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DATE: 20 August 2015

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

AeroScout Ltd.

Equipment under test:

WIFI Active RFID Pendant Tag

TAG-P1000
2.4 GHz WIFI

Approved by: _____
I. Siboni

Approved by: _____
D. Shidlowsky

Measurement/Technical Report for

AeroScout Ltd.

WIFI Active RFID Pendant Tag

TAG-P1000

FCC ID: Q3HTAGP1000

This report concerns:	Original Grant: X Class I Change: Class II Change:
Equipment type:	Digital Transmission System
Limits used:	47CFR15 Section 15.247

Measurement procedure used is KDB 558074 D01 v03r03 and ANSI C63.4-2009.

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

1.1 *Administrative Information*

Manufacturer:	AeroScout Ltd.
Manufacturer's Address:	Building 11, 6th floor, 2 Ilan Ramon St., Science Park, Ness Ziona, 7403635 Israel Tel: +972-8-936-9315 Fax: +972-8-936-5977
Manufacturer's Representative:	Dmitry Bobkov
Equipment Under Test (E.U.T):	WIFI Active RFID Pendant Tag
Equipment Model No.:	TAG-P1000
Equipment Serial No.:	0D0
Date of Receipt of E.U.T:	30.03.2015
Start of Test:	30.03.2015
End of Test:	07.04.2015
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101
Test Specifications:	FCC Part 15, Subpart C

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. US1004.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025A-1.

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 AeroScout P1000 Tag is a key component of the AeroScout Visibility System. The P1000 Tag is a small Wi-Fi and active RFID device that enables the wireless network infrastructure to locate patient not connected to a wireless network.
This enables tagged items to be accurately located in real-time and in any environment – from tight indoor locations such as hospital floors to open outdoor spaces such as parking lots.

AeroScout P1000 Tags contain on-board motion sensors. The motion sensor can be configured to trigger alerts. It also enables different transmission intervals for tags when they are stationary or in motion – which reduces unnecessary network traffic and conserves battery life.

1.4 Test Methodology

Radiated testing was performed according to the procedures in KDB 558074 D01 v03r03, ANSI C63.4: 2009. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 *Test Facility*

Radiated 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 US1004.

1.6 *Measurement Uncertainty*

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):

± 4.98 dB

Note: See ITL Procedure No. PM 198.

2. System Test Configuration

2.1 *Justification*

The E.U.T. contains an integral antenna but for testing purposes the integral antenna was replaced with a SMA coaxial connector.

Radiated spurious emissions was performed with another unit that contained the integral antenna.

Exploratory testing was performed in 3 orthogonal polarities to determine the worst case.

The fundamental results are shown in the below table:

Frequency (MHz)	X axis (dBuV/m)	Y axis (dBuV/m)	Z axis (dBuV/m)
2437.0	62.3	64.8	56.7

Figure 1. Screening Results

In all axes the spurious levels were under the noise level.
According to the above results the worst case was the Y axis.

The unit was tested while transmitting continuously at the low channel (2412MHz), the middle channel (2437MHz) and the high channel (2472MHz), modulated with two type of modulation: WIFI DSSS & OFDM.

2.2 *EUT Exercise Software*

No special exercise software was used.

2.3 *Special Accessories*

No special accessories were needed to achieve compliance.

2.4 *Equipment Modifications*

No modifications were necessary in order to achieve compliance.

2.5 *Configuration of Tested System*

Maximum activity interval: 0.25 sec (250msec) each transmission consists of 15 repetitions e.g. 15x4 times per sec. For better monitoring the transmission was changed to 1 time per sec.

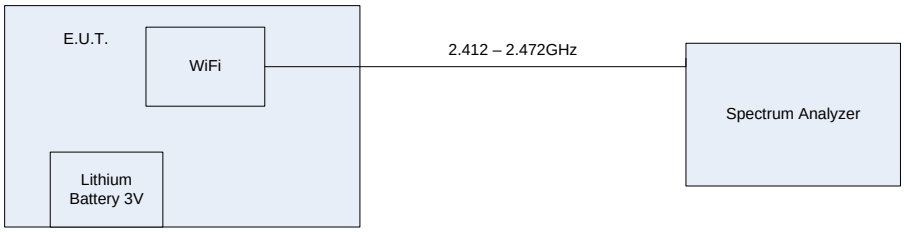

Figure 2. Configuration of Tested System

3. Radiated Measurement Test Set-up Photo

Figure 3. Radiated Emission Test

Figure 4. Radiated Emission Test

Figure 5. Radiated Emission Test

4. 6 dB Minimum Bandwidth

4.1 *Test Specification*

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

4.2 *Test Procedure*

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (30 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 1 MHz resolution BW and 1 or 3 MHz video BW (as applicable). The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded.

4.3 *Results Table*

Modulation	Operation Frequency (MHz)	Reading (MHz)	Specification (MHz)
DSS	2412	9.50	>0.5
	2437	11.00	>0.5
	2472	11.08	>0.5
4 QAM	2412	16.80	>0.5
	2437	16.83	>0.5
	2472	16.58	>0.5
64 QAM	2412	16.67	>0.5
	2437	16.50	>0.5
	2472	16.50	>0.5
16 QAM	2412	16.67	>0.5
	2437	16.92	>0.5
	2472	17.00	>0.5
BPSK	2412	16.95	>0.5
	2437	16.58	>0.5
	2472	16.75	>0.5

Figure 6 6 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 7* to *Figure 21*.

