



DATE: 2 June 2020

**I.T.L. (PRODUCT TESTING) LTD.
FCC/IC Radio Test Report**

for

Tyto Care Ltd.

Equipment under test:

**Tyto Device G2 with Tyto Exam
Camera, Tyto Stethoscope, Tyto
Otoscope, Tyto Thermometer**

G2

Tested by:

M. Zohar

Approved by:

D. Shidowsky

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This report relates only to items tested.



Measurement/Technical Report for Tyto Care Ltd.

Tyto Device G2 with Tyto Exam Camera, Tyto
Stethoscope, Tyto Otoscope, Tyto Thermometer
G2

FCC ID: 2AHKN-5G2
IC: 26056-5G2

This report concerns:	Original Grant: <input checked="" type="checkbox"/>
	Class I Change: <input type="checkbox"/>
	Class II Change: <input type="checkbox"/>
Equipment type:	FCC: (DTS) Digital Transmission System IC: Spread Spectrum Digital Device (2400- 2483.5)
Limits used:	47CFR15 Section 15.247 RSS 247, Issue 2, February 2017, Section 5 RSS-Gen, Issue 5, April 2018

Measurement procedure used is KDB 558074 D01 v05r02, ANSI C63.10:2013
and RSS Gen Issue 5, April 2018

Application for Certification prepared by:	Applicant for this device: (different from "prepared by")
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1. General Information

1.1 Administrative Information

Manufacturer:	Tyto Care Ltd.
Manufacturer's Address:	14 Beni Gaon St., PO Box 8299 Netanya, 4250803, Israel Tel: +972- 72-221-0750 Fax: +972-72-221-0752
Manufacturer's Representative:	Assaf Shkler – FCC Stella Raizelman Perry - ISED
Equipment Under Test (E.U.T):	Tyto Device G2 with Tyto Exam Camera, Tyto Stethoscope, Tyto Otoscope, Tyto Thermometer
Equipment PMN:	Tyto Device G2
Equipment Serial No.:	Not designated
Equipment HVIN:	G2
Equipment FVIN:	4.2.0 (G2.0)
Date of Receipt of E.U.T:	October 03, 2019
Start of Test:	October 03, 2019
End of Test:	April 01, 2020
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101
Test Specifications:	FCC Part 15, Subpart C RSS 247, Issue 2, February 2017, Section 5 RSS-Gen, Issue 5, April 2018



1.2 ***List of Accreditations***

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. Department of Innovation, Science and Economic Development (ISED) Canada, CAB identifier: IL1002

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.



1.3 Product Description

The Tyto Device G2 includes Tyto Stethoscope, Tyto Otoscope, Tyto Exam Camera and Tyto Thermometer. The device is designed for use by professional as well as lay users in clinical or non-clinical environments.

The Tyto Stethoscope is an electronic stethoscope that is designed to acquire, filter, amplify, and transmit heart, lung, and other body sound data.

The Tyto Otoscope is an electronic otoscope that digitally records video imaging of the ear canal and eardrum.

The Tyto Stethoscope and Tyto Otoscope consist of the following components:

The Tyto Device is hand-held and battery-operated, mounting the Tyto Stethoscope tip or Tyto Otoscope Tip and wirelessly (Wi-Fi based) connected. In case Wi-Fi communication is not enabled at the time of acquisition, the Tyto Stethoscope or Tyto Otoscope tip is still operable and the Tyto Device G2 allows interim storage of the data, until Wi-Fi communication is restored.

The Tyto Stethoscope and Otoscope Tips are mounted on the Tyto Device G2 via its proprietary port & connection.

The Tyto Exam Camera is an electronic Exam Camera that digitally records video imaging of the skin and throat. The device is designed for use by professional as well as lay users in clinical or non-clinical environments.

Tyto Exam Camera is integrated in the Tyto Device G2.

For throat exams, if the person taking the exam cannot get a clear view of the tonsils, a disposable tongue depressor tip, provided as part of the Tyto Exam Camera, can be used to lower the tongue. The tongue depressor is composed of a tongue depressor base and the Tongue Depressor Tip.

The Tyto Thermometer is a non-contact infrared thermometer that enables measuring of the human body temperature. The device is an infrared thermometer that, when positioned within 2 inches of a patient's forehead, measures the infrared energy emitted from the surface of the skin and converts it to a Core body temperature scale (Celsius, Fahrenheit) as represented on the oral body site.

Working voltage	3.7VDC battery operated
Mode of operation	Transceiver
Modulations	OFDM(BPSK,QPSK,16QAM ,64QAM)
Assigned Frequency Range	2400.0-2483.5MHz
Operating Frequency Range	For Wi-Fi/g/n: 2412.0-2462.0MHz
Transmit power(conducted)	~18.0dBm
Antenna Gain	+3.0dBi/+1.5dBi/-0.3dBi
Modulation BW	20MHz
Bit rate (Mbit/s)	For Wi-Fi/g: 6, 9, 12, 18, 24, 36, 48, 54 For Wi-Fi/n: 6.5,13,19.5,26,39,52,58.5,65



1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 v05r02, ANSI C63.10: 2013 and RSS Gen Issue 5, April 2018. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

Emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005 and its ISED CAB identifier is IL1002.

1.6 Measurement Uncertainty

Conducted Emission

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)

0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 3.44 dB

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site:

30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.96 dB

1 GHz to 6 GHz

Expanded Uncertainty (95% Confidence, K=2):

± 5.19 dB

>6 GHz

Expanded Uncertainty (95% Confidence, K=2):

± 5.51 dB



2. System Test Configuration

2.1 Justification

1. The E.U.T contains a standard IEEE 802.11g/n (Wi-Fi/g/n) transceiver with only 20MHz CBW.
2. The E.U.T has 4 types of add-on configurations: exam camera, otoscope, thermometer and stethoscope. For all options, the PCB board including radio are identical in the device.
3. The unit was evaluated while transmitting at the low channel (2412MHz), the mid channel (2437MHz) and the high channel (2462MHz).
4. Conducted emission tests were performed with the E.U.T. antenna terminal connected by a RF cable to the Spectrum Analyzer through external attenuator.
5. Only for testing, the E.U.T was powered by a typical AC/DC adapter.
6. Final radiated emission for Wi-Fi g/n modes tests were performed using the highest optional antenna gain type for “worst case” and at the lowest and highest bit rates for each different protocol type. The bit rates for each protocol are shown in the table below:

Protocol Type	“Worst Case” Bit Rate
Wi-Fi/g	6,54 Mbit/s
Wi-Fi/n	6.5,65 Mbit/s (MCS0,MCS7)

7. Final radiated emission tests was performed after exploratory emission testing that was performed in 3 orthogonal polarities to determine the “worst case” radiation. According to the below results the worst case was the Y axis.

Orientation	Frequency	2 nd Harmonic	4 th Harmonic	Band Edge
	(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)
X axis	2412.0	52.0	50.0	65.6
	2437.0	52.2	49.8	-
	2462.0	51.4	49.9	72.1
Y axis	2412.0	56.0	53.4	65.8
	2437.0	56.0	53.2	-
	2462.0	56.2	53.4	72.3
Z axis	2412.0	55.4	52.9	65.0
	2437.0	55.8	53.2	-
	2462.0	55.7	52.4	69.6

Figure 1. Screening Results Wi-Fi mode



8. Final radiated emission test for spurious emission performed after exploratory emission testing that was performed for 4 types of configurations: exam camera, otoscope, thermometer and stethoscope to determine the “worst case” radiation. The “worst case” was determined to be the otoscope configuration.

2.2 *EUT Exercise Software*

No special exercise software was used.

2.3 *Special Accessories*

No special accessories were used

2.4 *Equipment Modifications*

Initially the E.U.T failed in the restricted band test (2483.5-2500MHz & 2310-2390MHz bands) at the low & high channel (2412 & 2462MHz). The customer reduced the power code for the low channel & high channel to 08.



2.5 Configuration of Tested System

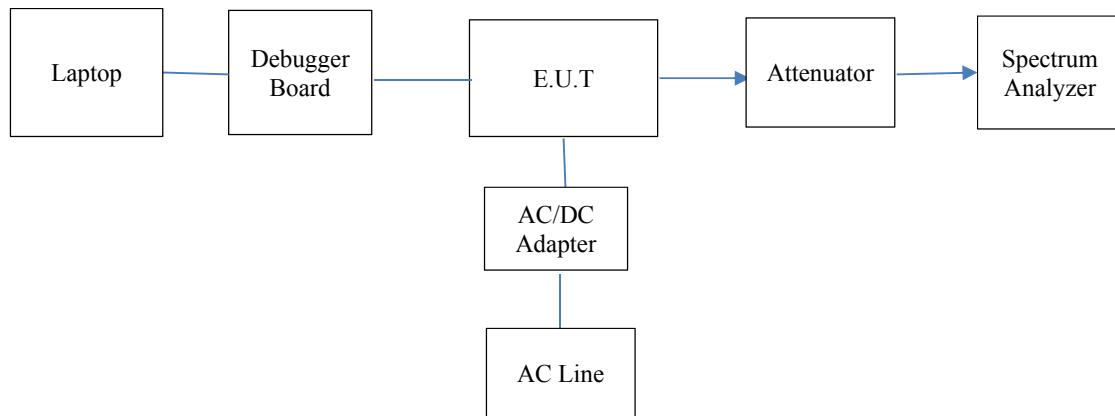


Figure 2. Configuration of Tested System Conducted

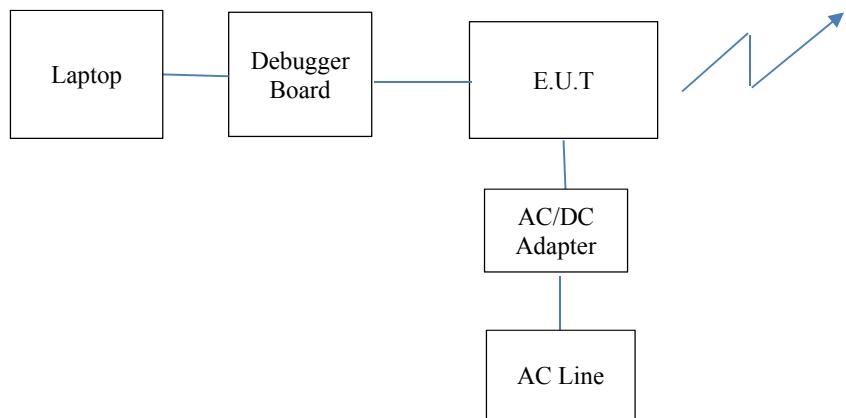


Figure 3. Configuration of Tested System Radiated

3. Conducted & Radiated Measurement Test Set-Up Photos



Figure 4. Conducted Test Set Up



Figure 5. Radiated Emission Test, 0.009-30MHz



Figure 6. Radiated Emission Test, 30-200MHz



Figure 7. Radiated Emission Test, 200-1000MHz



Figure 8. Radiated Emission Test, 1-18GHz



Figure 9. Radiated Emission Test, 18-26.5GHz



4. 6 dB Minimum Bandwidth

4.1 Test Specification

FCC Part 15, Subpart C, Section 247(a)(2)

RSS 247, Issue 2, Section 5.2(a)

4.2 Test Procedure

(Temperature (20°C)/ Humidity (58%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss=31.0 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded. The RBW was set to 100 kHz.

