

# Doughty Design

TEST REPORT ADDENDUM TO 98667-11

**MarqMetrix RF Module**  
**Model: METRIX01**

Tested To The Following Standards:

FCC Part 15 Subpart C Section(s)

**15.207 & 15.247**  
**(DTS 2400-2483.5 MHz)**

**Report No.: 98667-11A**

Date of issue: November 22, 2016



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

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

**TABLE OF CONTENTS**

Administrative Information ..... 3

    Test Report Information .....3

    Revision History .....3

    Report Authorization .....3

    Test Facility Information .....4

    Software Versions .....4

    Site Registration & Accreditation Information .....4

    Summary of Results .....5

    Modifications During Testing.....5

    Conditions During Testing.....5

    Equipment Under Test.....6

    General Product Information.....7

FCC Part 15 Subpart C ..... 8

    15.247(a)(2) 6dB Bandwidth.....8

    15.247(b)(3) Output Power .....12

        15.35(c) Duty Cycle Correction Factor .....18

    15.247(e) Power Spectral Density .....21

    15.247(d) RF Conducted Emissions & Band Edge .....26

    15.247(d) Radiated Emissions & Band Edge .....33

    15.207 AC Conducted Emissions.....70

Supplemental Information..... 79

    Measurement Uncertainty .....79

    Emissions Test Details.....79

## ADMINISTRATIVE INFORMATION

### Test Report Information

**REPORT PREPARED FOR:**

Doughty Design  
7344 31st Ave SW  
Seattle, WA 98126

**REPORT PREPARED BY:**

Joyce Walker  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

REPRESENTATIVE: Chris Doughty

Project Number: 98667

**DATE OF EQUIPMENT RECEIPT:**

August 29, 2016

**DATE(S) OF TESTING:**

August 29 -31, 2016 and October 31, 2016

### Revision History

**Original:** Testing of the MarqMetrix RF Module Model: METRIX01 to FCC Part 15 Subpart C Section(s) 15.207 & 15.247.

**Addendum A:** The addendum is to correct calculations that were based on an incorrect antenna gain. The antenna gain of 0.7dBi was changed to 1.1dBi.

### Report Authorization

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



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

## Test Facility Information



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

TEST LOCATION(S):  
CKC Laboratories, Inc.  
22116 23<sup>rd</sup> Drive SE Suite A  
Bothell, WA 98021-4413

## Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.02

## Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
Bothell	US0081	SL2-IN-E-1145R	3082C-1	US1022	A-0148

## SUMMARY OF RESULTS

### Standard / Specification: FCC Part 15 Subpart C - 15.247 (DTS)

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	Pass
15.247(b)(3)	Output Power	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	Pass
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	Pass

NA = Not Applicable

### Modifications During Testing

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

Summary of Conditions
No modifications were made during testing.

**Modifications listed above must be incorporated into all production units.**

### Conditions During Testing

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

Summary of Conditions
None

## EQUIPMENT UNDER TEST (EUT)

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

### Configuration 1

*Equipment Tested:*

Device	Manufacturer	Model #	S/N
MarqMetrix RF Module	Doughty Design	METRIX01	NA

*Support Equipment:*

Device	Manufacturer	Model #	S/N
Coordinator Test Board	Doughty Design	3247Rev3	NA
AC Adapter	NorthPada	LA-520WF	NA

### Configuration 2

*Equipment Tested:*

Device	Manufacturer	Model #	S/N
MarqMetrix RF Module	Doughty Design	METRIX01	NA

*Support Equipment:*

Device	Manufacturer	Model #	S/N
Coordinator Test Board	Doughty Design	3247Rev3	NA
AC Adapter	NorthPada	LA-520WF	NA
5 dBi Antenna	SparkFun	WRL-00558	NA

### Configuration 3

*Equipment Tested:*

Device	Manufacturer	Model #	S/N
MarqMetrix RF Module	Doughty Design	METRIX01	NA

*Support Equipment:*

Device	Manufacturer	Model #	S/N
Coordinator Test Board	Doughty Design	3247Rev3	NA
AC Adapter	HTC	TC U250	NA
5 dBi Antenna	SparkFun	WRL-00558	NA

## General Product Information:

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Product Information	Manufacturer-Provided Details
Equipment Type:	Radio Module
Type of Wideband System:	Zigbee 802.15.4
Operating Frequency Range:	2405-2475MHz
Modulation Type(s):	DSSS
Maximum Duty Cycle:	38%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral or RSMA External
Nominal Input Voltage:	2.7-3.6VDC (3.0V Nominal)
Firmware / Software used for Test:	Firmware 1.00

## FCC Part 15 Subpart C

### 15.247(a)(2) 6dB Bandwidth

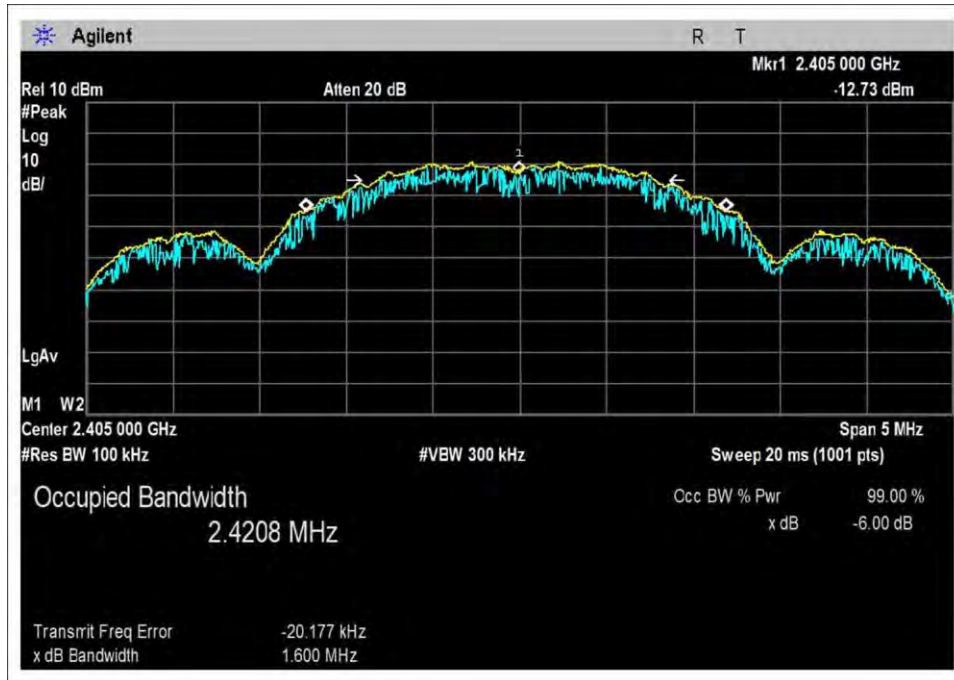
Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	M. Atkinson
Test Method:	ANSI C63.10 (2013), KDB 558074 v03r05 (April 8, 2016)	Test Date(s):	8/29/2016
Configuration:	1		
Test Setup:	Frequency Range: 2405-2475MHz Frequency tested: 2405, 2445, 2475MHz Firmware power setting: Max Power EUT Firmware: 1.00 Protocol /MCS/Modulation: DSSS  Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi  Duty Cycle: 100% (Test Mode)  Test Mode: Continuously transmitting Test Setup: The EUT is transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer. Modifications Added: None		

Environmental Conditions			
Temperature (°C)	21	Relative Humidity (%):	40

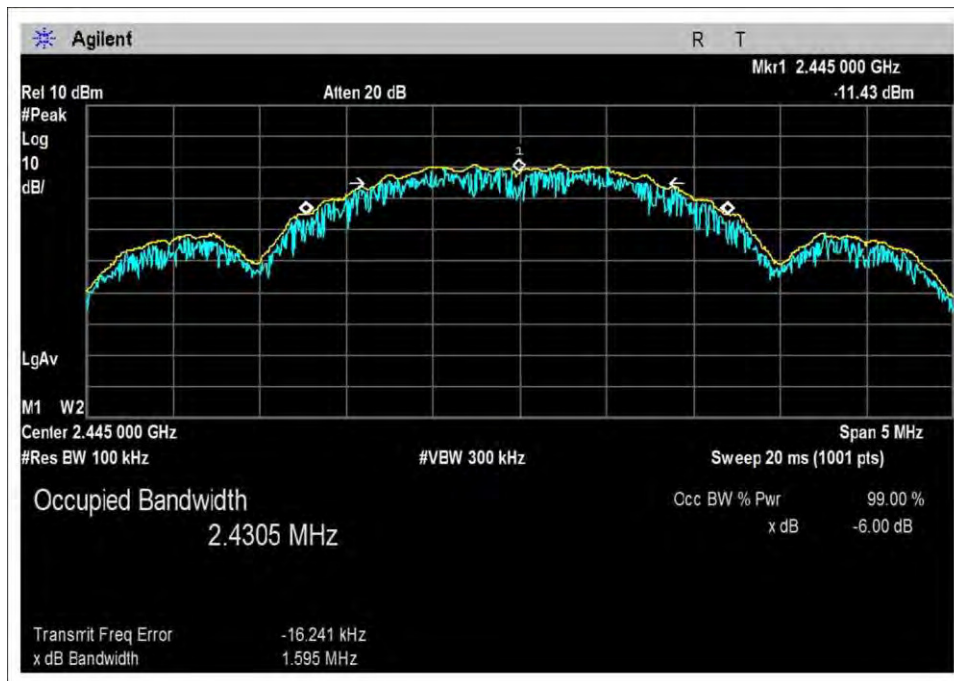
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02673	Spectrum Analyzer	Agilent	E4446A	10/12/2015	10/12/2017
P05747	Attenuator	Pasternack	PE7004-20	1/29/2016	1/29/2018
P06678	Cable	Astrolab	32026-29801- 29801-144	9/18/2014	9/18/2016

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2405	1	DSSS	1600	≥500	Pass
2445	1	DSSS	1595	≥500	Pass
2475	1	DSSS	1603	≥500	Pass

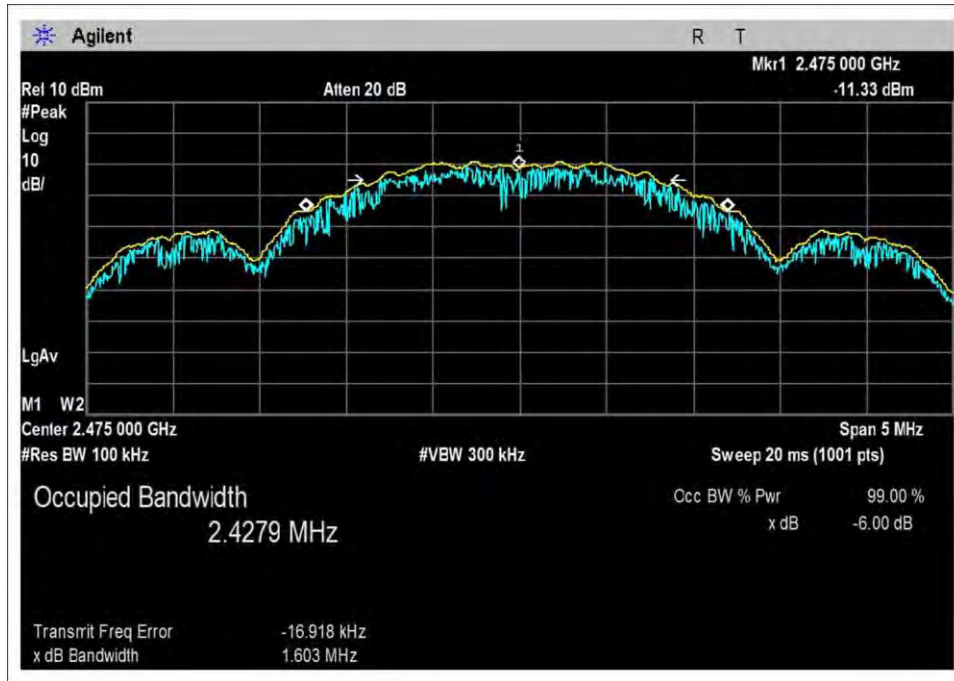
## Plots



Low Channel



Middle Channel



High Channel

**Test Setup Photo**



## 15.247(b)(3) Output Power

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation / Ant Port	V <sub>Minimum</sub> (dBm)	V <sub>Nominal</sub> (dBm)	V <sub>Maximum</sub> (dBm)	Max Deviation from V <sub>Nominal</sub> (dB)
2405	DSSS	16.7	17.3	17.4	0.6
2445	DSSS	16.3	16.8	17.4	0.6
2475	DSSS	16.1	16.7	17.5	0.8

Note: Test performed using operational mode with the highest output power, representing worst case.

The conducted measurements were recorded in dBuV and converted into dBm using a conversion factor for known system impedance of 50 ohms.

### Parameter Definitions:

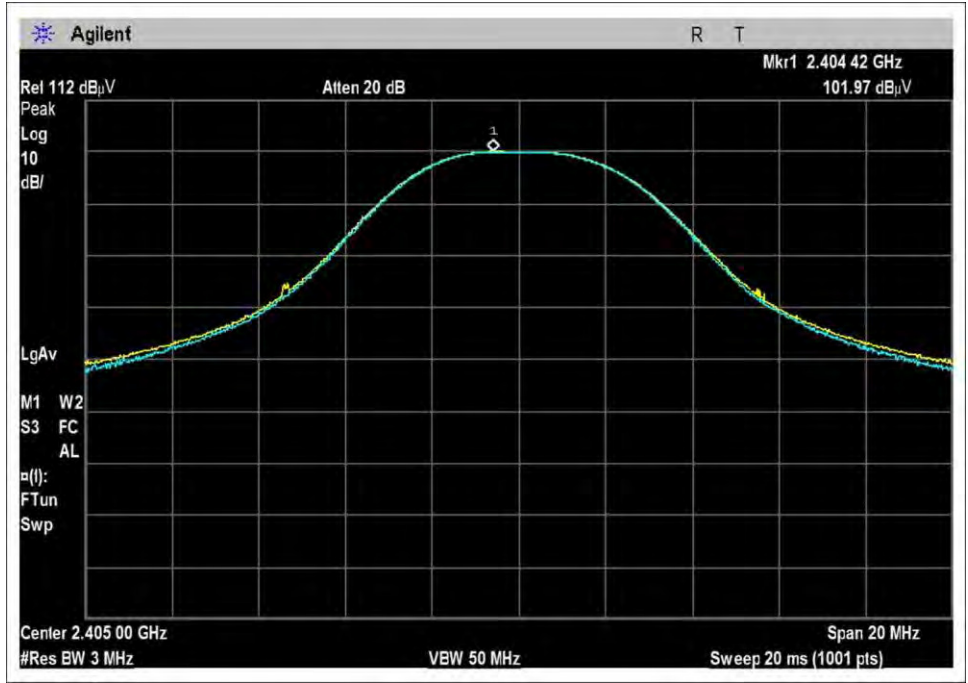
Measurements performed at input voltage according to manufacturer specification.

Parameter	Value
V <sub>Nominal</sub> :	3.0VDC
V <sub>Minimum</sub> :	2.7VDC
V <sub>Maximum</sub> :	3.6VDC

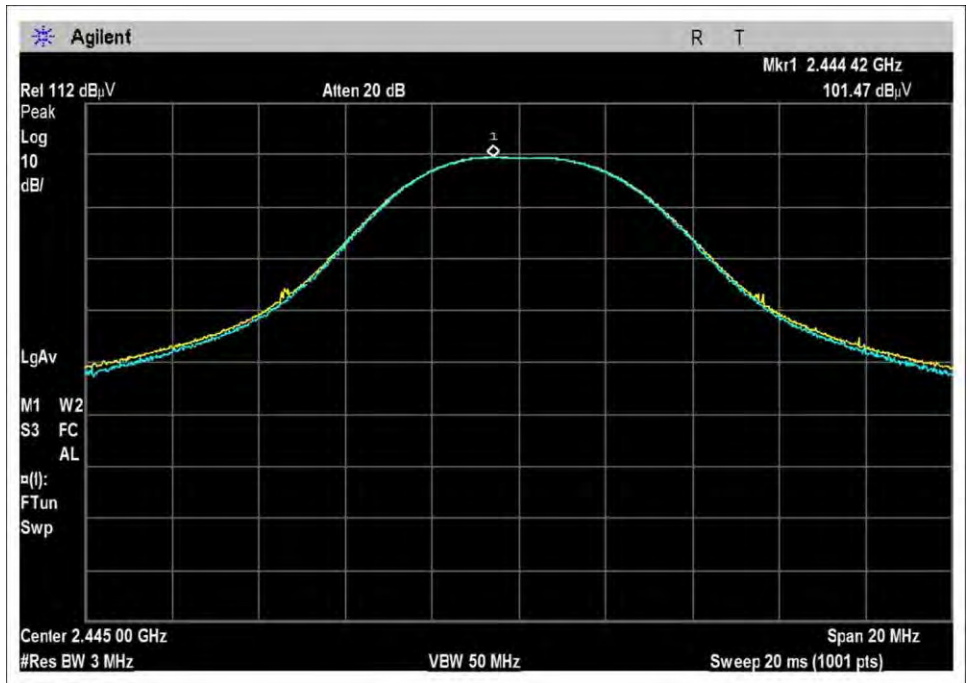
Power Output Test Data Summary - RF Conducted Measurement					
Measurement Option: RBW > DTS Bandwidth					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
2405	DSSS	Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi	17.3	≤30	Pass
2445	DSSS	Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi	16.8	≤30	Pass
2475	DSSS	Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi	16.7	≤30	Pass

Note: The conducted measurements were recorded in dBuV and converted into dBm using a conversion factor for known system impedance of 50 ohms.

