	Sweep Time	4 ms
Number of Traces	100		

EUT Parameters

Input Power	3.7 VDC Battery	Mode	WLAN TX
Channel	(20): 1, 6, 11 (40): 3, 7		

Data Table

IEE Standard	Data Rate	Channel Bandwidth (MHz)	Channel	PSD Reading (dBm/300kHz)	PSD Limit (dBm/3kHz)	PSD Margin (dB)
802.11b	1Mbps	20	1	-2.8	8.0	10.8
802.11b	11Mbps	20	1	-2.1	8.0	10.1
802.11g	6Mbps	20	1	-7.1	8.0	15.1
802.11g	54Mbps	20	1	-6.5	8.0	14.5
802.11n	MCS0	20	1	-7.8	8.0	15.8
802.11n	MCS7	20	1	-7.8	8.0	15.8
802.11b	1Mbps	20	6	-3.8	8.0	11.8
802.11b	11Mbps	20	6	-3.4	8.0	11.4
802.11g	6Mbps	20	6	-3.1	8.0	11.1
802.11g	54Mbps	20	6	-4.9	8.0	12.9
802.11n	MCS0	20	6	-3.1	8.0	11.1
802.11n	MCS7	20	6	-5.4	8.0	13.4
802.11b	1Mbps	20	11	-6.4	8.0	14.4
802.11b	11Mbps	20	11	-6.3	8.0	14.3
802.11g	6Mbps	20	11	-7.5	8.0	15.5
802.11g	54Mbps	20	11	-7.1	8.0	15.1
802.11n	MCS0	20	11	-9.5	8.0	17.5
802.11n	MCS7	20	11	-9.6	8.0	17.6
802.11n	MCS0	40	3	-12.3	8.0	20.3
802.11n	MCS7	40	3	-12.5	8.0	20.5
802.11n	MCS0	40	7	-9.1	8.0	17.1
802.11n	MCS7	40	7	-9.8	8.0	17.8

Plots



PSD, Channel 1, 802.11b, 1Mbps



PSD, Channel 6, 802.11b, 1Mbps



PSD, Channel 11, 802.11b, 1Mbps



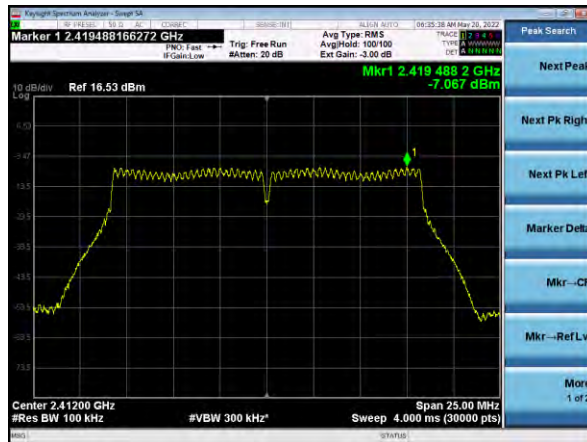
PSD, Channel 1, 802.11b, 11Mbps



PSD, Channel 6, 802.11b, 11Mbps



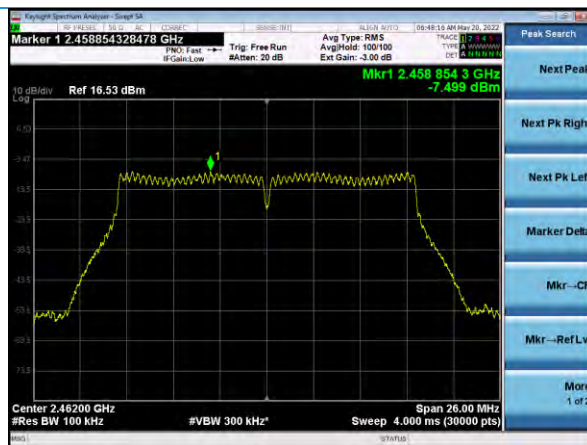
PSD, Channel 11, 802.11b, 11Mbps



PSD, Channel 1, 802.11g, 6Mbps



PSD, Channel 6, 802.11g, 6Mbps



PSD, Channel 11, 802.11g, 6Mbps



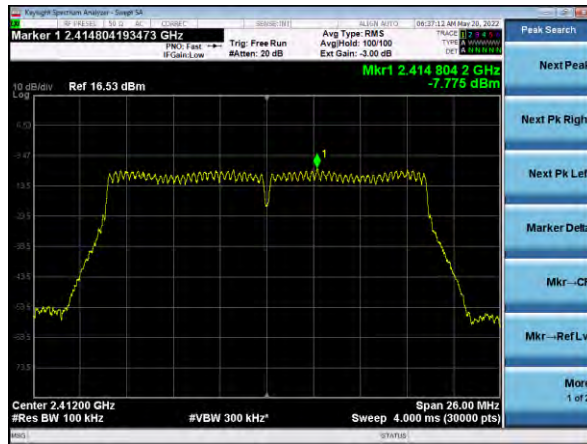
PSD, Channel 1, 802.11g, 54Mbps



PSD, Channel 6, 802.11g, 54Mbps



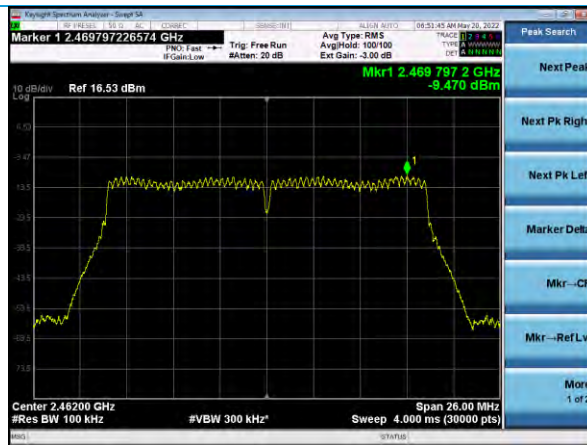
PSD, Channel 11, 802.11g, 54Mbps



PSD, Channel 1, 802.11n, MCS0



PSD, Channel 6, 802.11n, MCS0



PSD, Channel 11, 802.11n, MCS0



PSD, Channel 1, 802.11n, MCS7



PSD, Channel 6, 802.11n, MCS7



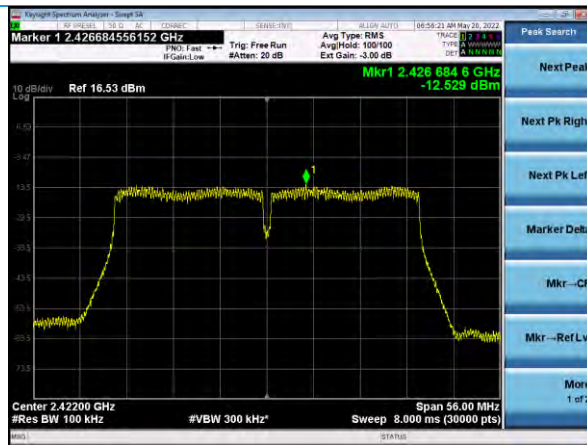
PSD, Channel 11, 802.11n, MCS7



PSD, Channel 3, 802.11n(40), MCS0



PSD, Channel 7, 802.11n(40), MCS0



PSD, Channel 3, 802.11n(40), MCS7



PSD, Channel 7, 802.11n(40), MCS7

5.1.5 Conducted Transmitter Emissions

Operator	Anthony Smith	QA	Zach Wilson
Temperature	21.6, 20.7, 22.2	R.H. %	35.6, 44.8, 54.2
Test Date	5/17/2022, 5/19/2022, 5/20/2022, 8/11/2022	Location	Conducted Bench
Requirement	FCC 15.247, RSS-247	Method	ANSI C63.10 §11.10.2