4.3 Test Limit

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

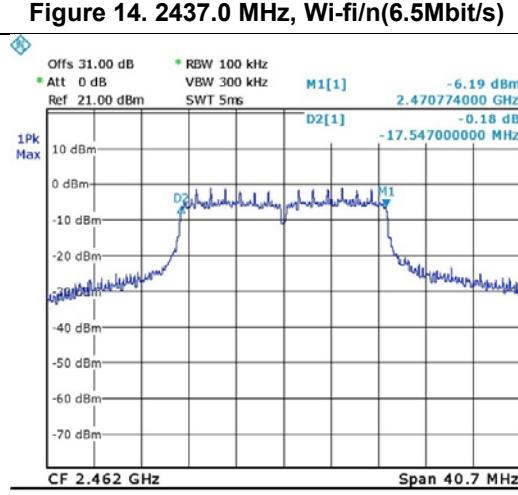
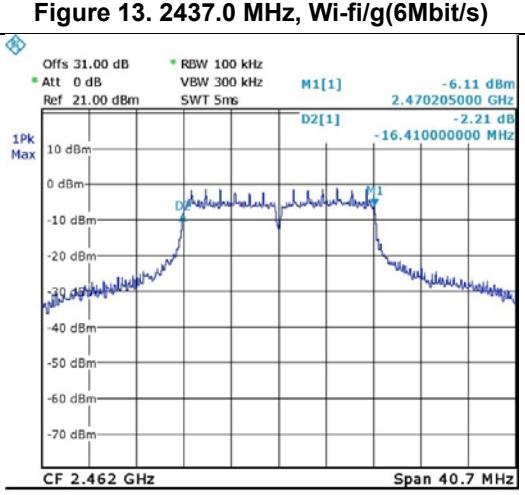
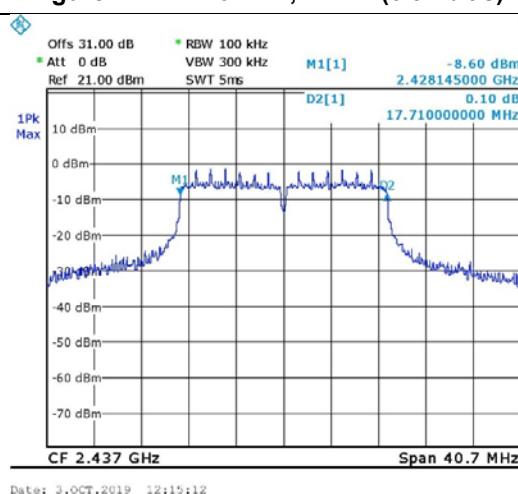
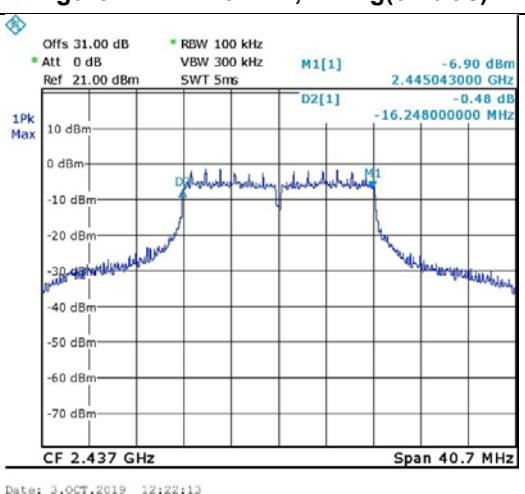
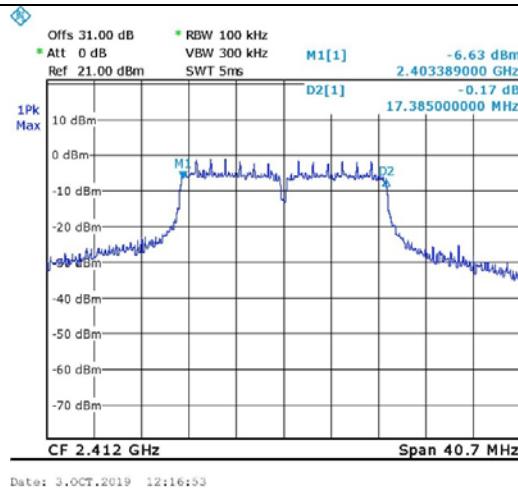
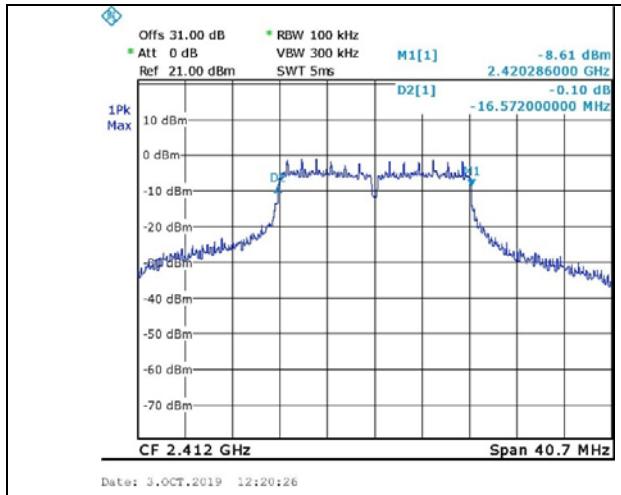
4.4 Test Results

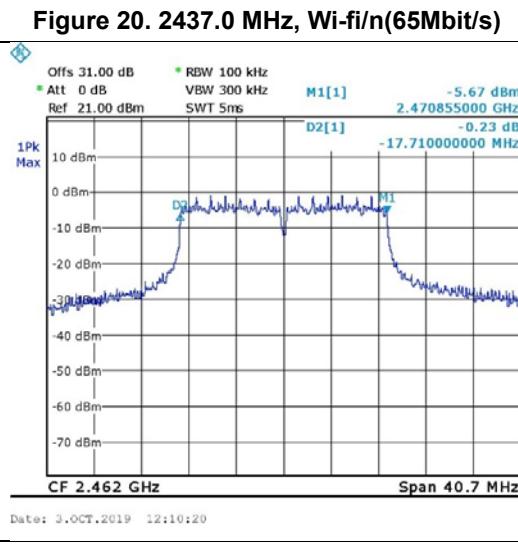
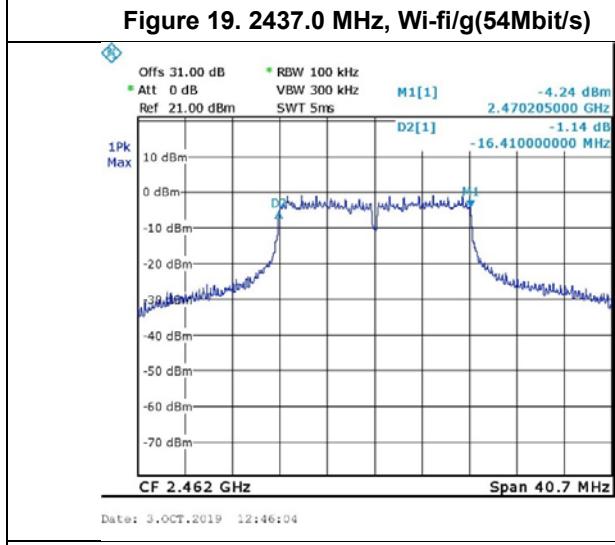
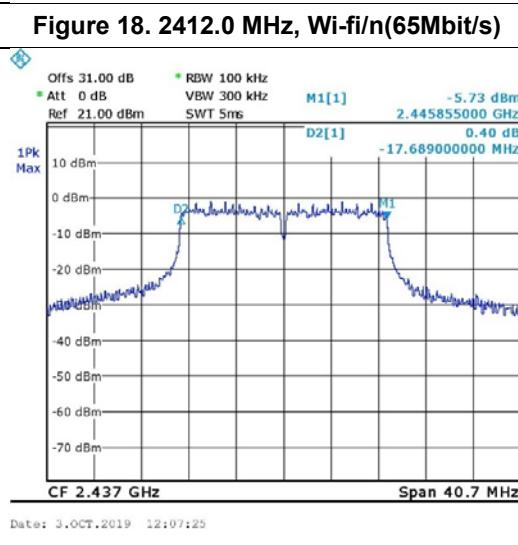
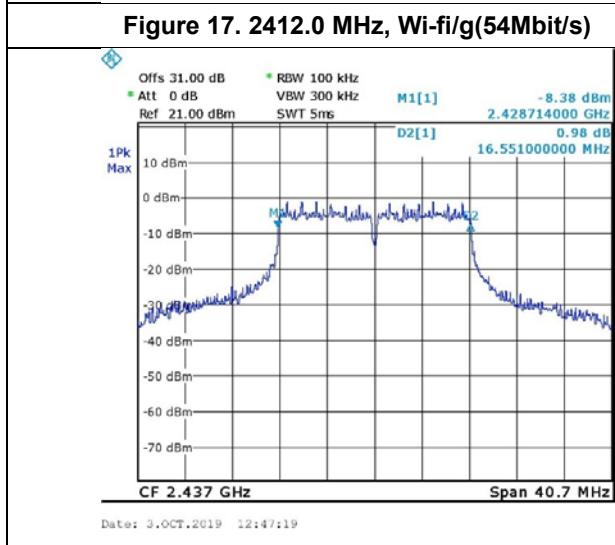
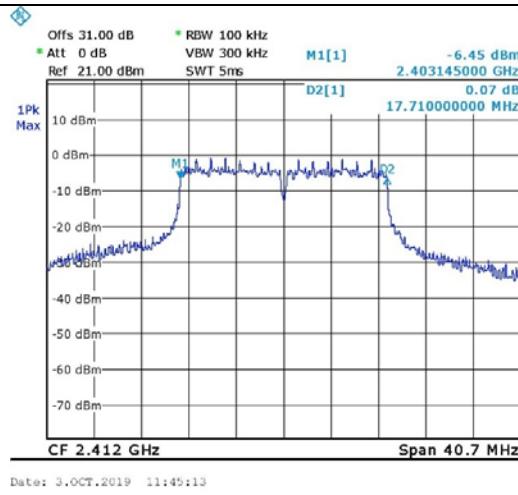
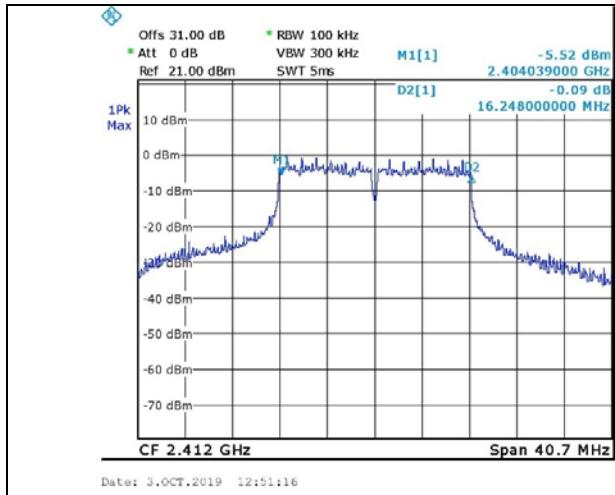
Protocol Type	Operation Frequency	Reading	Limit
	(MHz)	(kHz)	(kHz)
Wi-fi/g(6Mbit/s)	2412.0	16,572.0	>500.0
	2437.0	16,248.0	>500.0
	2462.0	16,410.0	>500.0
Wi-fi/g(54Mbit/s)	2412.0	16,248.0	>500.0
	2437.0	15,551.0	>500.0
	2462.0	16,410.0	>500.0
Wi-fi/n(6.5Mbit/s)	2412.0	17,385.0	>500.0
	2437.0	17,710.0	>500.0
	2462.0	17,547.0	>500.0
Wi-fi/n(65Mbit/s)	2412.0	17,710.0	>500.0
	2437.0	17,689.0	>500.0
	2462.0	17,710.0	>500.0

Figure 10 6 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 11* to *Figure 22*.







4.5 **Test Equipment Used; 6dB Bandwidth***

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2020
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2020

*Testing performed October 3, 2019

Figure 23 Test Equipment Used



5. Maximum Conducted Output Power

5.1 Test Specification

FCC, Part 15, Subpart C, Section 247(b)(3)

RSS 247, Issue 2, Section 5.4(d)

5.2 Test Procedure

(Temperature (20°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss=31.0 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

