



DATE: 08 March 2020

I.T.L. (PRODUCT TESTING) LTD.
FCC/IC Radio Test Report
for
Munters Israel Ltd

Equipment under test:
Poultry House Monitoring Equipment

ECHO

Tested by:

M. Zohar

Approved by:

D. Shidlowsky

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This report relates only to items tested.



Measurement/Technical Report for
Munters Israel Ltd
Poultry House Monitoring Equipment

ECHO

FCC ID: 2ATJLECHO
IC: 25363-ECHO

This report concerns:	Original Grant: X Class I Change: Class II Change:
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 and 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: Munters Israel Ltd

Manufacturer's Address: 2691 Ena Drive
Lansing, MI 48917-8521
U.S.A.
Tel: +1 517 899 6849

Manufacturer's Representative: Wouter Claassens

Equipment Under Test (E.U.T): Poultry House Monitoring Equipment

Equipment PMN: ECHO

Equipment Serial No.: 0519.08928

Equipment HVIN: 2
Equipment FVIN: 3.9.0.6
Date of Receipt of E.U.T: June 12, 2019

Start of Test: June 12, 2019

End of Test: June 30, 2019

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 Echo is a remote sensing device designed to be installed in poultry houses. It's powered by 24 volts DC and measures a variety of parameters including temperature, humidity, ammonia level, water flow, food flow, and bird weight. The Echo periodically transmits its measurements to a remote server through a dedicated 802.11b WiFi network that's connected to the Internet.

The data collected from the Echo sensors at a farm is used for remote monitoring, detection of alarm conditions, and prediction of future outcomes such as bird weight. The customers for this product are the poultry integrators who use it to insure that the animals are raised according to their standards, and who want better information to improve their planning and scheduling.

Working voltage	24VDC via AC/DC adapter
Mode of operation	Transceiver
Modulations	For Wi-Fi/b: DSSS, CCK For Wi-Fi/g: OFDM(BPSK,QPSK,16QAM ,64QAM) For Wi-Fi/n: OFDM(BPSK,QPSK,16QAM ,64QAM)
Assigned Frequency Range	2400.0-2483.5MHz
Operating Frequency Range	For Wi-Fi/b/g/n: 2412.0-2462.0MHz
Transmit power(conducted)	For Wi-Fi/b/g/n: ~20.0dBm
Antenna Gain	1.9 dBi chip antenna
Modulation BW	For Wi-Fi/b/g/n: 20MHz
Bit rate (Mbit/s)	For Wi-Fi/b: 1, 2, 5.5, 11 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.

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, FCC Designation Number is IL1005 and 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

- 2.1.1 The E.U.T contains an IEEE 802.11b/g/n standard (Wi-Fi/b/g/n) transceiver with only 20MHz CBW.
- 2.1.2 The unit was evaluated while transmitting at the low channel (2412MHz), mid channel (2437MHz) and the high channel (2462MHz) with duty cycle above 98% and maximum power settings.
- 2.1.3 Conducted emission tests were performed with the E.U.T. antenna terminal connected by a RF cable to the Spectrum Analyzer through a 30dB external attenuator.
- 2.1.4 Final radiated emission for Wi-Fi b/g/n modes tests were performed using 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/b	1,11 Mbit/s
Wi-Fi/g	6,54 Mbit/s
Wi-Fi/n	6.5,65 Mbit/s (MCS0,MCS7)

- 2.1.5 Final radiated emission tests were performed after exploratory emission testing that was performed in 3 orthogonal polarities to determine the "worst case" radiation.
- 2.1.6 According to the below screening results, the worst case was the "y axis".

Orientation	Frequency	2 nd Harmonic	3 rd Harmonic	Band Edge
	(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)
X axis	2412.0	52.3	45.3	50.1
	2437.0	51.2	45.4	-
	2462.0	51.6	45.2	50.6
Y axis	2412.0	54.3	45.6	50.3
	2437.0	53.5	45.5	-
	2462.0	52.5	45.6	50.7
Z axis	2412.0	53.0	45.5	49.9
	2437.0	52.7	45.5	-
	2462.0	52.3	45.4	50.5

Figure 1. Screening Results

2.2 EUT Exercise Software

TI radio tool GUI: CC3100/CC3200 Radio Tool v1.2.5942.19689.

2.3 *Special Accessories*

Equipment	Manufacturer	Part Number	Serial Number
Laptop	Lenovo	20BT-SOMX00	R9-0JJNAF
AC/DC adapter	MEAN WELL	APV-16-12	N/A
Debugger	TI	CC3220	N/A

2.4 *Equipment Modifications*

No modifications were necessary in order to achieve compliance.

2.5 Configuration of Tested System

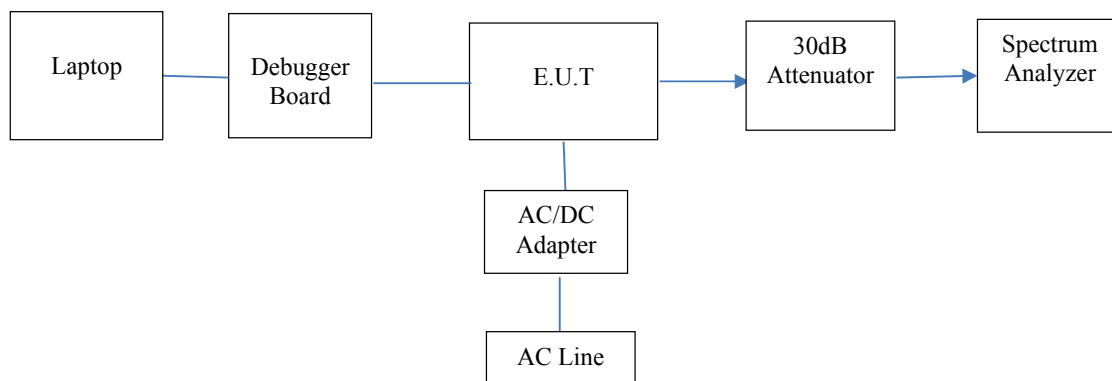


Figure 2. Configuration of Tested System Conducted

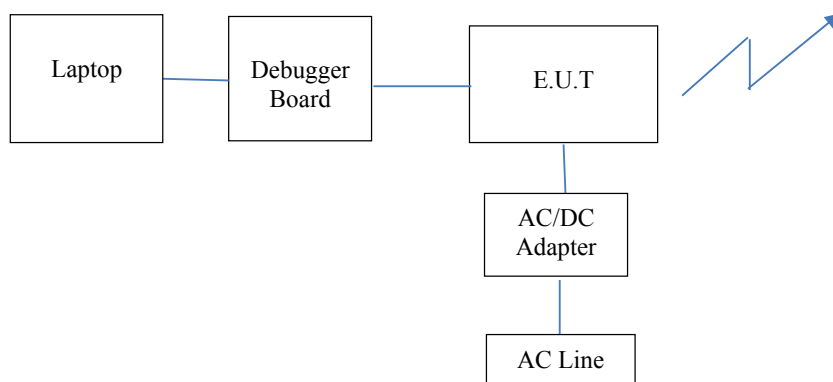


Figure 3. Configuration of Tested System Radiated

3. Conducted & Radiated Measurement Test Set-Up Photos



Figure 4. Conducted Emission from AC Line Test



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

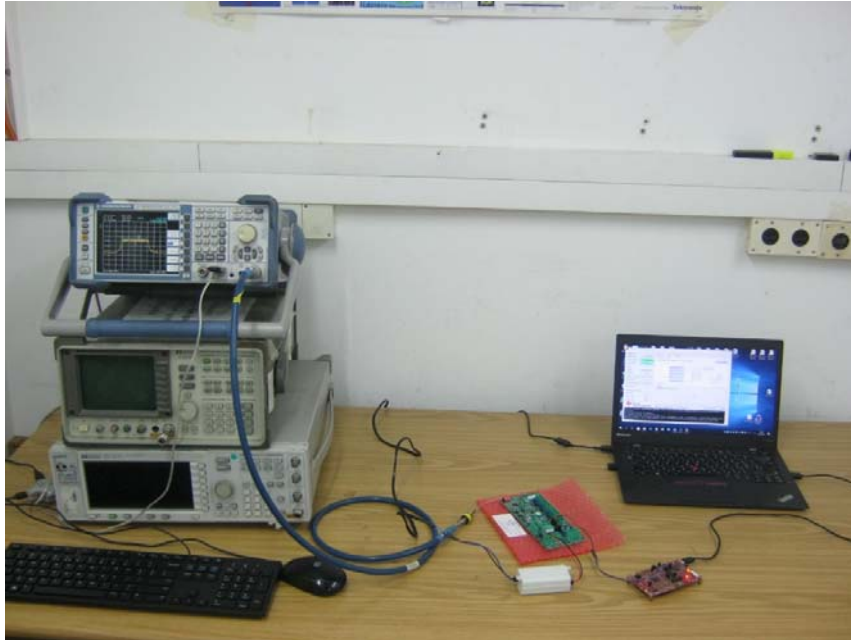


Figure 10. Conducted Emission Test

4. Conducted Emission From AC Mains

4.1 Test Specification

FCC Part 15, Subpart C, Section 15.207

RSS Gen, Issue 5, Clause 8.8

4.2 Test Procedure

(Temperature (21°C)/ Humidity (65%RH))

The E.U.T operation mode and test setup are as described in Section 2 of this report. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room, with the E.U.T placed on a 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 μ Hn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T.

