CERTIFICATION TEST REPORT

Report Number. : 11526345-E1V2

Applicant	:	NVIDIA CORP. 2701 SAN TOMAS EXPY SANTA CLARA, CA 95050
Model	:	P3310
FCC ID	:	VOB-P3310
IC	:	7361A-P3310
EUT Description	:	WLAN 2x2 MIMO 802.11a/b/g/n/ac with Bluetooth
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS - 247 ISSUE 1 INDUSTRY CANADA RSS-GEN Issue 4

Date Of Issue:

January 14, 2017

Prepared by:

UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	01/06/17	Initial Issue	D. Coronia
V2	01/14/17	Updated Section 1, 6 & 7.2.1	D. Coronia

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS 5

2. TEST METHODOLOGY 6

3. FACILITIES AND ACCREDITATION 6

4. CALIBRATION AND UNCERTAINTY 7

4.1. MEASURING INSTRUMENT CALIBRATION 7

4.2. SAMPLE CALCULATION 7

4.3. MEASUREMENT UNCERTAINTY 7

5. EQUIPMENT UNDER TEST 8

5.1. DESCRIPTION OF EUT 8

5.2. MAXIMUM OUTPUT POWER 8

5.3. DESCRIPTION OF AVAILABLE ANTENNAS 8

5.4. SOFTWARE AND FIRMWARE 8

5.5. WORST-CASE CONFIGURATION AND MODE 8

5.6. DESCRIPTION OF TEST SETUP 9

6. TEST AND MEASUREMENT EQUIPMENT 11

7. ANTENNA PORT TEST RESULTS 12

7.1. BASIC DATA RATE GFSK MODULATION 13

7.1.1. 20 dB AND 99% BANDWIDTH 13
7.1.2. HOPPING FREQUENCY SEPARATION 16
7.1.3. NUMBER OF HOPPING CHANNELS 17
7.1.4. AVERAGE TIME OF OCCUPANCY 19
7.1.5. OUTPUT POWER 21
7.1.6. AVERAGE POWER 23
7.1.7. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS 24
7.1.8. BASIC DATA RATE GFSK MODULATION HOPPING MODE 26

7.2. ENHANCED DATA RATE 8PSK MODULATION 27

7.2.1. 20 dB AND 99% BANDWIDTH 27
7.2.2. OUTPUT POWER 30
7.2.3. AVERAGE POWER 32
7.2.4. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS 33
7.2.5. BASIC DATA RATE 8PSK MODULATION HOPPING MODE 35

8. RADIATED TEST RESULTS 36

8.1. TRANSMITTER ABOVE 1 GHz 37

8.1.1. BASIC DATA RATE GFSK MODULATION 37

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

8.1.1. ENHANCED DATA RATE 8PSK MODULATION 47
8.1. WORST-CASE BELOW 30 MHz 57
8.2. WORST-CASE BELOW 1 GHz 58
8.3. WORST-CASE ABOVE 18 GHz 60
9. AC POWER LINE CONDUCTED EMISSIONS 62
10. SETUP PHOTOS 65

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: NVIDIA CORP.

EUT DESCRIPTION: WLAN 2x2 MIMO 802.11a/b/g/n/ac with Bluetooth

MODEL: P3310

SERIAL NUMBER: 0334916000038

DATE TESTED: DECEMBER 13 - 28, 2016

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-247 Issue 1	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

DAN CORONIA
WiSE Project Lead
UL VERIFICATION SERVICES INC.

Prepared By:

KIYA KEDIDA
WiSE Lab Engineer
UL VERIFICATION SERVICES INC.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 1.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A (IC:2324B-1)	☐ Chamber D (IC:2324B-4)
☐ Chamber B (IC:2324B-2)	☐ Chamber E (IC:2324B-5)
☒ Chamber C (IC:2324B-3)	☐ Chamber F (IC:2324B-6)
	☐ Chamber G (IC:2324B-7)
	☐ Chamber H (IC:2324B-8)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

Uncertainty figures are valid to a confidence level of 95%.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a WLAN 2x2 MIMO 802.11a/b/g/n/ac with Bluetooth.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Basic GFSK	8.65	7.33
2402 - 2480	Enhanced 8PSK	8.27	6.71

Note: GFSK& 8PSK average Power are all investigated, The GFSK & 8PSK Power are the worst case. Testing is based on these modes mode of showing compliance. For average power data, please refer to section 7.1.6 and 7.2.3.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The EUT utilizes a Dipole antenna, with a maximum gain of 2.86dBi across operation frequency 2.4GHz band.

5.4. SOFTWARE AND FIRMWARE

The software and firmware in the EUT during testing was C03A10387.0700.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three transmitting antenna degrees: 0, 45, and 90. It was determined that 90 degrees was the worst case antenna position; therefore all final radiated testing was performed with the antenna position at 90 degrees.

Worst-case data rates were:

GFSK mode: DH5
8PSK mode: 3-DH5

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number	FCC ID
EUT AC/DC Adapter	Mean Well Enterprises	GST90A19	EB68F90444	NA
Laptop	Lenovo	7659	L3-AL664 08/03	NA
Base Board	NVIDIA	P2597	0334916030604	DoC

I/O CABLES (CONDUCTED & RADIATED TEST)

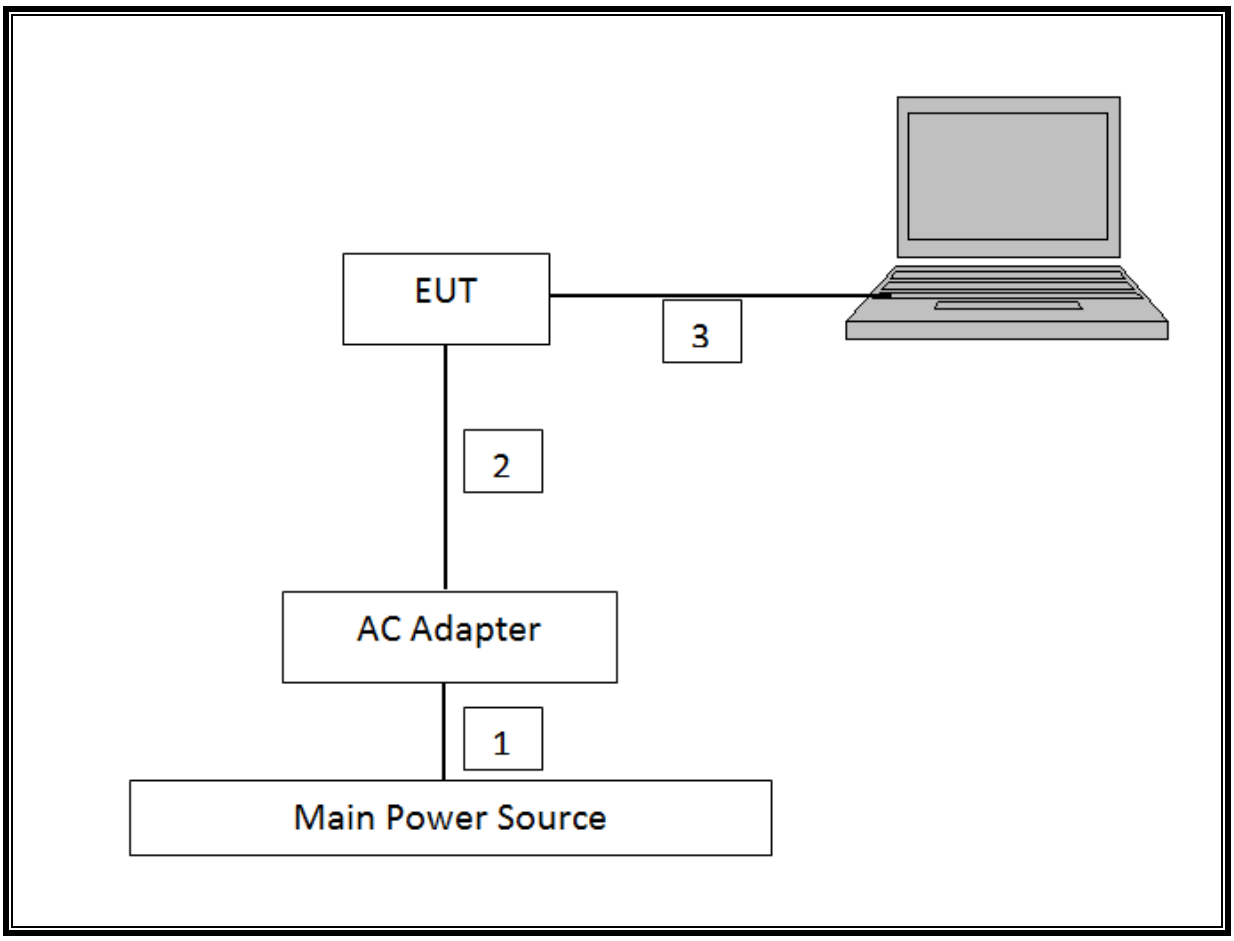
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US115V	Unshielded	0.5	For EUT
2	DC	1	19 Vdc	Unshielded	1	For EUT
3	USB	1	USB	Shielded	1.5	

TEST SETUP

The EUT was connected to a host Laptop via USB cable adapter. Test software exercised the EUT.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

SETUP DIAGRAM



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	**Manufacturer**	**Model**	**T Number**	**Cal Date**	**Cal Due**
PSA Series Spectrum Analyzer, 3Hz - 26.5GHz	Agilent	E4440A	199	07/22/16	07/22/17
PSA Series Spectrum Analyzer, 3Hz - 44GHz	Agilent	E4446A	146	07/13/16	07/13/17
Horn Antenna, 18 - 26.5 GHz	Seavey Division	MWH-1826/B	449	05/26/16	5/26/2017
Antenna, Horn 1-18GHz	ETS Lindgren	3117	119	02/04/16	02/04/17
Antenna, Broadband Hybrid 30MHz to 2000MHz	Sunol Sciences	JB1	122	01/29/16	01/29/17
Loop Antenna	EMCO	6502	35	03/24/16	03/24/17
Amplifier, 1-26.5GHz	Miteq	AFS42-00101800-25-S-42	931	08/26/16	08/26/17
Amplifier, 1 to 8GHz	Miteq	AMF-4D-01000800-30-29P	1170	04/28/16	04/28/17
Amplifier, 10KHz to 1GHz, 32dB	Keysight	8447D	15	08/26/16	08/26/17
P-Series Power Meter	Keysight	N1911A	1264	07/08/16	07/08/17
Wideband Power Sensor 50MHz - 18GHz	Agilent	N1921A	1224	03/22/16	03/22/17
EMI Receiver	Rohde & Schwarz	ESR-EMI	1436	12/19/16	12/19/17
LISN	FISCHER	FCC-LISN-50/250-25-2-01	1310	06/08/16	06/08/17

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	Ver 9.5, Apr 26, 2016
Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015
Antenna Port Software	UL	UL RF	Ver 5.1.1, July 15, 2016

NOTE: *testing is completed before equipment calibration expiration date.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7. ANTENNA PORT TEST RESULTS

ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

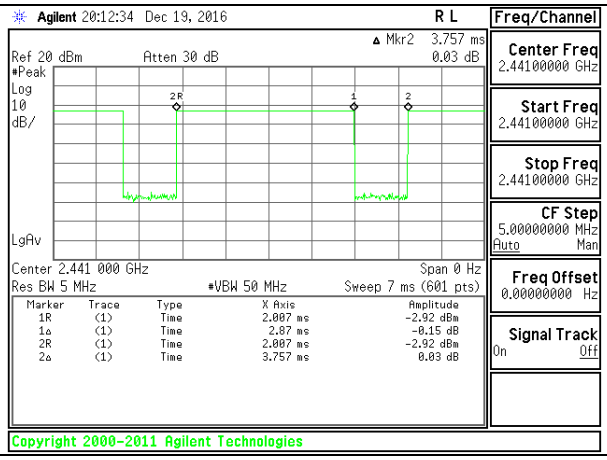
ON TIME AND DUTY CYCLE RESULTS

ON TIME AND DUTY CYCLE RESULTS

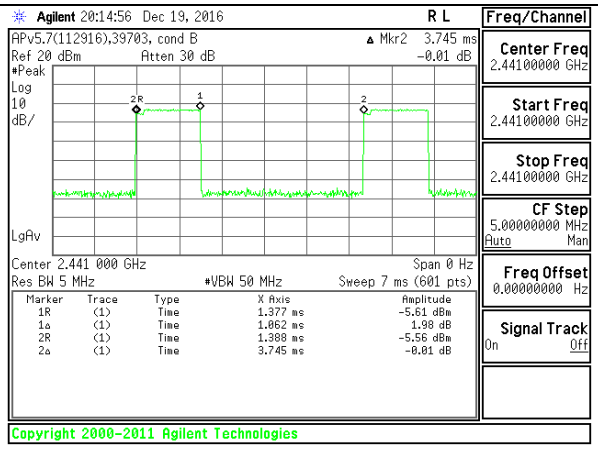
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
GFSK	2.870	3.757	0.764	76.39%	1.17	0.348
8PSK	1.062	3.745	0.284	28.36%	5.47	0.942

DUTY CYCLE PLOTS

GFSK



8PSK



NOTE: --

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.1. BASIC DATA RATE GFSK MODULATION

7.1.1. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

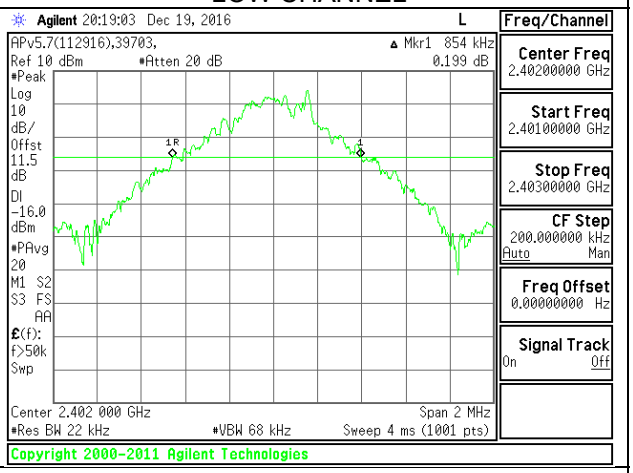
RESULTS

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

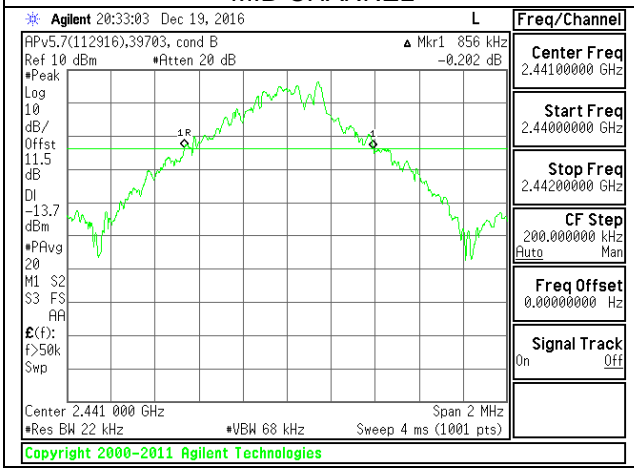
TEST RESULT TABLE

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402	0.854
Middle	2441	0.856
High	2480	0.858

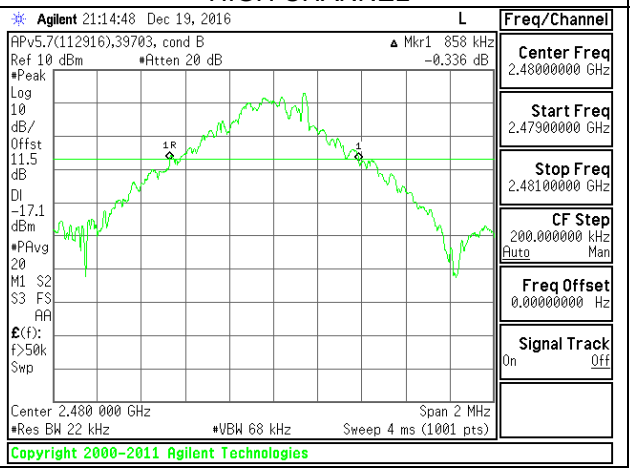
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

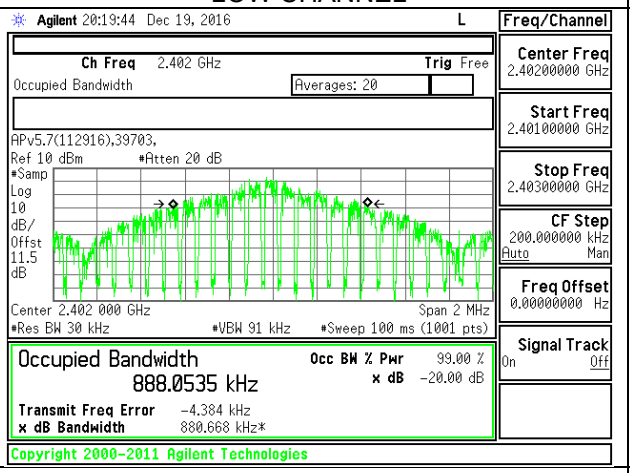


This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

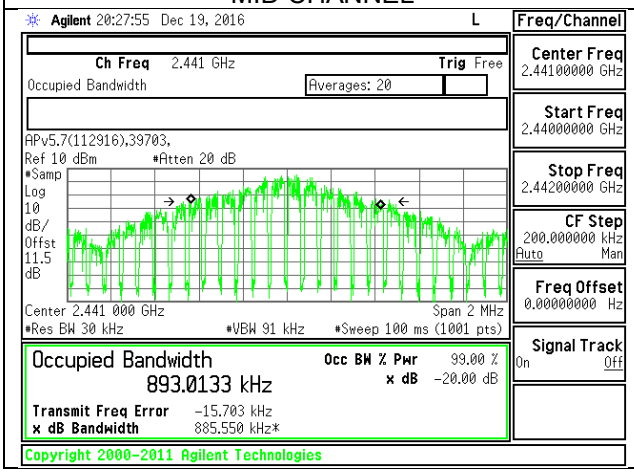
TEST RESULT TABLE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	0.888
Middle	2441	0.893
High	2480	0.897

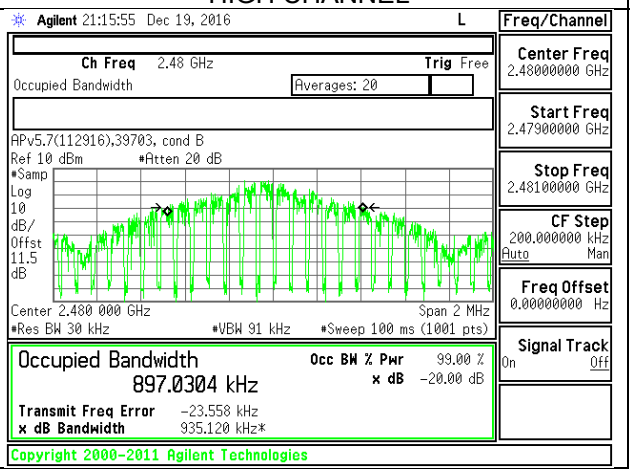
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.1.2. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

