

# Navdy

## TEST REPORT FOR

**NVD01**  
**Model: HUD**

**Tested to The Following Standard:**

**FCC Part 15 Subpart C Section:**

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

**Report No.: 98354-10**

**Date of issue: June 14, 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.

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## ADMINISTRATIVE INFORMATION

### Test Report Information

**REPORT PREPARED FOR:**

Navdy  
575 7th Street  
San Francisco, CA 94103

Representative: Doug Simpson  
Customer Reference Number: 1256

**REPORT PREPARED BY:**

Terri Rayle  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

Project Number: 98354

**DATE OF EQUIPMENT RECEIPT:**  
**DATE(S) OF TESTING:**

May 19, 2016  
May 19-25, 2016

### 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.  
1120 Fulton Place  
Fremont, CA 94539

## Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.02

## Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
Fremont	US0082	SL2-IN-E-1148R	3082B-1	958979	A-0149

## 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	NA1
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	NA2

NA = Not Applicable

NA1 = Not applicable because the EUT has an integral antenna.

NA2 = Not applicable because the EUT is powered by battery.

### 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
NVD01	Navdy	HUD	FPI619301231134A

#### *Support Equipment:*

Device	Manufacturer	Model #	S/N
AC/DC Adapter for Laptop	Asus	ADP-33AW	NA
Laptop	Asus	E200H	G2NLCX03681708B
Battery	DieHard	NA	NA

### General Product Information:

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Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	BLE 4.0
Operating Frequency Range:	2400MHz to 2483.5MHz
Modulation Type(s):	GFSK
Maximum Duty Cycle:	100%
Number of TX Chains:	40
Antenna Type(s) and Gain:	Integral/ -1dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	12VDC
Software used for Test:	Window Command Prompt

## FCC Part 15 Subpart C

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

#### Test Setup/Conditions

Test Location:	Fremont Lab C3	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2013), KDB 558074 v03r05 section 8	Test Date(s):	5/19/2016
Configuration:	1		
Test Setup:	The EUT is placed on Styrofoam on a table. It is powered by a car battery at 12VDC which is under the table. The EUT is set continuously transmitting as intended.		

#### Environmental Conditions

Temperature (°C)	22.7	Relative Humidity (%):	43
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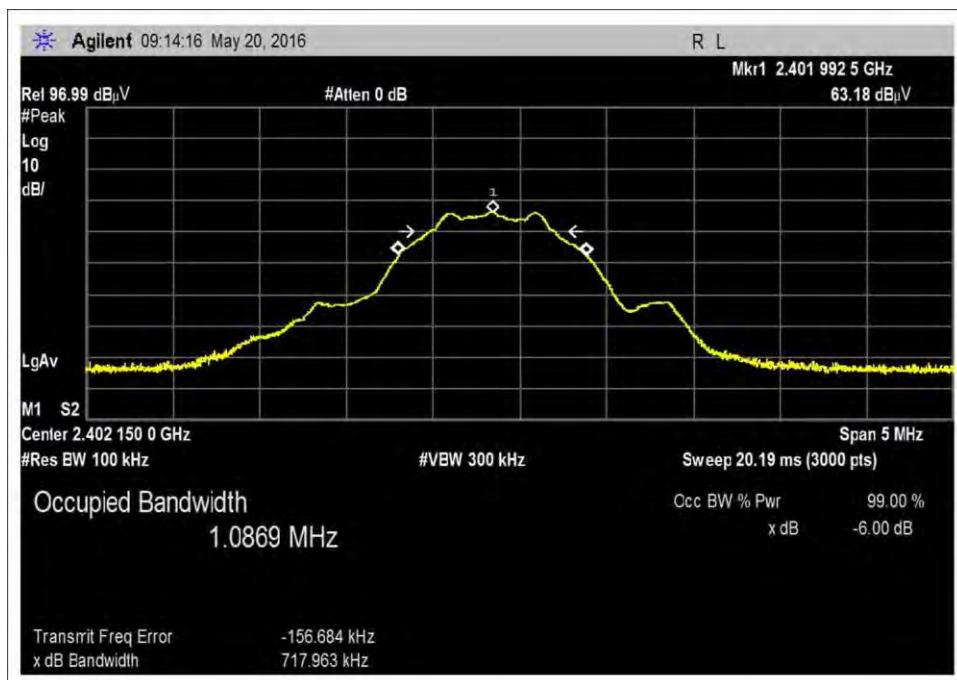
#### Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02157	Horn Antenna	EMCO	3115	12/2/2014	12/2/2016
P01210	Cable	Andrews	FSJ1P-50A-4A	1/15/2015	1/15/2017
03302	Cable	Astrolab	32026-29094K-29094K-72TC	1/29/2016	1/29/2018
03471	Spectrum Analyzer	Agilent	E4440A	1/4/2016	1/4/2018

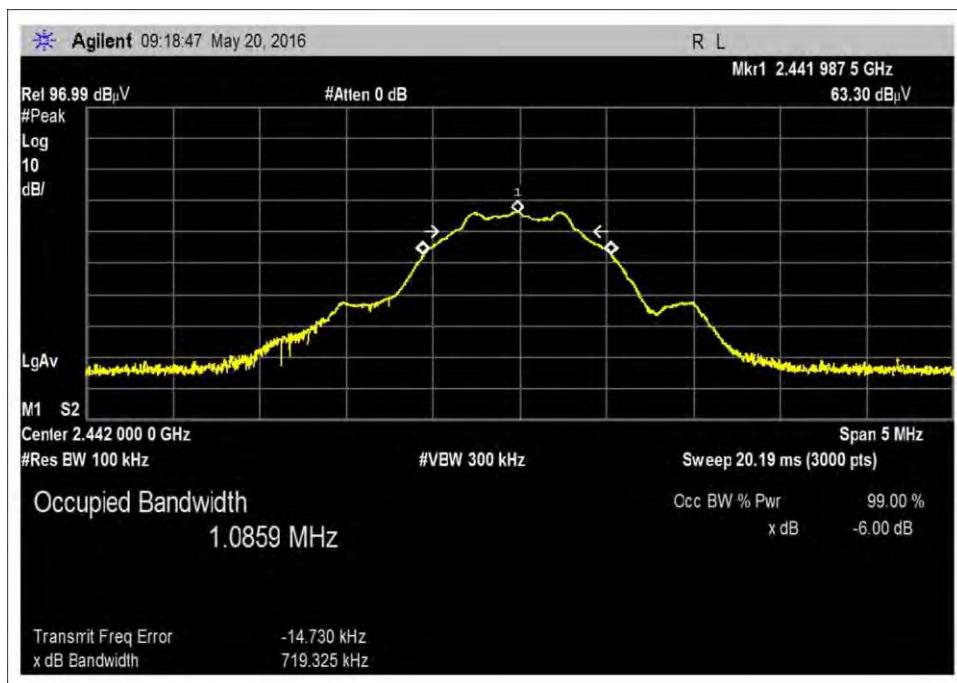
#### Test Data Summary

Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2402	1	GFSK	717.963	≥500	Pass
2442	1	GFSK	719.325	≥500	Pass
2480	1	GFSK	717.406	≥500	Pass

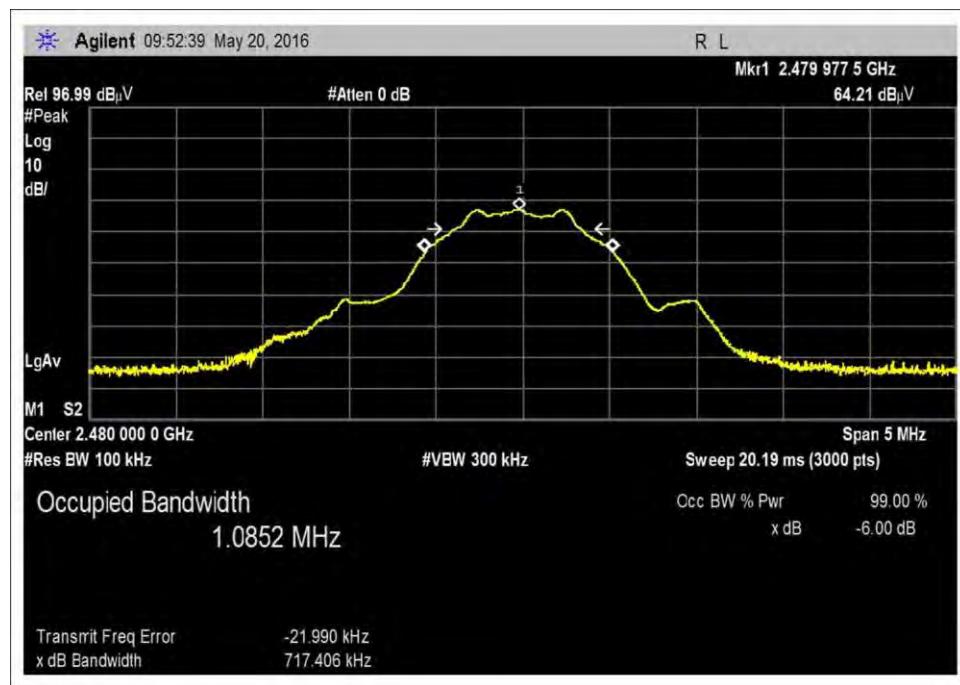
## Plots



Low Channel

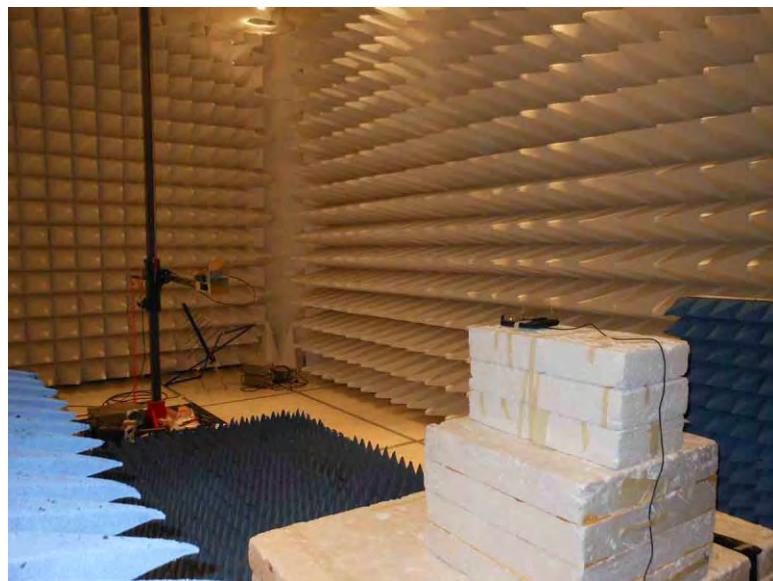
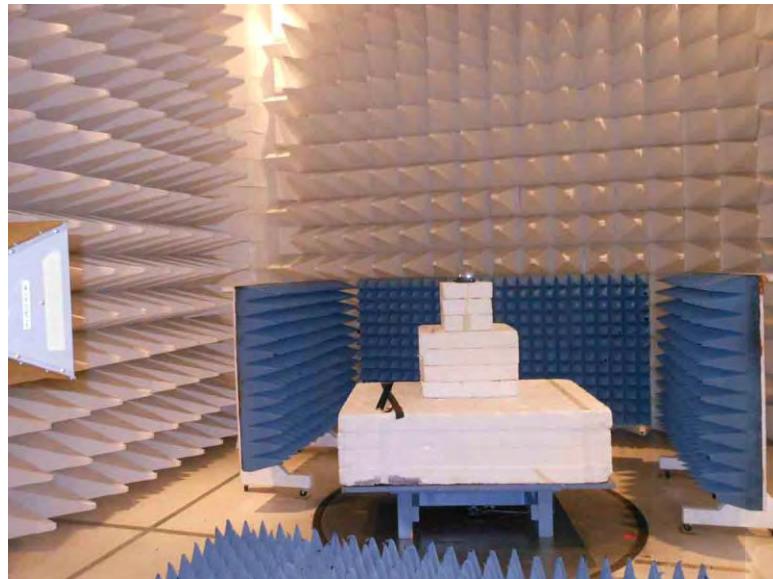


Middle Channel



High Channel

**Test Setup Photos**



## 15.247(b)(3) Output Power

### Test Data Summary - Voltage Variations

This equipment is battery powered. Power output tests were performed using a fresh battery.

#### Power Output Test Data Summary - Radiated Measurement

Measurement Option: RBW > DTS Bandwidth

Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Field Strength (dBuV/m @3m)	Calculated (dBm)	Limit (dBm)	Results
2402 Horizontal	GFSK	Integral/-1 dBi	96.5	2.271	≤ 30	Pass
2402 Vertical	GFSK	Integral/-1 dBi	89.7	-4.529	≤ 30	Pass
2442 Horizontal	GFSK	Integral/-1 dBi	96	1.771	≤ 30	Pass
2442 Vertical	GFSK	Integral/-1 dBi	90.6	-3.629	≤ 30	Pass
2480 Horizontal	GFSK	Integral/-1 dBi	95.3	1.071	≤ 30	Pass
2480 Vertical	GFSK	Integral/-1 dBi	90.3	-3.929	≤ 30	Pass

For fixed point-to-point antennas, the limit is calculated in accordance with 15.247(c)(1):  $Limit = 30 - Roundup\left(\frac{G-6}{3}\right)$

For directional beamforming antennas, the limit is calculated in accordance with 15.247(c)(2) and KDB 662911.