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission.

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver and are displayed on the receiver's spectrum display.

The E.U.T was evaluated in TX operation mode.

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

4.3 Test Limit

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.



4.4 Test Results

JUDGEMENT: Passed by 14.78 dB

The margin between the emission levels and the specification limit is, in the worst case, 14.85 dB for the phase line at 0.66 MHz and 14.78 dB at 0.66 MHz for the neutral line.

The EUT met the F.C.C. Part 15, Subpart C specification requirements.

The details of the highest emissions are given in *Figure 11* to *Figure 14*.

Conducted Emission

E.U.T Description Poultry House
Monitoring
Equipment
Type ECHO
Serial Number: 0519.08928

Specification: FCC Part 15, Subpart C;
RSS Gen, Issue 5, Clause 8.8
Lead: Phase
Detectors: : Peak, Quasi-peak, Average
Power Operation AC/DC Adapter

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CE22BQP			
Trace2:	CE22BAP			
Trace3:	---			
TRACE	FREQUENCY	LEVEL dBμV	DELTA	LIMIT dB
2 Average	202 kHz	21.32	-32.20	
1 Quasi Peak	250 kHz	35.31	-26.44	
1 Quasi Peak	394 kHz	38.17	-19.80	
2 Average	402 kHz	24.36	-23.45	
1 Quasi Peak	438 kHz	34.39	-22.70	
2 Average	658 kHz	31.14	-14.85	
2 Average	1.078 MHz	16.88	-29.11	
1 Quasi Peak	1.086 MHz	28.76	-27.24	
1 Quasi Peak	1.314 MHz	30.74	-25.25	
2 Average	1.314 MHz	25.23	-20.76	
1 Quasi Peak	2.63 MHz	28.10	-27.89	
2 Average	2.63 MHz	20.97	-25.02	
1 Quasi Peak	3.634 MHz	23.45	-32.54	
2 Average	4.602 MHz	16.07	-29.92	
2 Average	6.574 MHz	14.10	-35.89	
1 Quasi Peak	7.238 MHz	19.39	-40.61	
2 Average	15.118 MHz	14.35	-35.64	
1 Quasi Peak	17.534 MHz	21.44	-38.55	
1 Quasi Peak	20.422 MHz	27.97	-32.02	
2 Average	21.158 MHz	21.09	-28.90	

Date: 26.JUN.2019 07:27:17

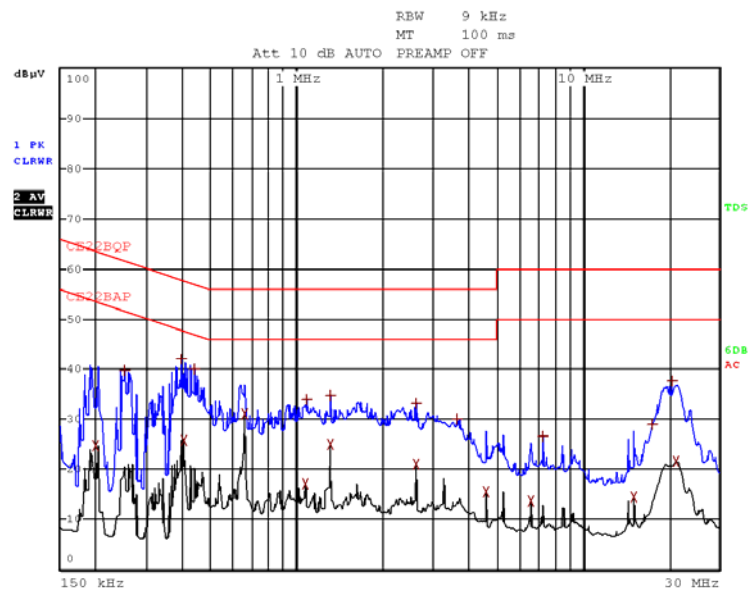
Figure 11. Detectors: Peak, Quasi-peak, Average

Note: QP Delta/Av Delta 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.

Conducted Emission

E.U.T Description Poultry House
Monitoring Equipment
Type ECHO
Serial Number: 0519.08928

Specification: FCC Part 15, Subpart C;
RSS Gen, Issue 5, Clause 8.8
Lead: Phase
Detectors: Peak, Quasi-peak, Average
Power Operation AC/DC Adapter



Date: 26.JUN.2019 07:24:30

Figure 12. Detectors: Peak, Quasi-peak, Average

Conducted Emission

E.U.T Description Poultry House
Monitoring Equipment
Type ECHO
Serial Number: 0519.08928

Specification: FCC Part 15, Subpart C;
RSS Gen, Issue 5, Clause 8.8
Lead: Neutral
Detectors: Peak, Quasi-peak, Average
Power Operation AC/DC Adapter

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CE22BQP			
Trace2:	CE22BAP			
Trace3:	---			
TRACE	FREQUENCY	LEVEL dBμV	DELTA	LIMIT dB
1 Quasi Peak	182 kHz	36.51	-27.87	
2 Average	202 kHz	22.58	-30.94	
2 Average	402 kHz	26.20	-21.60	
1 Quasi Peak	406 kHz	37.78	-19.94	
1 Quasi Peak	658 kHz	36.45	-19.54	
2 Average	658 kHz	31.22	-14.78	
2 Average	1.082 MHz	15.29	-30.70	
1 Quasi Peak	1.154 MHz	26.34	-29.65	
2 Average	1.314 MHz	25.79	-20.20	
1 Quasi Peak	1.318 MHz	28.41	-27.58	
1 Quasi Peak	2.502 MHz	25.28	-30.71	
2 Average	2.63 MHz	21.35	-24.64	
1 Quasi Peak	4.602 MHz	24.78	-31.21	
2 Average	4.602 MHz	16.97	-29.02	
2 Average	6.574 MHz	14.42	-35.57	
1 Quasi Peak	7.226 MHz	19.67	-40.33	
1 Quasi Peak	17.586 MHz	24.11	-35.89	
2 Average	17.614 MHz	16.27	-33.72	
1 Quasi Peak	19.062 MHz	30.73	-29.27	
2 Average	19.59 MHz	22.54	-27.45	

Date: 26.JUN.2019 07:36:46

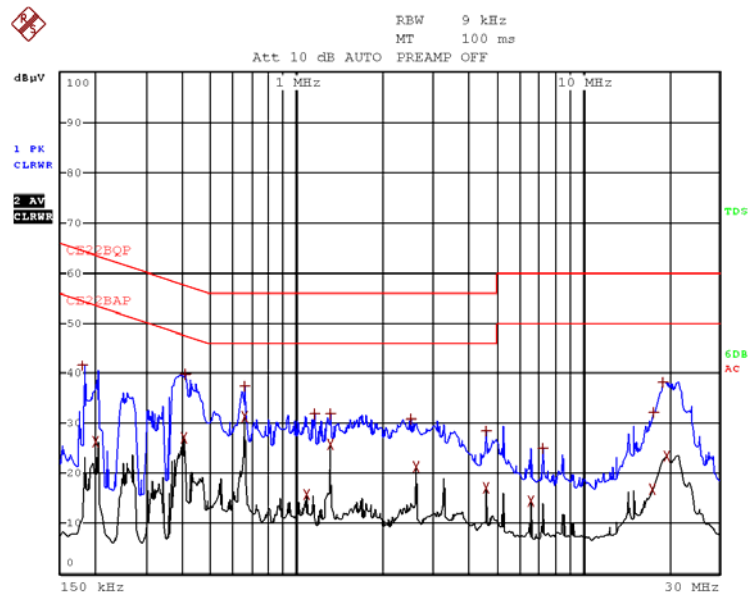
Figure 13. Detectors: Peak, Quasi-peak, Average

Note: QP Delta/Av Delta 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.