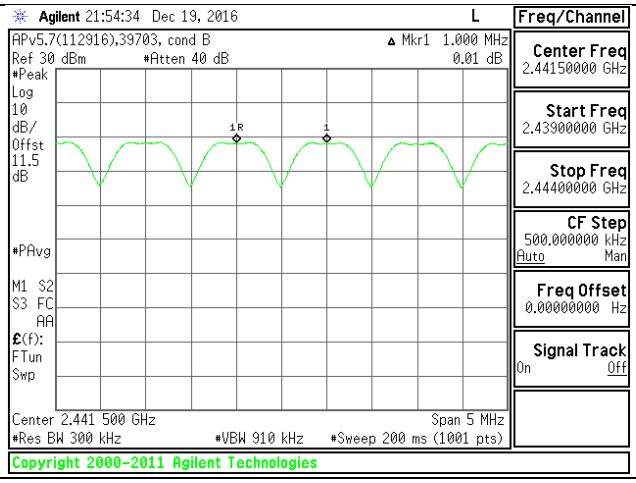
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION PLOT



NOTE: Hopping Frequency Separation is 1 MHz

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.1.3. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

TEST PROCEDURE

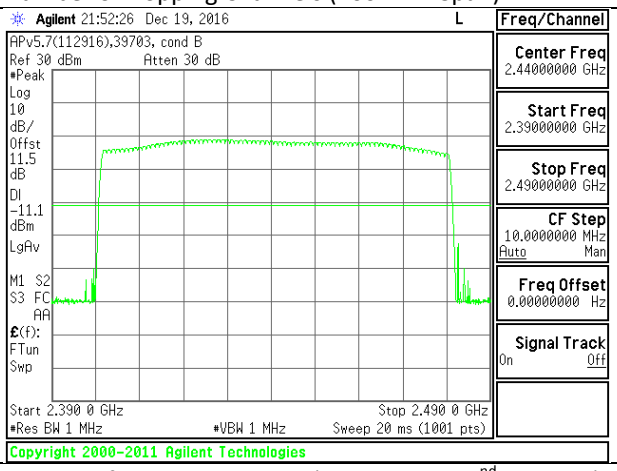
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

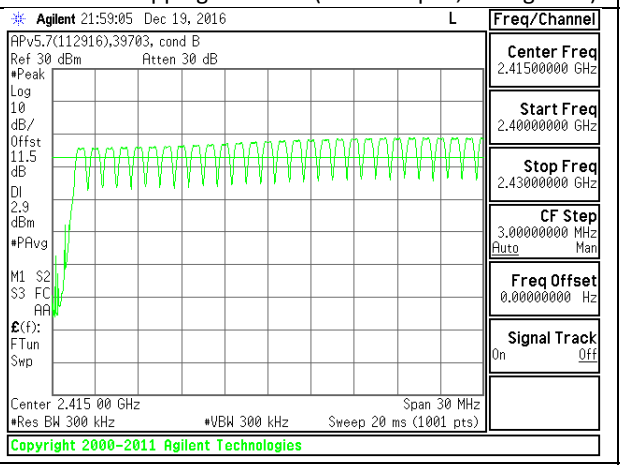
Normal Mode: 79 Channels observed.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

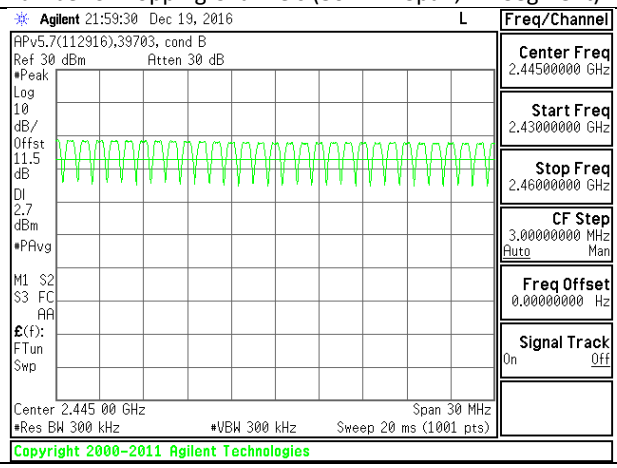
Number of Hopping Channels (100 MHz Span)



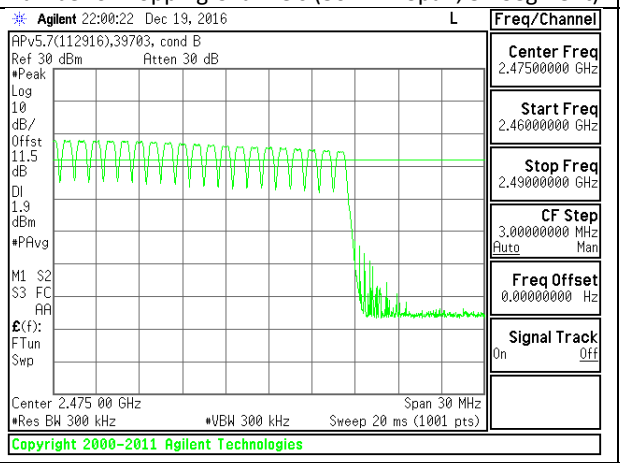
Number of Hopping Channels (30 MHz Span, 1st Segment)



Number of Hopping Channels (30 MHz Span, 2nd Segment)



Number of Hopping Channels (30 MHz Span, 3rd Segment)



NOTE: --

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.1.4. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

RESULTS

AVERAGE TIME OF OCCUPANCY

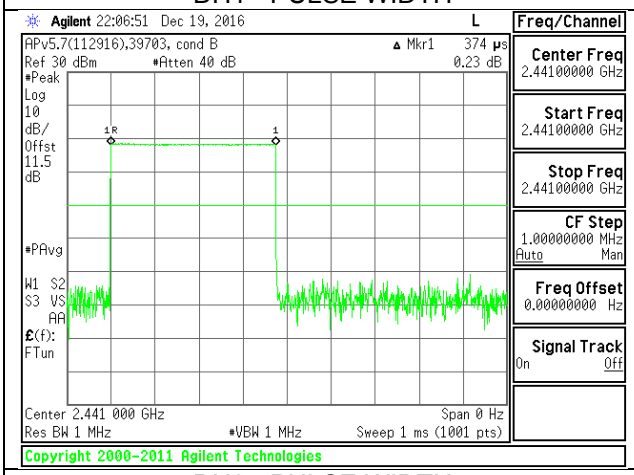
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.374	31	0.1159	0.4	-0.2841
DH3	1.638	13	0.2129	0.4	-0.1871
DH5	2.876	9	0.2588	0.4	-0.1412
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.374	7.75	0.02899	0.4	-0.3710
DH3	1.638	3.25	0.05324	0.4	-0.3468
DH5	2.876	2.25	0.06471	0.4	-0.3353

NOTE: --

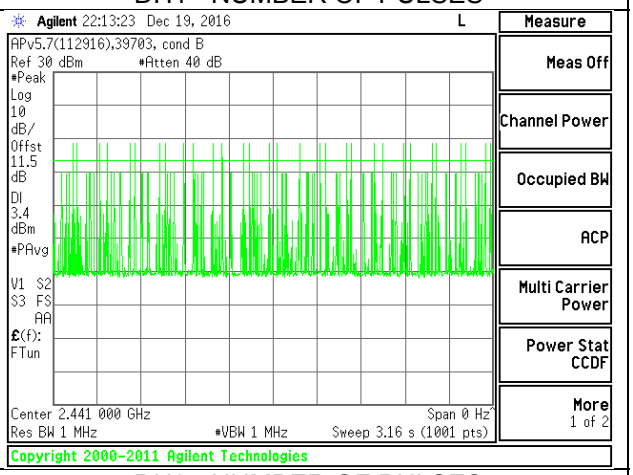
UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701J
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

Pulse Width and Number of Pulses in 3.16 Seconds Period Plots

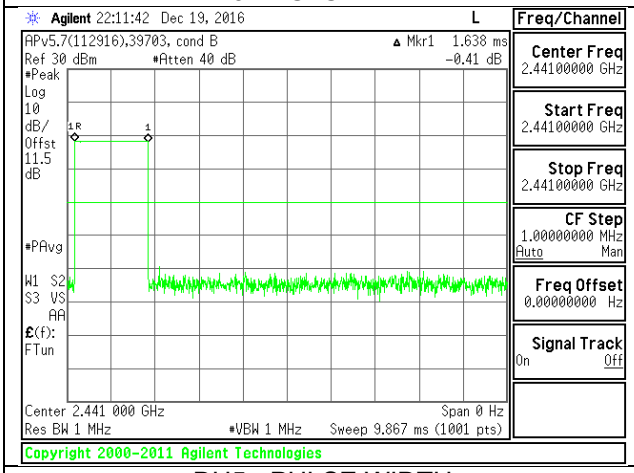
DH1 - PULSE WIDTH



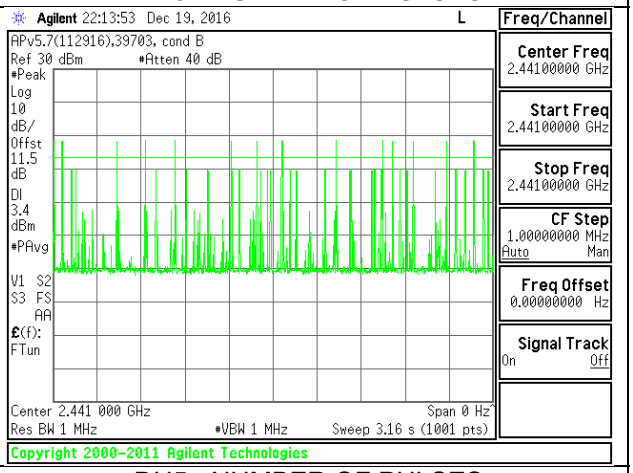
DH1 - NUMBER OF PULSES



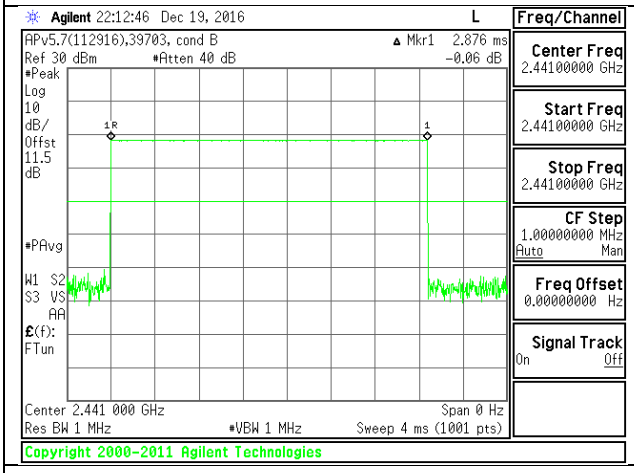
DH3 - PULSE WIDTH



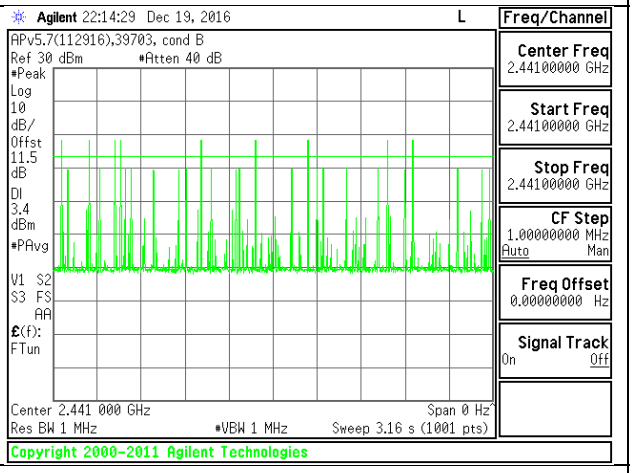
DH3 - NUMBER OF PULSES



DH5 - PULSE WIDTH



DH5 - NUMBER OF PULSES



NOTE: --

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.1.5. OUTPUT POWER

LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

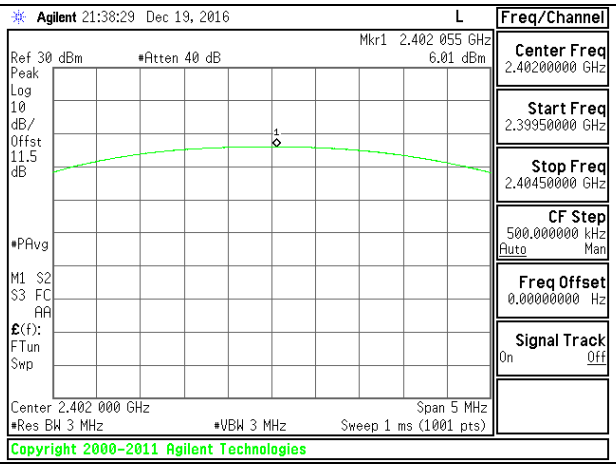
RESULTS

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

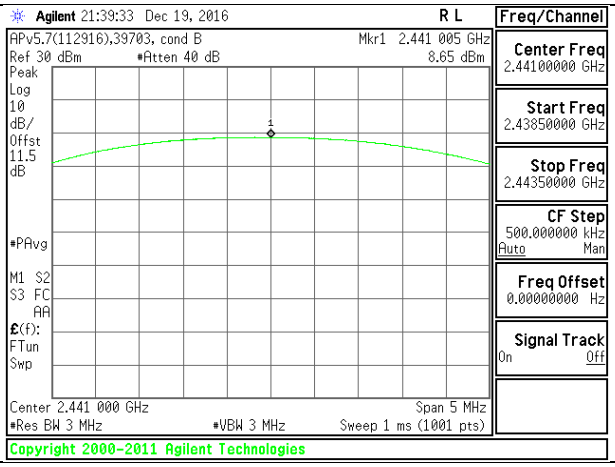
TEST RESULT TABLE

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	6.010	21	-14.99
Middle	2441	8.650	21	-12.35
High	2480	5.110	21	-15.89

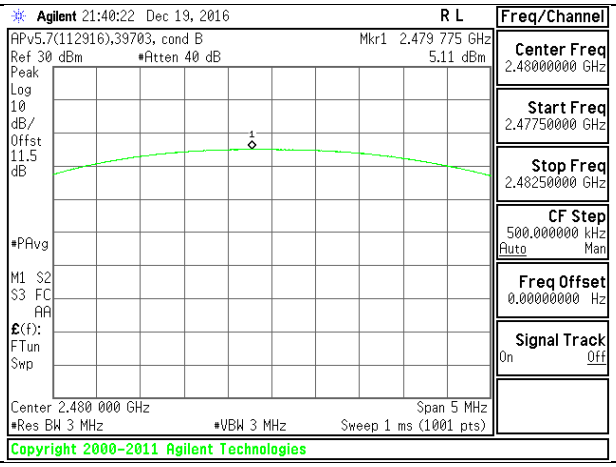
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



NOTE:

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.1.6. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

ID:	39703	Date:	12/19/16

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	5.7
Middle	2441	8.3
High	2480	4.7

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.1.7. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

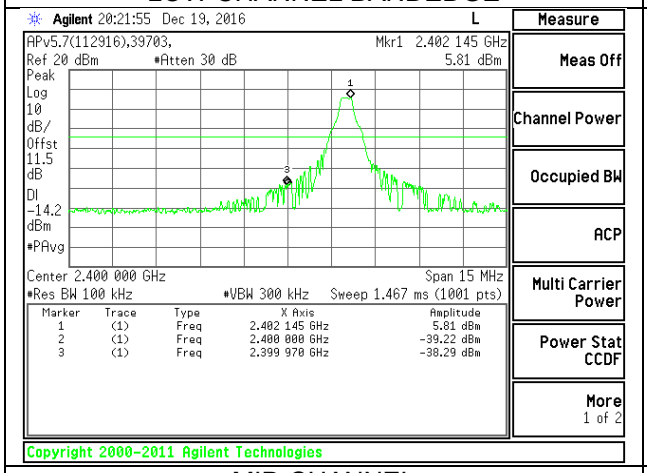
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

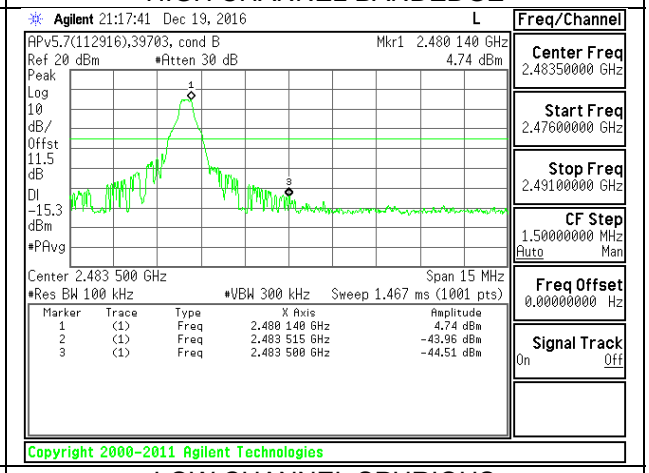
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

