CERTIFICATION TEST REPORT

Report Number. : 12804406-E3V2

Applicant	:	FITBIT INC. 199 FREMONT ST, 14TH FLOOR SAN FRANCISCO, CA 94105, U.S.A.
Model	:	FB507
Brand	:	Fitbit
FCC ID	:	XRAFB507
IC	:	8542A-FB507
EUT Description	:	SMARTWATCH
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
June 24, 2019

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888

NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	6/6/2019	Initial Issue	-
V2	6/24/2019	Updated Section 9 Test procedure to address TCB's question	Tina Chu

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS 5

2. TEST METHODOLOGY 7

3. FACILITIES AND ACCREDITATION 7

4. CALIBRATION AND UNCERTAINTY 8

4.1. MEASURING INSTRUMENT CALIBRATION 8

4.2. SAMPLE CALCULATION 8

4.3. MEASUREMENT UNCERTAINTY 8

5. EQUIPMENT UNDER TEST 9

5.1. EUT DESCRIPTION 9

5.2. MAXIMUM OUTPUT POWER 9

5.3. DESCRIPTION OF AVAILABLE ANTENNAS 9

5.4. SOFTWARE AND FIRMWARE 9

5.5. WORST-CASE CONFIGURATION AND MODE 10

5.6. DESCRIPTION OF TEST SETUP 11

6. TEST AND MEASUREMENT EQUIPMENT 14

7. MEASUREMENT METHODS 15

8. ANTENNA PORT TEST RESULTS 16

8.1. ON TIME AND DUTY CYCLE 16

8.2. 20 dB AND 99% BANDWIDTH 17

8.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION 18

8.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION 19

8.3. HOPPING FREQUENCY SEPARATION 20

8.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION 21

8.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION 21

8.4. NUMBER OF HOPPING CHANNELS 22

8.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION 23

8.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION 25

8.5. AVERAGE TIME OF OCCUPANCY 27

8.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION 28

8.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION 30

8.6. OUTPUT POWER 32

8.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION 33

8.6.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION 33

8.6.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION 33

8.7. AVERAGE POWER 34

8.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION 35

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

8.7.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION....35
8.7.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION 35

8.8. CONDUCTED SPURIOUS EMISSIONS....36
8.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION 37
8.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION....39

9. RADIATED TEST RESULTS....41

9.1. TRANSMITTER ABOVE 1 GHz....43
9.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION 43
9.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION....53

9.2. WORST CASE BELOW 30MHZ....63

9.3. WORST CASE BELOW 1 GHZ....64

9.4. WORST CASE 18-26 GHZ....66

10. AC POWER LINE CONDUCTED EMISSIONS....68

11. SETUP PHOTOS....71

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: FITBIT INC.
199 FREMONT ST, 14TH FLOOR
SAN FRANCISCO,
CA 94105, U.S.A.

EUT DESCRIPTION: SMARTWATCH

MODEL: FB507

SERIAL NUMBER: 23 42 BA C6 B0 41; 23 60 7F C6 B0 21 (RADIATED)
23 3C 06 0C 46 B0 41(CONDUCTED)

DATE TESTED: APRIL 17, 2019 –MAY 26, 2019

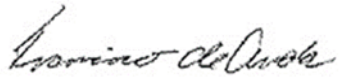
APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

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 the U.S. government.

Approved & Released For
UL Verification Services Inc. By:



FRANCISCO DE ANDA
OPERATIONS LEAD
UL Verification Services Inc.

Prepared By:

ERIC YU
TEST ENGINEER
UL Verification Services Inc.

Reviewed By:

TINA CHU
SENIOR PROJECT ENGINEER
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, KDB 558074 D01 15.247 Meas Guidance v05r02, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, 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	47658 Kato Road
☐ Chamber A	☐ Chamber D	☒ Chamber I
☐ Chamber B	☐ Chamber E	☒ Chamber J
☐ Chamber C	☐ Chamber F	☒ Chamber K
	☐ Chamber G	☐ Chamber L
	☐ Chamber H	☐ Chamber M

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code: 2324A.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

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

RADIATED EMISSIONS

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

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	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

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

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a smartwatch.

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	14.01	25.18
2402 - 2480	Enhanced DQPSK	13.48	22.28
2402 - 2480	Enhanced 8PSK	13.89	24.49

Note: GFSK, DQPSK, 8PSK average Power are all investigated, The GFSK & 8PSK Power are the worst case. Testing is based on these modes to showing compliance.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Peak Gain (dBi)
2.4	-4.60

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 35.6.0.239

The test utility software used during testing was TeraTerm

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

5.5. WORST-CASE CONFIGURATION AND MODE

EUT has 1 type of plastic wristband and 3 types of metallic bands: Link, Tri-Link and Mesh. The worst-case configuration was investigated with wristbands with and without a charger and it was determined that EUT with Tri-Link wristband and with a charger was the worst-case; therefore, all final radiated testing was performed with this configuration.

Radiated bandedge, harmonics, and spurious emissions from 1 GHz to 18GHz were performed with EUT set to transmit at the Low/Middle/High channels.

Radiated emission below 1GHz, above 18GHz, 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 orthogonal orientations X/Y/Z, it was determined that Z-Portrait orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Z-Portrait orientation

Worst-case data rates were:

GFSK mode: DH5
8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest power.

BT and Wifi bands do not transmit simultaneously.

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID/ DoC**
Laptop AC/DC Adapter	Lenovo	ADLX45DLCC2A	11S36200283ZZ10051KU2U	DoC
Laptop	Lenovo	ThinkPad X1 Carbon	R9-0G4NPM 15/06	DoC
AC/DC Adapter	HomeSpot	S005BPU0500100	N/A	DoC
EUT Charger	Fitbit	N/A	Proto 1	DoC

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	**Port**	**# of identical**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC	1	AC	Unshielded	1	AC Mains to AC/DC Adapter
2	DC	1	DC	Unshielded	1.5	AC/DC Adapter to Laptop
3	USB	1	USB	Unshielded	1	Laptop to EUT
4	Antenna	1	SMA	Unshielded	0.08	To spectrum analyzer

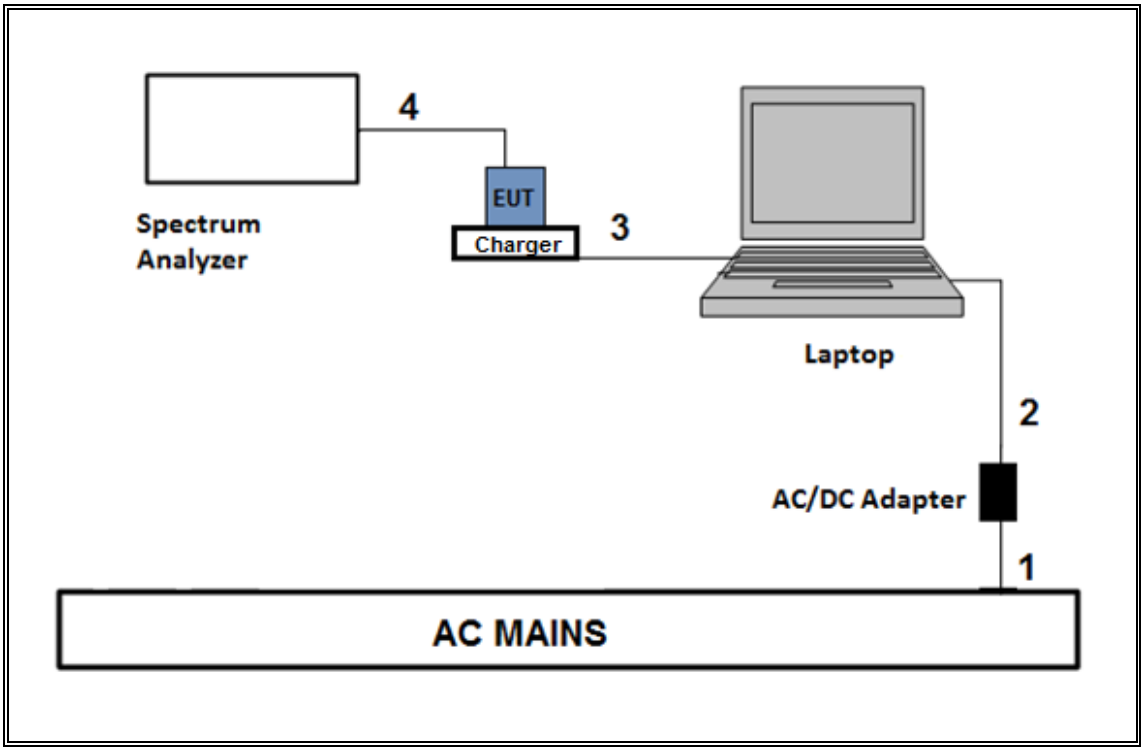
I/O CABLES (AC POWER CONDUCTED TEST AND RADIATED TEST)

I/O Cable List						
Cable No	**Port**	**# of identical**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB	1	USB	Unshielded	1	Charger to AC/DC adapter

TEST SETUP-CONDUCTED TEST

The EUT was placed in charger and powered by host laptop. Test software exercised the EUT.

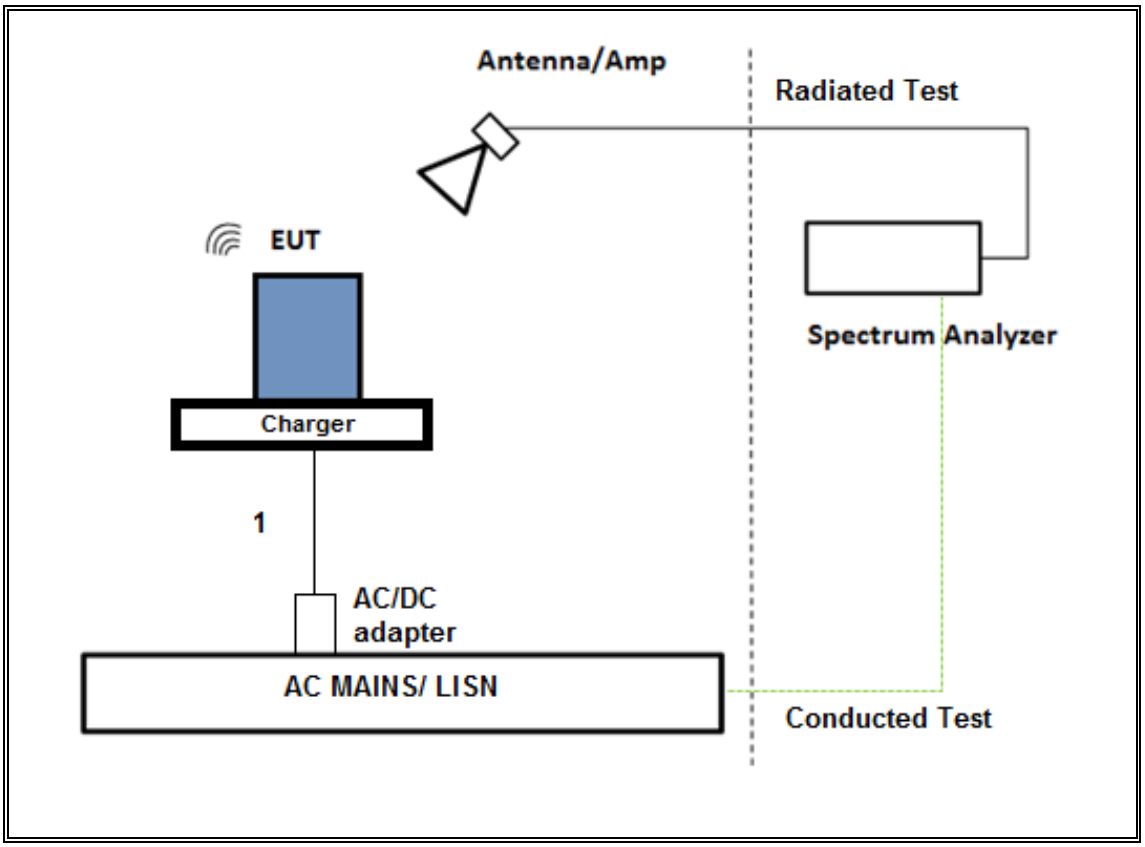
SETUP DIAGRAM



TEST SETUP- AC LINE CONDUCTED TEST AND RADIATED TEST

The EUT was placed in charger and powered by an AC/DC adapter. Test software exercised the EUT.

SETUP DIAGRAM



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**	**ID Num**	**Cal Due**	**Last Cal**
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T1265	01/29/2020	01/29/2019
Power Sensor, P-series, 50MHz to 18GHz, Wideband	Agilent (Keysight) Technologies	N1921A	T1227	02/05/2020	02/05/2019
Antenna, Passive Loop 30Hz to 1MHz	ELETRO METRICS	EM-6871	PRE0179465	05/22/2019	05/22/2018
Antenna, Passive Loop 100kHz to 30MHz	ELETRO METRICS	EM-6872	PRE0179467	05/22/2019	05/22/2018
Amplifier, 100kHz to 1GHz, 32 dB	Sonoma Instrument	310	PRE0180175	07/09/2019	07/09/2018
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T344*	04/30/2019	04/30/2018
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T863	06/21/2019	06/21/2018
Amplifier, 1 to18GHz, 35dB	AMPLICAL	AMP1G18-35	T1569*	04/30/2019	04/30/2018
Antenna, Horn 1-18GHz	AR	AMPL-ATH1G18	PRE0189055	04/20/2020	04/20/2018
Amplifier, 1 to18GHz, 35dB	AMPLICAL	AMP1G18-35	T1571	07/30/2019	07/30/2018
Hybrid Antenna, 30MHz to 3GHz	SunAR rf motion	JB3	PRE0181575	08/01/2019	08/01/2018
Amplifier, 100kHz to 1GHz, 32 dB	Sonoma Instrument	310	PRE0180174	05/31/2019	05/31/2018
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	PRE0182188	08/29/2019	08/29/2018
Rf Amplifier, 18-26.5GHz, 60dB gain	Amplical	AMP18G26.5-60	PRE0181238	05/01/2020	05/01/2019
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179367	02/14/2020	02/14/2019
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179377	02/15/2020	02/15/2019
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179376	02/14/2020	02/14/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T908	01/23/2020	01/23/2019
Spectrum Analyzer, PSA, 3Hz to 26.5GHz	Agilent (Keysight) Technologies	E4440A	T200	01/28/2020	01/28/2019
AC Line Conducted					
EMI Receiver	Rohde & Schwarz	ESR	T1436	02/14/2020	02/14/2019
LISN for Conducted Emissions CISPR-16	FCC INC.	FCC LISN 50/250	T1310	01/24/2020	01/24/2019
Test Software List					
Radiated Software	UL	UL EMC		Ver 9.5, June 22, 2018 & Jan 11, 2019	
Antenna Port Software	UL	UL RF		Ver 9.6, April 18, 2019	
AC Line Conducted Software	UL	UL EMC		Ver 9.5, May 26, 2015	

* Testing performed before calibration due date.

7. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

Occupied BW (20dB): ANSI C63.10-2013 Section 6.9.2

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Carrier Frequency Separation: ANSI C63.10-2013 Section 7.8.2

Number of Hopping Frequencies: ANSI C63.10-2013 Section 7.8.3

Time of Occupancy (Dwell Time): ANSI C63.10-2013 Section 7.8.4

Peak Output Power: ANSI C63.10-2013 Section 7.8.5

Conducted Spurious Emissions: ANSI C63.10-2013 Section 7.8.8

Conducted Band-Edge: ANSI C63.10-2013 Section 6.10.4

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

Radiated Spurious Emissions 30-1000MHz: ANSI C63.10-2013 Section 6.3 and 6.5

Radiated Spurious Emissions above 1GHz: ANSI C63.10-2013 Section 6.3 and 6.6

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5

AC Power-line conducted emissions: ANSI C63.10-2013, Section 6.2.

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

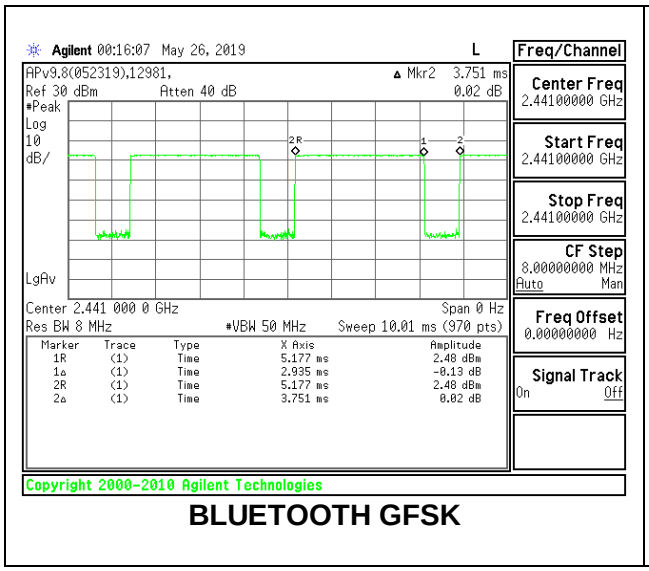
ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

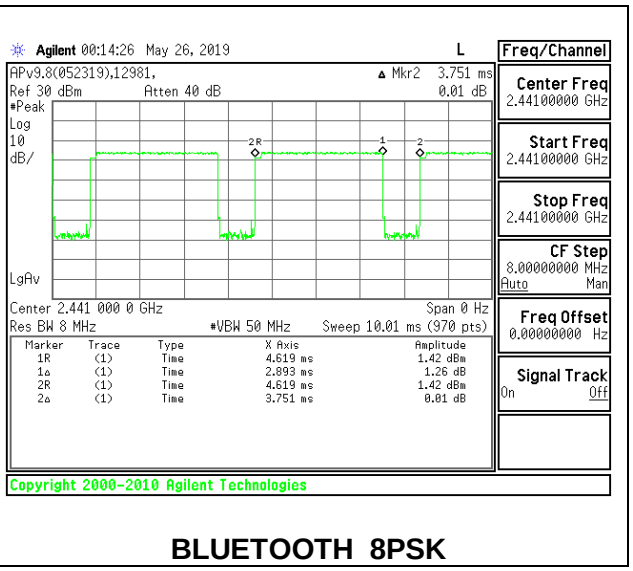
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
Bluetooth GFSK	2.94	3.75	0.782	78.2%	1.07	0.341
Bluetooth 8PSK	2.89	3.75	0.771	77.1%	1.13	0.346

DUTY CYCLE PLOTS

Tester ID:	10649 JR



BLUETOOTH GFSK



BLUETOOTH 8PSK

8.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

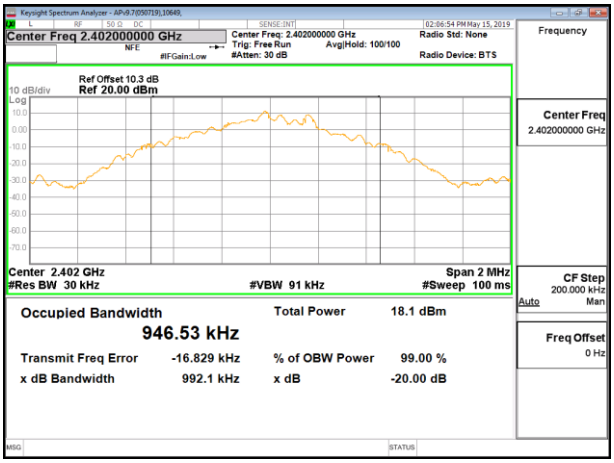
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

RESULTS

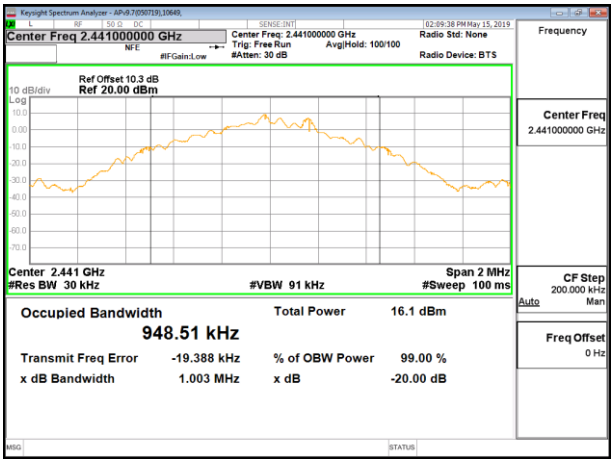
UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