Conducted Emission

E.U.T Description Poultry House
Monitoring Equipment
Type ECHO
Serial Number: 0519.08928

Specification: FCC Part 15, Subpart C;
RSS Gen, Issue 5, Clause 8.8
Lead: Neutral
Detectors: Peak, Quasi-peak, Average
Power Operation AC/DC Adapter



Date: 26.JUN.2019 07:33:02

Figure 14 Detectors: Peak, Quasi-peak, Average



4.5 Test Equipment Used; Conducted Emission

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
LISN	Fischer	FCC-LISN-25A	127	July 20, 2017	July 31, 2019
Transient Limiter	HP	11947A	3107A03042	June 25, 2018	June 30, 2019
EMI Receiver	Rohde & Schwarz	ESCI7	100724	February 27, 2019	February 28, 2020
Cable CE Chamber 3M + 3M	Testline 18 + RJ214	11556	-	March 31, 2019	March 31, 2020

Figure 15 Test Equipment Used

5. 6 dB Minimum Bandwidth

5.1 Test Specification

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

RSS 247, Issue 2, Section 5.2(a)

5.2 Test Procedure

(Temperature (21°C)/ Humidity (63%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.

5.3 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.

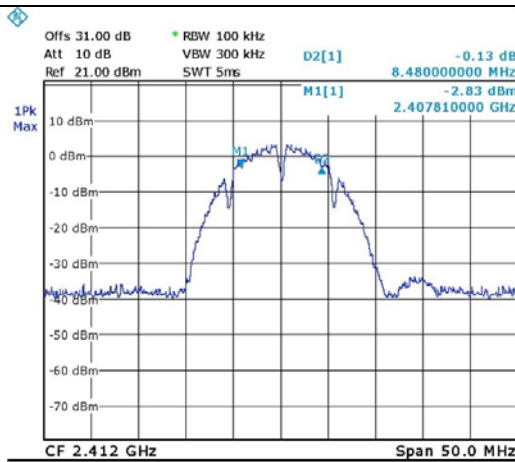
5.4 Test Results

Protocol Type	Operating Frequency	Reading	Limit
	(MHz)	(kHz)	(kHz)
Wi-fi/b(1Mbit/s)	2412.0	8480.0	>500.0
	2437.0	8580.0	>500.0
	2462.0	9580.0	>500.0
Wi-fi/b(11Mbit/s)	2412.0	8780.0	>500.0
	2437.0	8180.0	>500.0
	2462.0	8280.0	>500.0
Wi-fi/g(6Mbit/s)	2412.0	14,970.0	>500.0
	2437.0	14,270.0	>500.0
	2462.0	15,170.0	>500.0
Wi-fi/g(54Mbit/s)	2412.0	16,370.0	>500.0
	2437.0	16,370.0	>500.0
	2462.0	16,470.0	>500.0
Wi-fi/n(6.5Mbit/s)	2412.0	16,470.0	>500.0
	2437.0	14,930.0	>500.0
	2462.0	15,170.0	>500.0
Wi-fi/n(65Mbit/s)	2412.0	17,660.0	>500.0
	2437.0	17,610.0	>500.0
	2462.0	17,760.0	>500.0

Figure 16 6 dB Minimum Bandwidth

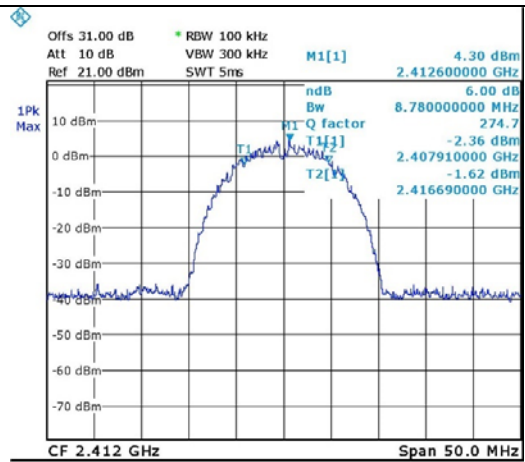
JUDGEMENT: Passed

For additional information see *Figure 17* to *Figure 34*.



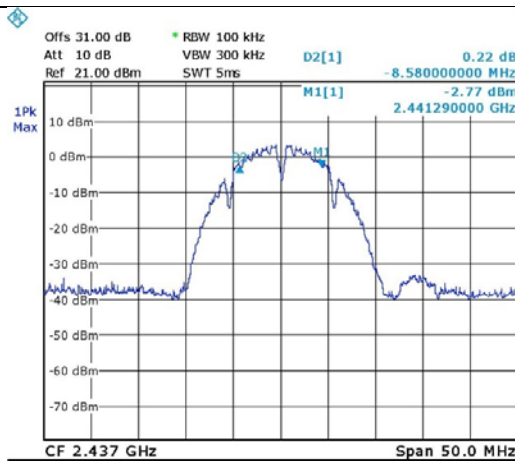
Date: 12.JUN.2019 07:52:25

Figure 17. 2412.0 MHz, Wi-fi/b(1Mbit/s)



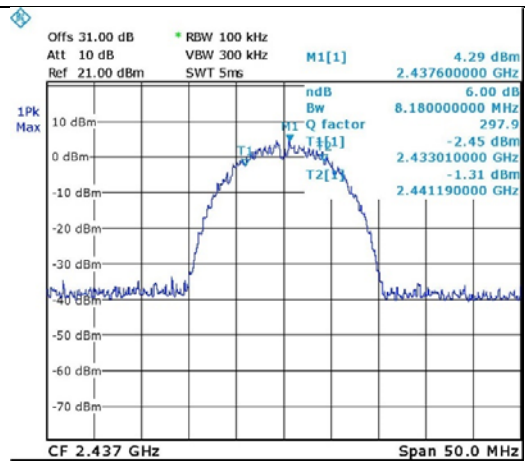
Date: 12.JUN.2019 08:00:19

Figure 18. 2412.0 MHz, Wi-fi/b(11Mbit/s)



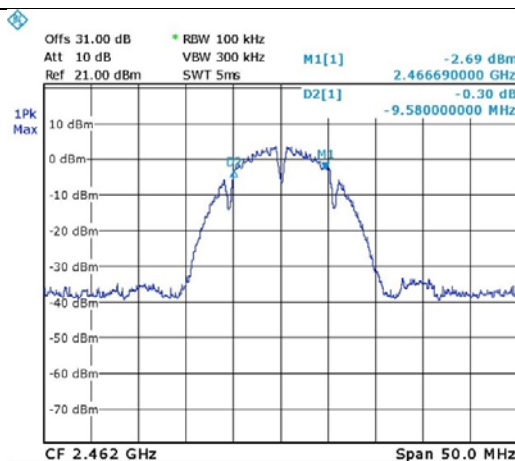
Date: 12.JUN.2019 07:54:08

Figure 19. 2437.0 MHz, Wi-fi/b(1Mbit/s)



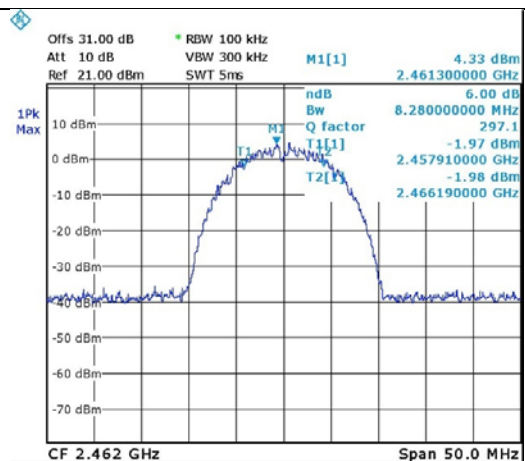
Date: 12.JUN.2019 07:58:58

Figure 20. 2437.0 MHz, Wi-fi/b(11Mbit/s)



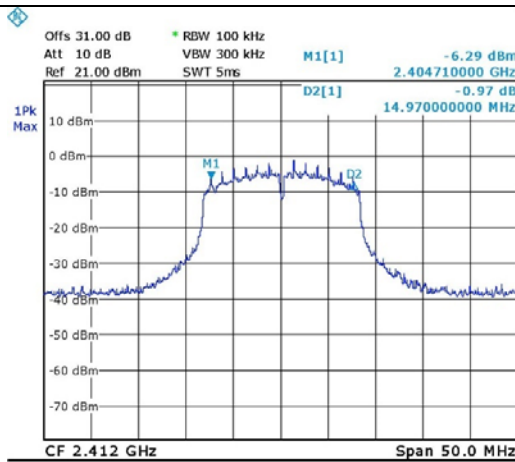
Date: 12.JUN.2019 07:56:55

Figure 21. 2462.0 MHz, Wi-fi/b(1Mbit/s)