BANDEDGE AND SPURIOUS EMISSIONS PLOTS

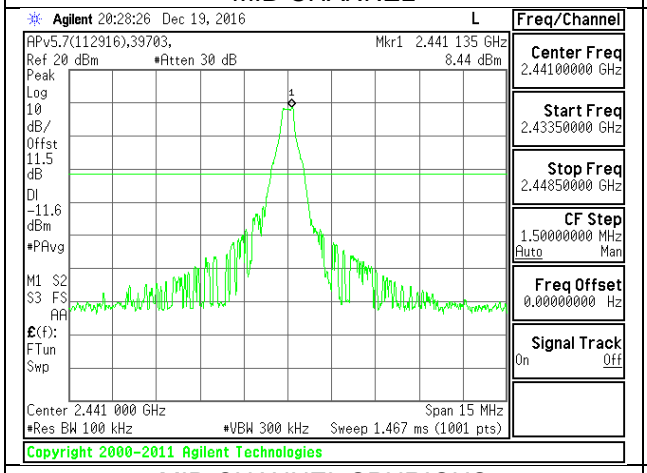
LOW CHANNEL BANDEDGE



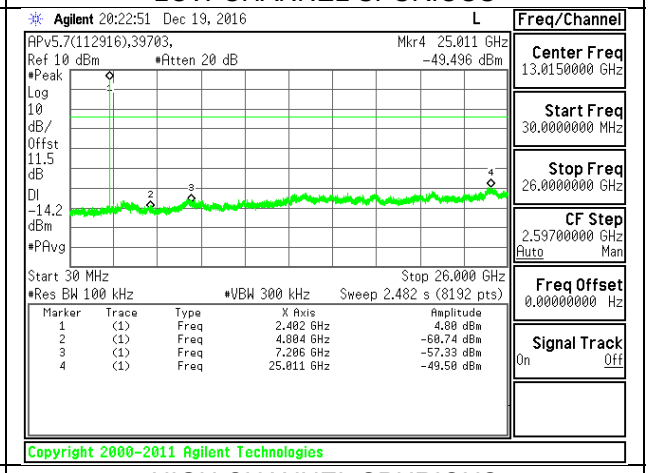
HIGH CHANNEL BANDEDGE



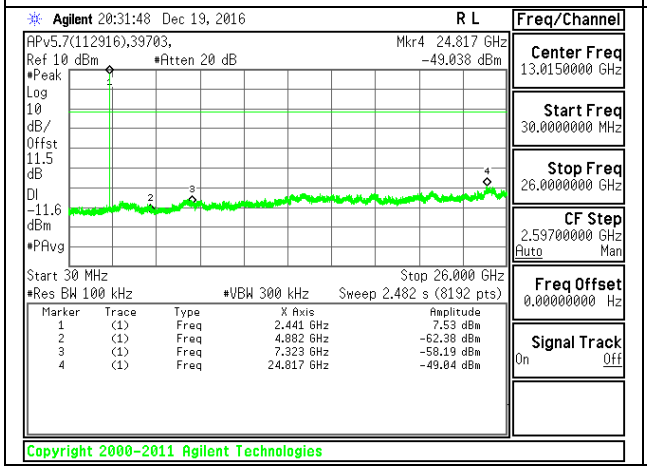
MID CHANNEL



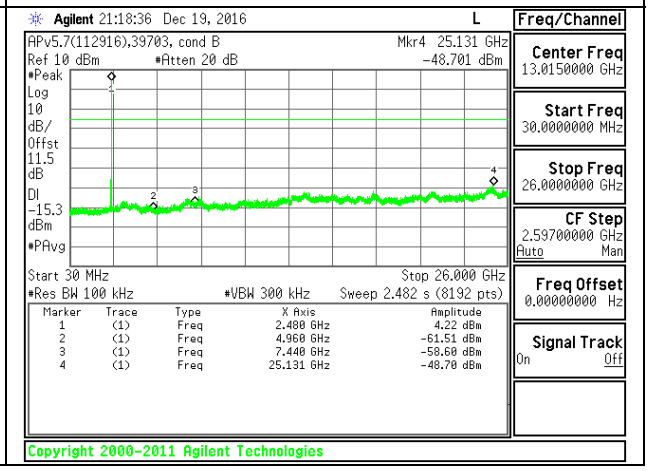
LOW CHANNEL SPURIOUS



MID CHANNEL SPURIOUS

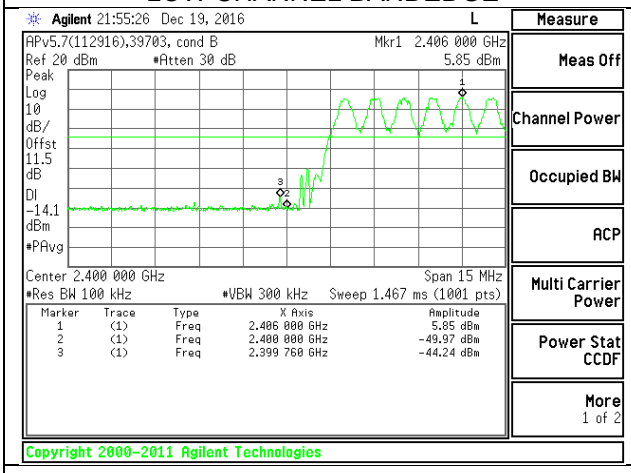
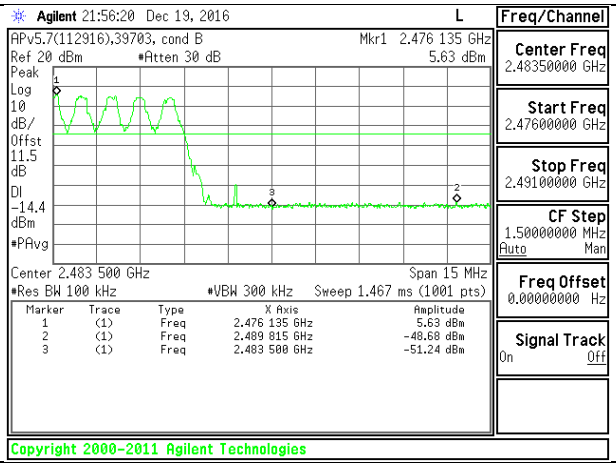


HIGH CHANNEL SPURIOUS



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.1.8. BASIC DATA RATE GFSK MODULATION HOPPING MODE

LOW CHANNEL BANDEDGE	HIGH CHANNEL BANDEDGE
	

NOTE:--

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.2. ENHANCED DATA RATE 8PSK MODULATION

7.2.1. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

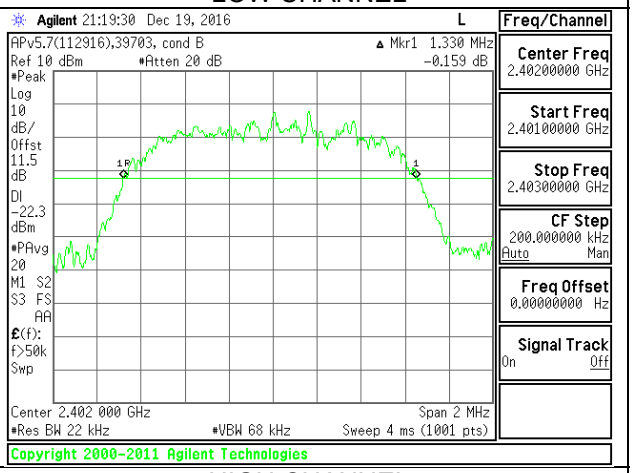
RESULTS

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

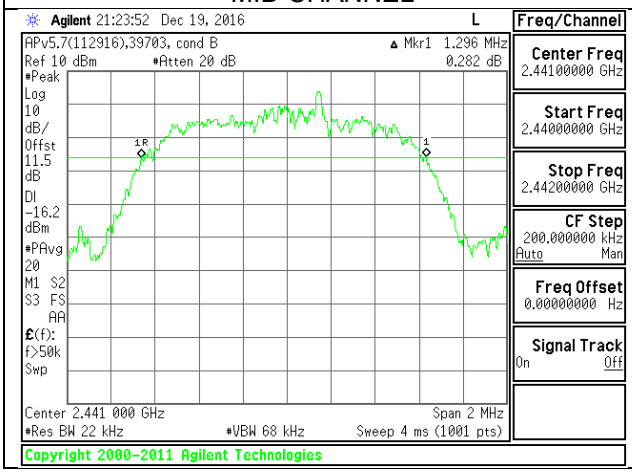
TEST RESULT TABLE

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402	1.330
Middle	2441	1.296
High	2480	1.310

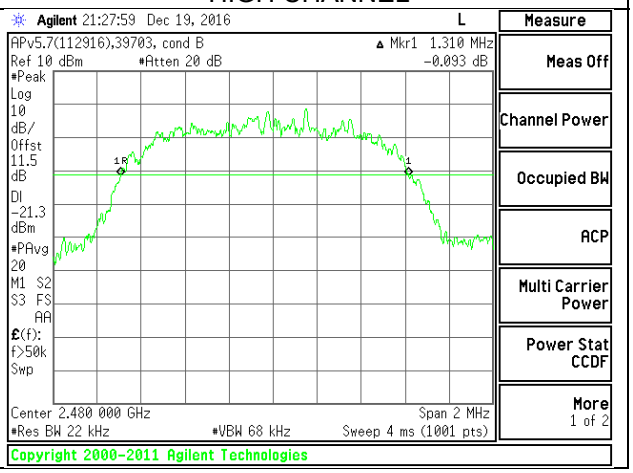
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

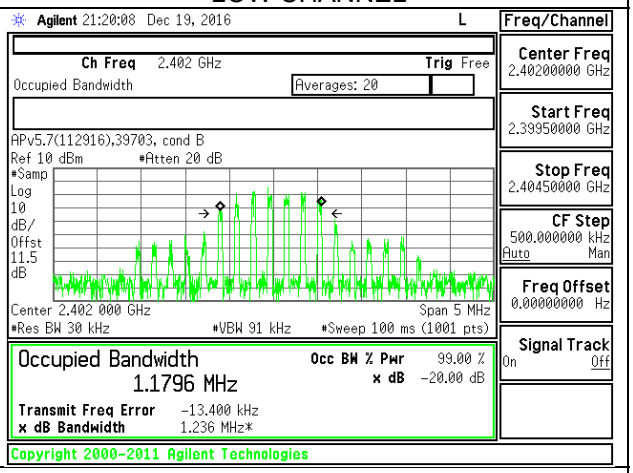


This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

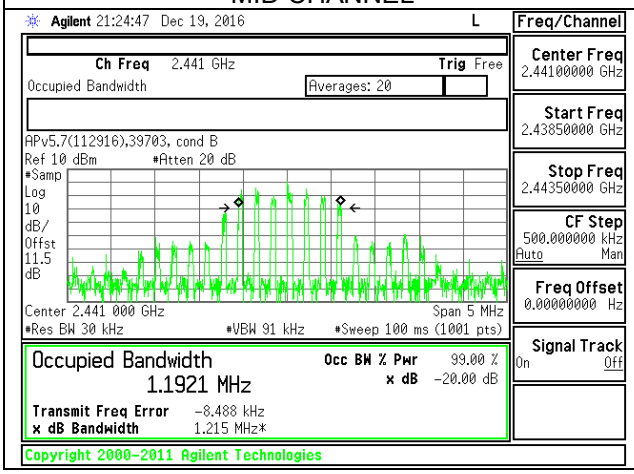
TEST RESULT TABLE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.1796
Middle	2441	1.1921
High	2480	1.2102

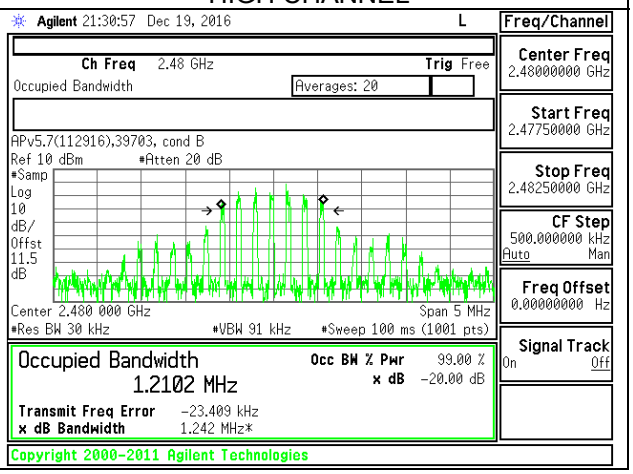
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.2.2. OUTPUT POWER

LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 21 dBm.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

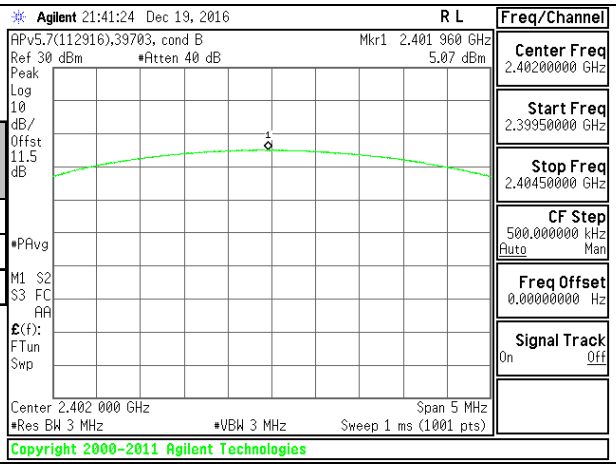
RESULTS

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

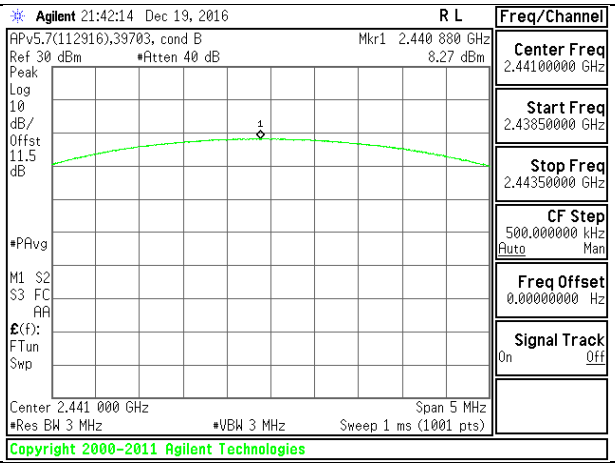
TEST RESULT TABLE

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.070	21	-15.93
Middle	2441	8.270	21	-12.73
High	2480	5.750	21	-15.25

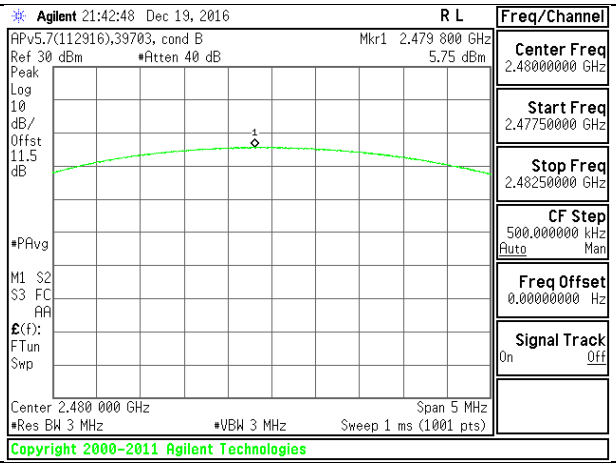
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



NOTE:

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.2.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

ID:	39703	Date:	12/19/12

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	2.4
Middle	2441	5.6
High	2480	3.2

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.2.4. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

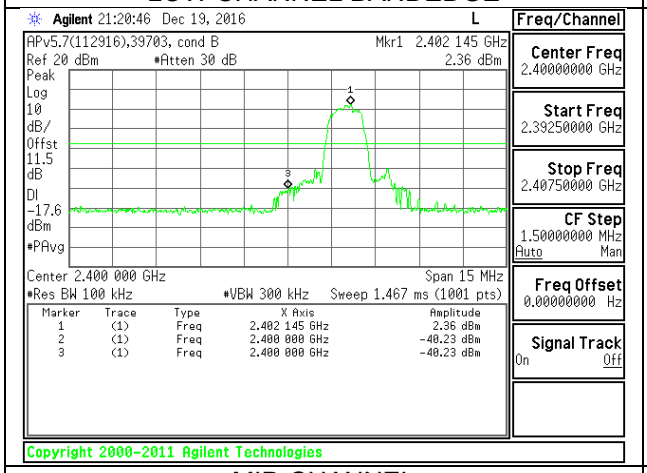
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

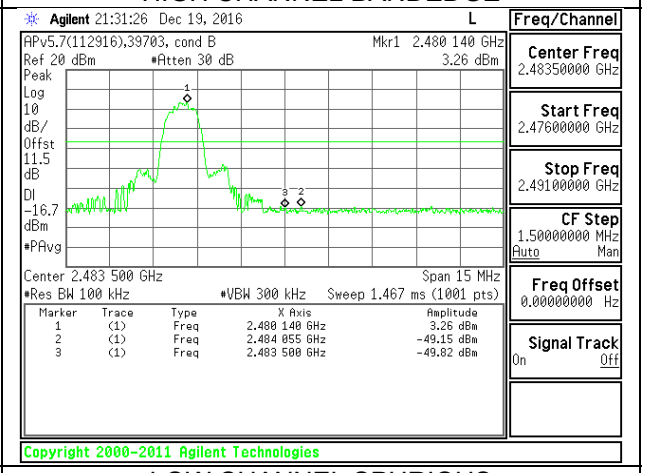
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

BANDEDGE AND SPURIOUS EMISSIONS PLOTS

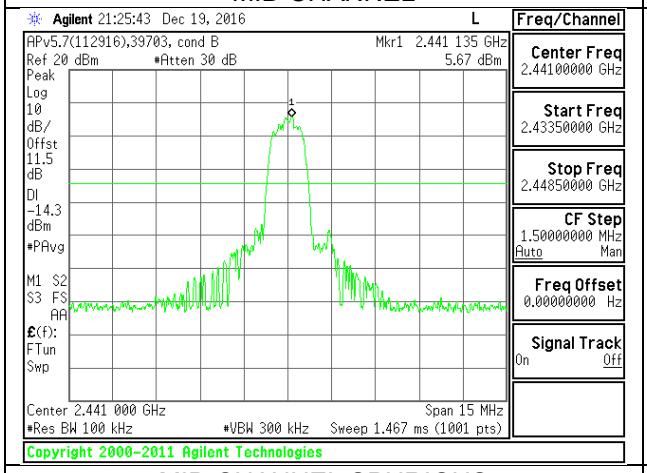
LOW CHANNEL BANDEDGE



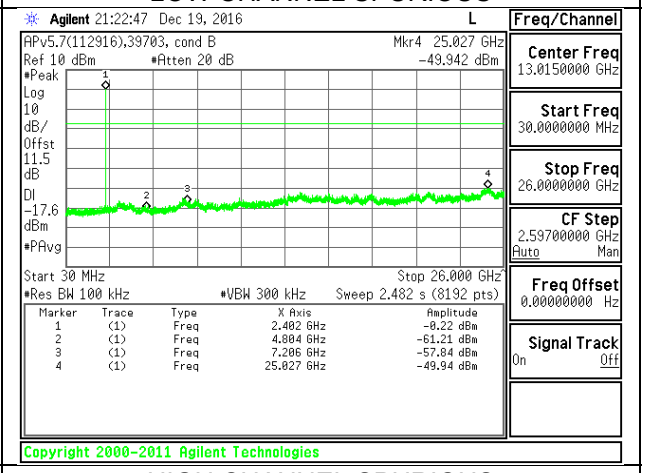
HIGH CHANNEL BANDEDGE



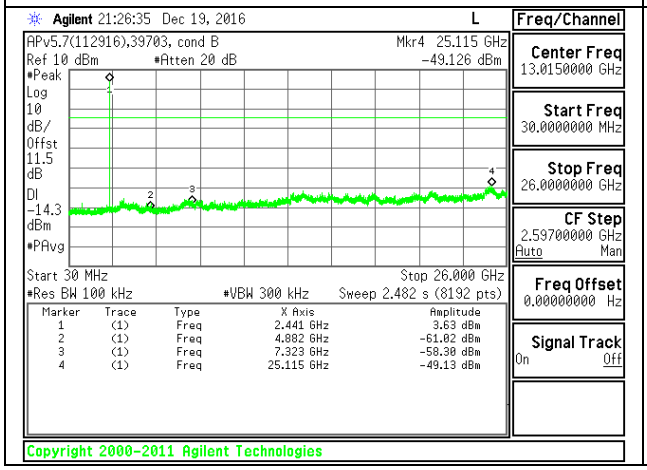
MID CHANNEL



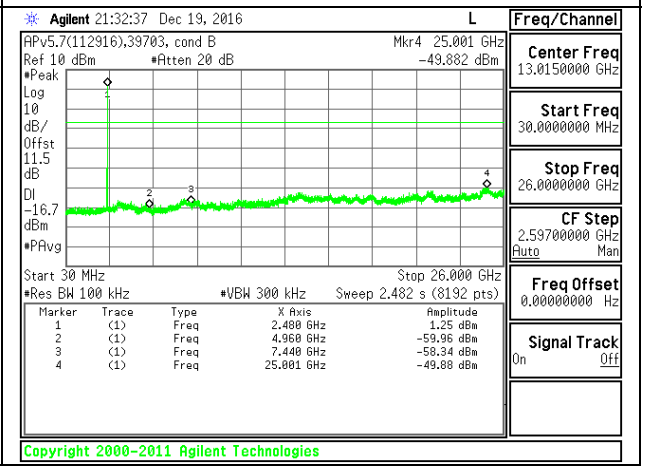
LOW CHANNEL SPURIOUS



MID CHANNEL SPURIOUS

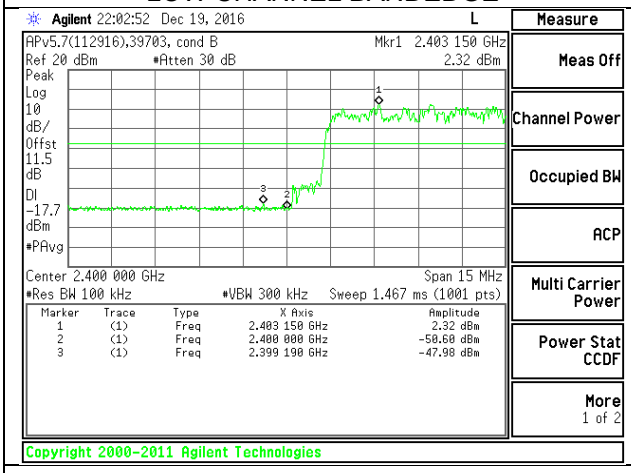
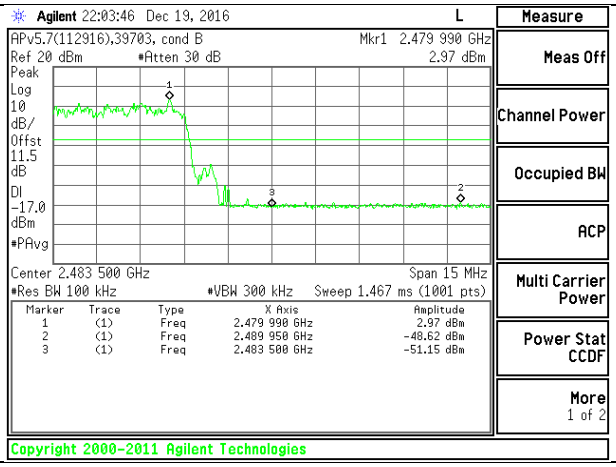


HIGH CHANNEL SPURIOUS



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.2.5. BASIC DATA RATE 8PSK MODULATION HOPPING MODE

LOW CHANNEL BANDEDGE	HIGH CHANNEL BANDEDGE
	

NOTE:--

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

8. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

IC RSS-GEN, Section 8.9 and 8.10.