5.3 Test Limit

The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

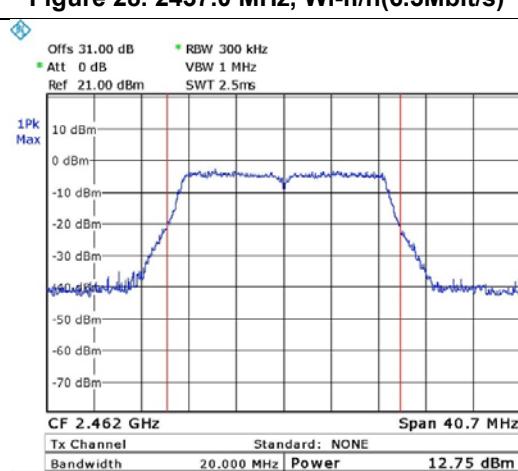
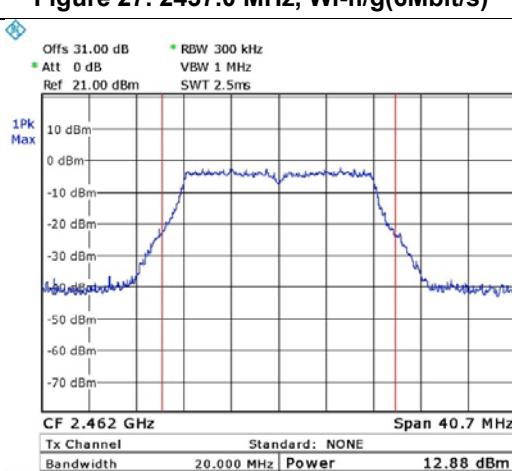
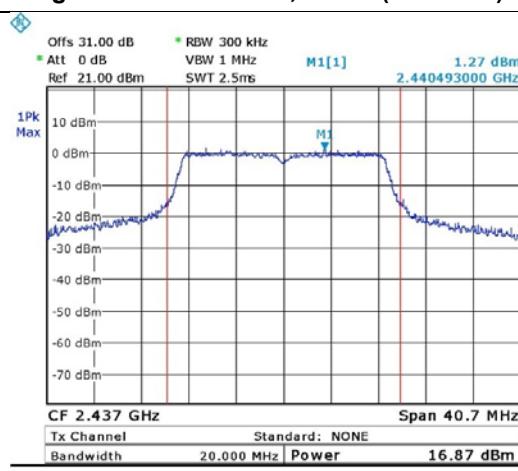
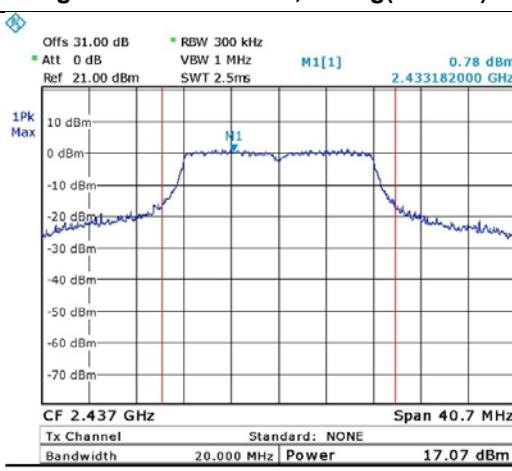
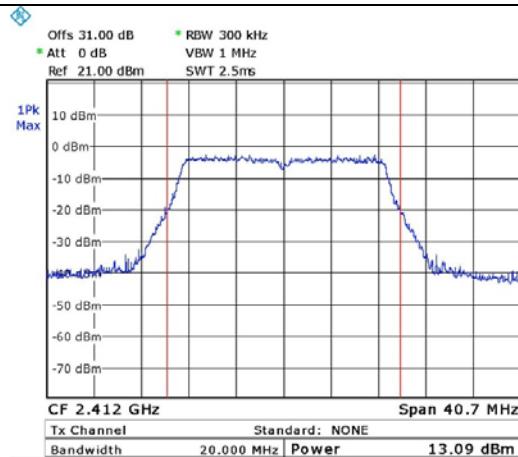
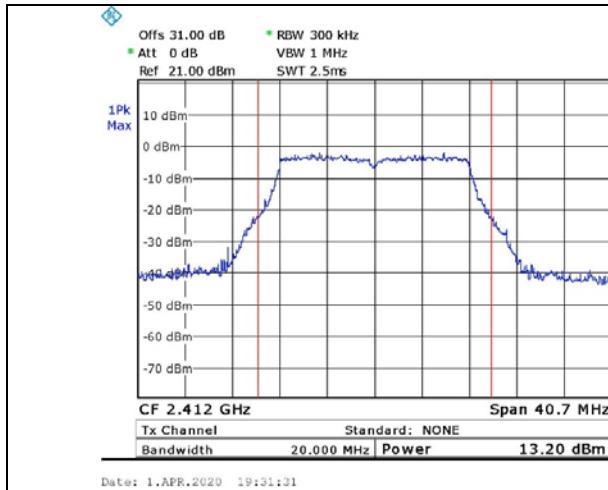
5.4 Test Results

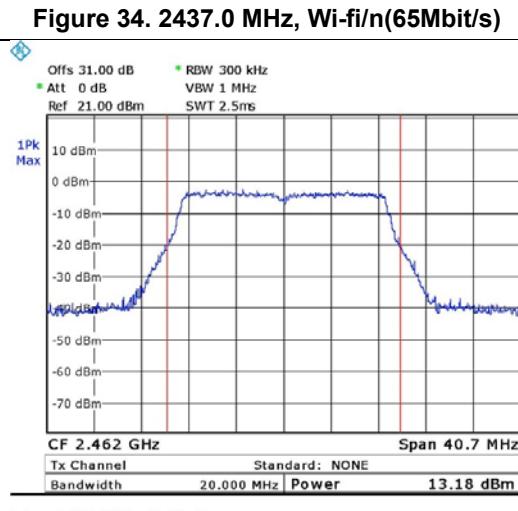
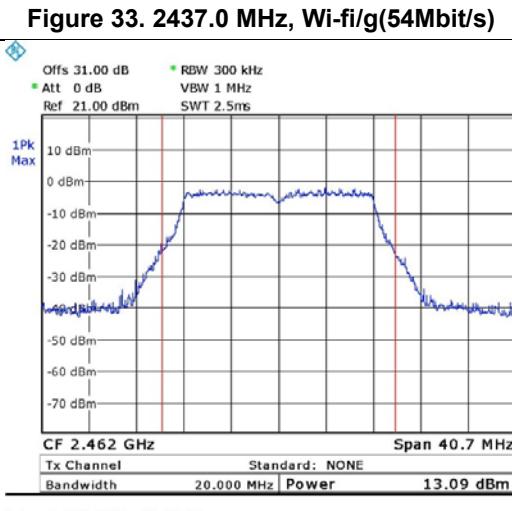
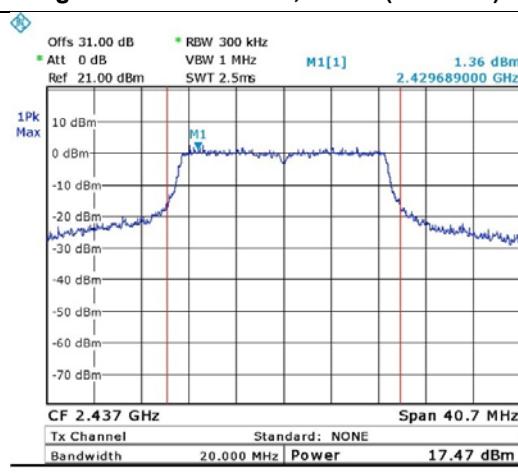
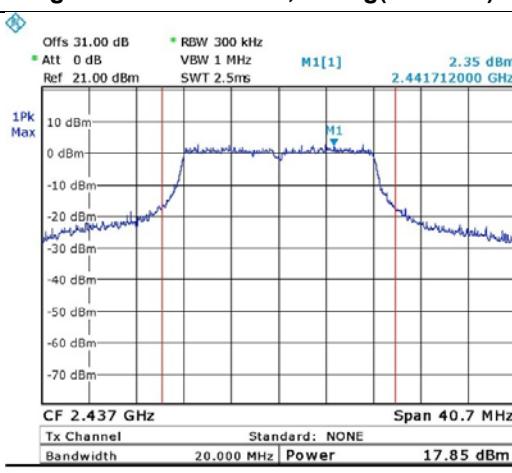
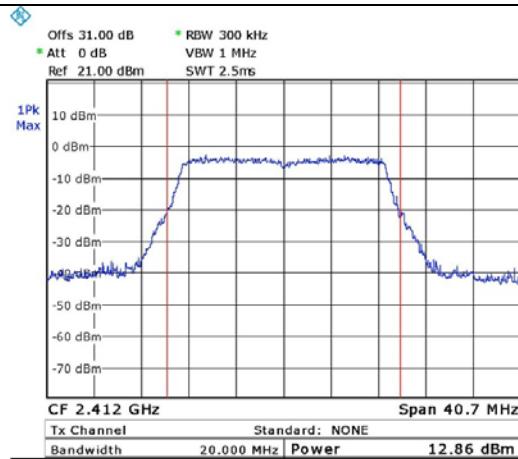
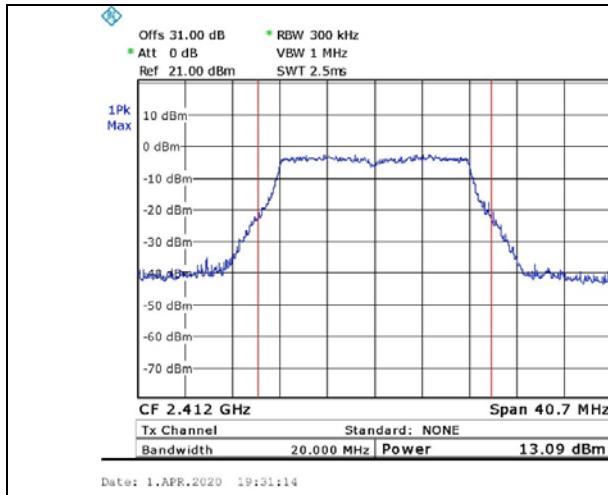
Protocol Type	Operation Frequency	Power	Power	Limit	Margin
	(MHz)	(dBm)	(mW)	(mW)	(mW)
Wi-fi/g(6Mbit/s)	2412.0	13.2	20.9	1000.0	-1979.1
	2437.0	17.0	50.1	1000.0	-1949.9
	2462.0	12.9	19.5	1000.0	-980.5
Wi-fi/g(54Mbit/s)	2412.0	13.1	20.4	1000.0	-979.6
	2437.0	17.9	61.7	1000.0	-938.3
	2462.0	13.1	20.4	1000.0	-979.6
Wi-fi/n(6.5Mbit/s)	2412.0	13.1	20.4	1000.0	-979.6
	2437.0	16.9	49.0	1000.0	-951
	2462.0	12.8	19.1	1000.0	-980.9
Wi-fi/n(65Mbit/s)	2412.0	12.9	19.5	1000.0	-980.5
	2437.0	17.5	56.2	1000.0	-943.8
	2462.0	13.2	20.9	1000.0	-979.1

Figure 24 Maximum Peak Power Output

JUDGEMENT: Passed by 943.8mW

For additional information see *Figure 25* to *Figure 36*.







5.5 Test Equipment Used; Maximum Peak Power Output*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 10, 2020	March 31, 2021
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	June 30, 2020
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	June 30, 2020

*Testing performed on April 1, 2020

Figure 37 Test Equipment Used



6. Band Edge Spectrum

6.1 Test Specification

FCC, Part 15, Subpart C, Section 247(d)

RSS 247, Issue 2, Section 5.5

6.2 Test Procedure

(Temperature (20°C)/ Humidity (59%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=31.0 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The RBW was set to 100 kHz.

6.3 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

6.4 Test Results

Protocol Type	Operation Frequency	Band Edge Frequency	Spectrum Level	Limit	Margin
	(MHz)	(MHz)	(dBm)	(dBm)	(dB)
Wi-fi/g(6Mbit/s)	2412.0	2400.0	-25.6	-21.3	-4.3
	2462.0	2483.5	-32.8	-21.9	-10.9
Wi-Fi/g(54Mbit/s)	2412.0	2400.0	-25.4	-21.2	-4.2
	2462.0	2483.5	-32.2	-21.1	-11.1
Wi-Fi/n(6.5Mbit/s)	2412.0	2400.0	-26.6	-21.5	-5.1
	2462.0	2483.5	-27.9	-21.2	-6.7
Wi-fi/n(65Mbit/s)	2412.0	2400.0	-25.5	-20.8	-4.7
	2462.0	2483.5	-30.7	-21.1	-9.6

Figure 38 Band Edge Spectrum

JUDGEMENT: Passed by 4.2 dB

For additional information see *Figure 39* to *Figure 46*.

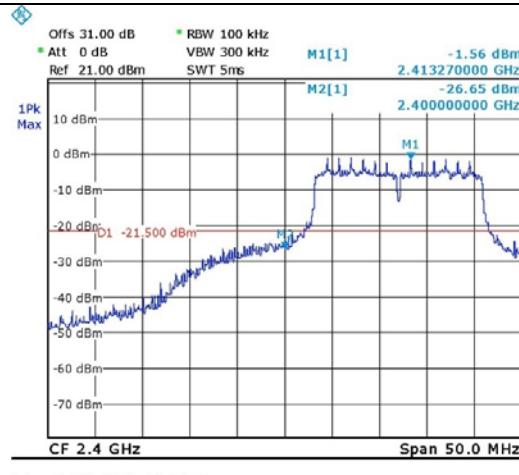
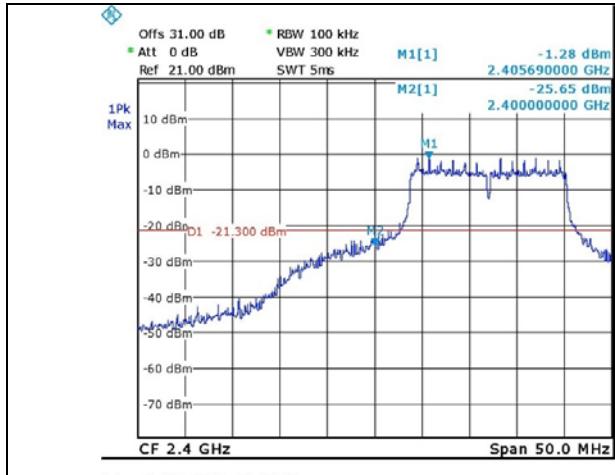


Figure 39. 2412.0 MHz, Wi-fi/g(6Mbit/s)

Figure 40. 2412.0 MHz, Wi-fi/n(6.5Mbit/s)