Limits:

30dBc = $8.8 - 30 = -21.2$ dBm



100 kHz reference (Channel 6 11 Mbps)

Test Parameters

Frequency	30 MHz – 25 GHz	Setup	Conducted
RBW	100 kHz	VBW	300 kHz
Detector(s)	Max hold with peak detector	Sweep Time	Auto

EUT Parameters

Input Power	3.7VDC Battery	Mode	WLAN TX
Channel	(20): 1, 6, 11 (40): 3, 7		

Data Tables

Channel	Freq (MHz)	Output Level (dBm)	Limit (dBm)	Margin (dB)	Data Rate	Channel Bandwidth (MHz)
1	805.5	-57.2	-21.2	36.0	1Mbps	20
1	2397.0	-43.4	-21.2	22.2	1Mbps	20
1	7233.1	-46.3	-21.2	25.1	1Mbps	20
6	811.8	-50.5	-21.2	29.3	1Mbps	20
6	1217.0	-48.5	-21.2	27.3	1Mbps	20
6	7311.9	-49.6	-21.2	28.4	1Mbps	20
11	821.2	-46.5	-21.2	25.3	1Mbps	20
11	1232.5	-51.0	-21.2	29.8	1Mbps	20
11	7385.5	-53.2	-21.2	32.0	1Mbps	20
1	805.3	-44.5	-21.2	23.3	11Mbps	20
1	1206.0	-44.6	-21.2	23.4	11Mbps	20
1	7230.1	-47.8	-21.2	26.6	11Mbps	20
6	813.4	-43.4	-21.2	22.2	11Mbps	20
6	1218.5	-45.9	-21.2	24.7	11Mbps	20
6	7315.0	-51.3	-21.2	30.1	11Mbps	20
11	823.1	-43.3	-21.2	22.1	11Mbps	20
11	1231.0	-45.9	-21.2	24.7	11Mbps	20
11	24642.7	-52.2	-21.2	31.0	11Mbps	20
1	801.2	-51.2	-21.2	30.0	6Mbps	20
1	2397.3	-42.8	-21.2	21.6	6Mbps	20
1	7240.6	-50.6	-21.2	29.4	6Mbps	20
6	814.0	-47.4	-21.2	26.2	6Mbps	20
6	1218.5	-43.6	-21.2	22.4	6Mbps	20
6	7307.4	-48.9	-21.2	27.7	6Mbps	20
11	827.3	-49.0	-21.2	27.8	6Mbps	20
11	1231.0	-49.6	-21.2	28.4	6Mbps	20
11	24738.0	-52.5	-21.2	31.3	6Mbps	20
1	805.5	-49.4	-21.2	28.2	54Mbps	20
1	2399.7	-44.5	-21.2	23.3	54Mbps	20
1	7233.1	-51.9	-21.2	30.7	54Mbps	20
6	810.4	-48.0	-21.2	26.8	54Mbps	20
6	1218.5	-46.7	-21.2	25.5	54Mbps	20
6	7305.9	-51.0	-21.2	29.8	54Mbps	20
11	813.5	-48.2	-21.2	27.0	54Mbps	20
11	1231.0	-49.2	-21.2	28.0	54Mbps	20

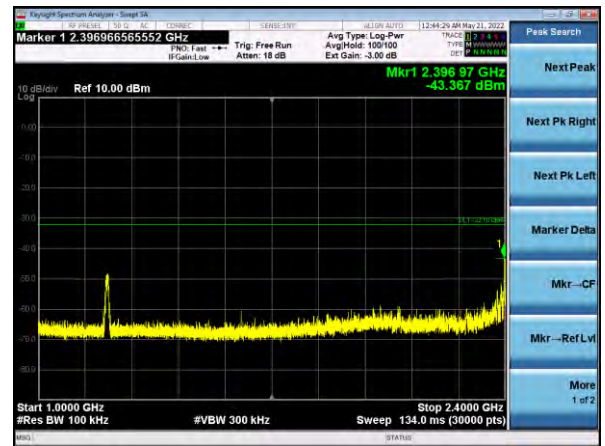
Channel	Freq (MHz)	Output Level (dBm)	Limit (dBm)	Margin (dB)	Data Rate	Channel Bandwidth (MHz)
11	2484.3	-53.2	-21.2	32.0	54Mbps	20
1	796.5	-51.6	-21.2	30.4	MCS0	20
1	2397.7	-46.2	-21.2	25.0	MCS0	20
1	24663.7	-52.1	-21.2	30.9	MCS0	20
6	810.5	-46.2	-21.2	25.0	MCS0	20
6	1218.5	-43.4	-21.2	22.2	MCS0	20
6	7306.7	-46.4	-21.2	25.2	MCS0	20
11	824.4	-50.0	-21.2	28.8	MCS0	20
11	1231.0	-51.6	-21.2	30.4	MCS0	20
11	24611.2	-52.6	-21.2	31.4	MCS0	20
1	800.9	-49.9	-21.2	28.7	MCS7	20
1	2399.9	-45.0	-21.2	23.8	MCS7	20
1	7236.9	-53.8	-21.2	32.6	MCS7	20
6	819.8	-46.2	-21.2	25.0	MCS7	20
6	1218.5	-46.5	-21.2	25.3	MCS7	20
6	7302.9	-50.4	-21.2	29.2	MCS7	20
11	812.9	-48.8	-21.2	27.6	MCS7	20
11	1231.0	-51.0	-21.2	29.8	MCS7	20
11	24705.8	-53.1	-21.2	31.9	MCS7	20

Channel	Freq (MHz)	Output Level (dBm)	Limit (dBm)	Margin (dB)	Data Rate	Bandwidth (MHz)
3	822.3	-54.6	-21.2	33.4	MCS0	40
3	2396.7	-47.9	-21.2	26.7	MCS0	40
3	24627.7	-53.4	-21.2	32.2	MCS0	40
7	820.9	-51.7	-21.2	30.5	MCS0	40
7	1221.0	-48.0	-21.2	26.8	MCS0	40
7	24695.3	-52.8	-21.2	31.6	MCS0	40
3	820.7	-54.1	-21.2	32.9	MCS7	40
3	2397.1	-47.4	-21.2	26.2	MCS7	40
3	24010.7	-53.4	-21.2	32.2	MCS7	40
7	829.7	-51.4	-21.2	30.2	MCS7	40
7	2398.6	-48.4	-21.2	27.2	MCS7	40
7	23991.2	-52.9	-21.2	31.7	MCS7	40