8.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

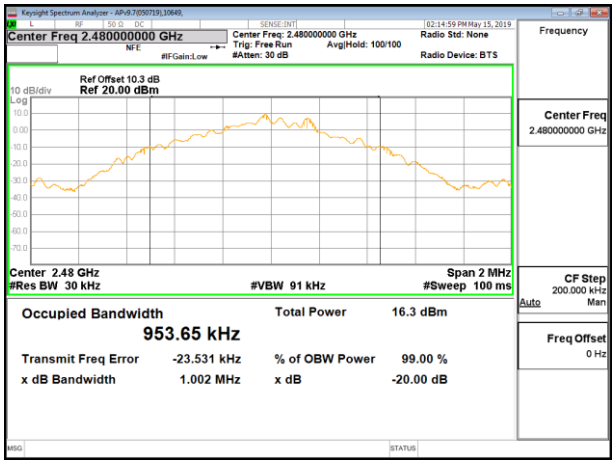
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.992	0.947
Mid	2441	1.003	0.949
High	2480	1.002	0.954



LOW CHANNEL



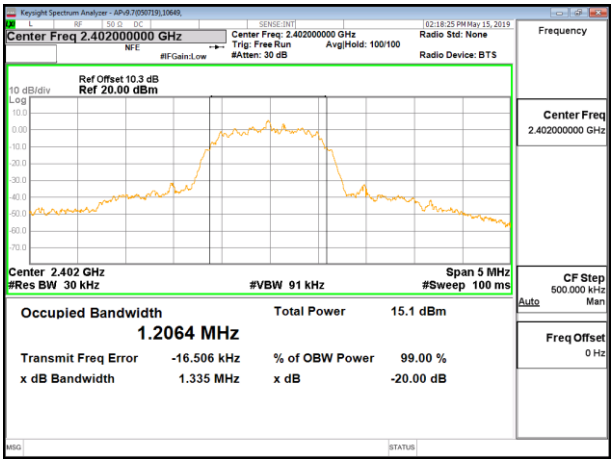
MID CHANNEL



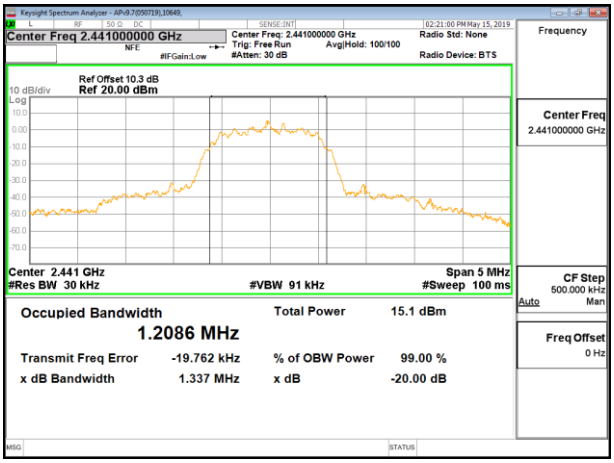
HIGH CHANNEL

8.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

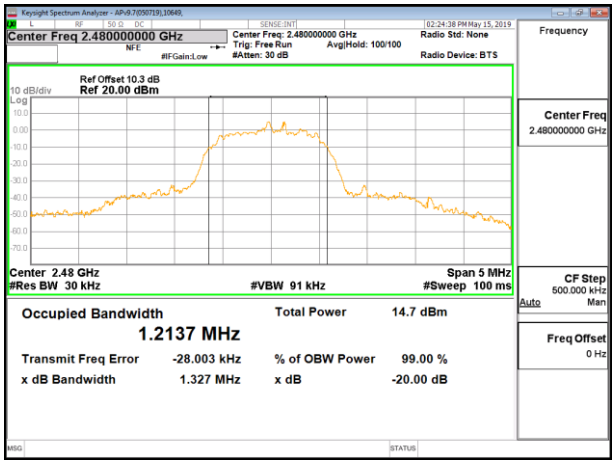
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.335	1.206
Mid	2441	1.337	1.209
High	2480	1.327	1.214



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.3. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

RSS-247 (5.1) (b)

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

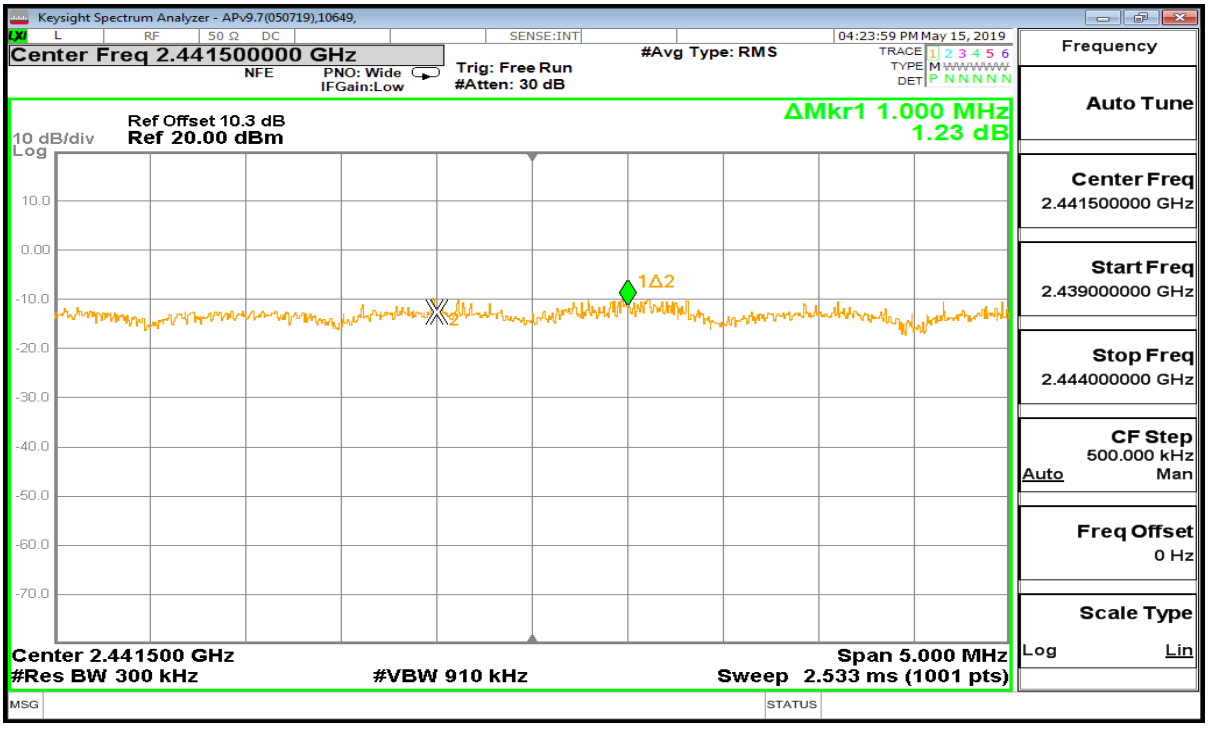
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to VBW >= RBW. The sweep time is coupled.

RESULTS

8.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

HOPPING FREQUENCY SEPARATION PLOT

8.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

8.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

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

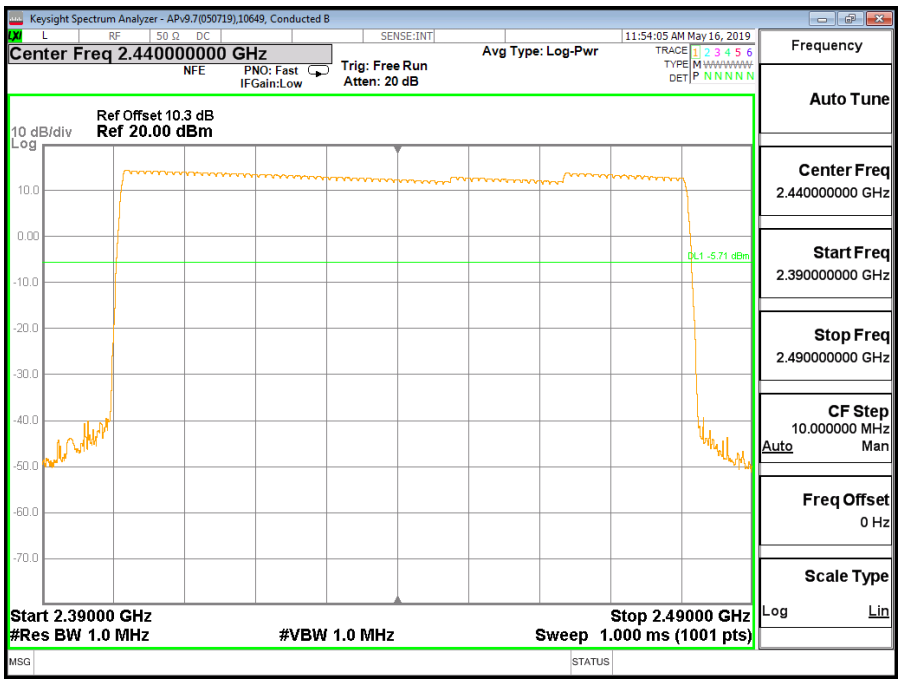
TEST PROCEDURE

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.

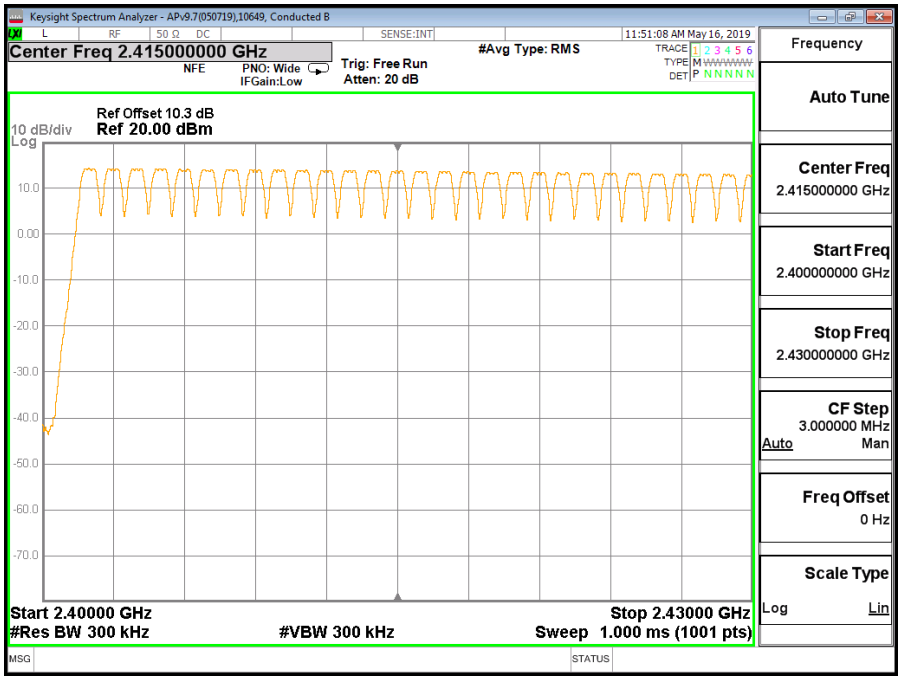
RESULTS

Normal Mode: 79 Channels Observed

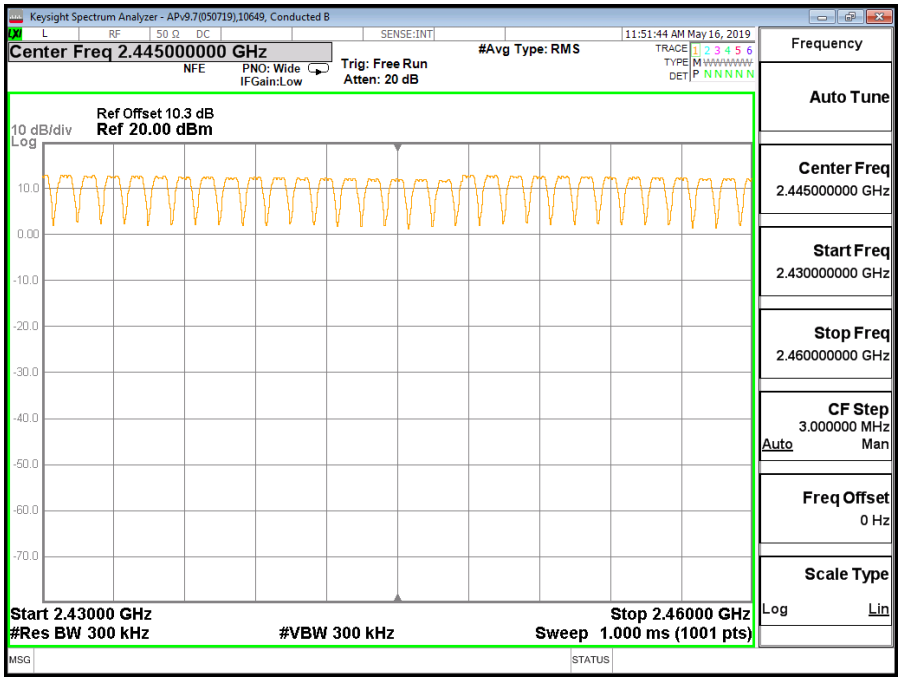
8.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



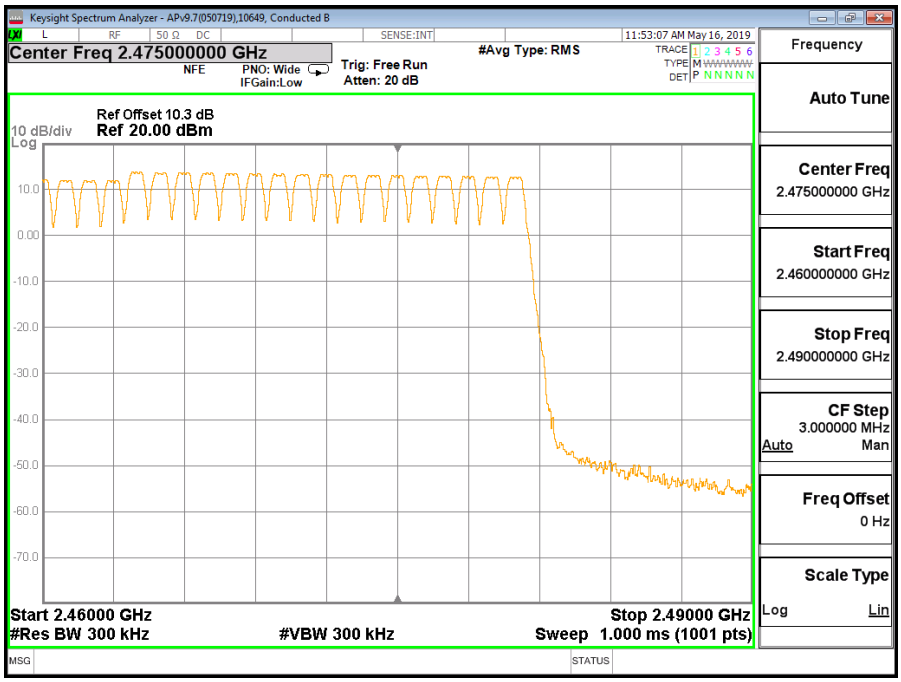
100MHz SPAN



30MHz SPAN, SEGMENT 1 OF 3

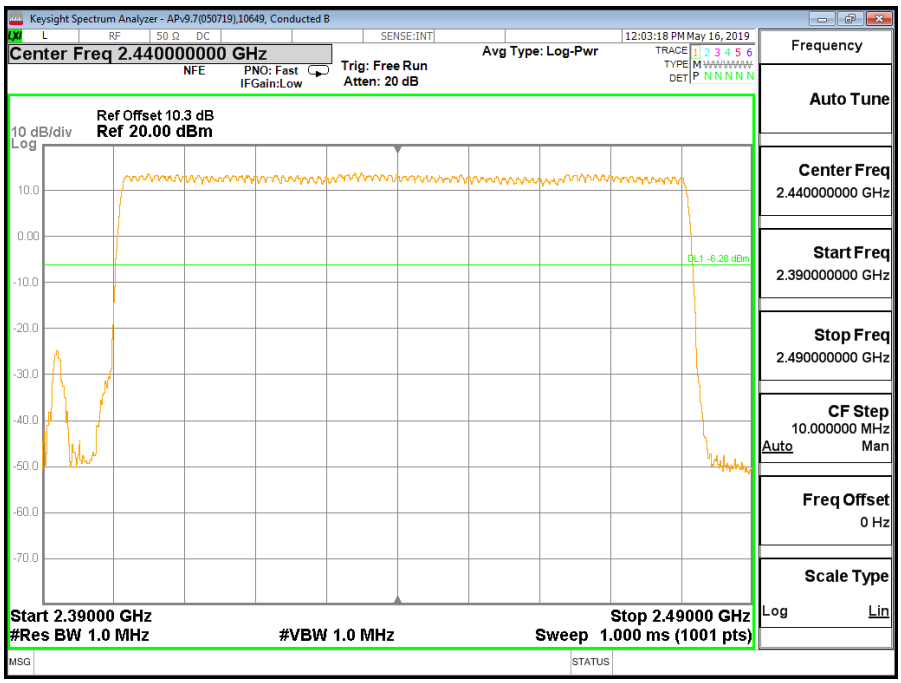


30MHz SPAN, SEGMENT 2 OF 3

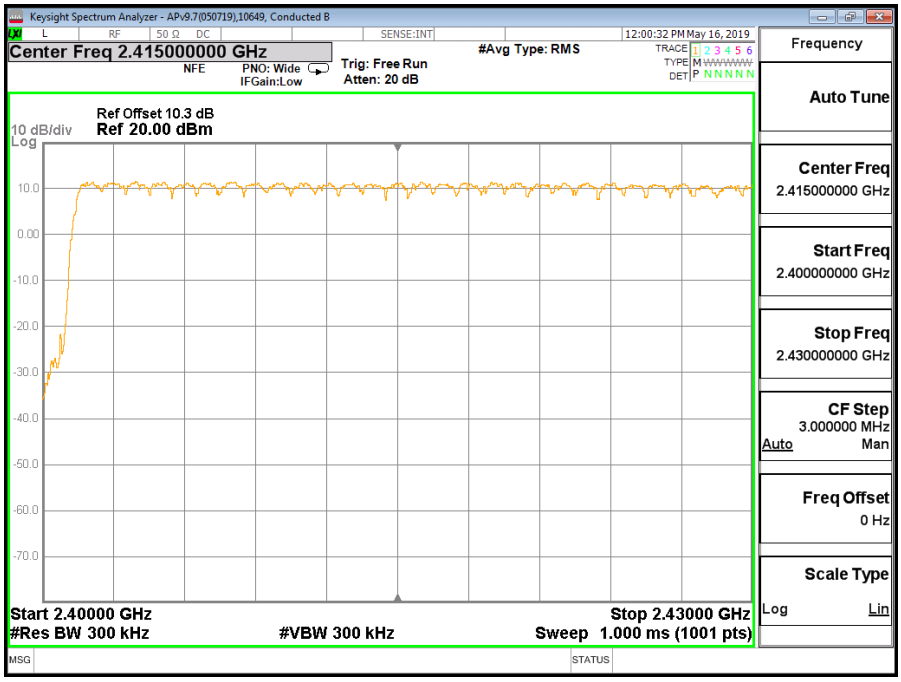


30MHz SPAN, SEGMENT 3 OF 3

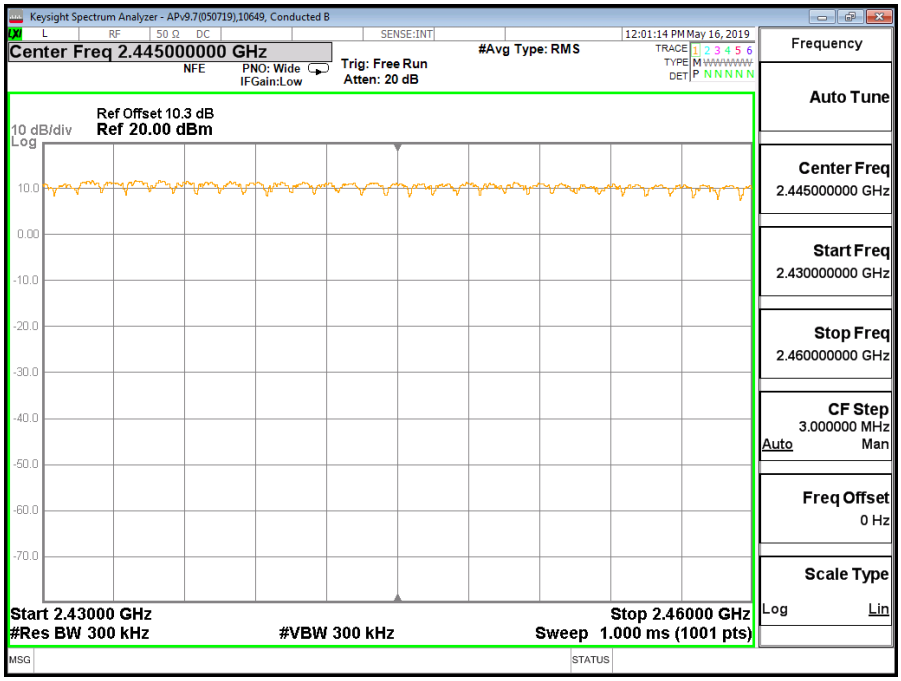
8.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