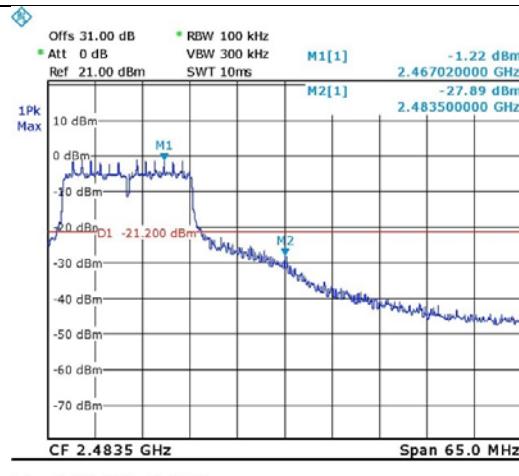
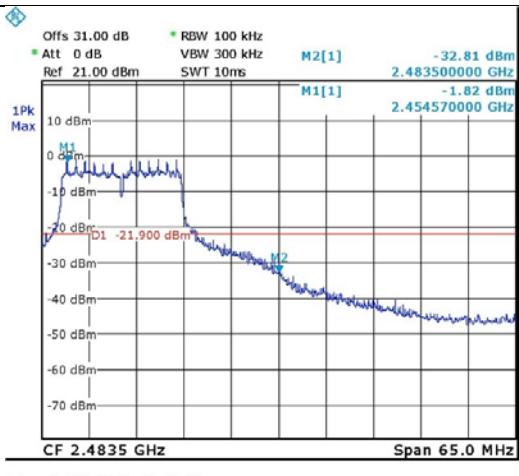
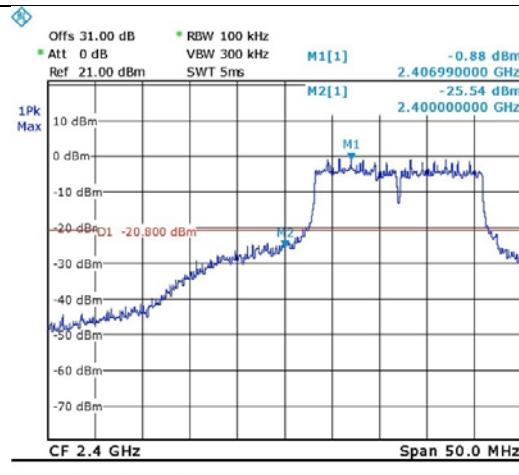
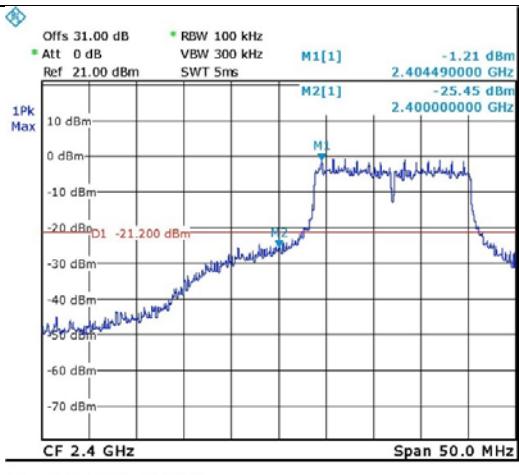
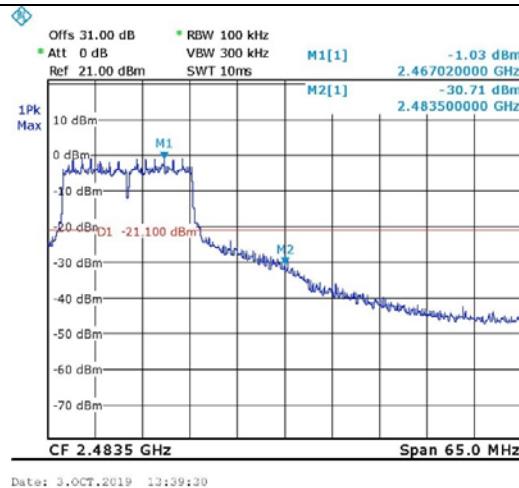
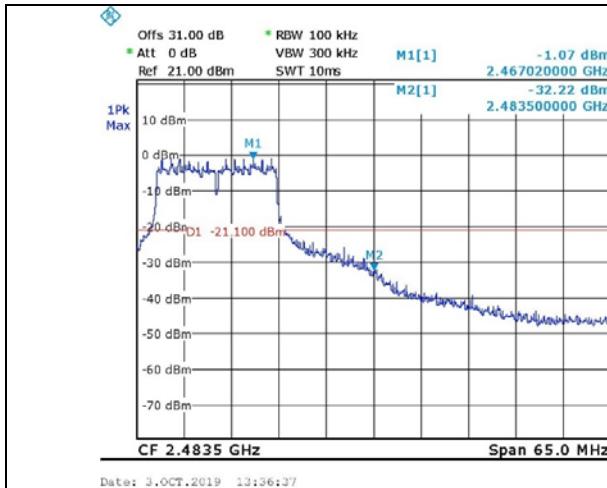


Figure 41. 2462.0 MHz, Wi-fi/g(6Mbit/s)

Figure 42. 2462.0 MHz, Wi-fi/n(6.5Mbit/s)





6.5 Test Equipment Used; Band Edge*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	June 30, 2020
RF Cable	Huber Suner	Sucofelex	27502/4PE A	December 24, 2018	June 30, 2020

*Testing performed October 3, 2019

Figure 47 Test Equipment Used



7. Transmitted Power Density

7.1 Test Specification

FCC, Part 15, Subpart C, Section 247(e)

RSS 247, Issue 2, Section 5.2(b)

7.2 Test Procedure

(Temperature (20°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 31.0dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The spectrum analyzer was set to 3 kHz RBW.

7.3 Test Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.



7.4 Test Results

Protocol Type	Operation Frequency	PSD Reading	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Wi-fi/g(6Mbit/s)	2412.0	-23.0	8.0	-31.0
	2437.0	-25.5	8.0	-33.5
	2462.0	-27.6	8.0	-35.6
Wi-fi/g(54Mbit/s)	2412.0	-26.2	8.0	-34.2
	2437.0	-26.2	8.0	-34.2
	2462.0	-28.0	8.0	-36.0
Wi-fi/n(6.5Mbit/s)	2412.0	-26.2	8.0	-34.2
	2437.0	-26.7	8.0	-34.7
	2462.0	-26.3	8.0	-34.3
Wi-fi/n(65Mbit/s)	2412.0	-27.3	8.0	-35.3
	2437.0	-27.1	8.0	-35.1
	2462.0	-27.7	8.0	-35.7

Figure 48 Test Results

JUDGEMENT: Passed by 31.0dB

For additional information see *Figure 49* to *Figure 60*.

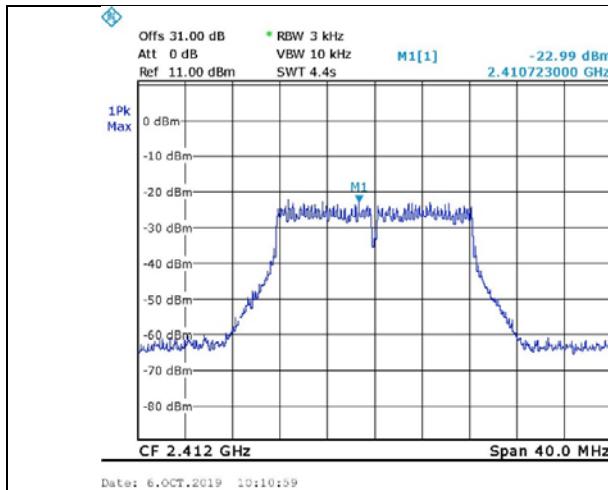


Figure 49. 2412.0 MHz, Wi-fi/g(6Mbit/s)

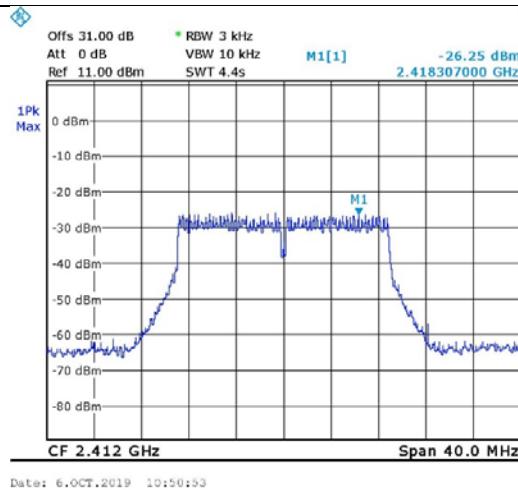


Figure 50. 2412.0 MHz, Wi-fi/n(6.5Mbit/s)

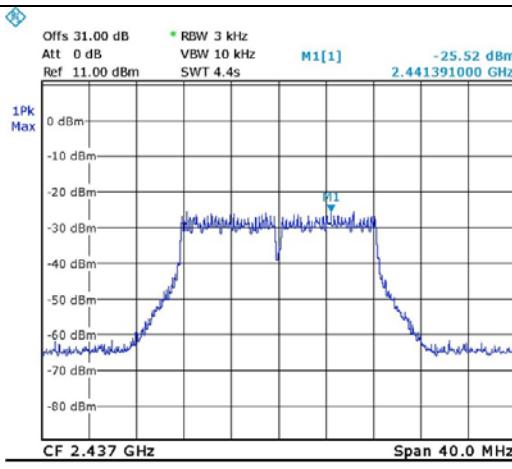


Figure 51. 2437.0 MHz, Wi-fi/g(6Mbit/s)

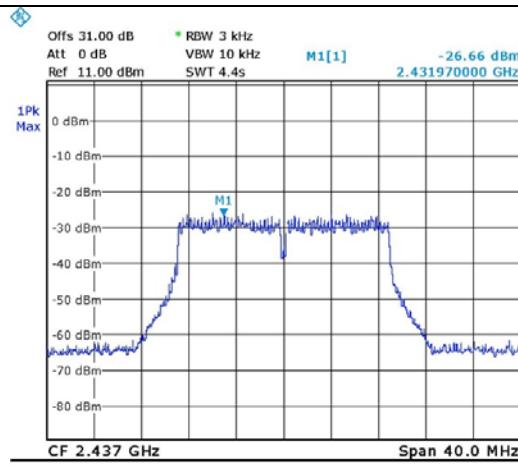


Figure 52. 2437.0 MHz, Wi-fi/n(6.5Mbit/s)

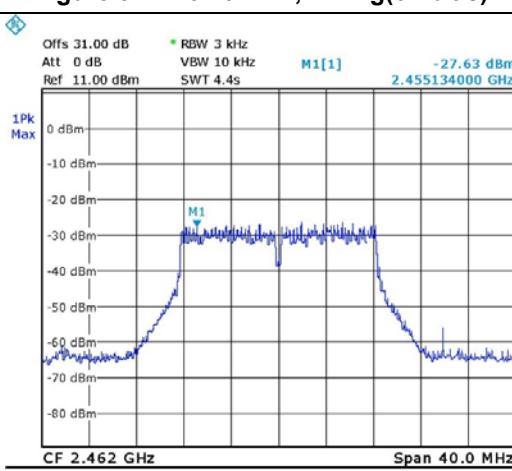


Figure 53. 2462.0 MHz, Wi-fi/g(6Mbit/s)