IC RSS-GEN Clause 7.1.2 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300m	2400/F(kHz) @ 300m
0.490-1.705	24000/F(kHz) @ 30m	24000/F(kHz) @ 30m
1.705-30.0	30 @ 30m	30 @ 30m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

NOTE: KDB 937606 OATS and Chamber Correlation Justification

- Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
- OATs and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T (10 Hz) video bandwidth with peak detector for average measurements.
Note: The pre-scan measurements above 1GHz the VBW is set to 30 kHz

The spectrum from 9 kHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

RESULTS

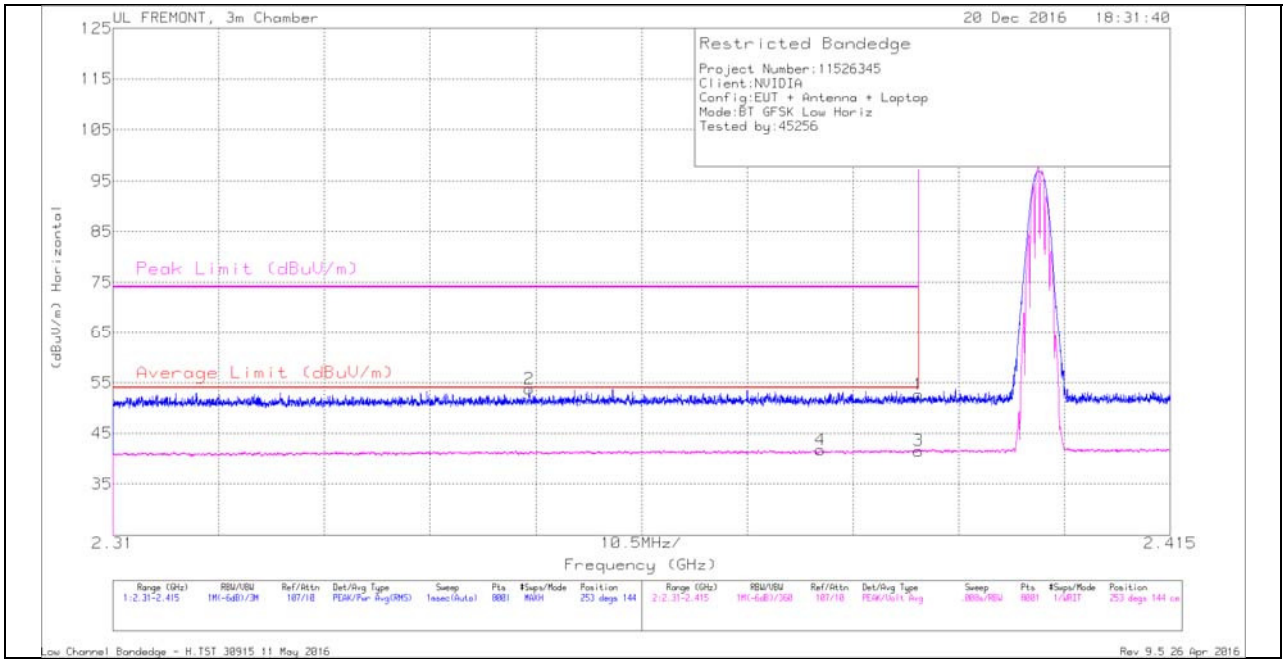
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

8.1. TRANSMITTER ABOVE 1 GHz

8.1.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	2.351	42.69	Pk	31.9	-20.8	53.79	-	-	74	-20.21	253	144	H
4	2.38	29.3	VA1T	32	-20.8	40.5	54	-13.5	-	-	253	144	H
1	2.39	41.31	Pk	32.1	-20.8	52.61	-	-	74	-21.39	253	144	H
3	2.39	29.07	VA1T	32.1	-20.8	40.37	54	-13.63	-	-	253	144	H

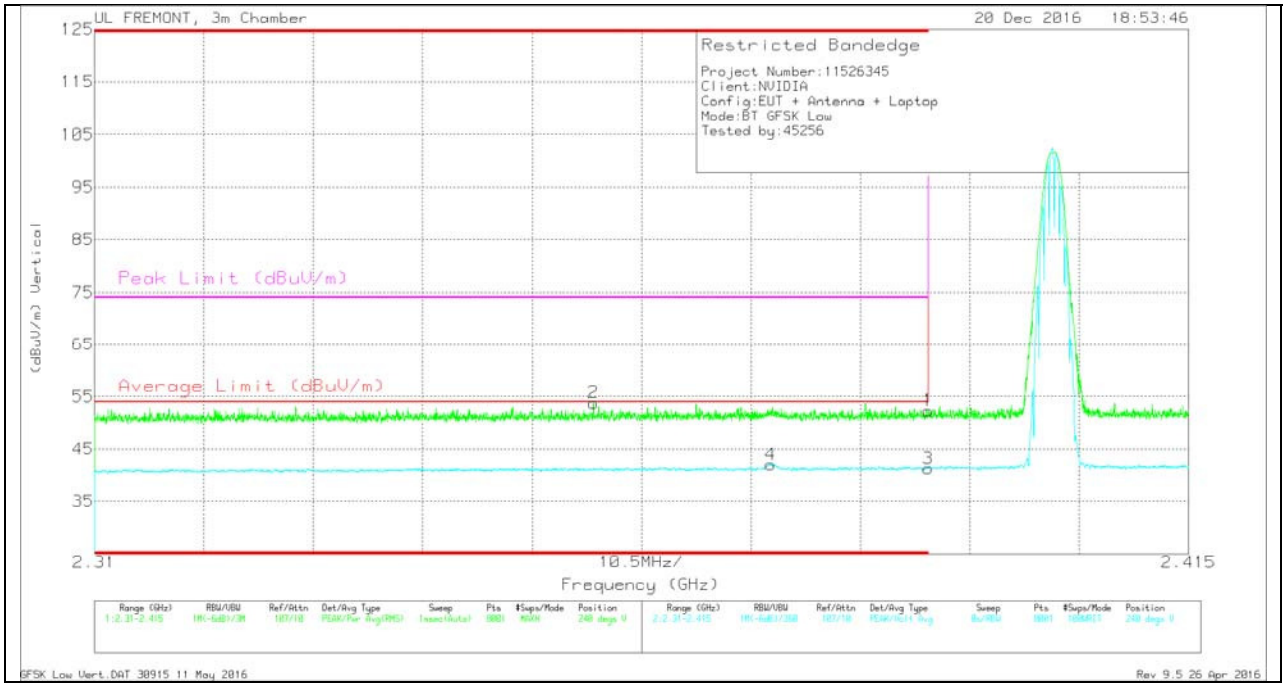
* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	2.358	42.78	Pk	31.9	-20.9	53.78	-	-	74	-20.22	240	150	V
4	2.375	29.71	VA1T	32	-20.9	40.81	54	-13.19	-	-	240	150	V
1	2.39	41	Pk	32.1	-20.8	52.3	-	-	74	-21.7	240	150	V
3	2.39	28.8	VA1T	32.1	-20.8	40.1	54	-13.9	-	-	240	150	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

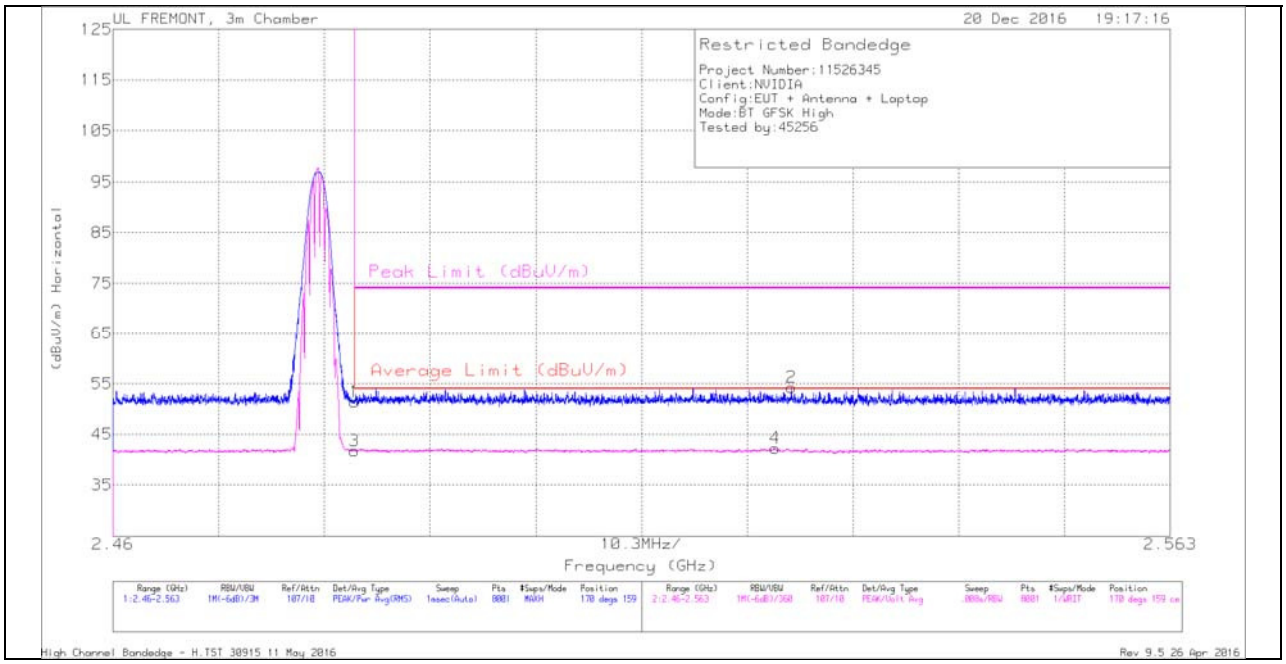
Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.484	39.86	Pk	32.4	-20.8	51.46	-	-	74	-22.54	170	159	H
3	2.484	28.94	VA1T	32.4	-20.8	40.54	54	-13.46	-	-	170	159	H
4	2.525	29.31	VA1T	32.4	-20.6	41.11	54	-12.89	-	-	170	159	H
2	2.526	42.54	Pk	32.4	-20.7	54.24	-	-	74	-19.76	170	159	H

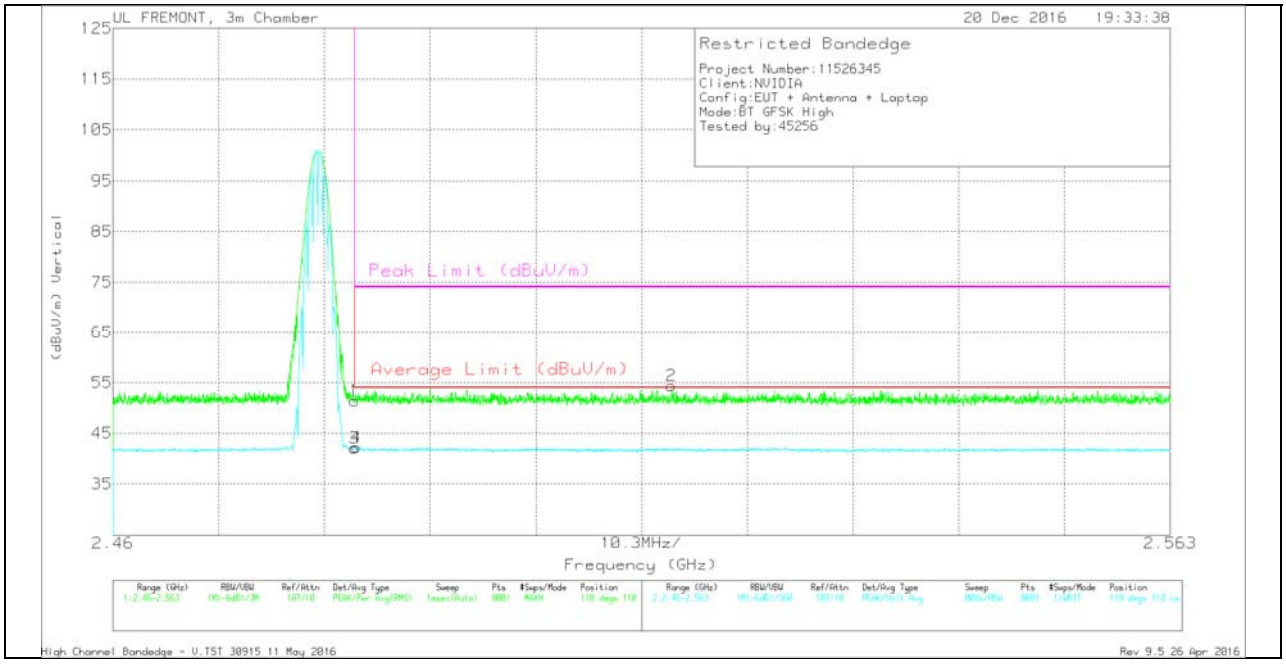
* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.484	39.85	Pk	32.4	-20.8	51.45	-	-	74	-22.55	118	110	V
3	2.484	29.35	VA1T	32.4	-20.8	40.95	54	-13.05	-	-	118	110	V
4	2.484	29.49	VA1T	32.4	-20.8	41.09	54	-12.91	-	-	118	110	V
2	2.514	42.7	Pk	32.4	-20.7	54.4	-	-	74	-19.6	118	110	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

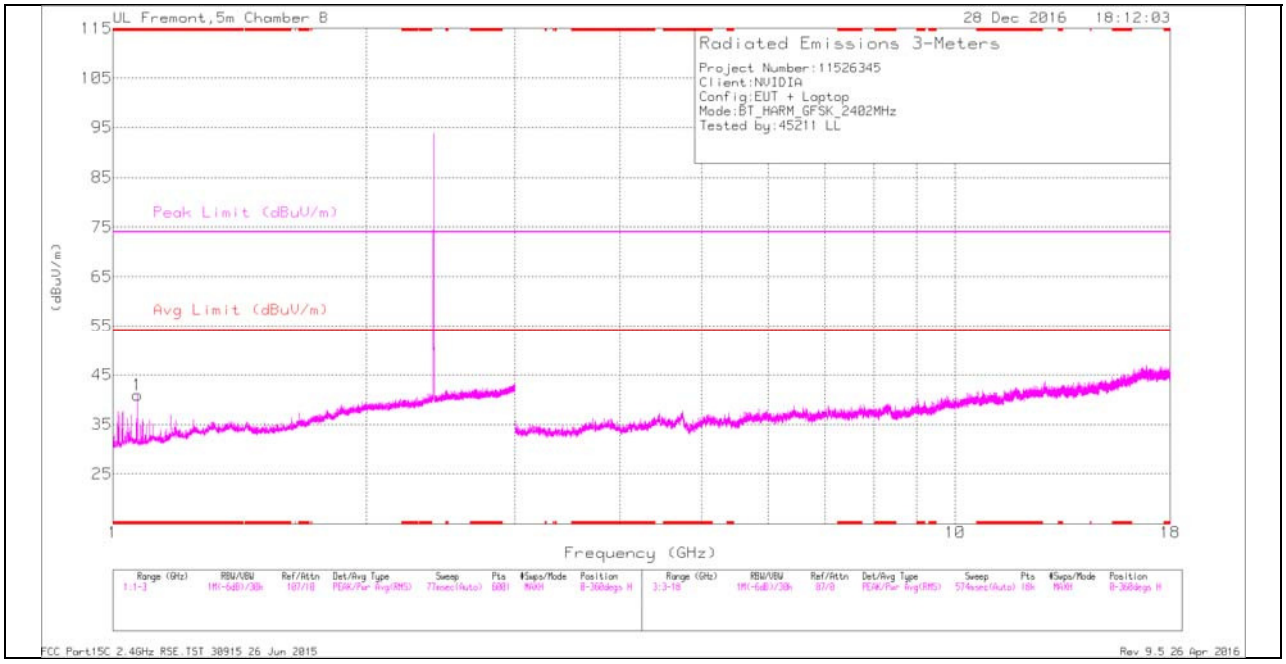
Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