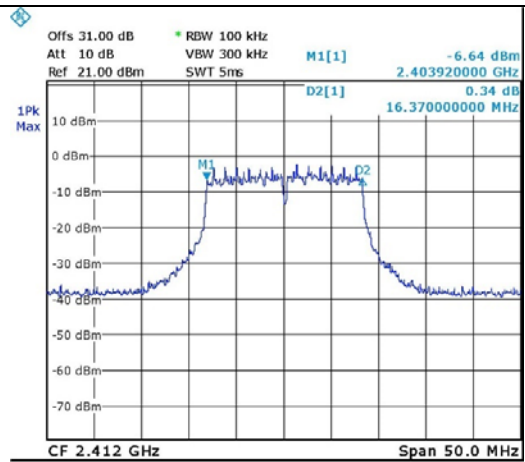
Date: 12.JUN.2019 07:57:58

Figure 22. 2462.0 MHz, Wi-fi/b(11Mbit/s)



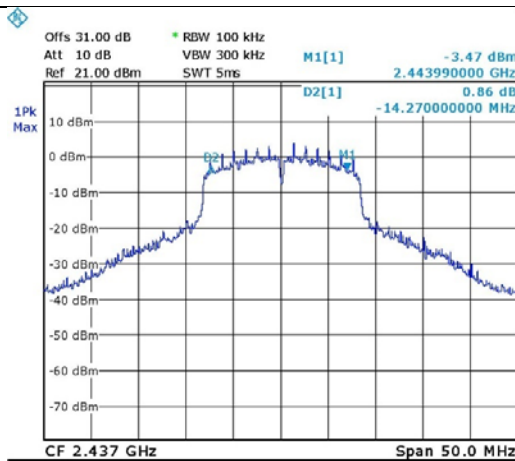
Date: 12.JUN.2019 08:05:58

Figure 23. 2412.0 MHz, Wi-fi/g(6Mbit/s)



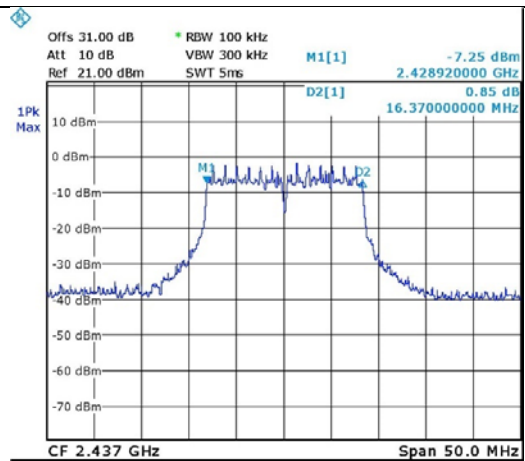
Date: 12.JUN.2019 08:19:46

Figure 24. 2412.0 MHz, Wi-fi/g(54Mbit/s)



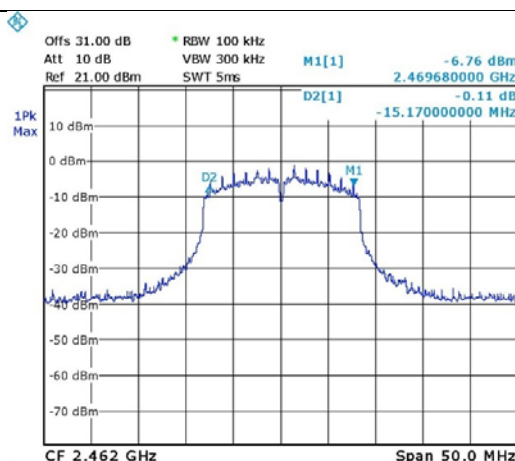
Date: 12.JUN.2019 08:09:53

Figure 25. 2437.0 MHz, Wi-fi/g(6Mbit/s)



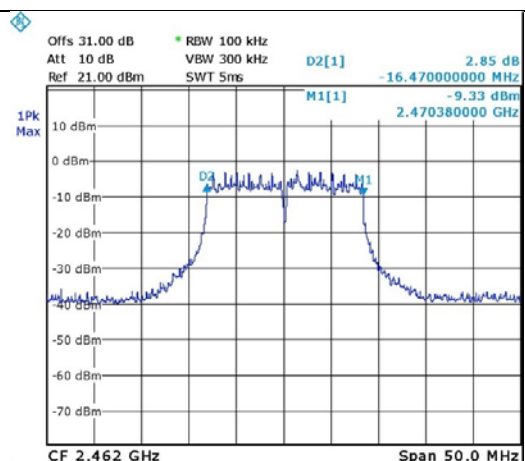
Date: 12.JUN.2019 08:14:09

Figure 26. 2437.0 MHz, Wi-fi/g(54Mbit/s)



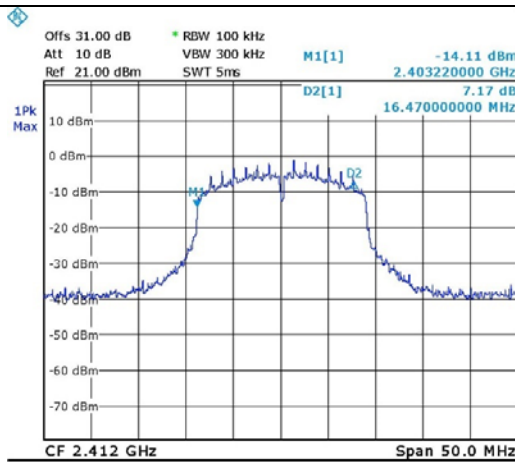
Date: 12.JUN.2019 08:10:44

Figure 27. 2462.0 MHz, Wi-fi/g(6Mbit/s)



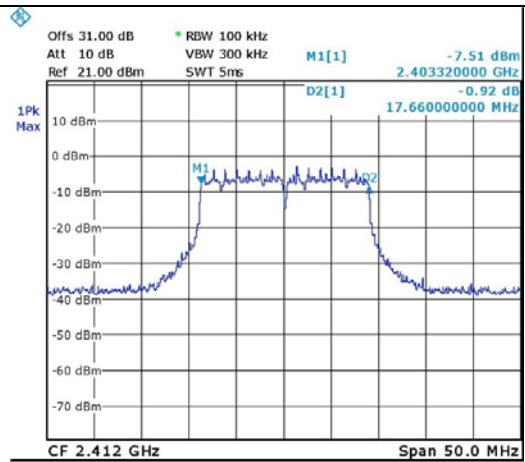
Date: 12.JUN.2019 08:12:44

Figure 28. 2462.0 MHz, Wi-fi/g(54Mbit/s)



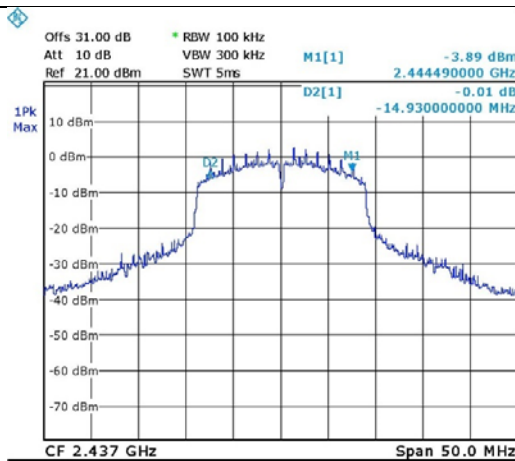
Date: 12.JUN.2019 08:22:04

Figure 29. 2412.0 MHz, Wi-fi/n(6.5Mbit/s)



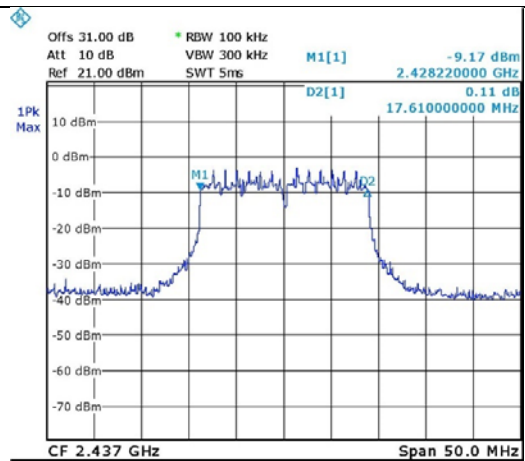
Date: 12.JUN.2019 08:49:02

Figure 30. 2412.0 MHz, Wi-fi/n(65Mbit/s)