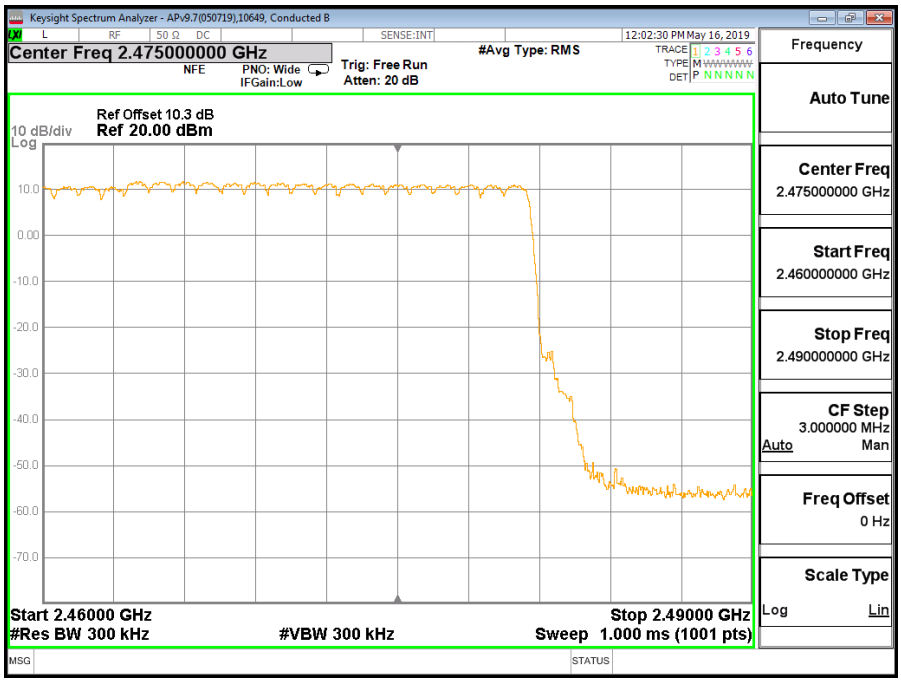
100MHz SPAN



30MHz SPAN, SEGMENT 1 OF 3



30MHz SPAN, SEGMENT 2 OF 3



30MHz SPAN, SEGMENT 3 OF 3

8.5. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

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 3.16 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

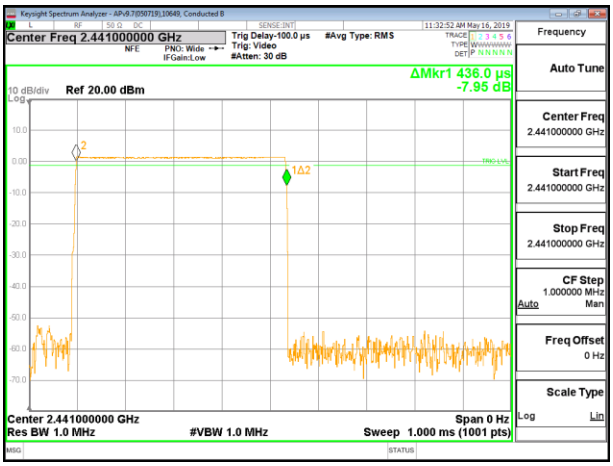
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

RESULTS

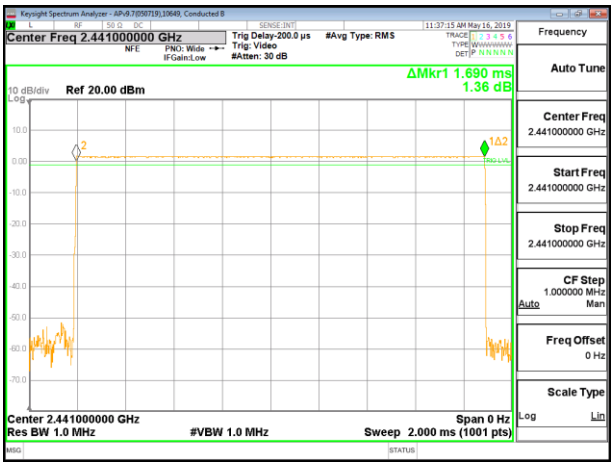
UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

8.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

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	0.436	32	0.1395	0.4	-0.2605
DH3	1.690	16	0.2704	0.4	-0.1296
DH5	2.940	11	0.3234	0.4	-0.0766
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	0.436	8	0.03488	0.4	-0.3651
DH3	1.690	4	0.06760	0.4	-0.3324
DH5	2.940	2.75	0.08085	0.4	-0.3192

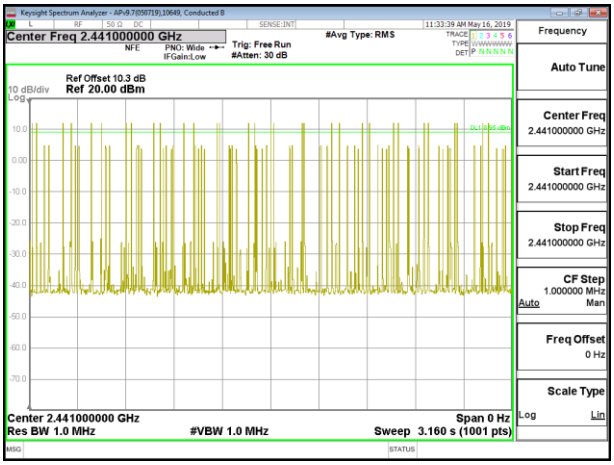


PULSE WIDTH – DH1

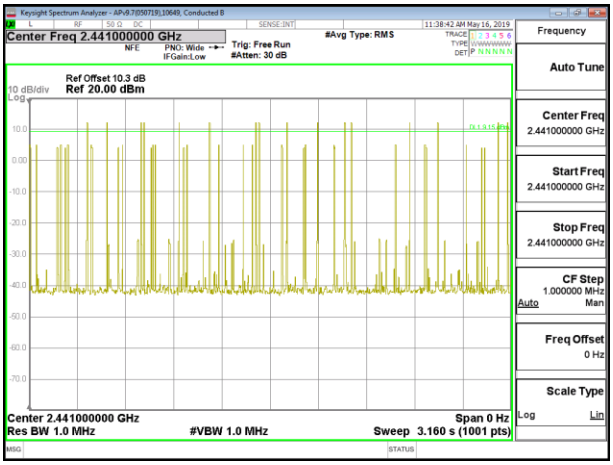


PULSE WIDTH – DH3

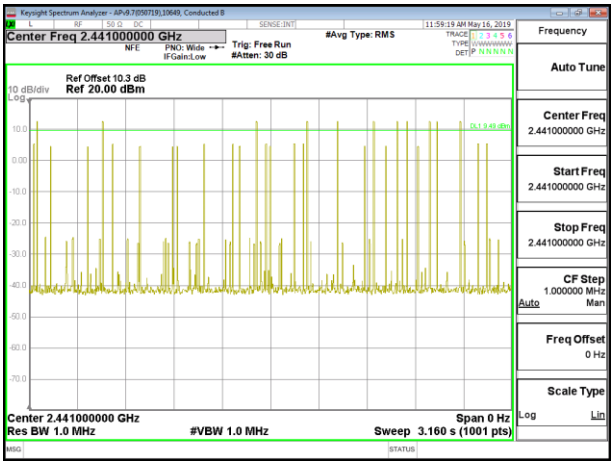
PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3

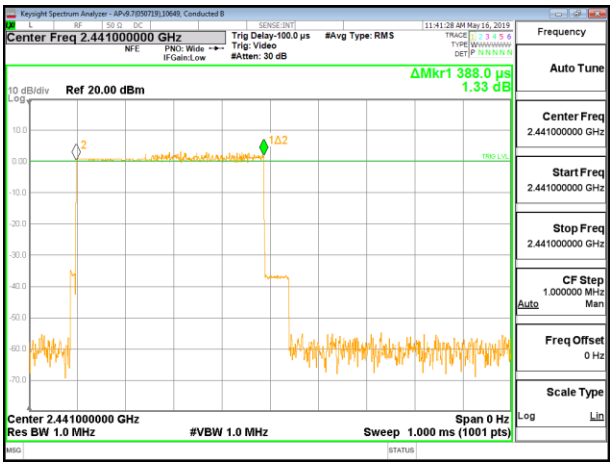


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5

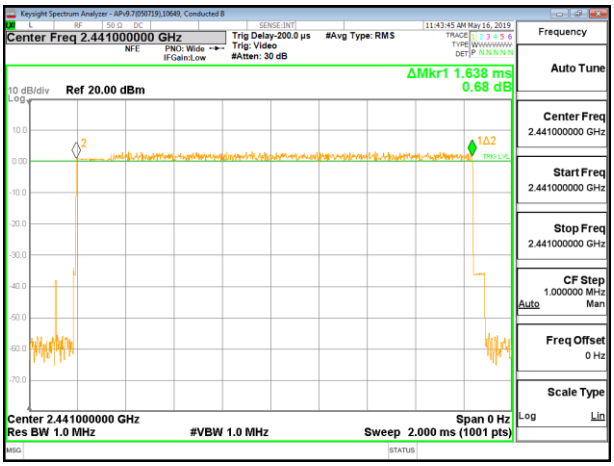
8.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
8PSK (EDR) Mode					
3DH1	0.338	32	0.10816	0.4	-0.29184
3DH3	1.638	14	0.22932	0.4	-0.17068
3DH5	2.94	12	0.3528	0.4	-0.0472

Note: for AFH(8PSK) mode, please refer to the results of AFH(GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate demonstrates compliance with channel occupancy when AFH is employed.

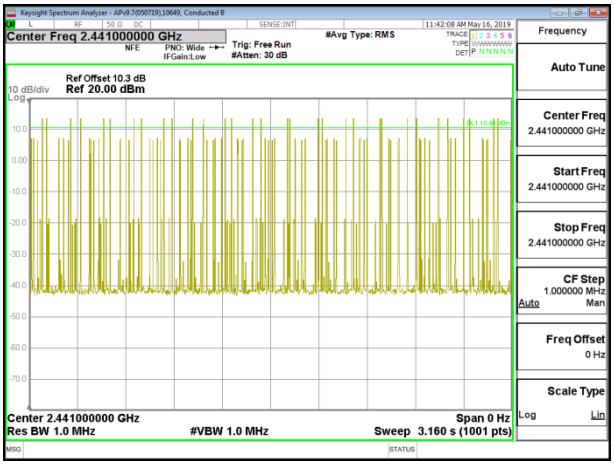


PULSE WIDTH – 3DH1

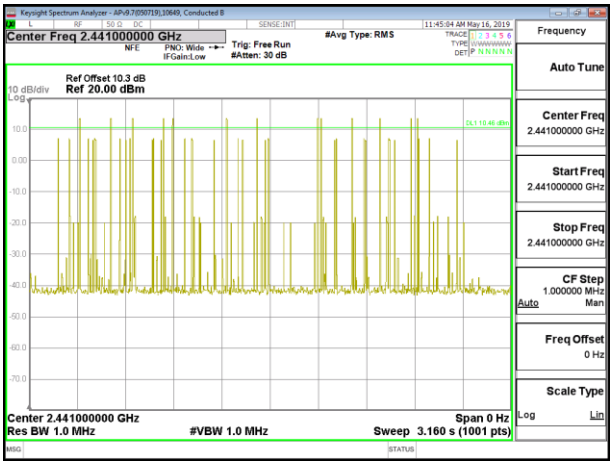


PULSE WIDTH – 3DH3

PULSE WIDTH – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH3

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5

8.6. OUTPUT POWER

LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

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

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

The cable assembly insertion loss of 10.3 dB (including 10 dB pad and 0.3 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

RESULTS

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

8.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	10649 JR
Date:	5/15/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	14.01	21	-6.99
Middle	2441	12.22	21	-8.78
High	2480	12.64	21	-8.36

8.6.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	10649 JR
Date:	5/15/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.50	21	-7.5
Middle	2441	13.89	21	-7.11
High	2480	13.66	21	-7.34

8.6.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	10649 JR
Date:	5/15/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.48	21	-7.52
Middle	2441	13.45	21	-7.55
High	2480	13.04	21	-7.96

8.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

The cable assembly insertion loss of 10.3 dB (including 10 dB pad and 0.3 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

8.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	10649 JR
Date:	5/15/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	13.86
Middle	2441	12.03
High	2480	12.49

8.7.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	10649 JR
Date:	5/15/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.29
Middle	2441	11.66
High	2480	10.98

8.7.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	10649 JR
Date:	5/15/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.08
Middle	2441	11.11
High	2480	10.91

8.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

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.

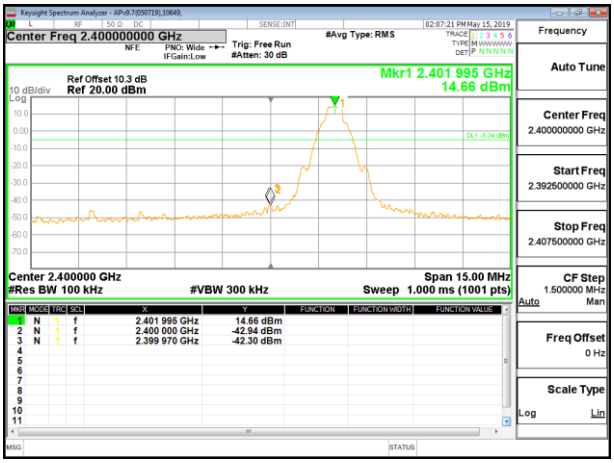
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

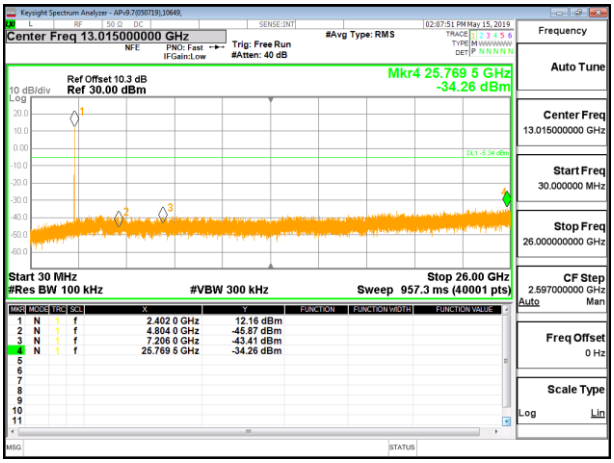
RESULTS

8.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

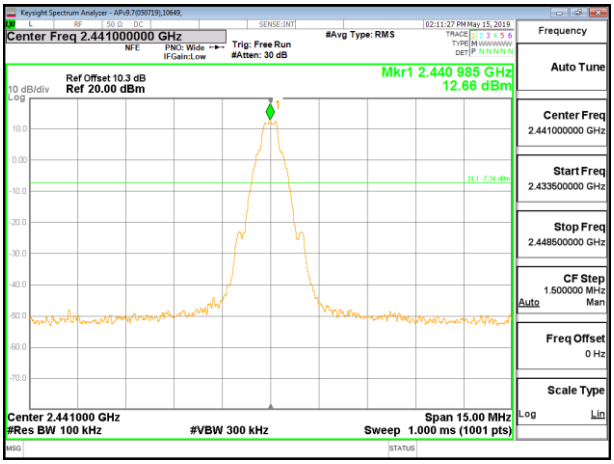
SPURIOUS EMISSIONS, NON-HOPPING



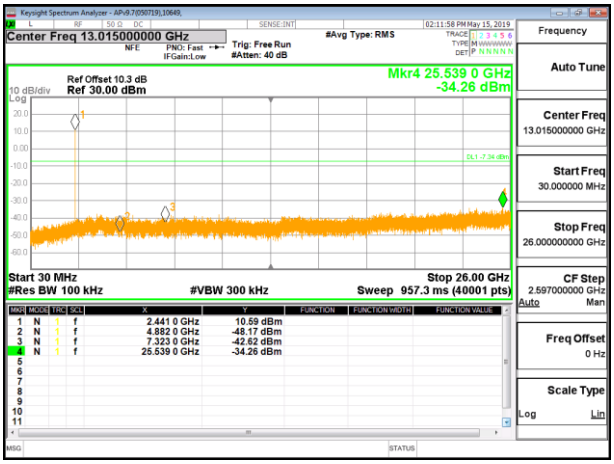
LOW CHANNEL BANDEDGE



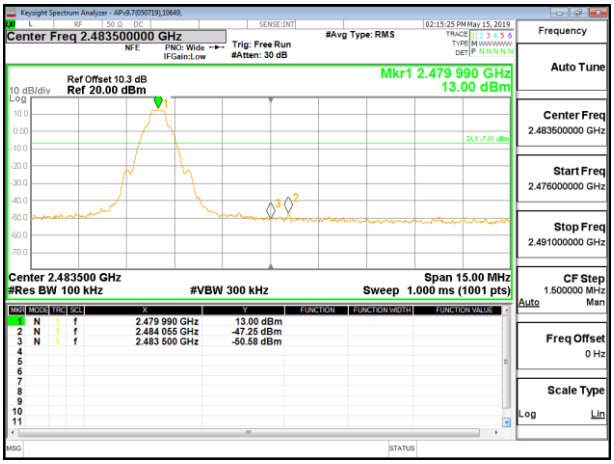
OUT-OF-BAND LOW CHANNEL



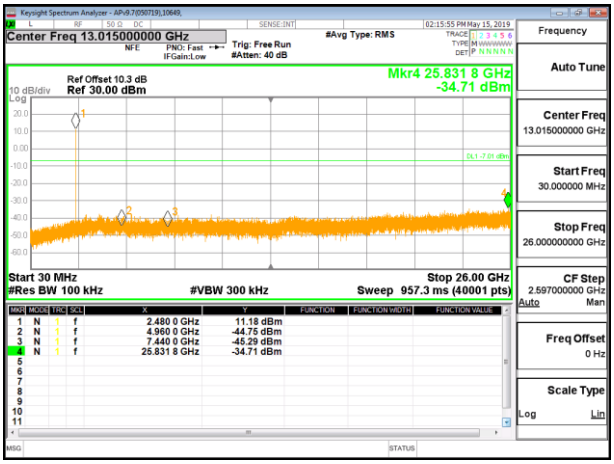
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