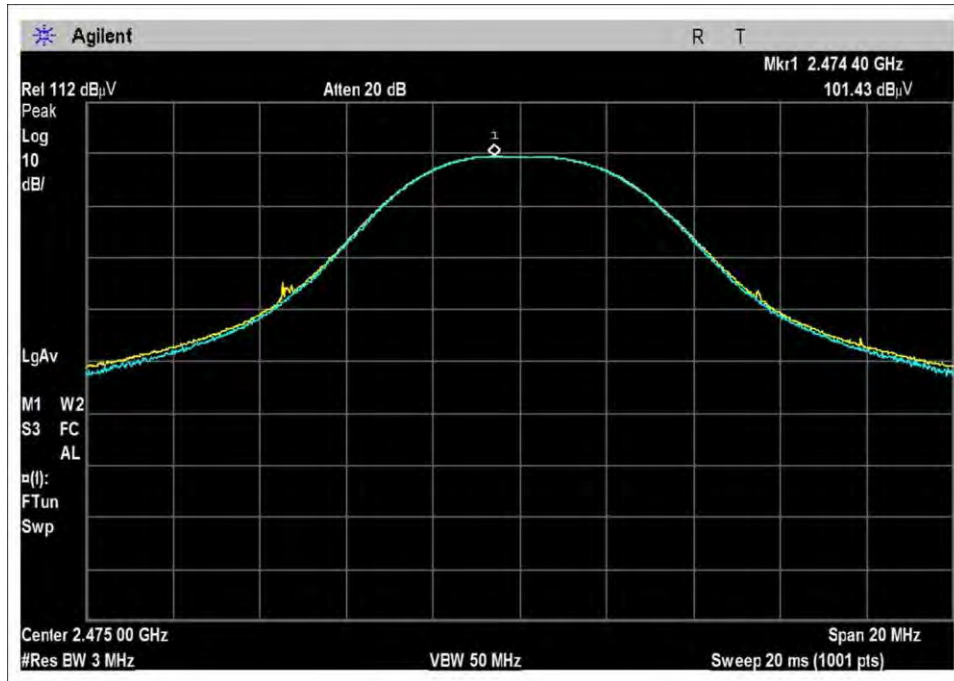
Plots



Low Channel



Middle Channel



High Channel

**Test Setup / Conditions / Data**

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.247(b) Power Output (2400-2483.5 MHz DTS)**  
 Work Order #: **98667** Date: 8/29/2016  
 Test Type: **Maximized Emissions** Time: 13:56:06  
 Tested By: Michael Atkinson Sequence#: 3  
 Software: EMITest 5.03.02

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
Configuration 1			

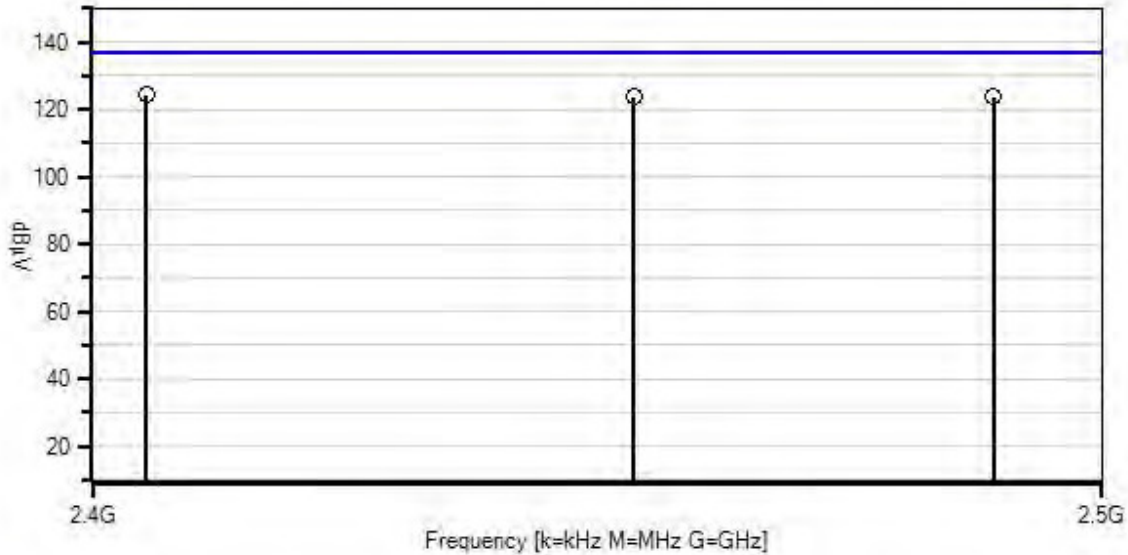
**Support Equipment:**

Device	Manufacturer	Model #	S/N
Configuration 1			

**Test Conditions / Notes:**

Temperature: 21°C  
 Humidity: 40%  
 Pressure: 103.3kPa  
  
 Frequency Range: 2405-2475MHz  
 Frequency tested: 2405, 2445, 2475MHz  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS  
  
 Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi  
  
 Duty Cycle: 100% (Test Mode)  
  
 Test Mode: Continuously transmitting  
 Test Setup: The EUT is transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013) and KDB 558074 v03r05 (April 8, 2016)

Doughty Design WO#: 98667 Sequence#: 3 Date: 8/29/2016  
 15.247(b) Power Output (2400-2483.5 MHz DTS) Test Distance: None None



— Readings  
 × QP Readings  
 ▼ Ambient  
 ○ Peak Readings  
 \* Average Readings  
 Software Version: 5.03.02  
 — 1 - 15.247(b) Power Output (2400-2483.5 MHz DTS)

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02673	Spectrum Analyzer	E4446A	10/12/2015	10/12/2017
T2	ANP05747	Attenuator	PE7004-20	1/29/2016	1/29/2018
T3	ANP06678	Cable	32026-29801-29801-144	9/18/2014	9/18/2016

**Measurement Data:**

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	Dist Table dB	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2404.420M	102.0	+0.0	+20.0	+2.3	+0.0	124.3	137.0	-12.7	None
2	2444.420M	101.5	+0.0	+20.0	+2.3	+0.0	123.8	137.0	-13.2	None
3	2474.400M	101.4	+0.0	+20.0	+2.3	+0.0	123.7	137.0	-13.3	None

**Test Setup Photo**



### 15.35(c) Duty Cycle Correction Factor

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03530	RF Powerhead	ETS	7002-006	3/31/2015	3/31/2017

Test Data Summary			
Antenna Port	Operational Mode	Measured On Time (mS / P <sub>obs</sub> )	Calculated DCCF (dB)
1	Worst Case Message	0.38	-8.4

Observation Period, P<sub>obs</sub> is the duration of the pulse train or maximum 100mS

Measured results are calculated as follows:

$$On\ Time = \left( \sum_{Bursts} RF\ Burst\ On\ Time + \sum_{Control} Control\ Signal\ On\ time \right) \Big|_{P_{obs} \text{ (max 100ms)}}$$

Measured Values:

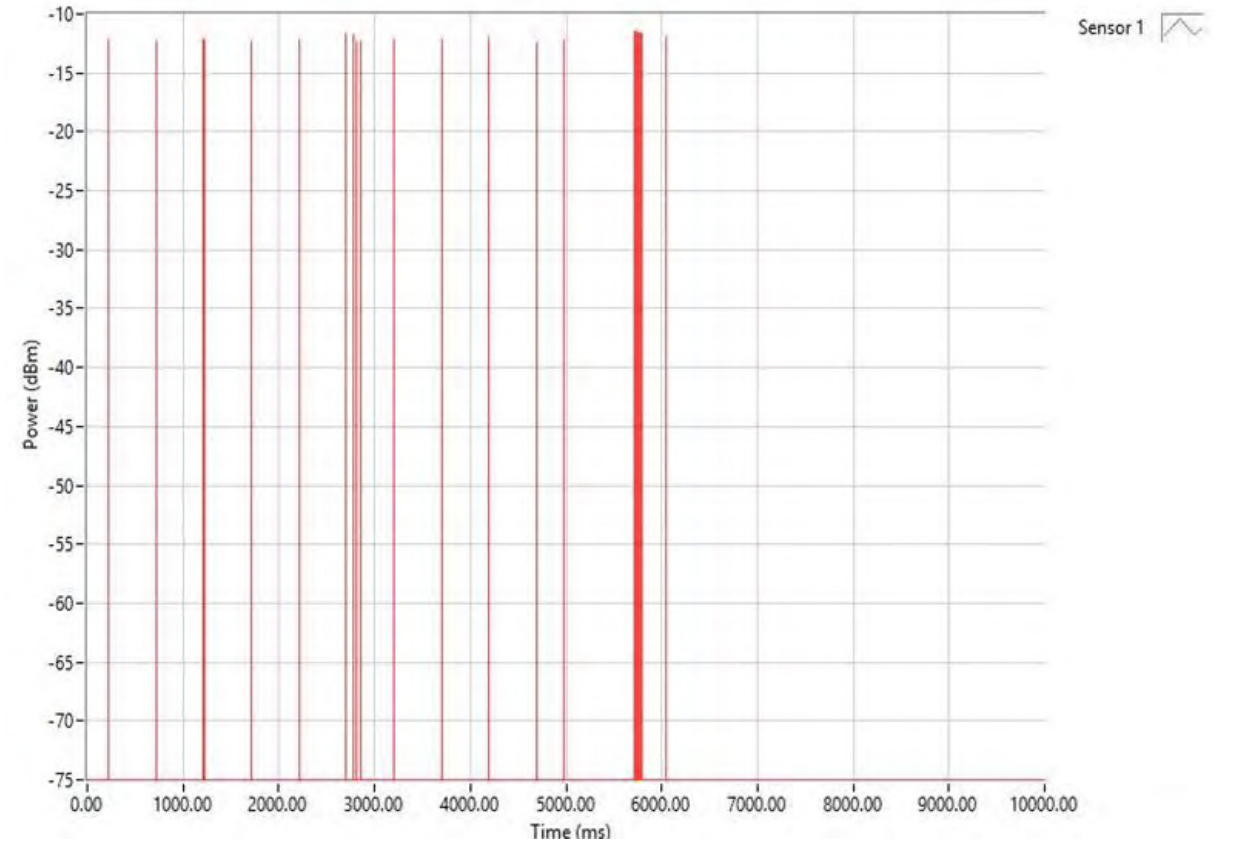
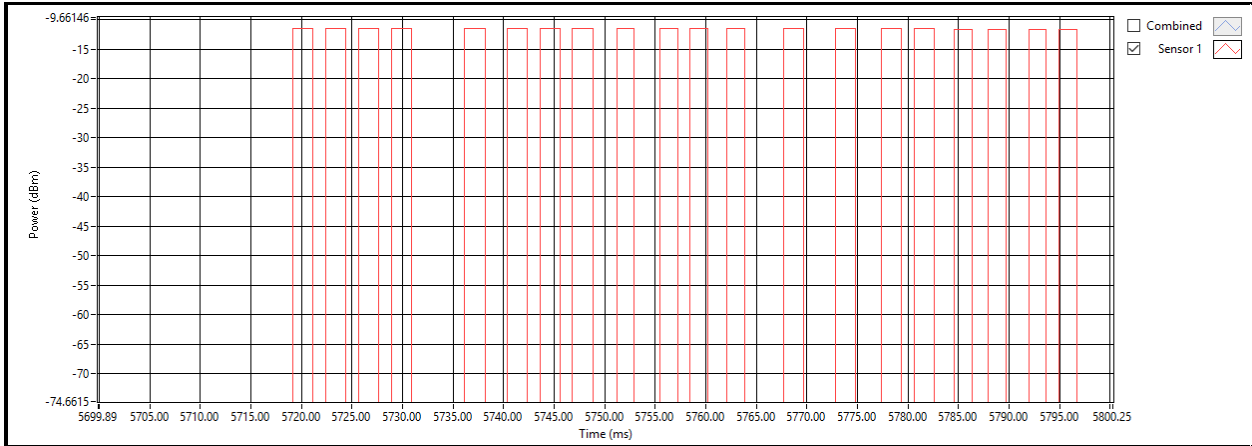
Parameter	Value
Observation Period (P <sub>obs</sub> ):	100ms
Number of RF Bursts / P <sub>obs</sub> :	20
On time of RF Burst:	Varies: 1.75-1.98mS
Number of Control or other signals / P <sub>obs</sub> :	0
On time of Control or other Signals:	0
Total Measured On Time:	38mS

Duty Cycle Correction Factor (DCCF) is calculated in accordance with ANSI C63.10:

$$DCCF = 20 \cdot \text{Log} \left( \frac{On\ Time}{P_{obs}} \right)$$

Note: Worst case of 100ms window reported. Investigated a longer sample time initially to find worst 100ms message.

**Duty Cycle Correction Factor Test Data**



Test Setup Photo



## 15.247(e) Power Spectral Density

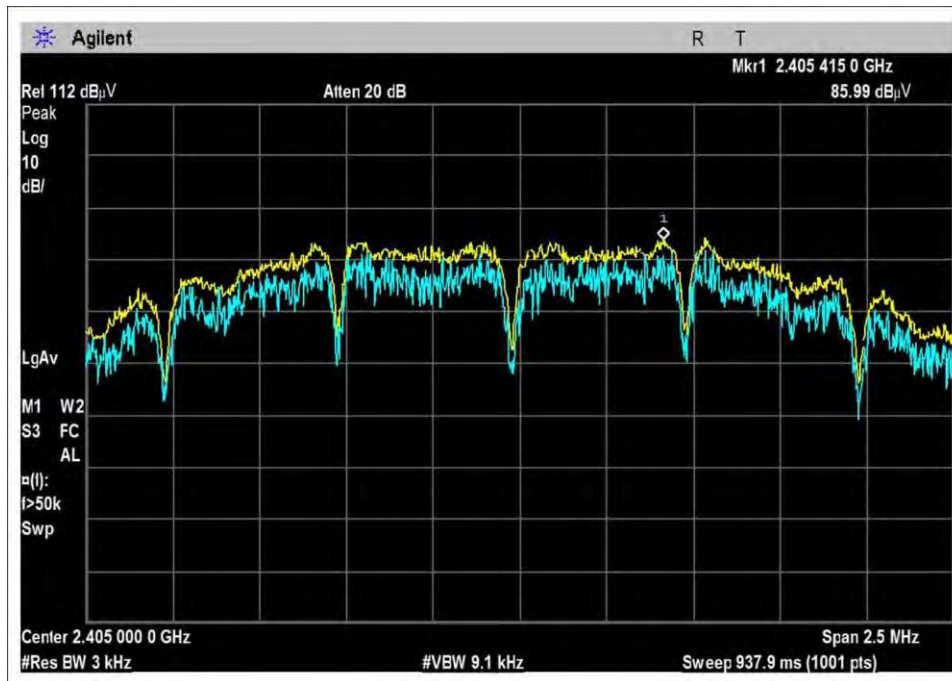
### PSD Test Data Summary - RF Conducted Measurement

Measurement Method: PKPSD

Frequency (MHz)	Modulation	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
2405	DSSS	0.51	≤8	Pass
2445	DSSS	1.91	≤8	Pass
2475	DSSS	1.51	≤8	Pass

Note: The conducted measurements were recorded in dBuV and converted into dBm using a conversion factor for known system impedance of 50 ohms.