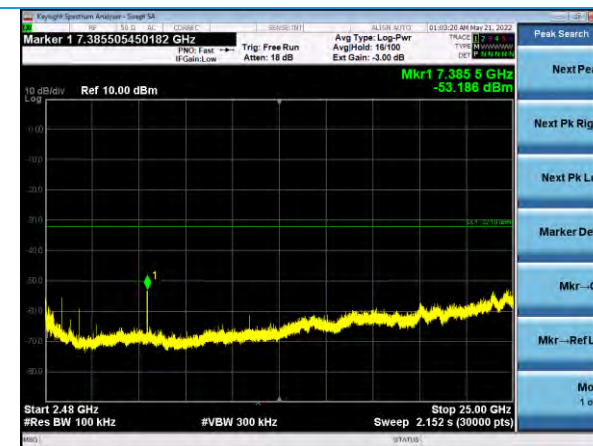
Plots



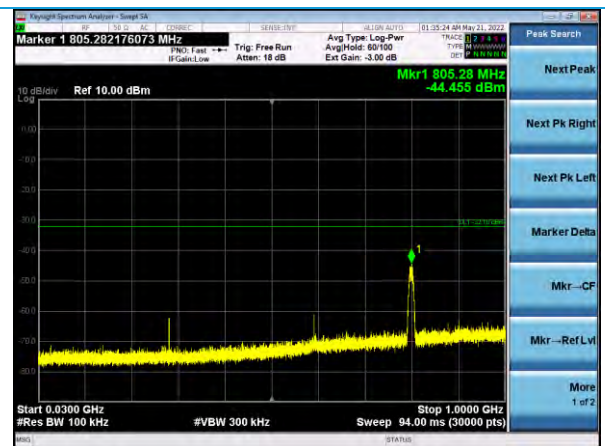
30-1000 MHz, Channel 1, 802.11b, 1Mbps



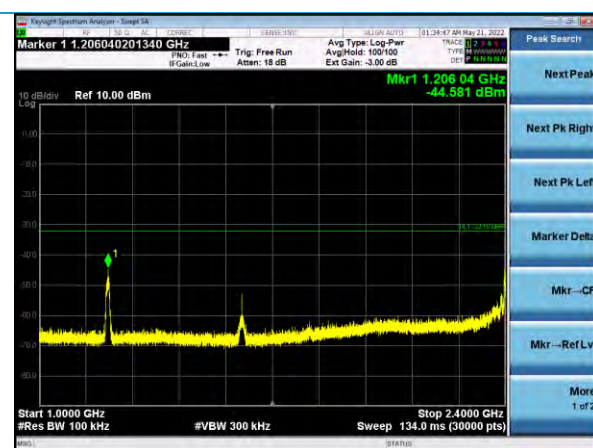
1-2.4 GHz, Channel 1, 802.11b, 1Mbps



2.4835-25 GHz, Channel 11, 802.11b, 1Mbps



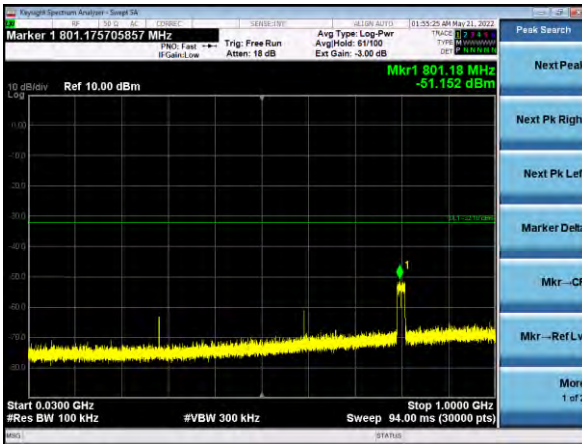
30-1000 MHz, Channel 1, 802.11b, 11Mbps



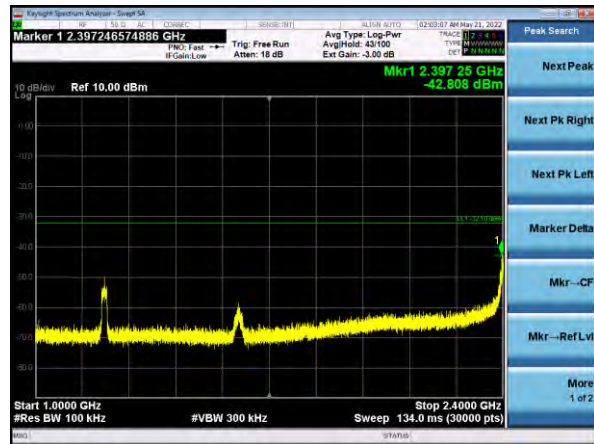
1-2.4 GHz, Channel 1, 802.11b, 11Mbps



2.4835-25 GHz, Channel 11, 802.11b, 11Mbps



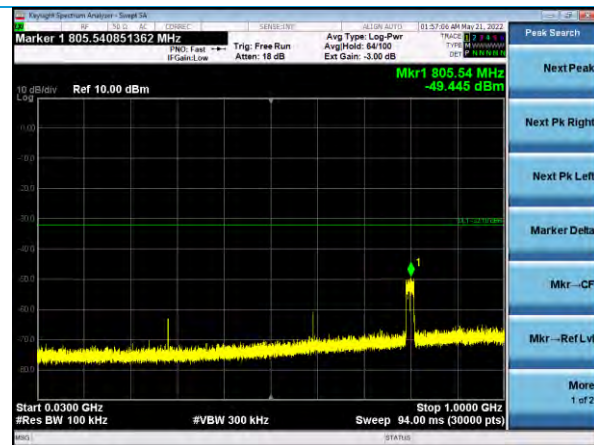
30-1000 MHz, Channel 1, 802.11g, 6Mbps



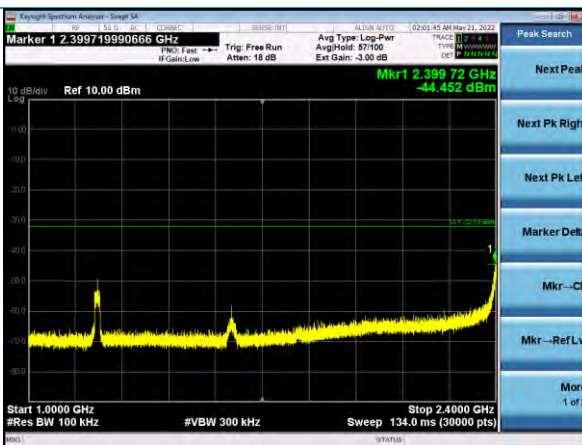
1-2.4 GHz, Channel 1, 802.11g, 6Mbps



2.4835-25 GHz, Channel 11, 802.11g, 6Mbps



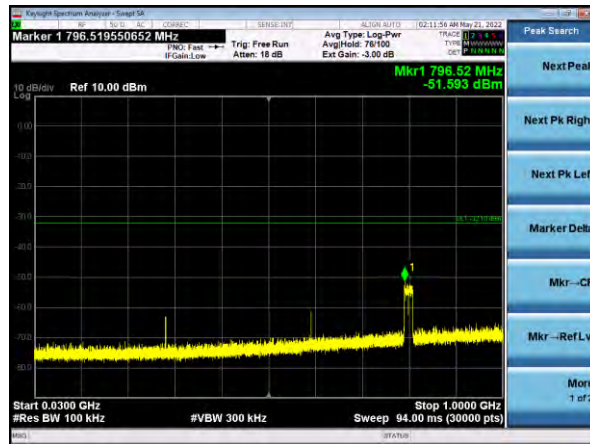