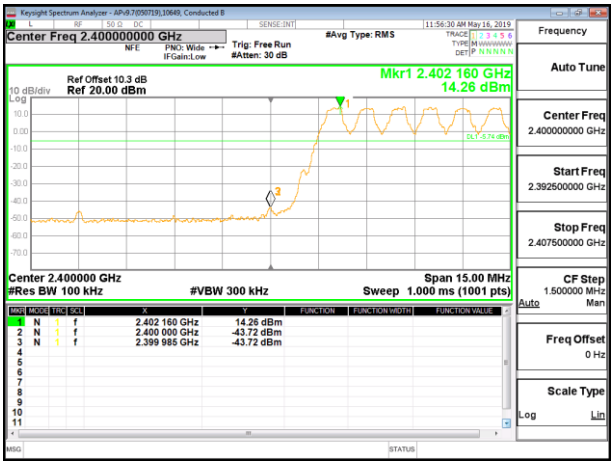


HIGH CHANNEL BANDEDGE

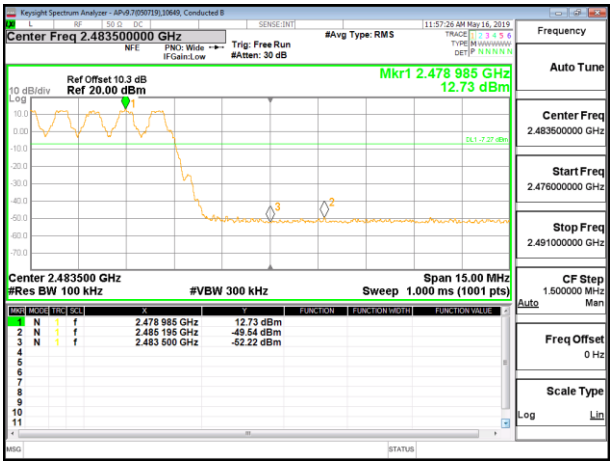


OUT-OF-BAND HIGH CHANNEL

SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



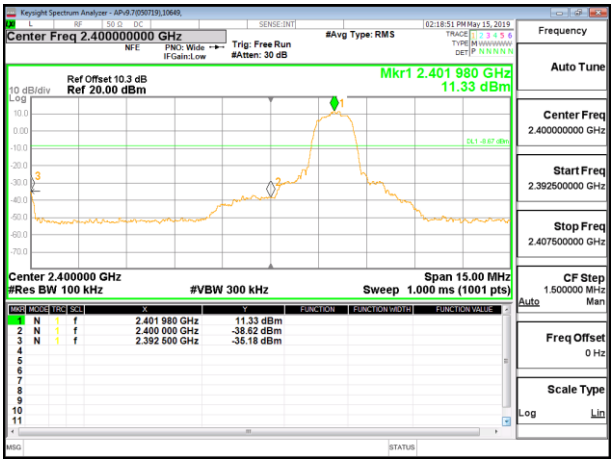
LOW BANDEDGE



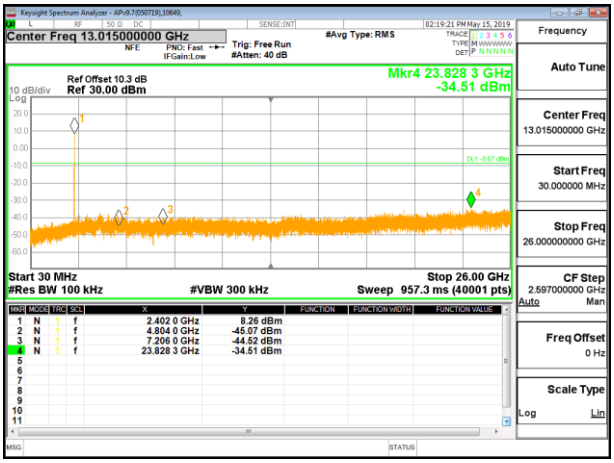
HIGH BANDEDGE

8.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

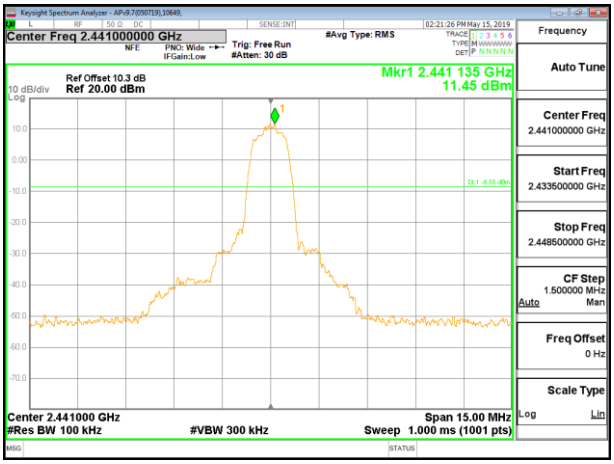
SPURIOUS EMISSIONS, NON-HOPPING



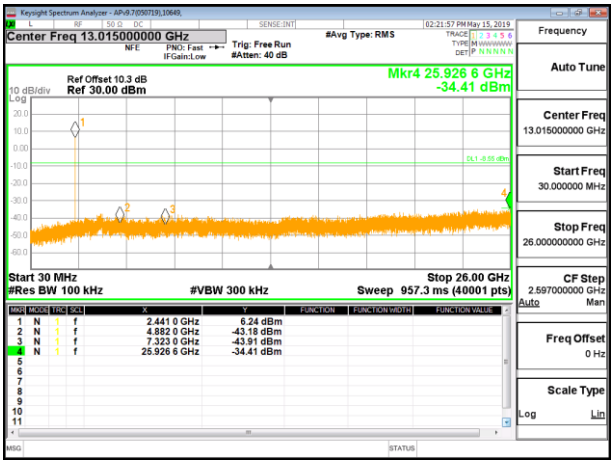
LOW CHANNEL BANDEDGE



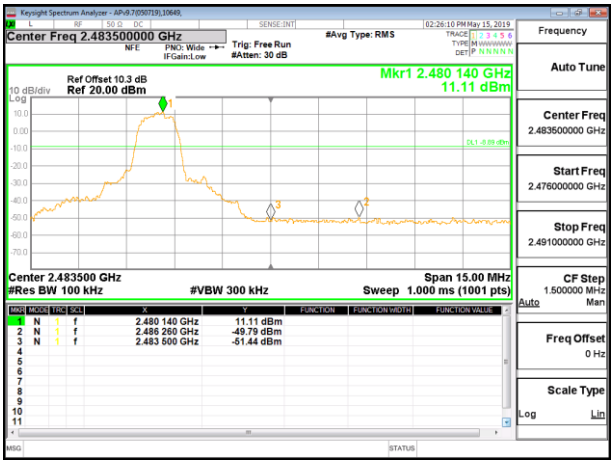
OUT-OF-BAND LOW CHANNEL



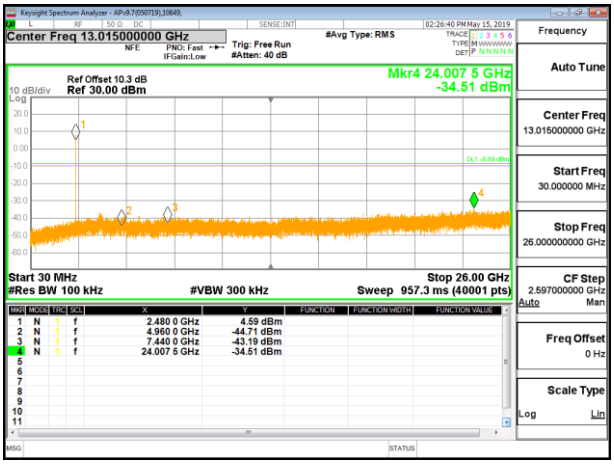
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

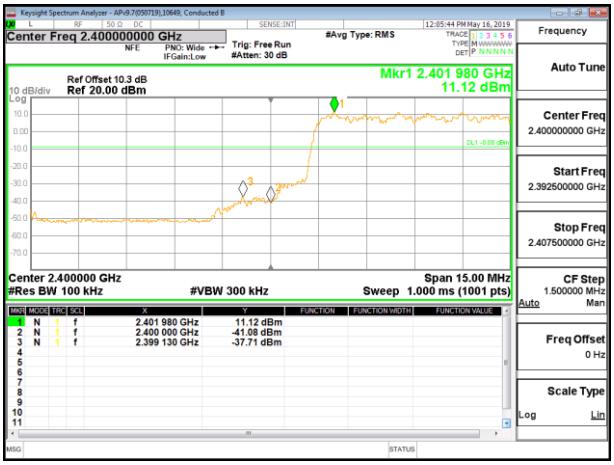


HIGH CHANNEL BANDEDGE

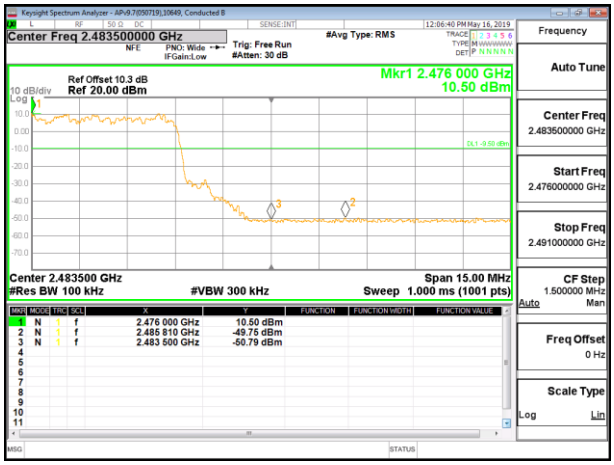


OUT-OF-BAND HIGH CHANNEL

SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

9. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

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) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

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 pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

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.

For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.

KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

Base 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.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

KDB 558074 D01 15.247 Meas Guidance v05r02

Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (i.e., not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period.

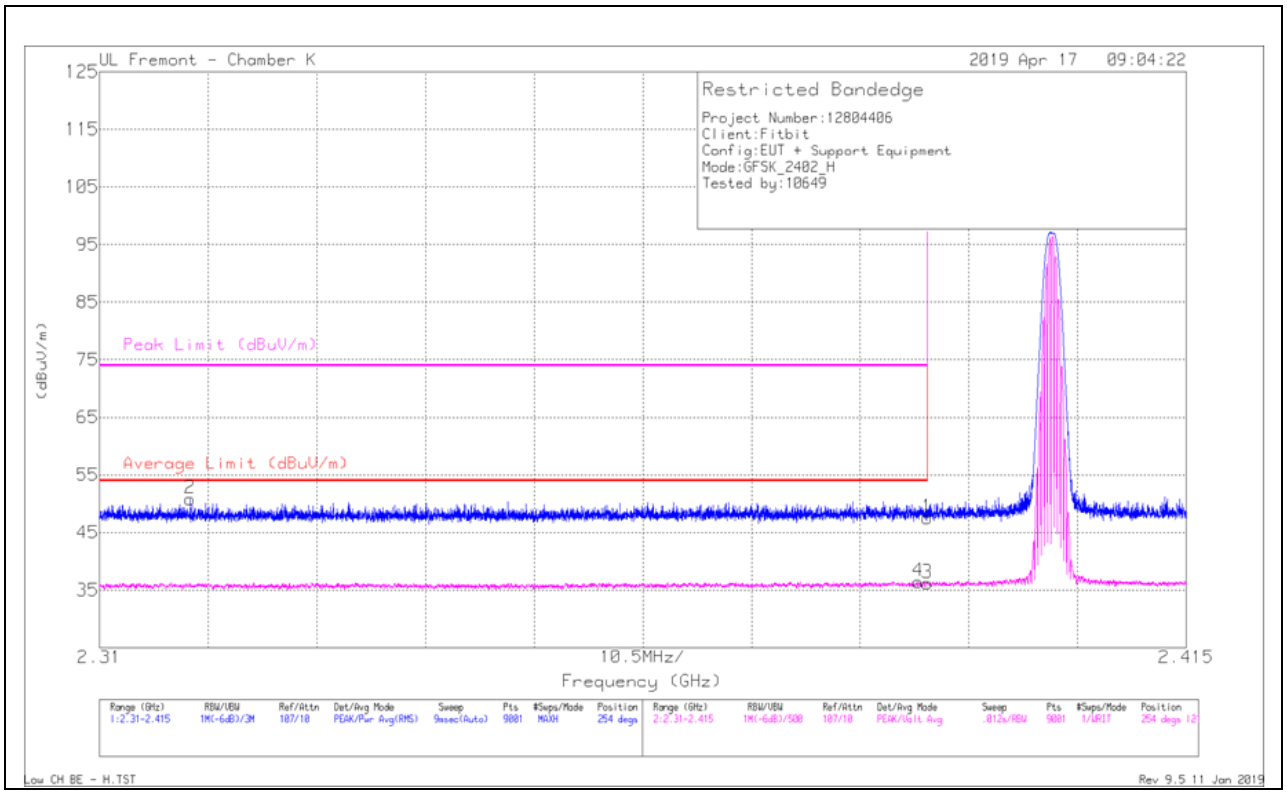
UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

9.1. TRANSMITTER ABOVE 1 GHz

9.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

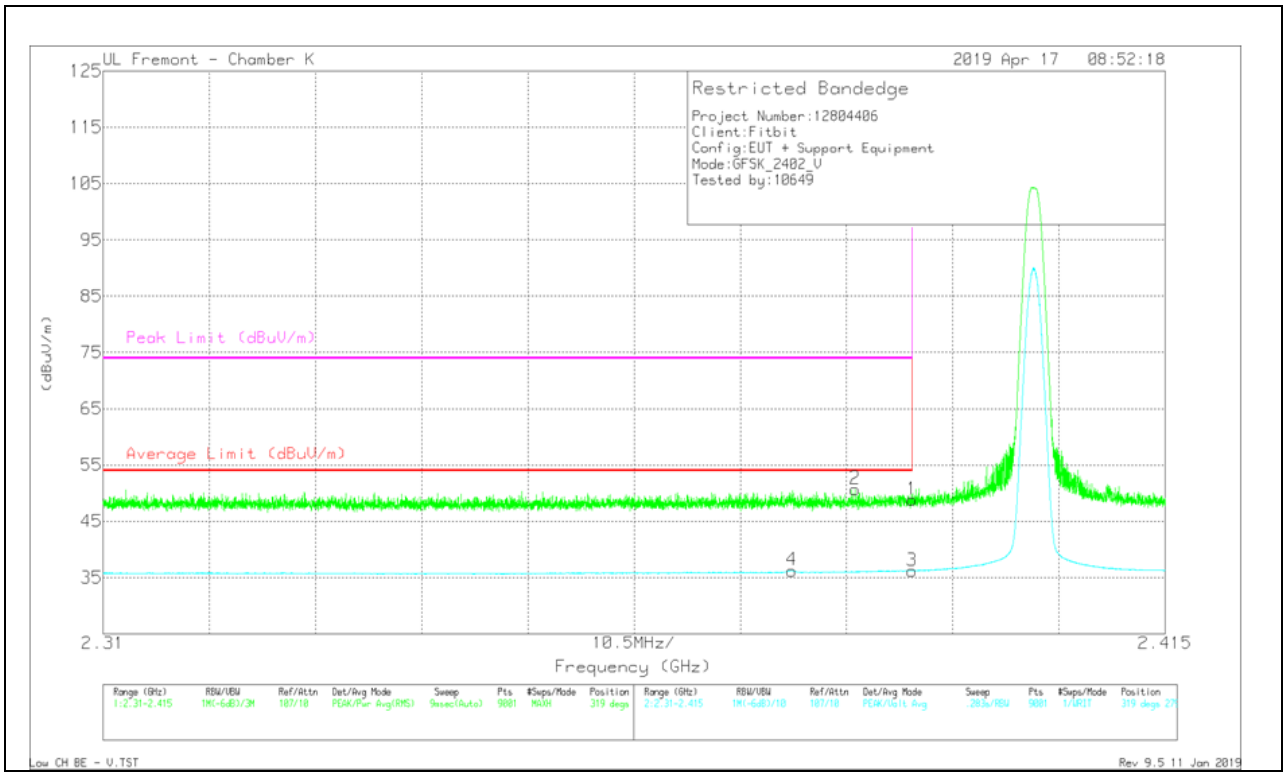
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (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	* 2.39	40.39	Pk	31.9	-24.7	47.59	-	-	74	-26.41	254	121	H
2	* 2.319	43.77	Pk	31.7	-24.6	50.87	-	-	74	-23.13	254	121	H
3	* 2.39	29.01	VA1T	31.9	-24.7	36.21	54	-17.79	-	-	254	121	H
4	* 2.389	29.29	VA1T	31.9	-24.7	36.49	54	-17.51	-	-	254	121	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT

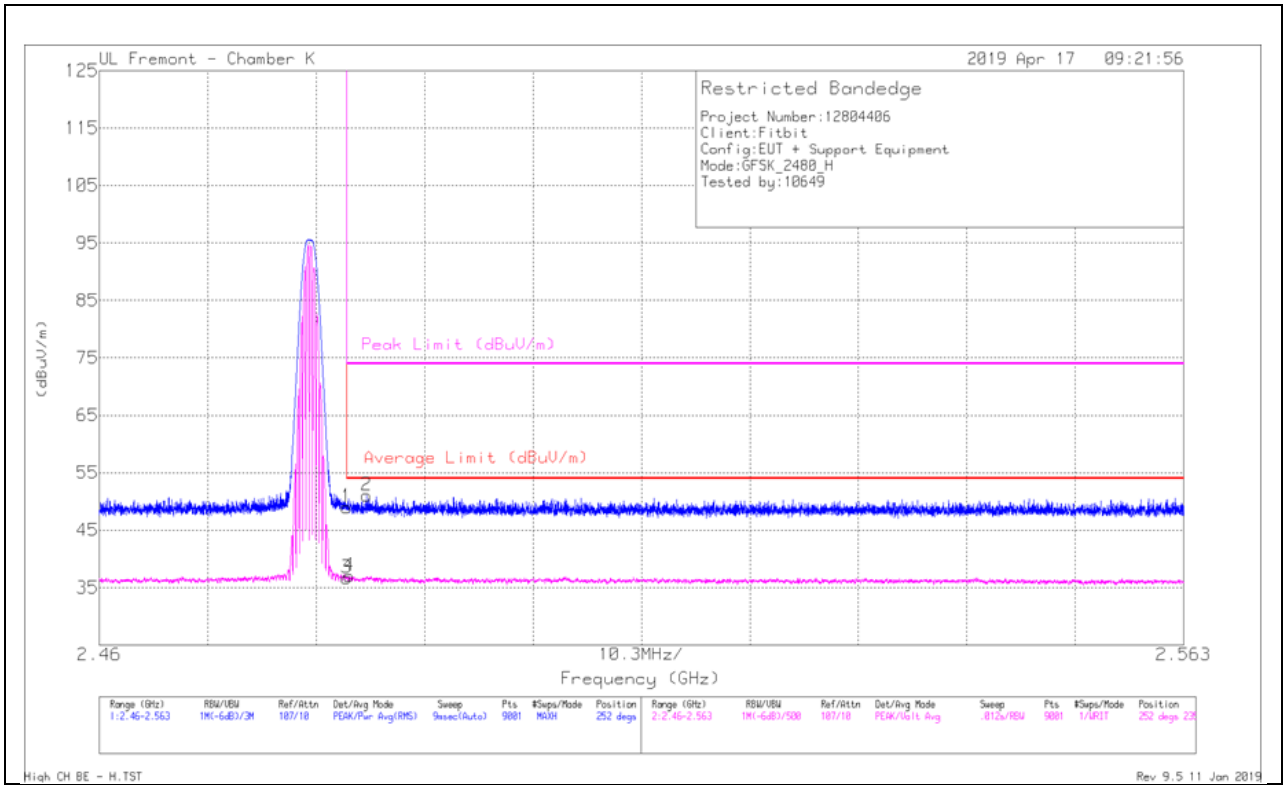


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr /Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.63	Pk	31.9	-24.7	48.83	-	-	74	-25.17	319	279	V
2	* 2.384	43.4	Pk	31.9	-24.6	50.7	-	-	74	-23.3	319	279	V
3	* 2.39	28.98	VA1T	31.9	-24.7	36.18	54	-17.82	-	-	319	279	V
4	* 2.378	29.15	VA1T	31.8	-24.7	36.25	54	-17.75	-	-	319	279	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

BANDEDGE (HIGH CHANNEL)