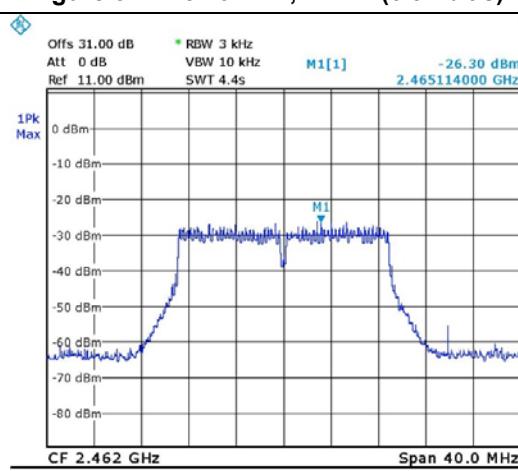
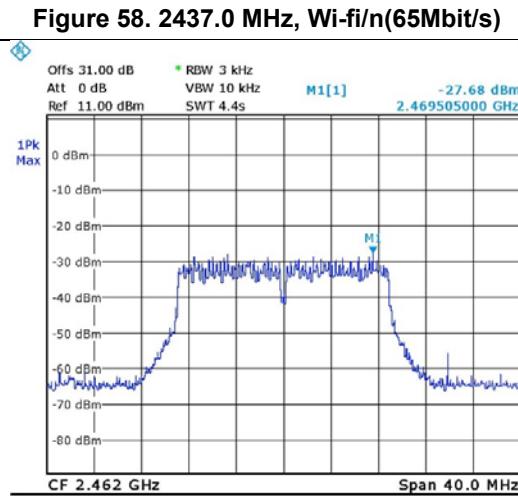
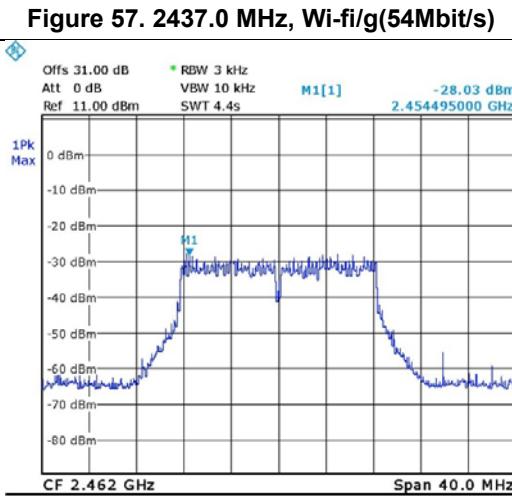
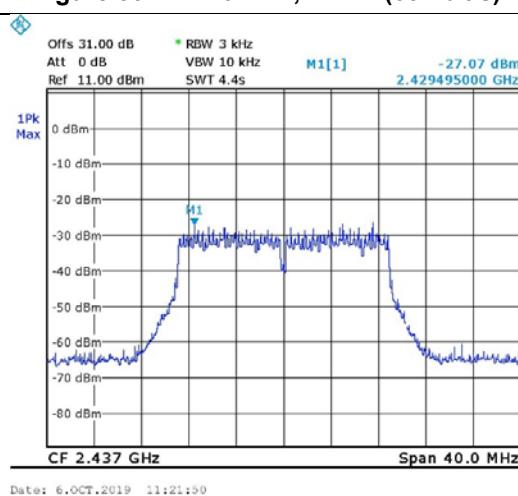
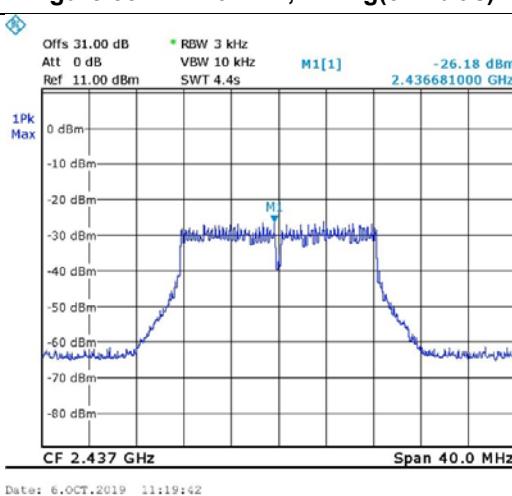
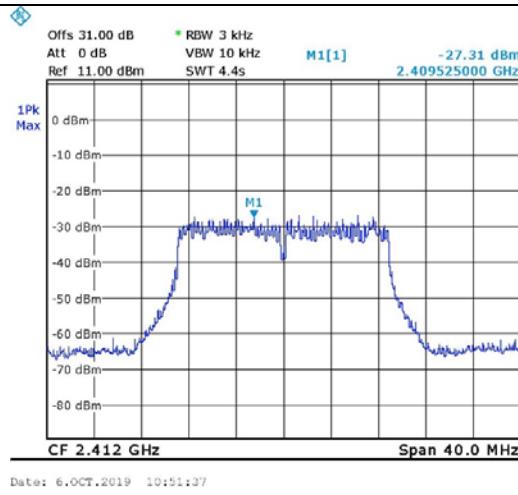
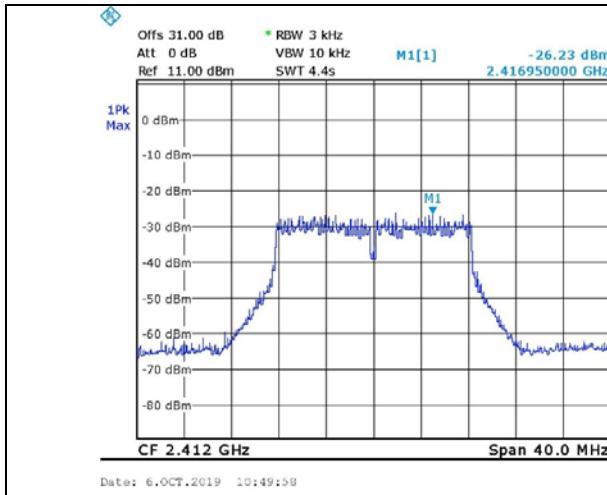


Figure 54. 2462.0 MHz, Wi-fi/n(6.5Mbit/s)





7.5 Test Equipment Used; Transmitted Power Density*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	June 30, 2020
RF Cable	Huber Suner	Sucofelex	27502/4PE A	December 24, 2018	June 30, 2020

*Testing performed October 6, 2019

Figure 61 Test Equipment Used



8. Occupied Bandwidth

8.1 Test Specification

FCC, Part 2, Sub part J, Section 2.1049

RSS-Gen, Issue 5: 2014, Section 6.6

8.2 Test Procedure

(Temperature (20°C)/ Humidity (60%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 31.0dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The RBW set to the range of 1% to 5% of the OBW. The span was set to ~ 3 times the OBW.

99% occupied bandwidth function was set on.

8.3 Test Limit

N/A

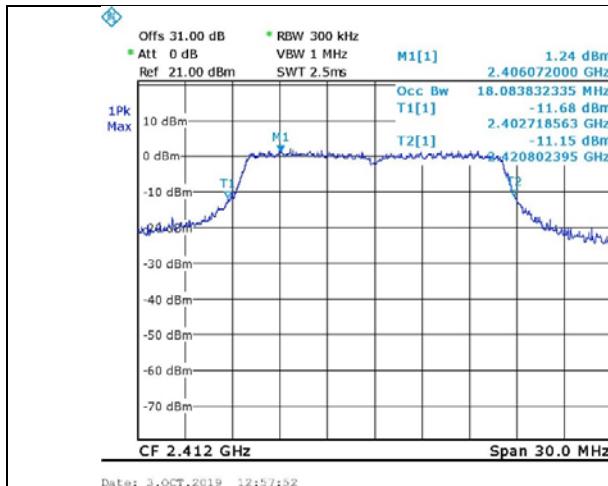
8.4 Test Results

Protocol Type	Operation Frequency	Reading
	(MHz)	(kHz)
Wi-fi/g(6Mbit/s)	2412.0	18,083.0
	2437.0	17,964.0
	2462.0	18,024.0
Wi-fi/g(54Mbit/s)	2412.0	17,365.2
	2437.0	17,305.3
	2462.0	17,365.2
Wi-fi/n(6.5Mbit/s)	2412.0	18,802.4
	2437.0	18,562.8
	2462.0	18,682.6
Wi-fi/n(65Mbit/s)	2412.0	18,323.3
	2437.0	18,203.6
	2462.0	18,263.4

Figure 62. Bandwidth Test Results

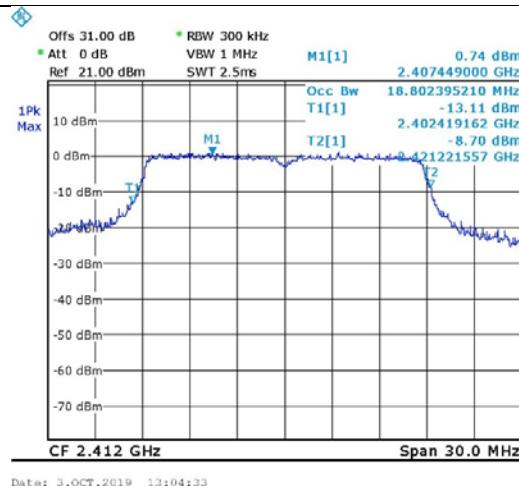
JUDGEMENT: N/A

See additional information in Figure 63 to Figure 74.



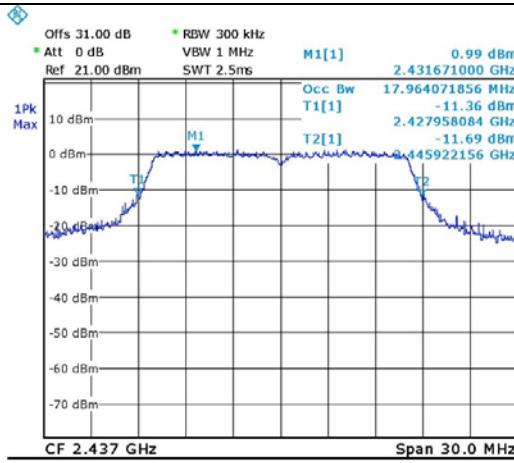
Date: 3.OCT.2019 12:57:32

Figure 63. 2412.0 MHz, Wi-fi/g(6Mbit/s)



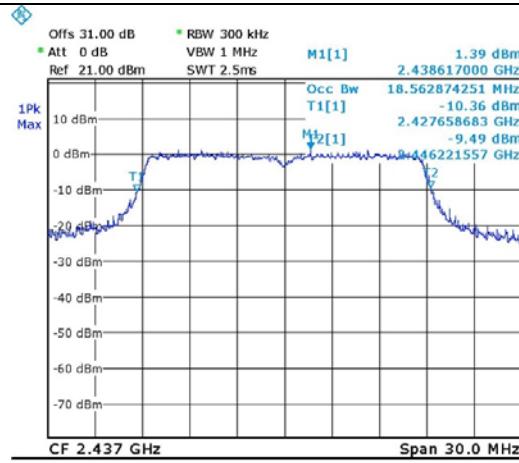
Date: 3.OCT.2019 13:04:33

Figure 64. 2412.0 MHz, Wi-fi/n(6.5Mbit/s)



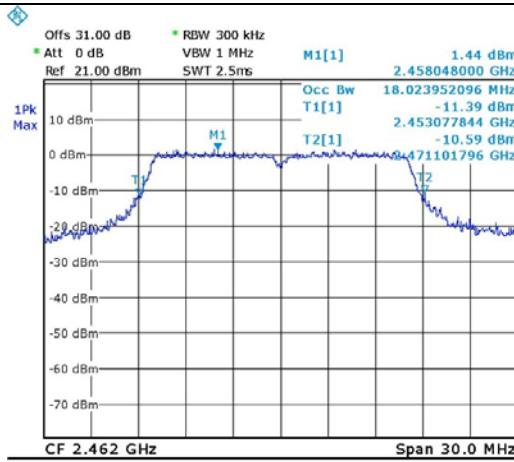
Date: 3.OCT.2019 12:59:07

Figure 65. 2437.0 MHz, Wi-fi/g(6Mbit/s)



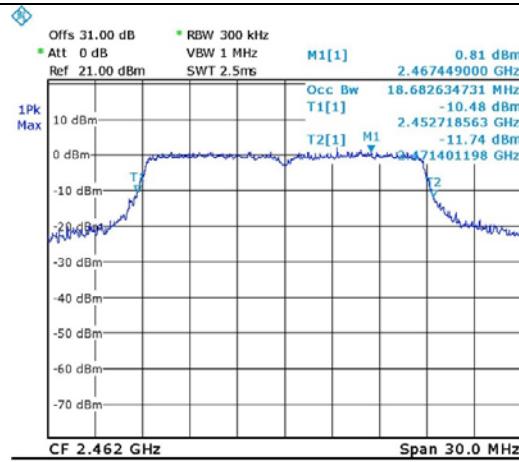
Date: 3.OCT.2019 13:05:53

Figure 66. 2437.0 MHz, Wi-fi/n(6.5Mbit/s)