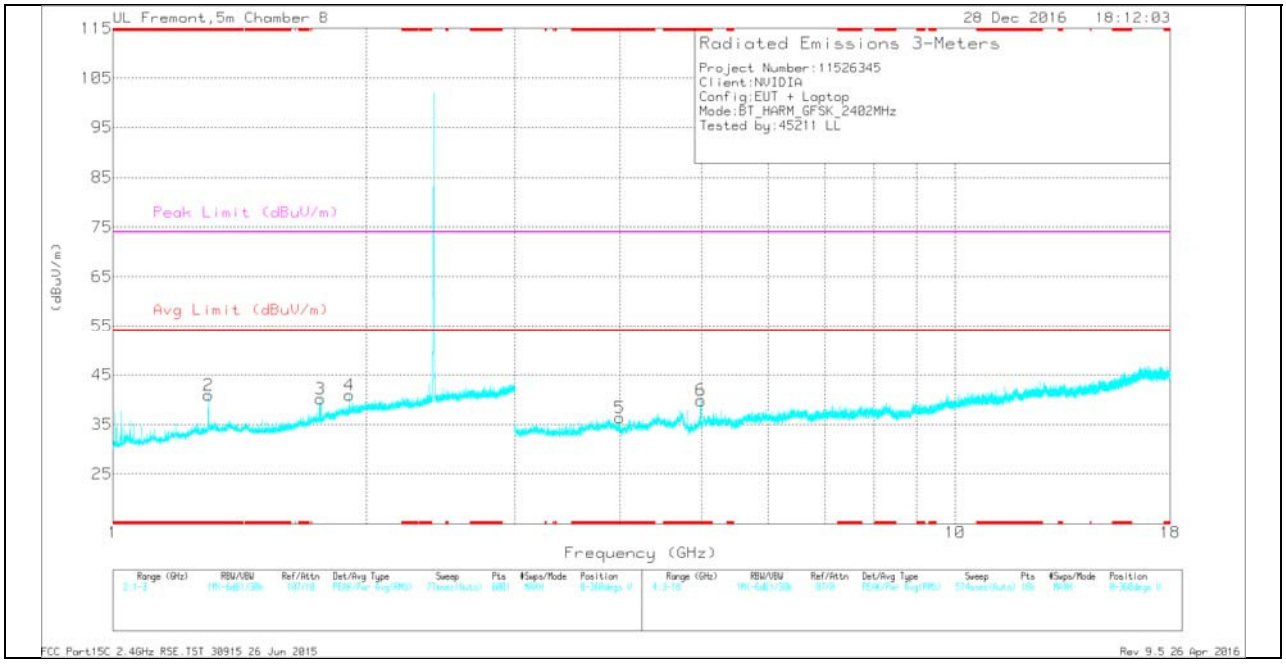
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

LOW CHANNEL DATA

TRACE MARKERS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.068	37.09	Pk	27.9	-24.1	40.89	-	-	74	-33.11	0-360	101	H
2	* 1.298	35.04	Pk	29	-23.1	40.94	-	-	74	-33.06	0-360	98	V
5	* 4	35.9	Pk	33.3	-32.9	36.3	-	-	74	-37.7	0-360	201	V
6	* 4.988	37.63	Pk	34	-31.8	39.83	-	-	74	-34.17	0-360	98	V
3	1.762	32.62	Pk	29.7	-22.2	40.12	-	-	-	-	0-360	98	V
4	1.91	32.14	Pk	30.9	-22.1	40.94	-	-	-	-	0-360	201	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Avg - Video bandwidth < Resolution bandwidth

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.072	39.66	PKFH	27.9	-24.1	43.46	-	-	74	-30.54	289	211	H
* 1.064	22.28	VA1T	27.8	-24.1	25.98	54	-28.02	-	-	289	211	H
* 1.295	33.32	PKFH	28.9	-23.1	39.12	-	-	74	-34.88	283	252	V
* 1.298	22.74	VA1T	29	-23.1	28.64	54	-25.36	-	-	283	252	V
* 4	42.53	PKFH	33.3	-32.9	42.93	-	-	74	-31.07	96	281	V
* 4	35	VA1T	33.3	-32.9	35.4	54	-18.6	-	-	96	281	V
* 4.985	42.54	PKFH	34	-31.8	44.74	-	-	74	-29.26	1	100	V
* 4.989	28.43	VA1T	34	-31.8	30.63	54	-23.37	-	-	1	100	V
1.763	22.61	VA1T	29.8	-22.3	30.11	-	-	-	-	243	230	V
1.765	33.39	PKFH	29.8	-22.3	40.89	-	-	-	-	243	230	V
1.911	34.64	PKFH	30.9	-22.1	43.44	-	-	-	-	221	248	V
1.914	23.23	VA1T	30.9	-22.1	32.03	-	-	-	-	221	248	V

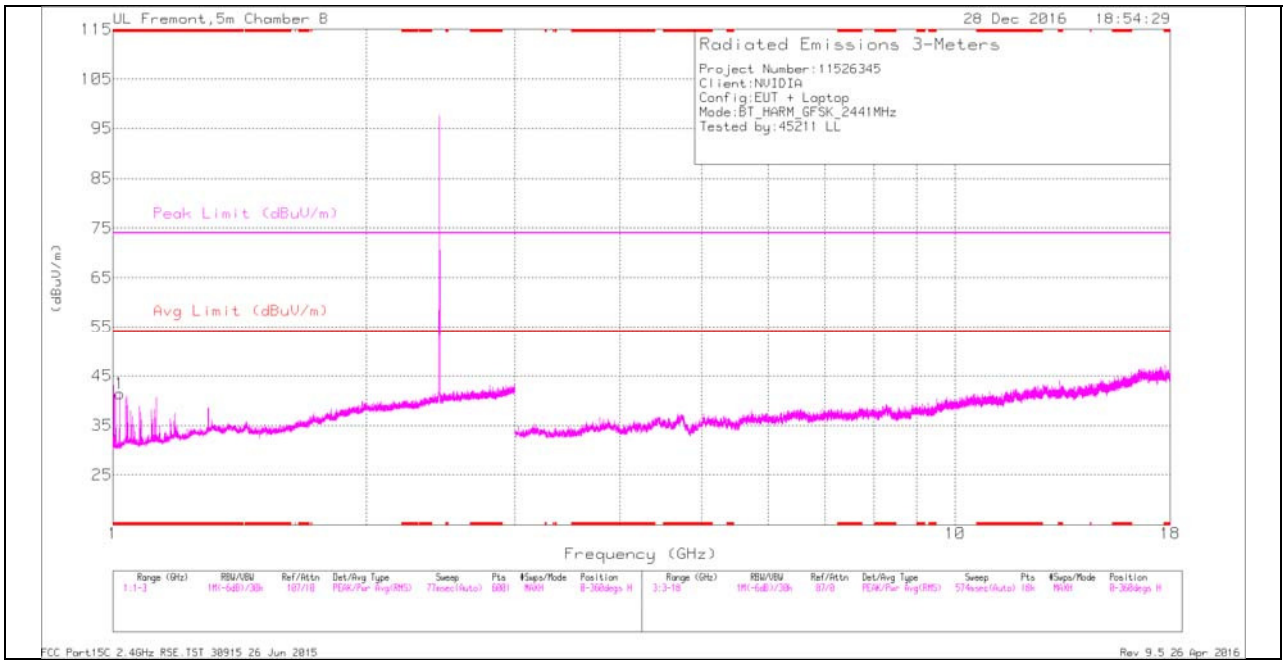
* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

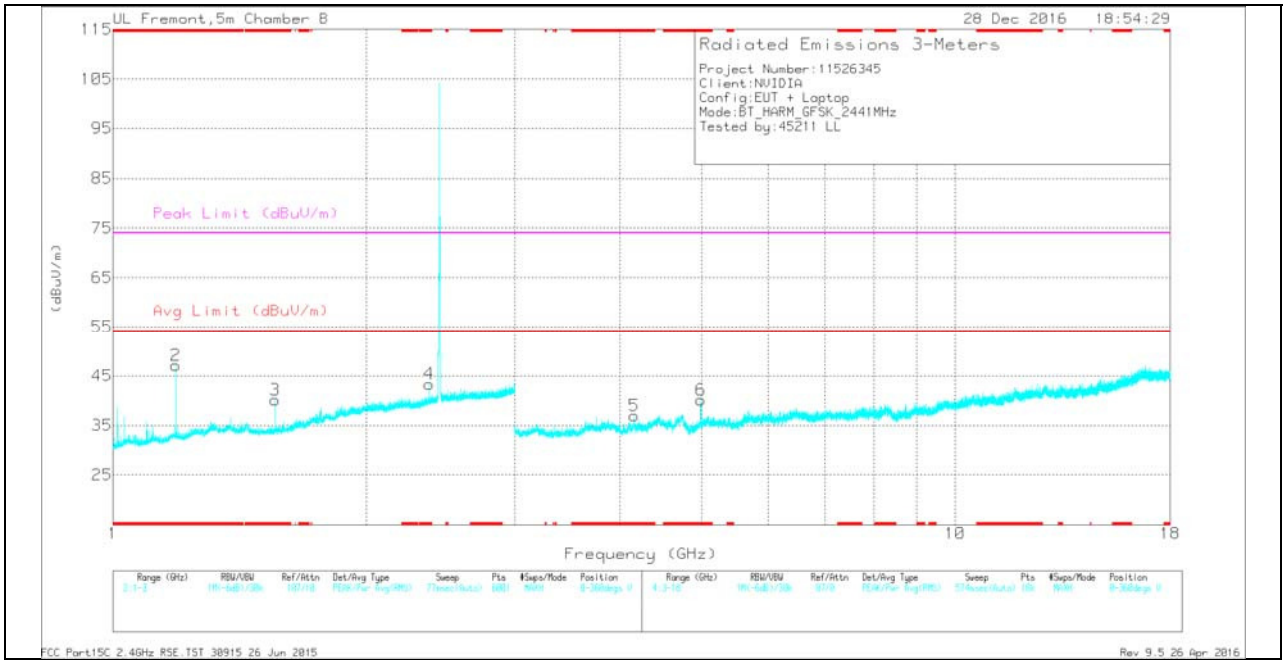
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701J
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

MID CHANNEL DATA

TRACE MARKERS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.019	38.22	Pk	27.8	-24.6	41.42	-	-	74	-32.58	0-360	100	H
2	* 1.187	42.42	Pk	28.3	-23.6	47.12	-	-	74	-26.88	0-360	98	V
3	* 1.557	34.57	Pk	28	-22.4	40.17	-	-	74	-33.83	0-360	98	V
4	* 2.375	33.68	Pk	32	-22.3	43.38	-	-	74	-30.62	0-360	201	V
5	* 4.157	35.47	Pk	33.7	-32.2	36.97	-	-	74	-37.03	0-360	98	V
6	* 4.988	37.93	Pk	34	-31.8	40.13	-	-	74	-33.87	0-360	201	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Avg - Video bandwidth < Resolution bandwidth

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.02	34.06	PKFH	27.8	-24.6	37.26	-	-	74	-36.74	152	353	H
* 1.023	22.42	VA1T	27.8	-24.5	25.72	54	-28.28	-	-	152	353	H
* 1.184	34.31	PKFH	28.3	-23.6	39.01	-	-	74	-34.99	37	139	V
* 1.183	22.94	VA1T	28.3	-23.6	27.64	54	-26.36	-	-	37	139	V
* 1.556	33.44	PKFH	28	-22.4	39.04	-	-	74	-34.96	85	134	V
* 1.558	22.52	VA1T	28	-22.4	28.12	54	-25.88	-	-	85	134	V
* 2.375	37.82	PKFH	32	-22.3	47.52	-	-	74	-26.48	62	243	V
* 2.375	30.66	VA1T	32	-22.3	40.36	54	-13.64	-	-	62	243	V
* 4.16	39.32	PKFH	33.7	-32.1	40.92	-	-	74	-33.08	110	360	V
* 4.158	28.33	VA1T	33.7	-32.2	29.83	54	-24.17	-	-	110	360	V
* 4.988	43.03	PKFH	34	-31.8	45.23	-	-	74	-28.77	33	276	V
* 4.988	28.66	VA1T	34	-31.8	30.86	54	-23.14	-	-	33	276	V

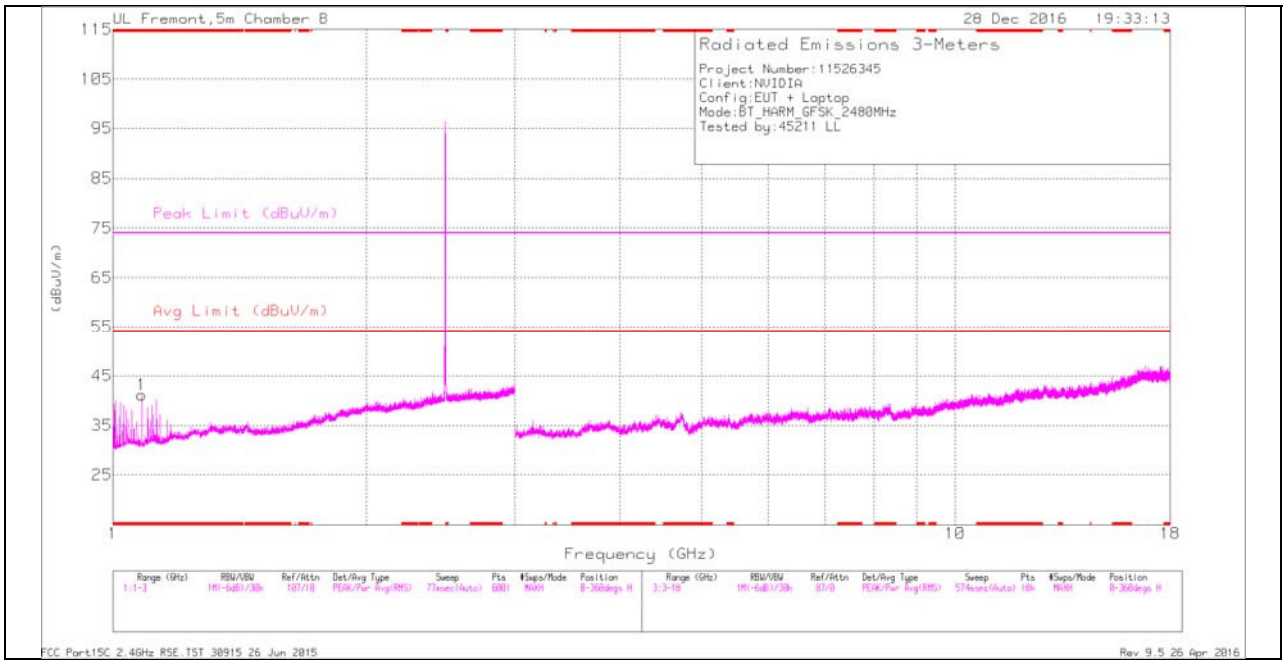
* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

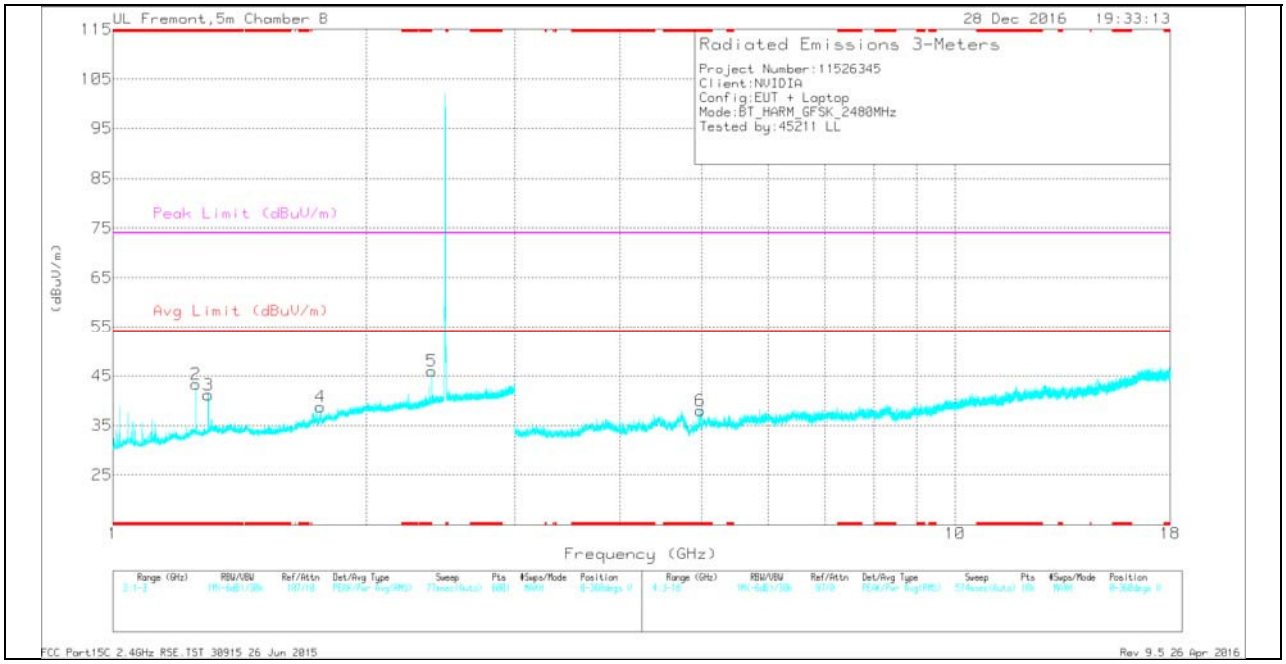
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HIGH CHANNEL DATA

TRACE MARKERS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.082	37.34	Pk	27.9	-24.1	41.14	-	-	74	-32.86	0-360	201	H
2	* 1.254	37.85	Pk	28.7	-23.2	43.35	-	-	74	-30.65	0-360	201	V
3	* 1.297	35.25	Pk	29	-23.1	41.15	-	-	74	-32.85	0-360	201	V
6	* 4.978	35.91	Pk	34	-31.9	38.01	-	-	74	-35.99	0-360	201	V
4	1.764	31.19	Pk	29.8	-22.3	38.69	-	-	-	-	0-360	98	V
5	2.392	36.33	Pk	32.1	-22.4	46.03	-	-	-	-	0-360	98	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Avg - Video bandwidth < Resolution bandwidth

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.079	33.5	PKFH	27.9	-24.1	37.3	-	-	74	-36.7	199	248	H
* 1.082	22.01	VA1T	27.9	-24.2	25.71	54	-28.29	-	-	199	248	H
* 1.254	34.04	PKFH	28.7	-23.2	39.54	-	-	74	-34.46	156	302	V
* 1.252	22.75	VA1T	28.7	-23.3	28.15	54	-25.85	-	-	156	302	V
* 1.296	33.51	PKFH	28.9	-23.1	39.31	-	-	74	-34.69	10	252	V
* 1.294	24.57	VA1T	28.9	-23.1	30.37	54	-23.63	-	-	10	252	V
* 4.979	43.51	PKFH	34	-31.9	45.61	-	-	74	-28.39	30	307	V
* 4.979	29.01	VA1T	34	-31.9	31.11	54	-22.89	-	-	30	307	V
1.761	22.45	VA1T	29.7	-22.2	29.95	-	-	-	-	186	207	V
1.762	34.15	PKFH	29.7	-22.2	41.65	-	-	-	-	186	207	V
2.392	34.37	PKFH	32.1	-22.4	44.07	-	-	-	-	29	298	V
2.395	23.91	VA1T	32.2	-22.4	33.71	-	-	-	-	29	298	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