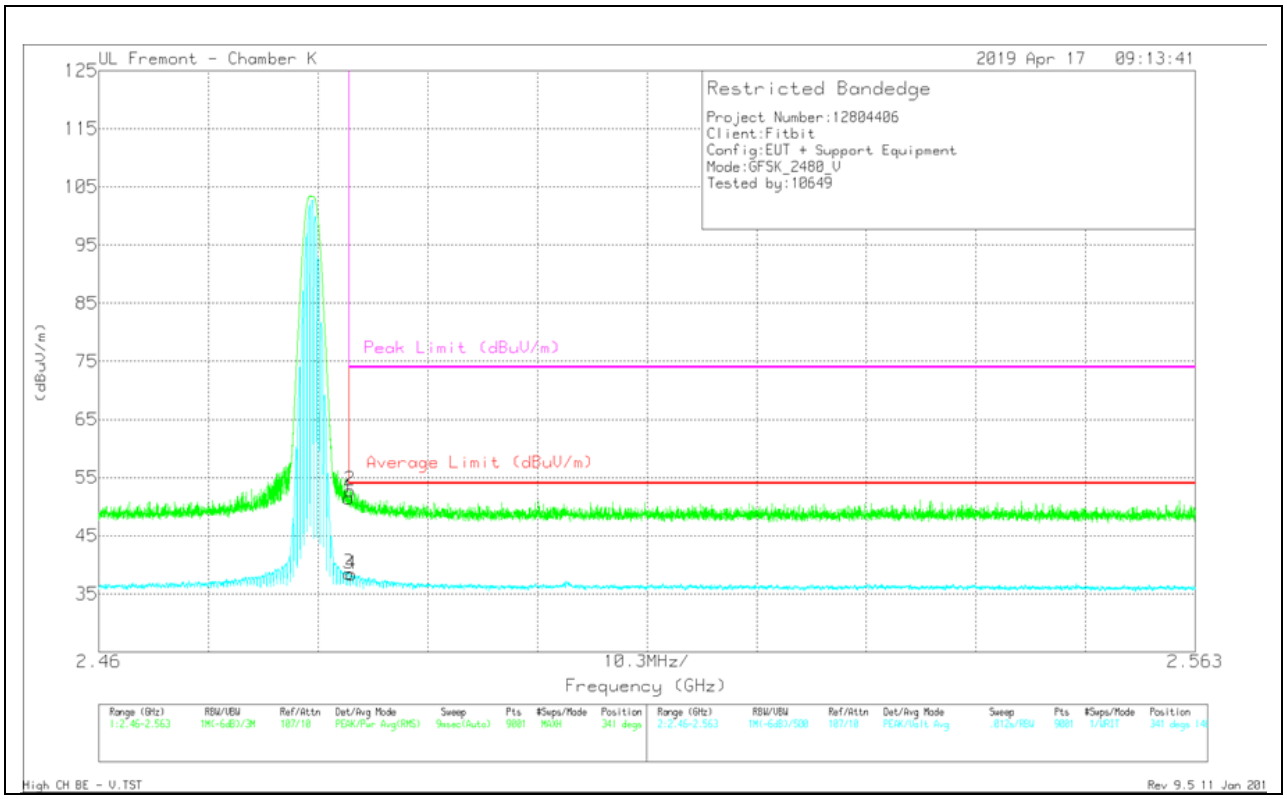
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (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	41.49	Pk	32.3	-24.8	48.99	-	-	74	-25.01	252	235	H
2	* 2.485	43.54	Pk	32.3	-24.8	51.04	-	-	74	-22.96	252	235	H
3	* 2.484	29.15	VA1T	32.3	-24.8	36.65	54	-17.35	-	-	252	235	H
4	* 2.484	29.54	VA1T	32.3	-24.8	37.04	54	-16.96	-	-	252	235	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT

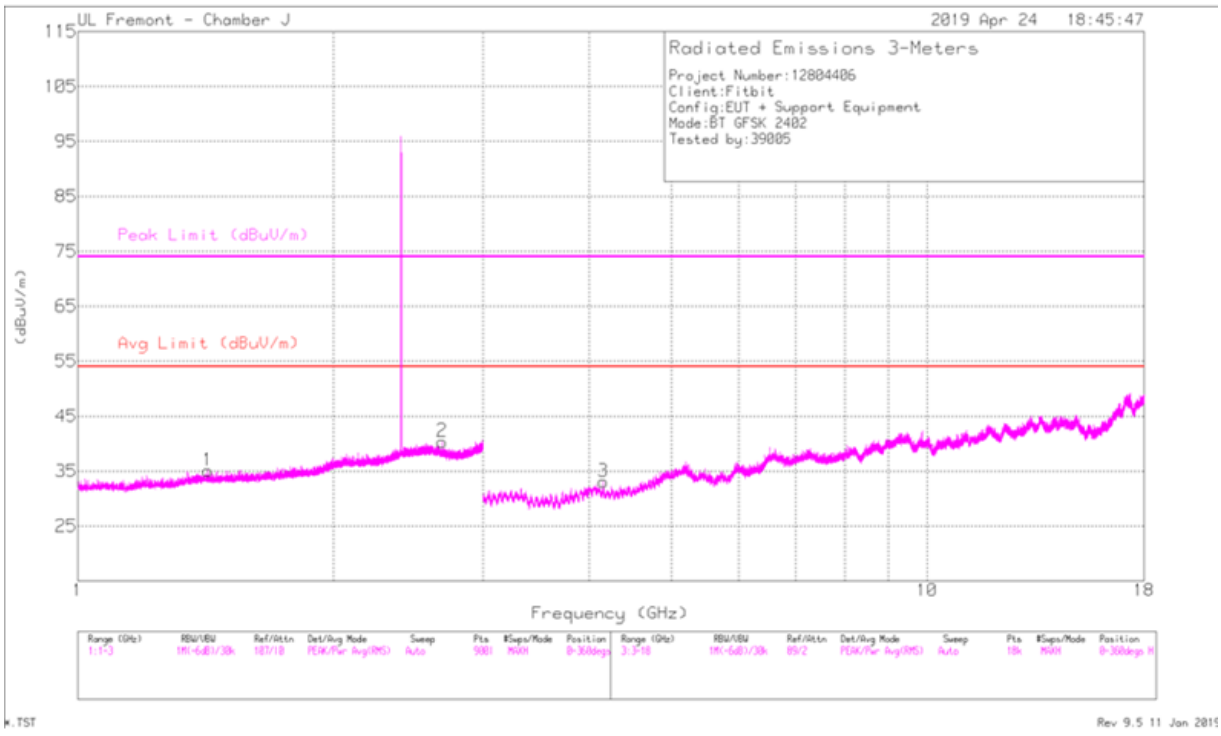


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr /Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	43.99	Pk	32.3	-24.8	51.49	-	-	74	-22.51	341	146	V
2	* 2.484	45.3	Pk	32.3	-24.8	52.8	-	-	74	-21.2	341	146	V
3	* 2.484	31.01	VA1T	32.3	-24.8	38.51	54	-15.49	-	-	341	146	V
4	* 2.484	30.86	VA1T	32.3	-24.8	38.36	54	-15.64	-	-	341	146	V

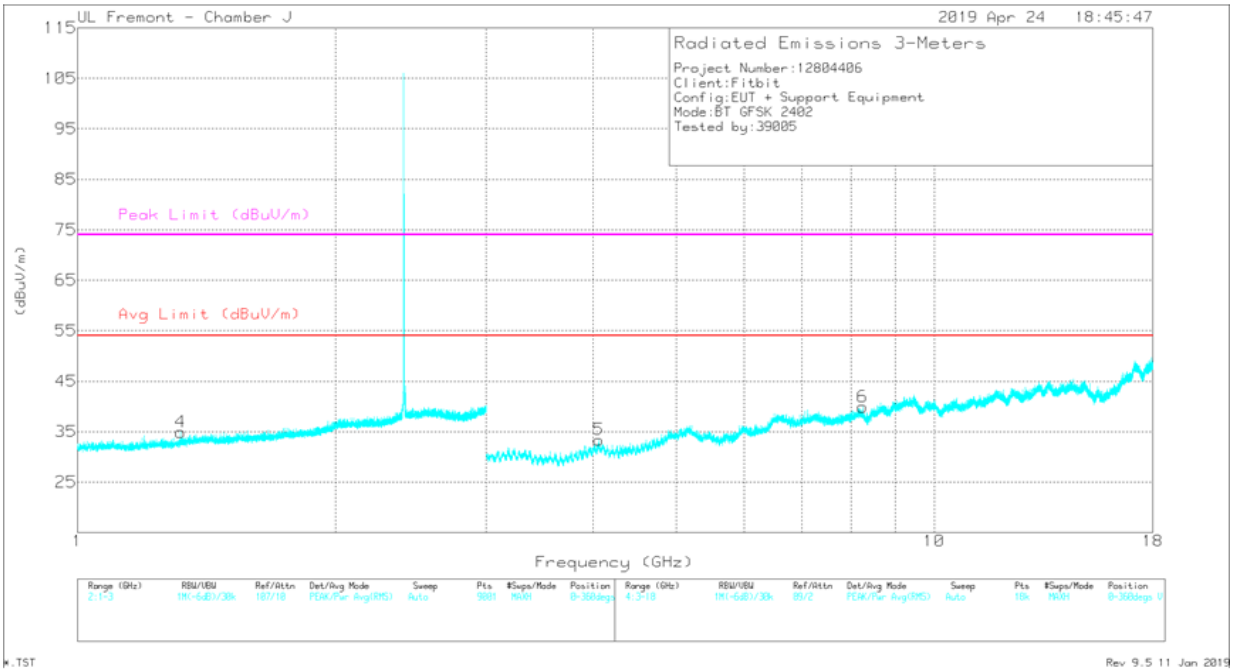
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

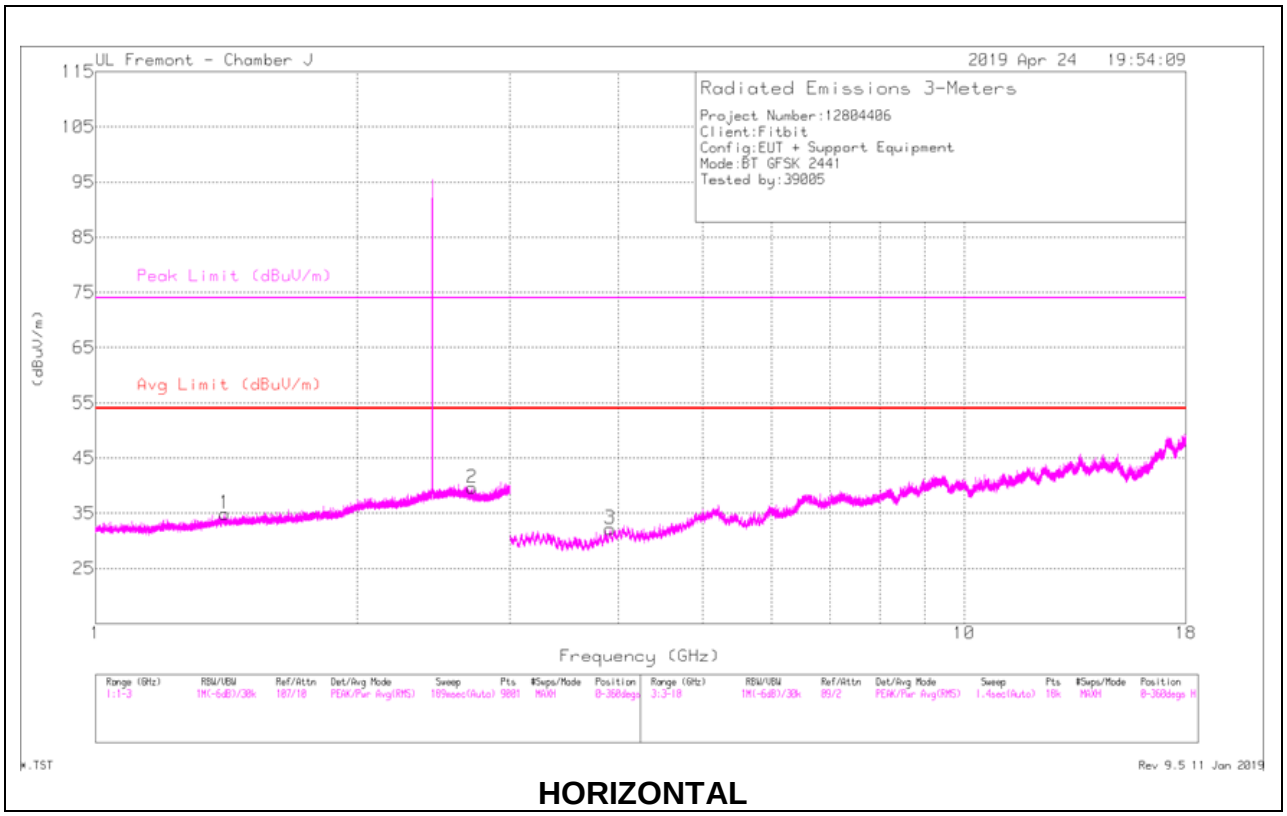
RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (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
* 1.424	42.61	PKFH	25.1	-26.1	41.61	-	-	74	-32.39	30	168	H
* 1.424	30.56	VA1T	25.1	-26.1	29.56	54	-24.44	-	-	30	168	H
* 2.686	42.34	PKFH	29.7	-25.5	46.54	-	-	74	-27.46	331	136	H
* 2.685	29.89	VA1T	29.7	-25.5	34.09	54	-19.91	-	-	331	136	H
* 1.318	43.29	PKFH	24.6	-26.1	41.79	-	-	74	-32.21	286	168	V
* 1.319	30.29	VA1T	24.6	-26.1	28.79	54	-25.21	-	-	286	168	V
* 4.164	39.7	PKFH	32.1	-31.9	39.9	-	-	74	-34.1	323	200	H
* 4.16	26.77	VA1T	32.1	-31.8	27.07	54	-26.93	-	-	323	200	H
* 4.061	40.17	PKFH	32.3	-32	40.47	-	-	74	-33.53	85	309	V
* 4.058	27.43	VA1T	32.3	-32	27.73	54	-26.27	-	-	85	309	V
* 8.249	35.07	PKFH	38.4	-26.5	46.97	-	-	74	-27.03	169	326	V
* 8.252	22.38	VA1T	38.4	-26.5	34.28	54	-19.72	-	-	169	326	V

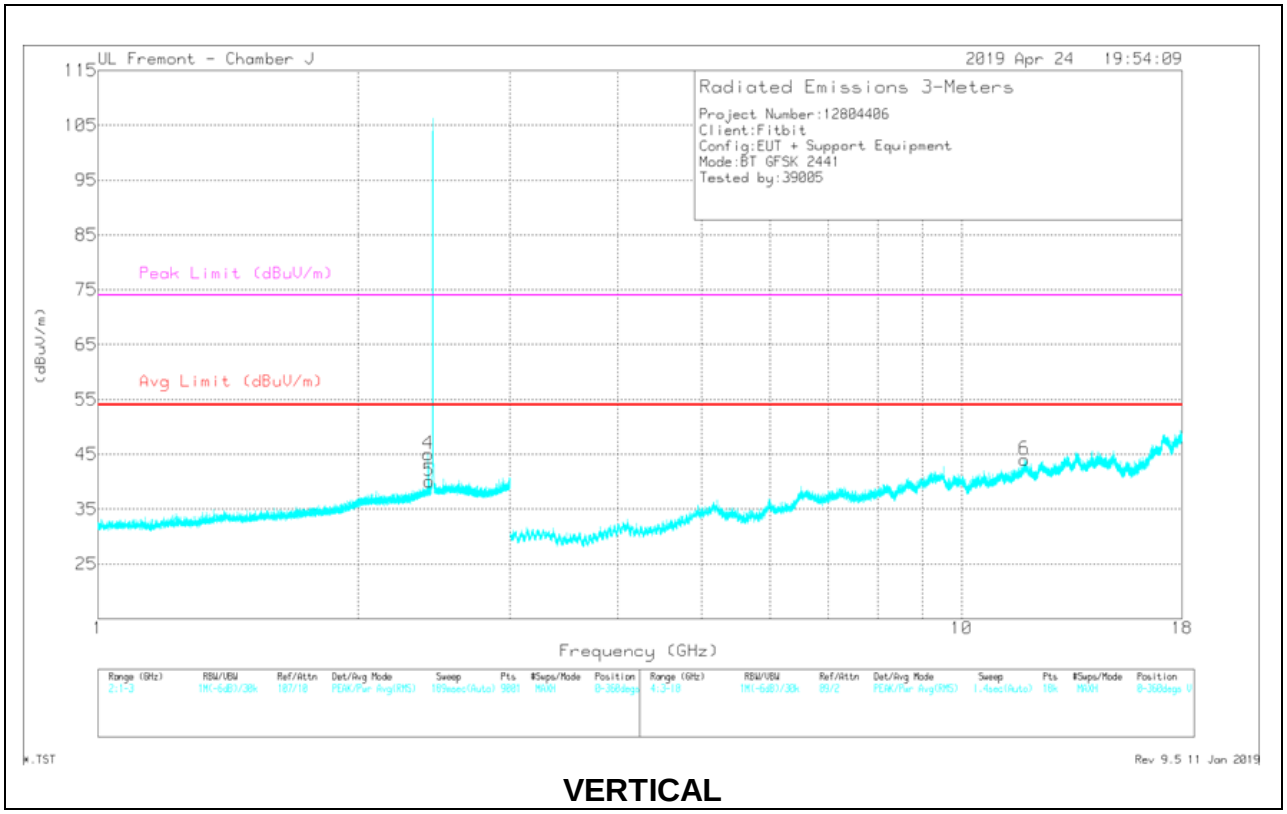
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

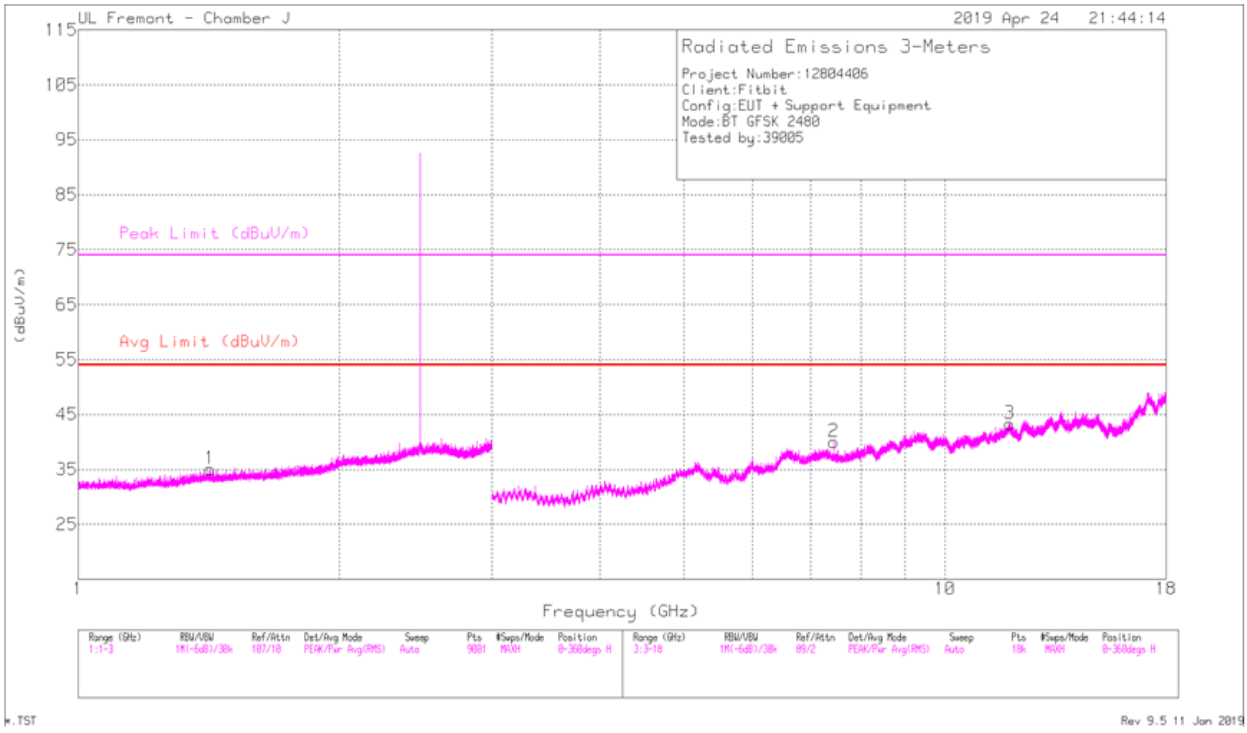
RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (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
* 1.407	43.25	PKFH	25.2	-26.1	42.35	-	-	74	-31.65	142	272	H
* 1.41	30.25	VA1T	25.2	-26.1	29.35	54	-24.65	-	-	142	272	H
* 2.712	42.38	PKFH	29.6	-25.5	46.48	-	-	74	-27.52	303	354	H
* 2.714	29.74	VA1T	29.6	-25.5	33.84	54	-20.16	-	-	303	354	H
2.411	47.03	PKFH	29.7	-25.8	50.93	-	-	-	-	304	354	V
2.411	30.16	VA1T	29.7	-25.8	34.06	-	-	-	-	304	354	V
2.417	42.25	PKFH	29.7	-25.8	46.15	-	-	-	-	310	386	V
2.417	30.49	VA1T	29.7	-25.8	34.39	-	-	-	-	310	386	V
* 3.914	39.45	PKFH	32.1	-32.5	39.05	-	-	74	-34.95	100	291	H
* 3.912	27.67	VA1T	32.1	-32.5	27.27	54	-26.73	-	-	100	291	H
* 11.825	31.37	PKFH	40	-22.2	49.17	-	-	74	-24.83	205	384	V
* 11.826	19.66	VA1T	40	-22.2	37.46	54	-16.54	-	-	205	384	V