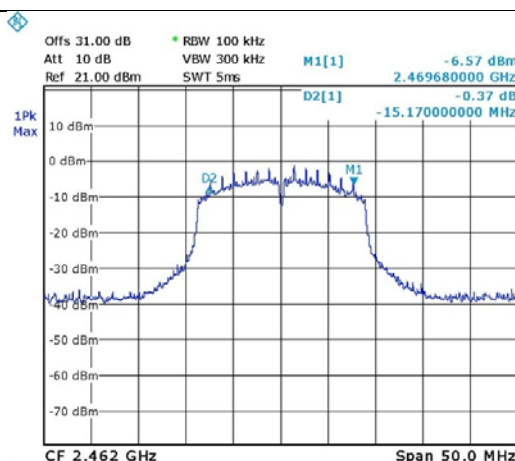
Date: 12.JUN.2019 08:24:29

Figure 31. 2437.0 MHz, Wi-fi/n(6.5Mbit/s)



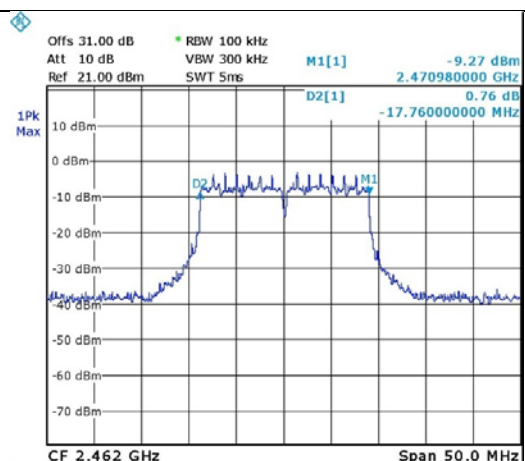
Date: 12.JUN.2019 08:30:33

Figure 32. 2437.0 MHz, Wi-fi/n(65Mbit/s)



Date: 12.JUN.2019 08:26:28

Figure 33. 2462.0 MHz, Wi-fi/n(6.5Mbit/s)



Date: 12.JUN.2019 08:28:33

Figure 34. 2462.0 MHz, Wi-fi/n(65Mbit/s)



5.5 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, 2019
RF Cable	Huber Suner	Sucofelex	28239/4PEA	December 24, 2018	December 31, 2019

Figure 35 Test Equipment Used

6. Maximum Conducted Output Power

6.1 Test Specification

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

RSS 247, Issue 2, Section 5.4(d)

6.2 Test Procedure

(Temperature (21°C)/ Humidity (63%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.

6.3 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.

6.4 Test Results

Protocol Type	Operation Frequency	Power	Power	Limit	Margin
	(MHz)	(dBm)	(mW)	(mW)	(mW)
Wi-fi/b(1Mbit/s)	2412.0	17.9	61.66	1000.0	-938.34
	2437.0	18.0	63.10	1000.0	-936.90
	2462.0	18.0	63.10	1000.0	-936.90
Wi-fi/b(11Mbit/s)	2412.0	20.3	107.15	1000.0	-892.85
	2437.0	20.6	114.82	1000.0	-885.18
	2462.0	21.0	125.89	1000.0	-874.11
Wi-fi/g(6Mbit/s)	2412.0	15.9	38.90	1000.0	-961.10
	2437.0	20.5	112.20	1000.0	-887.8
	2462.0	16.1	40.74	1000.0	-959.26
Wi-fi/g(54Mbit/s)	2412.0	16.1	40.74	1000.0	-959.26
	2437.0	16.5	44.67	1000.0	-955.33
	2462.0	16.5	44.67	1000.0	-955.33
Wi-fi/n(6.5Mbit/s)	2412.0	15.9	38.90	1000.0	-961.10
	2437.0	19.3	85.11	1000.0	-914.89
	2462.0	15.6	36.31	1000.0	-963.69
Wi-fi/n(65Mbit/s)	2412.0	15.2	33.11	1000.0	-966.89
	2437.0	14.8	30.20	1000.0	-969.8.0
	2462.0	15.1	32.36	1000.0	-967.64

Figure 36 Maximum Peak Power Output

JUDGEMENT: Passed by 874.11 mW

For additional information see *Figure 37* to *Figure 54*.

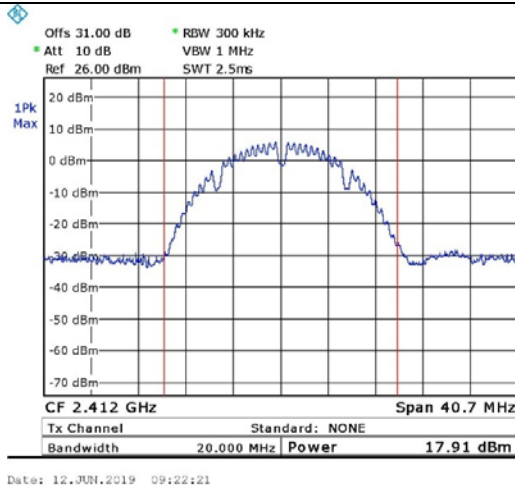


Figure 37. 2412.0 MHz, Wi-fi/b(1Mbit/s)

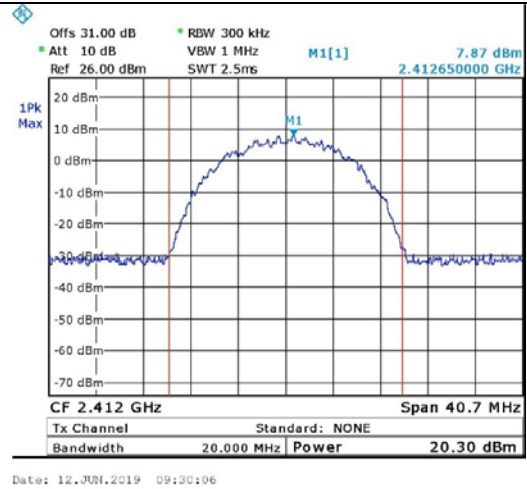


Figure 38. 2412.0 MHz, Wi-fi/b(11Mbit/s)

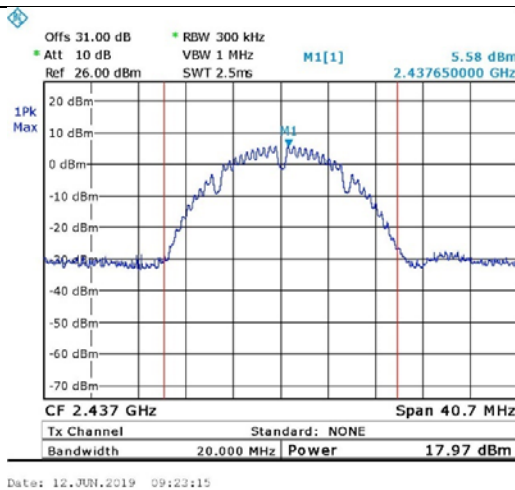


Figure 39. 2437.0 MHz, Wi-fi/b(1Mbit/s)

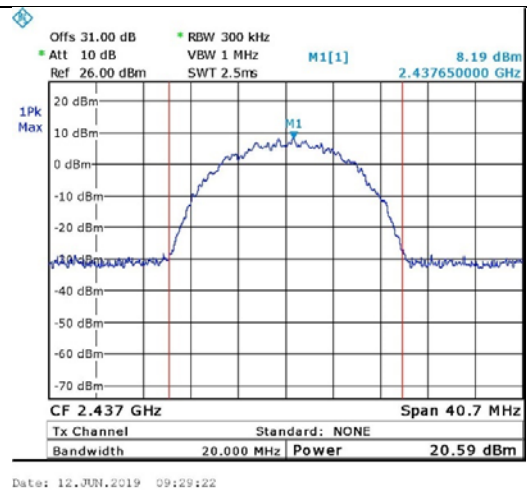


Figure 40. 2437.0 MHz, Wi-fi/b(11Mbit/s)

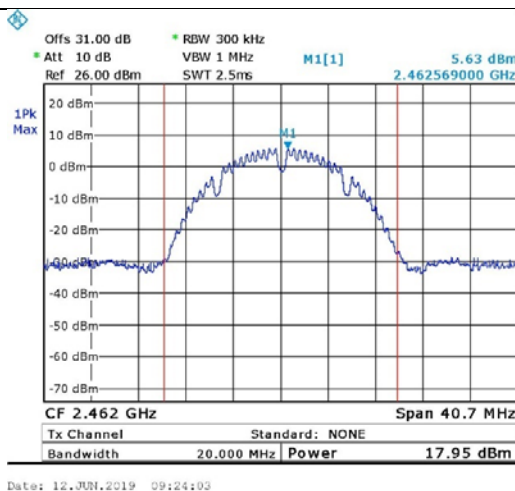


Figure 41. 2462.0 MHz, Wi-fi/b(1Mbit/s)