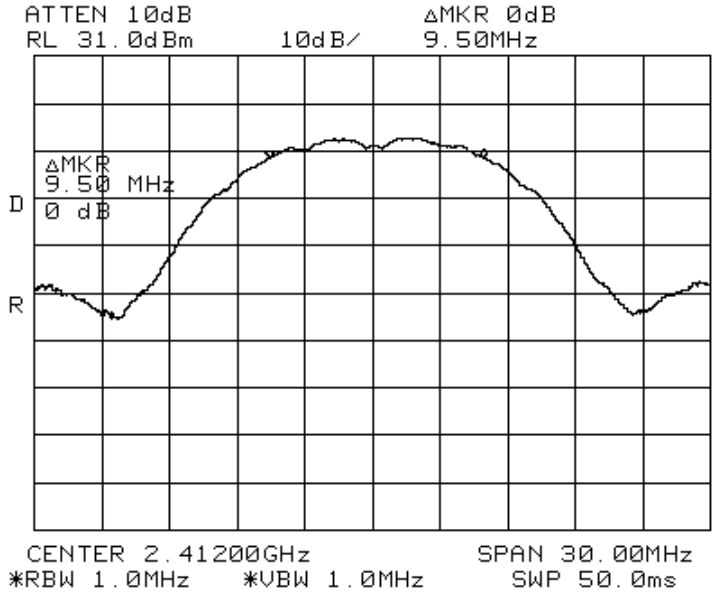

Figure 7. 2412 MHz, DSSS Modulation

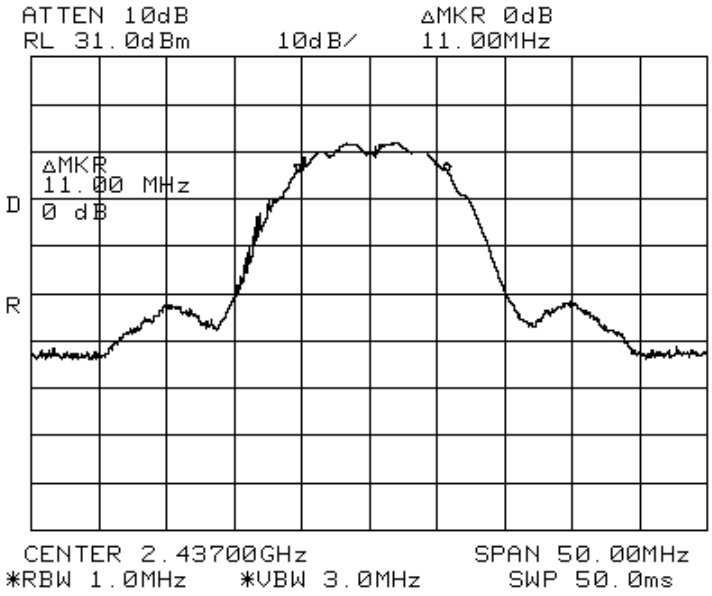

Figure 8. 2437 MHz, DSSS Modulation

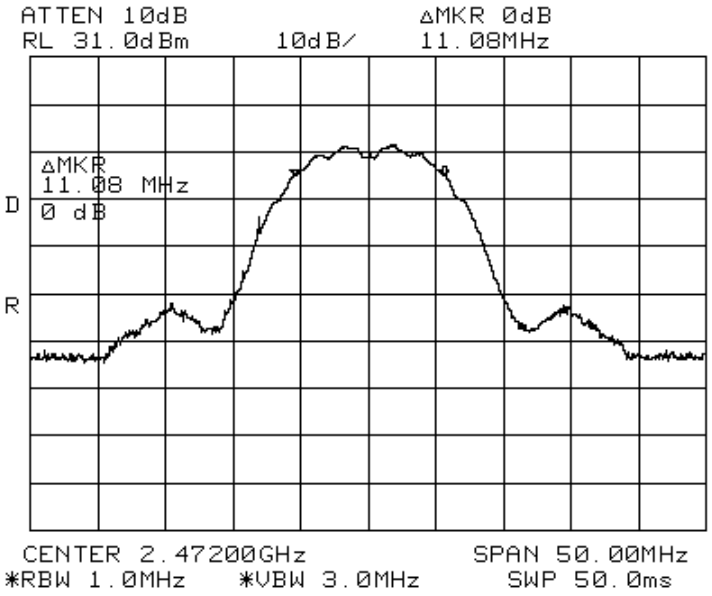

Figure 9. 2472 MHz, DSSS Modulation

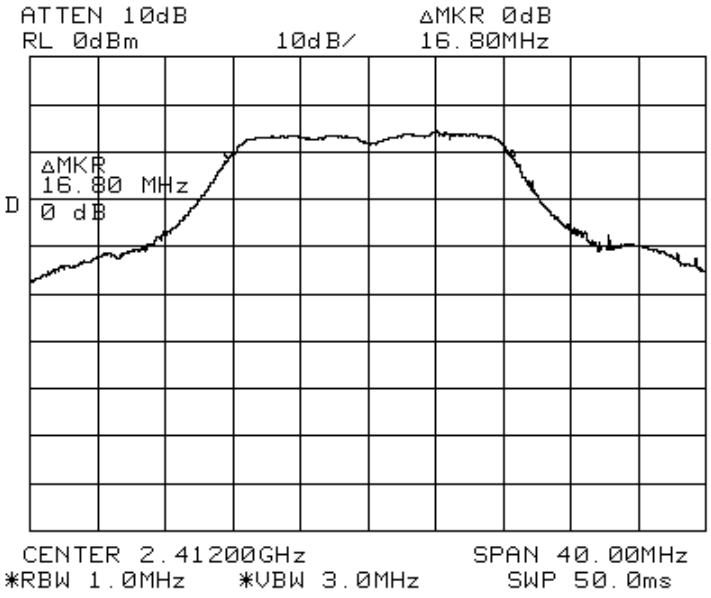

Figure 10. 2412 MHz, OFDM (4 QAM) Modulation

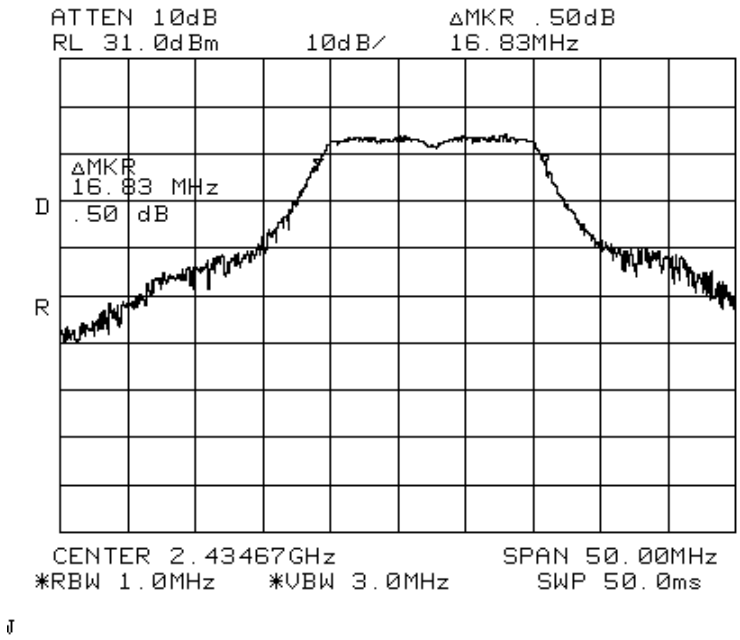

Figure 11. 2437 MHz, OFDM (4 QAM) Modulation

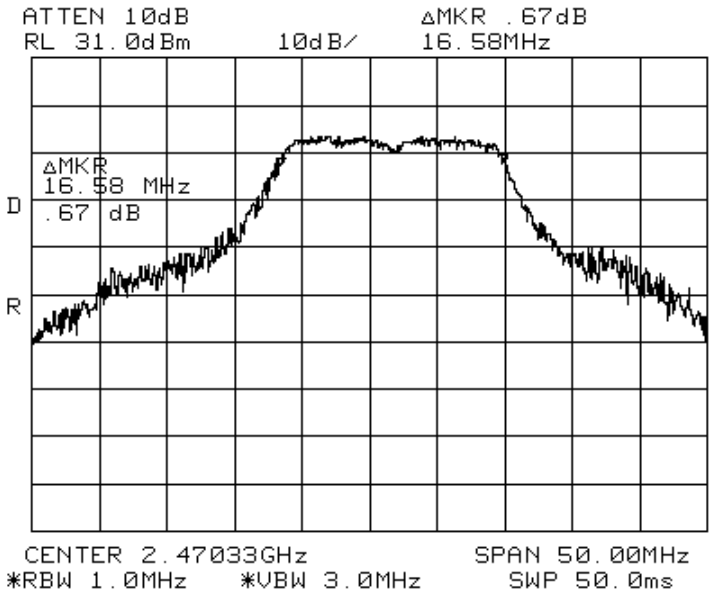

Figure 12. 2472 MHz, OFDM (4 QAM) Modulation

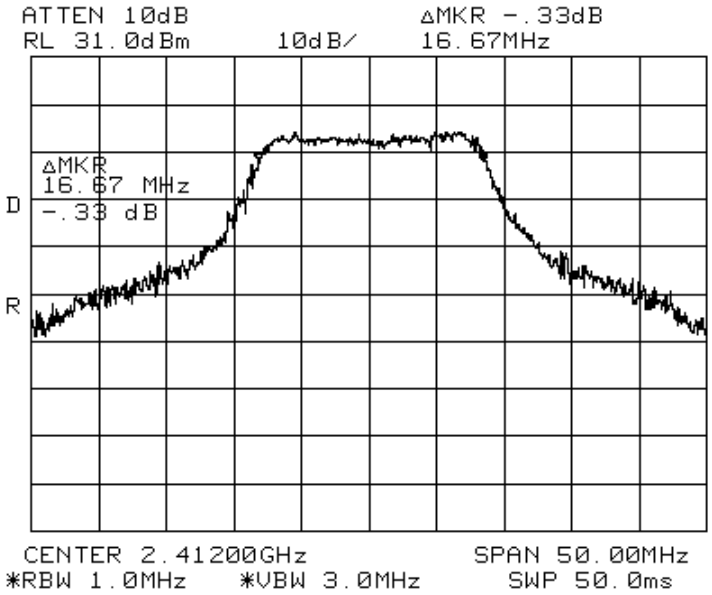

Figure 13. 2412 MHz, OFDM (64 QAM) Modulation

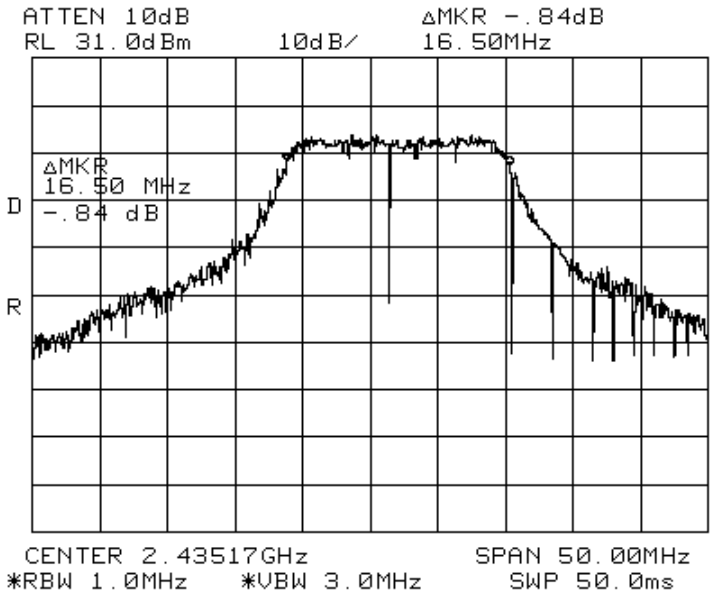

Figure 14. 2437 MHz, OFDM (64 QAM) Modulation

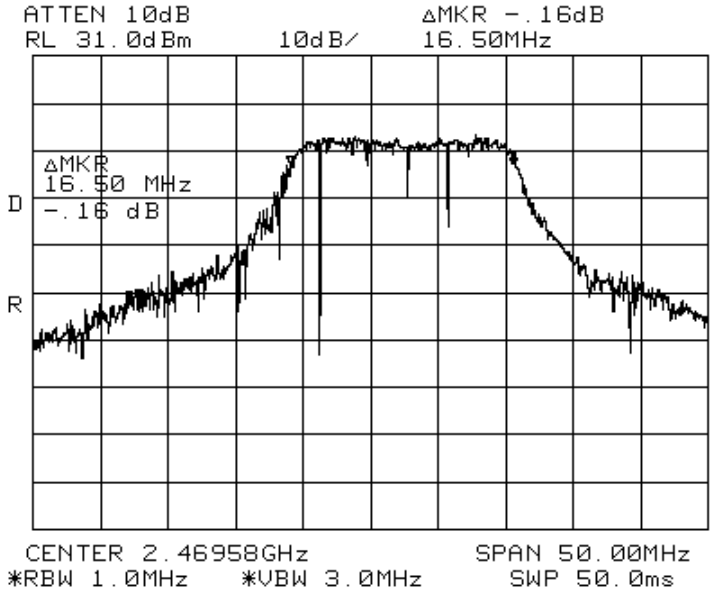

Figure 15. 2472MHz, OFDM (64 QAM) Modulation

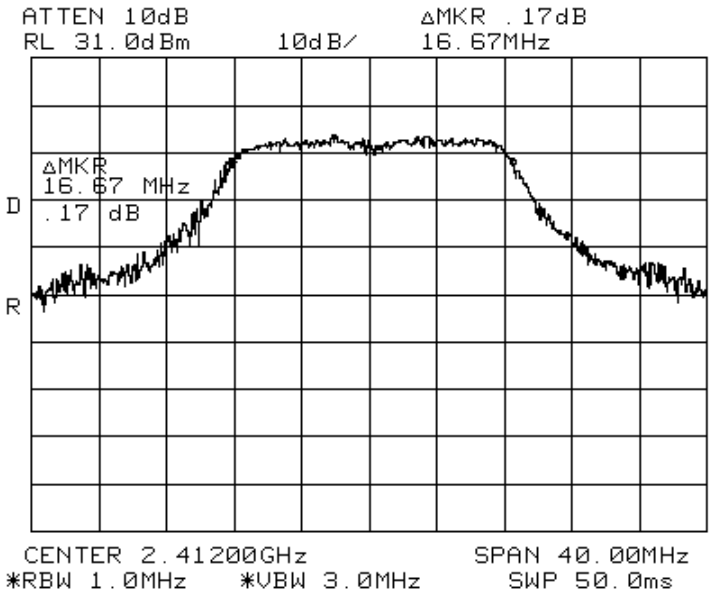

Figure 16. 2412 MHz, OFDM (16 QAM) Modulation

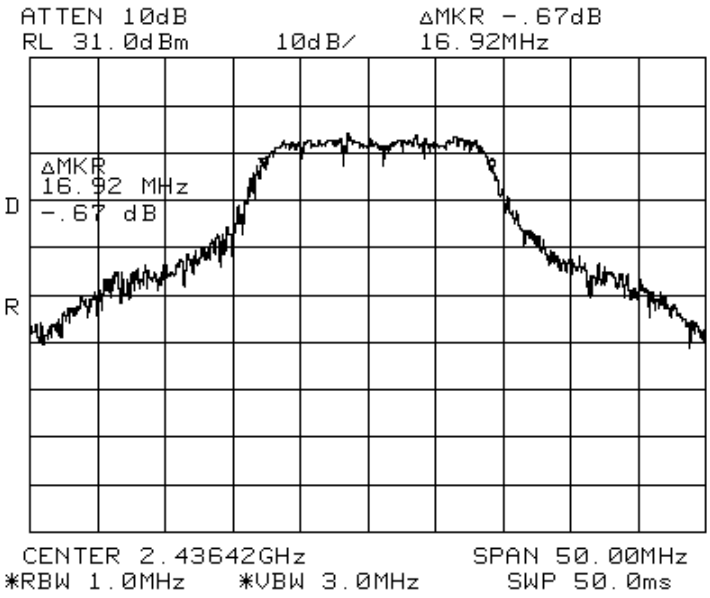

Figure 17. 2437 MHz, OFDM (16 QAM) Modulation

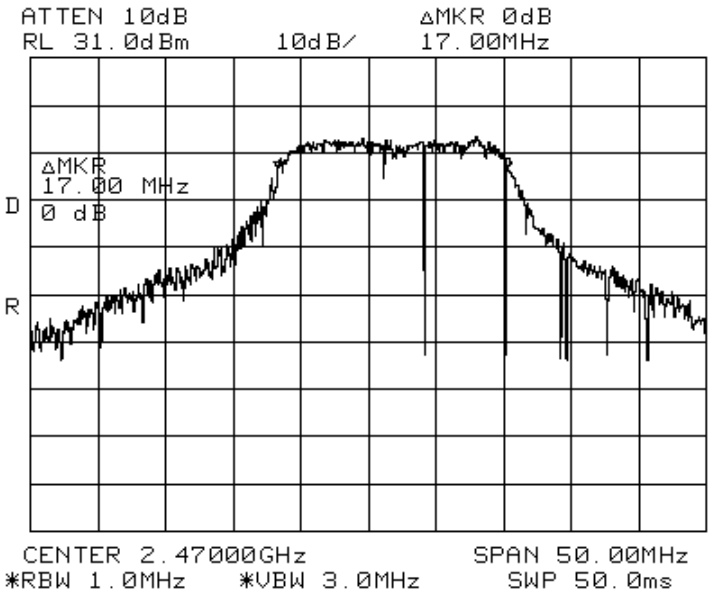

Figure 18. 2472 MHz, OFDM (16 QAM) Modulation

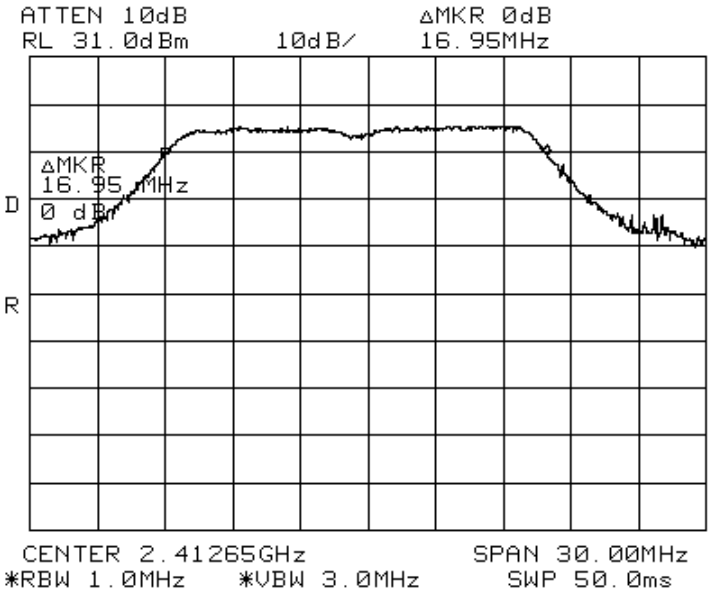

Figure 19. 2412 MHz, OFDM (BPSK) Modulation

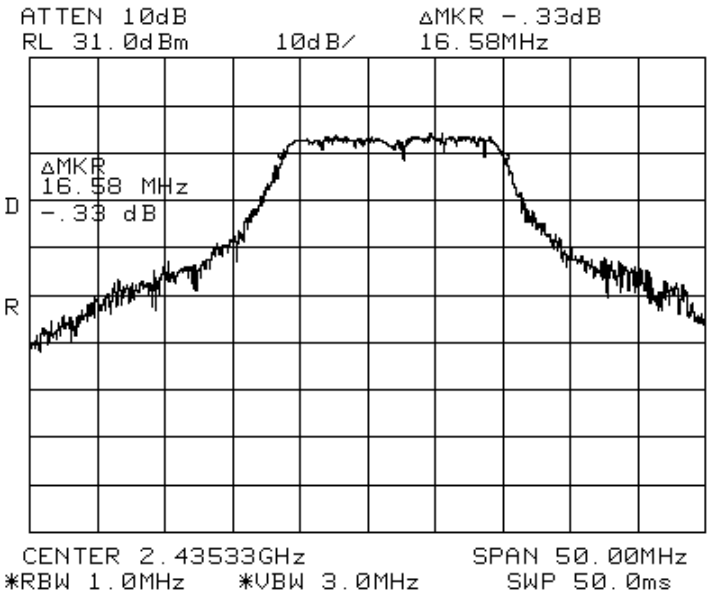

Figure 20. 2437 MHz, OFDM (BPSK) Modulation

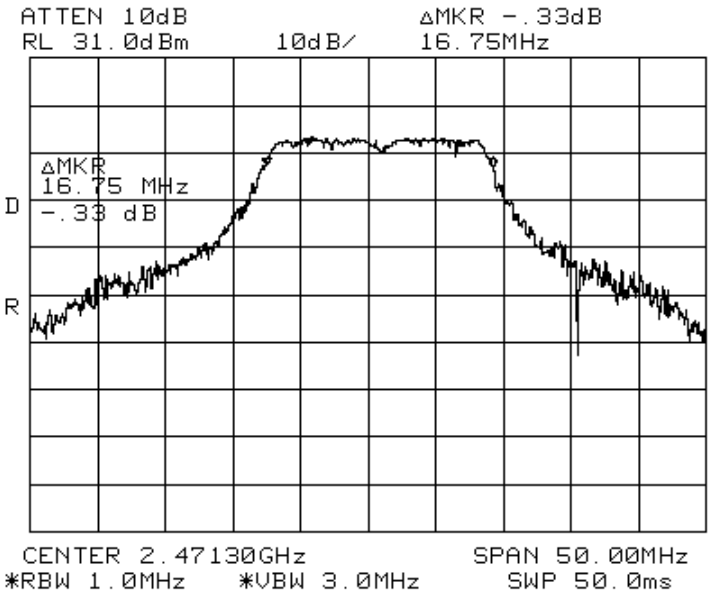

Figure 21. 2472 MHz, OFDM (BPSK) Modulation

4.4 *Test Equipment Used; 6dB Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Attenuator 30dB	Bird	8304-N30DB	N.A.	May 30, 2014	1 year
Spectrum Analyzer	HP	8563E	3810A8846	November 30, 2014	1 year

Figure 22 Test Equipment Used

5. 26 dB Minimum Bandwidth

5.1 *Test Specification*

F.C.C. Part 2, Section 2.1049

5.2 *Test Procedure*

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (30 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 1 MHz resolution BW and 1or 3 MHz video BW (as applicable).

The spectrum bandwidth of the E.U.T. at the point of 26 dB below maximum peak power was measured and recorded.

5.3 *Test Results*

Modulation	Operation Frequency (MHz)	Reading (MHz)
DSS	2412	18.60
	2437	18.08
	2472	18.08
4 QAM	2412	26.92
	2437	26.75
	2472	27.92
64 QAM	2412	25.67
	2437	26.42
	2472	24.75
16 QAM	2412	25.00
	2437	26.75
	2472	24.83
BPSK	2412	27.53
	2437	26.33
	2472	25.25

Figure 23 26 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 24* to *Figure 38.*