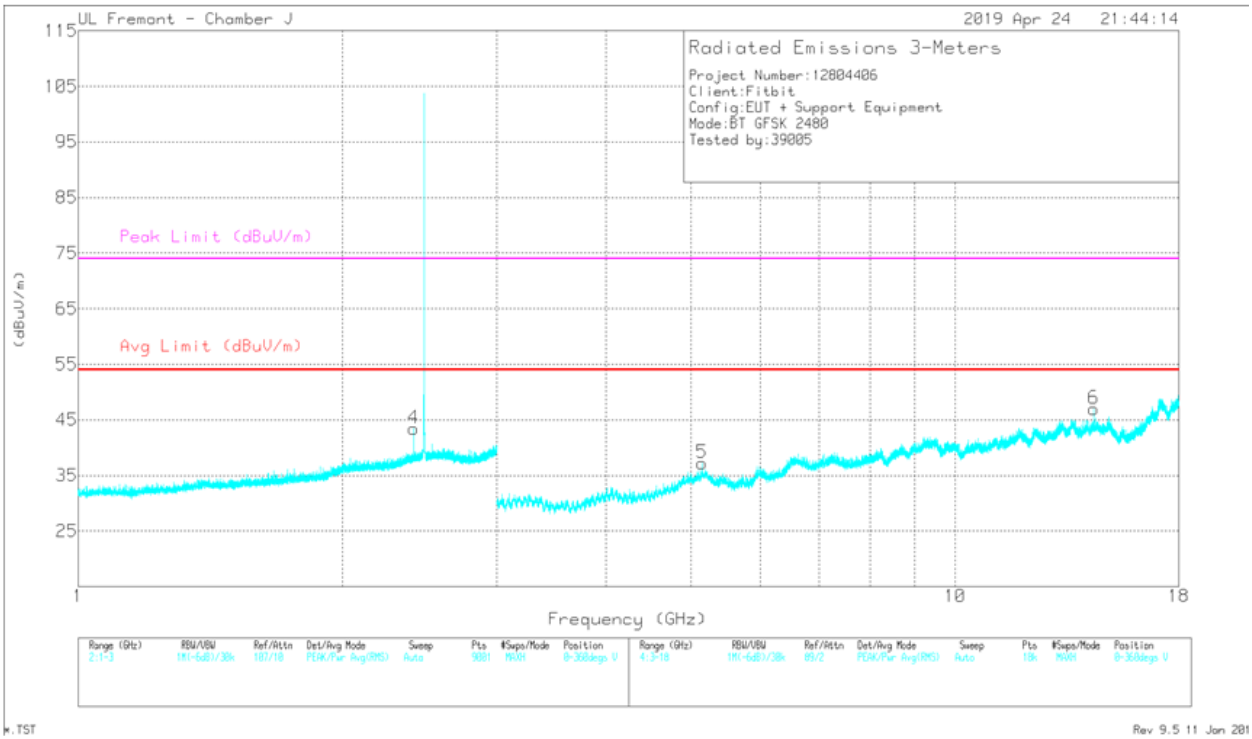
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (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
* 1.421	42.75	PKFH	25.1	-26.1	41.75	-	-	74	-32.25	5	342	H
* 1.421	30.28	VA1T	25.2	-26.1	29.38	54	-24.62	-	-	5	342	H
2.411	43.67	PKFH	29.7	-25.8	47.57	-	-	-	-	198	157	V
2.411	30.06	VA1T	29.7	-25.8	33.96	-	-	-	-	198	157	V
* 7.44	37.93	PKFH	37.6	-27.6	47.93	-	-	74	-26.07	308	151	H
* 7.44	25.03	VA1T	37.6	-27.6	35.03	54	-18.97	-	-	308	151	H
* 11.883	31.72	PKFH	39.9	-22.4	49.22	-	-	74	-24.78	159	345	H
* 11.885	19.74	VA1T	39.9	-22.4	37.24	54	-16.76	-	-	159	345	H
* 5.145	39.7	PKFH	35.7	-31.1	44.3	-	-	74	-29.7	166	279	V
* 5.145	26.64	VA1T	35.7	-31.1	31.24	54	-22.76	-	-	166	279	V
14.387	31.9	PKFH	41.2	-20.6	52.5	-	-	-	-	75	254	V
14.387	19.12	VA1T	41.2	-20.6	39.72	-	-	-	-	75	254	V

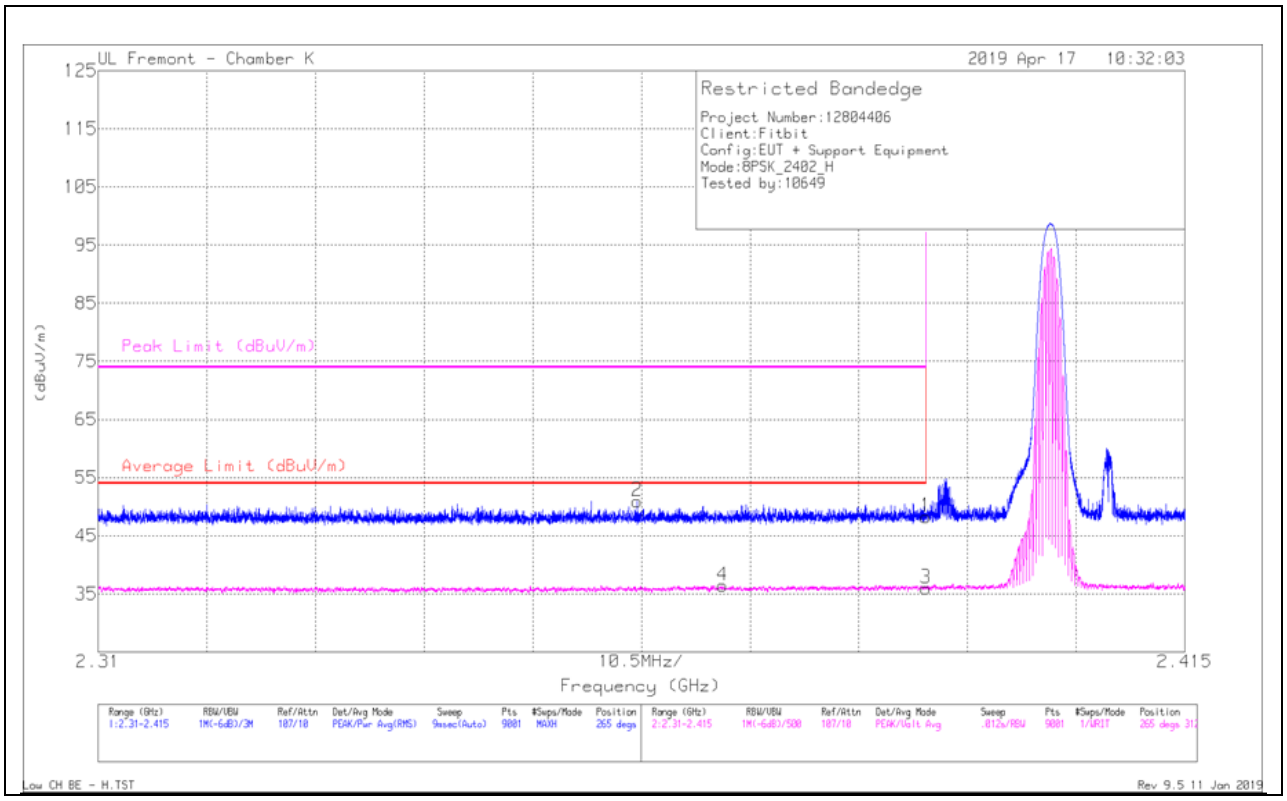
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

9.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

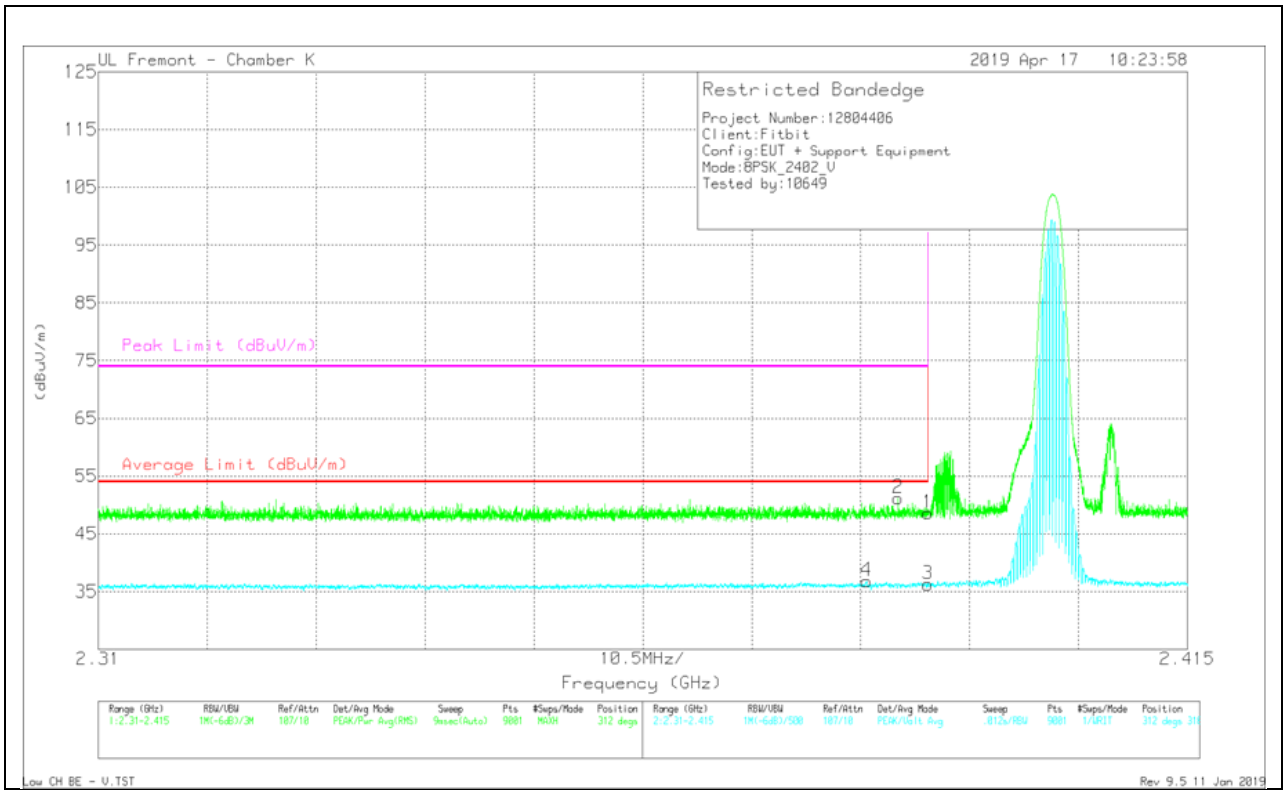
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (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	* 2.39	41.07	Pk	31.9	-24.7	48.27	-	-	74	-25.73	265	312	H
2	* 2.362	43.75	Pk	31.8	-24.6	50.95	-	-	74	-23.05	265	312	H
3	* 2.39	28.76	VA1T	31.9	-24.7	35.96	54	-18.04	-	-	265	312	H
4	* 2.37	29.22	VA1T	31.8	-24.6	36.42	54	-17.58	-	-	265	312	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT

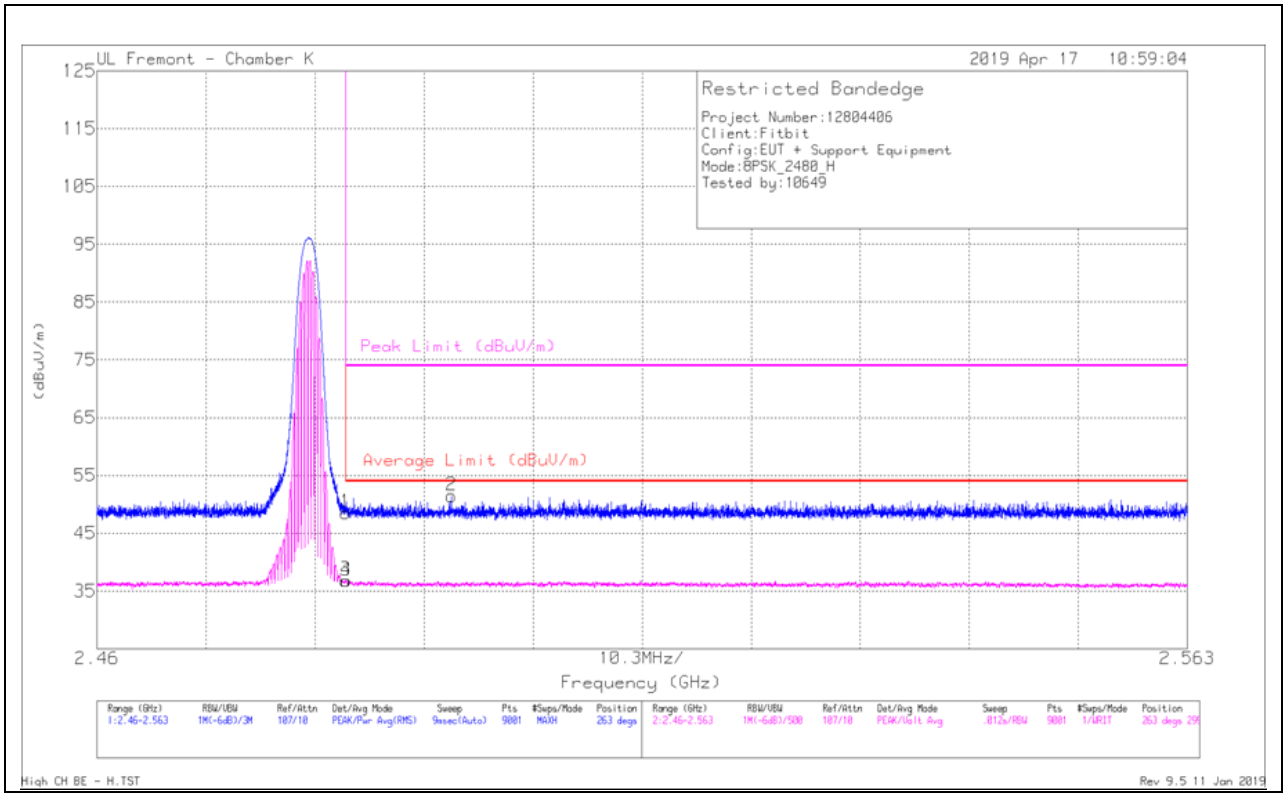


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr /Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.41	Pk	31.9	-24.7	48.61	-	-	74	-25.39	312	318	V
2	* 2.387	43.88	Pk	31.9	-24.6	51.18	-	-	74	-22.82	312	318	V
3	* 2.39	29.06	VA1T	31.9	-24.7	36.26	54	-17.74	-	-	312	318	V
4	* 2.384	29.53	VA1T	31.9	-24.6	36.83	54	-17.17	-	-	312	318	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

BANDEDGE (HIGH CHANNEL)

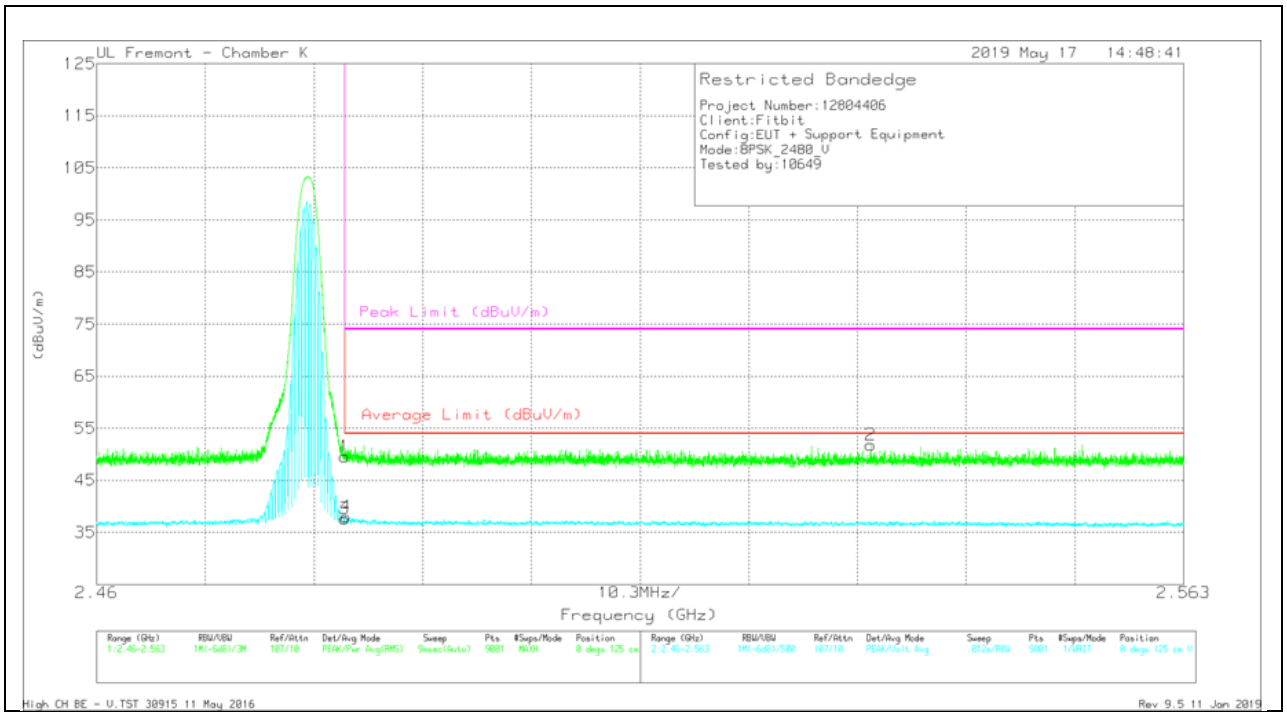
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (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	41.05	Pk	32.3	-24.8	48.55	-	-	74	-25.45	263	299	H
2	* 2.493	43.98	Pk	32.3	-24.8	51.48	-	-	74	-22.52	263	299	H
3	* 2.484	29.34	VA1T	32.3	-24.8	36.84	54	-17.16	-	-	263	299	H
4	* 2.484	29.3	VA1T	32.3	-24.8	36.8	54	-17.2	-	-	263	299	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT