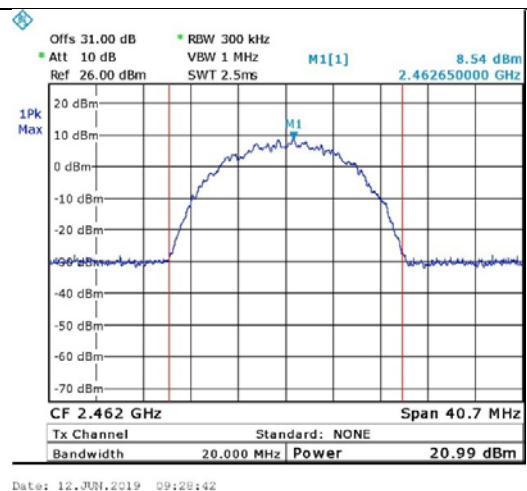


Figure 42. 2462.0 MHz, Wi-fi/b(11Mbit/s)

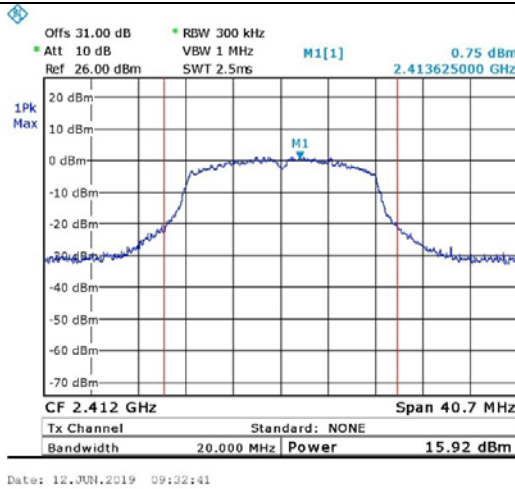


Figure 43. 2412.0 MHz, Wi-fi/g(6Mbit/s)

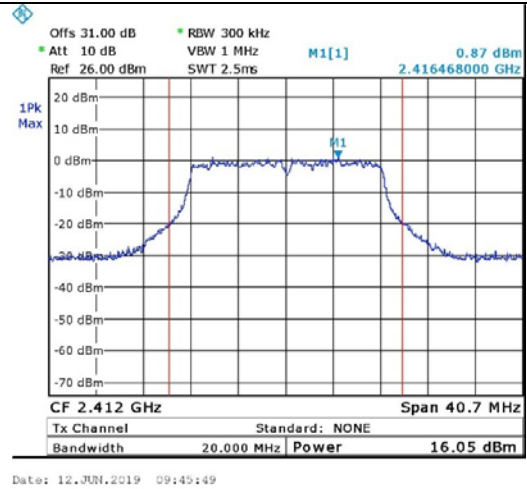


Figure 44. 2412.0 MHz, Wi-fi/g(54Mbit/s)

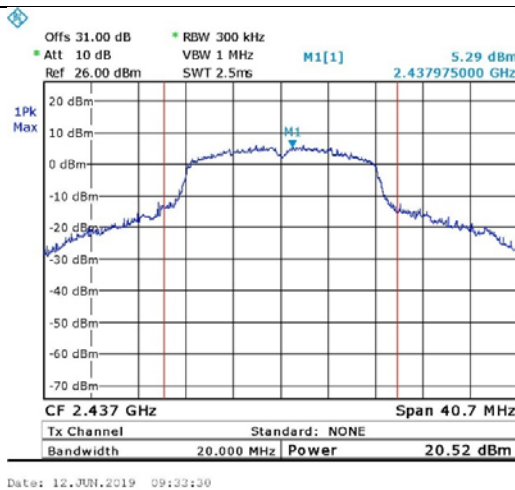


Figure 45. 2437.0 MHz, Wi-fi/g(6Mbit/s)

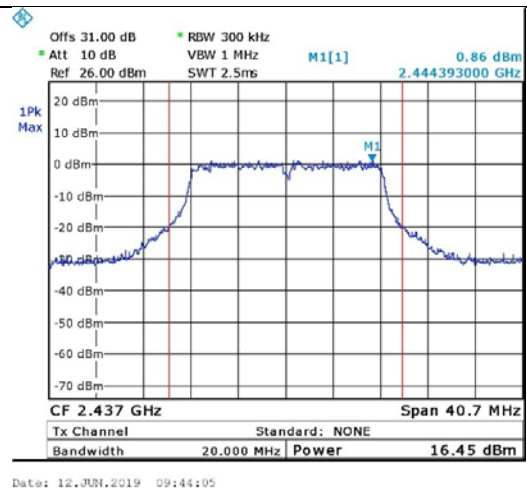


Figure 46. 2437.0 MHz, Wi-fi/g(54Mbit/s)

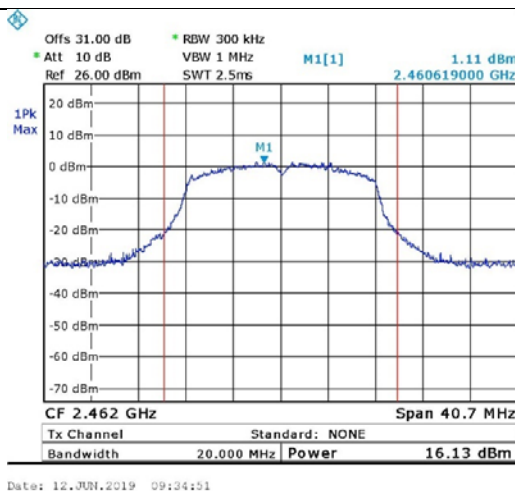


Figure 47. 2462.0 MHz, Wi-fi/g(6Mbit/s)

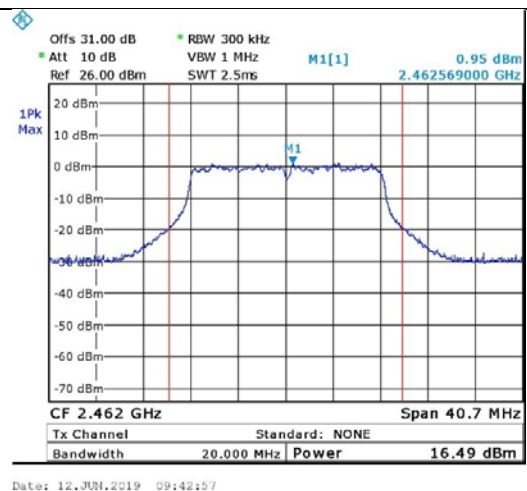


Figure 48. 2462.0 MHz, Wi-fi/g(54Mbit/s)

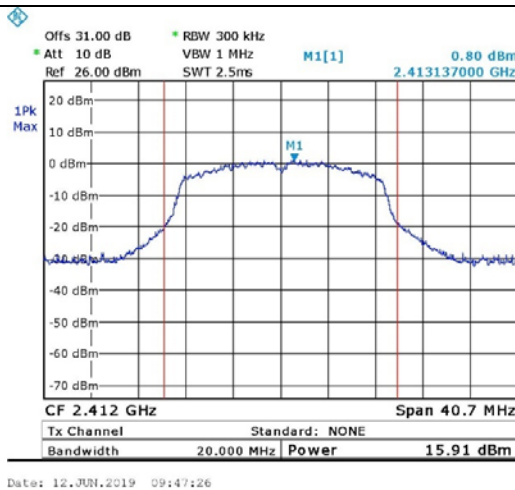


Figure 49. 2412.0 MHz, Wi-fi/n(6.5Mbit/s)

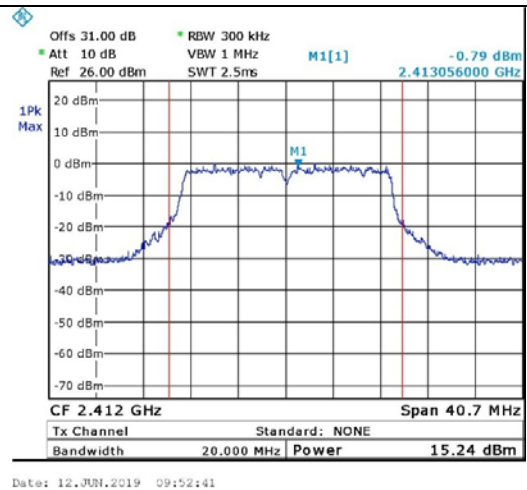


Figure 50. 2412.0 MHz, Wi-fi/n(65Mbit/s)