Conducted RF output power calculated in accordance with ANSI C63.10.

$$P(W) = \frac{(E \cdot d)^2}{30 G}$$

Or equivalently, in logarithmic form:

$$P(dBm) = E(dBuV/m) + 20LOG(d) - G - 104.77$$

## Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: **15.247(b) Power Output (2400-2483.5 MHz DTS)**  
 Work Order #: **98354** Date: 5/19/2016  
 Test Type: **Radiated Scan** Time: 15:20:11  
 Tested by: Hieu Song Nguyenpham Sequence#: 2  
 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:***

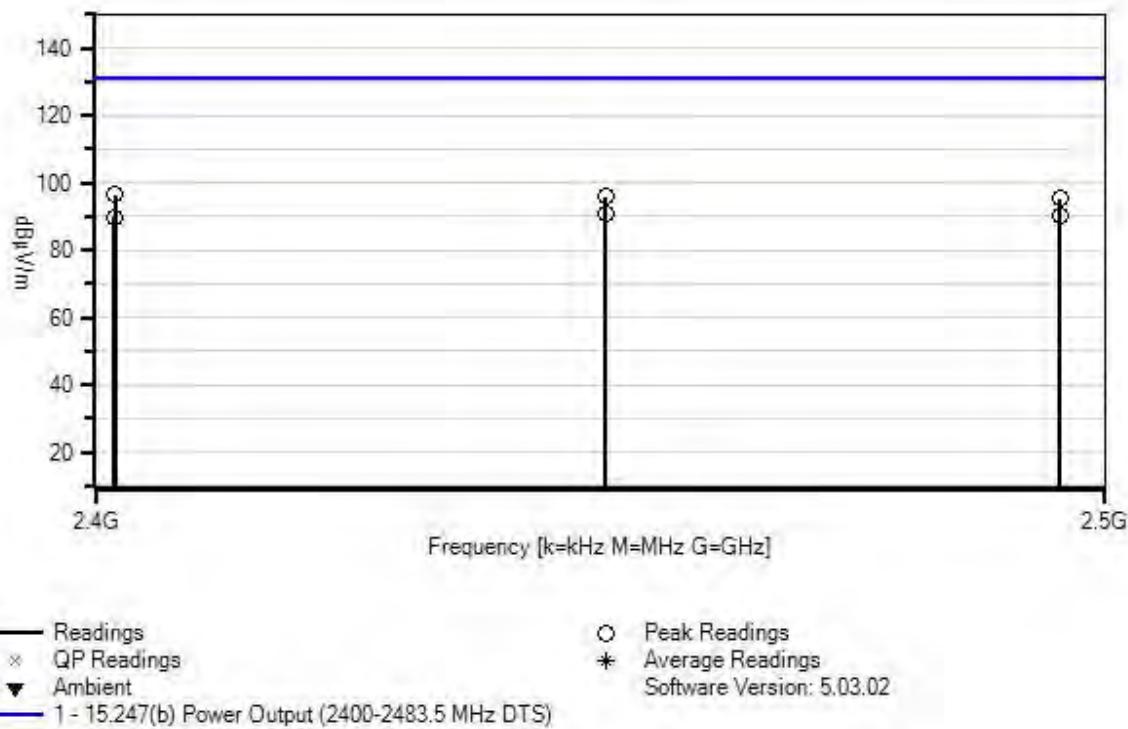
Temperature: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 ANSI C63.10 (2013) and KDB 558074v03r05 section 9.1  
 RBW=3MHz  
 VBW=8MHz

The EUT is placed on a non-conducted table. It is powered up with a 12VDC battery. It is set up continuously transmitting or receiving as intended.

***BLE on TX Mode***

Navdy WO#: 98354 Sequence#: 2 Date: 5/19/2016  
15.247(b) Power Output (2400-2483.5 MHz DTS) Test Distance: 3 Meters Vert



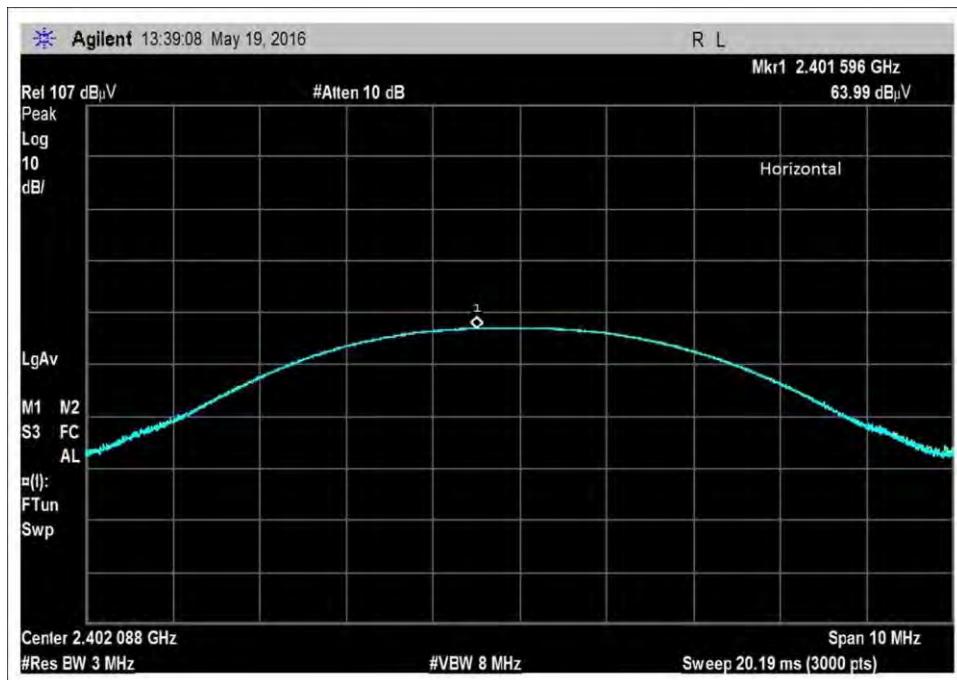
**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna- ANSI C63.5 Calibration	3115	12/2/2014	12/2/2016
T2	AN03302	Cable	32026-29094K- 29094K-72TC	1/29/2016	1/29/2018
T3	ANP01210	Cable	FSJ1P-50A-4A	1/15/2015	1/15/2017
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018

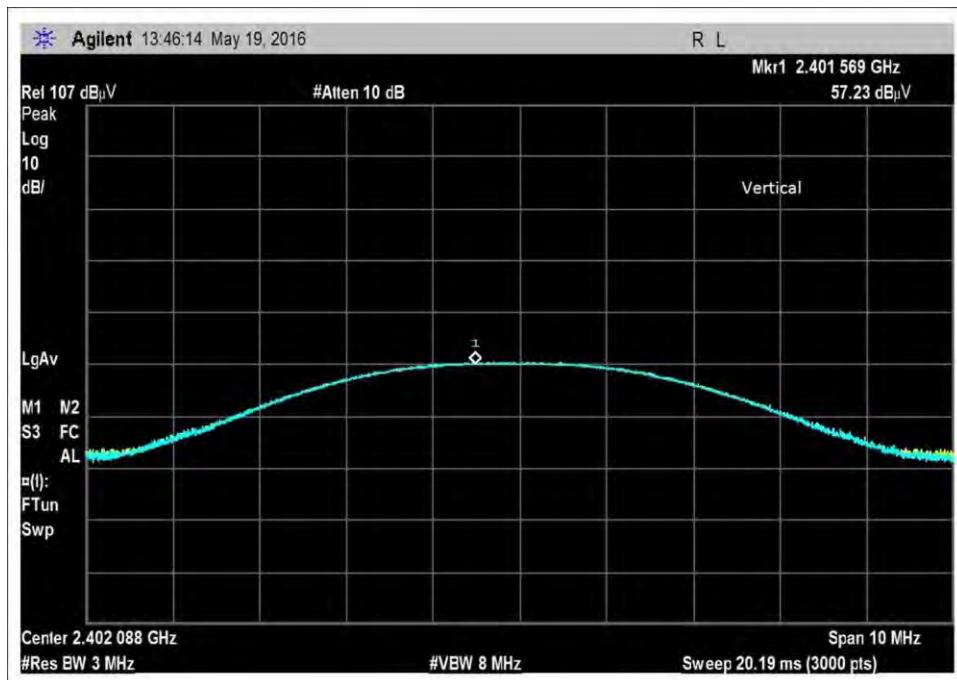
**Measurement Data:** Reading listed by margin. Test Distance: 3 Meters

#	Freq MHz	Rdng dB $\mu$ V	T1 dB	T2 dB	T3 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	2401.596M	64.0	+28.6	+1.3	+2.6	+0.0	96.5	131.2	-34.7	Horiz
2	2441.810M	63.4	+28.7	+1.3	+2.6	+0.0	96.0	131.2	-35.2	Horiz
3	2479.680M	62.6	+28.8	+1.3	+2.6	+0.0	95.3	131.2	-35.9	Horiz
4	2441.810M	58.0	+28.7	+1.3	+2.6	+0.0	90.6	131.2	-40.6	Vert
5	2479.680M	57.6	+28.8	+1.3	+2.6	+0.0	90.3	131.2	-40.9	Vert
6	2401.569M	57.2	+28.6	+1.3	+2.6	+0.0	89.7	131.2	-41.5	Vert