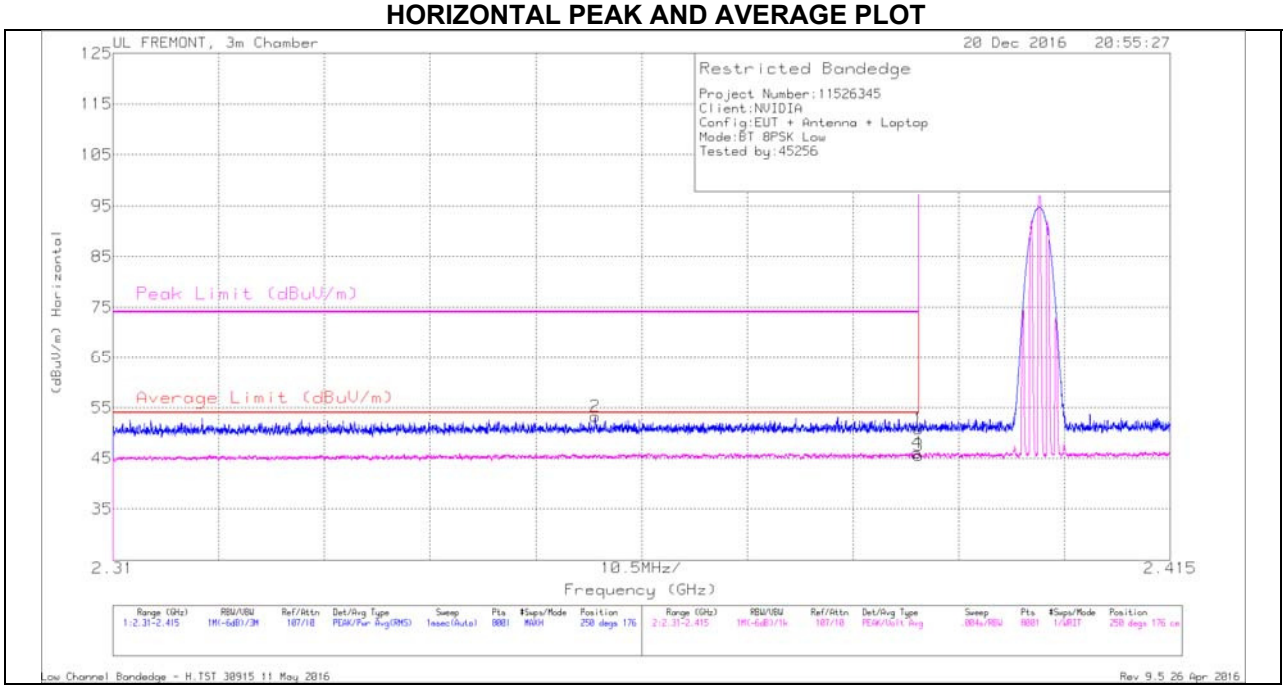
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

8.1.1. ENHANCED DATA RATE 8PSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	2.358	42.3	Pk	31.9	-20.9	53.3	-	-	74	-20.7	250	176	H
1	2.39	39.53	Pk	32.1	-20.8	50.83	-	-	74	-23.17	250	176	H
3	2.39	28.77	VA1T	32.1	-20.8	40.07	54	-13.93	-	-	250	176	H
4	2.39	29.29	VA1T	32.1	-20.8	40.59	54	-13.41	-	-	250	176	H

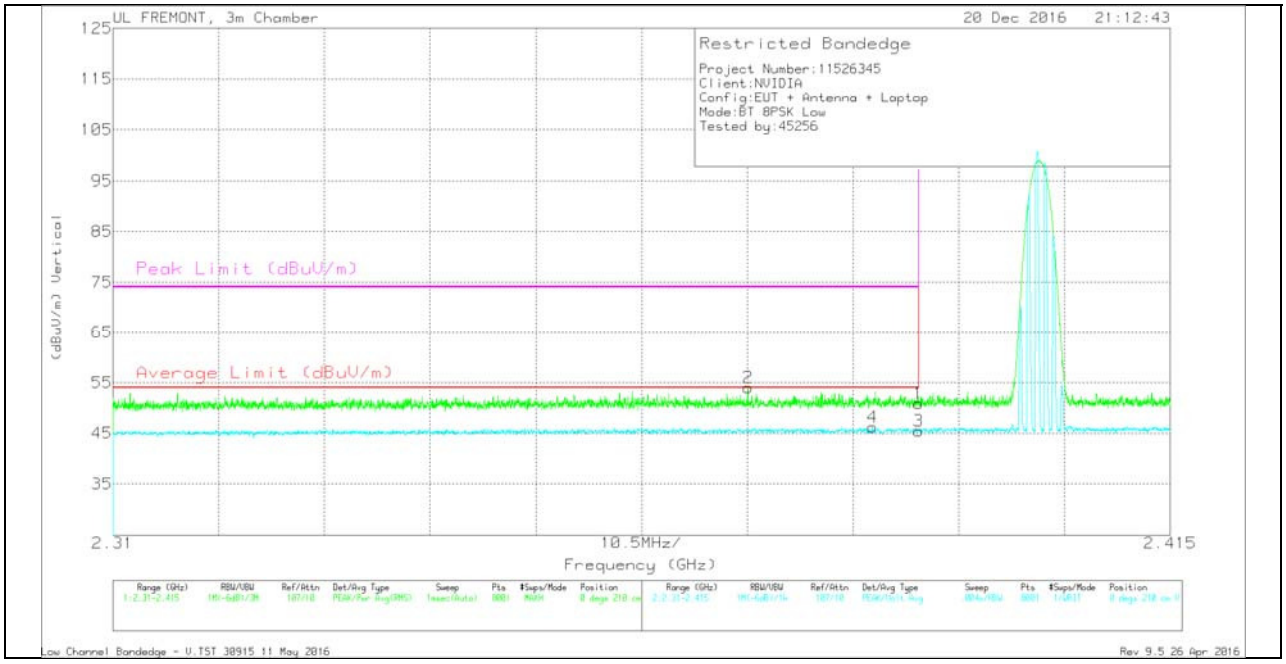
* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	2.373	42.86	Pk	32	-20.9	53.96	-	-	74	-20.04	0	210	V
4	2.385	29.57	VA1T	32	-20.9	40.67	54	-13.33	-	-	0	210	V
1	2.39	39.65	Pk	32.1	-20.8	50.95	-	-	74	-23.05	0	210	V
3	2.39	28.73	VA1T	32.1	-20.8	40.03	54	-13.97	-	-	0	210	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

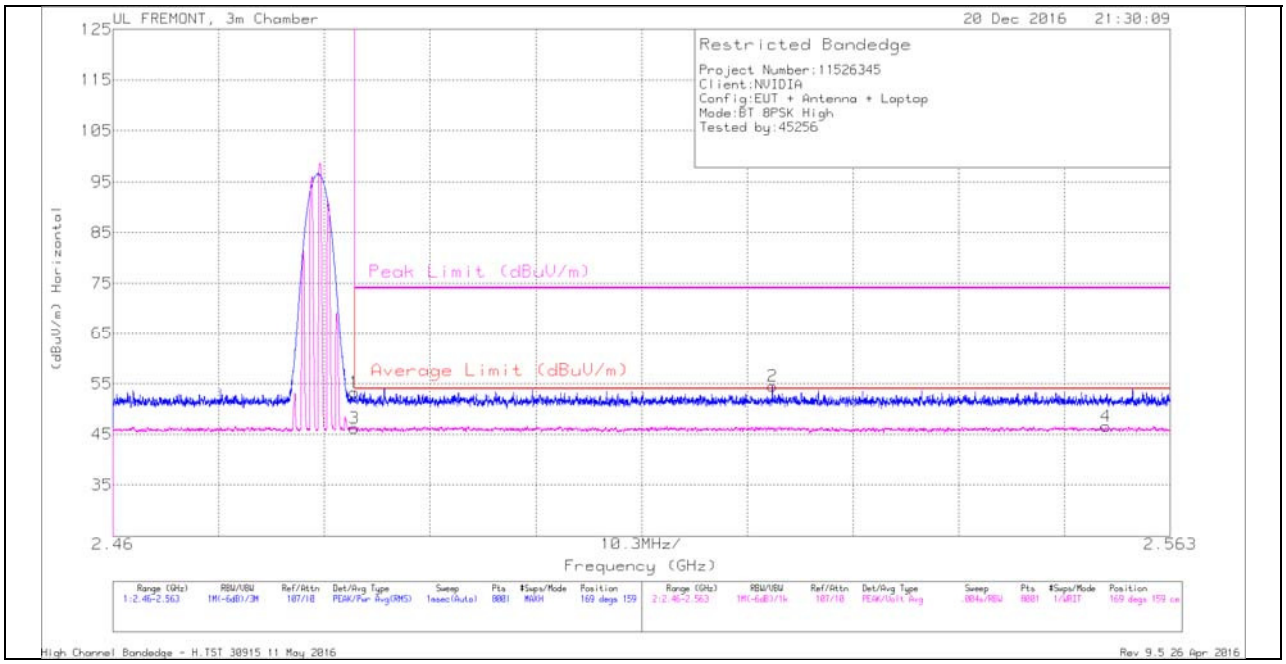
Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.484	41.66	Pk	32.4	-20.8	53.26	-	-	74	-20.74	169	159	H
3	2.484	29.16	VA1T	32.4	-20.8	40.76	54	-13.24	-	-	169	159	H
2	2.524	42.72	Pk	32.4	-20.6	54.52	-	-	74	-19.48	169	159	H
4	2.557	29.55	VA1T	32.4	-20.8	41.15	54	-12.85	-	-	169	159	H

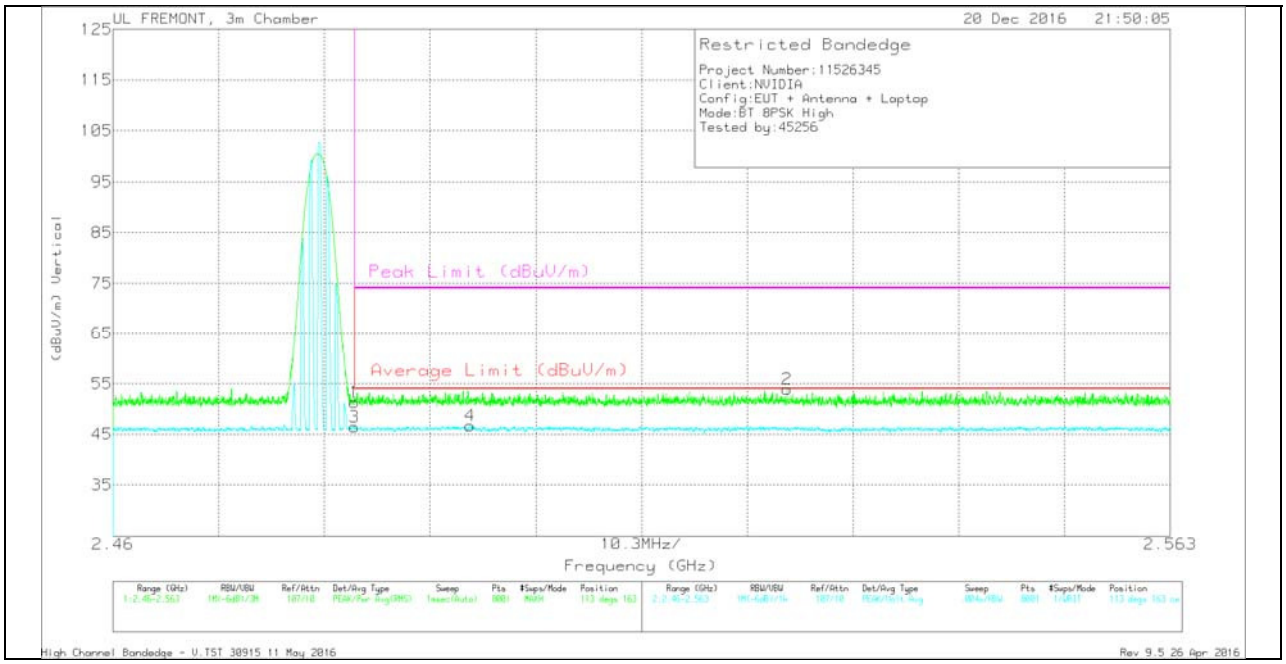
* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.484	39.63	Pk	32.4	-20.8	51.23	-	-	74	-22.77	113	163	V
3	2.484	29.39	VA1T	32.4	-20.8	40.99	54	-13.01	-	-	113	163	V
4	2.495	29.59	VA1T	32.4	-20.8	41.19	54	-12.81	-	-	113	163	V
2	2.526	42.11	Pk	32.4	-20.6	53.91	-	-	74	-20.09	113	163	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

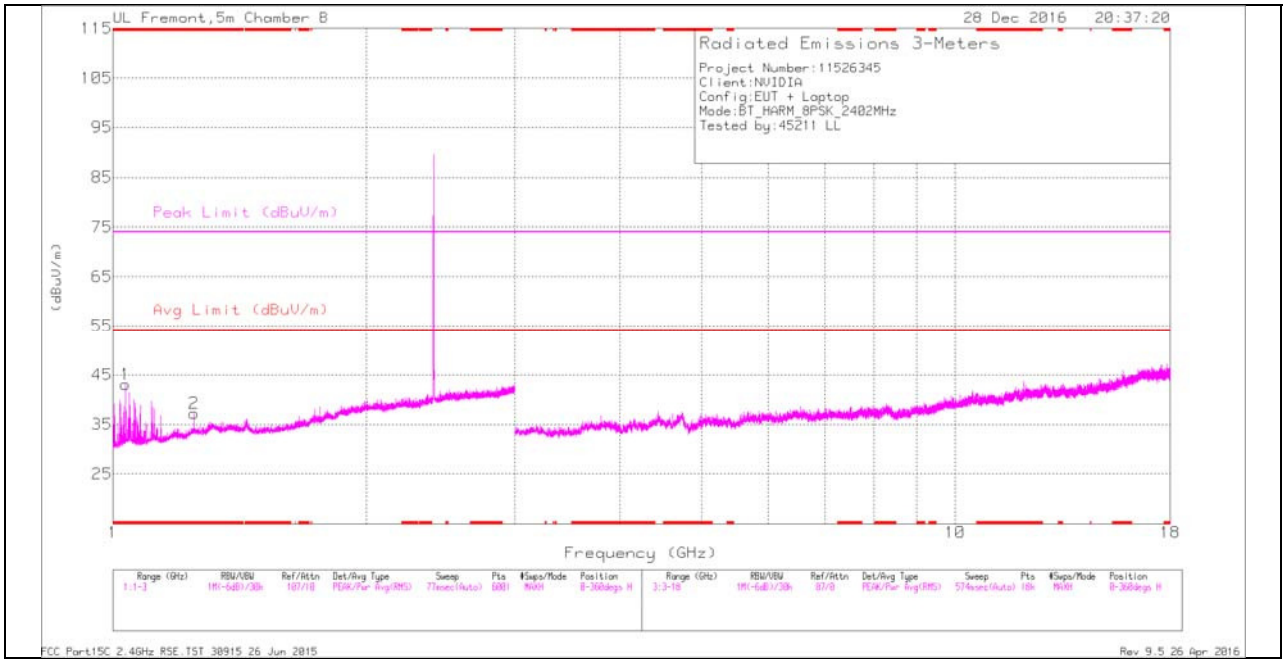
Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

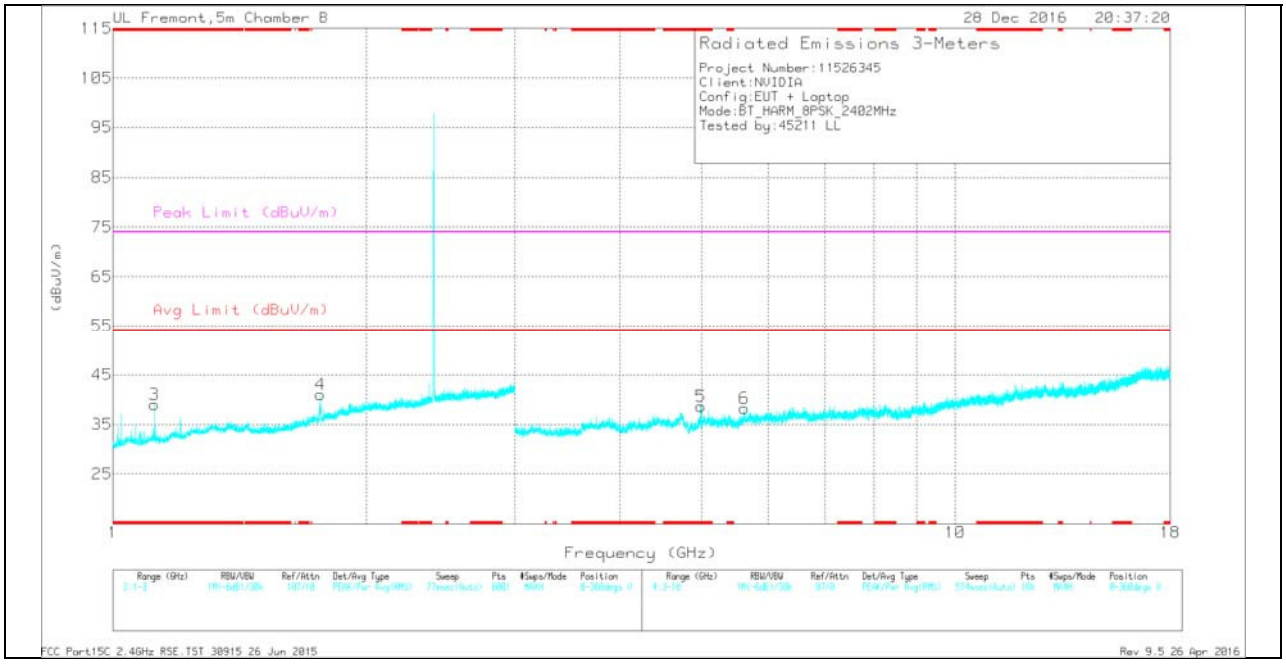
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

LOW CHANNEL DATA

TRACE MARKERS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.034	39.74	Pk	27.8	-24.5	43.04	-	-	74	-30.96	0-360	208	H
2	* 1.249	31.79	Pk	28.6	-23.2	37.19	-	-	74	-36.81	0-360	99	H
3	* 1.12	34.95	Pk	28	-23.9	39.05	-	-	74	-34.95	0-360	98	V
5	* 4.989	36.39	Pk	34	-31.8	38.59	-	-	74	-35.41	0-360	201	V
4	1.763	33.52	Pk	29.8	-22.3	41.02	-	-	-	-	0-360	198	V
6	5.617	34.92	Pk	34.6	-31.3	38.22	-	-	-	-	0-360	98	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Avg - Video bandwidth < Resolution bandwidth

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.035	33.64	PKFH	27.8	-24.5	36.94	-	-	74	-37.06	322	330	H
* 1.035	23.05	VA1T	27.8	-24.4	26.45	54	-27.55	-	-	322	330	H
* 1.249	35.05	PKFH	28.6	-23.2	40.45	-	-	74	-33.55	163	364	H
* 1.245	23.09	VA1T	28.6	-23.3	28.39	54	-25.61	-	-	163	364	H
* 1.122	37.83	PKFH	28	-23.8	42.03	-	-	74	-31.97	319	359	V
* 1.12	22.82	VA1T	28	-23.9	26.92	54	-27.08	-	-	319	359	V
* 4.988	43.27	PKFH	34	-31.8	45.47	-	-	74	-28.53	260	168	V
* 4.988	28.75	VA1T	34	-31.8	30.95	54	-23.05	-	-	260	168	V
1.765	33.41	PKFH	29.8	-22.3	40.91	-	-	-	-	88	213	V
1.765	22.61	VA1T	29.8	-22.3	30.11	-	-	-	-	88	213	V
5.613	27.64	VA1T	34.6	-31.4	30.84	-	-	-	-	119	327	V
5.617	38.76	PKFH	34.6	-31.3	42.06	-	-	-	-	119	327	V