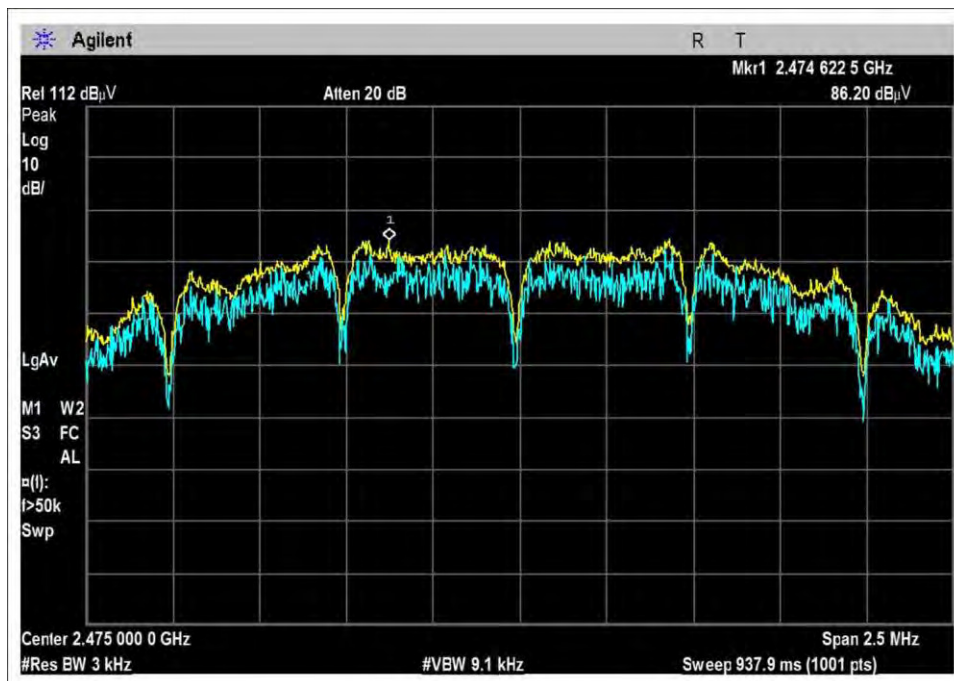
### Plots



Low Channel



Middle Channel



High Channel

**Test Setup / Conditions / Data**

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)**  
 Work Order #: **98667** Date: 8/29/2016  
 Test Type: **Maximized Emissions** Time: 15:29:41  
 Tested By: Michael Atkinson Sequence#: 5  
 Software: EMITest 5.03.02

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
Configuration 1			

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Configuration 1			

**Test Conditions / Notes:**

Temperature: 21°C  
 Humidity: 40%  
 Pressure: 103.3kPa

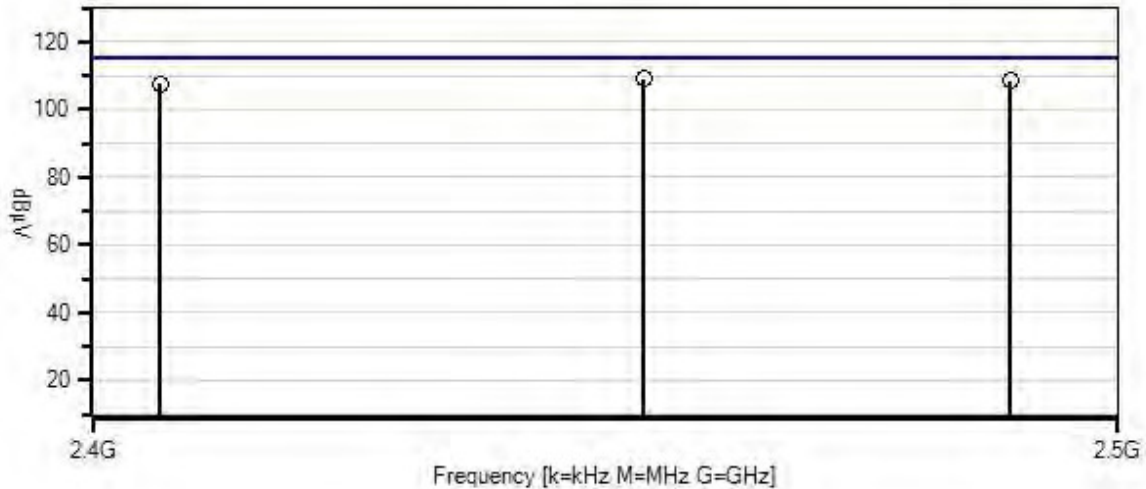
Frequency Range: 2405-2475MHz  
 Frequency tested: 2405, 2445, 2475MHz  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS

Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi

Duty Cycle: 100% (Test Mode)

Test Mode: Continuously transmitting  
 Test Setup: The EUT is transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013) and KDB 558074 v03r05 (April 8, 2016)

Doughty Design WD#: 98667 Sequence#: 5 Date: 8/29/2016  
 15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS) Test Distance: None None



- Readings
- Peak Readings
- × QP Readings
- \* Average Readings
- ▼ Ambient
- Software Version: 5.03.02
- 1 - 15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02673	Spectrum Analyzer	E4446A	10/12/2015	10/12/2017
T1	ANP05747	Attenuator	PE7004-20	1/29/2016	1/29/2018
T2	ANP06678	Cable	32026-29801-29801-144	9/18/2014	9/18/2016

**Measurement Data:**

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2444.538M	86.6	+20.0	+2.3			+0.0	108.9	115.0	-6.1	None
2	2474.623M	86.2	+20.0	+2.3			+0.0	108.5	115.0	-6.5	None
3	2405.415M	85.2	+20.0	+2.3			+0.0	107.5	115.0	-7.5	None

**Test Setup Photo**



## 15.247(d) RF Conducted Emissions & Band Edge

### Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.247(d) Conducted Spurious Emissions**  
 Work Order #: **98667** Date: 8/30/2016  
 Test Type: **Maximized Emissions** Time: 08:45:31  
 Tested By: Michael Atkinson Sequence#: 12  
 Software: EMITest 5.03.02

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

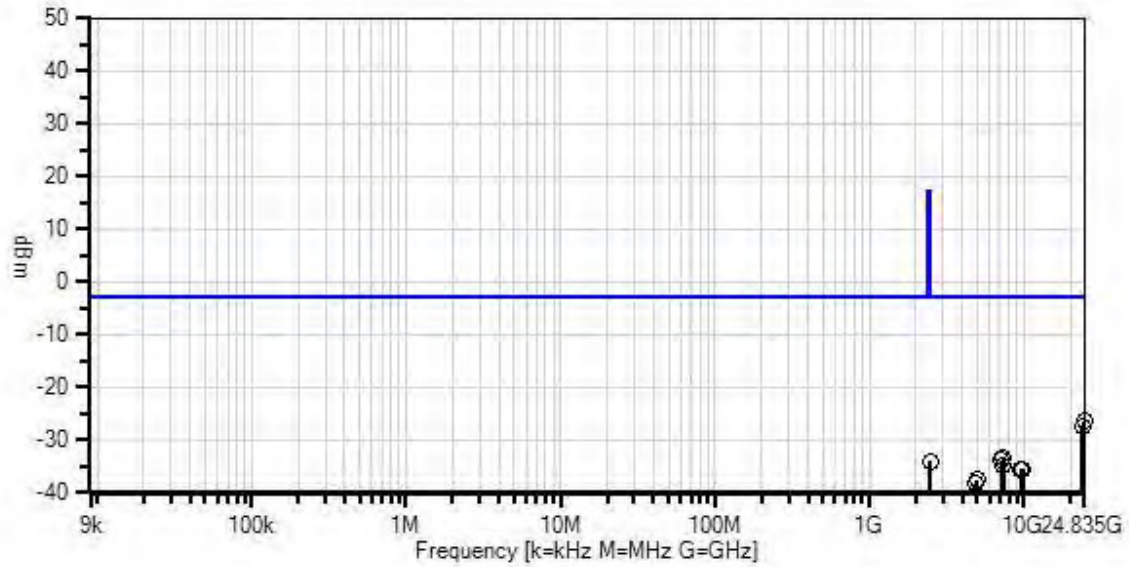
#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Test Conditions / Notes:

Temperature: 21°C  
 Humidity: 40%  
 Pressure: 103.3kPa  
  
 Frequency Range: 2405-2475MHz  
 Frequency tested: 2405, 2445, 2475MHz  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS  
  
 Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi  
  
 Duty Cycle: 100% (Test Mode)  
  
 Test Mode: Continuously transmitting  
 Test Setup: The EUT is transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013) and KDB 558074 v03r05 (April 8, 2016)

Doughty Design WD#: 98667 Sequence#: 12 Date: 8/30/2016  
 15.247(d) Conducted Spurious Emissions Test Distance: None None



- Readings
  - × QP Readings
  - ▼ Ambient
  - 1 - 15.247(d) Conducted Spurious Emissions
  - Peak Readings
  - \* Average Readings
- Software Version: 5.03.02

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02673	Spectrum Analyzer	E4446A	10/12/2015	10/12/2017
T1	ANP06678	Cable	32026-29801-29801-144	9/18/2014	9/18/2016
T2	ANP06242	Attenuator	54A-10	3/28/2016	3/28/2018
T3	ANP06243	Attenuator	54A-10	3/9/2016	3/9/2018
	ANP05747	Attenuator	PE7004-20	1/29/2016	1/29/2018

**Measurement Data:**

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBm	Spec dBm	Margin dB	Polar Ant
1	24748.950 M	-54.1	+7.8	+10.0	+9.9		+0.0	-26.4	-2.7	-23.7	None
									High		
2	24052.600 M	-55.2	+7.7	+10.1	+9.9		+0.0	-27.5	-2.7	-24.8	None
									Low		
3	24452.150 M	-55.3	+7.8	+10.1	+9.9		+0.0	-27.5	-2.7	-24.8	None
									Mid		
4	7425.250M	-57.2	+4.1	+9.9	+9.8		+0.0	-33.4	-2.7	-30.7	None
									High		
5	7214.900M	-57.4	+4.0	+9.9	+9.8		+0.0	-33.7	-2.7	-31.0	None
									Low		
6	2483.800M	-55.9	+2.3	+9.8	+9.8		+0.0	-34.0	-2.7	-31.3	None
									High		
7	7337.150M	-58.6	+4.1	+9.9	+9.8		+0.0	-34.8	-2.7	-32.1	None
									Mid		
8	9900.950M	-59.8	+4.8	+9.8	+9.8		+0.0	-35.4	-2.7	-32.7	None
									High		
9	9778.900M	-59.9	+4.8	+9.9	+9.8		+0.0	-35.4	-2.7	-32.7	None
									Mid		
10	9619.250M	-60.2	+4.7	+10.0	+9.8		+0.0	-35.7	-2.7	-33.0	None
									Low		
11	4951.800M	-60.5	+3.3	+9.9	+9.8		+0.0	-37.5	-2.7	-34.8	None
									High		
12	4889.850M	-61.0	+3.3	+9.9	+9.8		+0.0	-38.0	-2.7	-35.3	None
									Mid		
13	4810.500M	-61.2	+3.2	+9.9	+9.8		+0.0	-38.3	-2.7	-35.6	None
									Low		
14	861.400M	-61.5	+1.4	+9.8	+9.8		+0.0	-40.5	-2.7	-37.8	None
15	360.200k	-60.1	+0.0	+9.8	+9.7		+0.0	-40.6	-2.7	-37.9	None
16	259.480M	-61.7	+0.7	+9.8	+9.7		+0.0	-41.5	-2.7	-38.8	None

**Band Edge**

**Band Edge Summary**

Limit applied: Max Power/100kHz - 20dB.				
Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
2400.0	DSSS	-26.8	<-2.7	Pass
2483.5	DSSS	-39.3	<-2.7	Pass

**Test Setup / Conditions / Data**

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.247(d) Conducted Spurious Emissions**  
 Work Order #: **98667** Date: 8/30/2016  
 Test Type: **Maximized Emissions** Time: 08:45:31  
 Tested By: Michael Atkinson Sequence#: 12  
 Software: EMITest 5.03.02

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
Configuration 1			

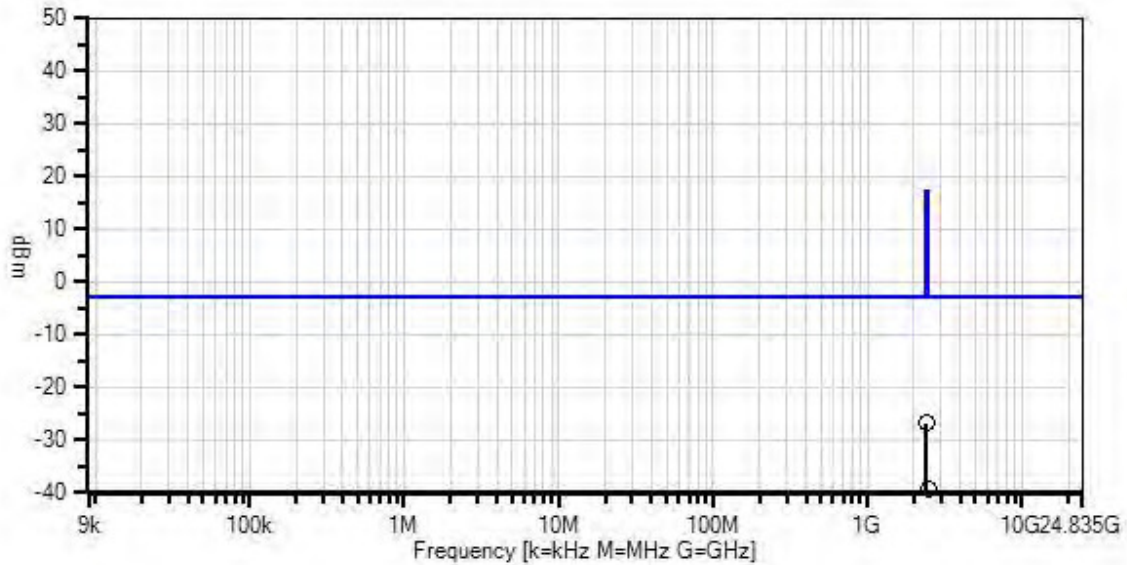
**Support Equipment:**

Device	Manufacturer	Model #	S/N
Configuration 1			

**Test Conditions / Notes:**

Frequency Range: 2405-2475MHz  
 Frequency tested: Band Edge  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS  
  
 Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi  
  
 Duty Cycle: 100% (Test Mode)  
  
 Test Mode: Continuously transmitting  
 Test Setup: The EUT is transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013) and KDB 558074 v03r05 (April 8, 2016)

Doughty Design WD#: 98667 Sequence#: 12 Date: 8/30/2016  
 15.247(d) Conducted Spurious Emissions Test Distance: None None



— Readings  
 × QP Readings  
 ▼ Ambient  
 — 1 - 15.247(d) Conducted Spurious Emissions  
 ○ Peak Readings  
 \* Average Readings  
 Software Version: 5.03.02

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02673	Spectrum Analyzer	E4446A	10/12/2015	10/12/2017
T1	ANP06678	Cable	32026-29801-29801-144	9/18/2014	9/18/2016
T2	ANP06242	Attenuator	54A-10	3/28/2016	3/28/2018
T3	ANP06243	Attenuator	54A-10	3/9/2016	3/9/2018
	ANP05747	Attenuator	PE7004-20	1/29/2016	1/29/2018

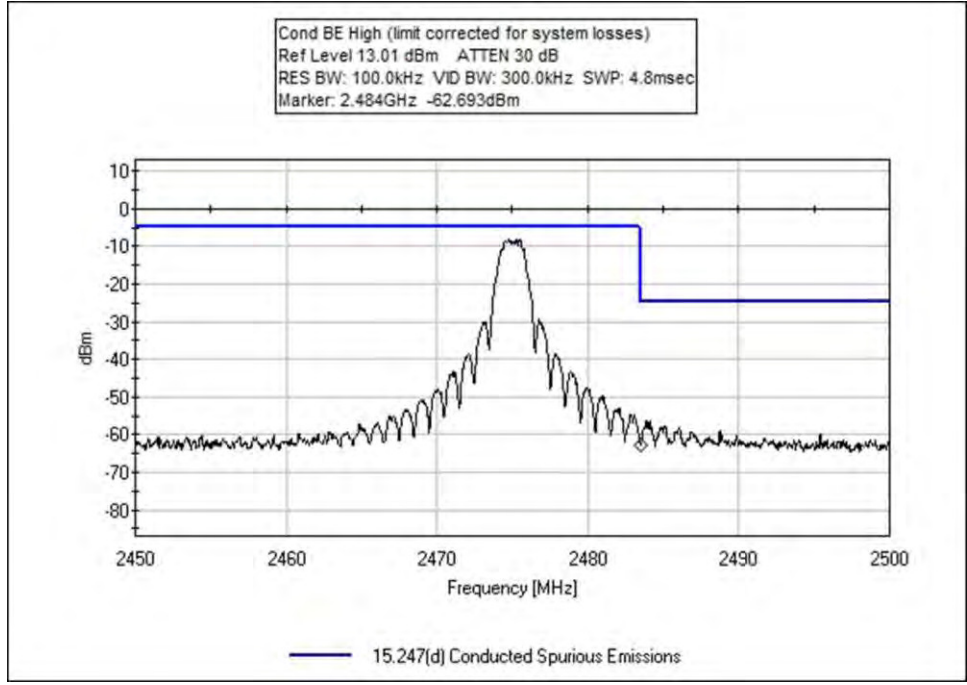
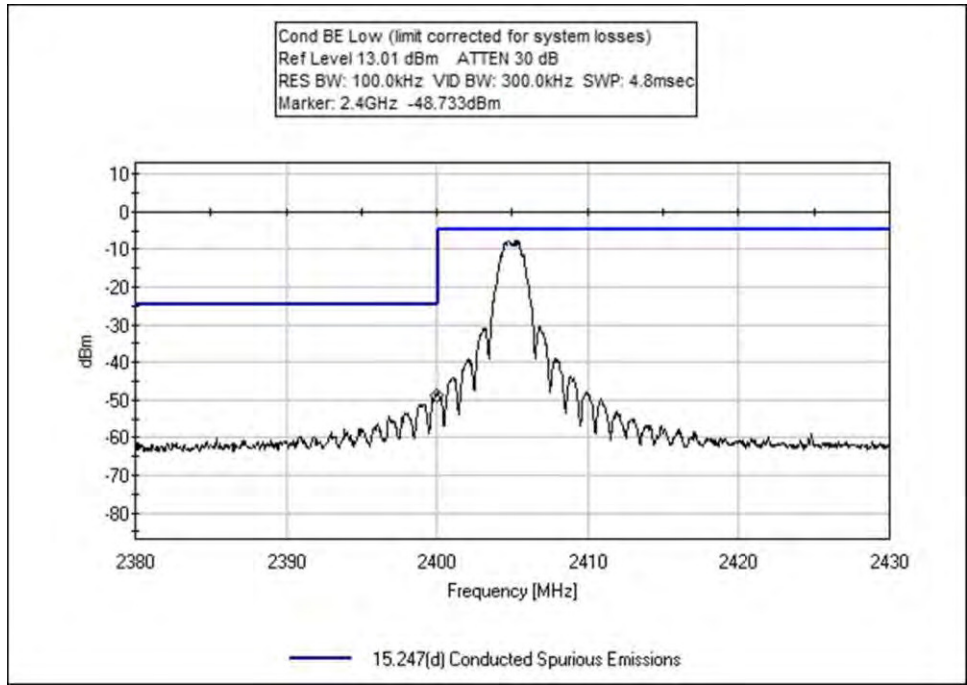
**Measurement Data:**

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	Dist dB	Table	Corr dBm	Spec dBm	Margin dB	Polar Ant
1	2400.000M	-48.7	+2.3	+9.8	+9.8	+0.0		-26.8	-2.7	-24.1	None
									Low BE		
2	2483.500M	-61.2	+2.3	+9.8	+9.8	+0.0		-39.3	-2.7	-36.6	None
									High BE		