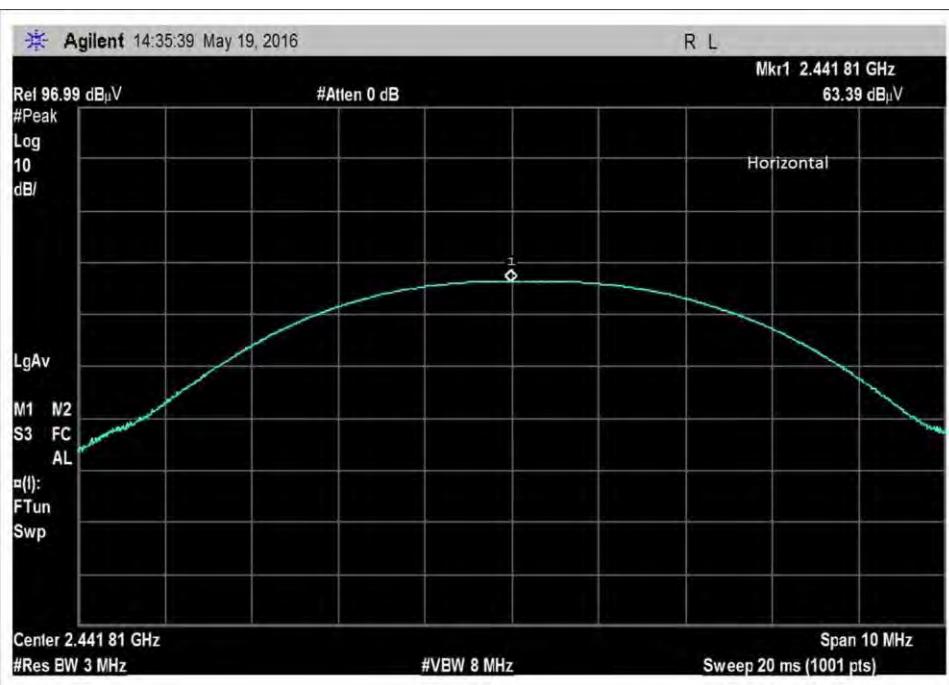
## Plots



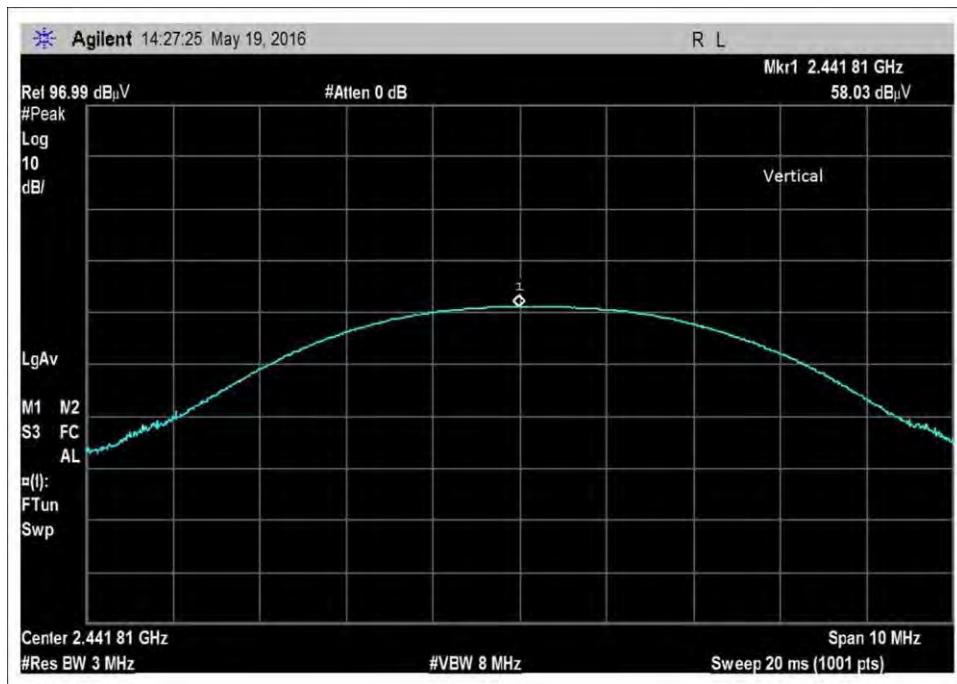
Low Channel, Horizontal



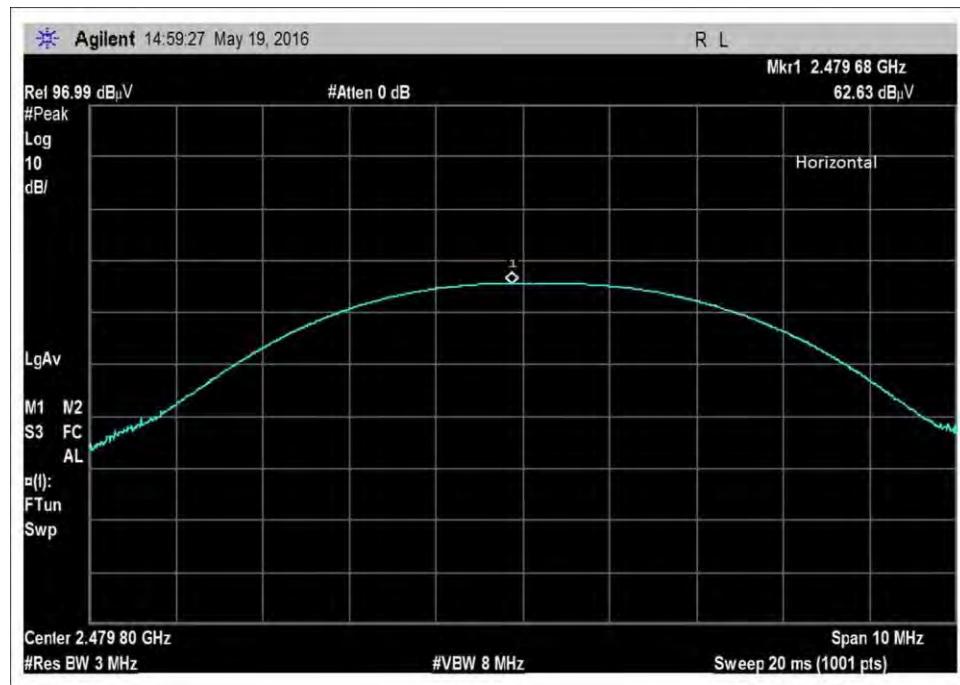
Low Channel, Vertical



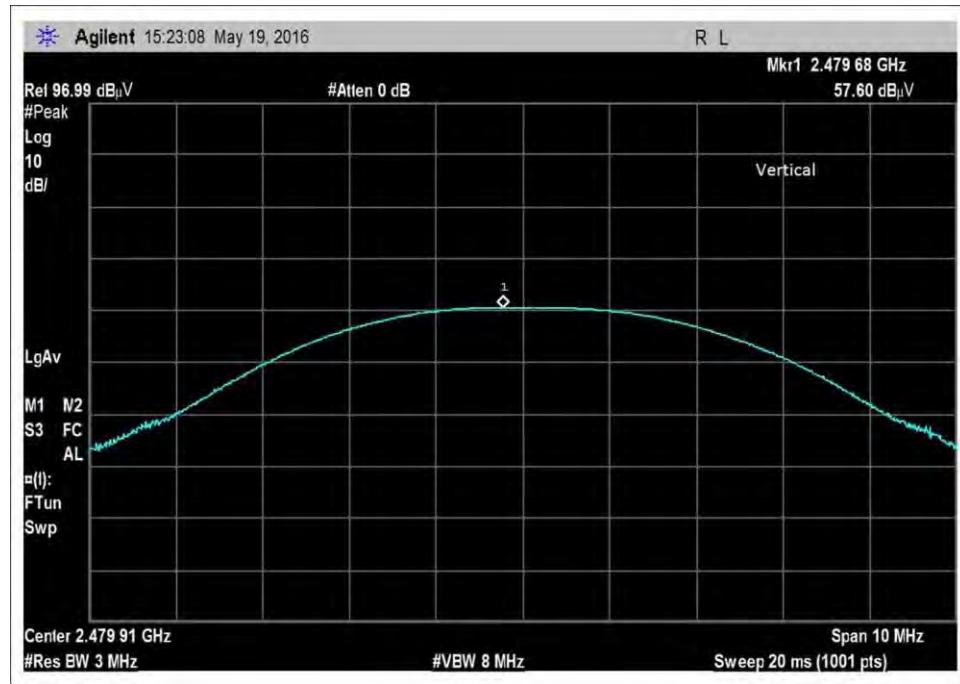
Middle Channel, Horizontal



Middle Channel, Vertical

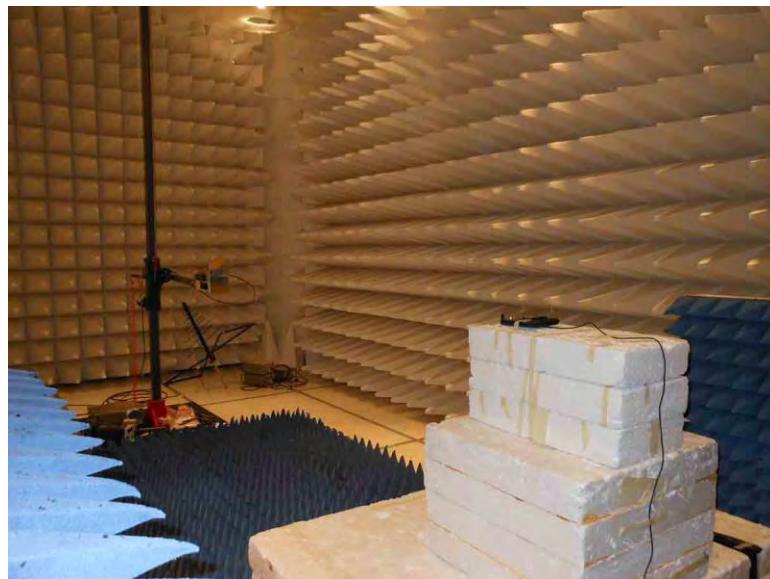
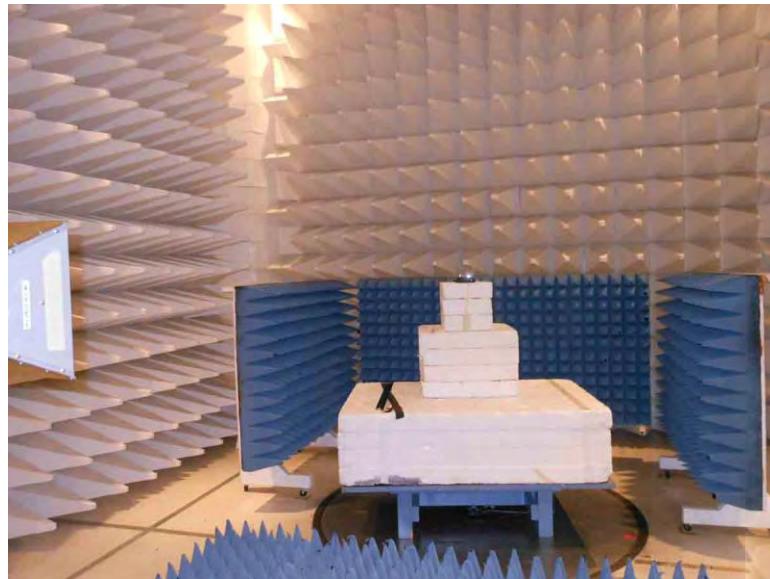


High Channel, Horizontal



High Channel, Vertical

**Test Setup Photos**



## 15.247(e) Power Spectral Density

### PSD Test Data Summary - Radiated Measurement

Measurement Method: PKPSD

Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Field Strength (dBuV/m @3m)	Calculated (dBm/3kHz)	Limit (dBm/3kHz)	Results
2402 Horizontal	GFSK	Integral/-1 dBi	81.5	-12.729	≤8	Pass
2402 Vertical	GFSK	Integral/-1 dBi	76	-18.229	≤8	Pass
2442 Horizontal	GFSK	Integral/-1 dBi	82.4	-11.829	≤8	Pass
2442 Vertical	GFSK	Integral/-1 dBi	75.8	-18.429	≤8	Pass
2480 Horizontal	GFSK	Integral/-1 dBi	83.3	-10.929	≤8	Pass
2480 Vertical	GFSK	Integral/-1 dBi	77.2	-17.029	≤8	Pass

Conducted RF output power calculated in accordance with ANSI C63.10.

$$P(W) = \frac{(E \cdot d)^2}{30 G}$$

Or equivalently, in logarithmic form:

$$P(dBm) = E(dBuV/m) + 20LOG(d) - G - 104.77$$

## Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: **15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)**  
 Work Order #: **98354** Date: 5/20/2016  
 Test Type: **Radiated Scan** Time: 09:53:08  
 Tested by: Hieu Song Nguyenpham 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:***

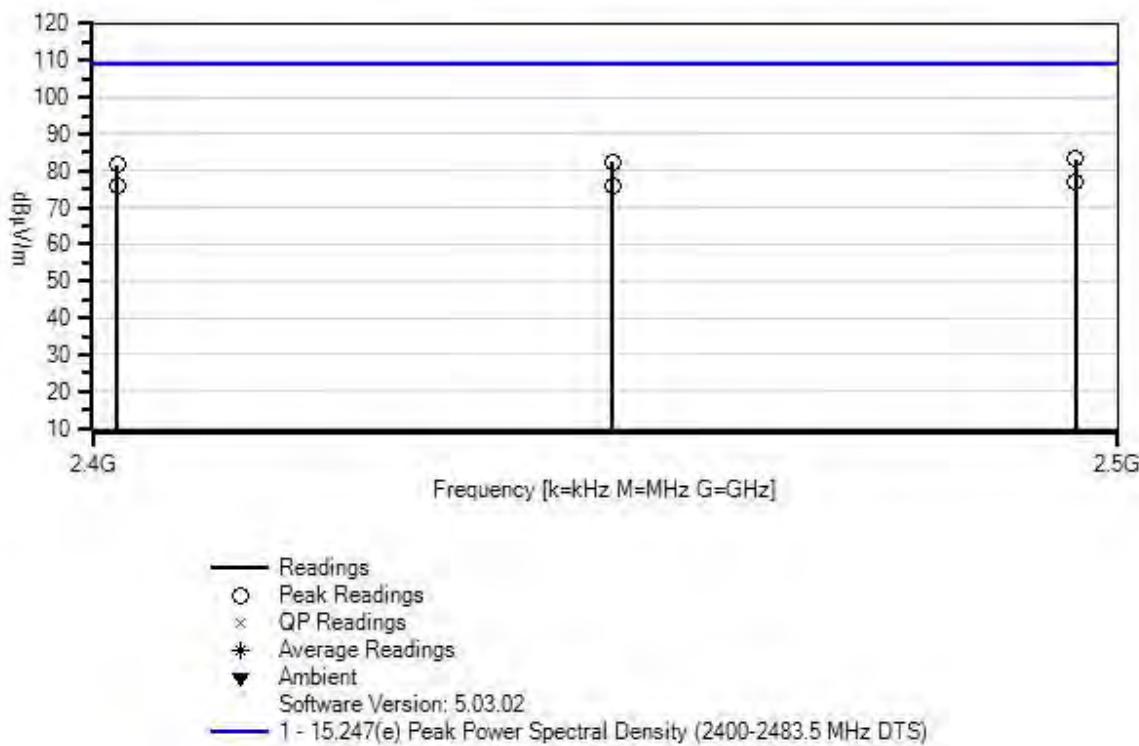
Temperature: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 Method: ANSI C63.10 (2013) and KDB 558074v03r05 section 10.2  
 RBW=3kHz  
 VBW=8kHz

The EUT is placed on a non-conducted table. It is powered up with a 12VDC battery. It is set up continuously transmitting or receiving as intended.