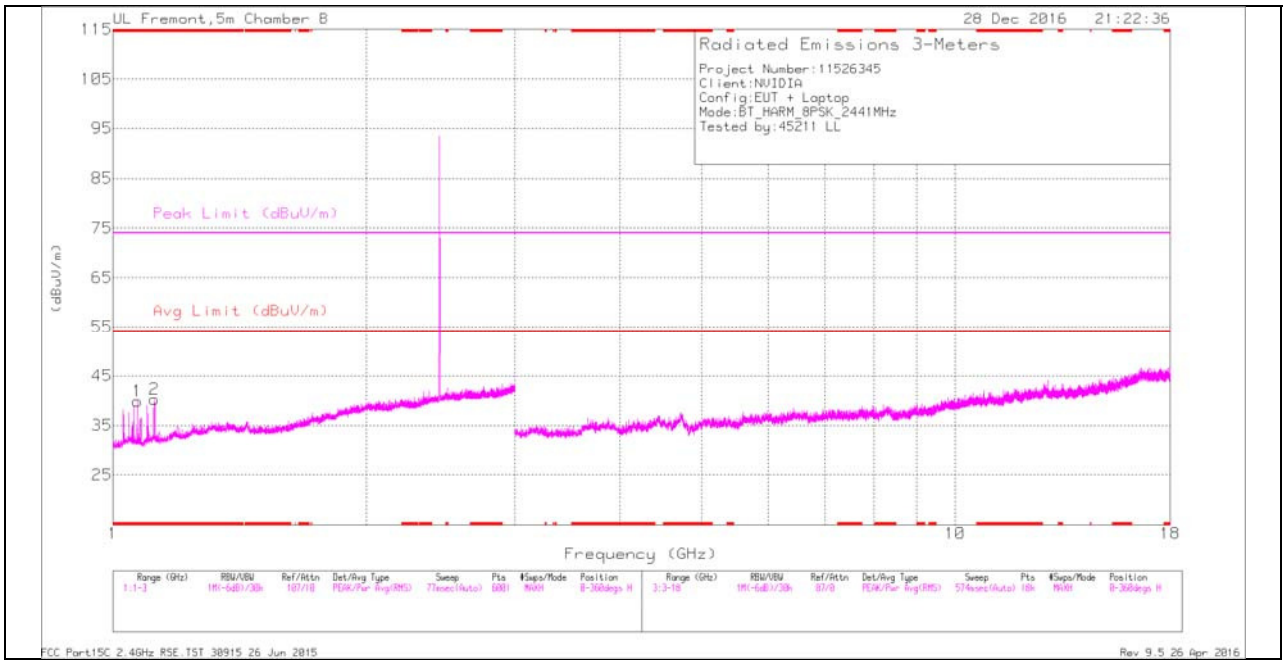
* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

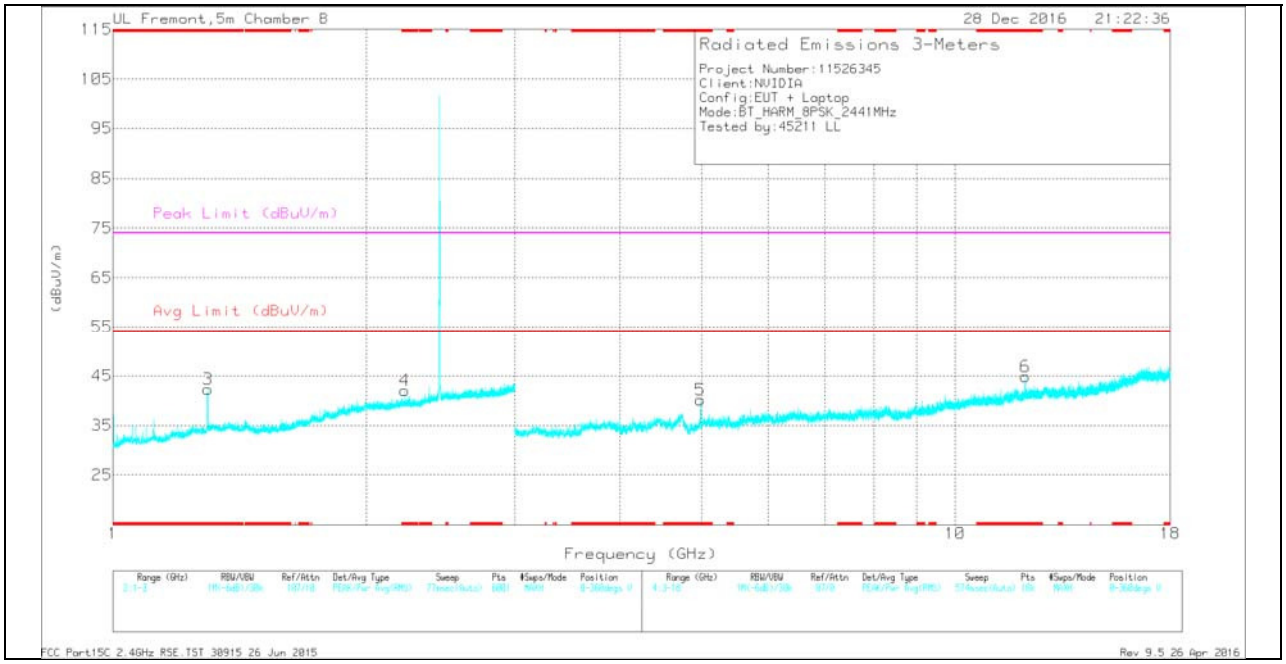
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

MID CHANNEL DATA

TRACE MARKERS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.069	36.08	Pk	27.9	-24.1	39.88	-	-	74	-34.12	0-360	99	H
2	* 1.121	36.21	Pk	28	-23.9	40.31	-	-	74	-33.69	0-360	99	H
3	* 1.296	36.45	Pk	29	-23.1	42.35	-	-	74	-31.65	0-360	98	V
4	* 2.22	32.74	Pk	31.6	-22.3	42.04	-	-	74	-31.96	0-360	199	V
5	* 4.982	37.9	Pk	34	-31.8	40.1	-	-	74	-33.9	0-360	98	V
6	* 12.124	30.77	Pk	39	-24.9	44.87	-	-	74	-29.13	0-360	98	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Avg - Video bandwidth < Resolution bandwidth

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.067	34	PKFH	27.9	-24.1	37.8	-	-	74	-36.2	233	383	H
* 1.071	22.24	VA1T	27.9	-24.1	26.04	54	-27.96	-	-	233	383	H
* 1.12	33.55	PKFH	28	-23.9	37.65	-	-	74	-36.35	240	171	H
* 1.12	22.72	VA1T	28	-23.9	26.82	54	-27.18	-	-	240	171	H
* 1.299	33.38	PKFH	29	-23.1	39.28	-	-	74	-34.72	359	358	V
* 1.295	26.46	VA1T	28.9	-23.1	32.26	54	-21.74	-	-	359	358	V
* 2.222	34.69	PKFH	31.6	-22.3	43.99	-	-	74	-30.01	213	110	V
* 2.224	23.96	VA1T	31.6	-22.2	33.36	54	-20.64	-	-	213	110	V
* 4.98	42.31	PKFH	34	-31.9	44.41	-	-	74	-29.59	0	137	V
* 4.982	29.82	VA1T	34	-31.8	32.02	54	-21.98	-	-	0	137	V
* 12.125	32.78	PKFH	39	-24.9	46.88	-	-	74	-27.12	212	105	V
* 12.126	22.21	VA1T	39	-25	36.21	54	-17.79	-	-	212	105	V

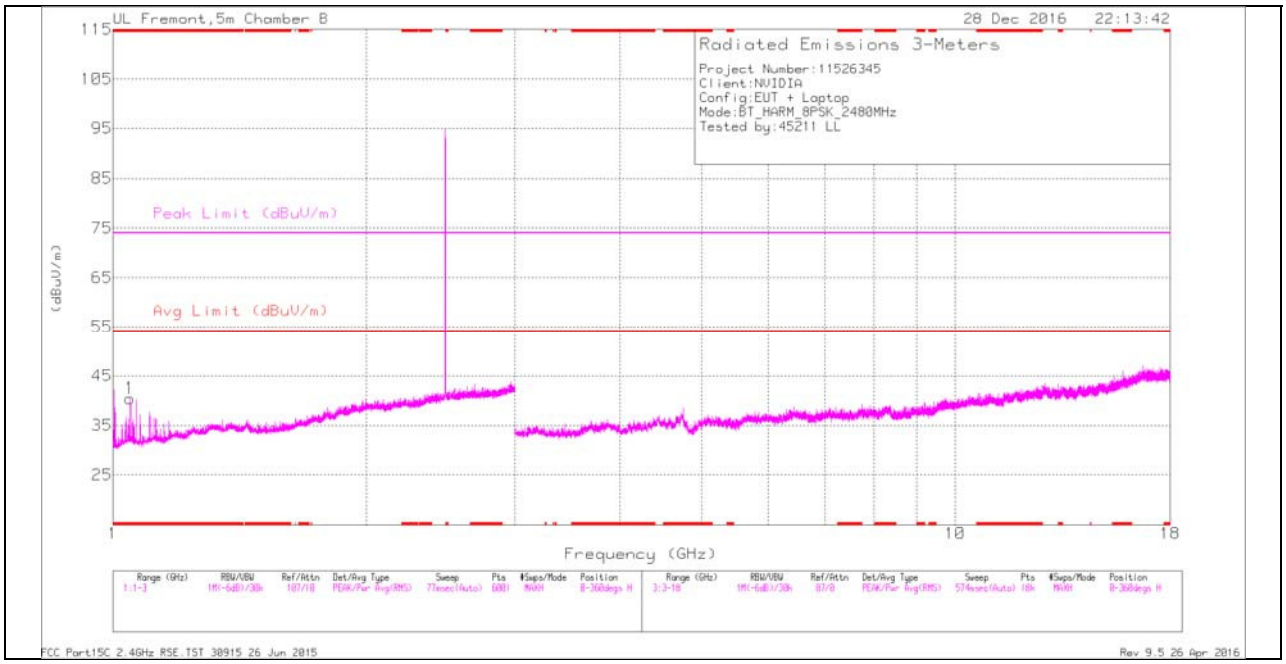
* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

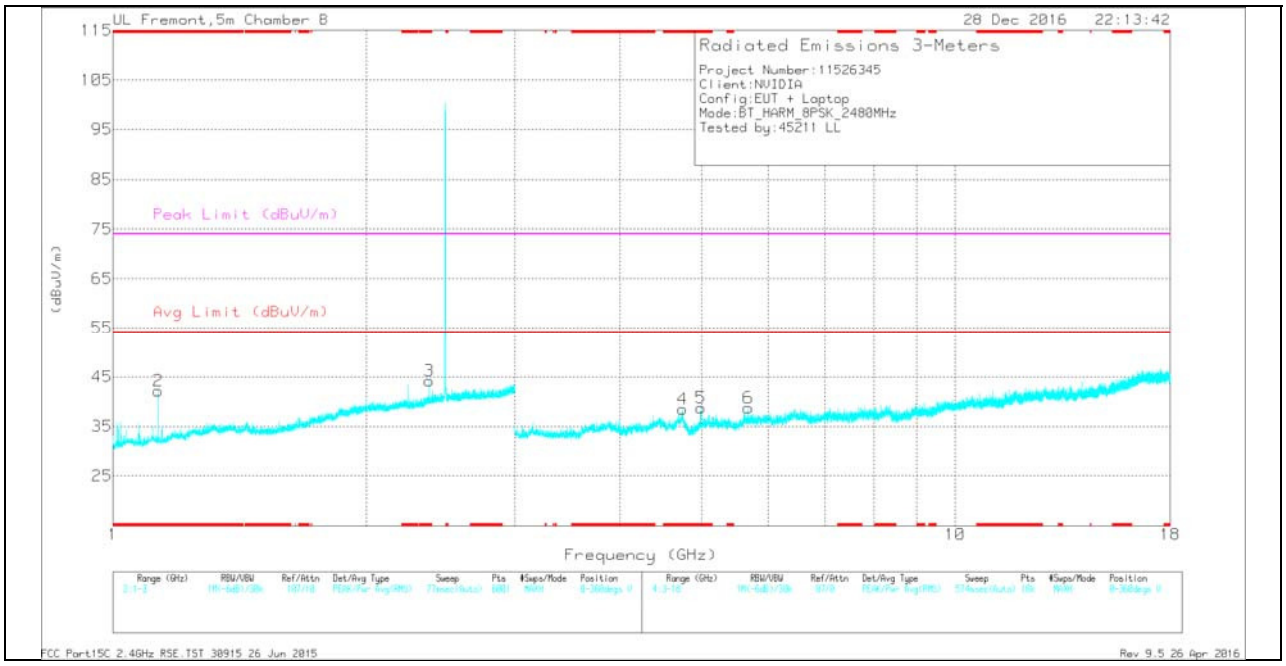
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HIGH CHANNEL DATA

TRACE MARKERS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.047	36.96	Pk	27.8	-24.3	40.46	-	-	74	-33.54	0-360	201	H
2	* 1.131	38.03	Pk	28	-23.8	42.23	-	-	74	-31.77	0-360	98	V
3	* 2.375	34.46	Pk	32	-22.3	44.16	-	-	74	-29.84	0-360	201	V
4	* 4.748	35.45	Pk	33.9	-30.9	38.45	-	-	74	-35.55	0-360	98	V
5	* 4.988	36.52	Pk	34	-31.8	38.72	-	-	74	-35.28	0-360	98	V
6	5.682	35.04	Pk	34.8	-31.1	38.74	-	-	-	-	0-360	201	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

Avg - Video bandwidth < Resolution bandwidth

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.046	33.08	PKFH	27.8	-24.3	36.58	-	-	74	-37.42	324	320	H
* 1.047	22.93	VA1T	27.8	-24.3	26.43	54	-27.57	-	-	324	320	H
* 1.13	33.13	PKFH	28	-23.8	37.33	-	-	74	-36.67	186	166	V
* 1.131	22.33	VA1T	28	-23.8	26.53	54	-27.47	-	-	186	166	V
* 2.375	37.16	PKFH	32	-22.3	46.86	-	-	74	-27.14	65	318	V
* 2.375	31.02	VA1T	32	-22.3	40.72	54	-13.28	-	-	65	318	V
* 4.749	39.1	PKFH	33.9	-30.9	42.1	-	-	74	-31.9	73	115	V
* 4.749	28.37	VA1T	33.9	-30.9	31.37	54	-22.63	-	-	73	115	V
* 4.989	42.21	PKFH	34	-31.8	44.41	-	-	74	-29.59	360	105	V
* 4.989	28.53	VA1T	34	-31.8	30.73	54	-23.27	-	-	360	105	V
5.681	37.39	PKFH	34.8	-31.1	41.09	-	-	-	-	240	263	V
5.681	27.39	VA1T	34.8	-31.1	31.09	-	-	-	-	240	263	V

* - indicates frequency in CFR15.205/RSS-GEN 8.10 Restricted Band

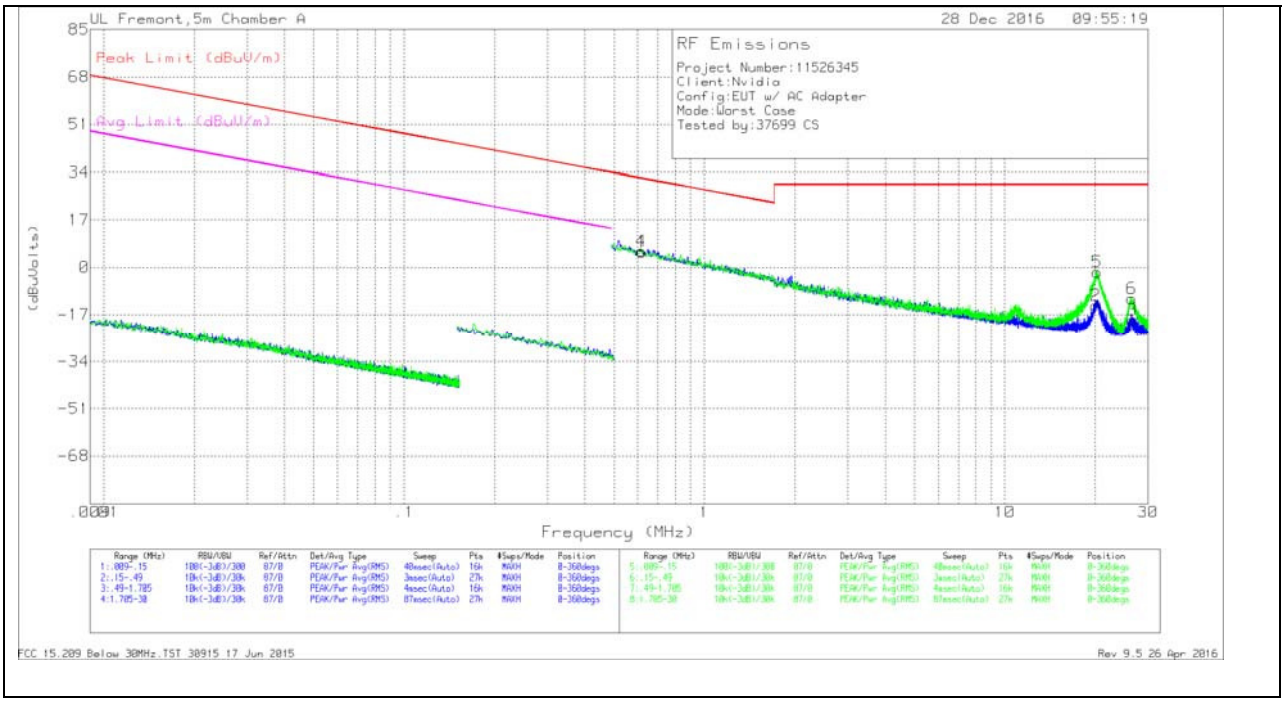
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

8.1. WORST-CASE BELOW 30 MHz

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 30m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
4	.61669	34.98	Pk	10.6	.1	-40	5.68	31.8	-26.12	-	-	0-360
1	.61901	34.8	Pk	10.6	.1	-40	5.5	31.77	-26.27	-	-	0-360
2	20.08902	15.55	Pk	10.1	.7	-40	-13.65	29.54	-43.19	-	-	0-360
5	20.27242	27.43	Pk	10.1	.7	-40	-1.77	29.54	-31.31	-	-	0-360
6	26.44514	19.04	Pk	8.9	.8	-40	-11.26	29.54	-40.8	-	-	0-360
3	26.56618	11.59	Pk	8.8	.8	-40	-18.81	29.54	-48.35	-	-	0-360