30-1000 MHz, Channel 1, 802.11g, 54Mbps



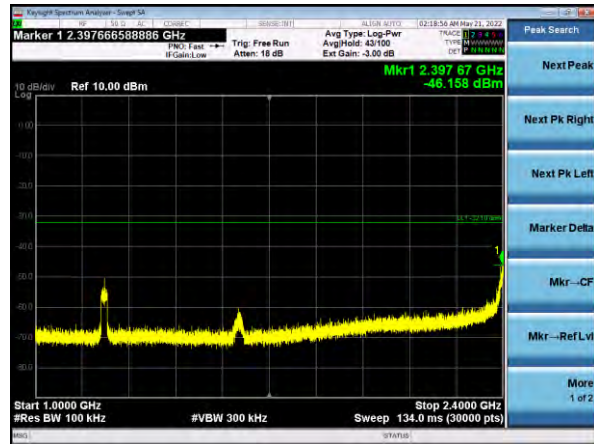
1-2.4 GHz, Channel 1, 802.11g, 54Mbps



2.4835-25 GHz, Channel 11, 802.11g, 54Mbps



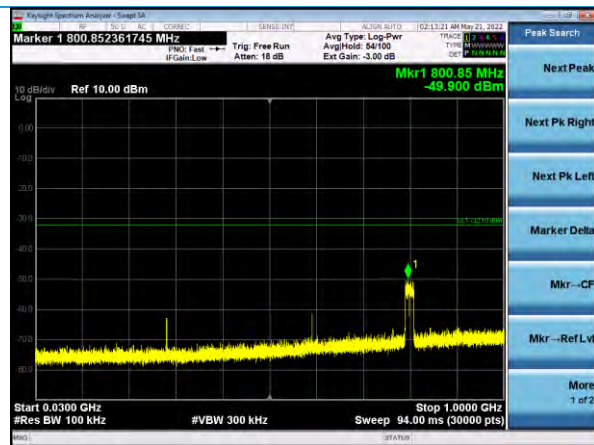
30-1000 MHz, Channel 1, 802.11n(20), MCS0



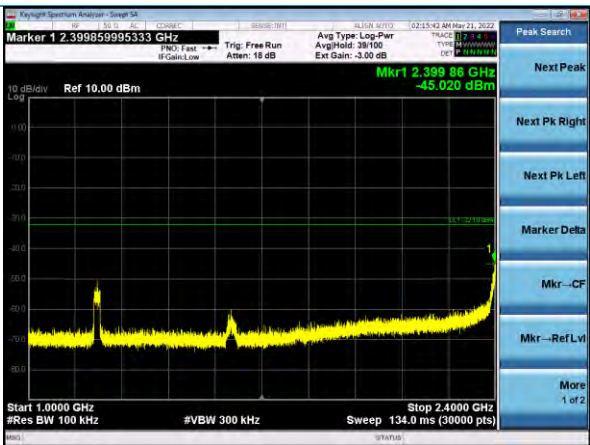
1-2.4 GHz, Channel 1, 802.11n(20), MCS0



2.4835-25 GHz, Channel 11, 802.11n(20), MCS0



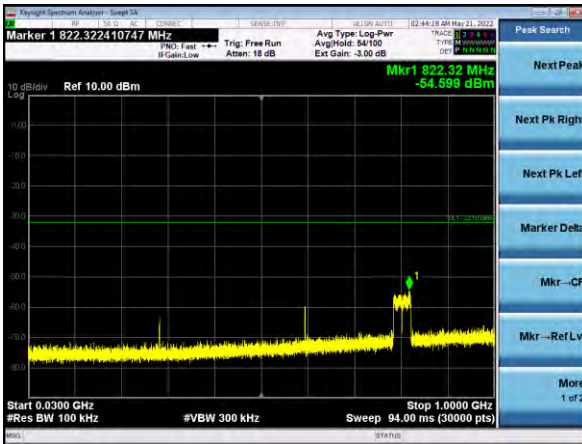
30-1000 MHz, Channel 1, 802.11n(20), MCS7



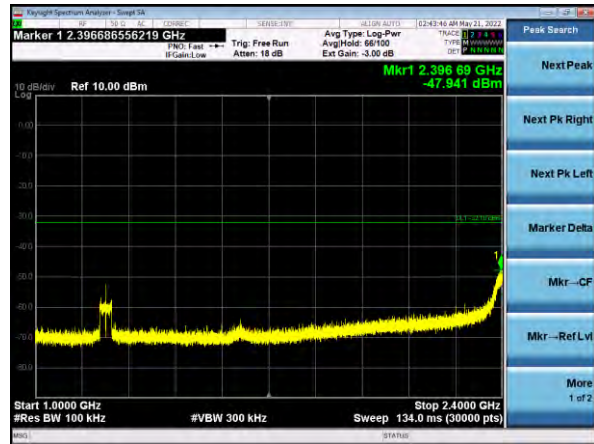
1-2.4 GHz, Channel 1, 802.11n(20), MCS7



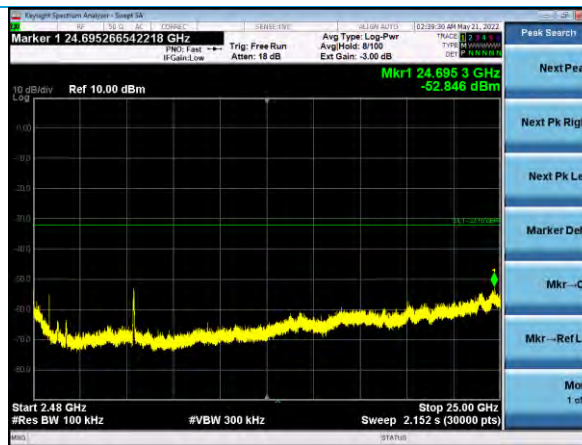
2.4835-25 GHz, Channel 11, 802.11n(20), MCS7



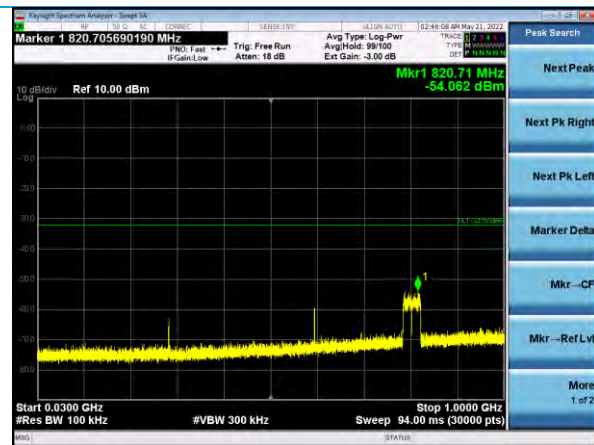
30-1000 MHz, Channel 3, 802.11n(40), MCS0