***BLE on TX Mode***

Navdy WO#: 98354 Sequence#: 3 Date: 5/20/2016  
15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS) Test Distance: 3 Meters Vert



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna- ANSI C63.5 Calibration	3115	12/2/2014	12/2/2016
T2	AN03302	Cable	32026-29094K- 29094K-72TC	1/29/2016	1/29/2018
T3	ANP01210	Cable	FSJ1P-50A-4A	1/15/2015	1/15/2017
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018

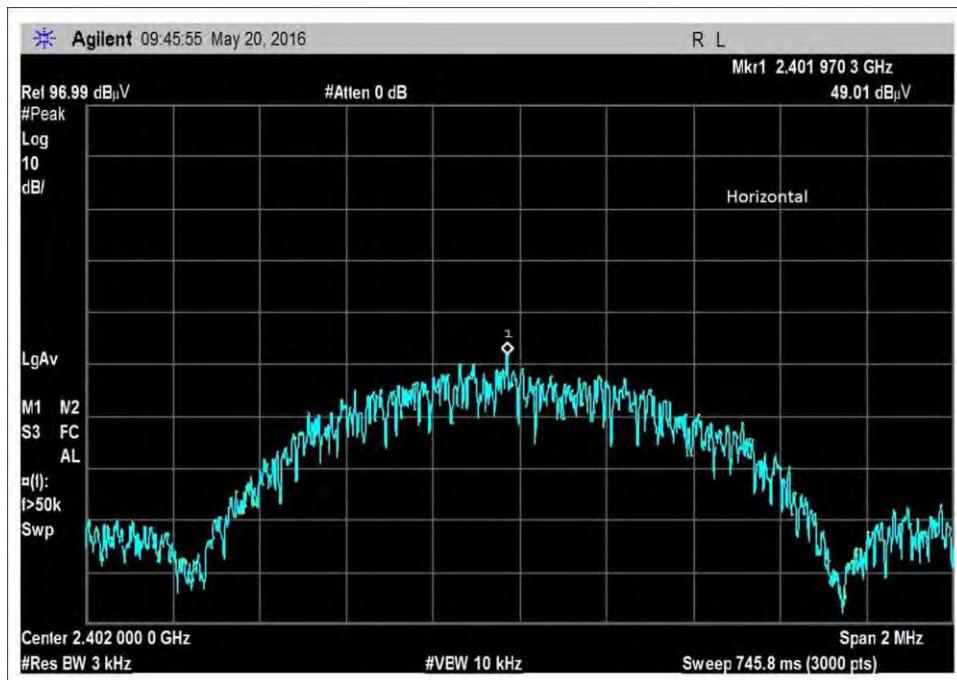
**Measurement Data:**

Reading listed by margin.

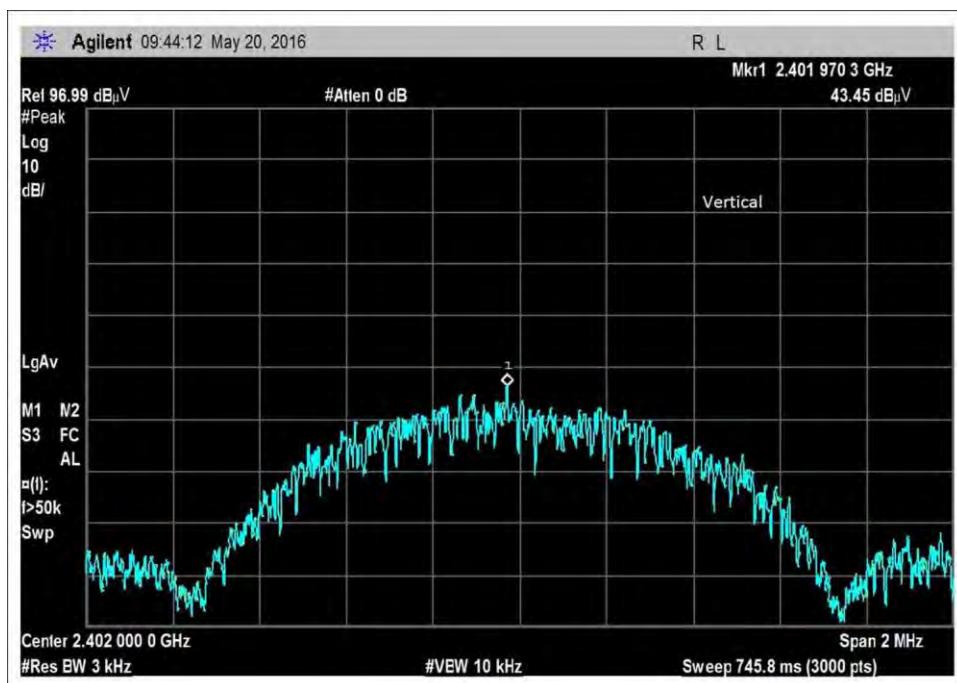
Test Distance: 3 Meters

#	Freq MHz	Rdng dB $\mu$ V	T1 dB	T2 dB	T3 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	2479.957M	50.6	+28.8	+1.3	+2.6	+0.0	83.3	109.2	-25.9	Horiz
2	2441.963M	49.8	+28.7	+1.3	+2.6	+0.0	82.4	109.2	-26.8	Horiz
3	2401.970M	49.0	+28.6	+1.3	+2.6	+0.0	81.5	109.2	-27.7	Horiz
4	2479.956M	44.5	+28.8	+1.3	+2.6	+0.0	77.2	109.2	-32.0	Vert
5	2401.970M	43.5	+28.6	+1.3	+2.6	+0.0	76.0	109.2	-33.2	Vert
6	2441.964M	43.2	+28.7	+1.3	+2.6	+0.0	75.8	109.2	-33.4	Vert