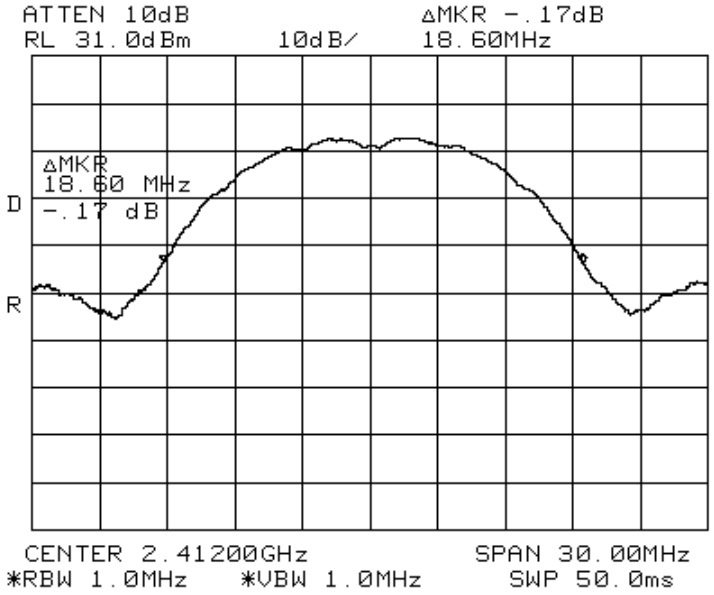

Figure 24. 2412 MHz, DSSS Modulation

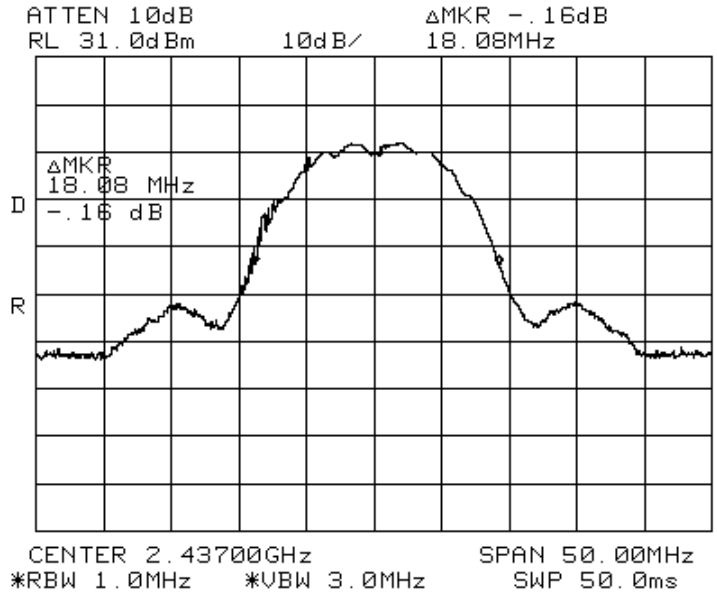

Figure 25. 2437 MHz, DSSS Modulation

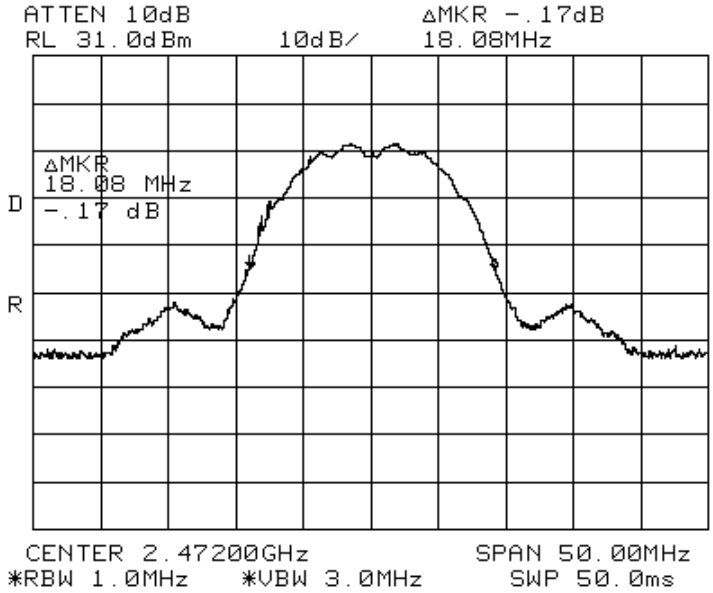

Figure 26. 2472 MHz, DSSS Modulation

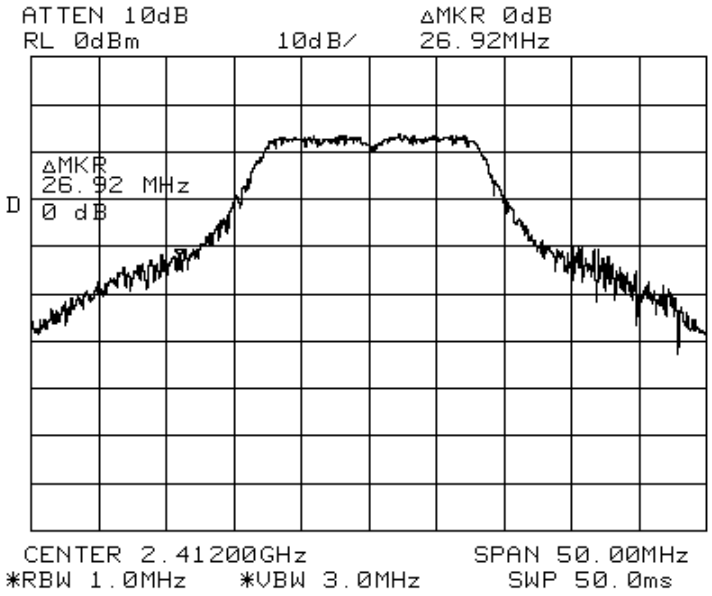

Figure 27. 2412 MHz, OFDM (4 QAM) Modulation

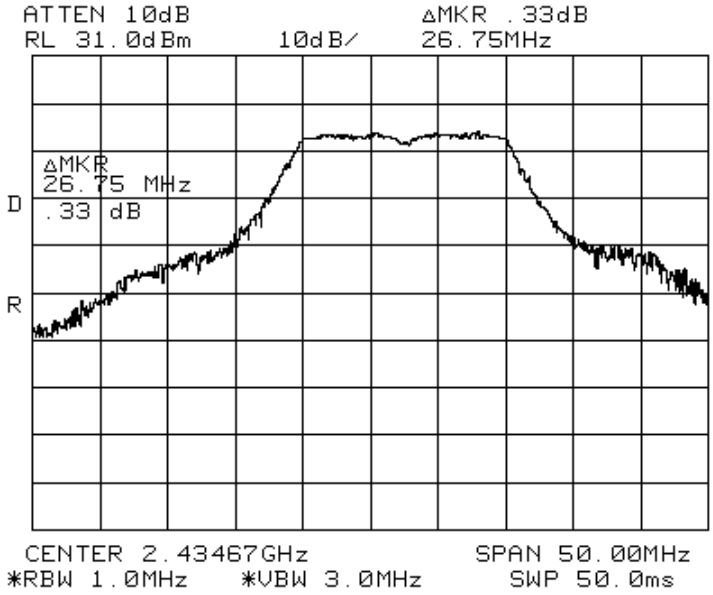

Figure 28. 2437 MHz, OFDM (4 QAM) Modulation

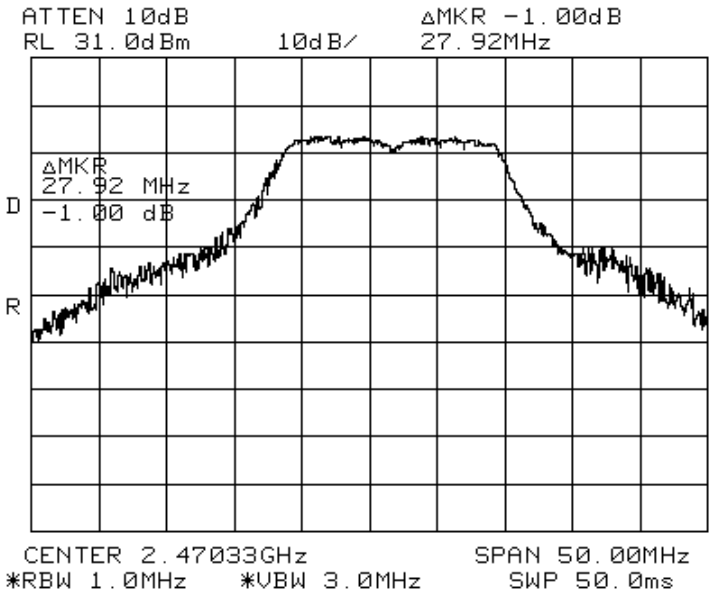

Figure 29. 2472 MHz, OFDM (4 QAM) Modulation

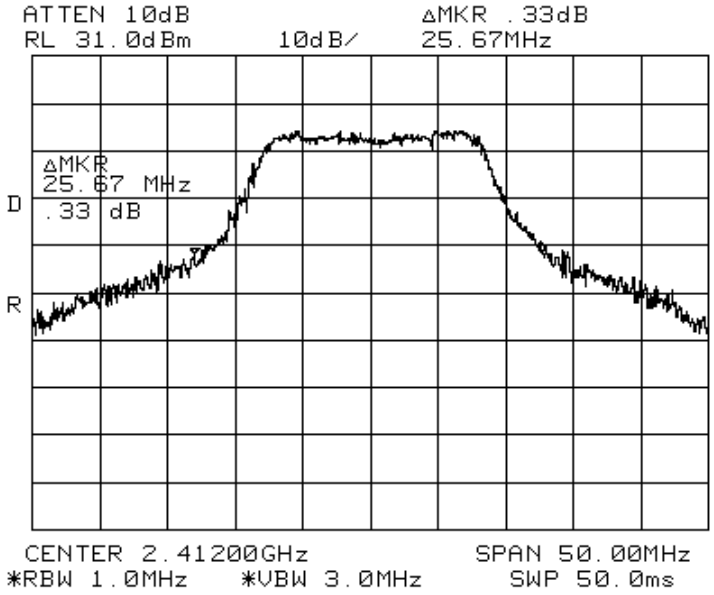

Figure 30. 2412 MHz, OFDM (64 QAM) Modulation

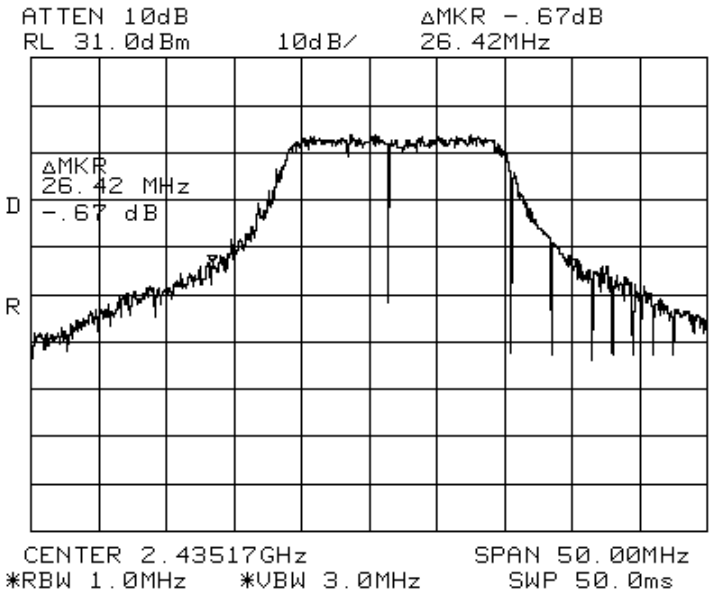

Figure 31. 2437 MHz, OFDM (64 QAM) Modulation

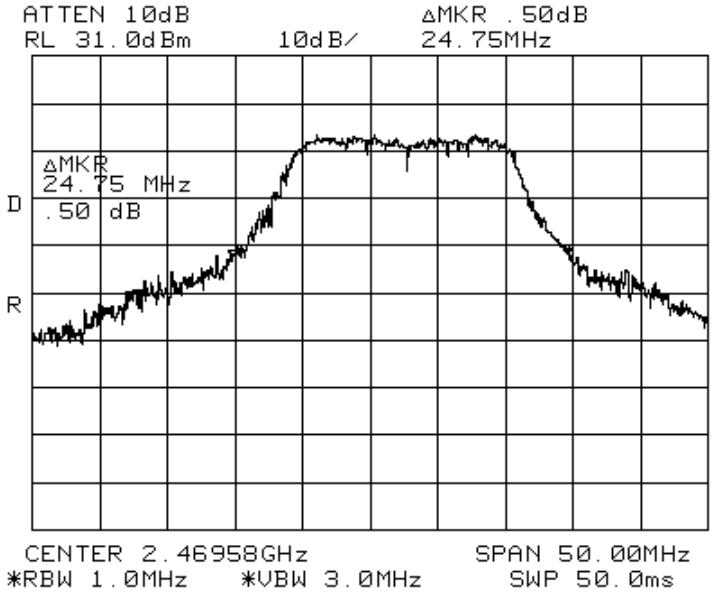

Figure 32. 2472 MHz, OFDM (64 QAM) Modulation

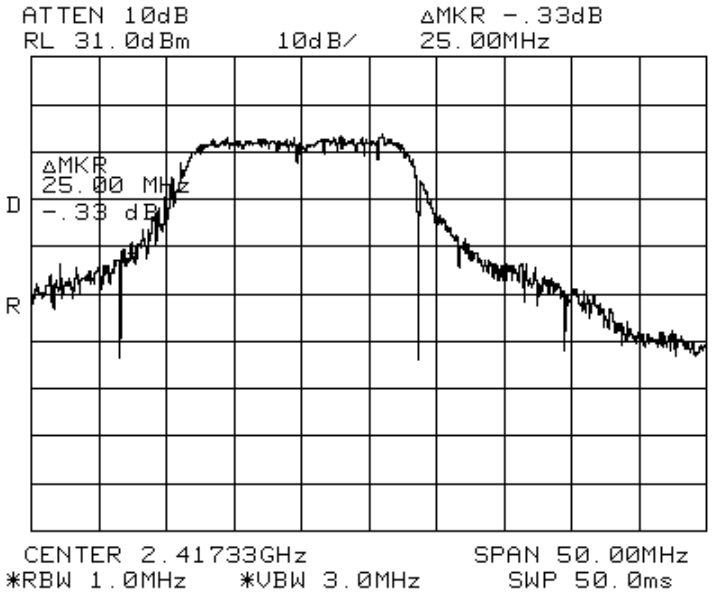

Figure 33. 2412 MHz, OFDM (16 QAM) Modulation

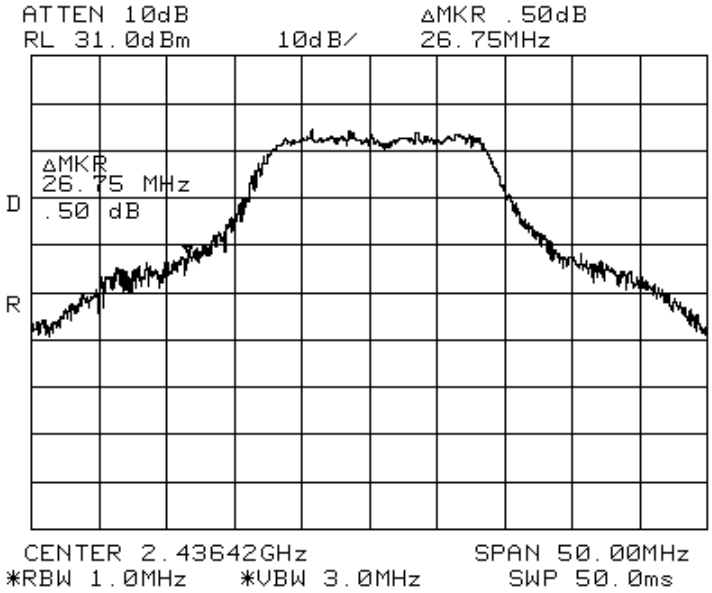

Figure 34. 2437 MHz, OFDM (16 QAM) Modulation

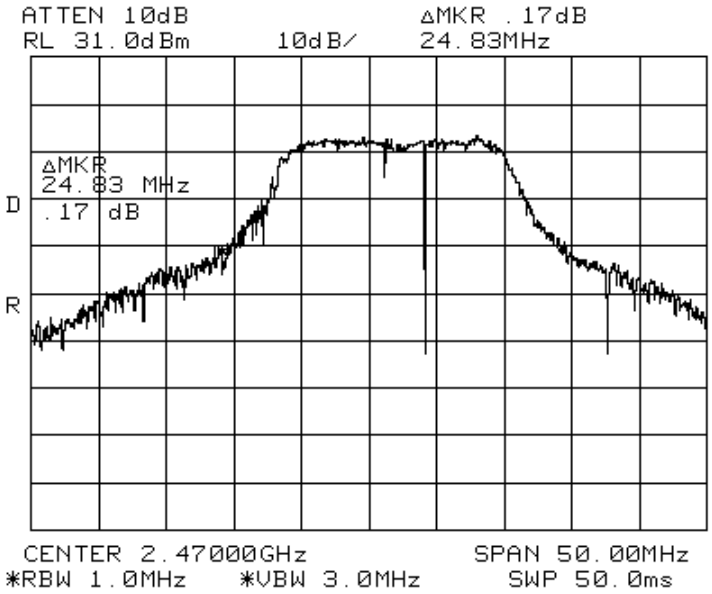

Figure 35. 2472 MHz, OFDM (16 QAM) Modulation

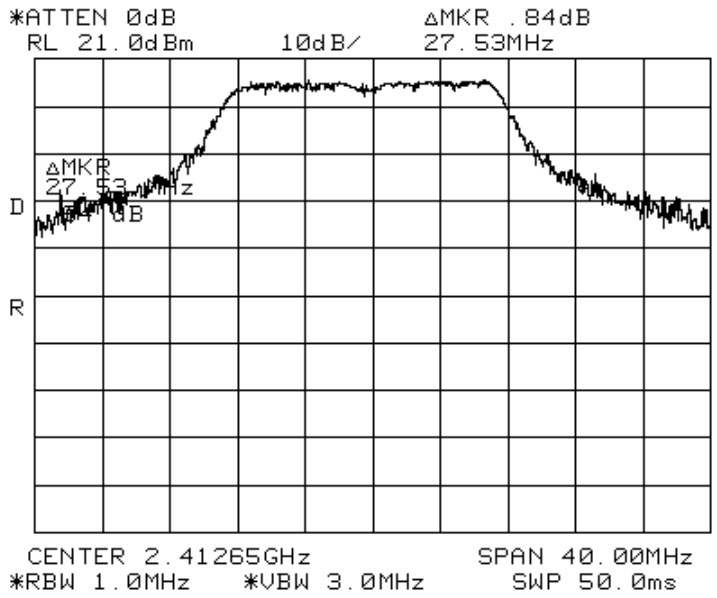

Figure 36. 2412 MHz, OFDM (BPSK) Modulation

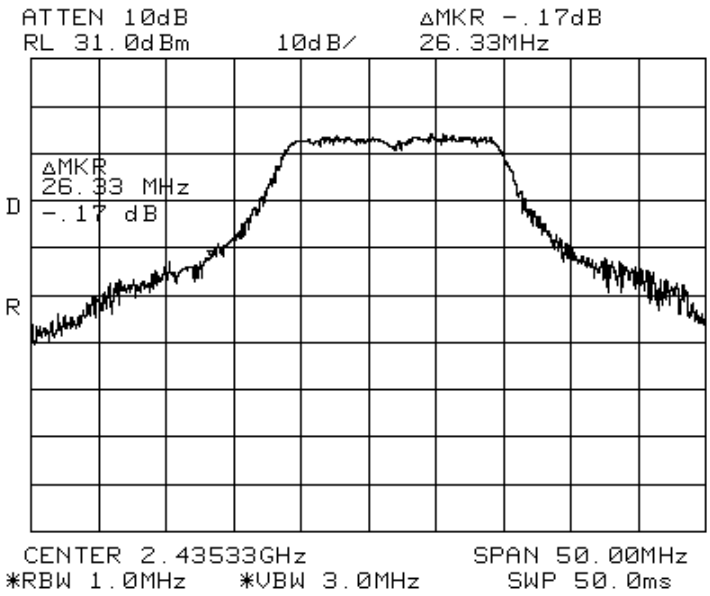

Figure 37. 2437 MHz, OFDM (BPSK) Modulation

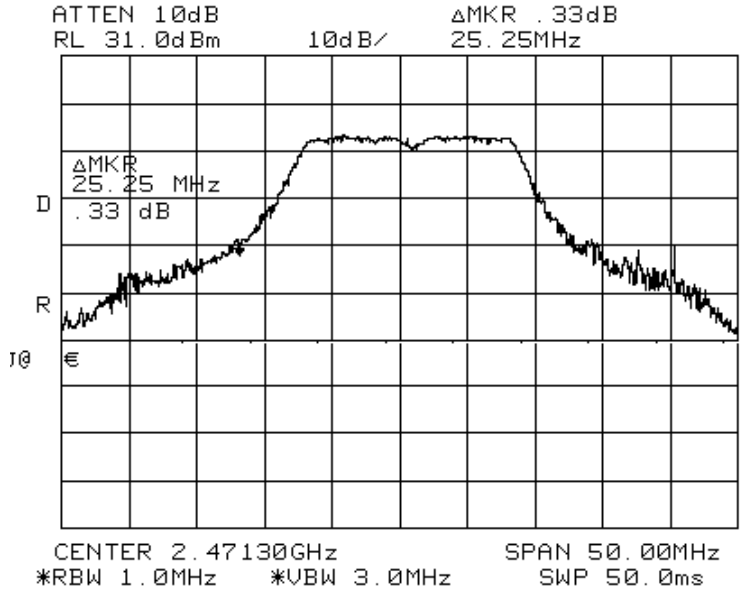

Figure 38. 2472 MHz, OFDM (BPSK) Modulation

5.4 *Test Equipment Used; 26dB Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Attenuator 30dB	Bird	8304-N30DB	N.A.	May 30, 2014	1 year
Spectrum Analyzer	HP	8563E	3810A8846	November 30, 2014	1 year

Figure 39 Test Equipment Used

6. Maximum Transmitted Peak Power Output

6.1 *Test Specification*

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

6.2 *Test Procedure*

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (30 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 1 MHz resolution BW and 1 or 3 MHz video BW (as applicable).

The E.U.T was evaluated in 3 channels: Low, Mid and High.

Conducted output power levels were measured at selected operation frequencies.

6.3 *Test Results*

Modulation	Operation Frequency (MHz)	Power (dBm)	Specification (dBm)	Margin (dB)
DSSS	2412	13.67	30.0	-16.33
	2437	12.83	30.0	-17.17
	2472	12.33	30.0	-17.67
4 QAM	2412	14.83	30.0	-15.17
	2437	15.00	30.0	-15.00
	2472	14.50	30.0	-15.50
64 QAM	2412	15.17	30.0	-14.83
	2437	14.67	30.0	-15.33
	2472	14.50	30.0	-15.50
16 QAM	2412	14.67	30.0	-15.33
	2437	15.50	30.0	-14.50
	2472	14.50	30.0	-15.50
BPSK	2412	16.17	30.0	-13.83
	2437	15.33	30.0	-14.67
	2472	14.33	30.0	-15.67

Figure 40 Maximum Peak Power Output

JUDGEMENT: Passed by 13.83

For additional information see *Figure 41* to *Figure 55*.