## Band Edge Plots



Test Setup Photo



## 15.247(d) Radiated Emissions & Band Edge

### Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **98667** Date: 8/31/2016  
 Test Type: **Maximized Emissions** Time: 11:40:39  
 Tested By: Michael Atkinson Sequence#: 2  
 Software: EMITest 5.03.02

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

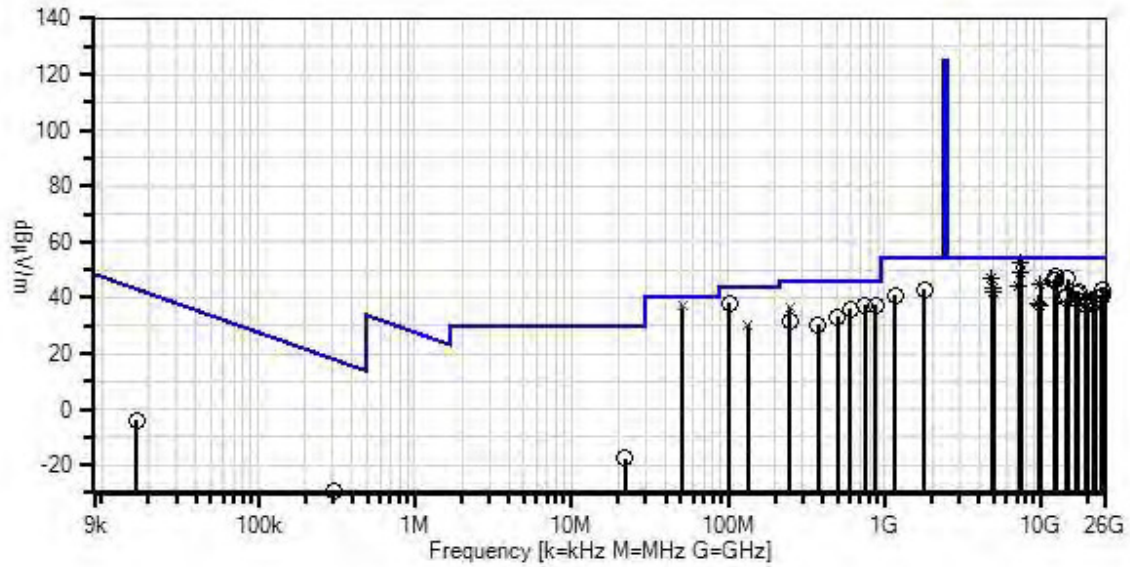
#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

#### Test Conditions / Notes:

Temperature: 24°C  
 Humidity: 36%  
 Pressure: 102.3kPa  
  
 Frequency Range: 2405-2475MHz  
 Frequency tested: 2405, 2445, 2475MHz  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS  
  
 Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi  
  
 Duty Cycle: 100% (Test Mode)  
  
 Test Mode: Continuously transmitting  
 Test Setup: The EUT is top of foam table, transmitting through External 5dBi antenna. Both antenna polarities and X, Y, Z EUT axes investigated. Only worst case reported.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013) and KDB 558074 v03r05 (April 8, 2016)

Doughty Design WO#: 98667 Sequence#: 2 Date: 8/31/2016  
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Para+Perp



- Readings
  - × QP Readings
  - ▼ Ambient
  - Peak Readings
  - \* Average Readings
- 1 - 15.247(d) / 15.209 Radiated Spurious Emissions  
 Software Version: 5.03.02

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02871	Spectrum Analyzer	E4440A	8/25/2015	8/25/2017
T2	ANP06540	Cable	Heliac	10/29/2015	10/29/2017
T3	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T4	AN03540	Preamp	83017A	4/30/2015	4/30/2017
T5	ANP06935	Cable	32026-29801-29801-18	3/11/2016	3/11/2018
T6	AN03116	High Pass Filter	11SH10-00313	2/6/2015	2/6/2017
T7	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	8/12/2015	8/12/2017
T8	ANP06124	Attenuator	18N-6	5/8/2015	5/8/2017
T9	AN02741	Active Horn Antenna	AMFW-5F-12001800-20-10P	1/14/2015	1/14/2017
	AN02673	Spectrum Analyzer	E4446A	10/12/2015	10/12/2017
T10	ANP06678	Cable	32026-29801-29801-144	9/18/2014	9/18/2016
T11	AN02742	Active Horn Antenna	AMFW-5F-18002650-20-10P	1/14/2015	1/14/2017
T12	AN00052	Loop Antenna	6502	4/8/2016	4/8/2018
T13	ANP05963	Cable	RG-214	2/15/2016	2/15/2018
T14	ANP05360	Cable	RG214	12/1/2014	12/1/2016
T15	AN02307	Preamp	8447D	2/15/2016	2/15/2018
T16	AN01994	Biconilog Antenna	CBL6111C	3/11/2016	3/11/2018
T17	ANP05505	Attenuator	NAT-6	3/31/2016	3/31/2018

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T8					
			T9	T10	T11	T12					
			T13	T14	T15	T16					
			T17								
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	7426.510M Ave	43.1	+0.0	+1.3	+4.8	-34.7	+0.0	52.3	54.0	-1.7	H+V
			+0.6	+0.7	+36.5	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	7426.510M	51.9	+0.0	+1.3	+4.8	-34.7	+0.0	61.1	54.0	+7.1	H+V
			+0.6	+0.7	+36.5	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
3	7336.471M Ave	40.1	+0.0	+1.2	+4.7	-34.6	+0.0	48.9	54.0	-5.1	H+V
			+0.6	+0.7	+36.2	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	7336.450M	48.9	+0.0	+1.2	+4.7	-34.6	+0.0	57.7	54.0	+3.7	H+V
			+0.6	+0.7	+36.2	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
5	12377.350 M	53.1	+0.0	+1.6	+6.4	+0.0	+0.0	47.8	54.0	-6.2	H+V
			+0.0	+0.0	+0.0	+0.0					
			-13.3	+0.0	+0.0	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
6	4808.920M Ave	41.7	+0.0	+0.9	+4.3	-34.2	+0.0	46.7	54.0	-7.3	H+V
			+0.5	+0.8	+32.7	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	4808.930M	49.7	+0.0	+0.9	+4.3	-34.2	+0.0	54.7	54.0	+0.7	H+V
			+0.5	+0.8	+32.7	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
8	12022.400 M	51.6	+0.0	+1.5	+6.4	+0.0	+0.0	46.3	54.0	-7.7	H+V
			+0.0	+0.0	+0.0	+0.0					
			-13.2	+0.0	+0.0	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
9	12227.350 M	51.5	+0.0	+1.5	+6.6	+0.0	+0.0	46.3	54.0	-7.7	H+V
			+0.0	+0.0	+0.0	+0.0					
			-13.3	+0.0	+0.0	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								

10	249.993M QP	41.2	+0.0 +0.0 +0.0 +1.5 +6.1	+0.2 +0.0 +0.0 +1.0	+0.0 +0.0 +0.0 -27.0	+0.0 +0.0 +0.0 +13.8	+0.0	36.8	46.0	-9.2	Para+
11	9901.950M Ave	33.2	+0.0 +0.8 +0.0 +0.0 +0.0	+1.3 +1.3 +0.0 +0.0	+6.1 +37.2 +0.0 +0.0	-35.1 +0.0 +0.0	+0.0	44.8	54.0 High	-9.2	H+V
^	9901.920M	43.3	+0.0 +0.8 +0.0 +0.0 +0.0	+1.3 +1.3 +0.0 +0.0	+6.1 +37.2 +0.0 +0.0	-35.1 +0.0 +0.0	+0.0	54.9	54.0 High	+0.9	H+V
13	7213.447M Ave	36.0	+0.0 +0.6 +0.0 +0.0 +0.0	+1.2 +0.8 +0.0 +0.0	+4.6 +35.7 +0.0 +0.0	-34.5 +0.0 +0.0	+0.0	44.4	54.0 Low	-9.6	H+V
^	7213.490M	46.7	+0.0 +0.6 +0.0 +0.0 +0.0	+1.2 +0.8 +0.0 +0.0	+4.6 +35.7 +0.0 +0.0	-34.5 +0.0 +0.0	+0.0	55.1	54.0 Low	+1.1	H+V
15	4888.955M Ave	38.6	+0.0 +0.5 +0.0 +0.0 +0.0	+0.9 +0.8 +0.0 +0.0	+4.4 +32.7 +0.0 +0.0	-34.2 +0.0 +0.0	+0.0	43.7	54.0 Mid	-10.3	H+V
^	4889.000M	47.0	+0.0 +0.5 +0.0 +0.0 +0.0	+0.9 +0.8 +0.0 +0.0	+4.4 +32.7 +0.0 +0.0	-34.2 +0.0 +0.0	+0.0	52.1	54.0 Mid	-1.9	H+V
17	1789.800M	42.2	+0.0 +0.3 +0.0 +0.0 +0.0	+0.5 +0.0 +0.0 +0.0	+2.5 +26.7 +0.0 +0.0	-35.1 +5.7 +0.0	+0.0	42.8	54.0	-11.2	H+V
18	4948.975M Ave	37.3	+0.0 +0.5 +0.0 +0.0 +0.0	+0.9 +0.7 +0.0 +0.0	+4.4 +32.8 +0.0 +0.0	-34.2 +0.0 +0.0	+0.0	42.4	54.0 High	-11.6	H+V
^	4948.975M	46.5	+0.0 +0.5 +0.0 +0.0 +0.0	+0.9 +0.7 +0.0 +0.0	+4.4 +32.8 +0.0 +0.0	-34.2 +0.0 +0.0	+0.0	51.6	54.0 High	-2.4	H+V

20	1160.200M	44.9	+0.0	+0.4	+2.0	-36.8	+0.0	40.7	54.0	-13.3	H+V
			+0.3	+0.0	+24.2	+5.7					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
21	134.800M QP	37.8	+0.0	+0.1	+0.0	+0.0	+0.0	30.2	43.5	-13.3	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+1.2	+0.6	-27.6	+12.0					
			+6.1								
^	134.800M	41.3	+0.0	+0.1	+0.0	+0.0	+0.0	33.7	43.5	-9.8	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+1.2	+0.6	-27.6	+12.0					
			+6.1								
23	22279.370 M	49.5	+0.0	+0.0	+0.0	+0.0	+0.0	40.2	54.0	-13.8	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+7.4	-16.7	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
24	250.200M	36.0	+0.0	+0.2	+0.0	+0.0	+0.0	31.6	46.0	-14.4	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+1.5	+1.0	-27.0	+13.8					
			+6.1								
25	19806.730 M	44.8	+0.0	+0.0	+0.0	+0.0	+0.0	38.4	54.0	-15.6	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+6.9	-13.3	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
26	9620.810M Ave	26.1	+0.0	+1.5	+6.1	-35.0	+0.0	38.2	54.0	-15.8	H+V
			+0.8	+1.3	+37.4	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	9620.810M	38.7	+0.0	+1.5	+6.1	-35.0	+0.0	50.8	54.0	-3.2	H+V
			+0.8	+1.3	+37.4	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
28	22011.930 M	47.0	+0.0	+0.0	+0.0	+0.0	+0.0	37.9	54.0	-16.1	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+7.4	-16.5	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
29	19242.470 M	44.4	+0.0	+0.0	+0.0	+0.0	+0.0	37.9	54.0	-16.1	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+6.8	-13.3	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								

30	19559.530 M	43.8	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +6.9 +0.0 +0.0	+0.0 +0.0 -13.2 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	37.5	54.0	-16.5	H+V
									Mid		
31	9781.367M Ave	25.8	+0.0 +0.7 +0.0 +0.0 +0.0	+1.4 +1.3 +0.0 +0.0 +0.0	+6.1 +37.3 +0.0 +0.0 +0.0	-35.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	37.5	54.0	-16.5	H+V
									Mid		
^	9781.367M	36.3	+0.0 +0.7 +0.0 +0.0 +0.0	+1.4 +1.3 +0.0 +0.0 +0.0	+6.1 +37.3 +0.0 +0.0 +0.0	-35.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	48.0	54.0	-6.0	H+V
									Mid		
33	14853.000 M	51.5	+0.0 +0.0 -14.2 +0.0 +0.0	+1.8 +0.0 +0.0 +0.0 +0.0	+7.8 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	46.9	92.0	-45.1	H+V
									High		
34	24743.930 M	47.5	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.8 +0.0 +0.0	+0.0 +0.0 -12.4 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	42.9	92.0	-49.1	H+V
									High		
35	17321.650 M	43.1	+0.0 +0.0 -11.7 +0.0 +0.0	+2.0 +0.0 +0.0 +0.0 +0.0	+8.8 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	42.2	92.0	-49.8	H+V
									High		
36	16831.300 M	42.3	+0.0 +0.0 -11.3 +0.0 +0.0	+2.1 +0.0 +0.0 +0.0 +0.0	+8.6 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	41.7	92.0	-50.3	H+V
									Low		
37	14666.800 M	45.3	+0.0 +0.0 -14.1 +0.0 +0.0	+1.8 +0.0 +0.0 +0.0 +0.0	+7.8 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	40.8	92.0	-51.2	H+V
									Mid		
38	24449.330 M	45.5	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.8 +0.0 +0.0	+0.0 +0.0 -12.9 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	40.4	92.0	-51.6	H+V
									Mid		
39	24055.400 M	46.2	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.7 +0.0 +0.0	+0.0 +0.0 -13.7 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	40.2	92.0	-51.8	H+V
									Low		

40	14432.850 M	44.7	+0.0 +0.0 -14.3 +0.0 +0.0	+1.8 +0.0 +0.0 +0.0	+7.7 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	39.9	92.0	-52.1	H+V
									Low		
41	17118.150 M	40.5	+0.0 +0.0 -11.9 +0.0 +0.0	+2.1 +0.0 +0.0 +0.0	+8.6 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	39.3	92.0	-52.7	H+V
									Mid		
42	21637.870 M	47.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.3 +0.0	+0.0 +0.0 -15.9 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	38.4	92.0	-53.6	H+V
									Low		
43	102.700M	47.4	+0.0 +0.0 +0.0 +1.2 +6.1	+0.1 +0.0 +0.0 +0.6	+0.0 +0.0 +0.0 -27.7	+0.0 +0.0 +0.0 +10.5	+0.0	38.2	92.0	-53.8	Para+
44	874.900M	30.2	+0.0 +0.0 +0.0 +2.4 +6.1	+0.3 +0.0 +0.0 +2.0	+0.0 +0.0 +0.0 -27.5	+0.0 +0.0 +0.0 +24.0	+0.0	37.5	92.0	-54.5	Para+
45	51.255M QP	49.5	+0.0 +0.0 +0.0 +0.6 +6.1	+0.1 +0.0 +0.0 +0.4	+0.0 +0.0 +0.0 -27.9	+0.0 +0.0 +0.0 +8.5	+0.0	37.3	92.0	-54.7	Para+
^	51.300M	52.3	+0.0 +0.0 +0.0 +0.6 +6.1	+0.1 +0.0 +0.0 +0.4	+0.0 +0.0 +0.0 -27.9	+0.0 +0.0 +0.0 +8.4	+0.0	40.0	92.0	-52.0	Para+
47	749.700M	31.7	+0.0 +0.0 +0.0 +2.2 +6.2	+0.3 +0.0 +0.0 +1.8	+0.0 +0.0 +0.0 -27.9	+0.0 +0.0 +0.0 +22.9	+0.0	37.2	92.0	-54.8	Para+
48	600.400M	33.1	+0.0 +0.0 +0.0 +2.1 +6.2	+0.3 +0.0 +0.0 +1.6	+0.0 +0.0 +0.0 -28.1	+0.0 +0.0 +0.0 +20.6	+0.0	35.8	92.0	-56.2	Para+

49	500.400M	33.0	+0.0	+0.3	+0.0	+0.0	+0.0	33.3	92.0	-58.7	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+2.0	+1.4	-28.1	+18.6					
			+6.1								
50	375.300M	32.3	+0.0	+0.3	+0.0	+0.0	+0.0	30.5	92.0	-61.5	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+1.8	+1.2	-27.5	+16.3					
			+6.1								
51	16.745k	61.2	+0.0	+0.0	+0.0	+0.0	-80.0	-4.1	92.0	-96.1	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+14.7					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
52	22.083M	14.5	+0.0	+0.0	+0.3	+0.0	-40.0	-17.5	92.0	-109.5	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+7.7					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
53	308.100k	41.3	+0.0	+0.0	+0.0	+0.0	-80.0	-29.1	92.0	-121.1	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+9.6					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions (AVG)**  
 Work Order #: **98667** Date: 8/31/2016  
 Test Type: **Maximized Emissions** Time: 11:26:33  
 Tested By: Michael Atkinson Sequence#: 1  
 Software: EMITest 5.03.02