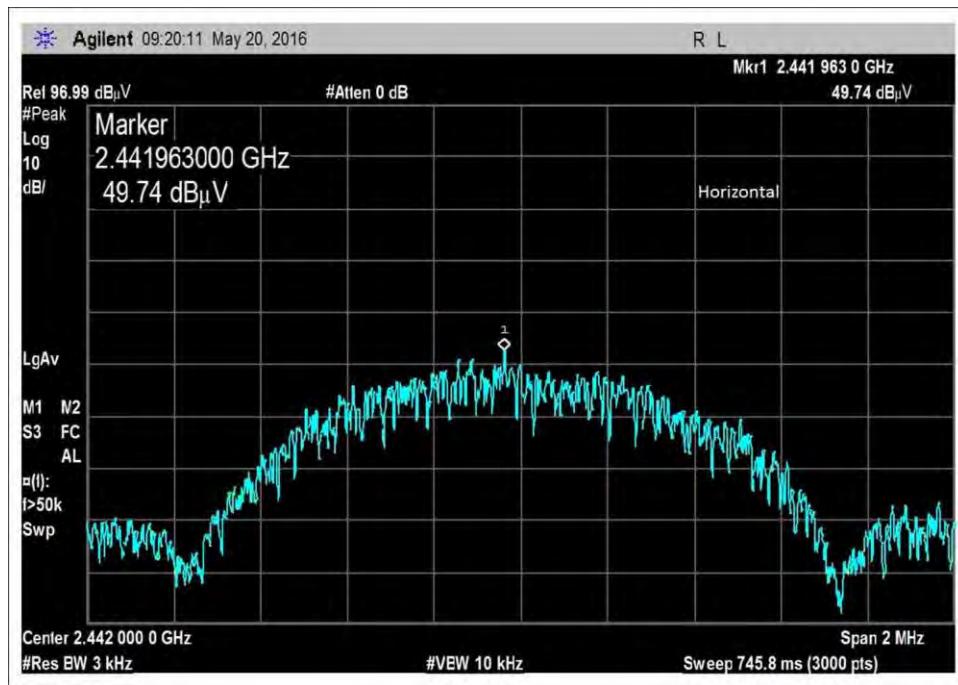
## Plots



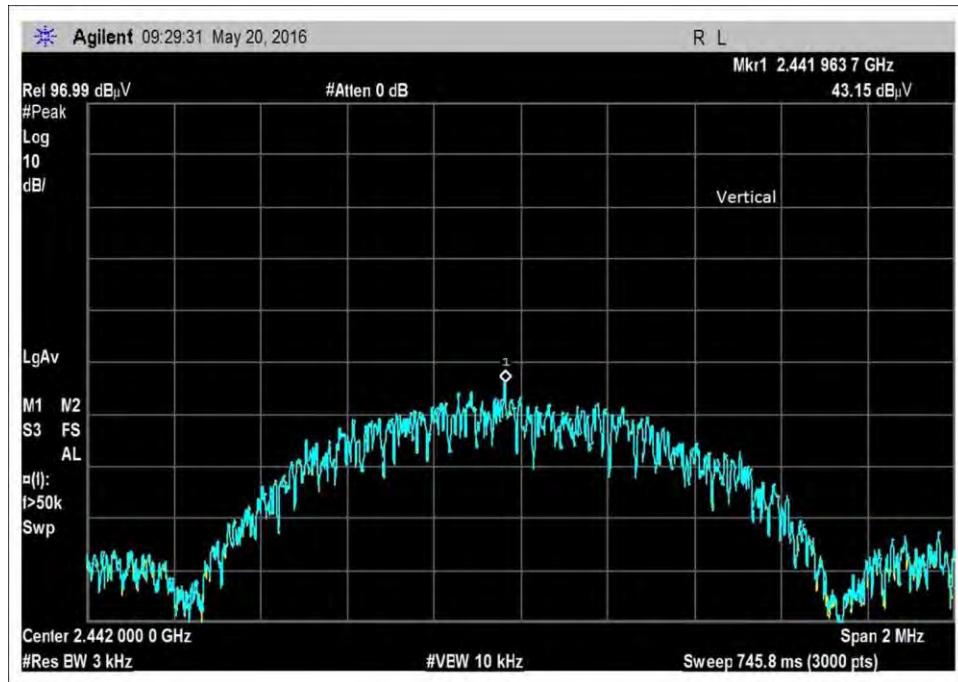
Low Channel, Horizontal



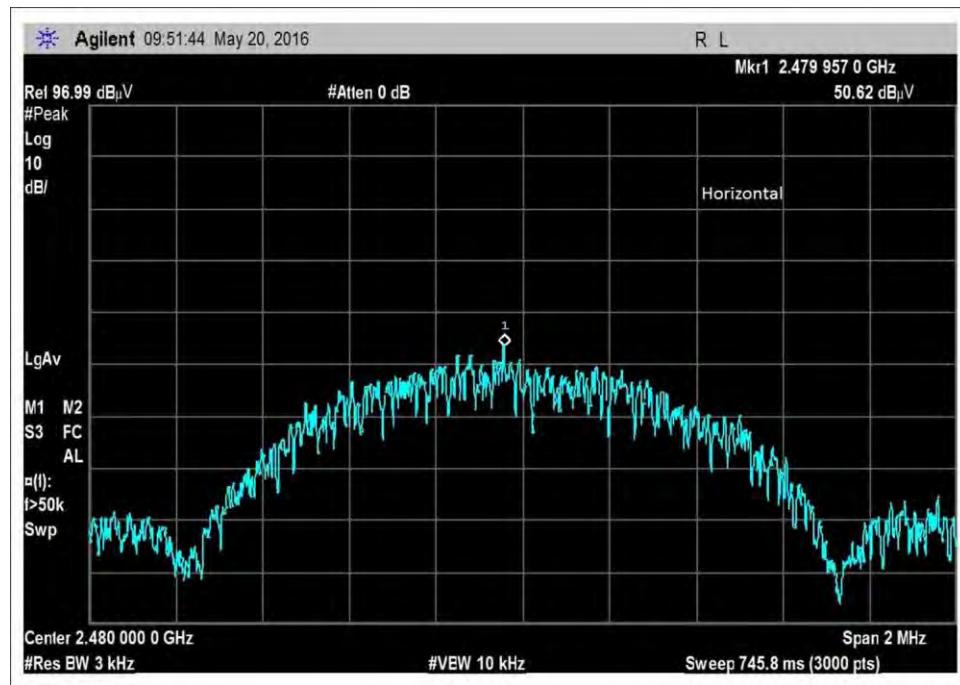
Low Channel, Vertical



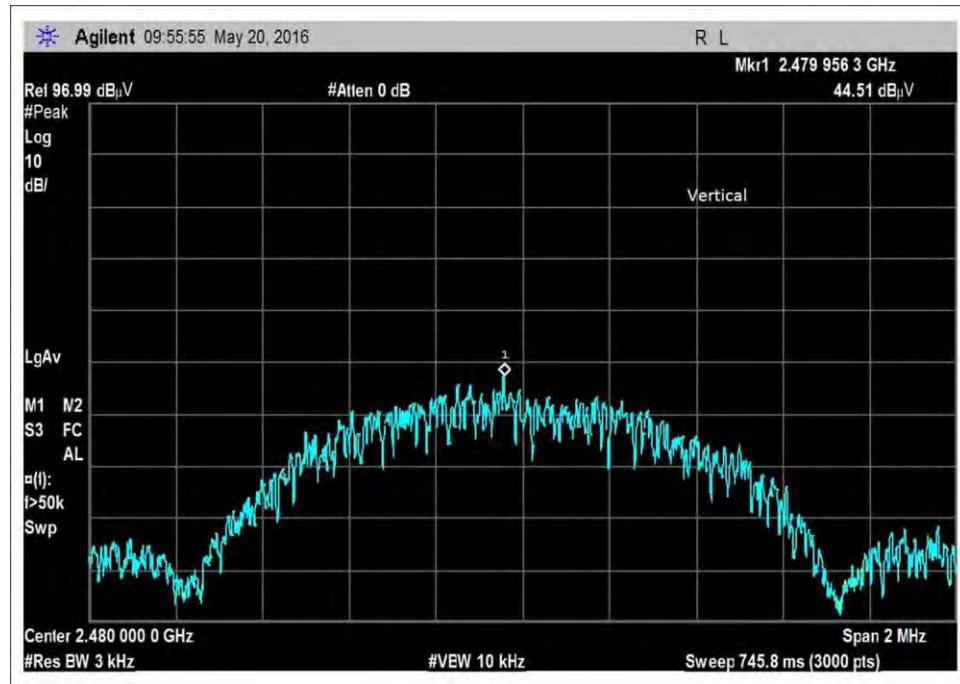
Middle Channel, Horizontal



Middle Channel, Vertical

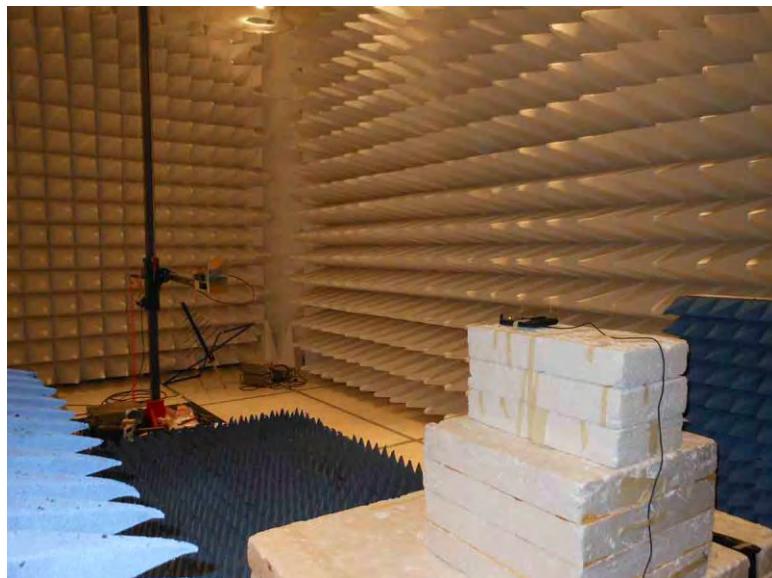
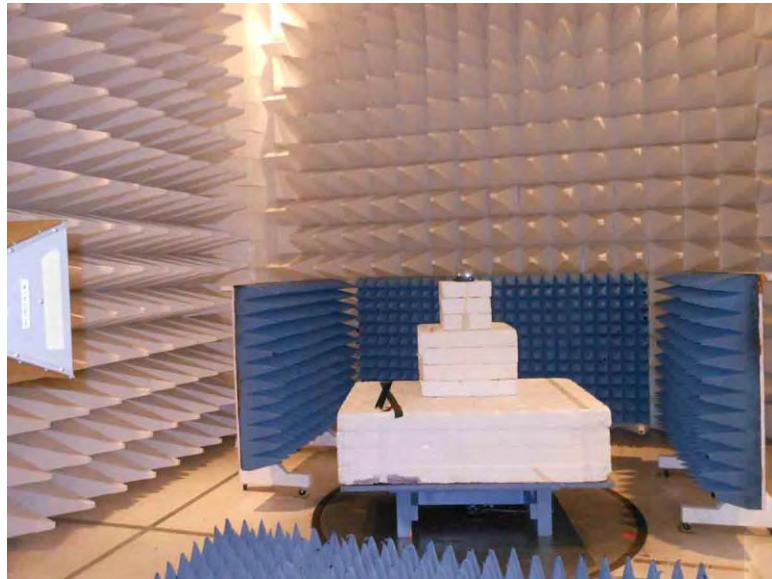


High Channel, Horizontal



High Channel, Vertical

**Test Setup Photos**



## 15.247(d) Radiated Emissions & Band Edge

### Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **98354** Date: **5/25/2016**  
 Test Type: **Radiated Scan** Time: **13:41:31**  
 Tested by: **Hieu Song Nguyenpham** Sequence#: **56**  
 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:***

Radiated Spurious Emission  
 Frequency Range: 9kHz to 1000MHz

Temperature: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

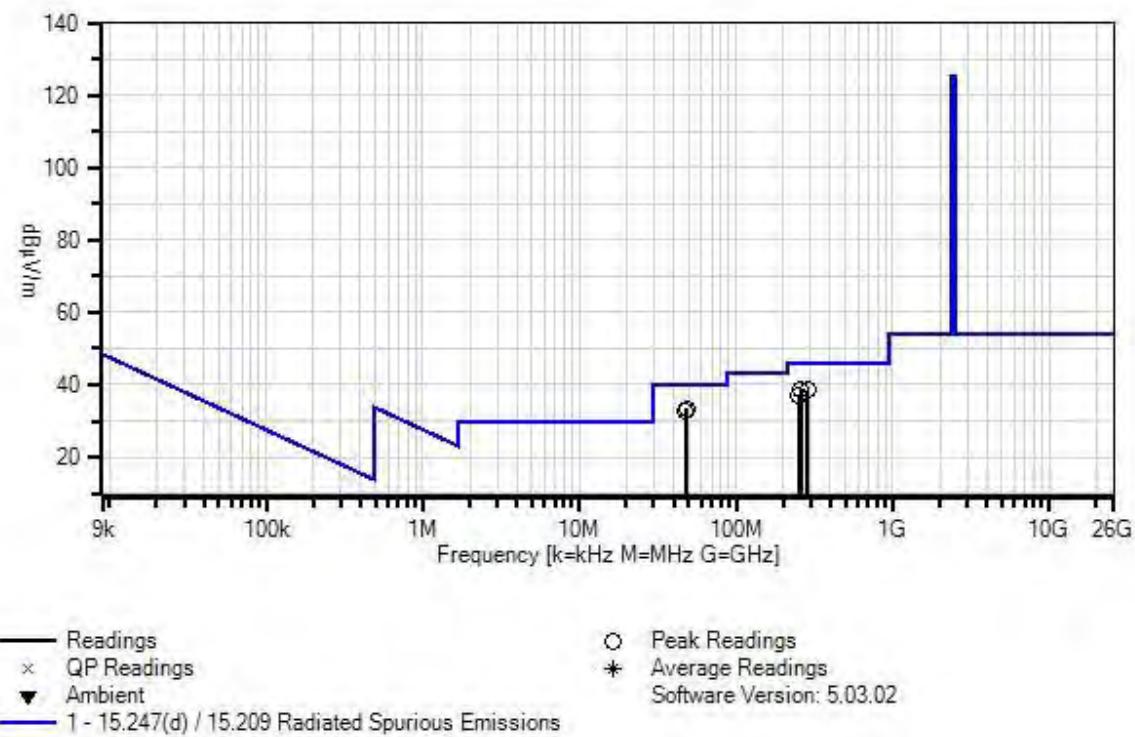
High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 Method: ANSI C63.10 (2013) and KDB 558074v03r05 section 12.2.7

9 kHz -150 kHz; RBW=200 Hz, VBW=200 Hz  
 150 kHz-30 MHz; RBW=9 kHz, VBW=9 kHz  
 30 MHz-1000 MHz; RBW=120 kHz, VBW=120 kHz  
 1000 MHz-25000MHz; RBW=1 MHz, VBW=1 MHz

The EUT is placed on a non-conducted table. It is powered up with a 12VDC battery. It is set up continuously transmitting as intended.

**BLE on TX Mode ( Low Channel)**

Navdy WO#: 98354 Sequence#: 56 Date: 5/25/2016  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00971A	Preamp	8447D	2/5/2016	2/5/2018
	AN00432	Loop Antenna	6502	5/8/2015	5/8/2017
T2	AN00852	Biconilog Antenna	CBL 6111C	11/24/2014	11/24/2016
T3	ANP06049	Attenuator	PE7002-6	5/9/2016	5/9/2018
T4	ANP00880	Cable	RG214U	5/10/2016	5/10/2018
T5	ANP01187	Cable	CNT-195	12/30/2014	12/30/2016
T6	ANP06691	Cable	PE3062-180	8/8/2014	8/8/2016
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB $\mu$ V	dB	dB	dB	dB	Table	dB $\mu$ V/m	dB $\mu$ V/m	dB	Ant
1	48.833M	44.8	-27.9 +0.1	+9.6 +0.2	+5.9	+0.6	+0.0	33.3	40.0	-6.7	Vert
2	48.035M	44.0	-27.9 +0.1	+10.0 +0.2	+5.9	+0.6	+0.0	32.9	40.0	-7.1	Vert
3	258.951M	44.2	-27.0 +0.3	+12.9 +0.6	+5.9	+1.6	+0.0	38.5	46.0	-7.5	Horiz
4	285.257M	43.7	-27.0 +0.3	+13.2 +0.7	+5.9	+1.7	+0.0	38.5	46.0	-7.5	Horiz
5	250.663M	43.0	-27.0 +0.3	+12.8 +0.6	+5.9	+1.6	+0.0	37.2	46.0	-8.8	Horiz

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **98354** Date: 5/23/2016  
 Test Type: **Radiated Scan** Time: 12:14:25  
 Tested by: Hieu Song Nguyenpham Sequence#: 9  
 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:***

Radiated Spurious Emission  
 Frequency Range: 1000MHz to 25000MHz

Temperature: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

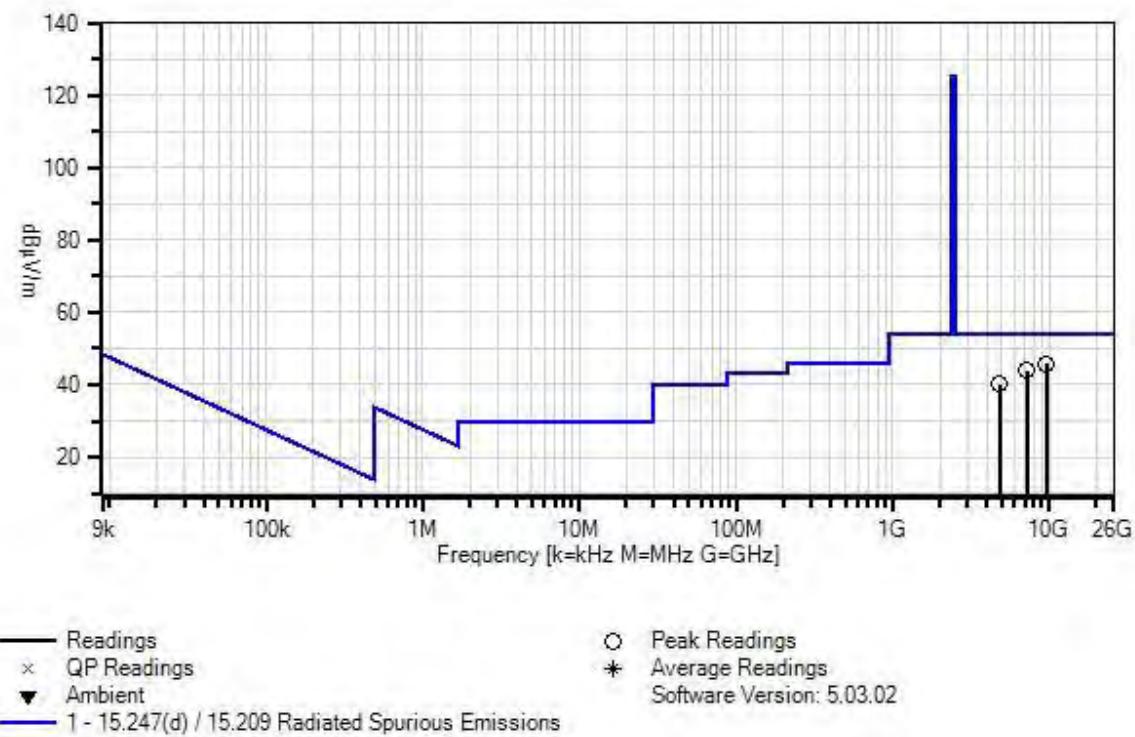
High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 Method: ANSI C63.10 (2013) and KDB 558074v03r05 section 12.2.7

9 kHz -150 kHz; RBW=200 Hz,VBW=200 Hz  
 150 kHz-30 MHz; RBW=9 kHz,VBW=9 kHz  
 30 MHz-1000 MHz; RBW=120 kHz,VBW=120 kHz  
 1000 MHz-25000MHz; RBW=1 MHz,VBW=1 MHz

The EUT is placed on non-conducted table. It is powered up with a 12VDC battery It is set up continuously transmitting as intended.