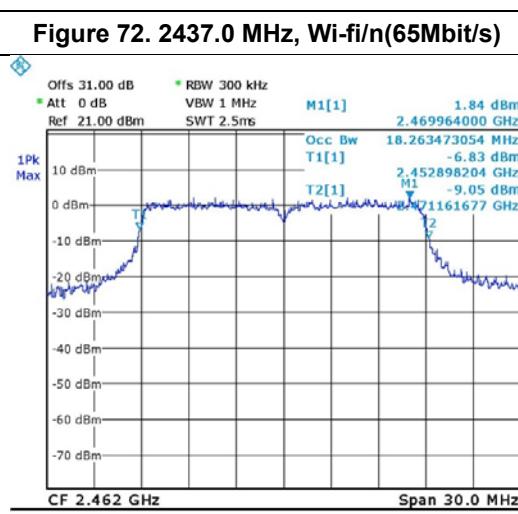
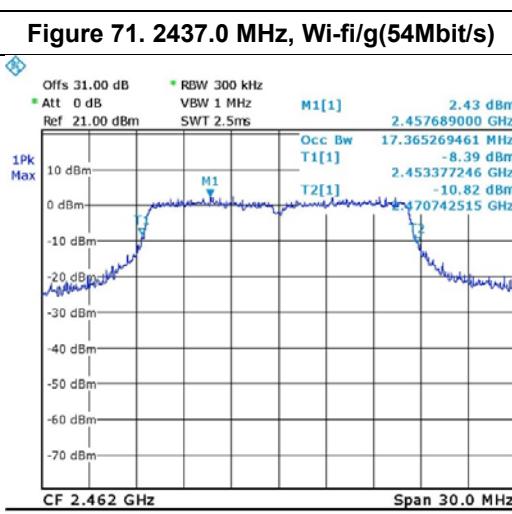
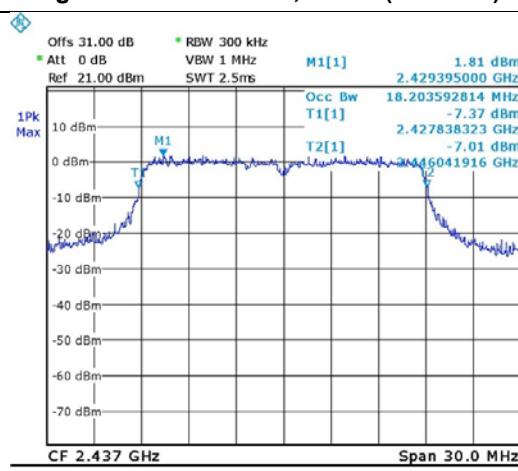
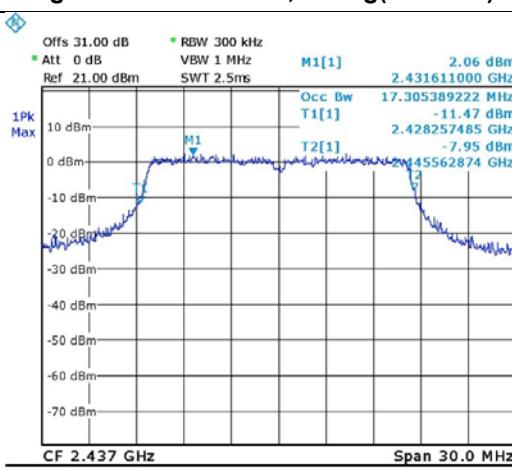
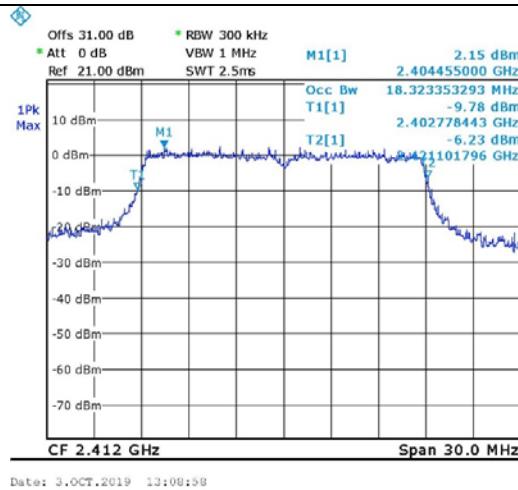
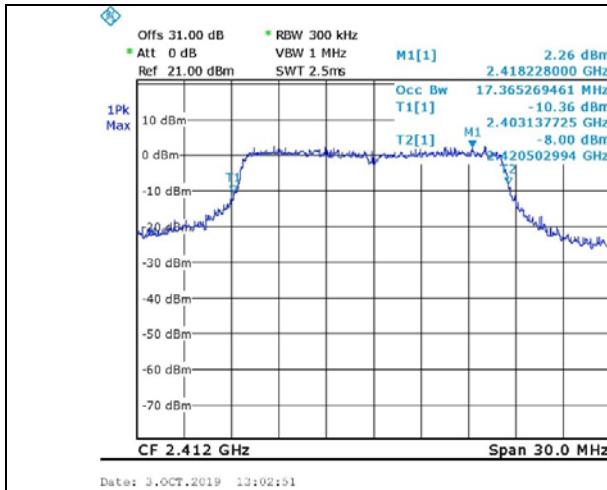
Date: 3.OCT.2019 12:59:48

Figure 67. 2462.0 MHz, Wi-fi/g(6Mbit/s)



Date: 3.OCT.2019 13:06:45

Figure 68. 2462.0 MHz, Wi-fi/n(6.5Mbit/s)





8.5 Test Equipment Used; Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2020
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2020

*Testing performed October 3, 2019

Figure 75 Test Equipment Used



9. Emissions in Non-Restricted Frequency Bands

9.1 Test Specification

FCC, Part 15, Subpart C, Section 247(d)

RSS 247, Issue 2, Section 5.5

9.2 Test Procedure

(Temperature (20°C)/ Humidity (60%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (max total loss=34.0 dB).

Special attention was taken to prevent Spectrum Analyzer RF input overload.

RBW was set to 100kHz, detector set to max peak and trace to “max hold”.

9.3 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

9.4 Test Results

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 247(d) specification.

For additional information see *Figure 76* to *Figure 87*.



Emissions in Non-Restricted Frequency Bands

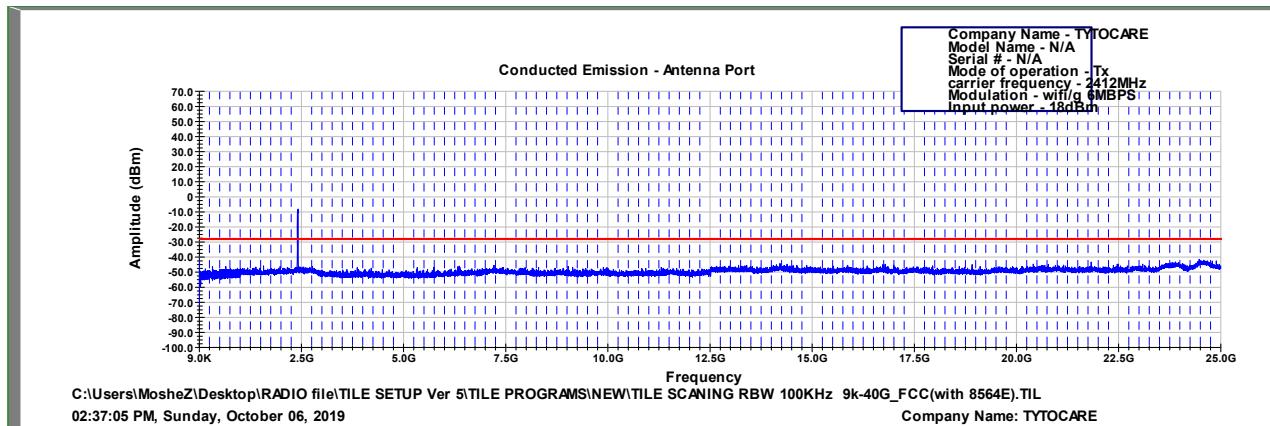


Figure 76 2412.0 MHz, Wi-Fi/g(6Mbit/s)

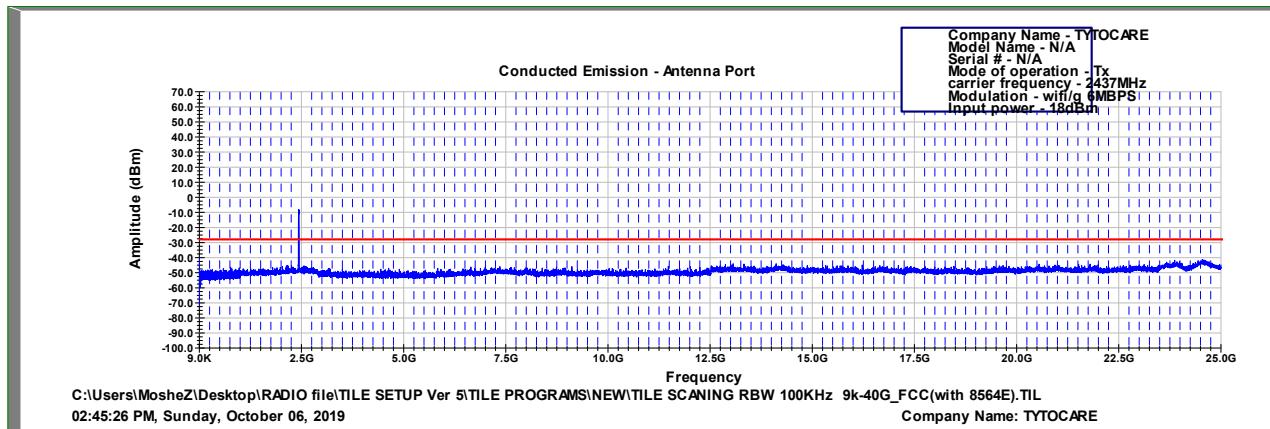


Figure 77 2437.0 MHz, Wi-Fi/g(6Mbit/s)

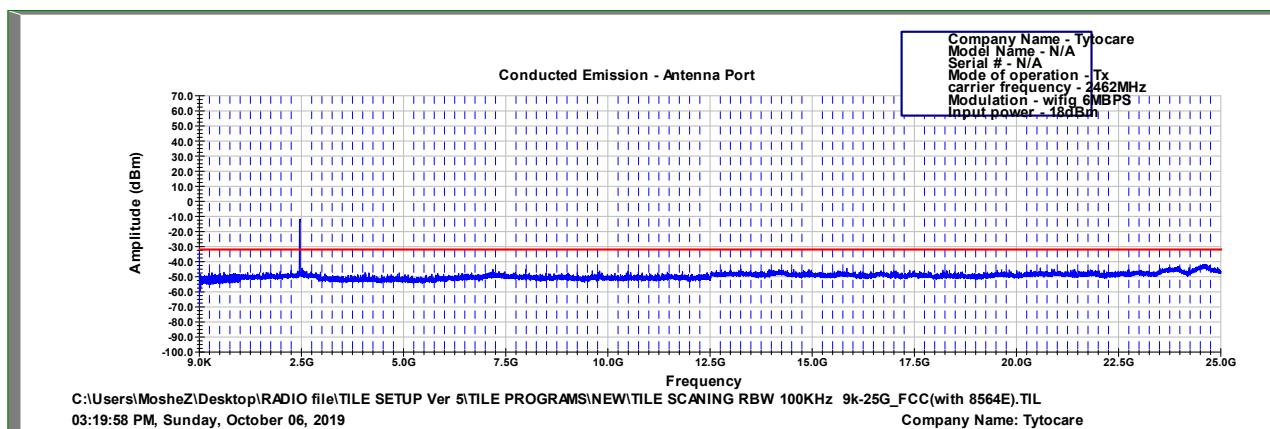


Figure 78 2462.0 MHz, Wi-Fi/g(6Mbit/s)



Emissions in Non-Restricted Frequency Bands

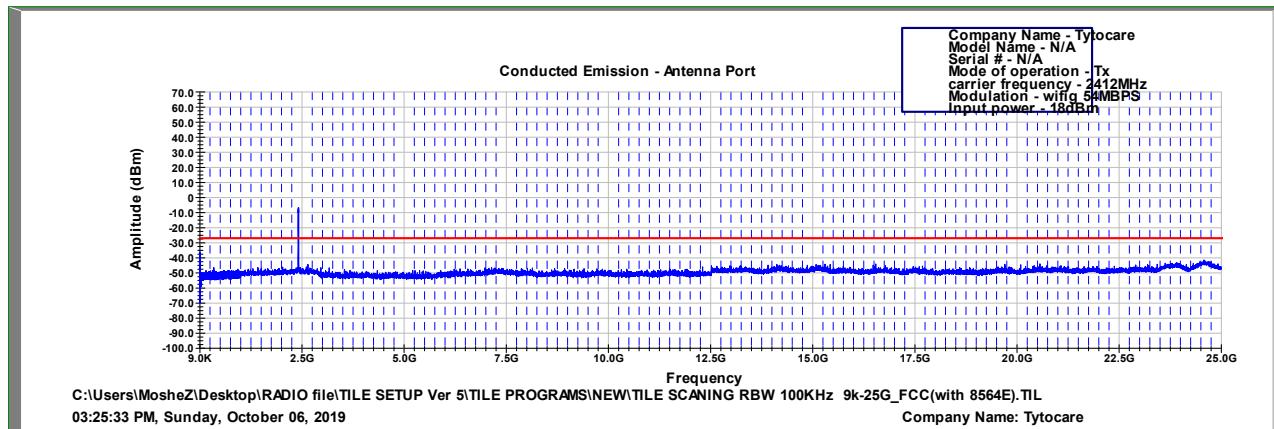


Figure 79 2412.0 MHz, Wi-Fi/g(54Mbit/s)

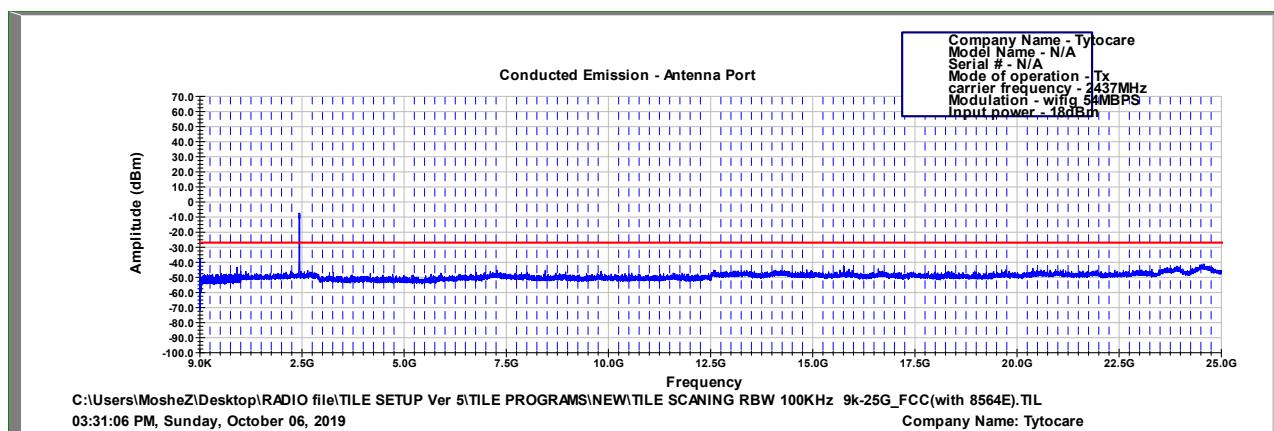


Figure 80 2437.0 MHz, Wi-Fi/g(54Mbit/s)