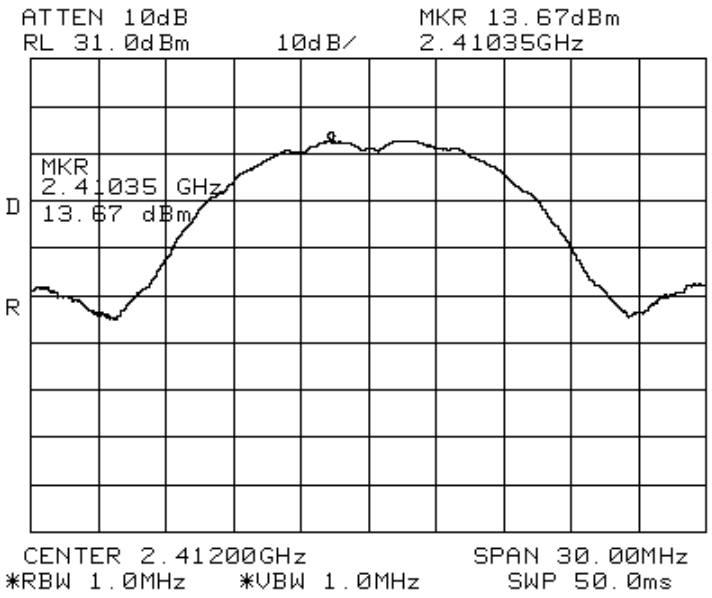

Figure 41. 2412 MHz, DSSS Modulation

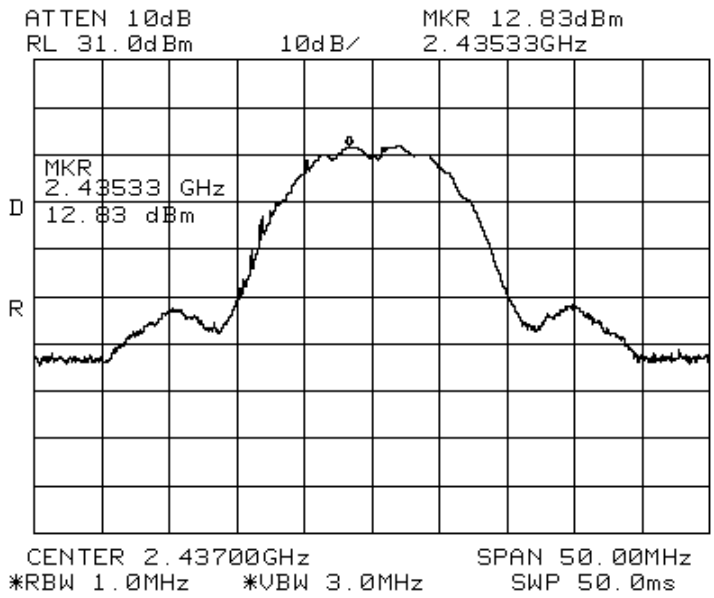

Figure 42. 2437 MHz, DSSS Modulation

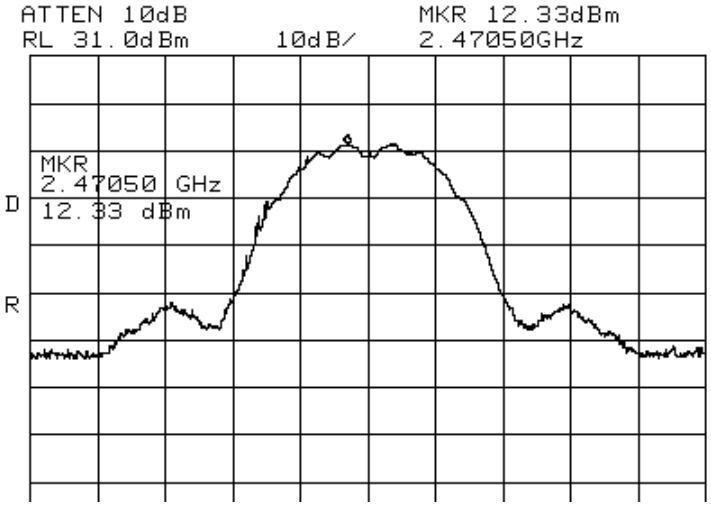

Figure 43. 2472 MHz, DSSS Modulation

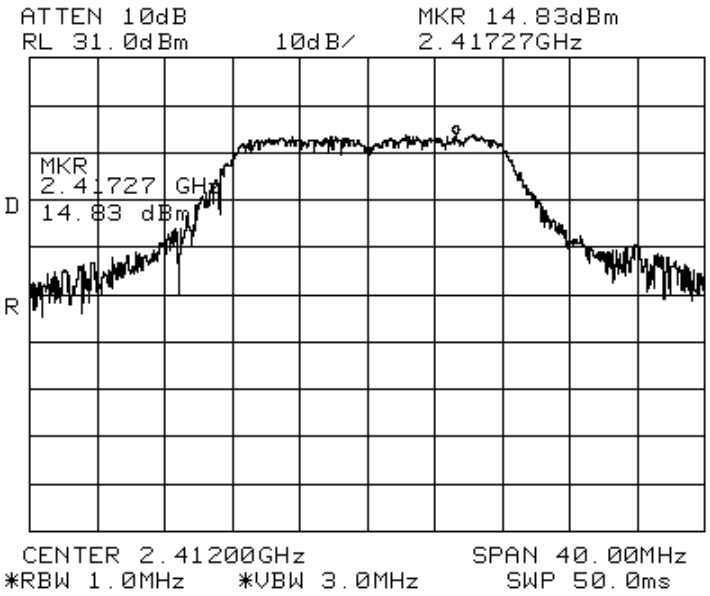

Figure 44. 2412 MHz, OFDM (4 QAM) Modulation

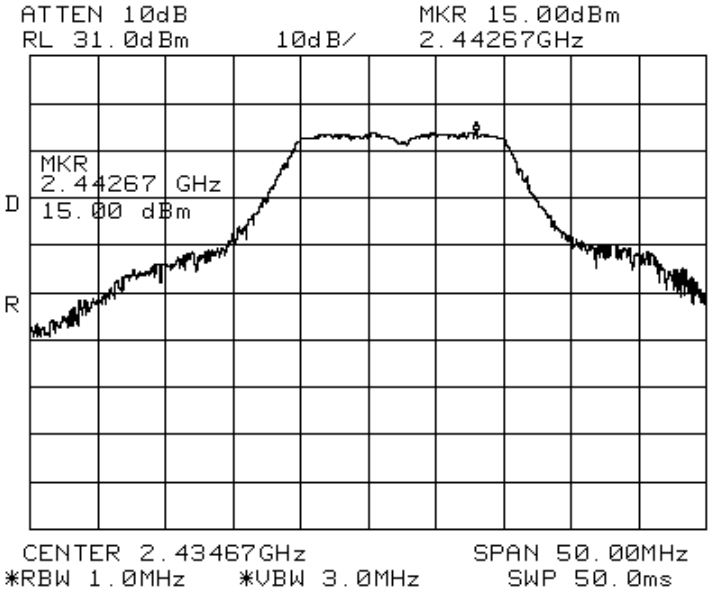

Figure 45. 2437 MHz, OFDM (4 QAM) Modulation

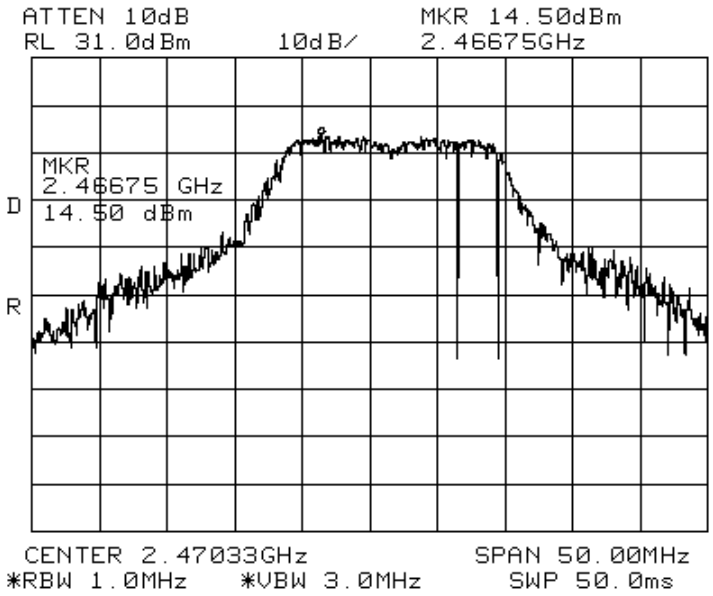

Figure 46. 2472 MHz, OFDM (4 QAM) Modulation

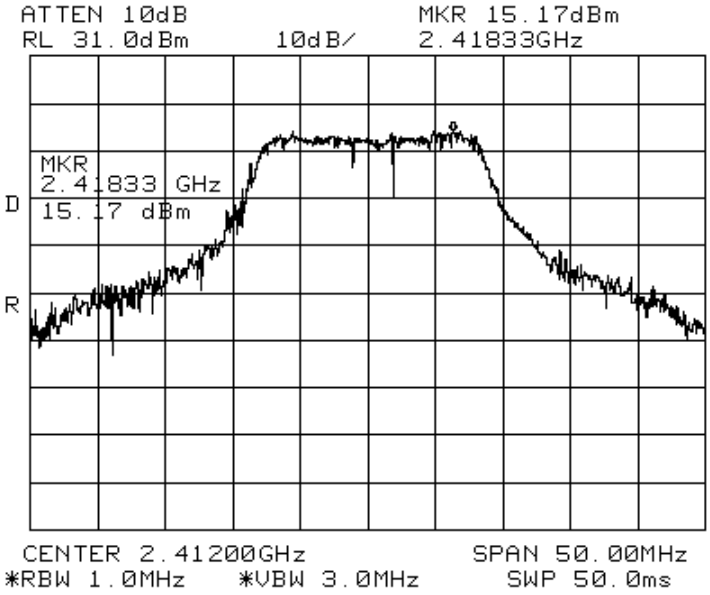

Figure 47. 2412 MHz, OFDM (64 QAM) Modulation

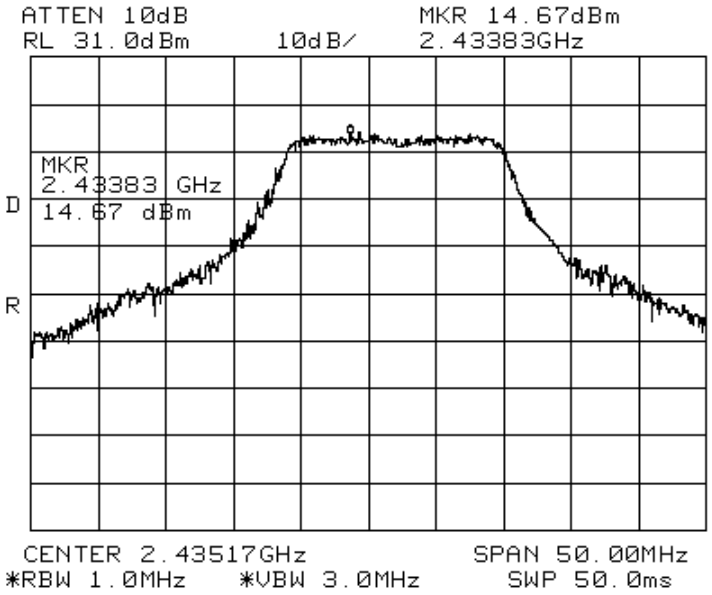

Figure 48. 2437 MHz, OFDM (64 QAM) Modulation

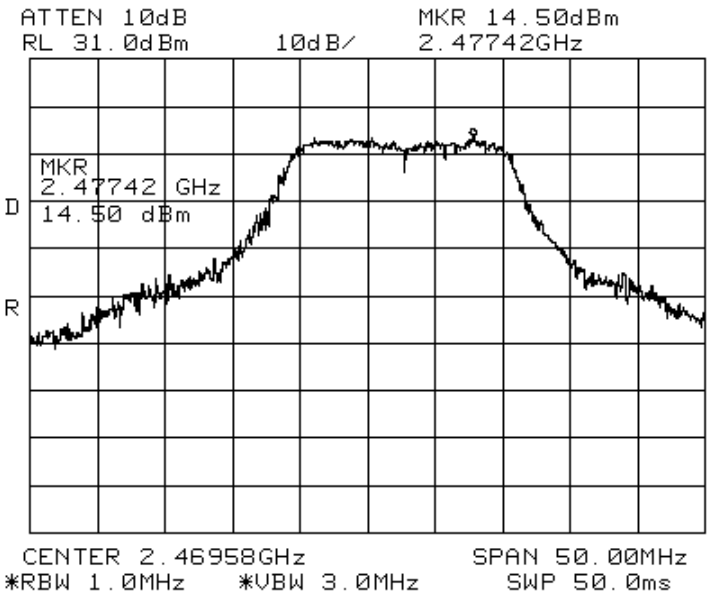

Figure 49. 2472 MHz, OFDM (64 QAM) Modulation

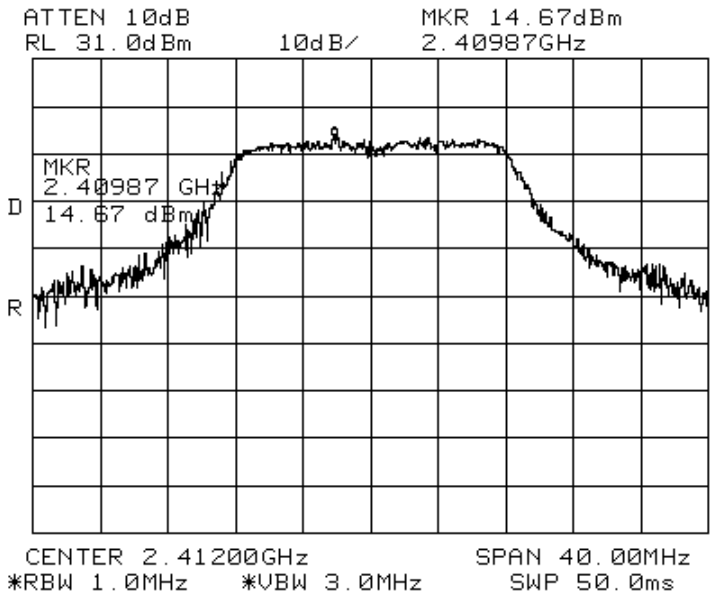

Figure 50. 2412 MHz, OFDM (16 QAM) Modulation

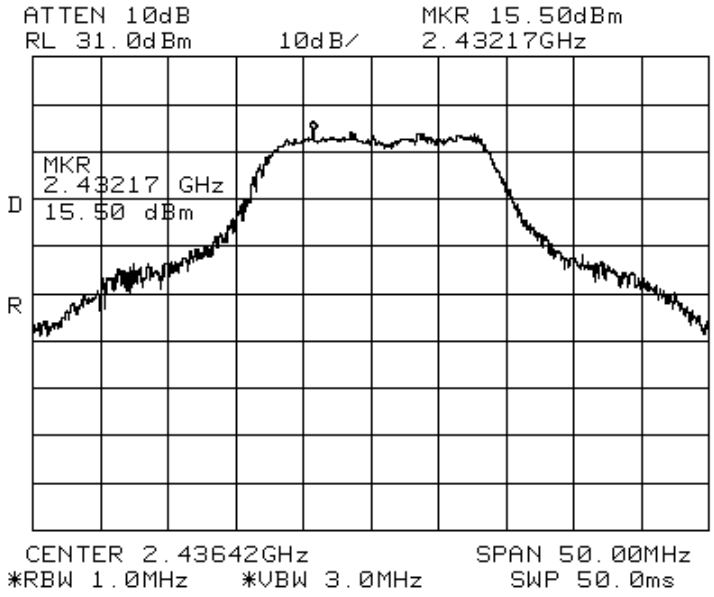

Figure 51. 2437 MHz, OFDM (16 QAM) Modulation

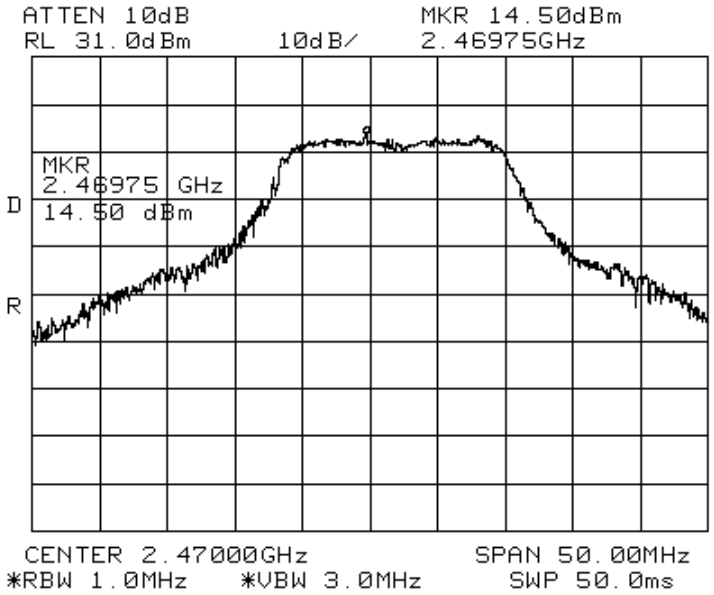

Figure 52. 2472 MHz, OFDM (16 QAM) Modulation

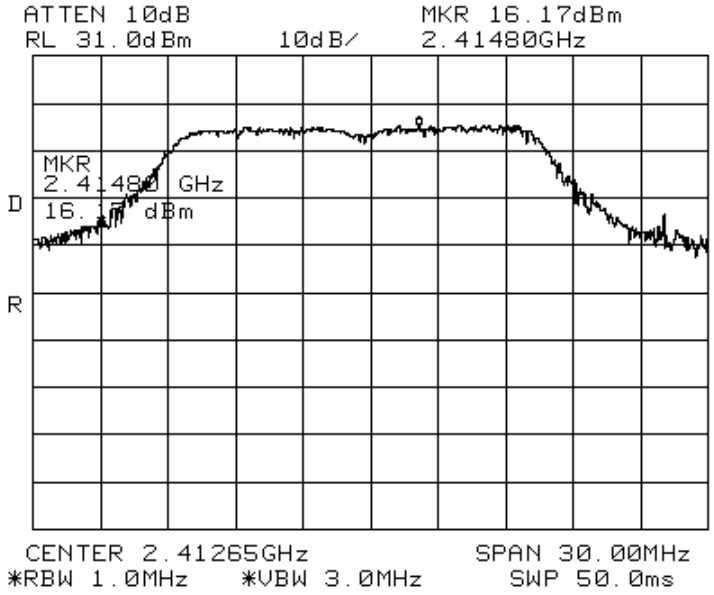

Figure 53. 2412 MHz, OFDM (BPSK) Modulation

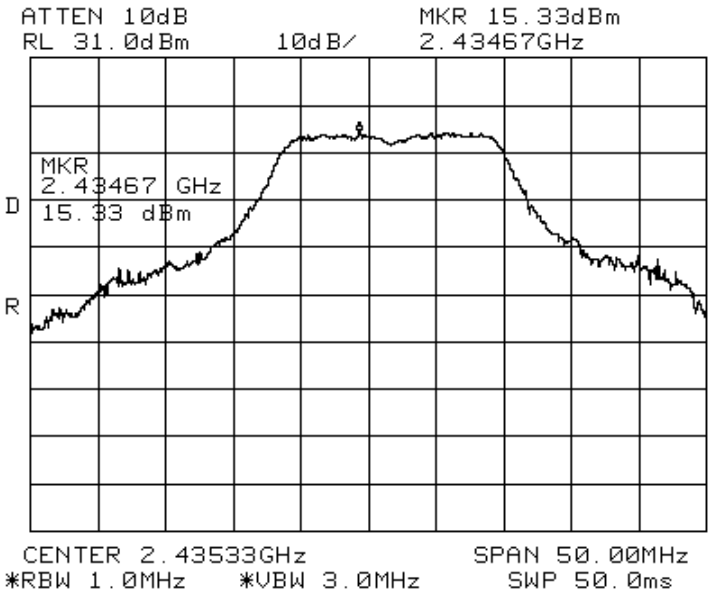

Figure 54. 2437 MHz, OFDM (BPSK) Modulation

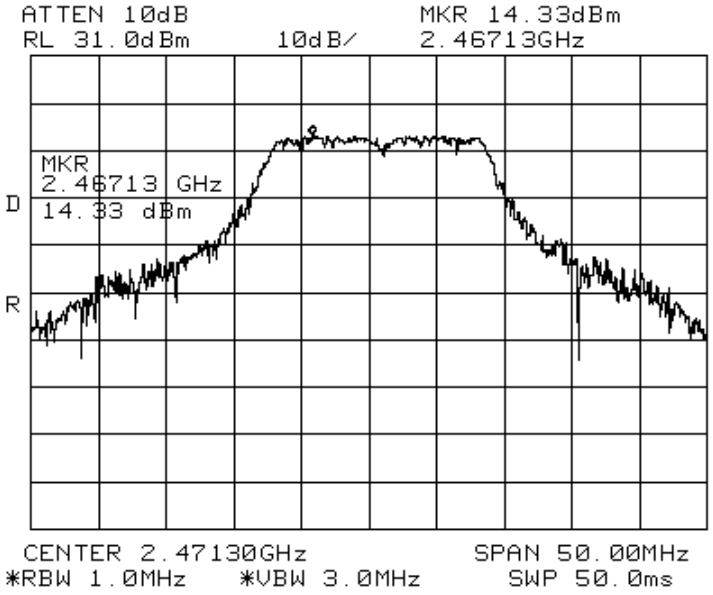

Figure 55. 2472 MHz, OFDM (BPSK) Modulation

6.4 *Test Equipment Used; Maximum Peak Power Output*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Attenuator 30dB	Bird	8304-N30DB	N.A.	May 30, 2014	1 year
Spectrum Analyzer	HP	8563E	3810A8846	November 30, 2014	1 year

Figure 56 Test Equipment Used

7. Band Edge Spectrum

7.1 *Test Specification*

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

7.2 *Test Procedure*

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (30 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW and 300 kHz video BW (as applicable).The E.U.T was evaluated in 2 channels: Low and High.

7.3 *Test Results*

Modulation	Operation Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBm)	Specification (dBm)	Margin (dB)
DSSS	Low	2400.0	-33.50	-6.30	-27.20
	High	2483.5	-37.00	-7.70	-29.30
QAM 4	Low	2400.0	-22.83	-5.20	-17.63
	High	2483.5	-23.33	-5.50	-17.83
QAM 64	Low	2400.0	-26.67	-4.80	-21.87
	High	2483.5	-27.33	-5.50	-21.83
QAM 16	Low	2400.0	-22.33	-5.40	-16.93
	High	2483.5	-26.17	-5.50	-20.67
BPSK	Low	2400.0	-21.17	-3.80	-17.37
	High	2483.5	-24.33	-5.70	-18.63