**BLE on TX Mode ( Low Channel)**

Navdy WO#: 98354 Sequence#: 9 Date: 5/23/2016  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna- ANSI C63.5 Calibration	3115	12/2/2014	12/2/2016
T2	AN03302	Cable	32026-29094K- 29094K-72TC	1/29/2016	1/29/2018
T3	ANP01210	Cable	FSJ1P-50A-4A	1/15/2015	1/15/2017
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
T4	AN03114	Preamp	AMF-7D- 00101800-30- 10P	4/22/2015	4/22/2017
	AN02694	Horn Antenna- ANSI C63.5 3m	AMFW-5F- 18002650-20- 10P	5/7/2015	5/7/2017
	ANP00928	Cable	various	1/25/2016	1/25/2018
	ANP00929	Cable	various	1/25/2016	1/25/2018
	ANP06126	Cable	32022-29094K- 29094K-168TC	3/18/2015	3/18/2017
T5	ANP06900	Cable	32022-29094K- 29094K-36TC	12/30/2015	12/30/2017
T6	AN03309	High Pass Filter	11SH10- 3000/T10000- O/O	1/18/2016	1/18/2018
	AN02693	Active Horn Antenna-ANSI C63.5 3m	AMFW-5F- 12001800-20- 10P	5/6/2015	5/6/2017

**Measurement Data:** Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6			Table	dB $\mu$ V/m	dB $\mu$ V/m		
	MHz	dB $\mu$ V	dB	dB	dB	dB				dB	Ant
1	9608.810M	55.0	+38.6 +1.1	+2.6 +0.3	+5.4	-57.2	+0.0	45.8	54.0	-8.2	Horiz
2	7201.380M	57.9	+35.9 +1.0	+2.2 +0.3	+5.0	-58.3	+0.0	44.0	54.0	-10.0	Horiz
3	4804.530M	57.9	+33.2 +0.8	+1.8 +0.3	+3.8	-57.8	+0.0	40.0	54.0	-14.0	Horiz

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **98354** Date: 5/25/2016  
 Test Type: **Radiated Scan** Time: 14:11:28  
 Tested by: Hieu Song Nguyenpham Sequence#: 59  
 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:**

Radiated Spurious Emission  
 Frequency Range: 9kHz to 1000MHz

Temperature: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

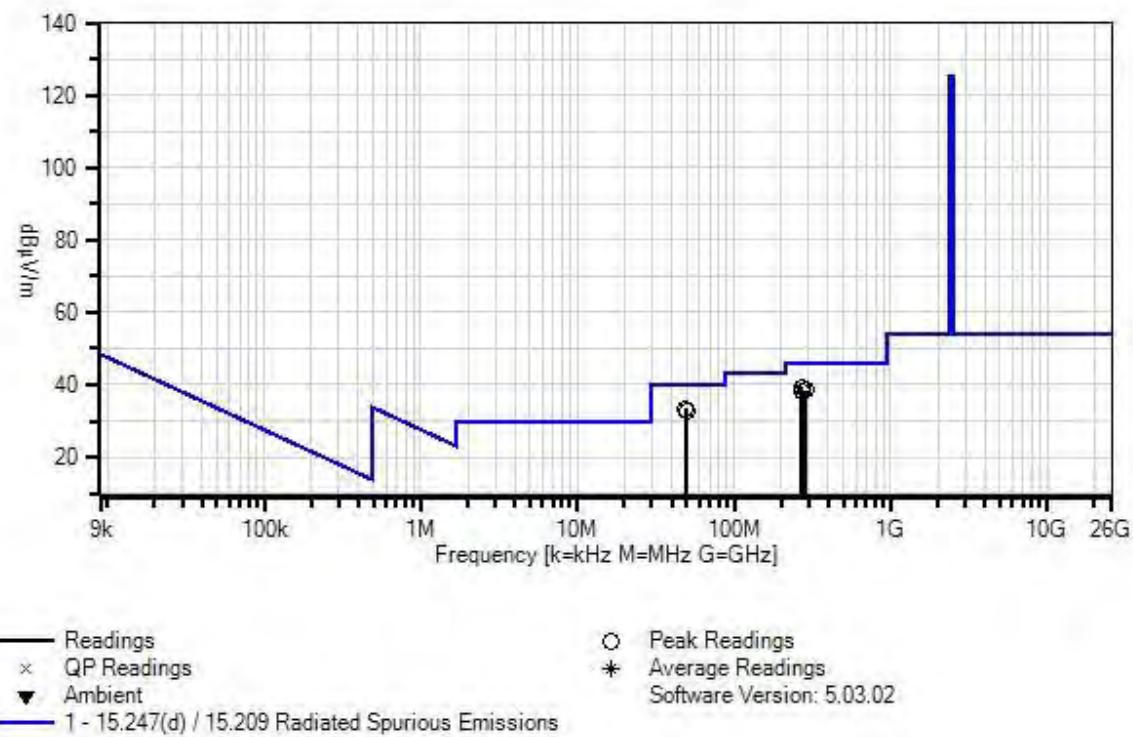
High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 Method: ANSI C63.10 (2013) and KDB 558074v03r05 section 12.2.7

9 kHz -150 kHz; RBW=200 Hz,VBW=200 Hz  
 150 kHz-30 MHz; RBW=9 kHz,VBW=9 kHz  
 30 MHz-1000 MHz; RBW=120 kHz,VBW=120 kHz  
 1000 MHz-25000MHz; RBW=1 MHz,VBW=1 MHz

The EUT is placed on a non-conducted table. It is powered up with a 12VDC battery It is set up continuously transmitting as intended.

**BLE on TX Mode ( Middle Channel)**

Navdy WO#: 98354 Sequence#: 59 Date: 5/25/2016  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00971A	Preamp	8447D	2/5/2016	2/5/2018
	AN00432	Loop Antenna	6502	5/8/2015	5/8/2017
T2	AN00852	Biconilog Antenna	CBL 6111C	11/24/2014	11/24/2016
T3	ANP06049	Attenuator	PE7002-6	5/9/2016	5/9/2018
T4	ANP00880	Cable	RG214U	5/10/2016	5/10/2018
T5	ANP01187	Cable	CNT-195	12/30/2014	12/30/2016
T6	ANP06691	Cable	PE3062-180	8/8/2014	8/8/2016
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB $\mu$ V	dB	dB	dB	dB	Table	dB $\mu$ V/m	dB $\mu$ V/m	dB	Ant
1	48.900M	44.9	-27.9 +0.1	+9.6 +0.2	+5.9	+0.6	+0.0	33.4	40.0	-6.6	Vert
2	269.180M	44.8	-27.0 +0.3	+13.0 +0.6	+5.9	+1.6	+0.0	39.2	46.0	-6.8	Horiz
3	49.832M	44.7	-27.9 +0.1	+9.2 +0.2	+5.9	+0.6	+0.0	32.8	40.0	-7.2	Vert
4	285.459M	43.6	-27.0 +0.3	+13.2 +0.7	+5.9	+1.7	+0.0	38.4	46.0	-7.6	Horiz
5	270.881M	43.7	-27.0 +0.3	+13.0 +0.6	+5.9	+1.6	+0.0	38.1	46.0	-7.9	Horiz

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **98354** Date: 5/23/2016  
 Test Type: **Radiated Scan** Time: 14:06:28  
 Tested by: Hieu Song Nguyenpham 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:**

Radiated Spurious Emission  
 Frequency Range: 1000MHz to 25000MHz

Temperature: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

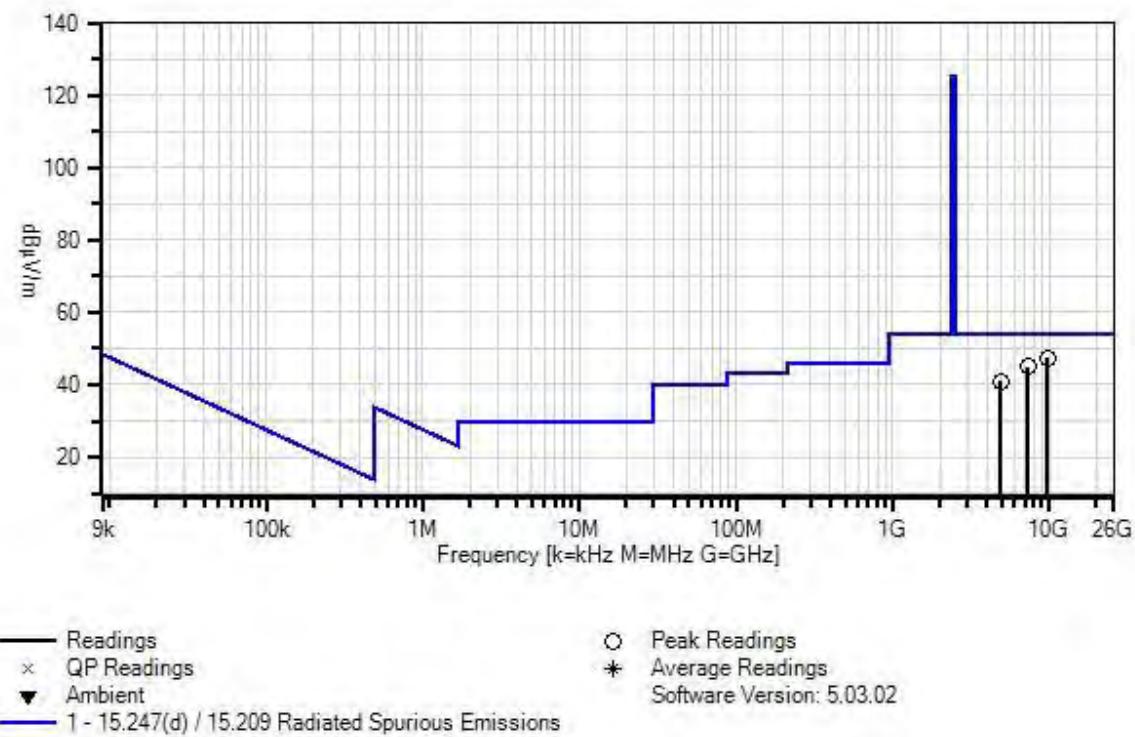
High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 Method: ANSI C63.10 (2013) and KDB 558074v03r05 section 12.2.7

9 kHz -150 kHz; RBW=200 Hz,VBW=200 Hz  
 150 kHz-30 MHz; RBW=9 kHz,VBW=9 kHz  
 30 MHz-1000 MHz; RBW=120 kHz,VBW=120 kHz  
 1000 MHz-25000MHz; RBW=1 MHz,VBW=1 MHz

The EUT is placed on a non-conducted table. It is powered up with a 12VDC battery It is set up continuously transmitting as intended.

**BLE on TX Mode ( Middle Channel)**

Navdy WO#: 98354 Sequence#: 12 Date: 5/23/2016  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna- ANSI C63.5 Calibration	3115	12/2/2014	12/2/2016
T2	AN03302	Cable	32026-29094K- 29094K-72TC	1/29/2016	1/29/2018
T3	ANP01210	Cable	FSJ1P-50A-4A	1/15/2015	1/15/2017
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
T4	AN03114	Preamp	AMF-7D- 00101800-30- 10P	4/22/2015	4/22/2017
	AN02694	Horn Antenna- ANSI C63.5 3m	AMFW-5F- 18002650-20- 10P	5/7/2015	5/7/2017
	ANP00928	Cable	various	1/25/2016	1/25/2018
	ANP00929	Cable	various	1/25/2016	1/25/2018
	ANP06126	Cable	32022-29094K- 29094K-168TC	3/18/2015	3/18/2017
T5	ANP06900	Cable	32022-29094K- 29094K-36TC	12/30/2015	12/30/2017
T6	AN03309	High Pass Filter	11SH10- 3000/T10000- O/O	1/18/2016	1/18/2018
	AN02693	Active Horn Antenna-ANSI C63.5 3m	AMFW-5F- 12001800-20- 10P	5/6/2015	5/6/2017

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6			Table	dB $\mu$ V/m	dB $\mu$ V/m		
	MHz	dB $\mu$ V	dB	dB	dB	dB				dB	Ant
1	9768.032M	56.3	+39.0 +1.1	+2.6 +0.3	+5.6	-57.6	+0.0	47.3	54.0	-6.7	Horiz
2	7325.683M	58.3	+36.4 +1.0	+2.3 +0.3	+5.0	-58.3	+0.0	45.0	54.0	-9.0	Horiz
3	4884.151M	58.4	+33.4 +0.8	+1.8 +0.3	+3.8	-57.6	+0.0	40.9	54.0	-13.1	Horiz

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **98354** Date: 5/25/2016  
 Test Type: **Radiated Scan** Time: 14:42:19  
 Tested by: Hieu Song Nguyenpham Sequence#: 62  
 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:***

Radiated Spurious Emission  
 Frequency Range: 9kHz to 1000MHz

Temperature: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

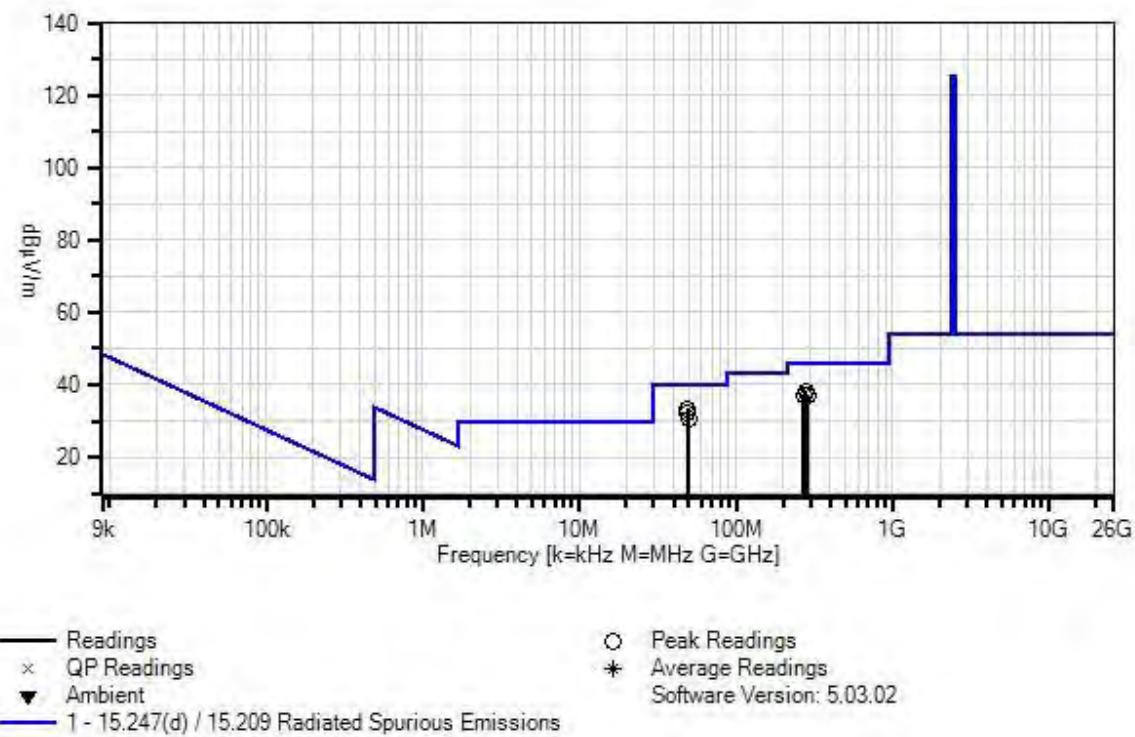
High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 Method: ANSI C63.10 (2013) and KDB 558074v03r05 section 12.2.7

9 kHz -150 kHz; RBW=200 Hz,VBW=200 Hz  
 150 kHz-30 MHz; RBW=9 kHz,VBW=9 kHz  
 30 MHz-1000 MHz; RBW=120 kHz,VBW=120 kHz  
 1000 MHz-25000MHz; RBW=1 MHz,VBW=1 MHz

The EUT is placed on a non-conducted table. It is powered up with a 12VDC battery It is set up continuously transmitting as intended.