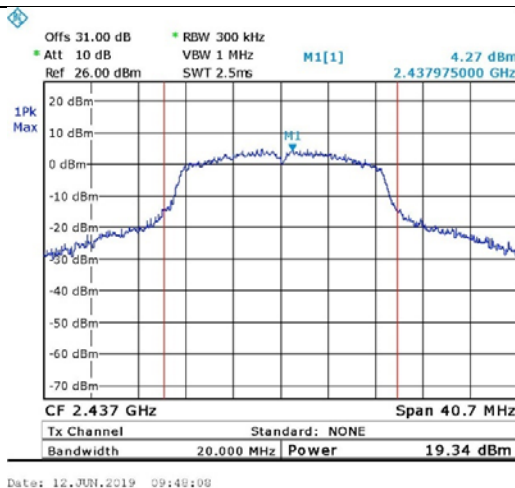


Figure 51. 2437.0 MHz, Wi-fi/n(6.5Mbit/s)

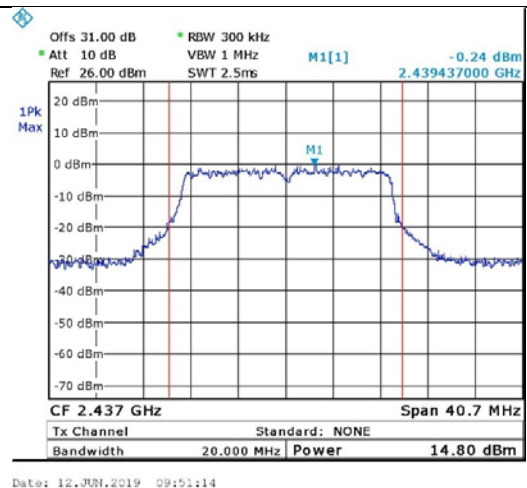


Figure 52. 2437.0 MHz, Wi-fi/n(65Mbit/s)

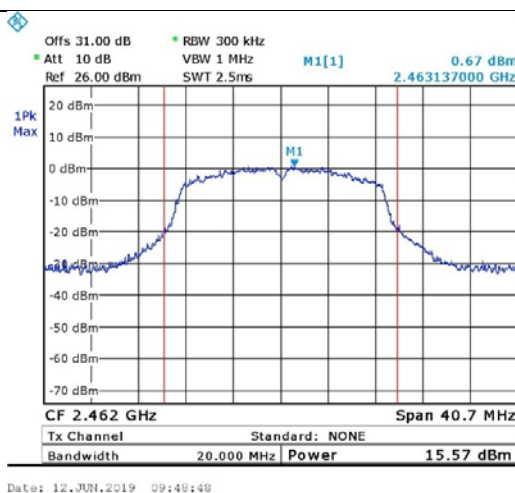


Figure 53. 2462.0 MHz, Wi-fi/n(6.5Mbit/s)

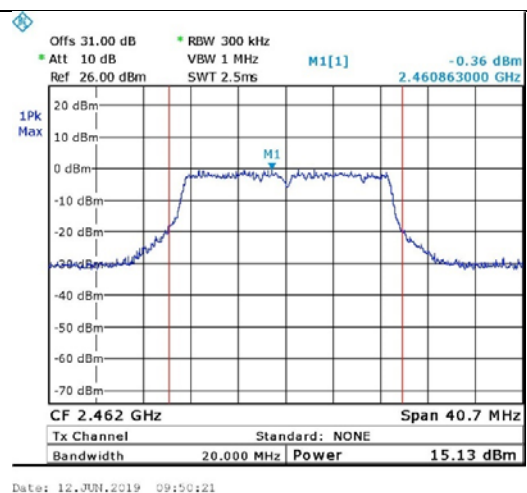


Figure 54. 2462.0 MHz, Wi-fi/n(65Mbit/s)



6.5 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 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	28239/4PEA	December 24, 2018	December 31, 2019

Figure 55 Test Equipment Used

7. Band Edge Spectrum

7.1 Test Specification

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

RSS 247, Issue 2, Section 5.5

7.2 Test Procedure

(Temperature (21°C)/ Humidity (63%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 RBW was set to 100 kHz.

7.3 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.

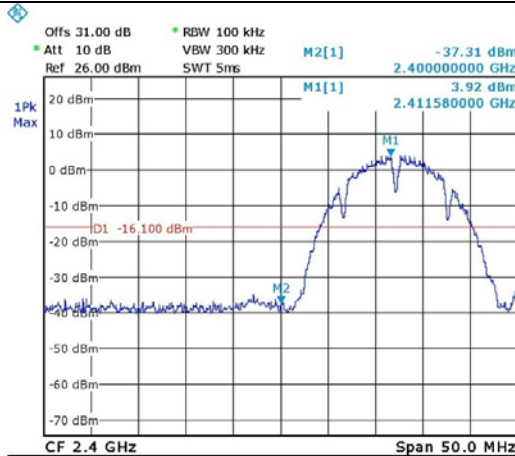
7.4 Test Results

Protocol Type	Operation Frequency	Band Edge Frequency	Spectrum Level	Limit	Margin
	(MHz)	(MHz)	(dBm)	(dBm)	(dB)
Wi-fi/b(1Mbit/s)	2412.0	2400.0	-37.3	-16.1	-21.2
	2462.0	2483.5	-38.7	-16.3	-22.4
Wi-fi/b(11Mbit/s)	2412.0	2400.0	-38.7	-15.3	-23.4
	2462.0	2483.5	-37.8	-14.9	-22.9
Wi-fi/g(6Mbit/s)	2412.0	2400.0	-33.3	-21.2	-12.1
	2462.0	2483.5	-38.8	-21.2	-17.6
Wi-Fi/g(54Mbit/s)	2412.0	2400.0	-33.5	-22.5	-11.0
	2462.0	2483.5	-38.1	-22.7	-15.4
Wi-Fi/n(6.5Mbit/s)	2412.0	2400.0	-33.7	-21.1	-12.6
	2462.0	2483.5	-38.0	-21.2	-16.8
Wi-fi/n(65Mbit/s)	2412.0	2400.0	-33.9	-23.0	-10.9
	2462.0	2483.5	-38.3	-23.3	-15.0

Figure 56 Band Edge Spectrum

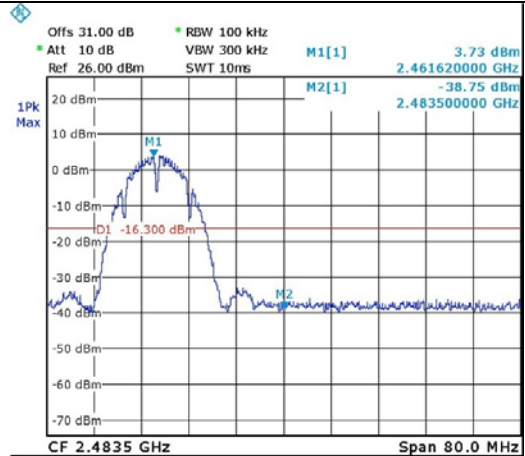
JUDGEMENT: Passed by 10.9 dB

For additional information see *Figure 57* to *Figure 68*.