Figure 57 Band Edge Spectrum

JUDGEMENT: Passed by 16.93 dB

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

For additional information see *Figure 58* to *Figure 67.*

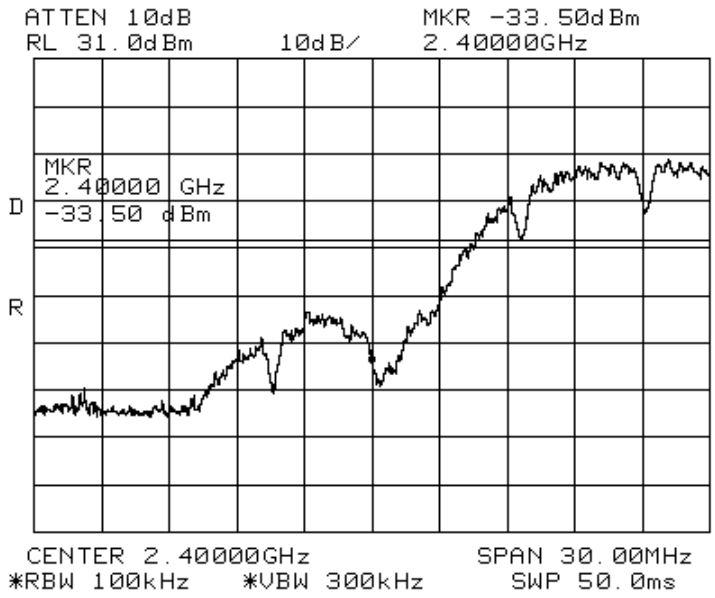

Figure 58 —Lower Band Edge, DSSS Modulation

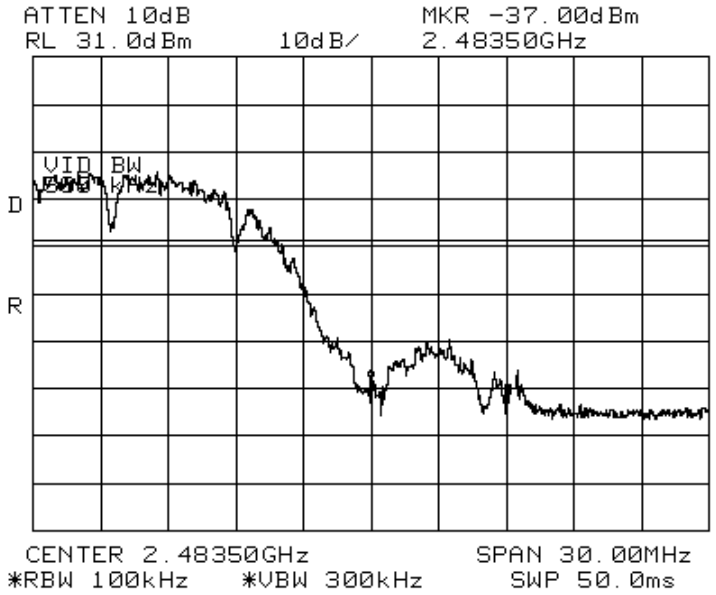

Figure 59 —Upper Band Edge, DSSS Modulation

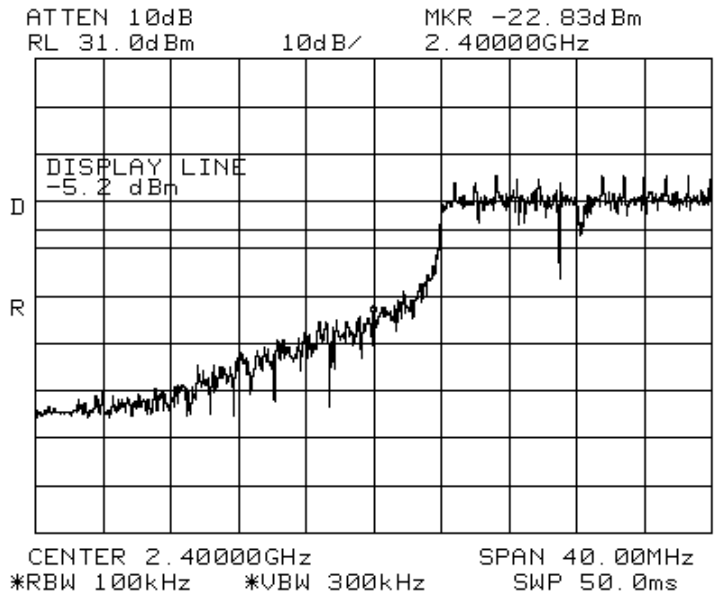

Figure 60 —Lower Band Edge, OFDM (4 QAM) Modulation

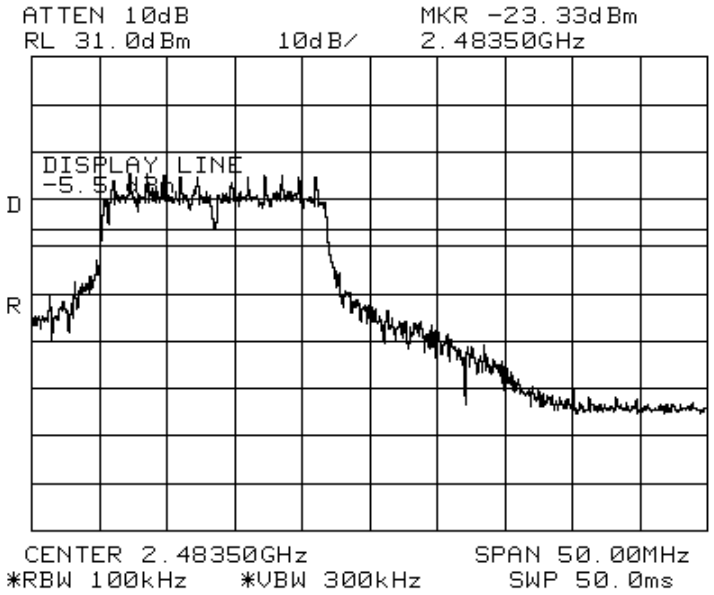

Figure 61 —Upper Band Edge, OFDM (4 QAM) Modulation

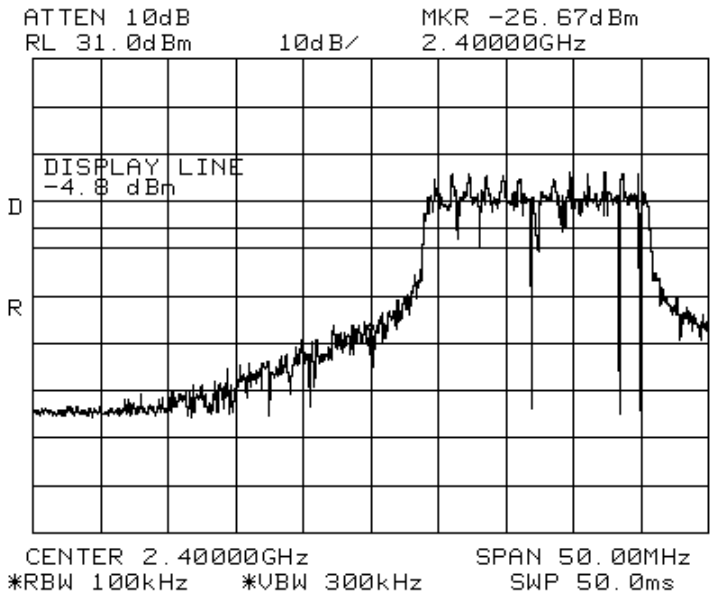

Figure 62 —Lower Band Edge, OFDM (64 QAM) Modulation

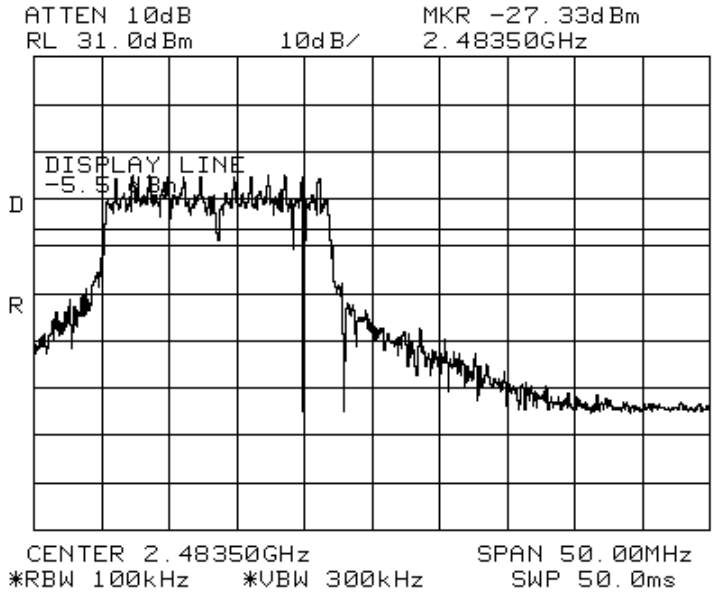

Figure 63 —Upper Band Edge, OFDM (64 QAM) Modulation

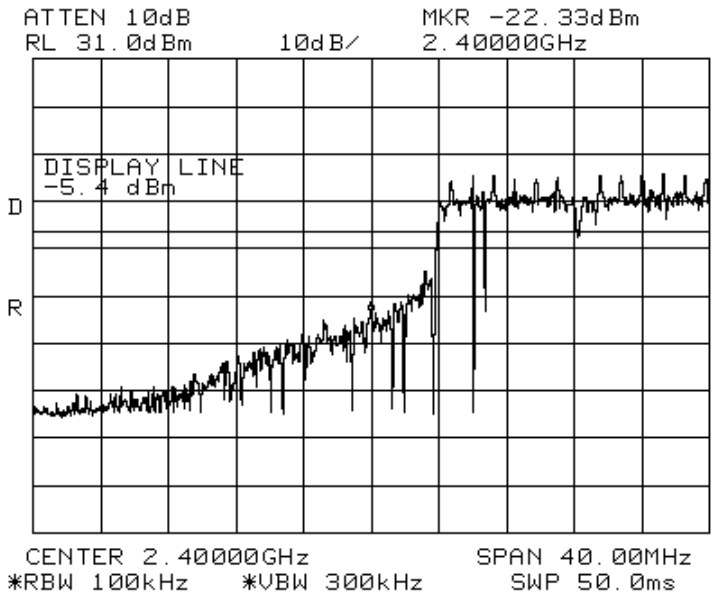

Figure 64 —Lower Band Edge, OFDM (16 QAM) Modulation

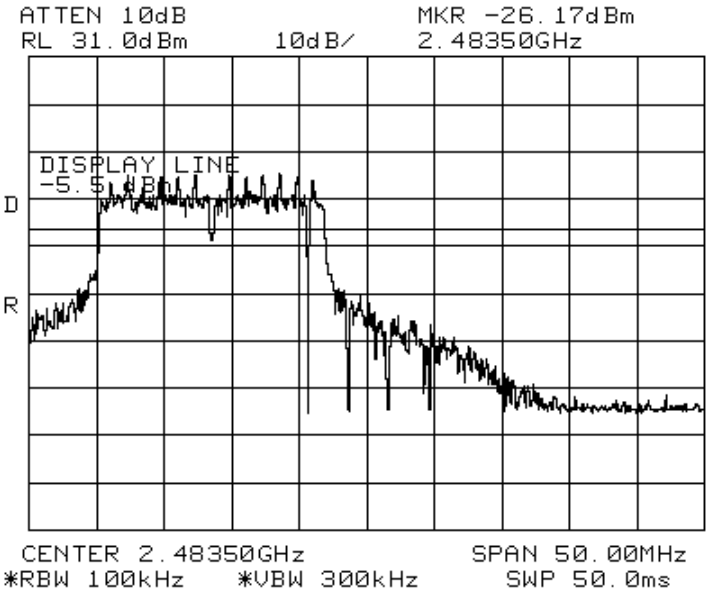

Figure 65 —Upper Band Edge, OFDM (16 QAM) Modulation

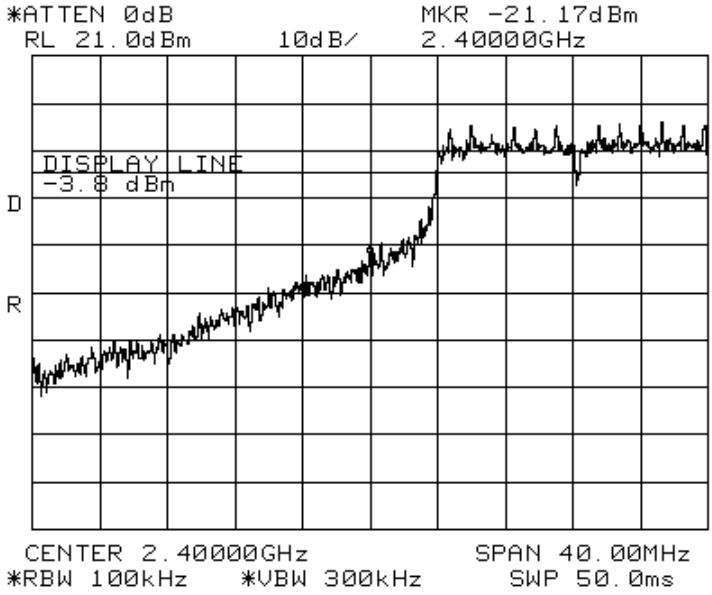

Figure 66 —Lower Band Edge, OFDM (BPSK) Modulation

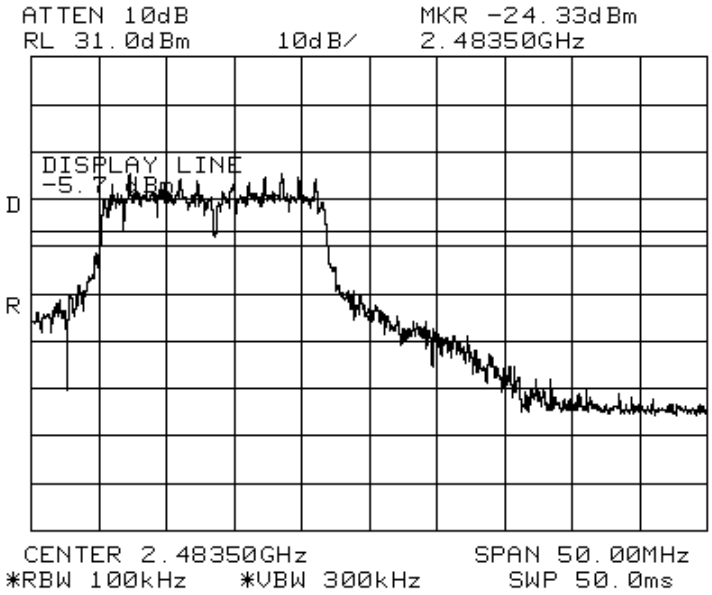

Figure 67 —Upper Band Edge, OFDM (BPSK) Modulation

7.4 *Test Equipment Used; Band Edge Spectrum*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Attenuator 30dB	Bird	8304-N30DB	N.A.	May 30, 2014	1 year
Spectrum Analyzer	HP	8563E	3810A8846	November 30, 2014	1 year

Figure 68 Test Equipment Used

8. Radiated Emission, 9 kHz – 30 MHz

8.1 *Test Specification*

9 kHz-30 MHz, FCC, Part 15, Subpart C, Section 209

8.2 *Test Procedure*

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

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 configuration tested is shown in Figure 1.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 9 kHz-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.

The E.U.T. was operated at the low, mid and high channels using a peak detector.

8.3 *Measured Data*

JUDGEMENT: Passed

All emissions were more than the EMI receiver noise level which is more than 6dB below the specification limit.

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 209 specification.

8.4 *Test Instrumentation Used, Radiated Measurements*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2014	1 year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 69 Test Equipment Used

8.5 *Field Strength Calculation*

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$FS = RA + AF + CF$$

FS: Field Strength [dBμv/m]
RA: Receiver Amplitude [dBμv]
AF: Receiving Antenna Correction Factor [dB/m]
CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dBμV (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dBμV

No external pre-amplifiers are used.

9. Spurious Radiated Emission, 30 – 25000 MHz

9.1 *Radiated Emission 30-25000 MHz*

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

See Section 2.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room, 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 configuration tested is shown in *Figure 2*.

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.
In the frequency range 1-6.0 GHz, a computerized EMI receiver complying with CISPR 16 requirements was used.
In the frequency range 6.0-25.0 GHz, a spectrum analyzer including a low noise amplifier was used. During average measurements, the IF bandwidth was 1 MHz and the video bandwidth was 100Hz. During peak measurements, the IF bandwidth was 1 MHz and the video bandwidth was 3 MHz.
The test distance was 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.
Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

The E.U.T. was operated at the low, mid and high channels using a peak detector.

9.2 *Test Data*

JUDGEMENT: Passed by 1.6dB

For the operation frequency of 2412 MHz, the margin between the emission level and the specification limit is in the worst case 6.5 dB at the frequency of 2390.0 MHz, horizontal polarization.

For the operation frequency of 2437 MHz, the margin between the emission level and the specification limit is in the worst case 7.5 dB at the frequency of 7326.0 MHz, horizontal polarization.

For the operation frequency of 2472 MHz, the margin between the emission level and the specification limit is in the worst case1.6 dB at the frequency of 7440.0 MHz, vertical polarization.

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

The details of the highest emissions are given in *Figure 70* to *Figure 71*.