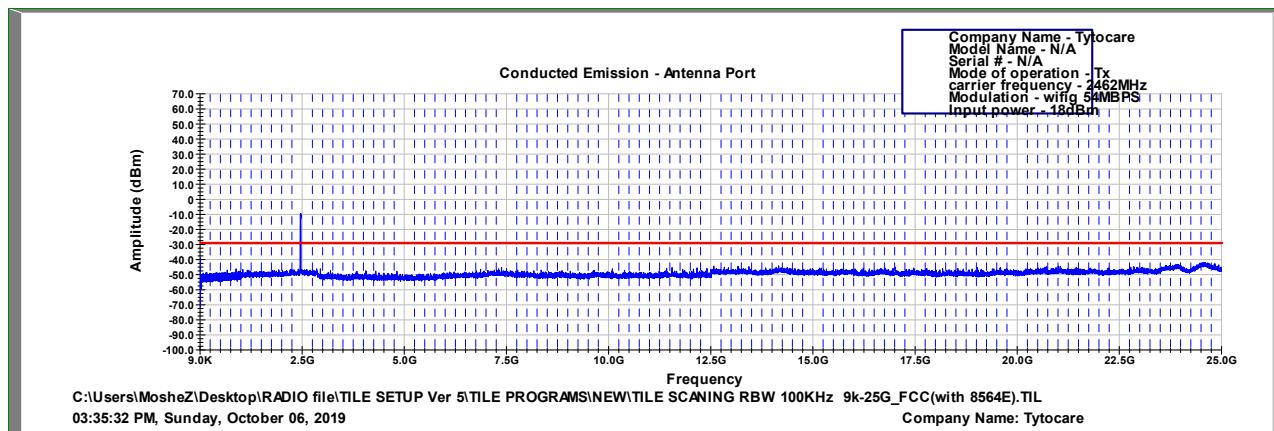


Figure 81 2462.0 MHz, Wi-Fi/g(54Mbit/s)



Emissions in Non-Restricted Frequency Bands

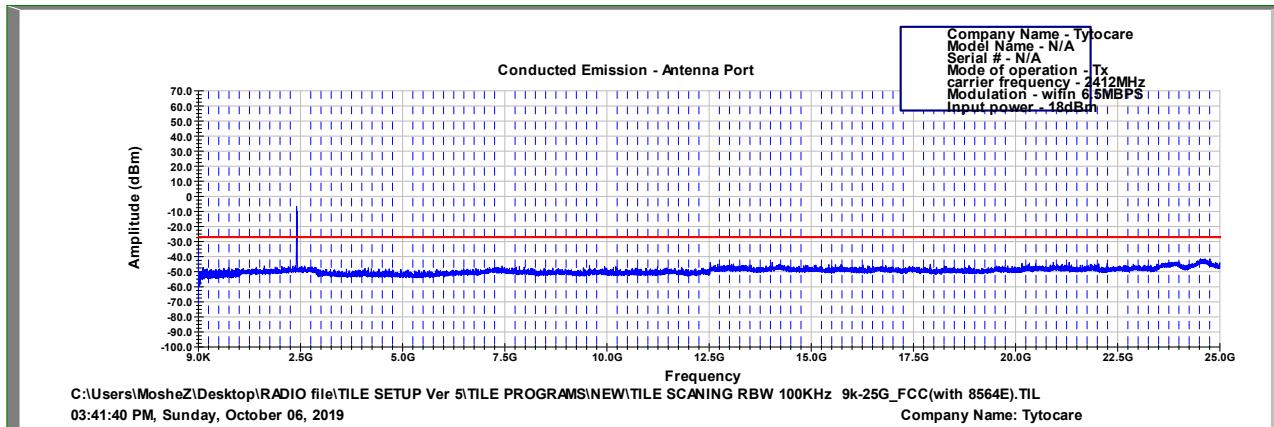


Figure 82 2412.0 MHz, Wi-Fi/n(6.5Mbit/s)

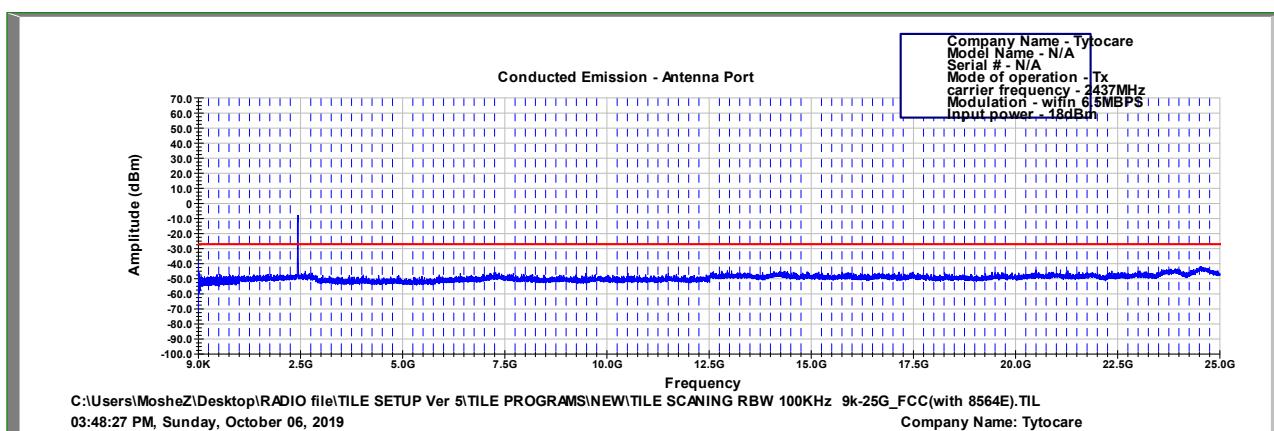


Figure 83 2437.0 MHz, Wi-Fi/n(6.5Mbit/s)

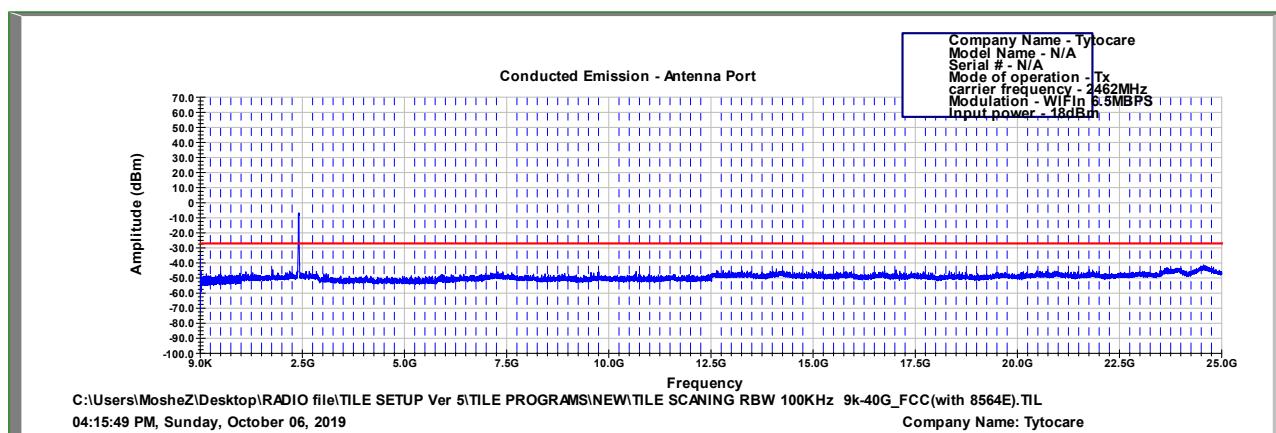


Figure 84 2462.0 MHz, Wi-Fi/n(6.5Mbit/s)



Emissions in Non-Restricted Frequency Bands

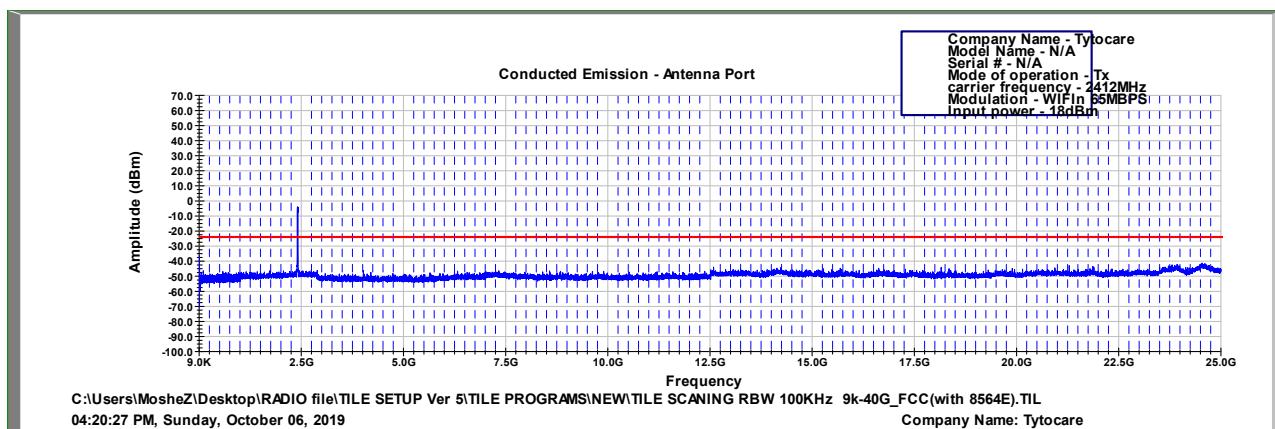


Figure 85 2412.0 MHz, Wi-Fi/n(65Mbit/s)

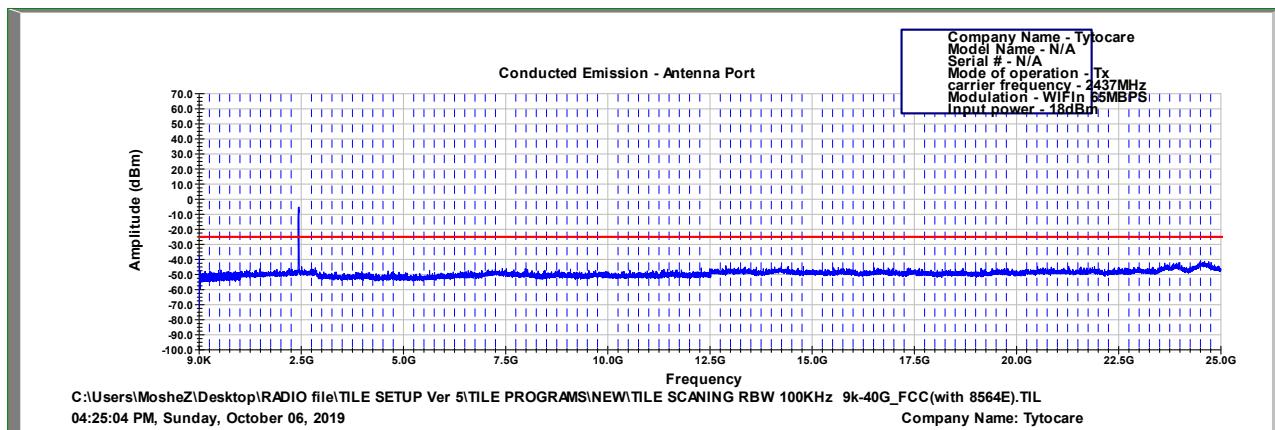


Figure 86 2437.0 MHz, Wi-Fi/n(65Mbit/s)

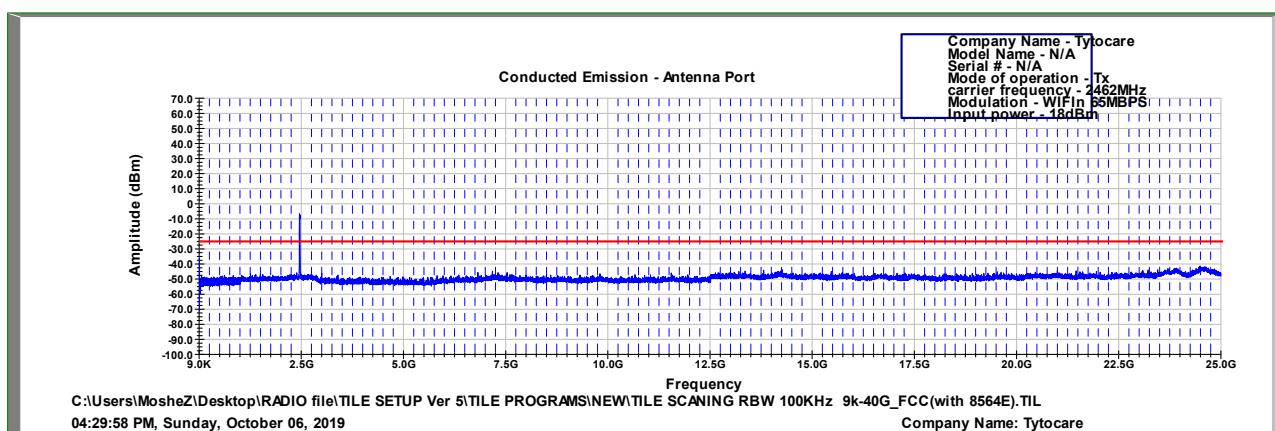


Figure 87 2462.0 MHz, Wi-Fi/n(65Mbit/s)

Note: All exceeding peaks in the plots are the fundamental transmission frequency.