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
Configuration 1			

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Configuration 1			

**Test Conditions / Notes:**

Temperature: 24°C  
 Humidity: 36%  
 Pressure: 102.3kPa

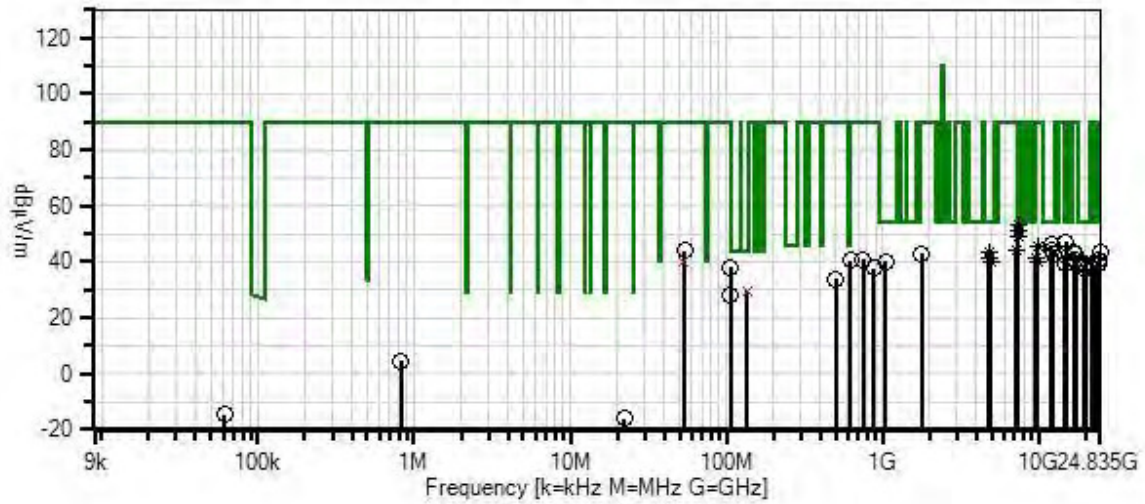
Frequency Range: 2405-2475MHz  
 Frequency tested: 2405, 2445, 2475MHz  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS

Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi

Duty Cycle: 100% (Test Mode)

Test Mode: Continuously transmitting  
 Test Setup: The EUT is top of foam table, transmitting through Internal 1.1dBi Antenna. Both antenna polarities and X, Y, Z EUT axes investigated. Only worst case reported.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013) and KDB 558074 v03r05 (April 8, 2016)

Doughty Design WD#: 98667 Sequence#: 1 Date: 8/31/2016  
 15.247(d) / 15.209 Radiated Spurious Emissions (AVG) Test Distance: 3 Meters H+V



- Readings
  - Peak Readings
  - × QP Readings
  - \* Average Readings
  - ▼ Ambient
- Software Version: 5.03.02  
 1 - 15.247(d) / 15.209 Radiated Spurious Emissions (AVG)

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02871	Spectrum Analyzer	E4440A	8/25/2015	8/25/2017
T2	ANP06540	Cable	Heliac	10/29/2015	10/29/2017
T3	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T4	AN03540	Preamp	83017A	4/30/2015	4/30/2017
T5	ANP06935	Cable	32026-29801-29801-18	3/11/2016	3/11/2018
T6	AN03116	High Pass Filter	11SH10-00313	2/6/2015	2/6/2017
T7	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	8/12/2015	8/12/2017
T8	ANP06124	Attenuator	18N-6	5/8/2015	5/8/2017
T9	AN02741	Active Horn Antenna	AMFW-5F-12001800-20-10P	1/14/2015	1/14/2017
	AN02673	Spectrum Analyzer	E4446A	10/12/2015	10/12/2017
T10	ANP06678	Cable	32026-29801-29801-144	9/18/2014	9/18/2016
T11	AN02742	Active Horn Antenna	AMFW-5F-18002650-20-10P	1/14/2015	1/14/2017
T12	AN00052	Loop Antenna	6502	4/8/2016	4/8/2018
T13	ANP05963	Cable	RG-214	2/15/2016	2/15/2018
T14	ANP05360	Cable	RG214	12/1/2014	12/1/2016
T15	AN02307	Preamp	8447D	2/15/2016	2/15/2018
T16	AN01994	Biconilog Antenna	CBL6111C	3/11/2016	3/11/2018
T17	ANP05505	Attenuator	NAT-6	3/31/2016	3/31/2018

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T8					
			T9	T10	T11	T12					
			T13	T14	T15	T16					
			T17								
	MHz	dB $\mu$ V	dB	dB	dB	dB	Table	dB $\mu$ V/m	dB $\mu$ V/m	dB	Ant
1	7426.483M Ave	43.9	+0.0	+1.3	+4.8	-34.7	+0.0	53.1	54.0	-0.9	H+V
			+0.6	+0.7	+36.5	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
2	7426.510M Ave	41.7	+0.0	+1.3	+4.8	-34.7	+0.0	50.9	54.0	-3.1	H+V
			+0.6	+0.7	+36.5	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	7426.483M	51.3	+0.0	+1.3	+4.8	-34.7	+0.0	60.5	54.0	+6.5	H+V
			+0.6	+0.7	+36.5	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
4	7333.394M Ave	40.3	+0.0	+1.2	+4.7	-34.6	+0.0	49.1	54.0	-4.9	H+V
			+0.6	+0.7	+36.2	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	7333.480M	49.4	+0.0	+1.2	+4.7	-34.6	+0.0	58.2	54.0	+4.2	H+V
			+0.6	+0.7	+36.2	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
6	12022.400 M	51.4	+0.0	+1.5	+6.4	+0.0	+0.0	46.1	54.0	-7.9	H+V
			+0.0	+0.0	+0.0	+0.0					
			-13.2	+0.0	+0.0	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
7	9897.930M Ave	33.7	+0.0	+1.3	+6.1	-35.1	+0.0	45.3	54.0	-8.7	H+V
			+0.8	+1.3	+37.2	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	9897.930M	42.9	+0.0	+1.3	+6.1	-35.1	+0.0	54.5	54.0	+0.5	H+V
			+0.8	+1.3	+37.2	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
9	12222.350 M	49.6	+0.0	+1.5	+6.6	+0.0	+0.0	44.4	54.0	-9.6	H+V
			+0.0	+0.0	+0.0	+0.0					
			-13.3	+0.0	+0.0	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								

10	7216.450M Ave	35.6	+0.0 +0.6 +0.0 +0.0 +0.0	+1.2 +0.8 +0.0 +0.0	+4.6 +35.7 +0.0 +0.0	-34.5 +0.0	+0.0	44.0	54.0 Low	-10.0	H+V
^	7216.450M	45.8	+0.0 +0.6 +0.0 +0.0 +0.0	+1.2 +0.8 +0.0 +0.0	+4.6 +35.7 +0.0 +0.0	-34.5 +0.0	+0.0	54.2	54.0 Low	+0.2	H+V
12	4810.984M Ave	38.4	+0.0 +0.5 +0.0 +0.0 +0.0	+0.9 +0.8 +0.0 +0.0	+4.3 +32.7 +0.0 +0.0	-34.2 +0.0	+0.0	43.4	54.0 Low	-10.6	H+V
^	4811.070M	46.2	+0.0 +0.5 +0.0 +0.0 +0.0	+0.9 +0.8 +0.0 +0.0	+4.3 +32.7 +0.0 +0.0	-34.2 +0.0	+0.0	51.2	54.0 Low	-2.8	H+V
14	1776.000M	42.3	+0.0 +0.3 +0.0 +0.0 +0.0	+0.5 +0.0 +0.0 +0.0	+2.5 +26.7 +0.0 +0.0	-35.2 +5.7 +0.0	+0.0	42.8	54.0	-11.2	H+V
15	12372.500 M	47.7	+0.0 +0.0 -13.3 +0.0 +0.0	+1.6 +0.0 +0.0 +0.0	+6.5 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0	+0.0	42.5	54.0 High	-11.5	H+V
16	4889.142M Ave	36.2	+0.0 +0.5 +0.0 +0.0 +0.0	+0.9 +0.8 +0.0 +0.0	+4.4 +32.7 +0.0 +0.0	-34.2 +0.0	+0.0	41.3	54.0 Mid	-12.7	H+V
^	4889.070M	45.3	+0.0 +0.5 +0.0 +0.0 +0.0	+0.9 +0.8 +0.0 +0.0	+4.4 +32.7 +0.0 +0.0	-34.2 +0.0	+0.0	50.4	54.0 Mid	-3.6	H+V
18	9617.787M Ave	29.0	+0.0 +0.8 +0.0 +0.0 +0.0	+1.5 +1.3 +0.0 +0.0	+6.1 +37.4 +0.0 +0.0	-35.0 +0.0	+0.0	41.1	54.0 Low	-12.9	H+V
^	9617.787M	41.0	+0.0 +0.8 +0.0 +0.0 +0.0	+1.5 +1.3 +0.0 +0.0	+6.1 +37.4 +0.0 +0.0	-35.0 +0.0	+0.0	53.1	54.0 Low	-0.9	H+V

20	1050.000M	45.2	+0.0	+0.4	+1.9	-37.3	+0.0	40.3	54.0	-13.7	H+V
			+0.2	+0.0	+24.2	+5.7					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
21	4950.970M Ave	35.1	+0.0	+0.9	+4.4	-34.2	+0.0	40.2	54.0	-13.8	H+V
			+0.5	+0.7	+32.8	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	4951.060M	44.2	+0.0	+0.9	+4.4	-34.2	+0.0	49.3	54.0	-4.7	H+V
			+0.5	+0.7	+32.8	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
23	134.800M QP	37.2	+0.0	+0.1	+0.0	+0.0	+0.0	29.6	43.5	-13.9	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+1.2	+0.6	-27.6	+12.0					
			+6.1								
^	134.800M	44.2	+0.0	+0.1	+0.0	+0.0	+0.0	36.6	43.5	-6.9	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+1.2	+0.6	-27.6	+12.0					
			+6.1								
25	9777.814M Ave	28.0	+0.0	+1.4	+6.1	-35.1	+0.0	39.7	54.0	-14.3	H+V
			+0.7	+1.3	+37.3	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
^	9777.814M	40.9	+0.0	+1.4	+6.1	-35.1	+0.0	52.6	54.0	-1.4	H+V
			+0.7	+1.3	+37.3	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
27	22279.430 M	48.5	+0.0	+0.0	+0.0	+0.0	+0.0	39.2	54.0	-14.8	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+7.4	-16.7	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
28	19803.200 M	45.4	+0.0	+0.0	+0.0	+0.0	+0.0	39.0	54.0	-15.0	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+6.9	-13.3	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
29	19556.400 M	44.6	+0.0	+0.0	+0.0	+0.0	+0.0	38.3	54.0	-15.7	H+V
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+6.9	-13.2	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
			+0.0								

30	19238.117 M	44.1	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +6.8 +0.0 +0.0	+0.0 +0.0 -13.3 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	37.6	54.0	-16.4	H+V
									Low		
31	14852.900 M	51.6	+0.0 +0.0 -14.2 +0.0 +0.0	+1.8 +0.0 +0.0 +0.0 +0.0	+7.8 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	47.0	90.0	-43.0	H+V
									High		
32	54.200M	56.8	+0.0 +0.0 +0.0 +0.6 +6.1	+0.1 +0.0 +0.0 +0.4 +0.0	+0.0 +0.0 +0.0 -27.9 +7.7	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	43.8	90.0	-46.2	H+V
33	16838.300 M	44.0	+0.0 +0.0 -11.4 +0.0 +0.0	+2.1 +0.0 +0.0 +0.0 +0.0	+8.6 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	43.3	90.0	-46.7	H+V
									Low		
34	24744.830 M	47.8	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.8 +0.0 +0.0	+0.0 +0.0 -12.4 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	43.2	90.0	-46.8	H+V
									High		
35	17321.300 M	43.5	+0.0 +0.0 -11.7 +0.0 +0.0	+2.0 +0.0 +0.0 +0.0 +0.0	+8.8 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	42.6	90.0	-47.4	H+V
									High		
36	14426.850 M	47.4	+0.0 +0.0 -14.3 +0.0 +0.0	+1.8 +0.0 +0.0 +0.0 +0.0	+7.7 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	42.6	90.0	-47.4	H+V
									Low		
37	749.700M	35.2	+0.0 +0.0 +0.0 +2.2 +6.2	+0.3 +0.0 +0.0 +1.8 +0.0	+0.0 +0.0 +0.0 -27.9 +22.9	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	40.7	90.0	-49.3	H+V
38	624.600M	37.4	+0.0 +0.0 +0.0 +2.1 +6.2	+0.3 +0.0 +0.0 +1.6 +0.0	+0.0 +0.0 +0.0 -28.1 +21.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	40.5	90.0	-49.5	H+V
39	17118.450 M	41.6	+0.0 +0.0 -11.9 +0.0 +0.0	+2.1 +0.0 +0.0 +0.0 +0.0	+8.6 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	40.4	90.0	-49.6	H+V
									Mid		

40	24459.730 M	45.5	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.8 +0.0 +0.0	+0.0 +0.0 -12.9 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	40.4	90.0	-49.6	H+V
									Mid		
41	53.710M QP	52.6	+0.0 +0.0 +0.0 +0.6 +6.1	+0.1 +0.0 +0.0 +0.4 +0.0	+0.0 +0.0 +0.0 -27.9 +7.8	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	39.7	90.0	-50.3	H+V
42	24049.133 M	45.4	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.7 +0.0 +0.0	+0.0 +0.0 -13.7 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	39.4	90.0	-50.6	H+V
									Low		
43	14666.950 M	43.7	+0.0 +0.0 -14.1 +0.0 +0.0	+1.8 +0.0 +0.0 +0.0 +0.0	+7.8 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	39.2	90.0	-50.8	H+V
									Mid		
44	106.600M	47.0	+0.0 +0.0 +0.0 +1.2 +6.1	+0.1 +0.0 +0.0 +0.6 +0.0	+0.0 +0.0 +0.0 -27.7 +10.9	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	38.2	90.0	-51.8	H+V
45	22007.300 M	47.2	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.4 +0.0 +0.0	+0.0 +0.0 -16.5 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	38.1	90.0	-51.9	H+V
									Mid		
46	21645.667 M	46.6	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +7.3 +0.0 +0.0	+0.0 +0.0 -15.9 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	38.0	90.0	-52.0	H+V
									Low		
47	874.900M	30.3	+0.0 +0.0 +0.0 +2.4 +6.1	+0.3 +0.0 +0.0 +2.0 +0.0	+0.0 +0.0 +0.0 -27.5 +24.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	37.6	90.0	-52.4	H+V
48	500.400M	33.5	+0.0 +0.0 +0.0 +2.0 +6.1	+0.3 +0.0 +0.0 +1.4 +0.0	+0.0 +0.0 +0.0 -28.1 +18.6	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	33.8	90.0	-56.2	H+V
49	105.700M	37.1	+0.0 +0.0 +0.0 +1.2 +6.1	+0.1 +0.0 +0.0 +0.6 +0.0	+0.0 +0.0 +0.0 -27.7 +10.8	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	28.2	90.0	-61.8	H+V

50	821.800k	34.8	+0.0	+0.0	+0.1	+0.0	-40.0	4.7	90.0	-85.3	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+9.8					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
51	61.423k	55.0	+0.0	+0.0	+0.0	+0.0	-80.0	-14.6	90.0	-104.6	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+10.4					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
52	22.141M	16.0	+0.0	+0.0	+0.3	+0.0	-40.0	-16.0	90.0	-106.0	Para+
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+7.7					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								

**Band Edge**

<b>Band Edge Summary</b>					
<b>Frequency (MHz)</b>	<b>Modulation</b>	<b>Ant. Type</b>	<b>Field Strength (dBuV/m @3m)</b>	<b>Limit (dBuV/m @3m)</b>	<b>Results</b>
2390.0 (Peak)	DSSS	External Monopole 5dBi	48.6	<74	Pass
2400.0 (Peak)	DSSS	External Monopole 5dBi	67.9	<112.0	Pass
2483.5 (Peak)	DSSS	External Monopole 5dBi	58.5	<74	Pass
2390.0 (Ave)	DSSS	External Monopole 5dBi	37.6	<54	Pass
2400.0 (Ave)	DSSS	External Monopole 5dBi	55.1	<92	Pass
2483.5 (Ave)	DSSS	External Monopole 5dBi	46.6	<54	Pass

<b>Band Edge Summary</b>					
<b>Frequency (MHz)</b>	<b>Modulation</b>	<b>Ant. Type</b>	<b>Field Strength (dBuV/m @3m)</b>	<b>Limit (dBuV/m @3m)</b>	<b>Results</b>
2390.0 (Peak)	DSSS	Integral Chip 1.1dBi	45.9	<74	Pass
2400.0 (Peak)	DSSS	Integral Chip 1.1dBi	62.9	<110.0	Pass
2483.5 (Peak)	DSSS	Integral Chip 1.1dBi	54.2	<74	Pass
2390.0 (Average)	DSSS	Integral Chip 1.1dBi	35.0	<54	Pass
2400.0 (Average)	DSSS	Integral Chip 1.1dBi	51.7	<90	Pass
2483.5 (Average)	DSSS	Integral Chip 1.1dBi	28.8	<54	Pass

**Test Setup / Conditions / Data**

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions (PEAK)**  
 Work Order #: **98667** Date: 10/31/2016  
 Test Type: **Maximized Emissions** Time: 13:59:50  
 Tested By: Michael Atkinson Sequence#: 2  
 Software: EMITest 5.03.02