Radiated Emission

E.U.T Description WIFI Active RFID Pendant Tag
Type TAG-P1000
Serial Number: 0D0

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Peak

Operation Frequency (MHz)	Freq. (MHz)	Polarity (H/V)	Peak Reading (dBµV/m)	Peak. Specification (dB µV/m)	Peak. Margin (dB)
2412.0	2390.0	H	59.8	74.0	-14.2
2412.0	2390.0	V	60.2	74.0	-13.8
2412.0	4824.0	H	59.7	74.0	-14.3
2412.0	4824.0	V	59.2	74.0	-14.8
2437.0	4874.0	H	58.5	74.0	-15.5
2437.0	4874.0	V	59.1	74.0	-14.9
2472.0	2483.5	H	60.8	74.0	-13.2
2472.0	2483.5	V	68.0	74.0	-6.0
2472.0	4944.0	H	60.3	74.0	-13.7
2472.0	4944.0	V	61.0	74.0	-13.0

Figure 70. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Peak

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 WIFI Active RFID Pendant Tag
Type TAG-P1000
Serial Number: 0D0

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Average

Operation Frequency (MHz)	Freq. (MHz)	Polarity (H/V)	Average Reading (dBµV/m)	Average Specification (dB µV/m)	Average Margin (dB)
2412.0	2390.0	H	47.4	54.0	-6.6
2412.0	2390.0	V	47.5	54.0	-6.5
2412.0	4824.0	H	46.6	54.0	-7.4
2412.0	4824.0	V	46.6	54.0	-7.4
2437.0	4874.0	H	46.5	54.0	-7.5
2437.0	4874.0	V	46.5	54.0	-7.5
2472.0	2483.5	H	48.5	54.0	-5.5
2472.0	2483.5	V	52.4	54.0	-1.6
2472.0	4944.0	H	47.7	54.0	-6.3
2472.0	4944.0	V	47.7	54.0	-6.3

Figure 71. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Average

Notes:

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.

"Average Amp" includes correction factor.

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

9.3 *Test Instrumentation Used, Radiated Measurements Above 1 GHz*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 1, 2015	1 year
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142B	1250	May 22, 2014	2 years
Horn Antenna	ETS	3115	6142	March 14, 2012	3 years*
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	August 22, 2014	1 year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 29, 2014	1 year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

*Note – Extended to May 19, 2015

Figure 72 Test Equipment Used

10. Transmitted Power Density

10.1 *Test Specification*

FCC Part 15, Subpart C, Section 15.247(d)

10.2 *Test Procedure*

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (30 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 3 kHz resolution BW and sweep time of 1 second for each 3 kHz "window". The spectrum peaks were located at each of the 3 operating frequencies.

10.3 *Test Results*

Modulation	Operation Frequency (MHz)	Reading Spectrum Analyzer (dBm)	Specification (dBm)	Margin (dB)
DSSS	2412	-4.00	8.0	-12.00
	2437	-4.17	8.0	-12.17
	2472	-7.00	8.0	-15.00
QAM 4	2412	-13.33	8.0	-21.33
	2437	-12.33	8.0	-20.33
	2472	-11.00	8.0	-19.00
QAM 64	2412	-11.50	8.0	-19.50
	2437	-15.00	8.0	-23.00
	2472	-13.50	8.0	-21.50
QAM 16	2412	-14.17	8.0	-22.17
	2437	-11.50	8.0	-19.50
	2472	-12.00	8.0	-20.00
BPSK	2412	-7.5	8.0	-15.50
	2437	-8.5	8.0	-16.50
	2472	-10.33	8.0	-18.33