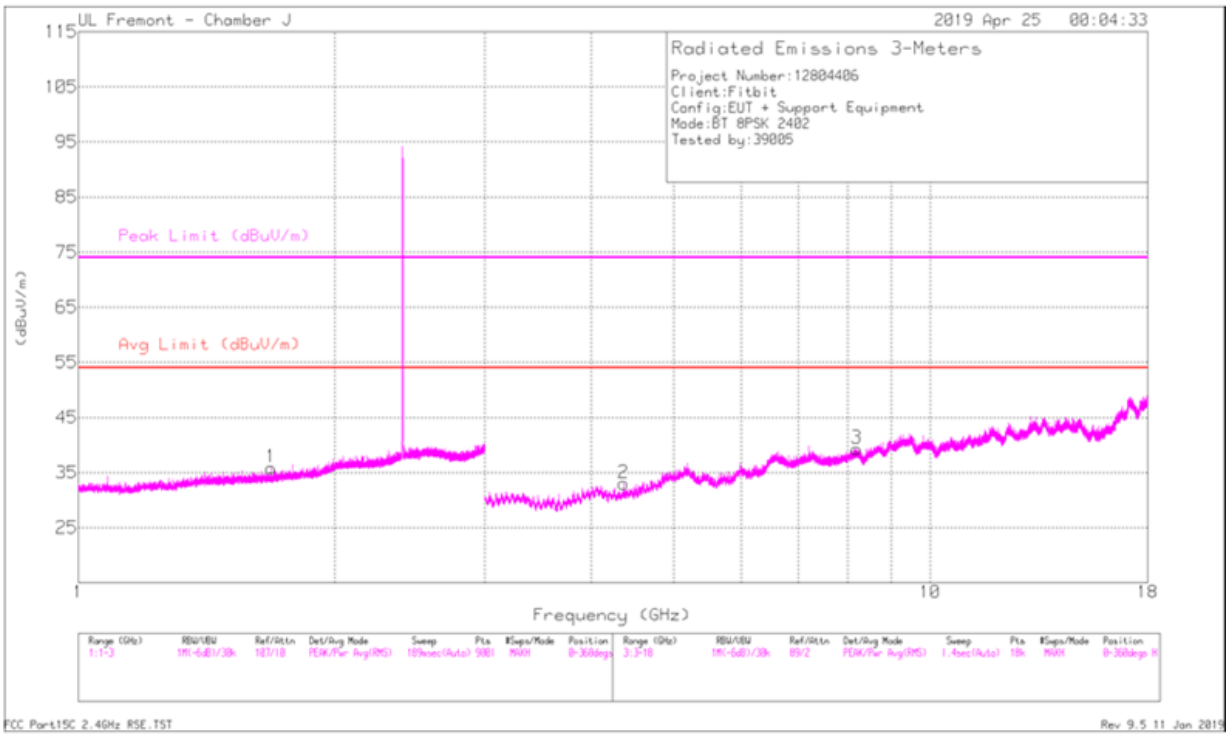


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/Fltr /Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41.7	Pk	32.6	-24.8	49.5	-	-	74	-24.5	0	125	V
2	2.533	43.79	Pk	32.7	-24.7	51.79	-	-	74	-22.21	0	125	V
3	* 2.484	29.79	VA1T	32.6	-24.8	37.59	54	-16.41	-	-	0	125	V
4	* 2.484	30.21	VA1T	32.6	-24.8	38.01	54	-15.99	-	-	0	125	V

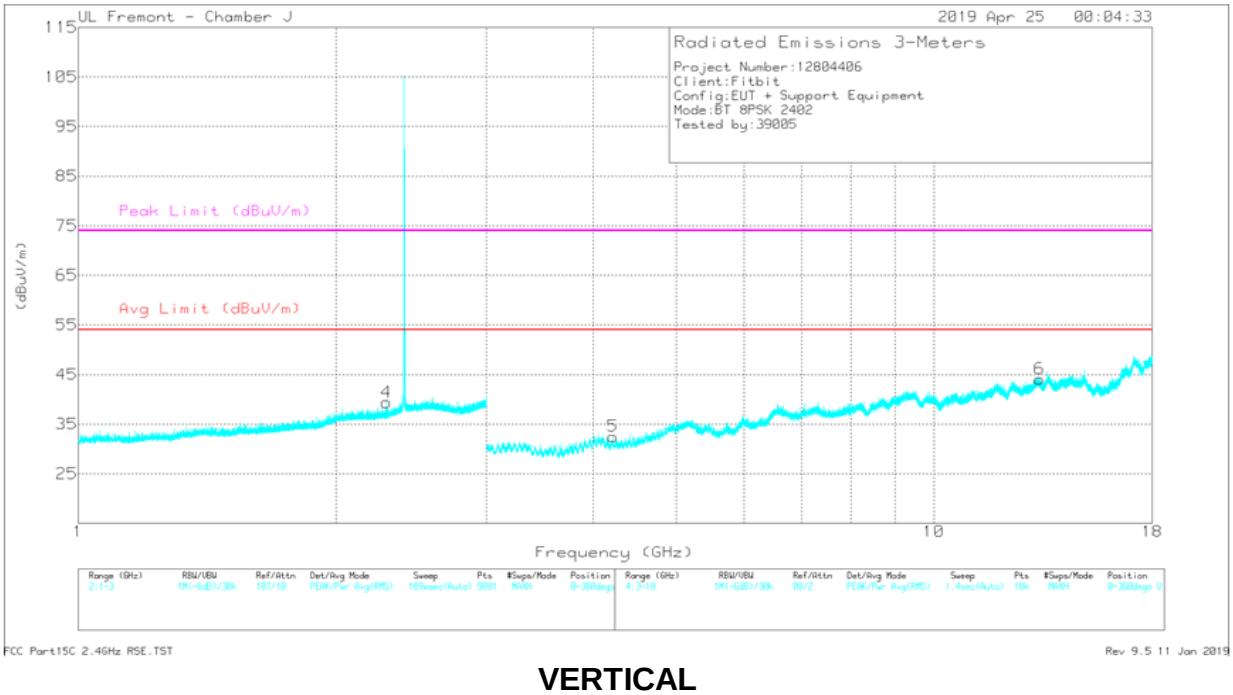
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

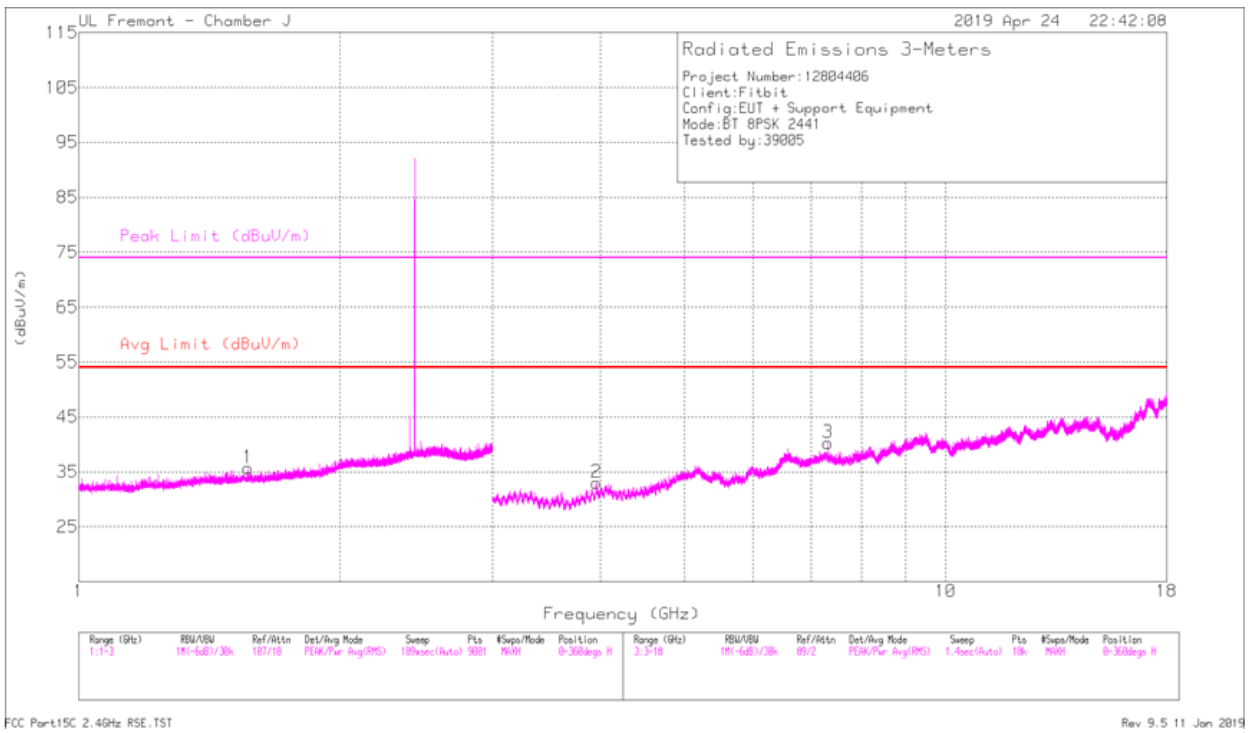
RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (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
* 1.685	42.41	PKFH	25.8	-26.1	42.11	-	-	74	-31.89	278	313	H
* 1.684	29.91	VA1T	25.8	-26.1	29.61	54	-24.39	-	-	278	313	H
* 2.294	42.27	PKFH	28.5	-25.8	44.97	-	-	74	-29.03	309	335	V
* 2.292	29.99	VA1T	28.5	-25.8	32.69	54	-21.31	-	-	309	335	V
* 4.364	38.91	PKFH	32	-31.6	39.31	-	-	74	-34.69	164	306	H
* 4.362	26.48	VA1T	32	-31.6	26.88	54	-27.12	-	-	164	306	H
* 8.2	34.28	PKFH	38.4	-26.6	46.08	-	-	74	-27.92	58	264	H
* 8.202	22.5	VA1T	38.4	-26.6	34.3	54	-19.7	-	-	58	264	H
* 4.215	39.37	PKFH	32	-32	39.37	-	-	74	-34.63	82	205	V
* 4.214	26.57	VA1T	32	-32	26.57	54	-27.43	-	-	82	205	V
* 13.298	31.6	PKFH	41.4	-21.8	51.2	-	-	74	-22.8	340	357	V
* 13.299	19.02	VA1T	41.4	-21.8	38.62	54	-15.38	-	-	340	357	V

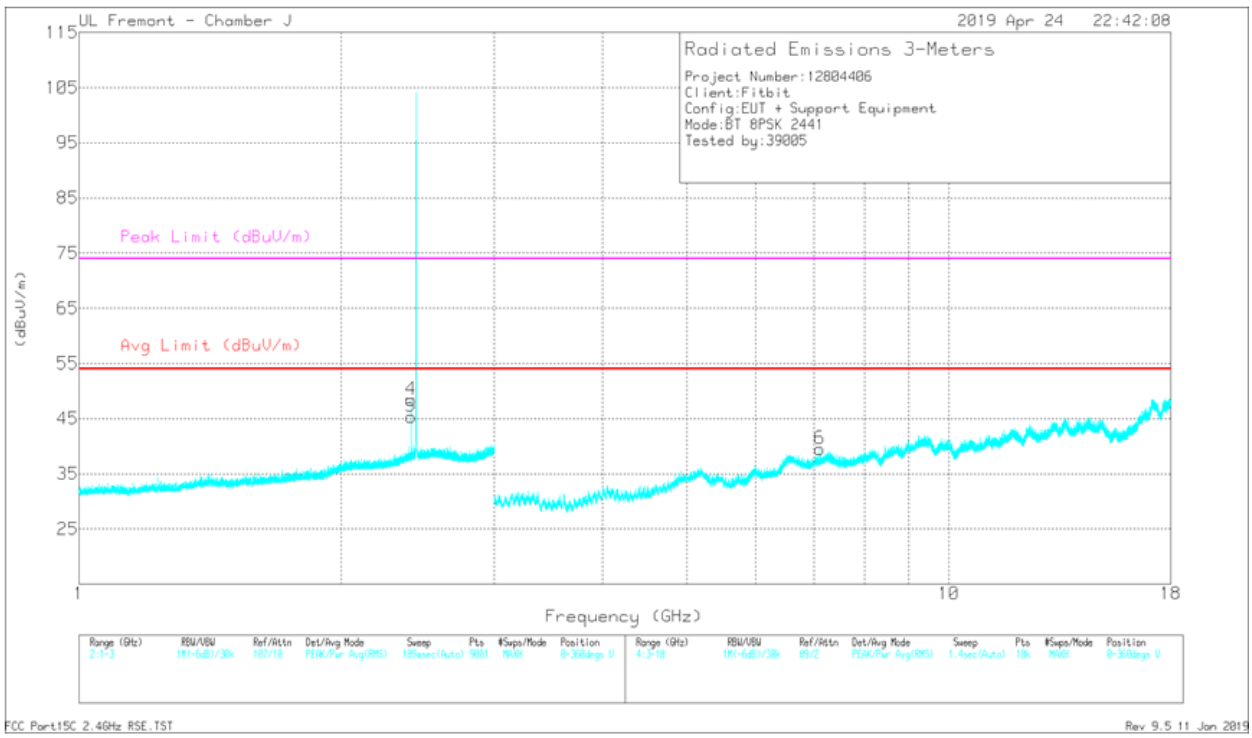
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

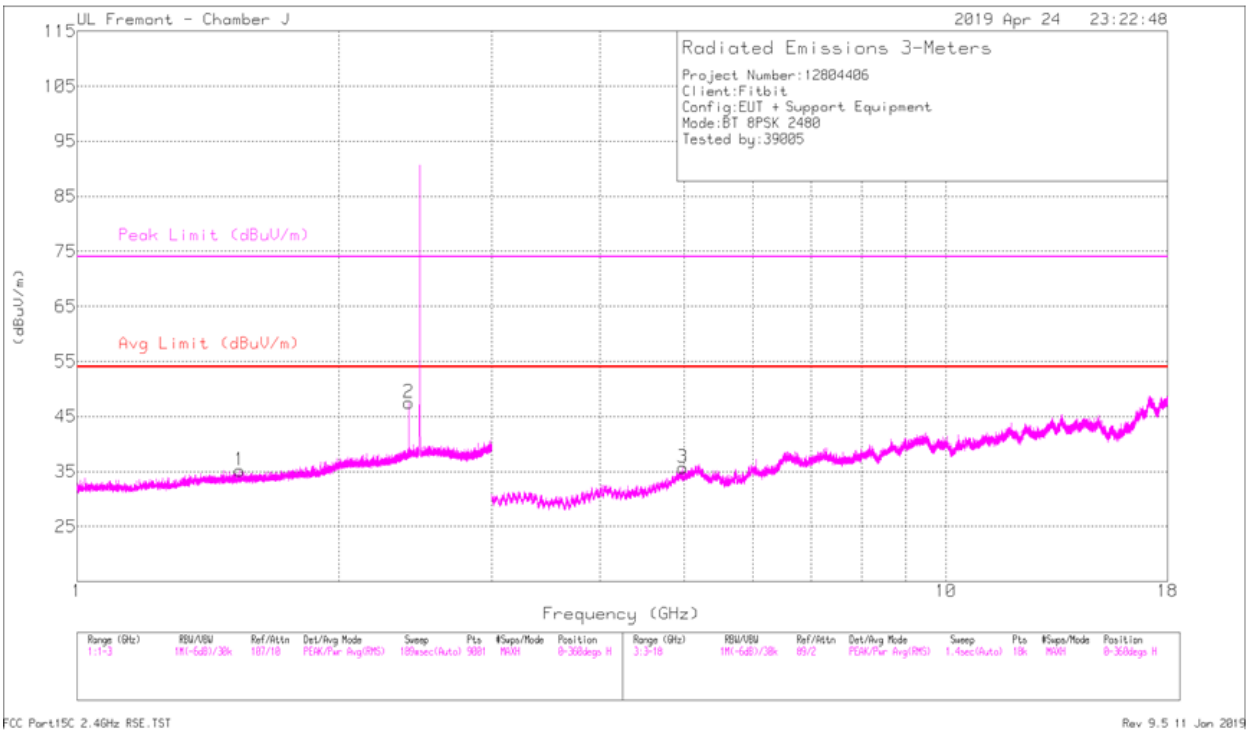
RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (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
* 1.569	43.12	PKFH	25.5	-26.1	42.52	-	-	74	-31.48	38	191	H
* 1.569	30.17	VA1T	25.5	-26.1	29.57	54	-24.43	-	-	38	191	H
2.41	47.61	PKFH	29.7	-25.8	51.51	-	-	-	-	55	396	V
2.409	30.12	VA1T	29.7	-25.8	34.02	-	-	-	-	55	396	V
2.409	43.52	PKFH	29.7	-25.8	47.42	-	-	-	-	62	311	V
2.411	30.04	VA1T	29.7	-25.8	33.94	-	-	-	-	62	311	V
* 3.957	40.59	PKFH	32.3	-32.5	40.39	-	-	74	-33.61	71	360	H
* 3.958	27.4	VA1T	32.3	-32.5	27.2	54	-26.8	-	-	71	360	H
* 7.323	36.15	PKFH	38	-27.5	46.65	-	-	74	-27.35	230	168	H
* 7.323	24.43	VA1T	38	-27.5	34.93	54	-19.07	-	-	230	168	H
7.113	34.95	PKFH	37.8	-27.6	45.15	-	-	-	-	224	183	V
7.113	22.9	VA1T	37.8	-27.6	33.1	-	-	-	-	224	183	V

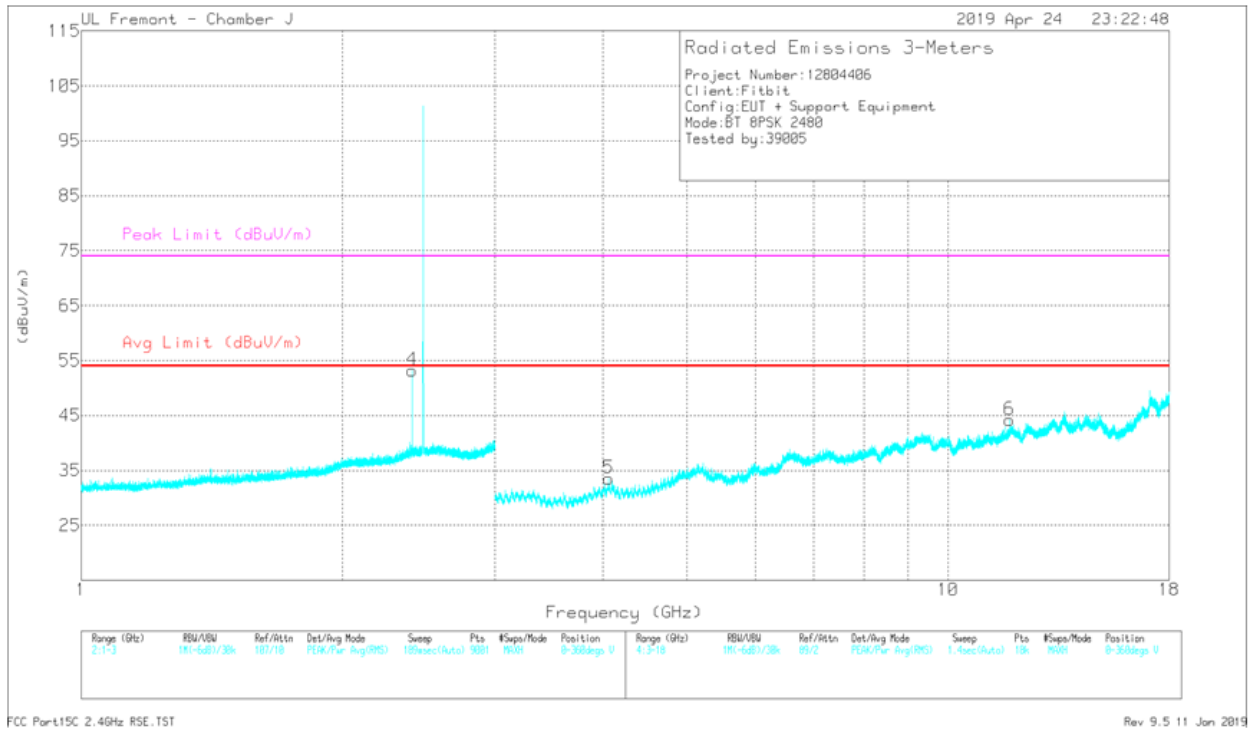
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