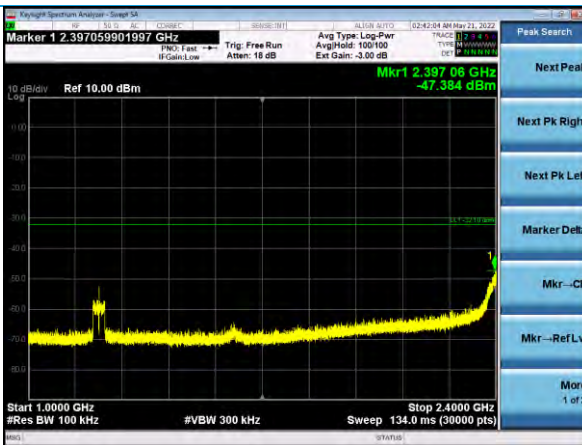
1-2.4 GHz, Channel 3, 802.11n(40), MCS0



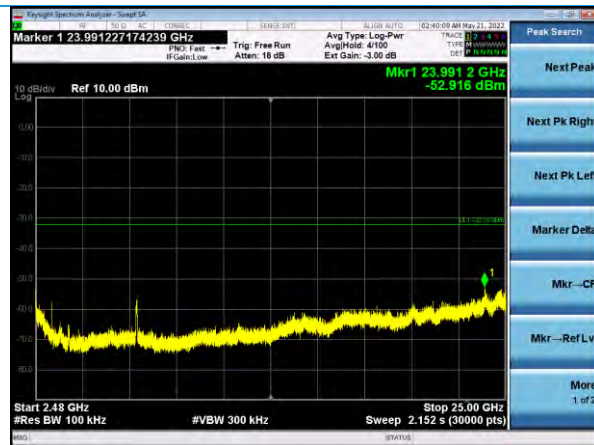
2.4835-25 GHz, Channel 7, 802.11n(40), MCS0



30-1000 MHz, Channel 3, 802.11n(40), MCS7



1-2.4 GHz, Channel 3, 802.11n(40), MCS7



2.4835-25 GHz, Channel 7, 802.11n(40), MCS7

5.1.6 Frequency Stability

Operator	Anthony Smith	QA	Zach Wilson
Temperature	21.6, 20.7, 22.2	R.H. %	35.6, 44.8, 54.2
Test Date	5/17/2022, 5/19/2022, 5/20/2022	Location	Conducted Bench
Requirement	FCC 15.1055 (d) (1)	Method	ANSI C63.10 §6.8.2

Limits: Reported

Test Parameters

Frequency	2412, 2437, 2462 MHz	Setup	Conducted
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EUT Parameters

Input Power	3.3, 3.6, 4.1 VDC	Mode	WLAN TX CW
Channel	(20): 1, 6, 11 (40): 3, 7		

Data Table

Channel	Frequency (Hz) 3.3VDC	Frequency (Hz) 3.6VDC	Frequency (Hz) 4.1VDC
1	2411998378	2411998642	2411992825
3	2421997195	2421993075	2421994538
6	2436998193	2436999790	2436992670
7	2441998269	2441991742	2441994386
11	2461998273	2461997026	2461996154

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	Ivan Alvarez, Anthony Smith	QA	Braden Smith, Zach Wilson
Temperature	24.1°C, 24.6°C	R.H. %	35.60%, 46.20%
Test Date	5/4/2022, 5/9/2022	Location	C3
Requirement	FCC 15.209, RSS-GEN	Method	ANSI C63.10

Limits:

Frequency (MHz)	Quasi-peak Limit (dBμV/m)	Average Limit (dBμV/m)	Peak Limit (dBμV/m)
30-88	40.0	-	-
88-216	43.5	-	-
216-960	46.0	-	-
960-1000	54.0	-	-
1000-25000	-	54.0	74.0

Test Parameters

Frequency	30-25000 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 10 Hz.	Table height	Below 1 GHz: 80cm Above 1 GHz: 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: 10 Hz
Notes	1Mbps for spurious, all rates for Band Edges. Worst-case data reported. All three channels checked for spurious, only showing worst case (channel 1). The worst-case orientation and polarization for band edges was found by peaking out the fundamental.		

EUT Parameters

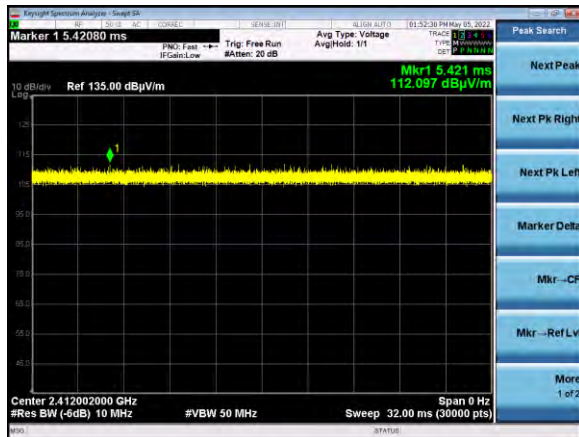
Input Power	3.7VDC	Mode	WLAN TX Modulated
Channel	(20): 1, 6, 11 (40): 3, 7	Data Rate	1Mbps for spurious, all rates for Band Edges

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960007	Antenna - Double Ridge Horn	EMCO	3115	9311-4138	8/23/2021	8/23/2022	Active Calibration
AA 960081	Antenna - Double Ridge Horn	EMCO	3115	6907	9/7/2021	9/7/2022	Active Calibration
AA 960150	Antenna - Biconical	ETS Lindgren	3110B	0003-3346	10/7/2021	10/7/2022	Active Calibration
AA 960154	Filter - High Pass 2.4 GHz	KWM	HPF-L-14186	7272-02	4/13/2022	4/13/2023	Active Calibration
EE 960161	Antenna - Low Noise Amplifier	Ducommun Technologies	ALN-33144030-01	1003717-01	8/16/2021	8/16/2022	Active Calibration
EE 960203	Analyzer - EMI Receiver	Keysight	N9038A	MY56400072	4/13/2022	4/13/2023	Active Calibration
LSC-300	Cable	Chamber 3 Emissions	-	-	4/26/2022	4/26/2023	Active Verification

Duty Cycle

Data Rate	On Time	Average VBW
All	100%	10Hz



Data Tables

Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Quasi - Peak Reading (dBμV/m)	Quasi - Peak Limit (dBμV/m)	Quasi - Peak Margin (dB)	Note
193.9	Horizontal	150	0	19.8	43.5	23.7	CH11, Noise Floor
194.0	Horizontal	100	0	19.9	43.5	23.7	CH6, Noise Floor
196.0	Vertical	100	0	20.0	43.5	23.5	CH11, Noise Floor
197.1	Vertical	100	0	20.2	43.5	23.4	CH6, Noise Floor
198.1	Vertical	100	0	20.2	43.5	23.3	CH1, Noise Floor
200.0	Horizontal	150	0	21.7	43.5	21.8	CH1, Noise Floor
600.0	Horizontal	150	89	40.6	46.0	5.4	CH6, Not a function of the radio
800.0	Horizontal	100	0	35.7	46.0	10.4	CH6, Not a function of the radio