9.5 Test Instrumentation Used, Emission in Non Restricted Frequency Bands*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	HP	8564E	3442A00275	September 1, 2019	September 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2020
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2020

*Testing performed October 6, 2019

Figure 88 Test Equipment Used



10. Emissions in Restricted Frequency Bands

10.1 Test Specification

FCC Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

RSS 247, Issue 2, Section 3.3

RSS Gen, Issue 5, Section 8.10

10.2 Test Procedure

(Temperature (23°C)/ Humidity (65%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009-30MHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 0.009MHz-30MHz was scanned.

For measurements between 30-1000MHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30MHz -1000MHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1GHz-25GHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 1GHz -25GHz was scanned.

Tests were performed for all “worst case”, for each protocol type. The highest radiations are described in the tables below.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.



10.3 FCC Test Limit

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)	Field Strength* (dB μ V/m)	Field Strength* (dB μ V/m)@3m
0.009-0.490	2400/F(kHz)	300	48.5-13.8	128.5-73.8
0.490-1.705	24000/F(kHz)	30	33.8-23.0	73.8-63.0
1.705-30.0	30	30	29.5	69.5
30-88	100	3	40.0	40.0
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

Figure 89 FCC Table of Limits

10.4 IC Test Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Magnetic Field strength (microampere/meter)	Measurement distance (meters)	Magnetic Field strength (dB μ A/m)	Magnetic Field strength* (dB μ A/m)@3m
0.009-0.490	6.37/F(kHz)	300	-3.0-(-37.7)	77.0-42.2
0.490-1.705	63.7/F(kHz)	30	-17.7-(-28.5)	22.3-11.4
1.705-30.0	0.08	30	-21.9	18.0
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	Field strength (dB μ V/m)	Field strength* (dB μ V/m)@3m
30-88	100	3	40.0	40.0
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

Figure 90 IC Table of Limits



10.5 **Test Results**

JUDGEMENT: Passed by 0.9 dB

For the operation frequency of 2412 MHz, the margin between the emission level and the specification limit is in the worst case 0.9 dB at the frequency of 2390.0 MHz, vertical polarization.

For the operation frequency of 2437 MHz, the margin between the emission level and the specification limit is in the worst case 12.0dB at the frequency of 4874.0 MHz, vertical polarization.

For the operation frequency of 2462 MHz, the margin between the emission level and the specification limit is in the worst case 1.7 dB at the frequency of 2483.5 MHz, vertical polarization.

The EUT met the requirements of the F.C.C. Part 15, Subpart C Sections 15.209, 15.205, 15.247(d) specifications.

The details of the highest emissions are given in *Figure 91* and *Figure 92*.



Radiated Emission

E.U.T Description Tyto Device G2 with Tyto Otoscope
Type G2
Serial Number: Not designated

Specifications: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)
RSS 247, Issue 2, Section 3.3; RSS Gen, Issue 5, Section 8.10

Antenna Polarization: Horizontal/Vertical Frequency Range: 9kHz to 25.0 GHz
Protocol Type: WI-FI/g 6Mbps Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dB μ V/m)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
2412.0	2390.0	V	69.4	74.0	-4.6	46.8	54.0	-7.2
	2390.0	H	67.2	74.0	-6.8	45.1	54.0	-8.9
	4824.0	V	58.0	74.0	-16.0	41.6	54.0	-12.4
	4824.0	H	54.3	74.0	-19.7	40.4	54.0	-13.6
2437.0	4874.0	V	58.2	74.0	-15.8	42.0	54.0	-12.0
	4874.0	H	55.1	74.0	-18.9	40.9	54.0	-13.1
2462.0	4924.0	V	57.9	74.0	-16.1	42.2	54.0	-11.8
	4924.0	H	55.0	74.0	-19.0	41.4	54.0	-12.6
	2483.5	V	72.3	74.0	-1.7	51.6	54.0	-2.4
	2483.5	H	65.7	74.0	-8.3	44.2	54.0	-9.8

Figure 91. Radiated Emission Results

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain



Radiated Emission

E.U.T Description Tyto Device G2 with Tyto Otoscope
Type G2
Serial Number: Not designated

Specifications: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)
RSS 247, Issue 2, Section 3.3; RSS Gen, Issue 5, Section 8.10

Antenna Polarization: Horizontal/Vertical Frequency Range: 9kHz to 25.0 GHz
Protocol Type: WI-FI/n 6.5Mbps Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dB μ V/m)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
2412.0	2390.0	V	73.1	74.0	-0.9	51.3	54.0	-2.7
	2390.0	H	70.5	74.0	-3.5	48.9	54.0	-5.1
	4824.0	V	57.1	74.0	-16.9	41.0	54.0	-13.0
	4824.0	H	52.9	74.0	-21.1	40.0	54.0	-14.0
2437.0	4874.0	V	58.0	74.0	-16.0	41.3	54.0	-12.7
	4874.0	H	54.0	74.0	-20.0	39.2	54.0	-14.8
2462.0	4924.0	V	55.8	74.0	-18.2	41.2	54.0	-12.8
	4924.0	H	54.1	74.0	-19.9	41.0	54.0	-13.0
	2483.5	V	71.1	74.0	-2.9	51.6	54.0	-2.4
	2483.5	H	64.3	74.0	-9.7	45.5	54.0	-8.5

Figure 92. Radiated Emission Results

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain



10.6 Test Instrumentation Used; Emissions in Restricted Frequency Bands*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 27 2019	February 29, 2020
EMI Receiver	HP	8542E	3906A00276	February 28, 2019	February 29, 2020
RF Filter Section	HP	85420E	3705A00248	February 28, 2019	February 29, 2020
Spectrum Analyzer	HP	8593EM	3536A00120 ADI	February 26, 2019	February 29, 2020
Active Loop Antenna	EMCO	6502	9506-2950	February 5, 2019	February 29, 2021
Biconical Antenna	EMCO	3110B	9912-3337	May 21, 2019	May 31, 2020
Log Periodic Antenna	EMCO	3146	9505-4081	May 31, 2018	May 31, 2020
Horn Antenna	ETS	3115	29845	May 31, 2018	May 31, 2021
Horn Antenna	ARA	SWH-28	1007	December 31, 2017	December 31, 2020
MicroWave System Amplifier	HP	83006A	3104A00589	December 24, 2018	December 31, 2019
Low Noise Amplifier 1GHz-18GHz	Miteq	AFSX4-02001800-50-8P	-	December 24, 2018	December 31, 2019
RF Cable Chamber	Commscope ORS	0623 WBC-400	G020132	December 24, 2018	December 31, 2019
RF Cable Oats	EIM	RG214-11N(X2)		May 26, 2019	May 31, 2020
Filter Band Pass 4-20 GHz	Meuro	MFL040120H50	902252	December 24, 2018	December 31, 2019
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9608-1456	NCR	NCR

*Testing performed on October 7, 2019

Figure 93 Test Equipment Used



11. Antenna Gain/Information

	Antenna manufacturer	Antenna model number	Antenna type	Antenna peak gain UNII-1
Tested antenna	Antenova	SRF2W012Tyto	PCB type same cable length	3 dbi according to datasheet
Optional antenna	ethertronics	9001501	PCB type same cable length	1.4 dbi according to datasheet
Optional antenna	Wieson	WSY-CareG2	PCB type same cable length	-0.3 dbi according to datasheet



12. R.F Exposure/Safety

The device's intended use is to operate in a user home environment, linked to the home router, allowing a two way video call and upload of files to the network.

The typical distance between the E.U.T. and the user is at least 20cm. Transmission occurs when the device is placed on a surface.

Calculation of Maximum Permissible Exposure (MPE)

Based on 47CFR1 Section 1.1307(b)(1) and RSS 102 Issue 5, Table 4 Requirements

(a) FCC : The limit at 2437 MHz is: $1 \frac{mW}{cm^2}$

Using Table 1 of 47CFR1 Section 1.1310 limit for general population/uncontrolled exposures, the above levels are an average over 30 minutes.

For FCC, the power density produced by the E.U.T. is:

$$S = \frac{P_t G_t}{4\pi R^2}$$

P_t = Conducted Transmitted Power 17.9 dBm = 61.7 mW

G_t = Antenna Gain 3dBi = 2 numeric

R = Distance From Transmitter 20 cm

The peak power density produced by the E.U.T. is:

$$S = 61.7 * 2 / 4\pi(20^2) = 0.024 \text{ mW/cm}^2$$

This is below the FCC limit

(b) ISED: The limit: 300-6000MHz = $1.31 \times 10^{-2} f^{0.6834} \text{ W} = 1.31 \times 10^{-2} f^{0.6834} \text{ W} = 1.31 \times 0.01 \times 206.34 = 2.7 \text{ W}$

$$(\text{EIRP} = 17.9 \text{ dBm} + 3 \text{ dBi} = 20.9 \text{ dBm}) = 0.123 \text{ W}$$

This is below the ISED limit.



13. APPENDIX A - CORRECTION FACTORS

13.1 *Correction factors for RF OATS Cable 35m ITL #1911*

Frequency (MHz)	loss (dB)
30.0	1.3
50.0	1.7
100.0	2.6
200.0	3.7
300.0	4.7
400.0	5.5
500.0	6.3
600.0	7.0
700.0	7.6
800.0	8.4
900.0	9.0
1000.0	9.6



13.2 Correction Factors for RF Cable for Anechoic Chamber

ITL #1840

FREQ (MHz)	LOSS (dB)
1000.0	1.5
2000.0	2.1
3000.0	2.7
4000.0	3.1
5000.0	3.5
6000.0	4.1
7000.0	4.6
8000.0	4.9
9000.0	5.7
10000.0	5.7
11000.0	6.1
12000.0	6.1
13000.0	6.2
14000.0	6.7
15000.0	7.4
16000.0	7.5
17000.0	7.9
18000.0	8.1
19000.0	8.8
20000.0	9.1

NOTES:

1. The cable is manufactured by Commscope
2. The cable type is 0623 WBC-400, serial # G020132 and 10m long



13.3 Correction Factors for Active Loop Antenna ITL # 1075

F(MHz)	AF(dB/m)
0.01	18.4
0.02	14.3
0.03	13.3
0.05	11.7
0.1	11.4
0.2	11.2
0.3	11.2
0.5	11.2
0.7	11.2
1	11.4
2	11.5
3	11.5
4	11.4
5	11.3
6	11.1
7	11.1
8	11.1
9	11
10	11
20	10
30	8



13.4 Correction Factors for Biconical Antenna
ITL #1356, EMCO 3110B 9912-3337

Frequency [MHz]	AF [dB/m]
30	13.00
35	10.89
40	10.59
45	10.63
50	10.12
60	9.26
70	7.74
80	6.63
90	8.23
100	11.12
120	13.16
140	13.07
160	14.80
180	16.95
200	17.17



13.5 Correction Factors for Log Periodic Antenna
ITL # 1349, EMC0 3146 s/n 9505-4081

Frequency [MHz]	AF [dB/m]
200	11.58
250	12.04
300	14.76
400	15.55
500	17.85
600	18.66
700	20.87
800	21.15
900	22.32
1000	24.22



**13.6 Correction Factors for Double – Ridged Waveguide Horn
ANTENNA 3 meter range;**

ITL # 1352, ETS 3115 s/n 29845

FREQUENCY (GHz)	AFE (dB/m)	FREQUENCY (GHz)	AFE (dB/m)
0.75	25.0	9.5	38.0
1.0	23.5	10.0	38.5
1.5	26.0	10.5	38.5
2.0	29.0	11.0	38.5
2.5	27.5	11.5	38.5
3.0	30.0	12.0	38.0
3.5	31.5	12.5	38.5
4.0	32.5	13.0	40.0
4.5	32.5	13.5	41.0
5.0	33.0	14.0	40.0
5.5	35.0	14.5	39.0
6.0	36.5	15.0	38.0
6.5	36.5	15.5	37.5
7.0	37.5	16.0	37.5
7.5	37.5	16.5	39.0
8.0	37.5	17.0	40.0
8.5	38.0	17.5	42.0
9.0	37.5	18.0	42.5



13.7 Correction Factors for Horn Antenna Model SWH-28 ITL # 1353

CALIBRATION DATA

3 m distance

Frequency, MHz	Measured antenna factor, dB/m ¹⁾
18000	32.4
18500	32.0
19000	32.3
19500	32.4
20000	32.3
20500	32.8
21000	32.8
21500	32.7
22000	33.1
22500	33.0
23000	33.1
23500	33.8
24000	33.5
24500	33.5
25000	33.8
25500	33.9
26000	34.2
26500	34.7

¹⁾ The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/m.