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
Configuration 2			

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Configuration 2			

**Test Conditions / Notes:**

Temperature: 24°C  
 Humidity: 36%  
 Pressure: 102.3kPa

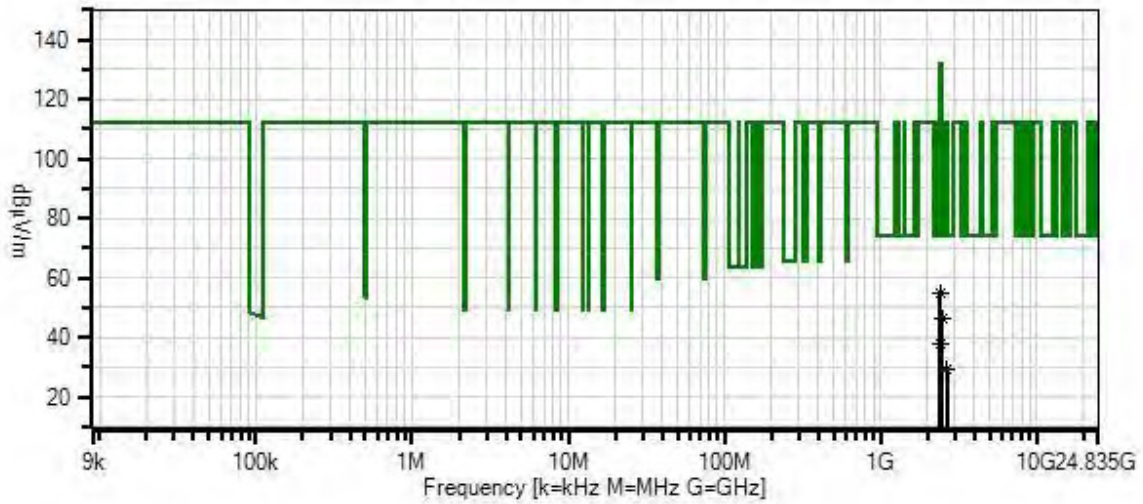
Frequency Range: 2405-2475MHz  
 Frequency tested: Band Edge  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS

Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi

Duty Cycle: 100% (Test Mode)

Test Mode: Continuously transmitting  
 Test Setup: The EUT is top of foam table, transmitting through External 5dBi antenna. Both antenna polarities and X, Y, Z EUT axes investigated. Only worst case reported.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013) and KDB 558074 v03r05 (April 8, 2016)

Doughty Design W/O#: 98667 Sequence#: 2 Date: 10/31/2016  
 15.247(d) / 15.209 Radiated Spurious Emissions (PEAK) Test Distance: 3 Meters H+V



- Readings
  - Peak Readings
  - × QP Readings
  - \* Average Readings
  - ▼ Ambient
- Software Version: 5.03.02
- 1 - 15.247(d) / 15.209 Radiated Spurious Emissions (PEAK)

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP06540	Cable	Heliac	10/29/2015	10/29/2017
T2	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T3	AN03540	Preamp	83017A	4/30/2015	4/30/2017
T4	ANP06935	Cable	32026-29801- 29801-18	3/11/2016	3/11/2018
T5	AN01467	Horn Antenna- ANSI C63.5 Calibration	3115	8/12/2015	8/12/2017
T6	ANP06124	Attenuator	18N-6	5/8/2015	5/8/2017
T7	AN02673	Spectrum Analyzer	E4446A	10/12/2015	10/12/2017
T8	AN38% DCCF	Test Data Adjustment		10/28/2016	10/28/2018

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dB $\mu$ V	Reading listed by margin.				Test Distance: 3 Meters				Margin dB	Polar Ant
			T1 T5 dB	T2 T6 dB	T3 T7 dB	T4 T8 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m			
1	2483.500M	52.2	+0.6	+2.9	-34.5	+0.4	+0.0	46.6	54.0	-7.4	H+V	
	Ave		+27.7	+5.7	+0.0	-8.4			BE AVG			
^	2483.500M	64.1	+0.6	+2.9	-34.5	+0.4	+0.0	58.5	74.0	-15.5	H+V	
			+27.7	+5.7	+0.0	-8.4			BE PEAK			
3	2390.000M	43.4	+0.6	+2.8	-34.6	+0.4	+0.0	37.6	54.0	-16.4	H+V	
	Ave		+27.7	+5.7	+0.0	-8.4			BE AVG			
^	2390.000M	54.4	+0.6	+2.8	-34.6	+0.4	+0.0	48.6	74.0	-25.4	H+V	
			+27.7	+5.7	+0.0	-8.4			BE PEAK			
5	2655.000M	33.8	+0.7	+3.0	-34.5	+0.4	+0.0	29.1	54.0	-24.9	H+V	
	Ave		+28.4	+5.7	+0.0	-8.4			BE AVG			
^	2655.000M	45.5	+0.7	+3.0	-34.5	+0.4	+0.0	40.8	74.0	-33.2	H+V	
			+28.4	+5.7	+0.0	-8.4			BE PEAK			
7	2400.000M	60.9	+0.6	+2.8	-34.6	+0.4	+0.0	55.1	92.0	-36.9	H+V	
	Ave		+27.7	+5.7	+0.0	-8.4			BE AVG			
^	2400.000M	73.7	+0.6	+2.8	-34.6	+0.4	+0.0	67.9	112.0	-44.1	H+V	
			+27.7	+5.7	+0.0	-8.4			BE PEAK			

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions (PEAK)**  
 Work Order #: **98667** Date: 10/31/2016  
 Test Type: **Maximized Emissions** Time: 13:46:59  
 Tested By: Michael Atkinson Sequence#: 1  
 Software: EMITest 5.03.02

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
Configuration 1			

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Configuration 1			

**Test Conditions / Notes:**

Temperature: 24°C  
 Humidity: 36%  
 Pressure: 102.3kPa

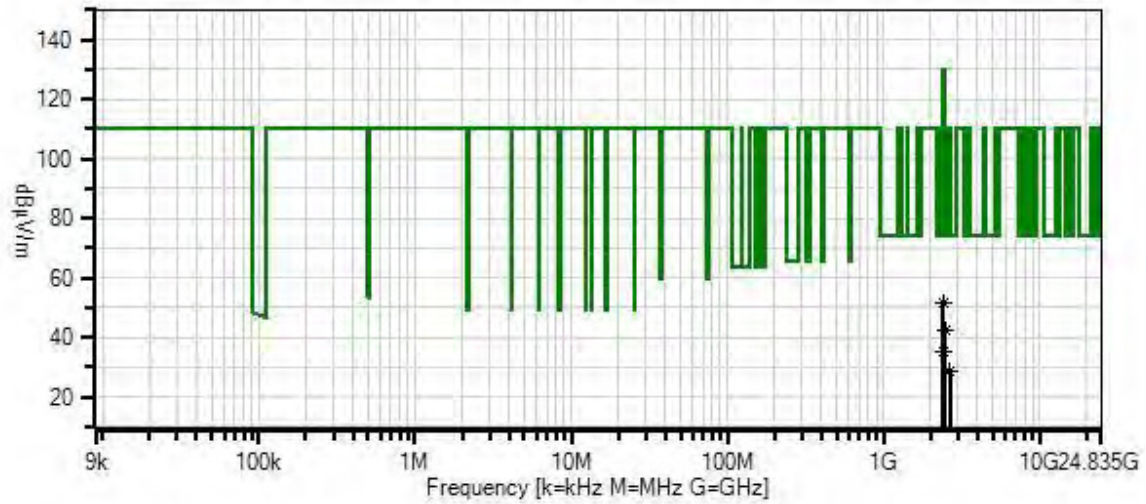
Frequency Range: 2405-2475MHz  
 Frequency tested: Band Edge  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS

Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi

Duty Cycle: 100% (Test Mode)

Test Mode: Continuously transmitting  
 Test Setup: The EUT is top of foam table, transmitting through Internal 1.1dBi Antenna. Both antenna polarities and X, Y, Z EUT axes investigated. Only worst case reported.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013) and KDB 558074 v03r05 (April 8, 2016)

Doughty Design W/O#: 98667 Sequence#: 1 Date: 10/31/2016  
 15.247(d) / 15.209 Radiated Spurious Emissions (PEAK) Test Distance: 3 Meters H+V



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP06540	Cable	Heliac	10/29/2015	10/29/2017
T2	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T3	AN03540	Preamp	83017A	4/30/2015	4/30/2017
T4	ANP06935	Cable	32026-29801-29801-18	3/11/2016	3/11/2018
T5	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	8/12/2015	8/12/2017
T6	ANP06124	Attenuator	18N-6	5/8/2015	5/8/2017
	AN02673	Spectrum Analyzer	E4446A	10/12/2015	10/12/2017
T7	AN38% DCCF	Test Data Adjustment		10/28/2016	10/28/2018

**Measurement Data:**

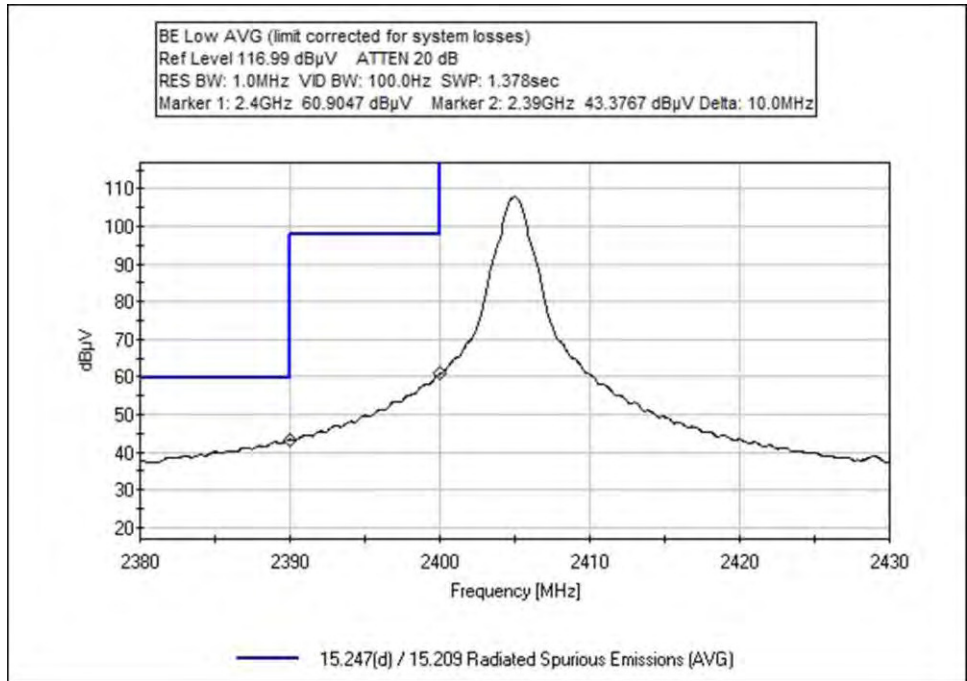
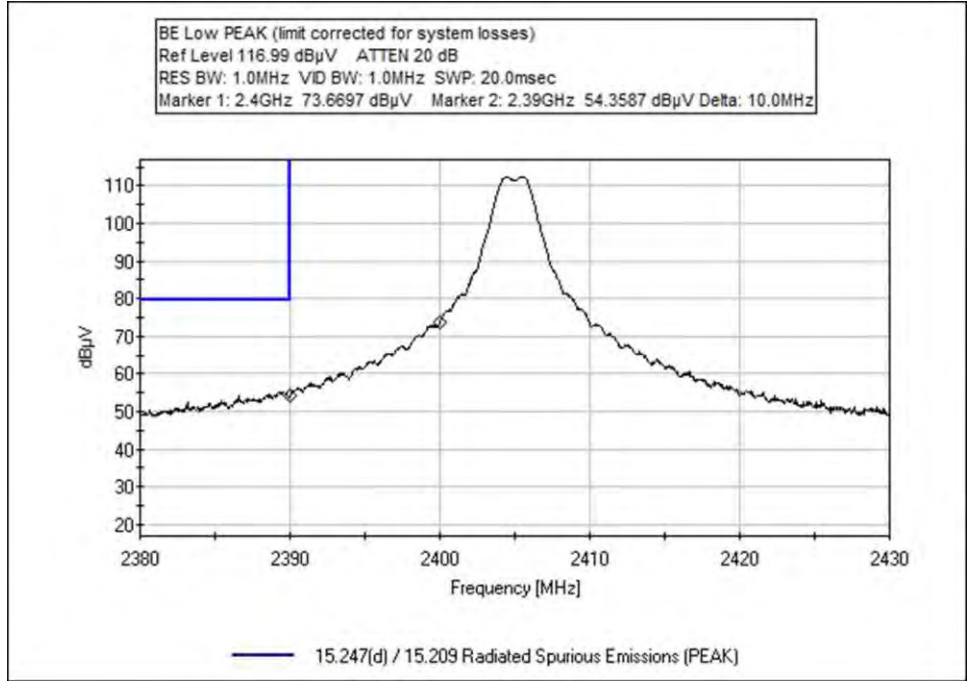
Reading listed by margin.

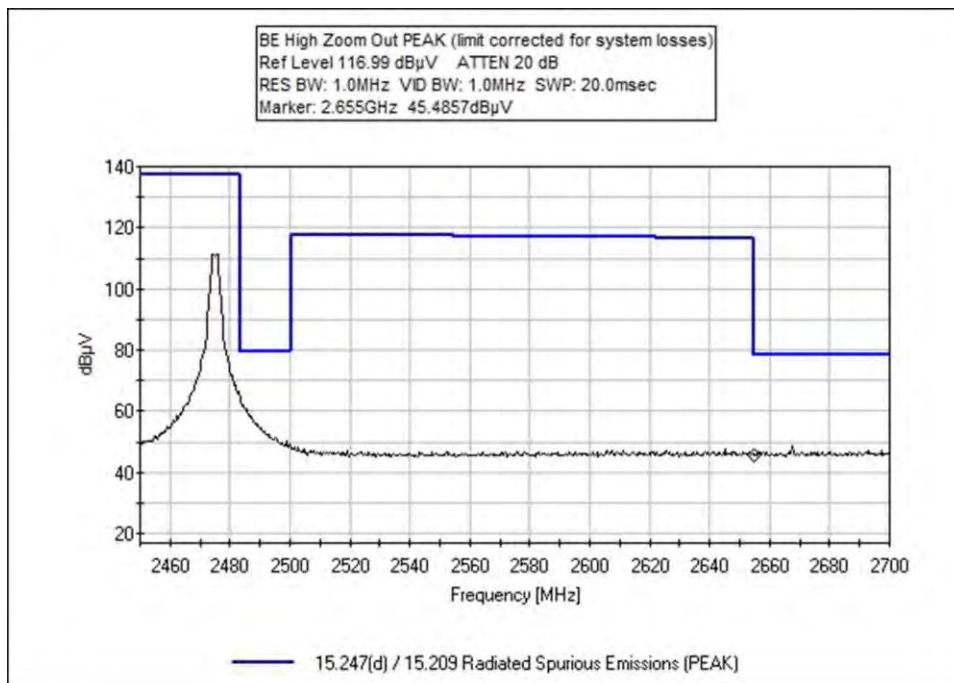
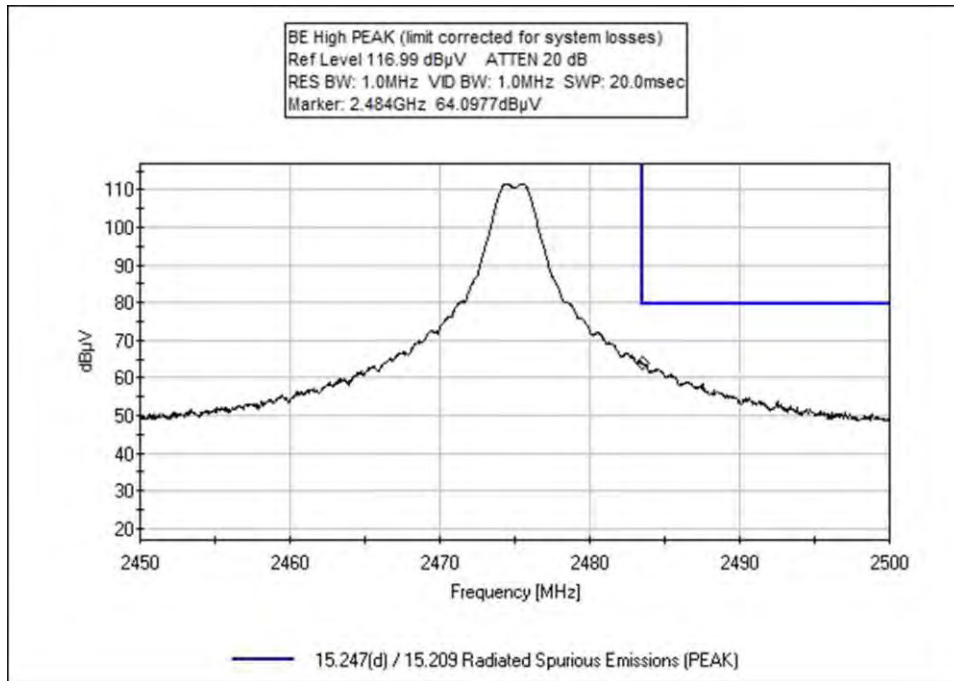
Test Distance: 3 Meters