Frequency (MHz)	IEEE Standard	Data Rate	Channel	Antenna Polarity	Height (cm)	Azimuth (degree)	Peak Reading (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)
2363.9	802.11b	1Mbps	1	Vertical	150	67	61.3	74.0	12.7
2388.2	802.11n(40)	MCS7	3	Vertical	150	67	62.0	74.0	12.0
2388.9	802.11b	11Mbps	1	Vertical	150	67	62.1	74.0	11.9
2389.0	802.11n(40)	MCS0	3	Vertical	150	67	62.3	74.0	11.7
2389.8	802.11n(20)	MCS7	1	Vertical	150	67	62.4	74.0	11.6
2389.8	802.11g	54Mbps	1	Vertical	150	67	62.3	74.0	11.7
2389.9	802.11n(20)	MCS0	1	Vertical	150	67	63.1	74.0	10.9
2389.9	802.11g	6Mbps	1	Vertical	150	67	63.5	74.0	10.5

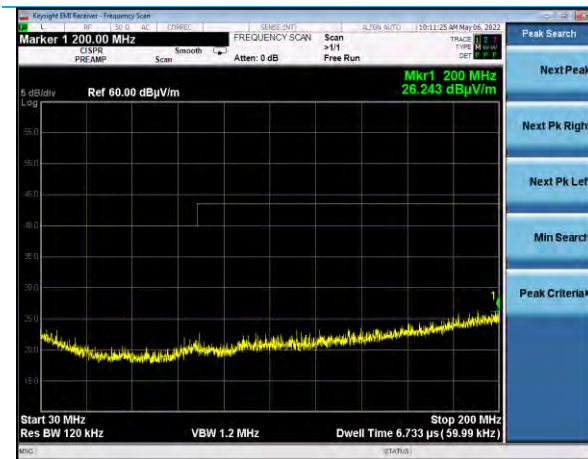
Frequency (MHz)	IEEE Standard	Data Rate	Channel	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)
2381.9	802.11b	11Mbps	1	Vertical	150	67	49.2	54.0	4.8
2389.1	802.11b	1Mbps	1	Vertical	150	67	49.2	54.0	4.8
2390.0	802.11g	54Mbps	1	Vertical	150	67	50.4	54.0	3.6
2390.0	802.11n(40)	MCS7	3	Vertical	150	67	50.2	54.0	3.8
2390.0	802.11n(40)	MCS0	3	Vertical	150	67	50.6	54.0	3.4
2390.0	802.11n(20)	MCS7	1	Vertical	150	67	50.5	54.0	3.5
2390.0	802.11g	6Mbps	1	Vertical	150	67	50.4	54.0	3.6
2390.0	802.11n(20)	MCS0	1	Vertical	150	67	50.8	54.0	3.2

Frequency (MHz)	IEEE Standard	Data Rate	Channel	Antenna Polarity	Height (cm)	Azimuth (degree)	Peak Reading (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)
2483.6	802.11g	54Mbps	11	Vertical	150	58	62.8	74.0	11.2
2483.7	802.11g	6Mbps	11	Vertical	150	58	62.7	74.0	11.3
2484.1	802.11n(40)	MCS0	7	Vertical	150	58	62.3	74.0	11.7
2485.2	802.11n(20)	MCS0	11	Vertical	150	58	61.6	74.0	12.4
2485.4	802.11n(40)	MCS7	7	Vertical	150	58	61.9	74.0	12.1
2486.5	802.11n(20)	MCS7	11	Vertical	150	58	61.7	74.0	12.3
2486.6	802.11b	1Mbps	11	Vertical	150	58	61.8	74.0	12.2
2488.6	802.11b	11Mbps	11	Vertical	150	58	61.9	74.0	12.1

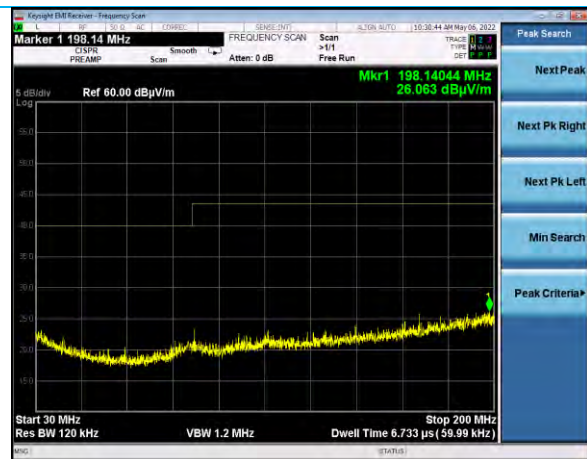
Frequency (MHz)	IEEE Standard	Data Rate	Channel	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)
2483.5	802.11g	6Mbps	11	Vertical	150	58	49.8	54.0	4.2
2483.5	802.11g	54Mbps	11	Vertical	150	58	49.9	54.0	4.1
2483.6	802.11n(20)	MCS7	11	Vertical	150	58	49.5	54.0	4.5
2483.7	802.11n(20)	MCS0	11	Vertical	150	58	49.6	54.0	4.4
2483.7	802.11n(40)	MCS0	7	Vertical	150	58	49.8	54.0	4.2
2483.8	802.11n(40)	MCS7	7	Vertical	150	58	49.8	54.0	4.2
2489.0	802.11b	1Mbps	11	Vertical	150	58	49.4	54.0	4.6
2494.7	802.11b	11Mbps	11	Vertical	150	58	49.4	54.0	4.6

Frequency (MHz)	IEEE Standard	Data Rate	Channel	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	Peak Reading (dBμV/m)
7310.5	802.11g	6Mbps	6	Horizontal	132	66	49.5	54.0	4.5	60.0
7308.1	802.11g	6Mbps	6	Vertical	150	59	47.7	54.0	6.3	60.6
7387.8	802.11g	6Mbps	11	Vertical	150	54	46.0	54.0	8.0	58.1
7387.9	802.11g	6Mbps	11	Horizontal	134	71	47.2	54.0	6.8	60.1
7311.7	802.11n(20)	MCS0	6	Vertical	148	59	47.5	54.0	6.5	60.0
7386.8	802.11n(20)	MCS0	6	Horizontal	150	55	46.9	54.0	7.1	60.0
7311.8	802.11g	6Mbps	6	Vertical	150	155	45.2	54.0	8.8	57.4
7310.5	802.11n(20)	MCS0	6	Vertical	148	154	45.7	54.0	8.2	58.5

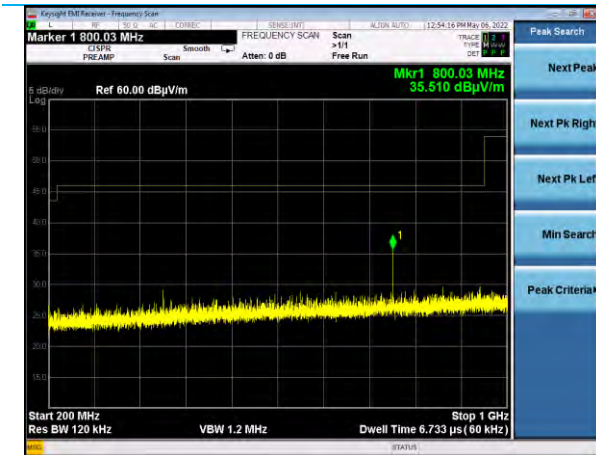
Plots



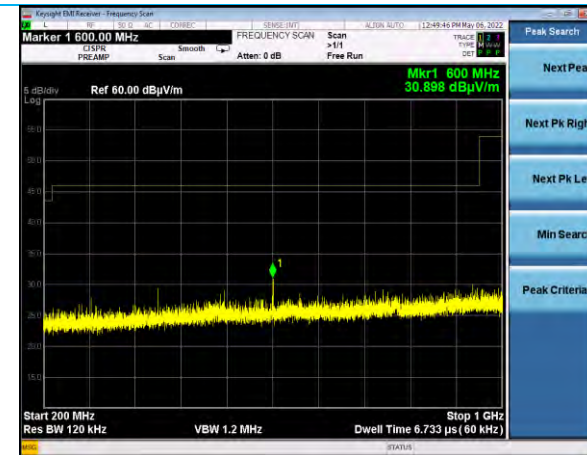
30-200 MHz, Horizontal Antenna, Vertical EUT Channel 1