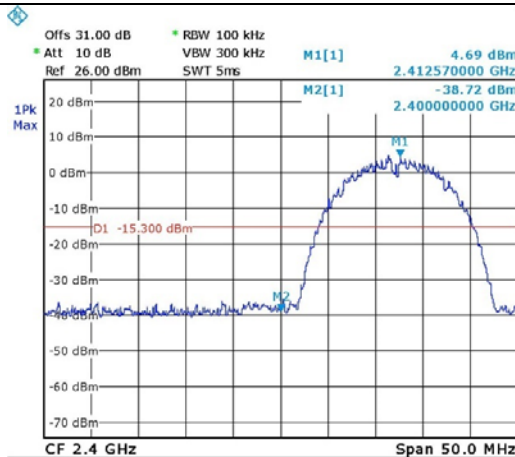
Date: 12.JUN.2019 10:26:46

Figure 57. 2412.0 MHz, Wi-fi/b(1Mbit/s)



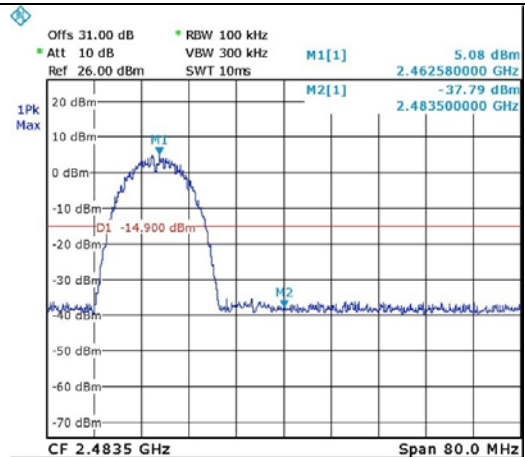
Date: 12.JUN.2019 10:43:37

Figure 58. 2462.0 MHz, Wi-fi/b(1Mbit/s)



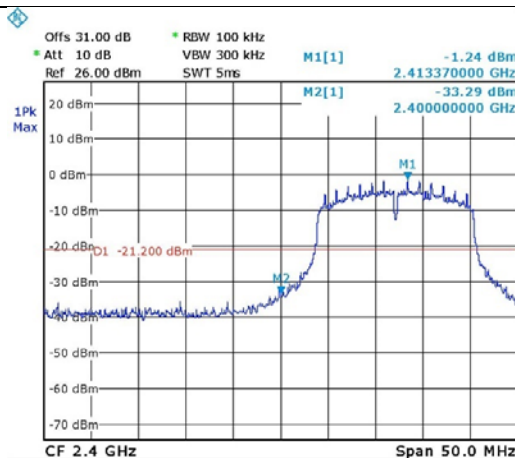
Date: 12.JUN.2019 10:28:10

Figure 59. 2412.0 MHz, Wi-fi/b(11Mbit/s)



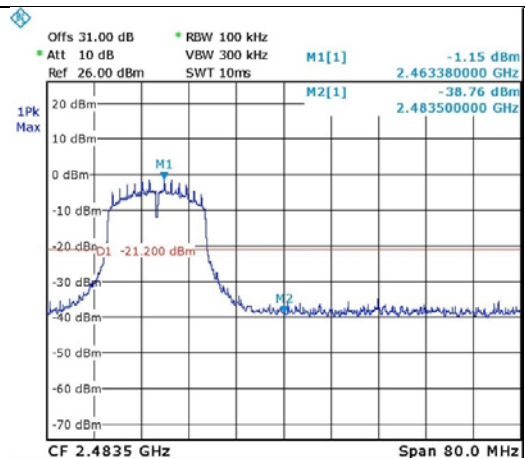
Date: 12.JUN.2019 10:42:34

Figure 60. 2462.0 MHz, Wi-fi/b(11Mbit/s)



Date: 12.JUN.2019 10:29:51

Figure 61. 2412.0 MHz, Wi-fi/g(6Mbit/s)



Date: 12.JUN.2019 10:41:28

Figure 62. 2462.0 MHz, Wi-fi/g(6Mbit/s)

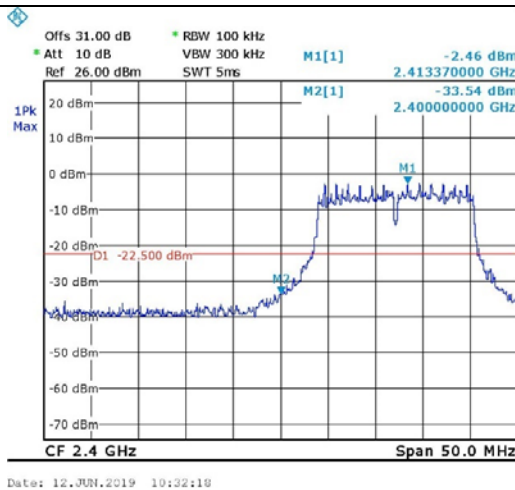


Figure 63. 2412.0 MHz, Wi-fi/g(54Mbit/s)

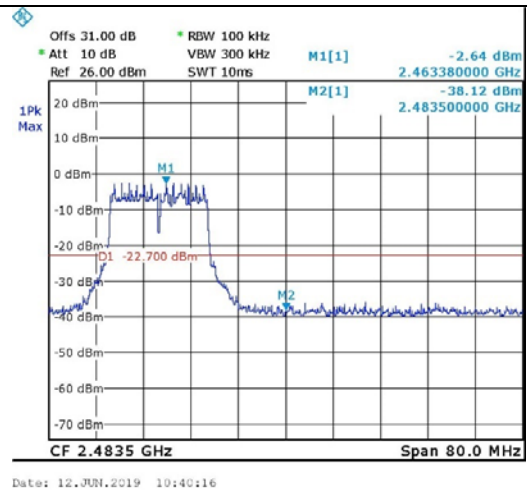


Figure 64. 2462.0 MHz, Wi-fi/g(54Mbit/s)

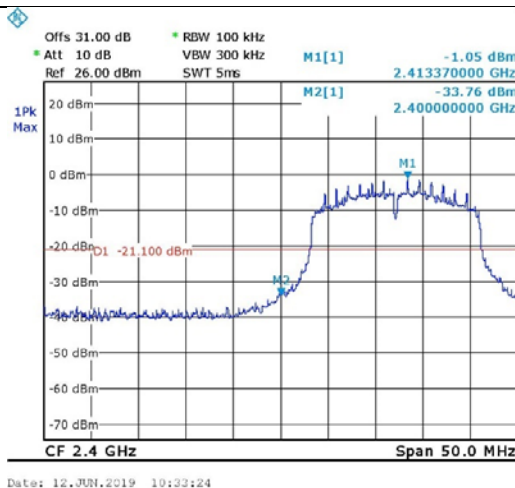


Figure 65. 2412.0 MHz, Wi-fi/n(6.5Mbit/s)

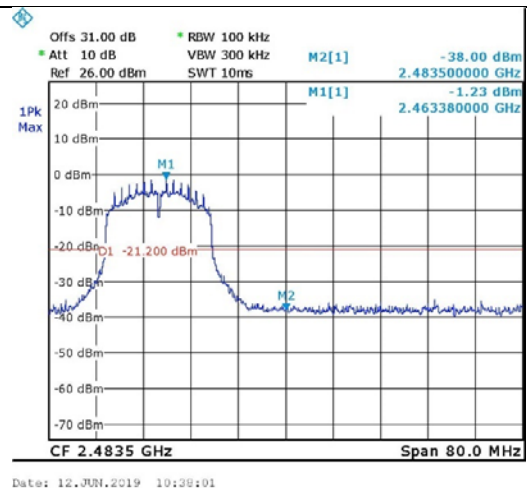


Figure 66. 2462.0 MHz, Wi-fi/n(6.5Mbit/s)

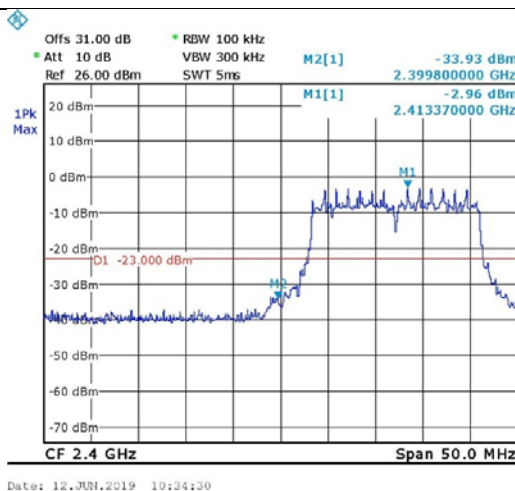


Figure 67. 2412.0 MHz, Wi-fi/n(65Mbit/s)

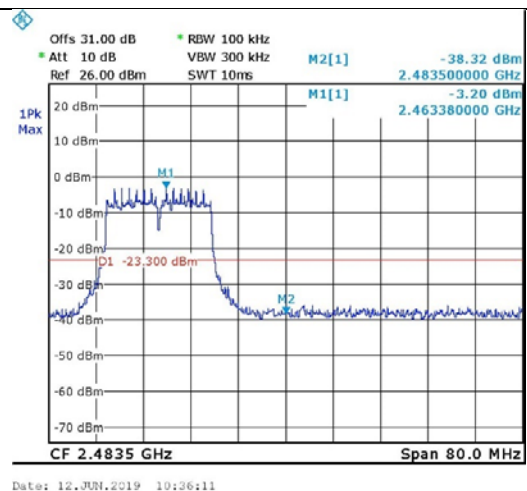


Figure 68. 2462.0 MHz, Wi-fi/n(65Mbit/s)



7.5 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	December 31, 2019
RF Cable	Huber Suner	Sucofelex	28239/4PE A	December 24, 2018	December 31, 2019

Figure 69 Test Equipment Used