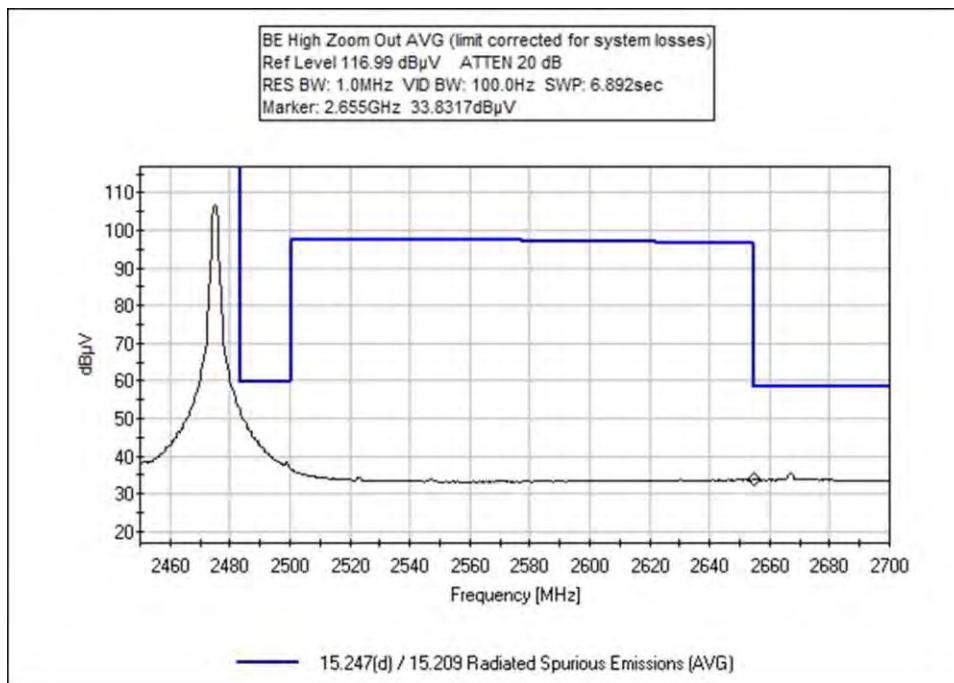
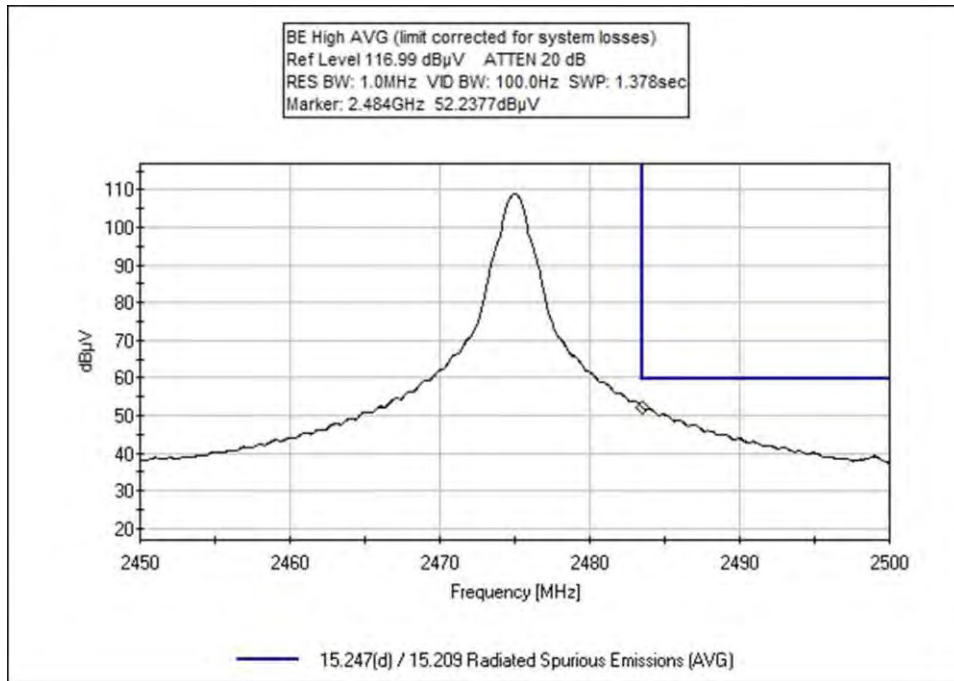
#	Freq MHz	Rdng dBμV	T1			T2			T3			T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T5	T6	T7	T5	T6	T7						
			dB	dB	dB	dB	dB	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant	
1	2483.500M	48.1	+0.6	+2.9	-34.5	+0.4	+0.0	42.5	54.0	-11.5	H+V						
	Ave		+27.7	+5.7	-8.4				BE AVG								
^	2483.500M	59.8	+0.6	+2.9	-34.5	+0.4	+0.0	54.2	74.0	-19.8	H+V						
			+27.7	+5.7	-8.4				BE PEAK								
3	2390.000M	40.8	+0.6	+2.8	-34.6	+0.4	+0.0	35.0	54.0	-19.0	H+V						
	Ave		+27.7	+5.7	-8.4				BE AVG								
^	2390.000M	51.7	+0.6	+2.8	-34.6	+0.4	+0.0	45.9	74.0	-28.1	H+V						
			+27.7	+5.7	-8.4				BE PEAK								
5	2655.000M	33.5	+0.7	+3.0	-34.5	+0.4	+0.0	28.8	54.0	-25.2	H+V						
	Ave		+28.4	+5.7	-8.4				BE AVG								
^	2655.000M	46.4	+0.7	+3.0	-34.5	+0.4	+0.0	41.7	74.0	-32.3	H+V						
			+28.4	+5.7	-8.4				BE PEAK								
7	2400.000M	57.5	+0.6	+2.8	-34.6	+0.4	+0.0	51.7	90.0	-38.3	H+V						
	Ave		+27.7	+5.7	-8.4				BE AVG								
^	2400.000M	68.7	+0.6	+2.8	-34.6	+0.4	+0.0	62.9	110.0	-47.1	H+V						
			+27.7	+5.7	-8.4				BE PEAK								

## Band Edge Plots

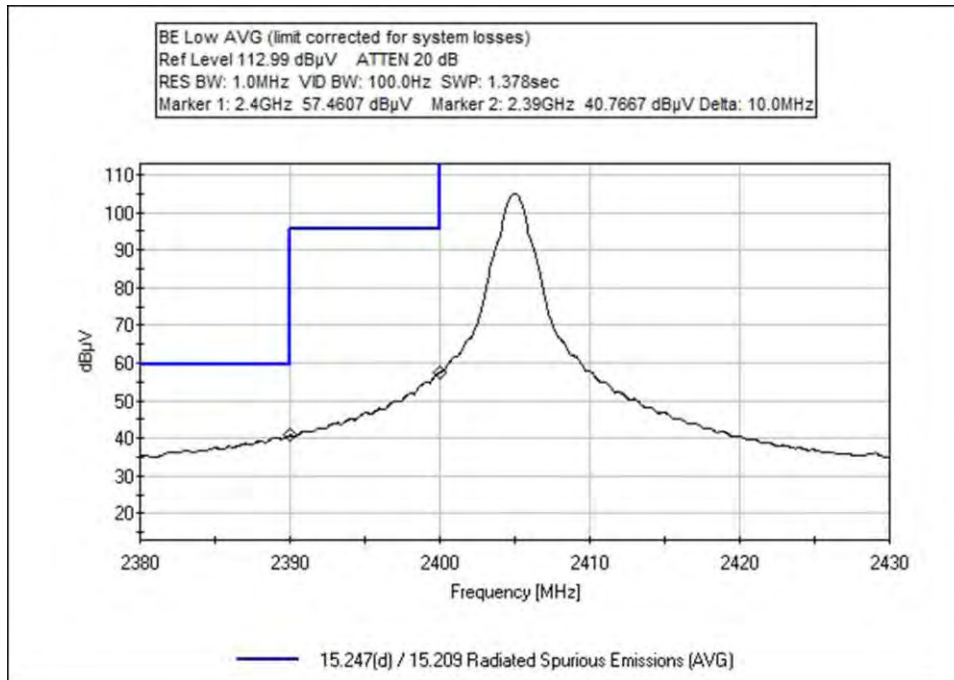
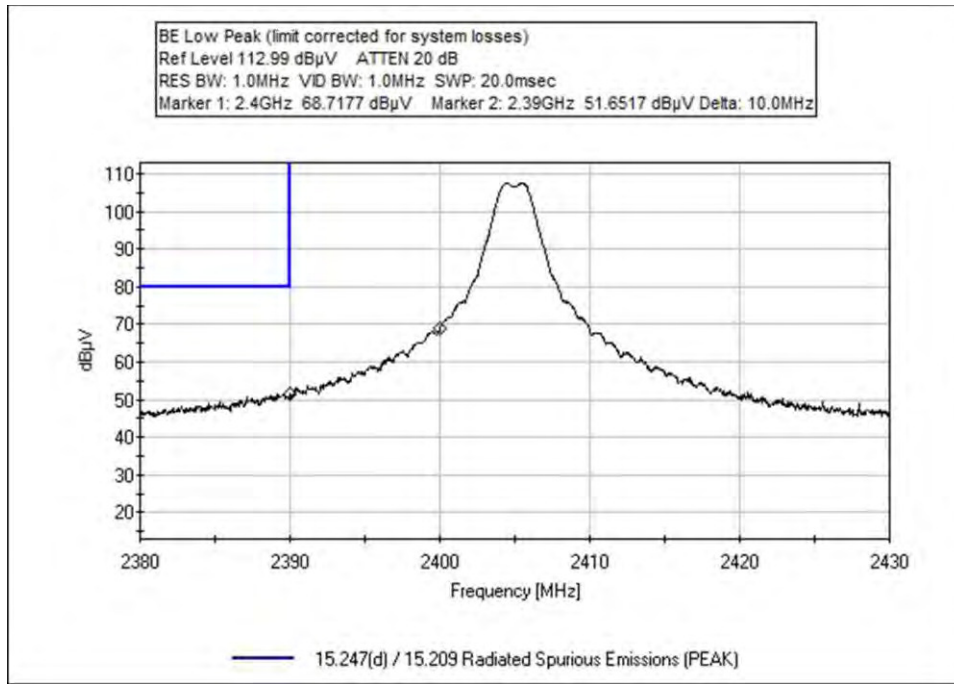
### External Antenna

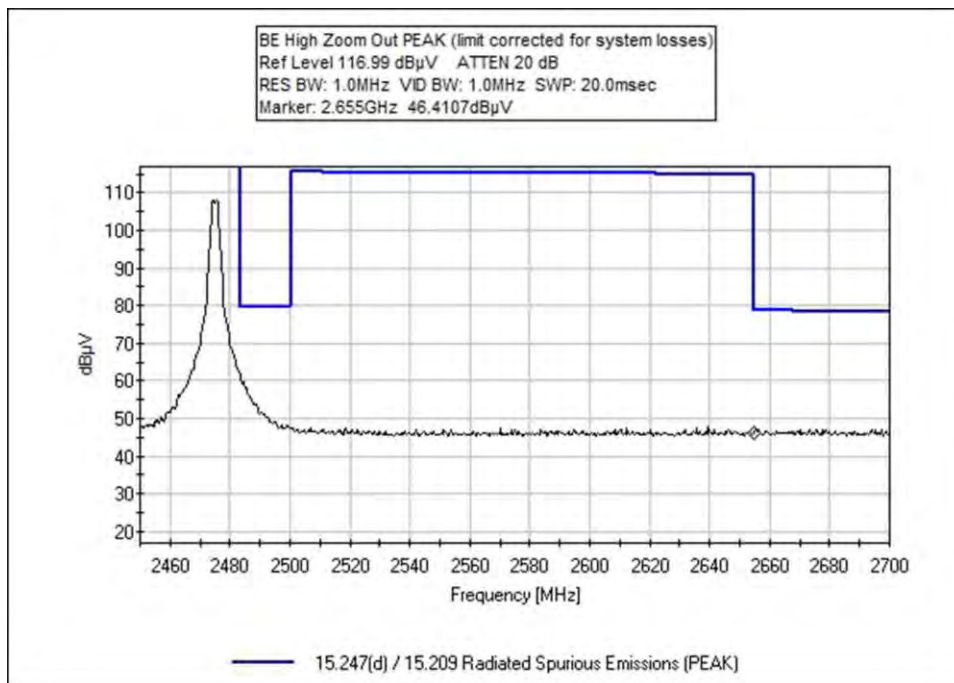
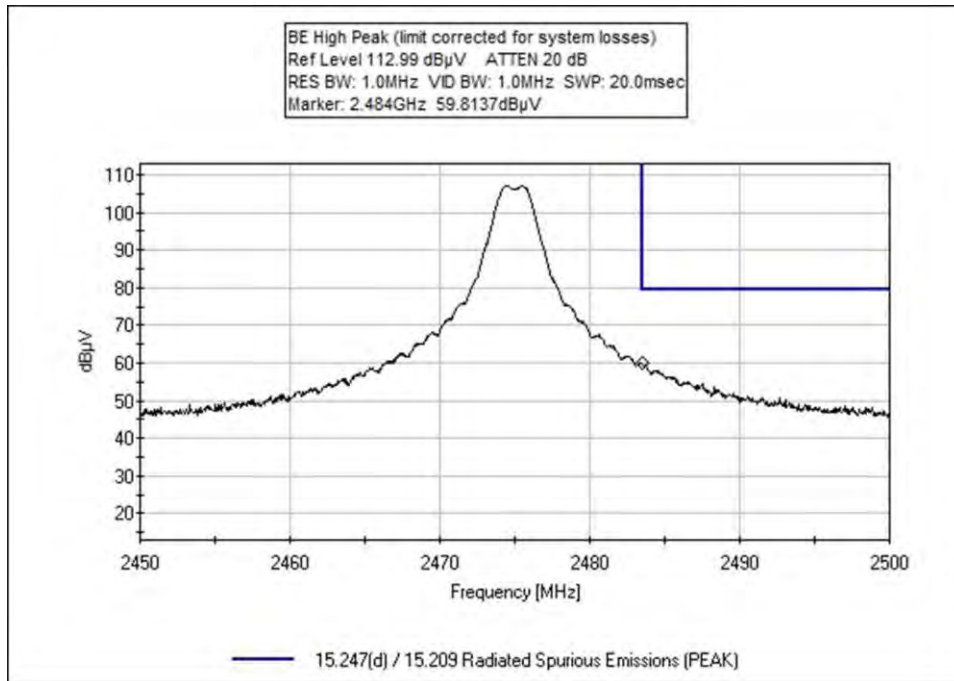


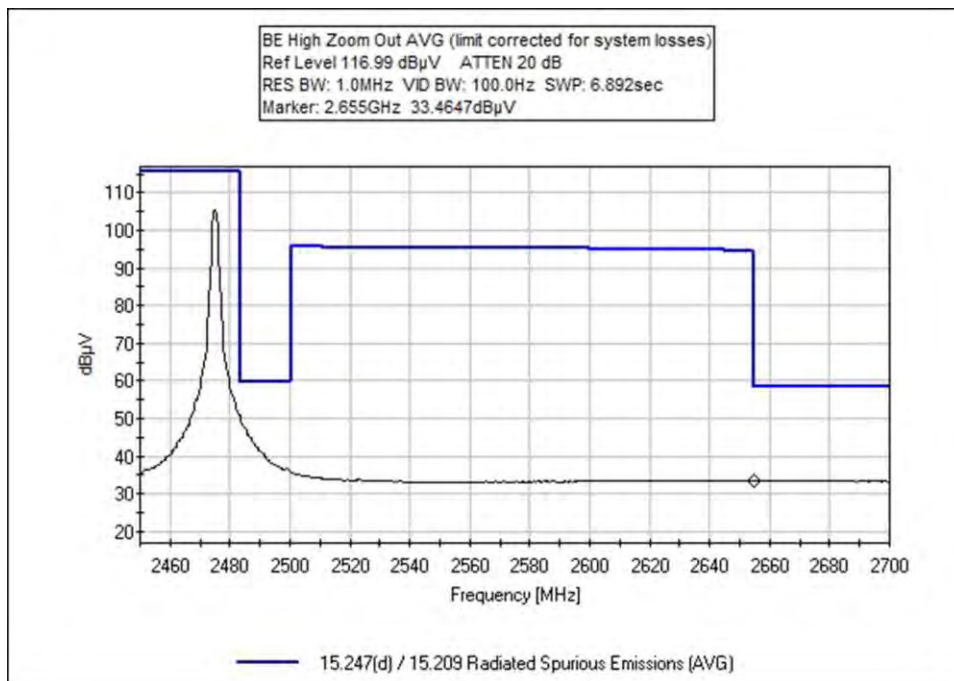
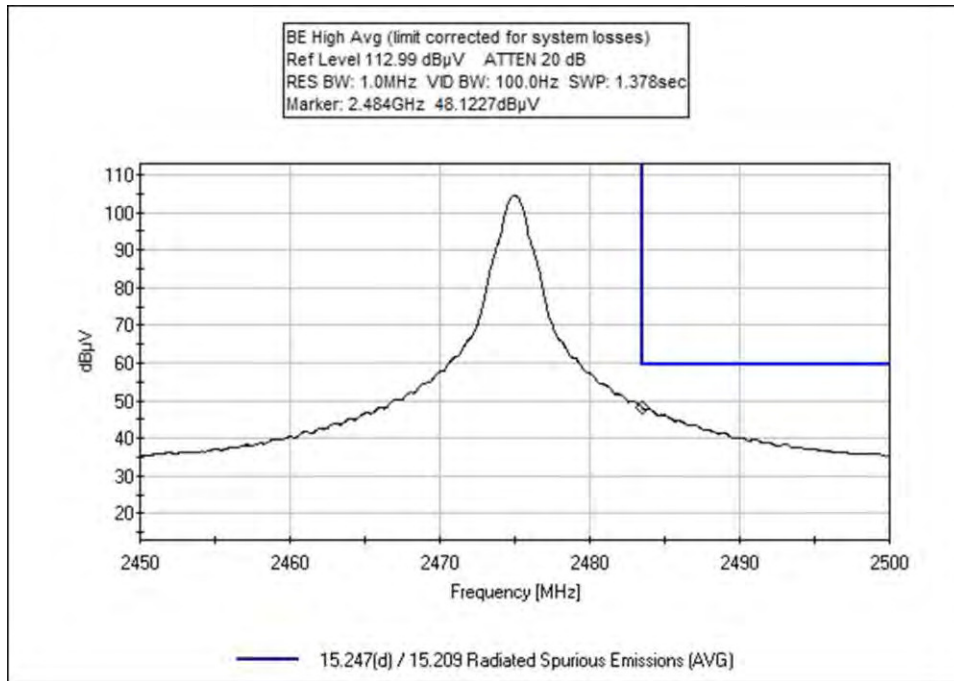