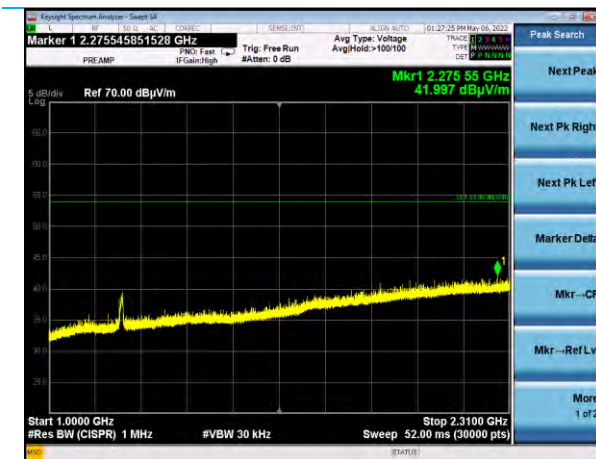
30-200 MHz, Vertical Antenna, Vertical EUT Channel 11



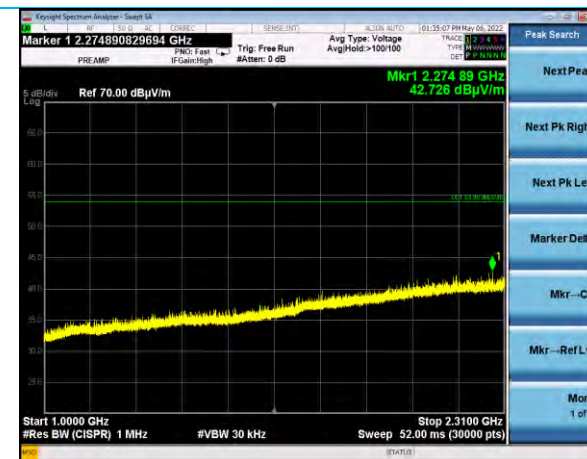
200-1000 MHz, Horizontal Antenna, Vertical EUT Channel 1



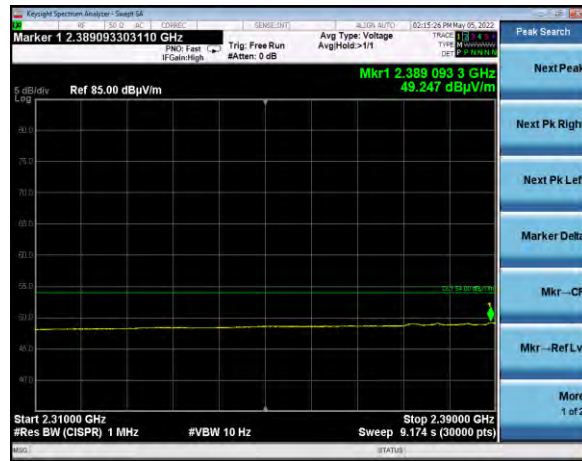
200-1000 MHz, Vertical Antenna, Vertical EUT Channel 1



1000-2310 MHz, Horizontal Antenna, Vertical EUT Channel 1



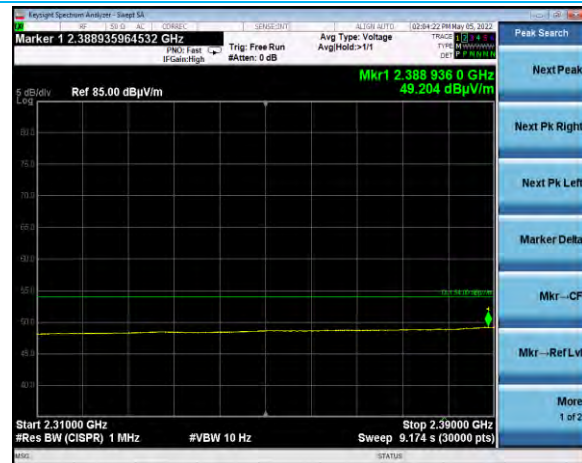
1000-2310 MHz, Vertical Antenna, Vertical EUT Channel 1



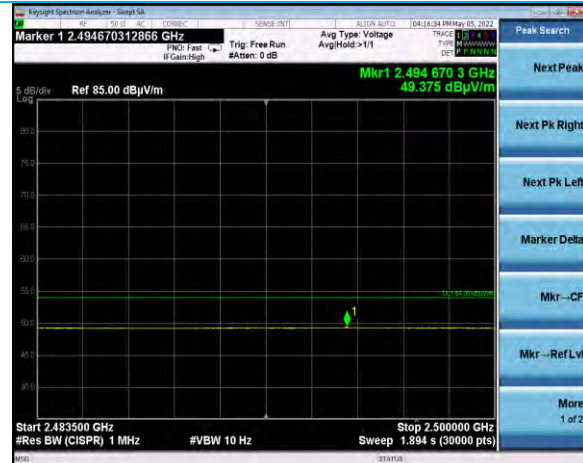
2310-2390 MHz, Vertical Antenna, Horizontal EUT
Channel 1, 1Mbps, Average



2483.5-2500 MHz, Vertical Antenna, Horizontal EUT
Channel 11, 1Mbps, Average



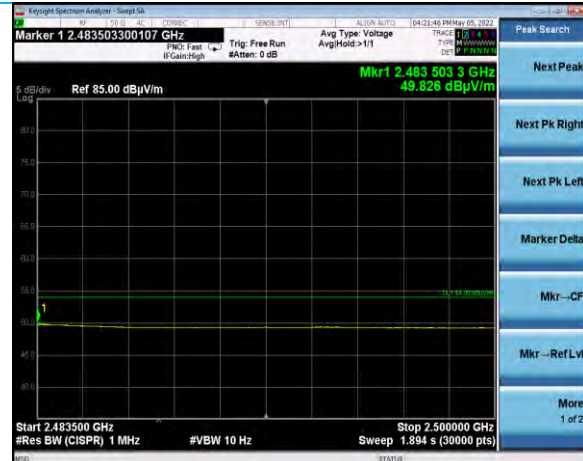
2310-2390 MHz, Vertical Antenna, Horizontal EUT
Channel 1, 11Mbps, Average