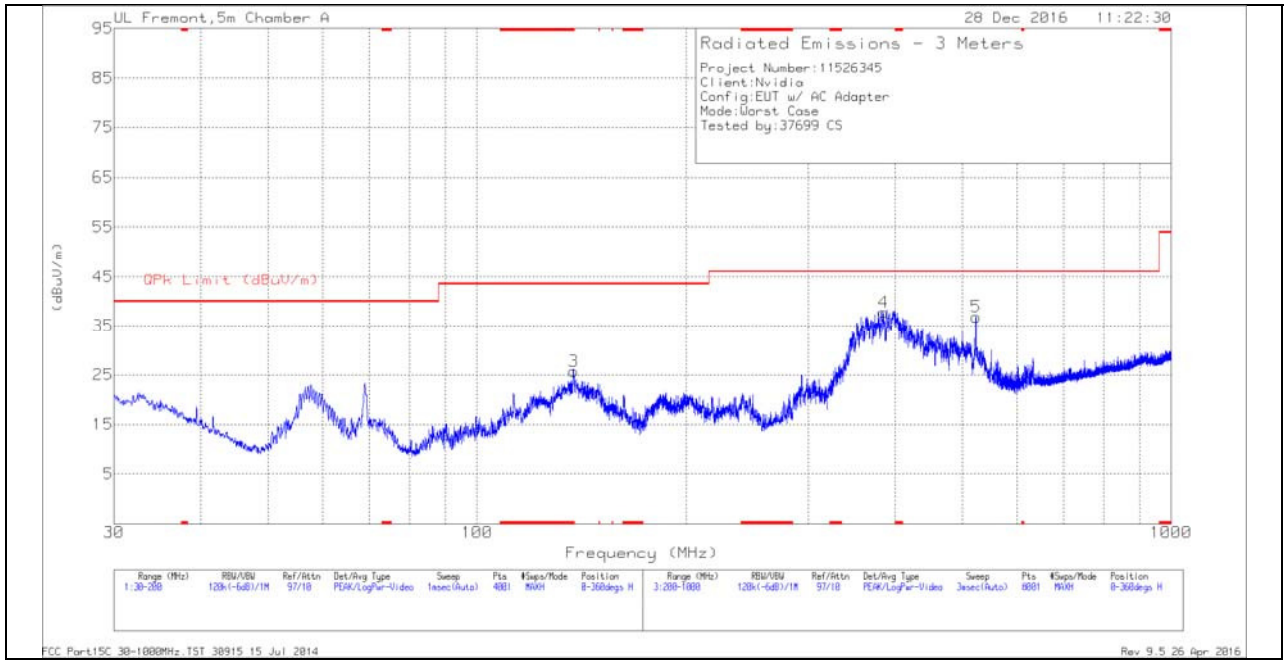
Pk - Peak detector

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

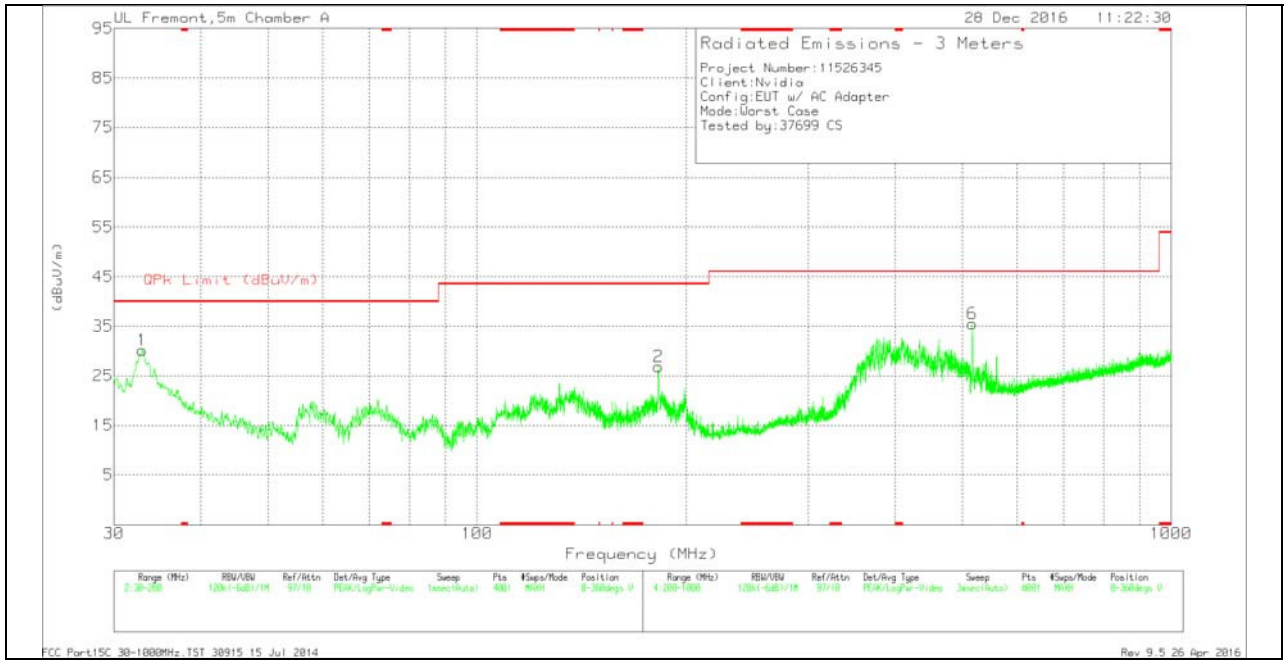
8.2. WORST-CASE BELOW 1 GHz

GFSK SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



VERTICAL PLOT



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

BELOW 1 GHz TABLE

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 137.695	38.63	Pk	17.4	-30.3	25.73	43.52	-17.79	0-360	300	H
1	32.975	37.44	Pk	23.9	-31.2	30.14	40	-9.86	0-360	100	V
2	182.49	41.62	Pk	15.3	-30.1	26.82	43.52	-16.7	0-360	100	V
4	385.1	47.83	Pk	19.1	-29.1	37.83	46.02	-8.19	0-360	100	H
6	517.3	42.47	Pk	21.7	-28.7	35.47	46.02	-10.55	0-360	200	V
5	523.1	43.64	Pk	21.8	-28.6	36.84	46.02	-9.18	0-360	200	H

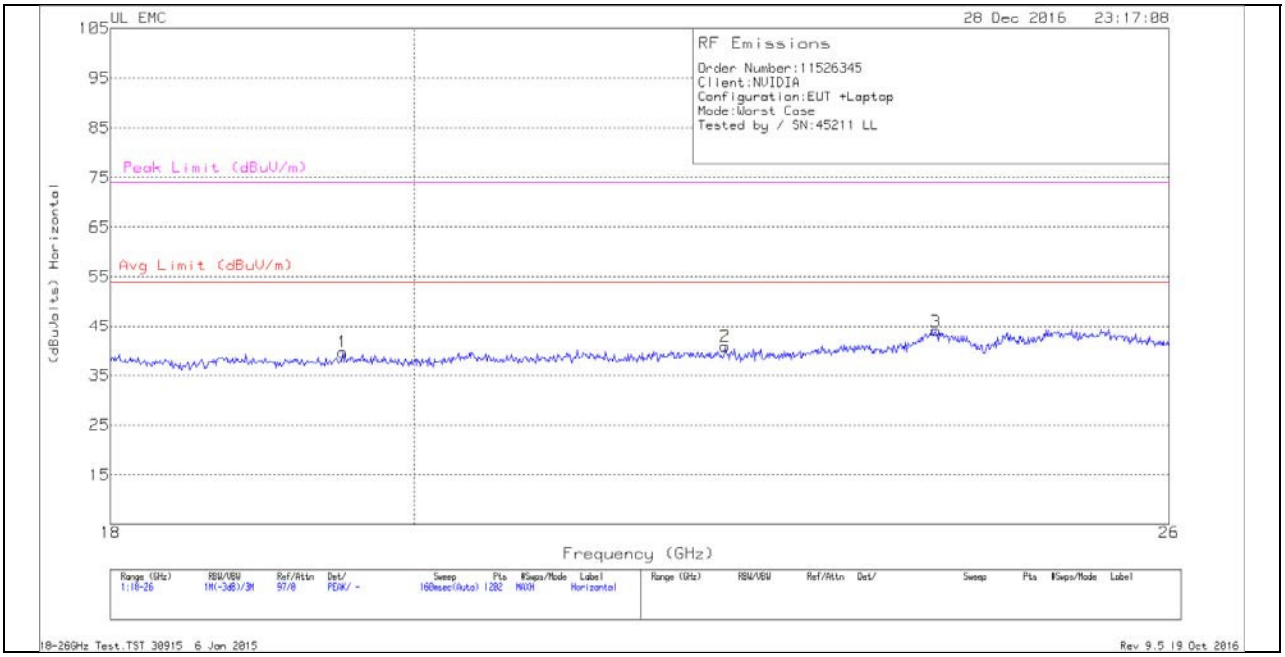
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701J
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

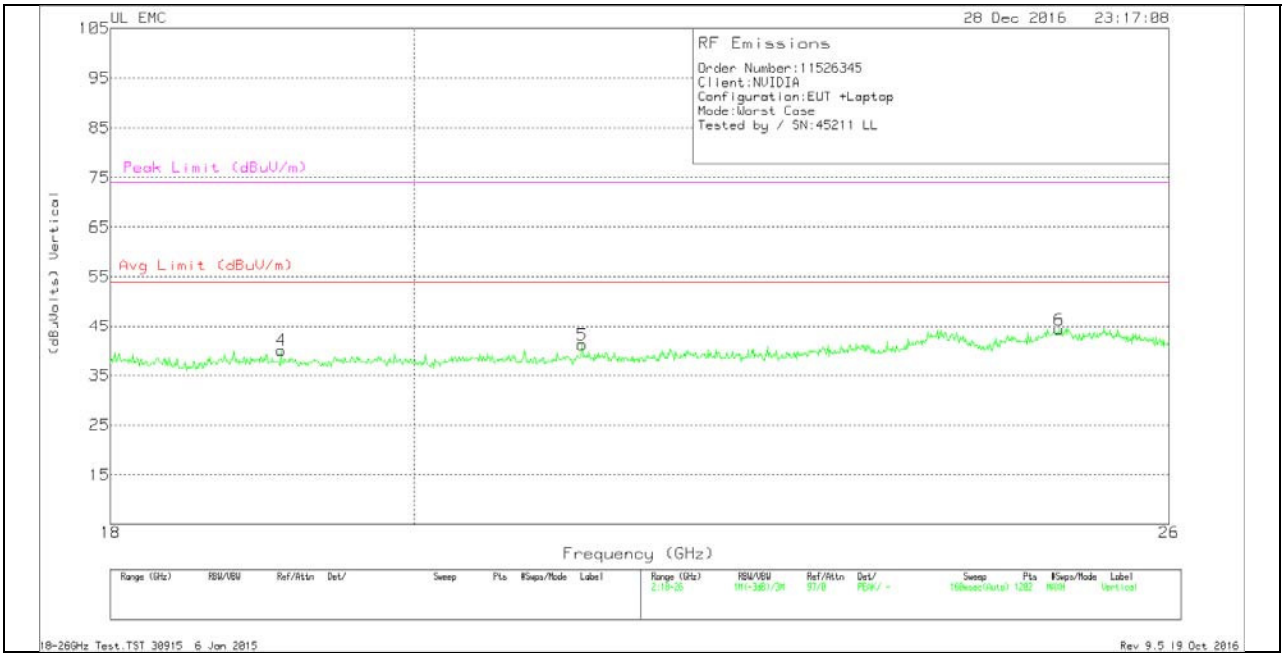
8.3. WORST-CASE ABOVE 18 GHz

GFSK SPURIOUS EMISSIONS 18 TO 26 GHz (WORST-CASE CONFIGURATION)

HORIZONTAL PLOT



VERTICAL PLOT



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

18 TO 26 GHz TABLE

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T449 (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	19.512	41.57	Pk	32.7	-25.1	-9.5	39.67	54	-14.33	74	-34.33
2	22.283	41.43	Pk	33.5	-24.6	-9.5	40.83	54	-13.17	74	-33.17
3	23.975	43.7	Pk	34	-24.2	-9.5	44	54	-10	74	-30
4	19.099	41.8	Pk	32.7	-25	-9.5	40	54	-14	74	-34
5	21.204	42.27	Pk	33.1	-24.7	-9.5	41.17	54	-12.83	74	-32.83
6	25.027	44.33	Pk	34.2	-24.7	-9.5	44.33	54	-9.67	74	-29.67

Pk - Peak detector

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701J
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

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

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

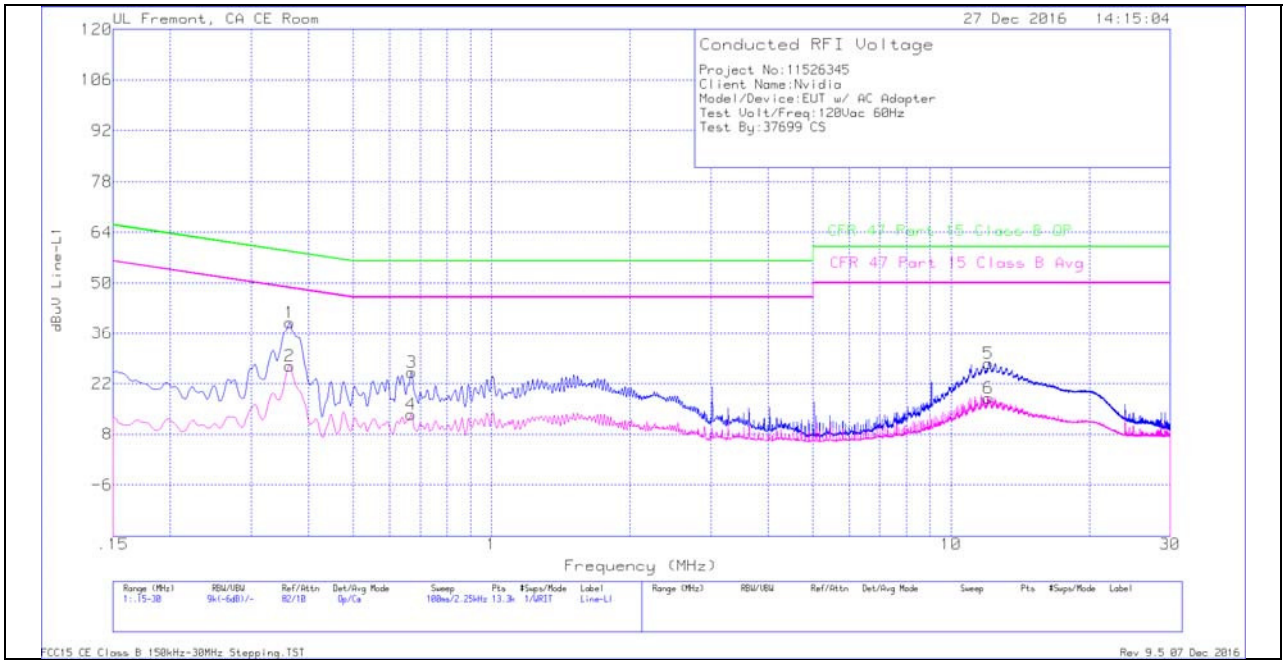
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

6 WORST EMISSIONS

LINE 1 PLOT



LINE 1 RESULT

Trace Markers

Range 1: Line-L1 .15 - 30MHz

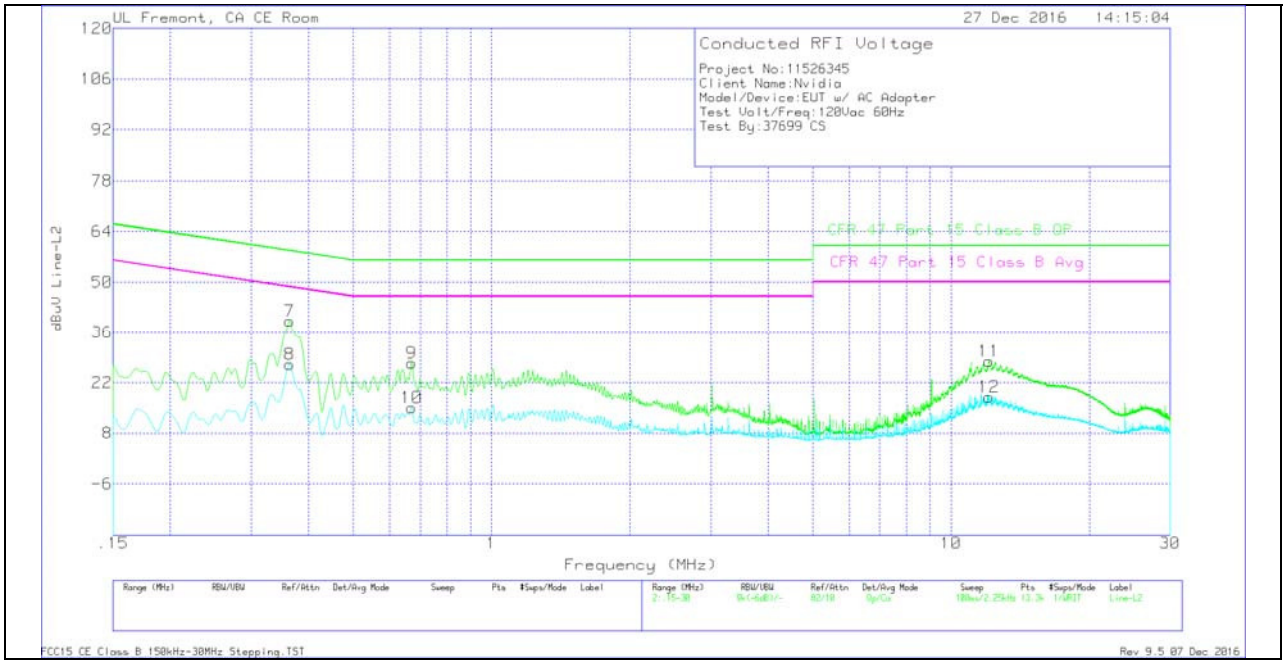
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables 1&3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
1	.36375	28.91	Qp	0	0	10.1	39.01	58.64	-19.63	-	-
2	.36375	16.78	Ca	0	0	10.1	26.88	-	-	48.64	-21.76
3	.66975	15.1	Qp	0	0	10.1	25.2	56	-30.8	-	-
4	.6675	3.33	Ca	0	0	10.1	13.43	-	-	46	-32.57
5	12.0705	17.08	Qp	.1	.2	10.2	27.58	60	-32.42	-	-
6	12.0705	7.57	Ca	.1	.2	10.2	18.07	-	-	50	-31.93

Qp - Quasi-Peak detector

Ca - CISPR average detection

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

LINE 2 PLOT



LINE 2 RESULT

Trace Markers

Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables 2&3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
7	.36375	29.05	Qp	0	0	10.1	39.15	58.64	-19.49	-	-
8	.36375	16.88	Ca	0	0	10.1	26.98	-	-	48.64	-21.66
9	.66975	17.31	Qp	0	0	10.1	27.41	56	-28.59	-	-
10	.66975	5	Ca	0	0	10.1	15.1	-	-	46	-30.9
11	12.08625	17.56	Qp	0	.2	10.2	27.96	60	-32.04	-	-
12	12.08625	7.56	Ca	0	.2	10.2	17.96	-	-	50	-32.04

Qp - Quasi-Peak detector

Ca - CISPR average detection

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.