**BLE on TX Mode ( High Channel)**

Navdy WO#: 98354 Sequence#: 62 Date: 5/25/2016  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00971A	Preamp	8447D	2/5/2016	2/5/2018
	AN00432	Loop Antenna	6502	5/8/2015	5/8/2017
T2	AN00852	Biconilog Antenna	CBL 6111C	11/24/2014	11/24/2016
T3	ANP06049	Attenuator	PE7002-6	5/9/2016	5/9/2018
T4	ANP00880	Cable	RG214U	5/10/2016	5/10/2018
T5	ANP01187	Cable	CNT-195	12/30/2014	12/30/2016
T6	ANP06691	Cable	PE3062-180	8/8/2014	8/8/2016
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
			MHz	dB $\mu$ V	dB	dB	dB	Table	dB $\mu$ V/m	dB $\mu$ V/m	
1	48.854M	44.9	-27.9 +0.1	+9.6 +0.2	+5.9	+0.6	+0.0	33.4	40.0	-6.6	Vert
2	49.485M	44.2	-27.9 +0.1	+9.3 +0.2	+5.9	+0.6	+0.0	32.4	40.0	-7.6	Vert
3	277.441M	43.8	-27.0 +0.3	+13.1 +0.6	+5.9	+1.6	+0.0	38.3	46.0	-7.7	Horiz
4	285.459M	42.5	-27.0 +0.3	+13.2 +0.7	+5.9	+1.7	+0.0	37.3	46.0	-8.7	Horiz
5	269.180M	42.7	-27.0 +0.3	+13.0 +0.6	+5.9	+1.6	+0.0	37.1	46.0	-8.9	Horiz
6	50.116M	42.6	-27.9 +0.1	+9.1 +0.2	+5.9	+0.6	+0.0	30.6	40.0	-9.4	Vert

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **98354** Date: 5/23/2016  
 Test Type: **Radiated Scan** Time: 14:36:24  
 Tested by: Hieu Song Nguyenpham Sequence#: 16  
 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:***

Radiated Spurious Emission  
 Frequency Range: 1000MHz to 25000MHz

Temperature: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

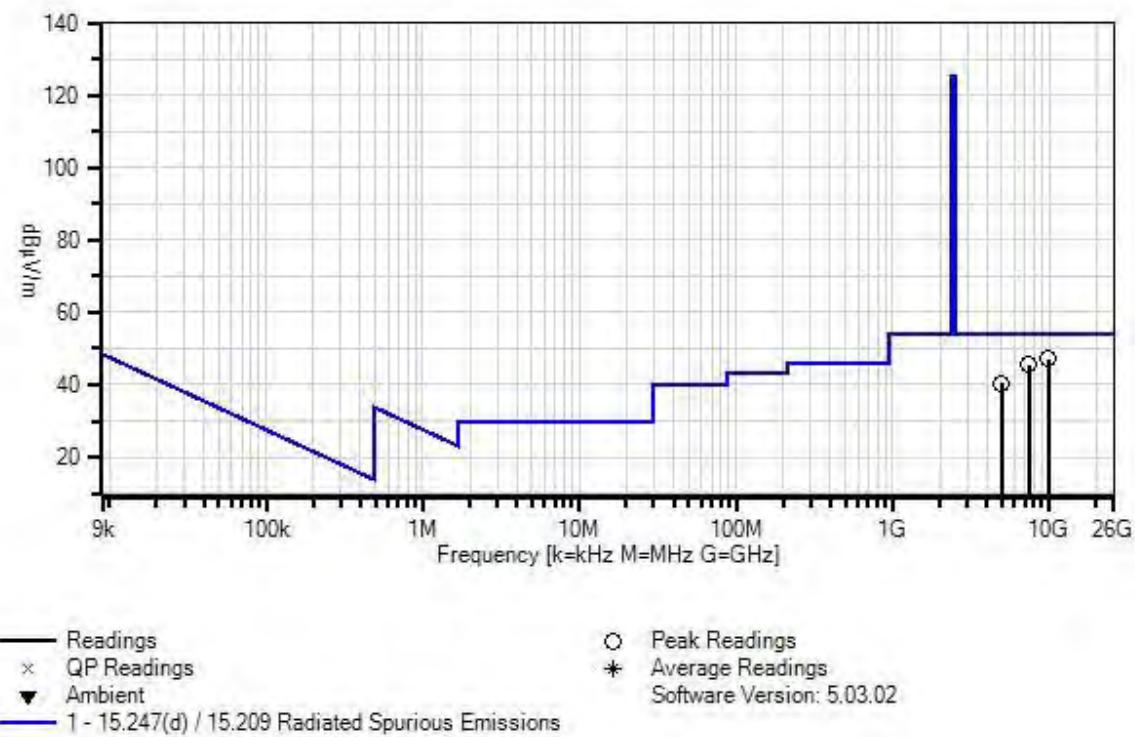
High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 Method: ANSI C63.10 (2013) and KDB 558074v03r05 section 12.2.7

9 kHz -150 kHz; RBW=200 Hz,VBW=200 Hz  
 150 kHz-30 MHz; RBW=9 kHz,VBW=9 kHz  
 30 MHz-1000 MHz; RBW=120 kHz,VBW=120 kHz  
 1000 MHz-25000MHz; RBW=1 MHz,VBW=1 MHz

The EUT is placed on a non-conducted table. It is powered up with a 12VDC battery It is set up continuously transmitting as intended.

**BLE on TX Mode ( High Channel)**

Navdy WO#: 98354 Sequence#: 16 Date: 5/23/2016  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna- ANSI C63.5 Calibration	3115	12/2/2014	12/2/2016
T2	AN03302	Cable	32026-29094K- 29094K-72TC	1/29/2016	1/29/2018
T3	ANP01210	Cable	FSJ1P-50A-4A	1/15/2015	1/15/2017
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
T4	AN03114	Preamp	AMF-7D- 00101800-30- 10P	4/22/2015	4/22/2017
	AN02694	Horn Antenna- ANSI C63.5 3m	AMFW-5F- 18002650-20- 10P	5/7/2015	5/7/2017
	ANP00928	Cable	various	1/25/2016	1/25/2018
	ANP00929	Cable	various	1/25/2016	1/25/2018
	ANP06126	Cable	32022-29094K- 29094K-168TC	3/18/2015	3/18/2017
T5	ANP06900	Cable	32022-29094K- 29094K-36TC	12/30/2015	12/30/2017
T6	AN03309	High Pass Filter	11SH10- 3000/T10000- O/O	1/18/2016	1/18/2018
	AN02693	Active Horn Antenna-ANSI C63.5 3m	AMFW-5F- 12001800-20- 10P	5/6/2015	5/6/2017

**Measurement Data:** Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dB $\mu$ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar
			T5 dB	T6 dB							Ant
1	9916.920M	55.6	+39.5 +1.1	+2.6 +0.4	+5.7	-57.7	+0.0	47.2	54.0	-6.8	Horiz
2	7447.320M	58.3	+36.6 +1.0	+2.3 +0.3	+5.1	-58.2	+0.0	45.4	54.0	-8.6	Horiz
3	4954.380M	57.6	+33.5 +0.8	+1.8 +0.3	+3.8	-57.4	+0.0	40.4	54.0	-13.6	Horiz

## Band Edge

### Band Edge Summary

Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
2390.0	GFSK	Integral	44.3	<54	Pass
2483.5	GFSK	Integral	44.5	<54	Pass

### Band Edge Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: **Navdy**  
 Specification: Band Edge  
 Work Order #: **98354** Date: 5/19/2016  
 Test Type: **Radiated Scan** Time: 15:20:11  
 Tested by: Hieu Song Nguyenpham Sequence#: 2  
 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: 22.7°C  
 Humidity: 43 %  
 Atmospheric Pressure: 100.9kPa

High Clock: 2480MHz  
 Application: Window Command Prompt  
 Transmitting operating frequency= 2402, 2442 and 2480MHz  
 Gain of the antenna: -1dBi  
 Method: ANSI C63.10 (2013) and KDB 558074v03r05 section 13

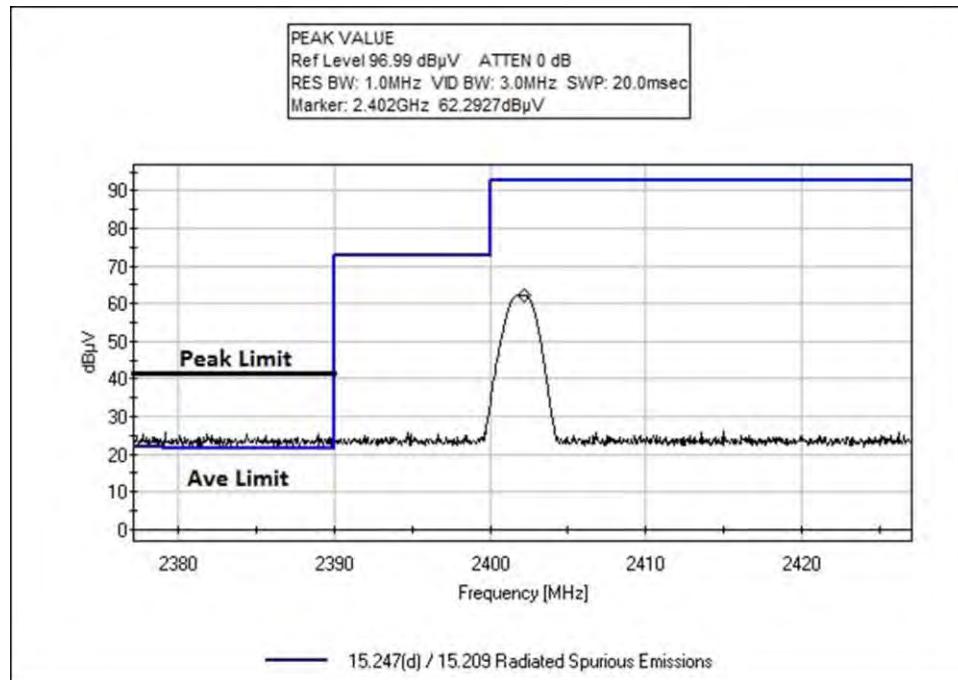
The EUT is placed on a non-conducted table. It is powered up with a 12VDC battery. It is set up continuously transmitting as intended.