2483.5-2500 MHz, Vertical Antenna, Horizontal EUT
Channel 11, 11Mbps, Average



2310-2390 MHz, Vertical Antenna, Horizontal EUT
Channel 1, 6Mbps, Average



2483.5-2500 MHz, Vertical Antenna, Horizontal EUT
Channel 11, 6Mbps, Average



2310-2390 MHz, Vertical Antenna, Horizontal EUT
Channel 1, 54Mbps, Average



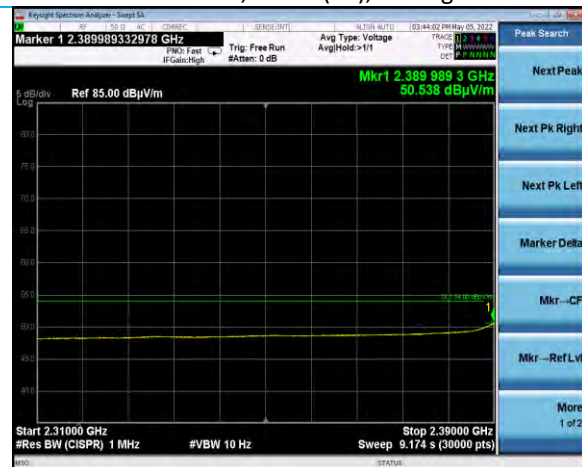
2483.5-2500 MHz, Vertical Antenna, Horizontal EUT
Channel 11, 54Mbps, Average



2310-2390 MHz, Vertical Antenna, Horizontal EUT
Channel 1, MCS0 (20), Average



2483.5-2500 MHz, Vertical Antenna, Horizontal EUT
Channel 11, MCS0 (20), Average



2310-2390 MHz, Vertical Antenna, Horizontal EUT
Channel 1, MCS7 (20), Average



2483.5-2500 MHz, Vertical Antenna, Horizontal EUT
Channel 11, MCS7 (20), Average



2310-2390 MHz, Vertical Antenna, Horizontal EUT
Channel 3, MCS0 (40), Average



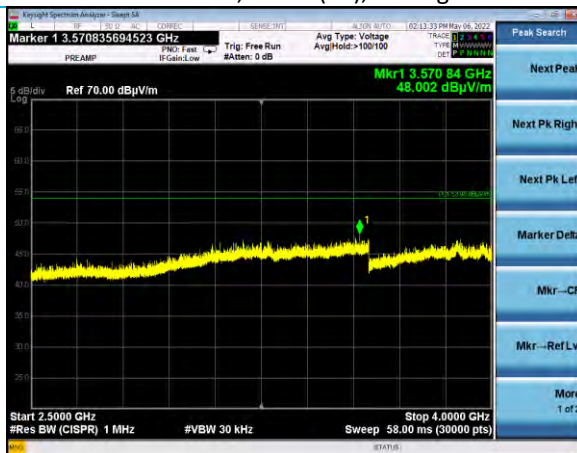
2483.5-2500 MHz, Vertical Antenna, Horizontal EUT
Channel 7, MCS0 (40), Average



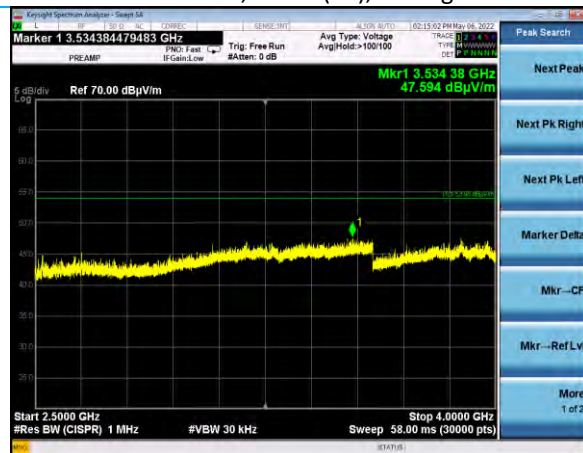
2310-2390 MHz, Vertical Antenna, Horizontal EUT
Channel 3, MCS7 (40), Average



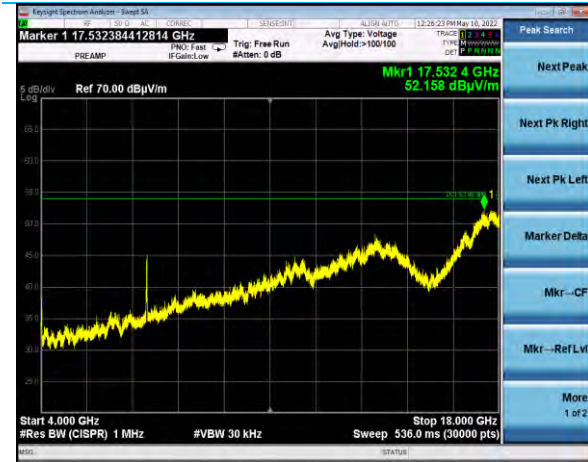
2483.5-2500 MHz, Vertical Antenna, Horizontal EUT
Channel 7, MCS7 (40), Average



2500-4000 MHz, Horizontal Antenna, Vertical EUT
Channel 11



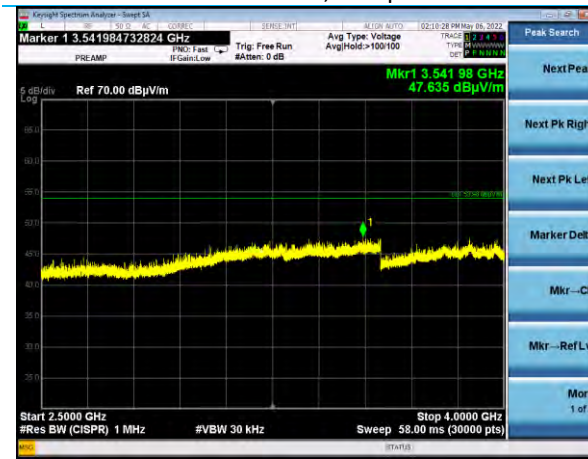
2500-4000 MHz, Vertical Antenna, Vertical EUT
Channel 11



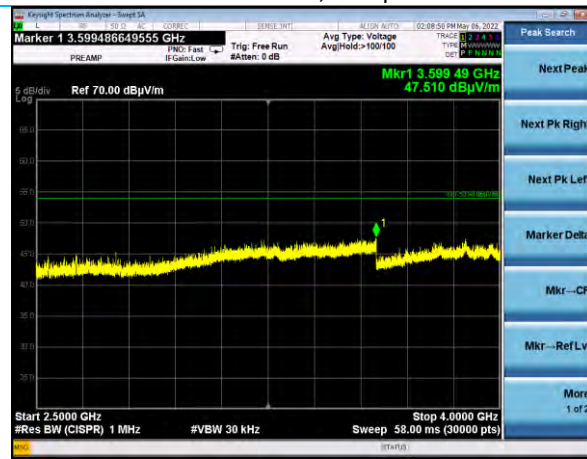
4-18 GHz, Horizontal Antenna, Vertical EUT
Channel 1, 6Mbps



4-18 GHz, Vertical Antenna, Vertical EUT
Channel 1, 6Mbps



18-25 GHz, Horizontal Antenna, Vertical EUT
Channel 1



18-25 GHz, Vertical Antenna, Vertical EUT
Channel 1

6 REVISION HISTORY

Version	Date	Notes	Person
0	6/29/2022	Initial Draft	Zach Wilson
1	7/6/2022	Final	Zach Wilson
2	8/11/2022	TCB comments addressed	Adam Alger
3	9/15/2022	Antenna gain updated	Adam Alger

END OF REPORT