Figure 73 Test Results Transmitted Power Density

JUDGEMENT: Passed by 12.0dB

For additional information see *Figure 74* to *Figure 88.*

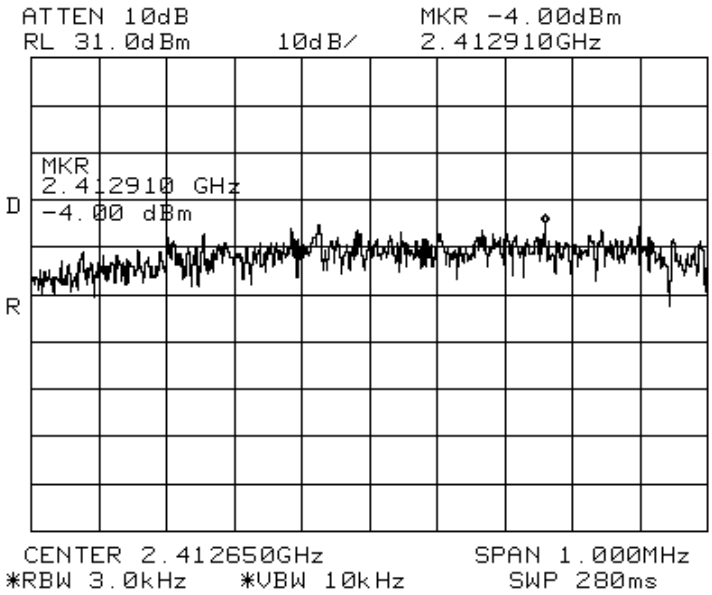

Figure 74. 2412 MHz, DSSS Modulation

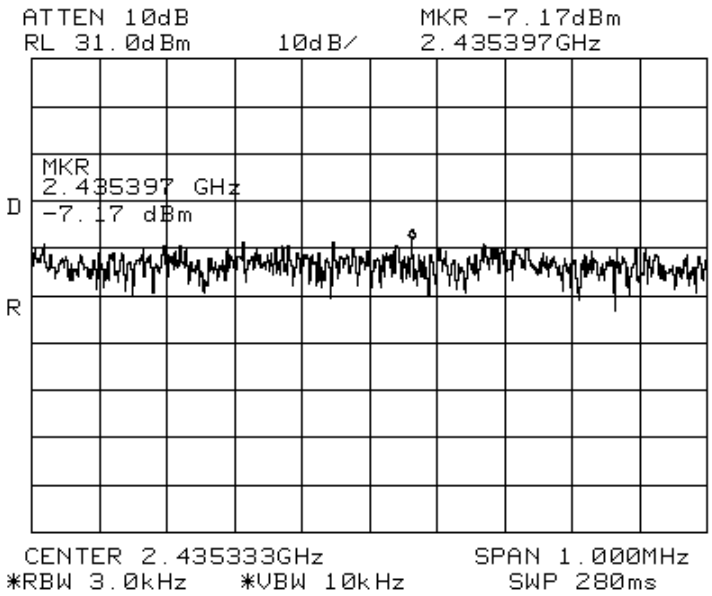

Figure 75. 2437 MHz, DSSS Modulation

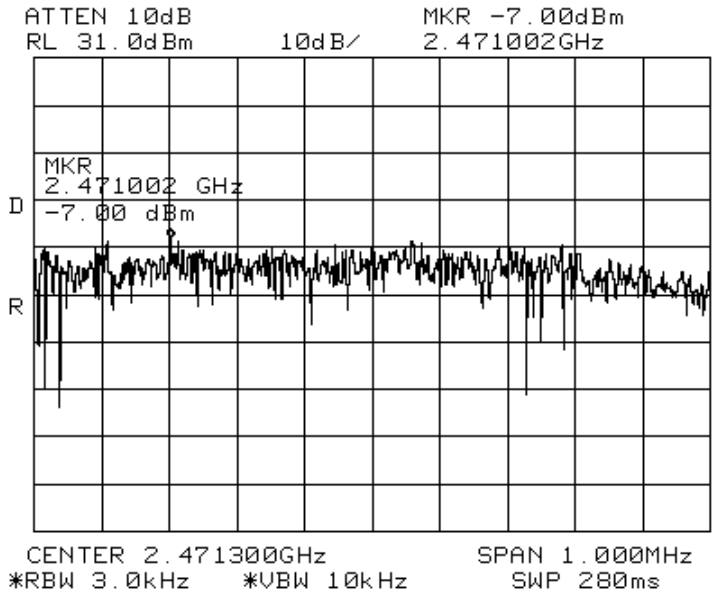

Figure 76. 2472 MHz, DSSS Modulation

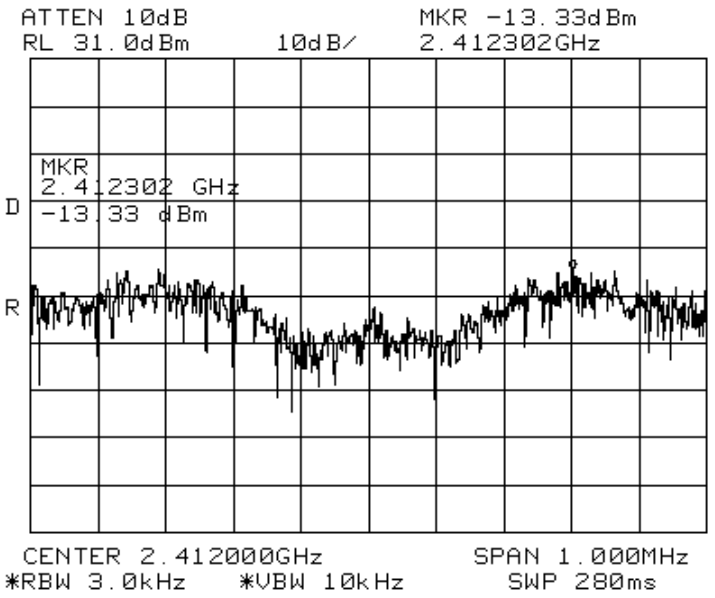

Figure 77. 2412 MHz, OFDM (4 QAM) Modulation

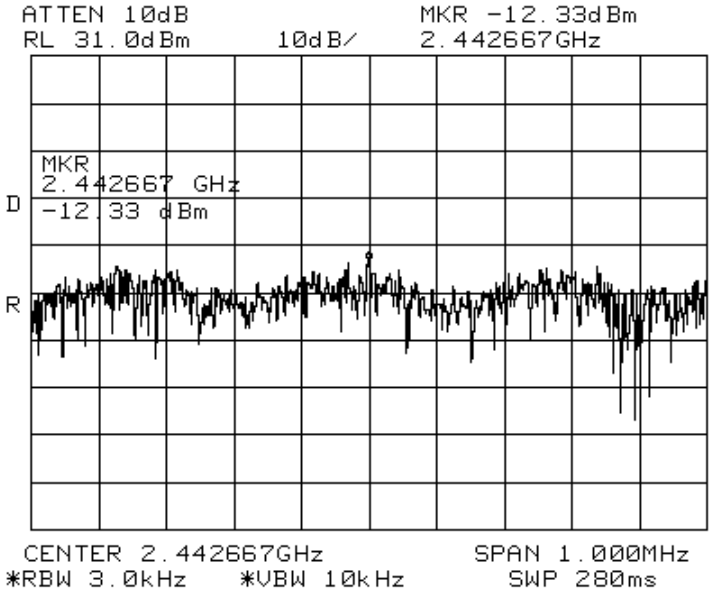

Figure 78. 2437 MHz, OFDM (4 QAM) Modulation

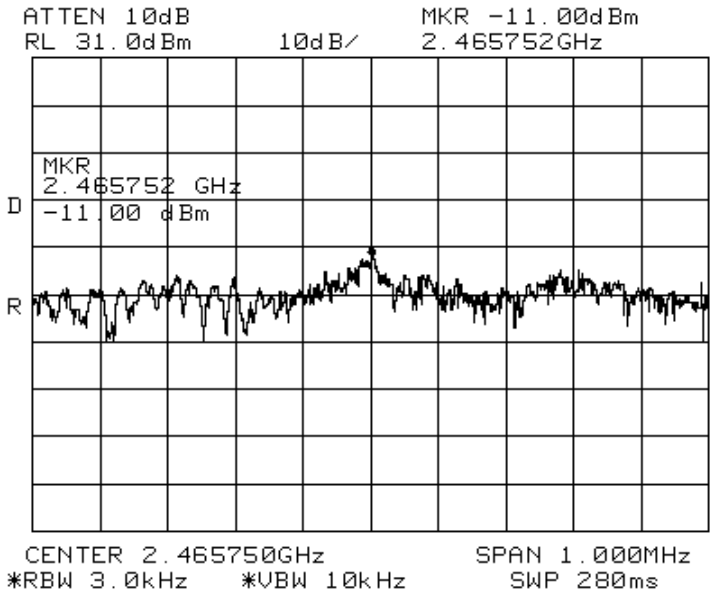

Figure 79. 2472 MHz, OFDM (4 QAM) Modulation

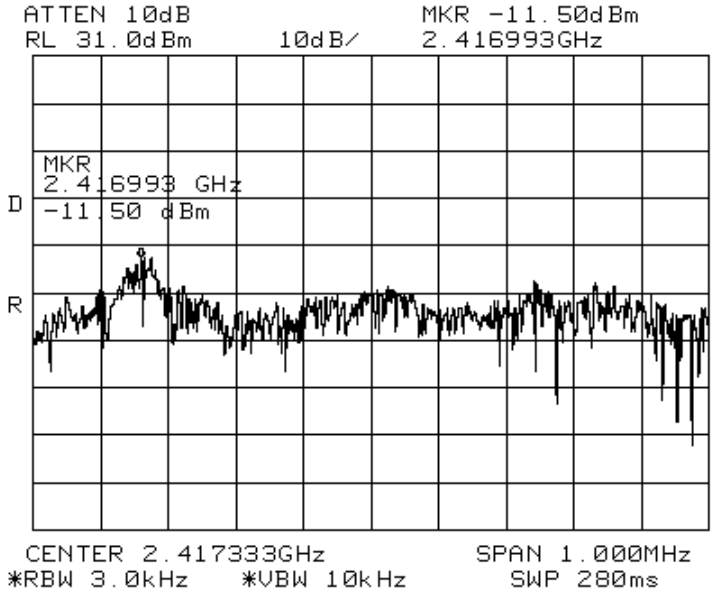

Figure 80. 2412 MHz, OFDM (64 QAM) Modulation

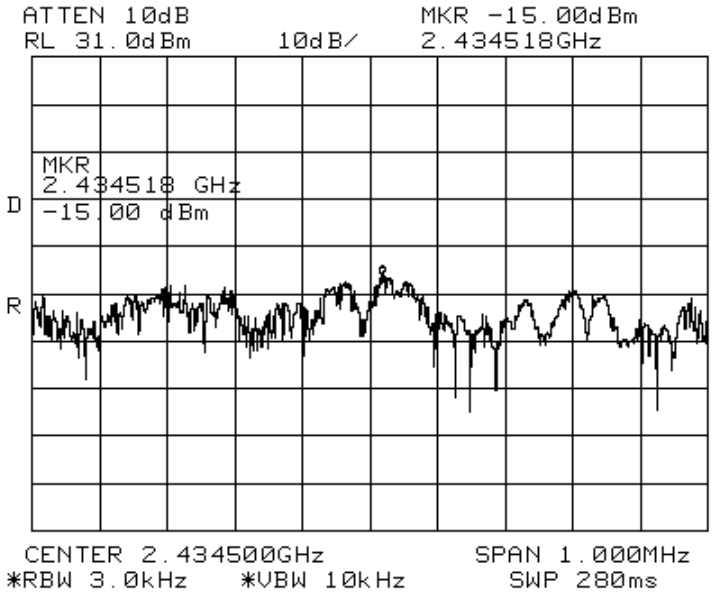

Figure 81. 2437 MHz, OFDM (64 QAM) Modulation

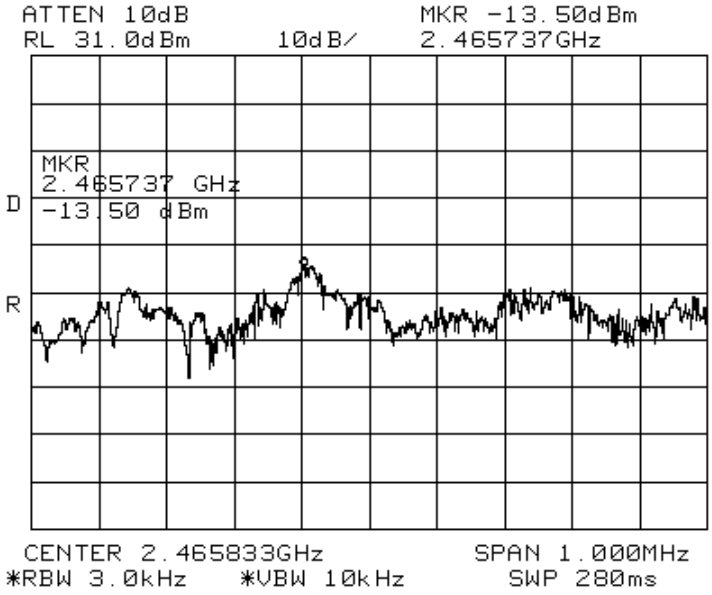

Figure 82. 2472 MHz, OFDM (64 QAM) Modulation

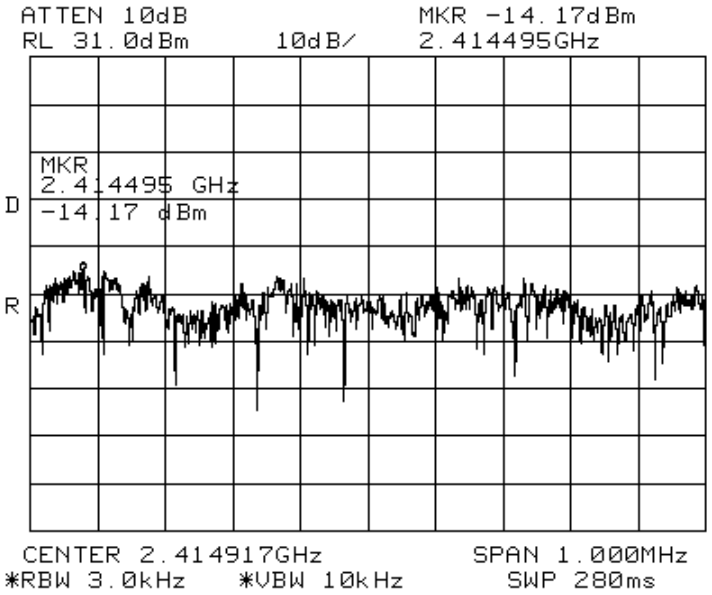

Figure 83. 2412 MHz, OFDM (16 QAM) Modulation

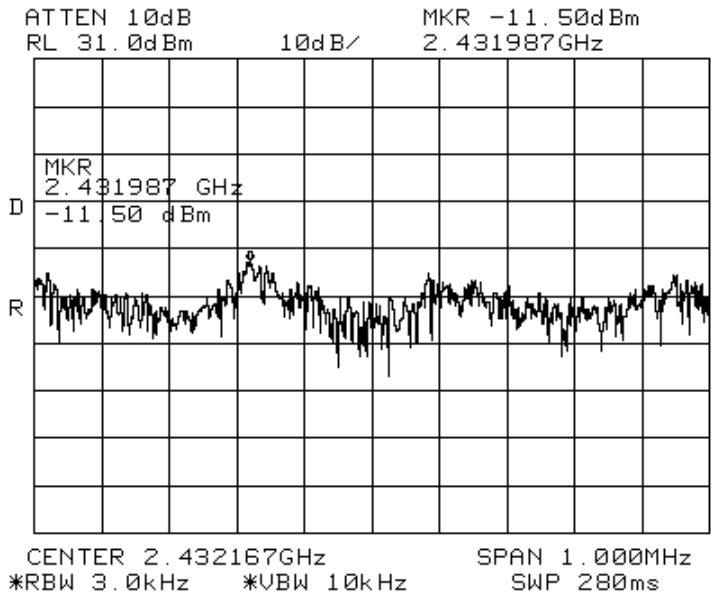

Figure 84. 2437 MHz, OFDM (16 QAM) Modulation

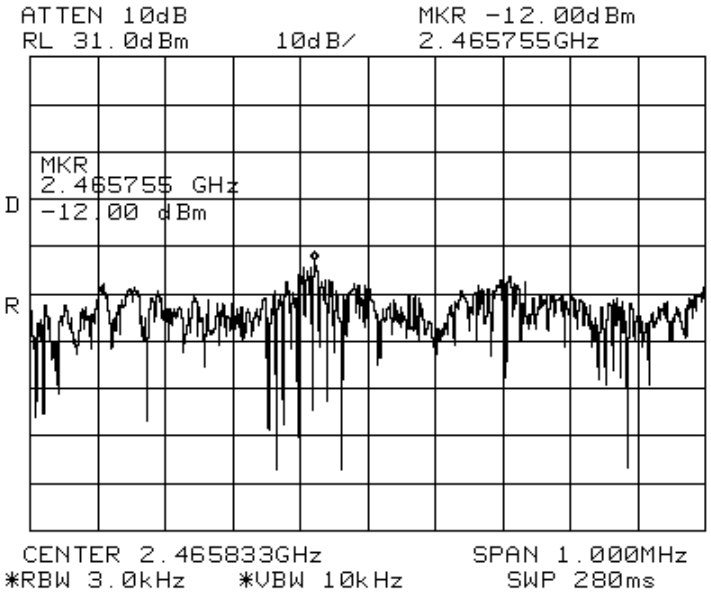

Figure 85. 2472 MHz, OFDM (16 QAM) Modulation

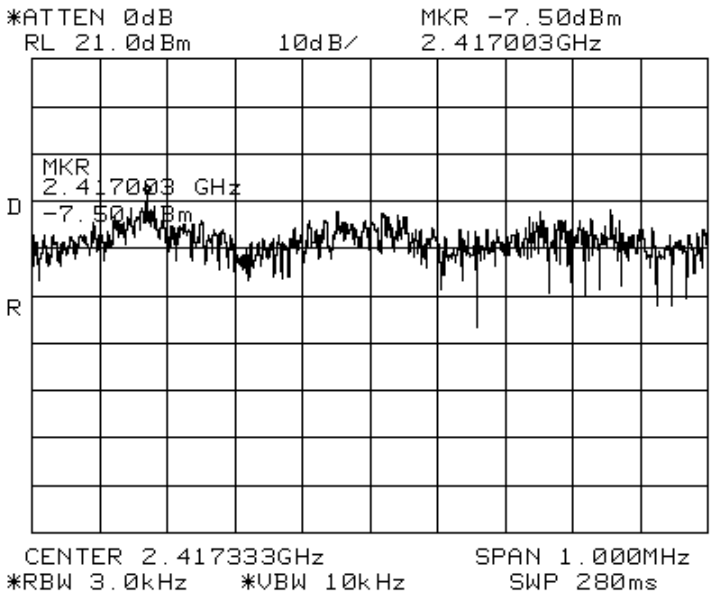

Figure 86. 2412 MHz, OFDM (BPSK) Modulation

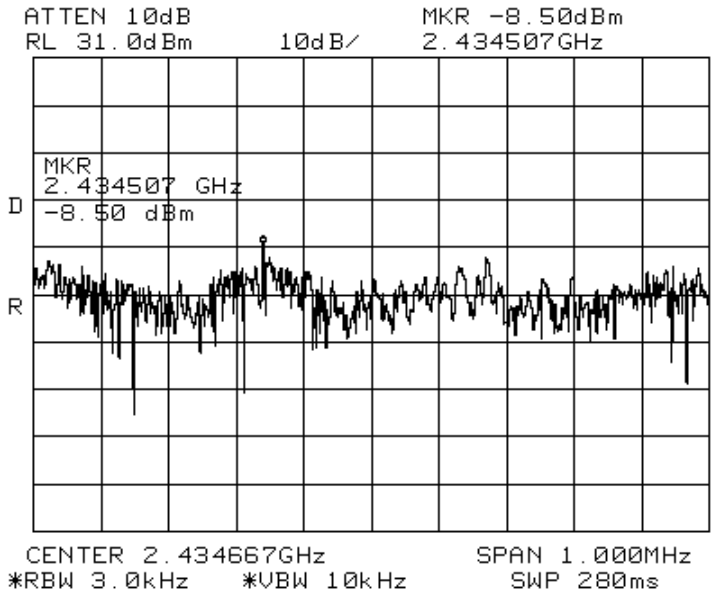

Figure 87. 2437 MHz, OFDM (BPSK) Modulation

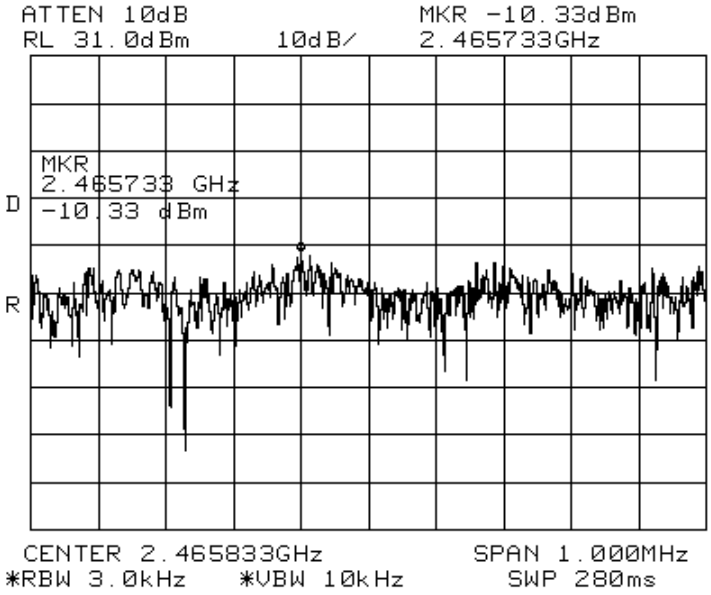

Figure 88. 2472 MHz, OFDM (BPSK) Modulation

10.4 *Test Equipment Used; Transmitted Power Density*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Attenuator 30dB	Bird	8304-N30DB	N.A.	May 30, 2014	1 year
Spectrum Analyzer	HP	8563E	3810A8846	November 30, 2014	1 year

Figure 89 Test Equipment Used

11. Antenna Gain/Information

The antenna gain is -2dBi, integral.

12. R.F Exposure/Safety

Typical use of the E.U.T. is as a pendant tag.

The typical placement of the E.U.T. is as a personal tag. The typical distance between the E.U.T. and the user in the worst case application, is 0.1 cm = 1 mm.

Calculation of Maximum Permissible Exposure (MPE)

Based on Section 1.1310 Requirements

(a) FCC limits at 2412 MHz is:

$$1\frac{mW}{cm^2}$$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

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

c)As per customer statement, the Duty Cycle is 0.0012 sec/hour.

$$AVG(Factor) = 10x\log(\frac{DutyCycle}{hour}) = 10x\log(\frac{0.0012}{3600}) = -64.77dB$$

P_t- Transmitted Power 16.17 dBm (Peak) – 64.77 dB (Avg factor) = -48.6 dBm = 1.38 x 10^{-8} mW

G_T- Antenna Gain, -2 dBi = 0.63 numeric

R- Distance from Transmitter using 0.1cm worst case

d)The peak power density is:

$$S_p = \frac{1.38x10^{-8} \times 0.63}{4\pi(0.1)^2} = 6.9239x10^{-8}\frac{mW}{cm^2}$$

e) This is below the FCC limit

13. APPENDIX A - CORRECTION FACTORS

13.1 *Correction factors for CABLE*