#### BLE on TX Mode

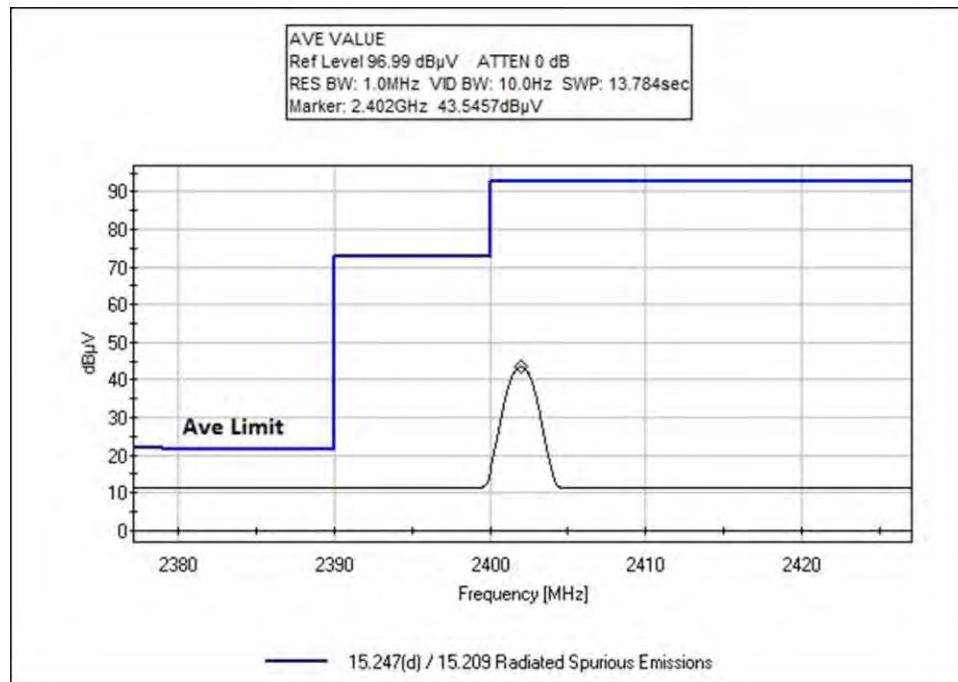
#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02157	Horn Antenna- ANSI C63.5 Calibration	3115	12/2/2014	12/2/2016
	AN03302	Cable	32026-29094K- 29094K-72TC	1/29/2016	1/29/2018
	ANP01210	Cable	FSJ1P-50A-4A	1/15/2015	1/15/2017
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018

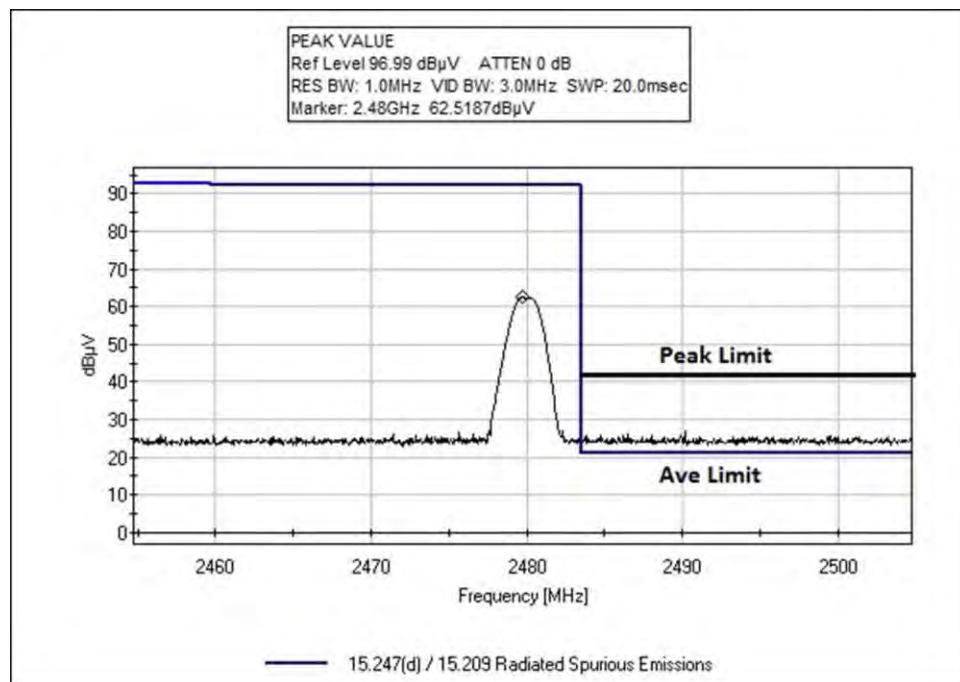
## Band Edge Plots



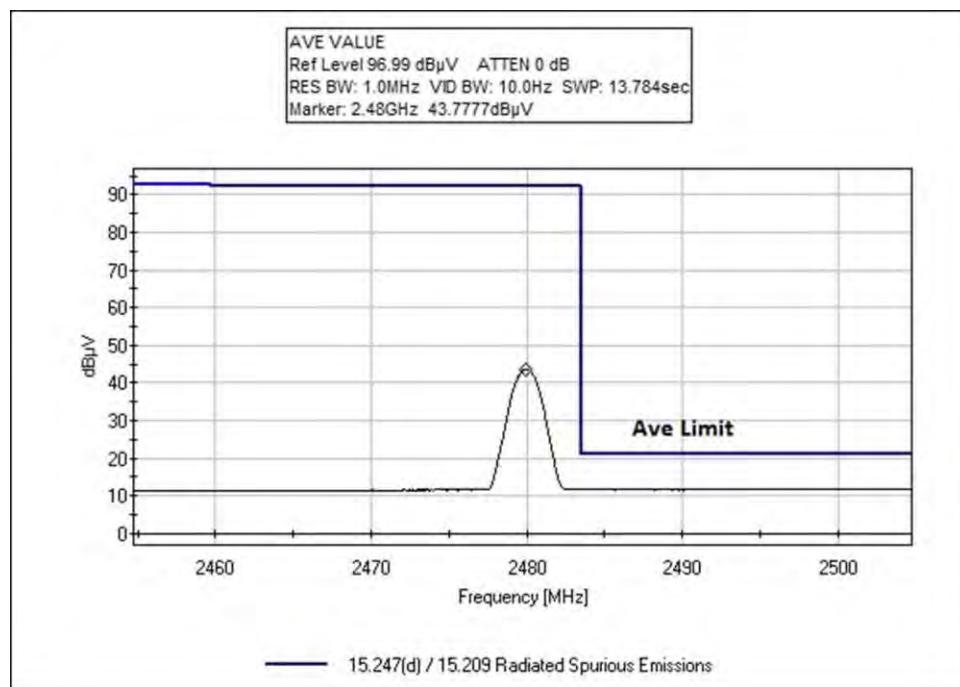
Low Channel



Low Channel



High Channel



High Channel

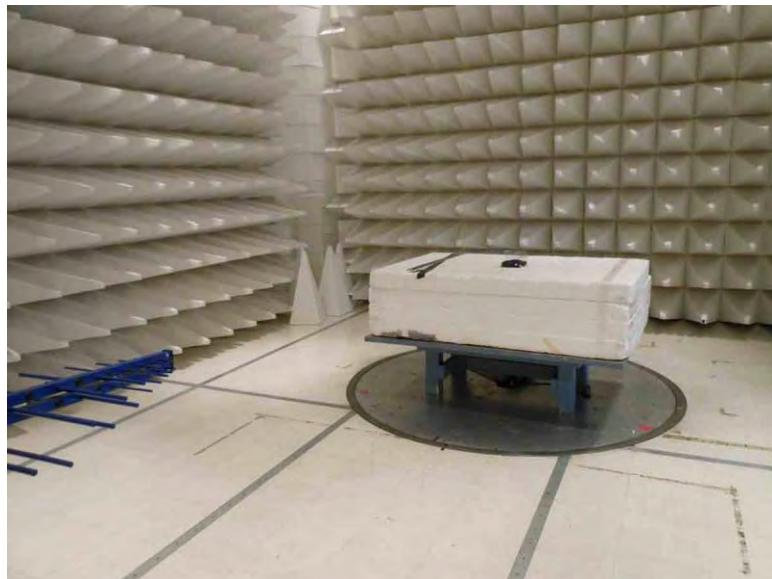
**Test Setup Photos**



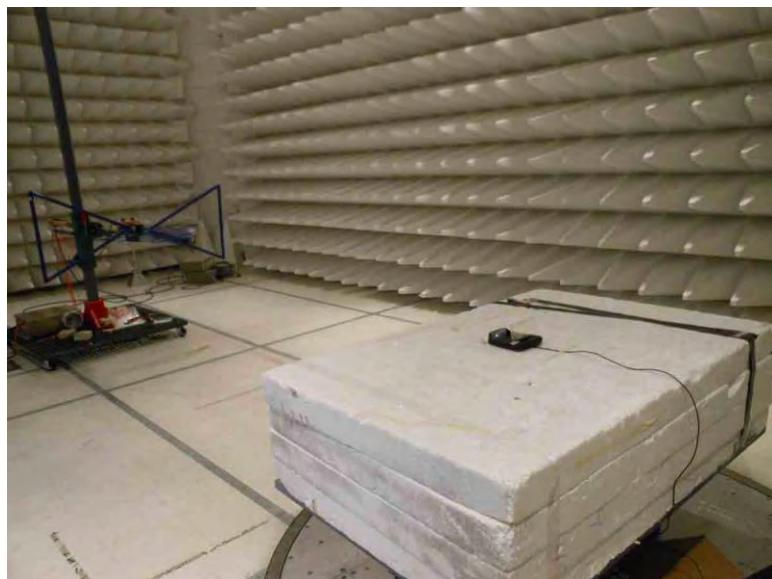
9kHz – 30MHz



9kHz – 30MHz



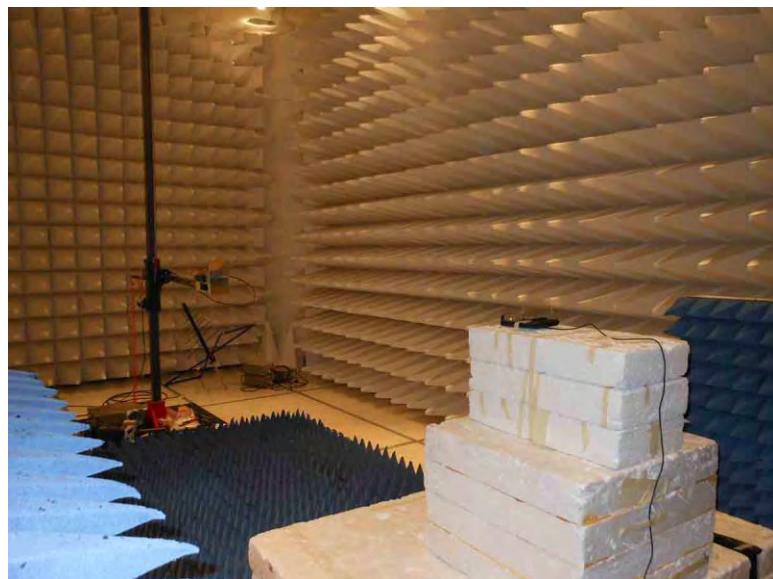
30MHz – 1GHz



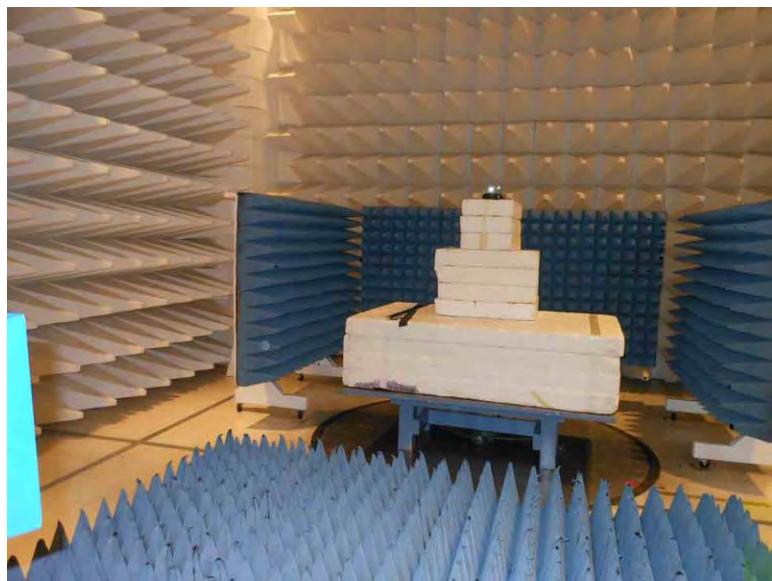
30MHz – 1GHz



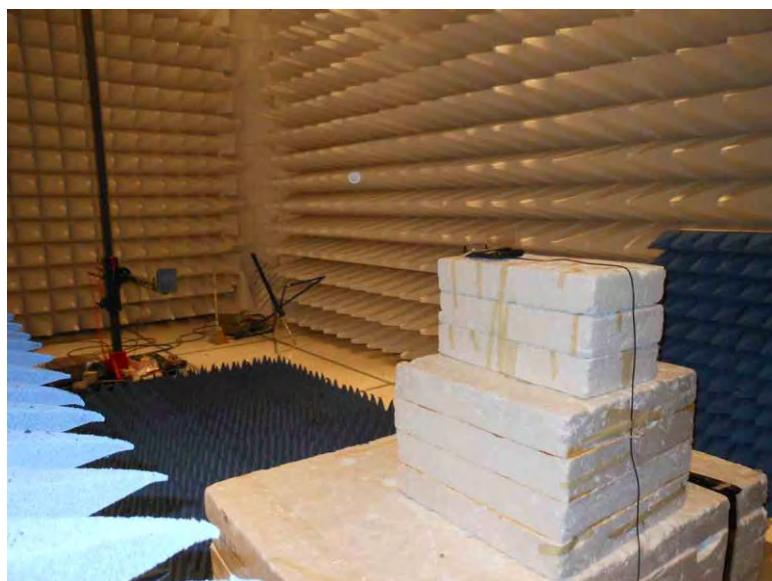
1 – 12GHz



1 – 12GHz



12 – 25GHz



12 – 25GHz

## 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 dB $\mu$ V/m, the spectrum analyzer reading in dB $\mu$ V 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	(dB $\mu$ V)
+ Antenna Factor	(dB/m)
+ Cable Loss	(dB)
- Distance Correction	(dB)
- Preamplifier Gain	(dB)
= Corrected Reading	(dB $\mu$ V/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.