### Internal Antenna







**Test Setup Photos**

**External Antenna**



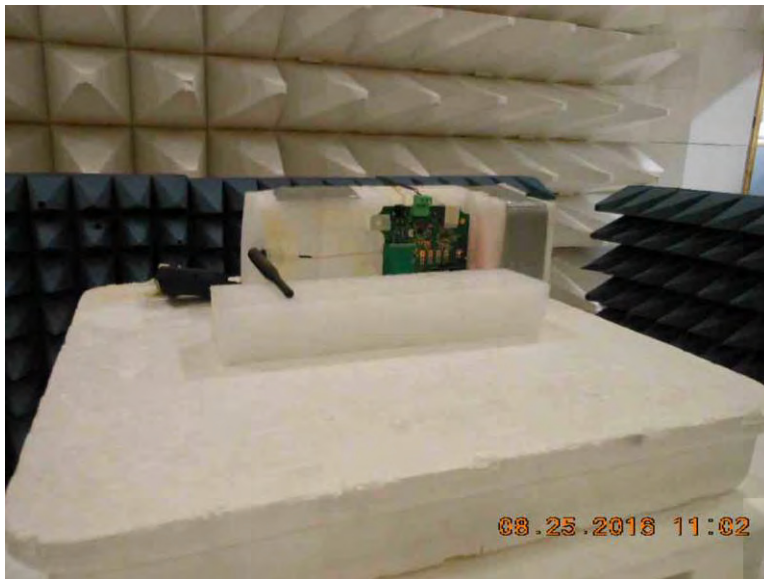
< 1GHz



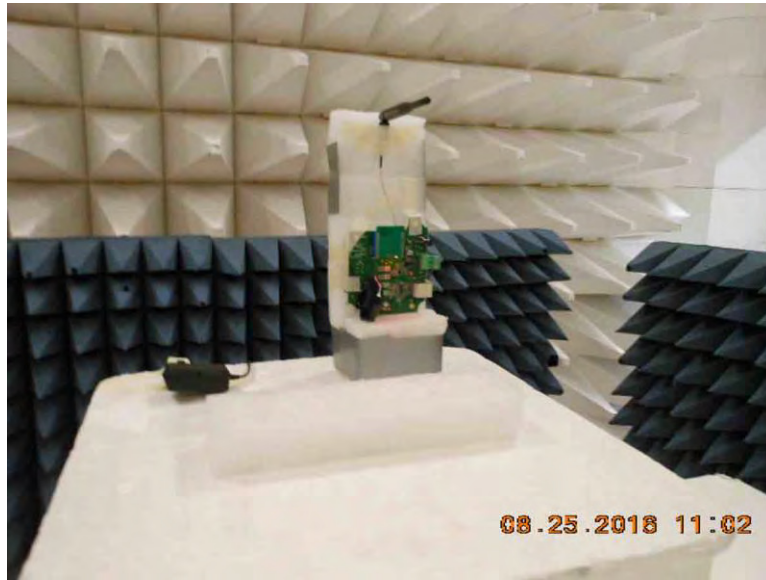
> 1GHz



X Axis



Y Axis



Z Axis

**Internal Antenna**



< 1GHz



> 1GHz



X Axis



Y Axis



Z Axis

## 15.207 AC Conducted Emissions

### Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.207 AC Mains - Average**  
 Work Order #: **98667** Date: 8/30/2016  
 Test Type: **Conducted Emissions** Time: 10:55:41  
 Tested By: Michael Atkinson Sequence#: 7  
 Software: EMITest 5.03.02 115V 60Hz

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 3			

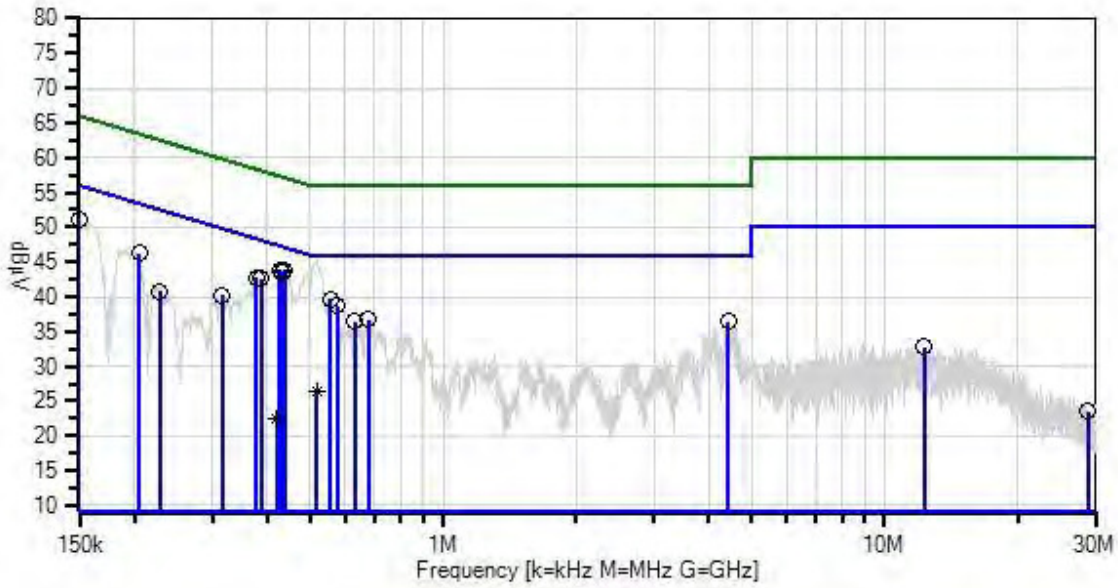
#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 3			

#### Test Conditions / Notes:

Temperature: 23°C  
 Humidity: 39%  
 Pressure: 102.0kPa  
  
 Frequency Range: 2405-2475MHz  
 Frequency tested: 0.15-30MHz  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS  
  
 Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi  
  
 Duty Cycle: 100% (Test Mode)  
  
 Test Mode: Continuously transmitting  
 Test Setup: The EUT is transmitting through external antenna. AC Adapter is connected to AC mains through LISN.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013)

Doughty Design W/O#: 98667 Sequence#: 7 Date: 8/30/2016  
 15.207 AC Mains - Average Test Lead: 115V 60Hz Line



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	8/25/2015	8/25/2017
T1	AN02611	High Pass Filter	HE9615-150K-50-720B	2/18/2016	2/18/2018
T2	ANP06540	Cable	Heliac	10/29/2015	10/29/2017
T3	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T4	ANP06219	Attenuator	768-10	4/12/2016	4/12/2018
T5	AN01492	50uH LISN-Line	3816/2NM	8/5/2015	8/5/2017
	AN01492	50uH LISN-Neutral	3816/2NM	8/5/2015	8/5/2017

**Measurement Data:**

Reading listed by margin.

Test Lead: Line

#	Freq MHz	Rdng dB $\mu$ V	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V	Spec dB $\mu$ V	Margin dB	Polar Ant
1	437.950k	33.9	+0.2 +0.6	+0.0	+0.0	+9.1	+0.0	43.8	47.1	-3.3	Line
2	427.470k	34.0	+0.2 +0.6	+0.0	+0.0	+9.1	+0.0	43.9	47.3	-3.4	Line
3	432.810k	33.7	+0.2 +0.6	+0.0	+0.0	+9.1	+0.0	43.6	47.2	-3.6	Line
4	150.000k	37.3	+2.9 +1.9	+0.0	+0.0	+9.1	+0.0	51.2	56.0	-4.8	Line
5	388.129k	32.8	+0.1 +0.6	+0.0	+0.0	+9.1	+0.0	42.6	48.1	-5.5	Line
6	377.092k	32.9	+0.1 +0.6	+0.0	+0.0	+9.1	+0.0	42.7	48.3	-5.6	Line
7	556.484k	29.8	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	39.6	46.0	-6.4	Line
8	204.914k	35.6	+0.2 +1.3	+0.0	+0.0	+9.1	+0.0	46.2	53.4	-7.2	Line
9	576.743k	28.8	+0.2 +0.5	+0.0	+0.1	+9.1	+0.0	38.7	46.0	-7.3	Line
10	677.437k	26.9	+0.2 +0.4	+0.0	+0.1	+9.1	+0.0	36.7	46.0	-9.3	Line
11	629.963k	26.6	+0.2 +0.5	+0.0	+0.1	+9.1	+0.0	36.5	46.0	-9.5	Line
12	315.677k	30.2	+0.1 +0.8	+0.0	+0.0	+9.1	+0.0	40.2	49.8	-9.6	Line

13	4.422M	26.7	+0.1 +0.4	+0.0	+0.1	+9.1	+0.0	36.4	46.0	-9.6	Line
14	228.290k	30.4	+0.2 +1.1	+0.0	+0.0	+9.1	+0.0	40.8	52.5	-11.7	Line
15	12.280M	22.9	+0.1 +0.5	+0.0	+0.2	+9.1	+0.0	32.8	50.0	-17.2	Line
16	517.779k Ave	16.7	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	26.5	46.0	-19.5	Line
^	517.779k	35.3	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	45.1	46.0	-0.9	Line
18	419.994k Ave	12.7	+0.2 +0.6	+0.0	+0.0	+9.1	+0.0	22.6	47.4	-24.8	Line
^	419.993k	34.5	+0.2 +0.6	+0.0	+0.0	+9.1	+0.0	44.4	47.4	-3.0	Line
20	28.880M	13.4	+0.2 +0.5	+0.0	+0.3	+9.1	+0.0	23.5	50.0	-26.5	Line

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC  
 Customer: **Doughty Design**  
 Specification: **15.207 AC Mains - Average**  
 Work Order #: **98667** Date: 8/30/2016  
 Test Type: **Conducted Emissions** Time: 11:03:01  
 Tested By: Michael Atkinson Sequence#: 8  
 Software: EMITest 5.03.02 115V 60Hz

**Equipment Tested:**

Device	Manufacturer	Model #	S/N
Configuration 3			

**Support Equipment:**

Device	Manufacturer	Model #	S/N
Configuration 3			

**Test Conditions / Notes:**

Temperature: 23°C  
 Humidity: 39%  
 Pressure: 102.0kPa

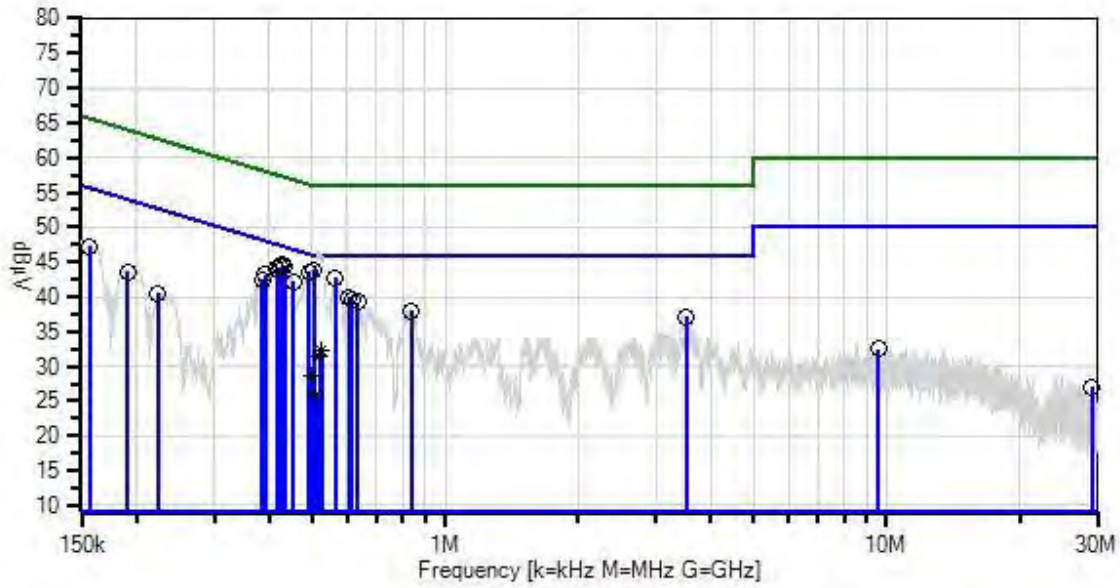
Frequency Range: 2405-2475MHz  
 Frequency tested: 0.15-30MHz  
 Firmware power setting: Max Power  
 EUT Firmware: 1.00  
 Protocol /MCS/Modulation: DSSS

Antenna type and Gain: Integral Chip Antenna 1.1dBi or External Antenna Monopole 5dBi

Duty Cycle: 100% (Test Mode)

Test Mode: Continuously transmitting  
 Test Setup: The EUT is transmitting through external antenna. AC Adapter is connected to AC mains through LISN.  
 Modifications Added: None  
 Test Method: ANSI C63.10 (2013)

Doughty Design W/O#: 98667 Sequence#: 8 Date: 8/30/2016  
 15.207 AC Mains - Average Test Lead: 115V 60Hz Return



- Sweep Data
- x QP Readings
- Software Version: 5.03.02
- Readings
- \* Average Readings
- 1 - 15.207 AC Mains - Average
- Peak Readings
- ▼ Ambient
- 2 - 15.207 AC Mains - Quasi-peak

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	8/25/2015	8/25/2017
T1	AN02611	High Pass Filter	HE9615-150K-50-720B	2/18/2016	2/18/2018
T2	ANP06540	Cable	Heliac	10/29/2015	10/29/2017
T3	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T4	ANP06219	Attenuator	768-10	4/12/2016	4/12/2018
	AN01492	50uH LISN-Line	3816/2NM	8/5/2015	8/5/2017
T5	AN01492	50uH LISN-Neutral	3816/2NM	8/5/2015	8/5/2017

**Measurement Data:**

Reading listed by margin.

Test Lead: Return

#	Freq MHz	Rdng dB $\mu$ V	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V	Spec dB $\mu$ V	Margin dB	Polar Ant
1	503.869k	34.0	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	43.8	46.0	-2.2	Retur
2	491.774k	33.8	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	43.6	46.1	-2.5	Retur
3	428.360k	34.7	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	44.5	47.3	-2.8	Retur
4	433.112k	34.5	+0.2 +0.6	+0.0	+0.0	+9.1	+0.0	44.4	47.2	-2.8	Retur
5	423.020k	34.4	+0.2 +0.6	+0.0	+0.0	+9.1	+0.0	44.3	47.4	-3.1	Retur
6	416.255k	34.3	+0.2 +0.6	+0.0	+0.0	+9.1	+0.0	44.2	47.5	-3.3	Retur
7	564.950k	32.9	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	42.7	46.0	-3.3	Retur
8	454.279k	32.4	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	42.2	46.8	-4.6	Retur
9	390.799k	33.4	+0.1 +0.6	+0.0	+0.0	+9.1	+0.0	43.2	48.0	-4.8	Retur
10	385.993k	32.7	+0.1 +0.6	+0.0	+0.0	+9.1	+0.0	42.5	48.1	-5.6	Retur
11	605.470k	30.1	+0.2 +0.4	+0.0	+0.1	+9.1	+0.0	39.9	46.0	-6.1	Retur
12	614.541k	29.9	+0.2 +0.4	+0.0	+0.1	+9.1	+0.0	39.7	46.0	-6.3	Retur
13	632.684k	29.4	+0.2 +0.4	+0.0	+0.1	+9.1	+0.0	39.2	46.0	-6.8	Retur
14	837.000k	28.2	+0.2 +0.4	+0.0	+0.1	+9.1	+0.0	38.0	46.0	-8.0	Retur
15	156.260k	35.6	+0.7 +1.8	+0.0	+0.0	+9.1	+0.0	47.2	55.7	-8.5	Retur
16	3.523M	27.5	+0.1 +0.4	+0.0	+0.1	+9.1	+0.0	37.2	46.0	-8.8	Retur
17	191.300k	32.9	+0.2 +1.4	+0.0	+0.0	+9.1	+0.0	43.6	54.0	-10.4	Retur
18	224.020k	30.1	+0.2 +1.1	+0.0	+0.0	+9.1	+0.0	40.5	52.7	-12.2	Retur

19	524.910k Ave	22.4	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	32.2	46.0	-13.8	Retur
^	524.910k	36.2	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	46.0	46.0	+0.0	Retur
21	519.291k Ave	21.7	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	31.5	46.0	-14.5	Retur
^	519.291k	36.7	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	46.5	46.0	+0.5	Retur
23	498.427k Ave	18.9	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	28.7	46.0	-17.3	Retur
^	498.426k	35.2	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	45.0	46.0	-1.0	Retur
25	9.558M	22.6	+0.1 +0.5	+0.0	+0.2	+9.1	+0.0	32.5	50.0	-17.5	Retur
26	509.310k Ave	15.9	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	25.7	46.0	-20.3	Retur
^	509.310k	37.0	+0.2 +0.5	+0.0	+0.0	+9.1	+0.0	46.8	46.0	+0.8	Retur
28	29.120M	17.1	+0.2 +0.4	+0.0	+0.3	+9.1	+0.0	27.1	50.0	-22.9	Retur

**Test Setup Photo**



## SUPPLEMENTAL INFORMATION

### Measurement Uncertainty

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

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

### Emissions Test Details

**TESTING PARAMETERS**

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

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

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

**CORRECTION FACTORS**

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

SAMPLE CALCULATIONS		
	Meter reading	(dBμV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBμV/m)

**TEST INSTRUMENTATION AND ANALYZER SETTINGS**

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

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

**SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS**

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

**Peak**

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

**Quasi-Peak**

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

**Average**

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