from EMI receiver to test antenna at 3 meter range.

Frequency (MHz)	Cable Loss (dB)	Frequency (MHz)	Cable Loss (dB)
0.010	0.4	50.00	1.2
0.015	0.2	100.00	0.7
0.020	0.2	150.00	20.1
0.030	0.3	200.00	2.3
0.050	0.3	300.00	2.9
0.075	0.3	500.00	3.8
0.100	0.2	750.00	4.8
0.150	0.2	1000.00	5.4
0.200	0.3	1500.00	6.7
0.500	0.4	2000.00	9.0
1.00	0.4	2500.00	9.4
1.50	0.5	3000.00	9.9
2.00	0.5	3500.00	10.2
5.00	0.6	4000.00	11.2
10.00	0.8	4500.00	12.1
15.00	0.9	5000.00	13.1
20.00	0.8	5500.00	13.5
		6000.00	14.5

NOTES:

1. The cable type is SPUMA400 RF-11N(X2) and 39m long

2. The cable is manufactured by Huber + Suhner

13.2 *Correction factors for CABLE* from EMI receiver to test antenna at 3 meter range.

FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.2
2.0	1.6
3.0	2.0
4.0	2.4
5.0	3.0
6.0	3.4
7.0	3.8
8.0	4.2
9.0	4.6
10.0	5.0
12.0	5.8

NOTES:

1. The cable type is RG-8.

2. The overall length of the cable is 10 meters.

13.3 *Correction factors for CABLE*

from spectrum analyzer to test antenna above 2.9 GHz

FREQUENCY (GHz)	CORRECTION FACTOR (dB)	FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.9	14.0	9.1
2.0	2.7	15.0	9.5
3.0	3.5	16.0	9.9
4.0	4.2	17.0	10.2
5.0	4.9	18.0	10.4
6.0	5.5	19.0	10.7
7.0	6.0	20.0	10.9
8.0	6.5	21.0	11.2
9.0	7.0	22.0	11.6
10.0	7.5	23.0	11.9
11.0	7.9	24.0	12.3
12.0	8.3	25.0	12.6
13.0	8.7	26.0	13.0

NOTES:

1. The cable type is SUCOFLEX 104 E manufactured by SUHNER.

2. The cable is used for measurements above 2.9 GHz.

3. The overall length of the cable is 10 meters.

13.4 *Correction factors for* *Bilog ANTENNA*

Model: 3142
Antenna serial number: 1250
3 meter range

FREQUENCY (MHz)	AFE (dB/m)	FREQUENCY (MHz)	AFE (dB/m)
30	18.4	1100	25
40	13.7	1200	24.9
50	9.9	1300	26
60	8.1	1400	26.1
70	7.4	1500	27.1
80	7.2	1600	27.2
90	7.5	1700	28.3
100	8.5	1800	28.1
120	7.8	1900	28.5
140	8.5	2000	28.9
160	10.8		
180	10.4		
200	10.5		
250	12.7		
300	14.3		
400	17		
600	19.6		
700	21.1		
800	21.4		
900	23.5		
1000	24.3		

13.5 *Correction factors for Horn ANTENNA.*

Model: 3115

Antenna serial number: 6142

3 meter range

FREQUENCY (MHz)	Antenna Factor (dB/m)	FREQUENCY (MHz)	Antenna Factor (dB/m)
1000	23.9	10500	38.4
1500	25.4	11000	38.5
2000	27.3	11500	39.4
2500	28.5	12000	39.2
3000	30.4	12500	39.4
3500	31.6	13000	40.7
4000	33	14000	42.1
4500	32.7	15000	40.1
5000	34.1	16000	38.2
5500	34.5	17000	41.7
6000	34.9	17500	45.7
6500	35.1	18000	47.7
7000	35.9		
7500	37.5		
8000	37.6		
8500	38.3		
9000	38.5		
9500	38.1		
10000	38.6		

13.6 *Correction factors for Horn Antenna*

Model: SWH-28
at 1 meter range.

FREQUENCY (GHz)	AFE (dB /m)	Gain (dB1)
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4

13.7 *Correction factors for ACTIVE LOOP ANTENNA*

Model 6502
S/N 9506-2950

FREQUENCY (MHz)	Magnetic Antenna Factor (dB)	Electric Antenna Factor (dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2