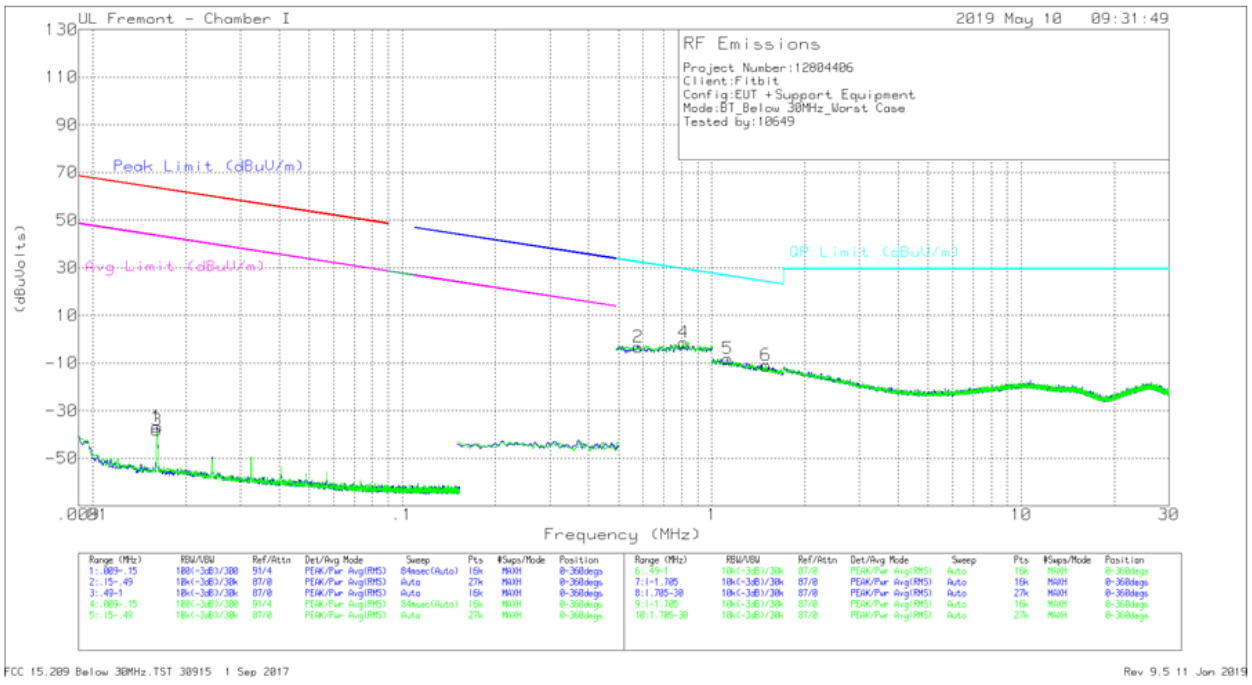
Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.539	43.41	PKFH	25.4	-26.1	42.71	-	-	74	-31.29	5	141	H
* 1.537	30.91	VA1T	25.3	-26.1	30.11	54	-23.89	-	-	5	141	H
2.409	53.27	PKFH	29.7	-25.8	57.17	-	-	-	-	220	369	H
2.409	30.12	VA1T	29.7	-25.8	34.02	-	-	-	-	220	369	H
2.409	58.66	PKFH	29.7	-25.8	62.56	-	-	-	-	310	334	V
2.408	30.32	VA1T	29.7	-25.8	34.22	-	-	-	-	310	334	V
* 4.978	38.98	PKFH	34.9	-30.5	43.38	-	-	74	-30.62	283	112	H
* 4.978	25.39	VA1T	34.9	-30.6	29.69	54	-24.31	-	-	283	112	H
* 4.058	40.67	PKFH	32.3	-32	40.97	-	-	74	-33.03	267	355	V
* 4.059	27.79	VA1T	32.3	-32	28.09	54	-25.91	-	-	267	355	V
* 11.782	32.28	PKFH	40	-22.4	49.88	-	-	74	-24.12	274	293	V
* 11.783	19.65	VA1T	40	-22.4	37.25	54	-16.75	-	-	274	293	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

9.2. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

Below 30MHz Data

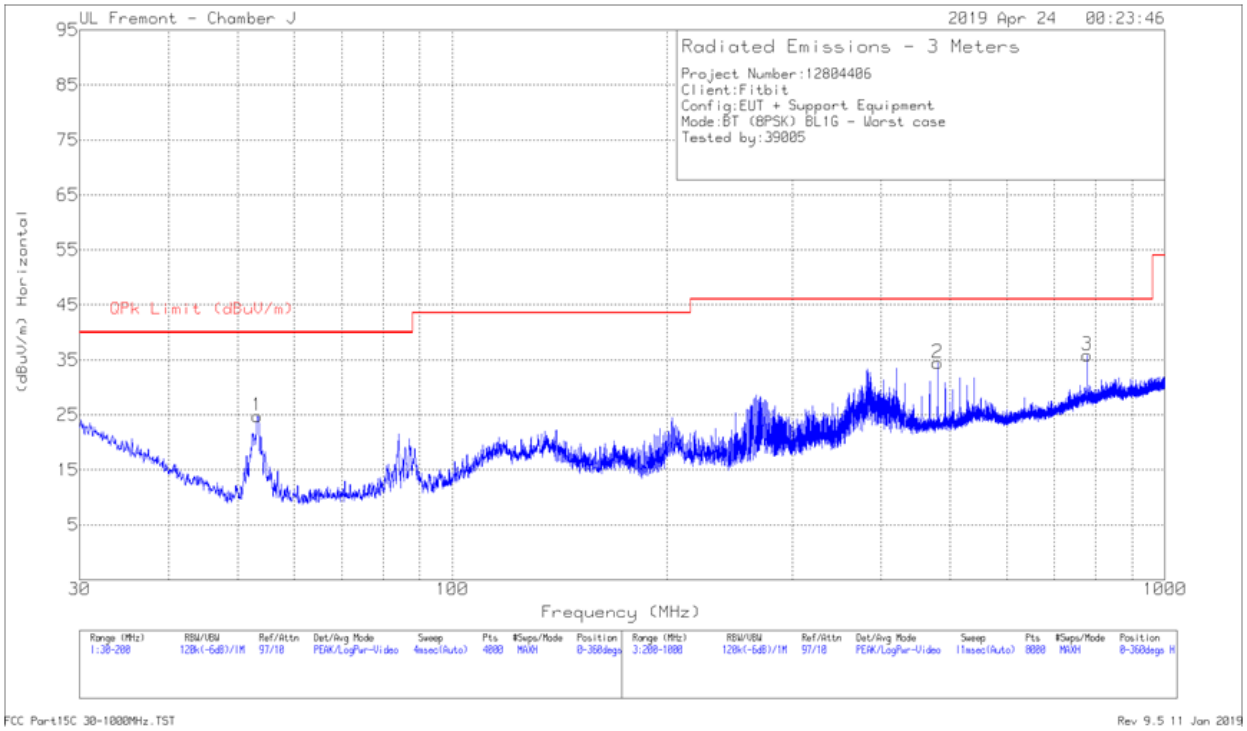
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Cables w/ PRE0180175 (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.01616	16.03	Pk	59.5	-32.4	-80	-36.87	63.42	-100.29	43.42	-80.29	0-360
3	.01615	14.72	Pk	59.5	-32.4	-80	-38.18	63.42	-101.6	43.42	-81.6	0-360

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Cables w/ PRE0180175 (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
2	.57976	12.21	Pk	56.3	-31.8	-40	-3.29	32.34	-35.63	0-360
4	.8112	14.21	Pk	56.3	-31.8	-40	-1.29	29.43	-30.72	0-360
5	1.12617	18.01	Pk	45.7	-31.8	-40	-8.09	26.59	-34.68	0-360
6	1.49458	16.98	Pk	43.8	-31.8	-40	-11.02	24.14	-35.16	0-360

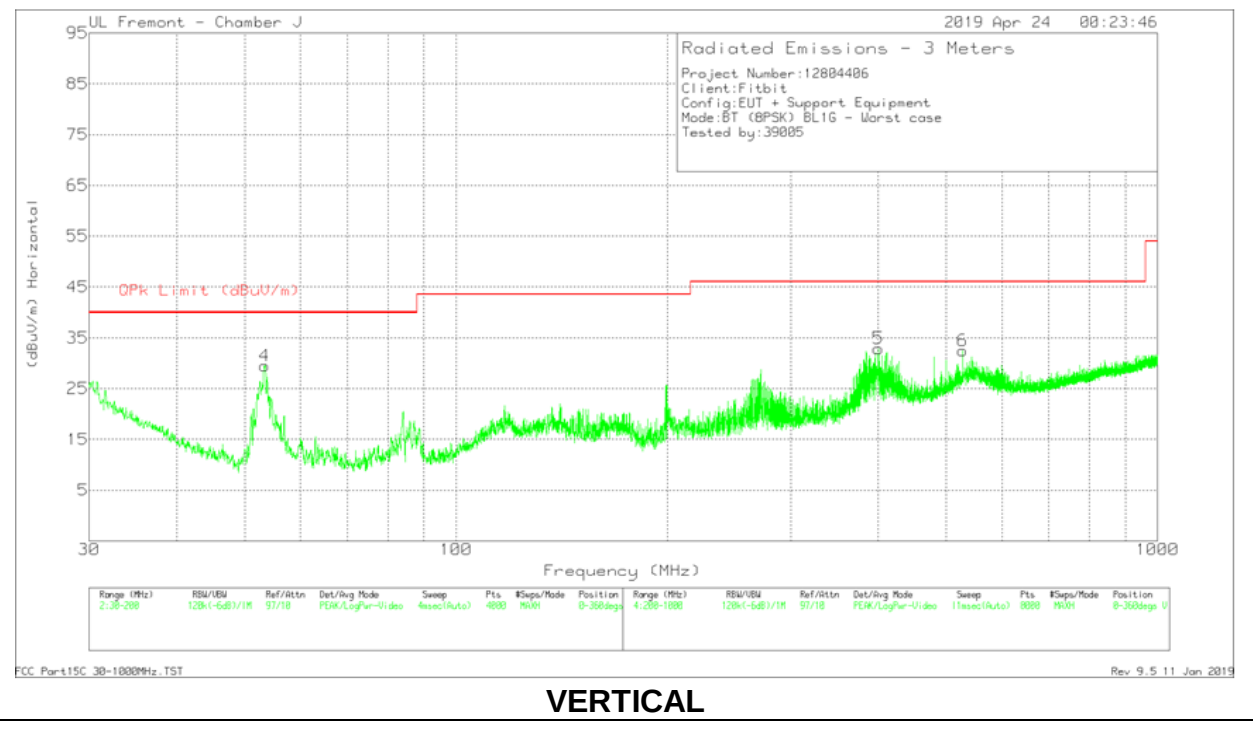
Pk - Peak detector

9.3. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



VERTICAL

Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	53.2535	42.91	Pk	13.2	-31.3	24.81	40	-15.19	0-360	398	H
4	53.3385	47.58	Pk	13.2	-31.3	29.48	40	-10.52	0-360	101	V
	53.257	46.12	Qp	13.2	-31.3	28.02	40	-11.98	176	105	V
2	479.9364	40.28	Pk	23.6	-29.4	34.48	46.02	-11.54	0-360	198	H
3	777.7751	37.08	Pk	27	-28.2	35.88	46.02	-10.14	0-360	101	H
5	* 400.126	41.09	Pk	21.5	-29.7	32.89	46.02	-13.13	0-360	101	V
6	528.0426	38.06	Pk	23.8	-29.4	32.46	46.02	-13.56	0-360	199	V

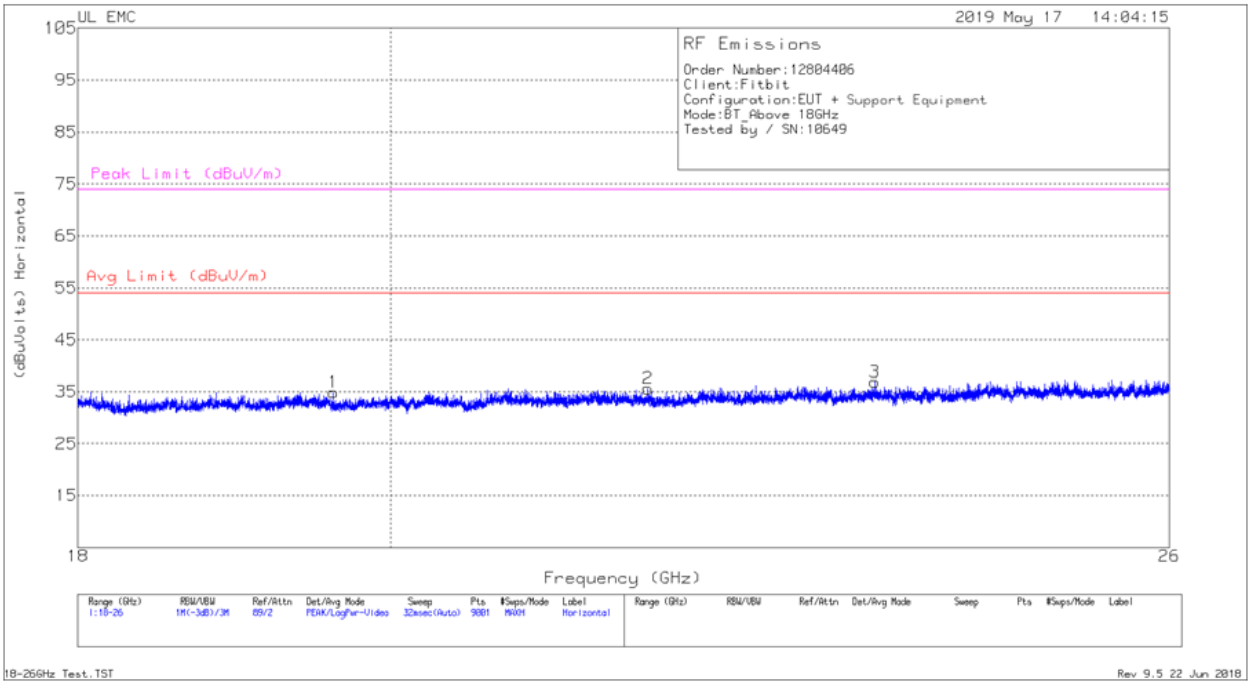
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

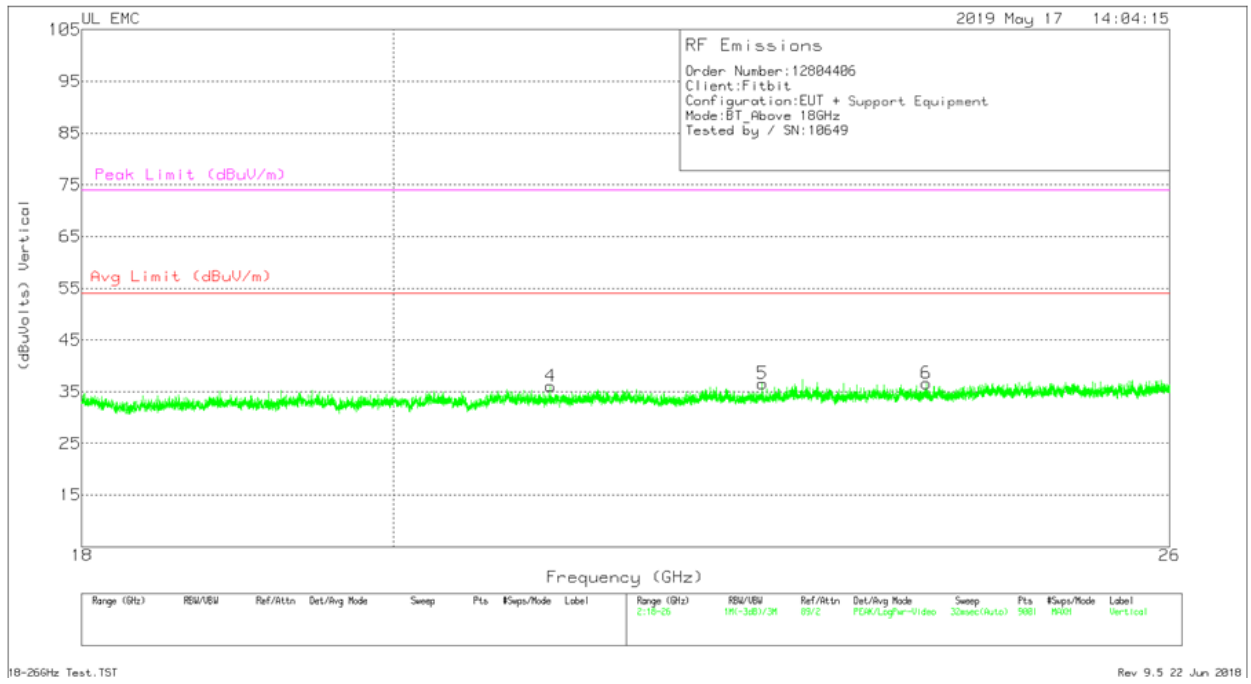
Qp - Quasi-Peak detector

9.4. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0182188 (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	19.618	68.16	Pk	33.1	-56.9	-9.5	34.86	54	-19.14	74	-39.14
2	21.81	68.48	Pk	33.9	-57.3	-9.5	35.58	54	-18.42	74	-38.42
3	23.545	68.76	Pk	34.5	-56.9	-9.5	36.86	54	-17.14	74	-37.14
4	21.09	68.96	Pk	33.6	-57	-9.5	36.06	54	-17.94	74	-37.94
5	22.656	69.78	Pk	34.1	-57.8	-9.5	36.58	54	-17.42	74	-37.42
6	23.947	68.3	Pk	34.6	-56.8	-9.5	36.6	54	-17.4	74	-37.4

Pk - Peak detector

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

10. 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 C63.4.

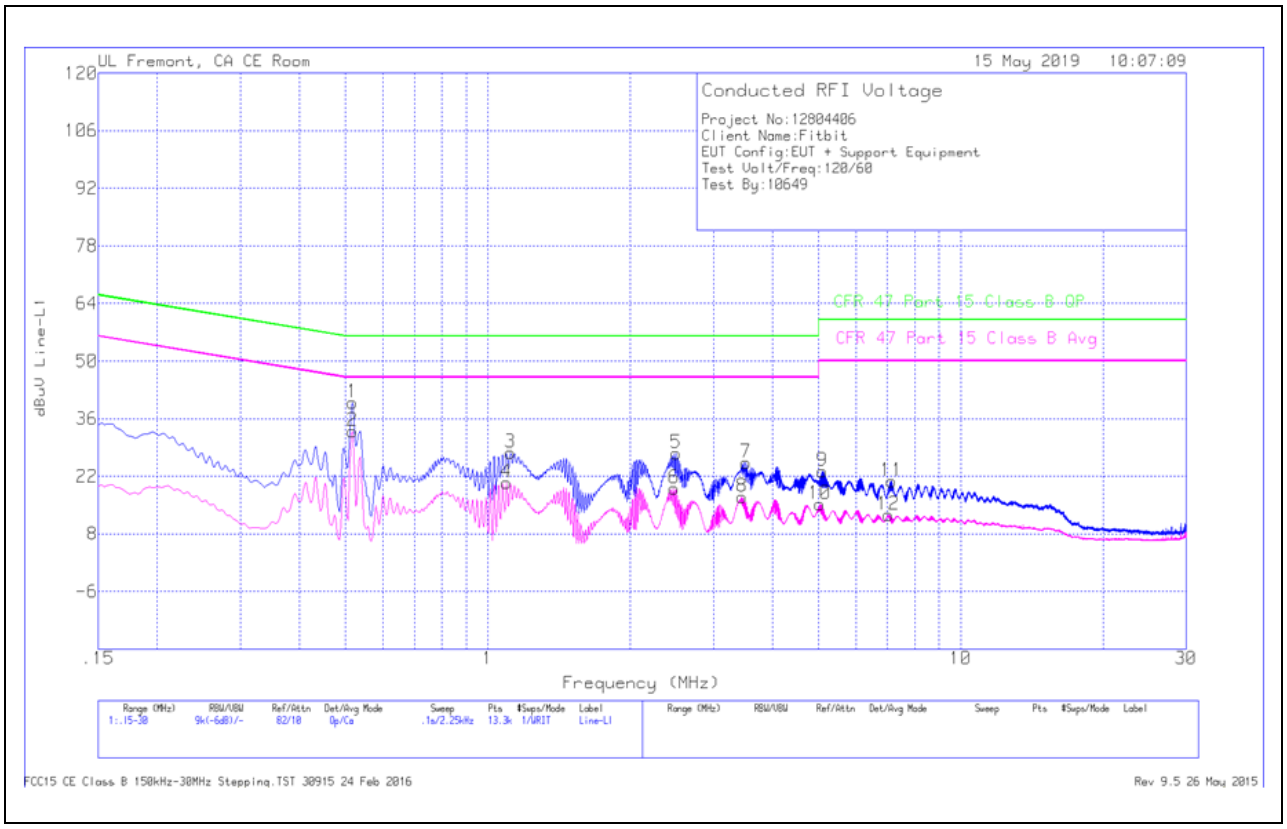
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

LINE 1 RESULTS

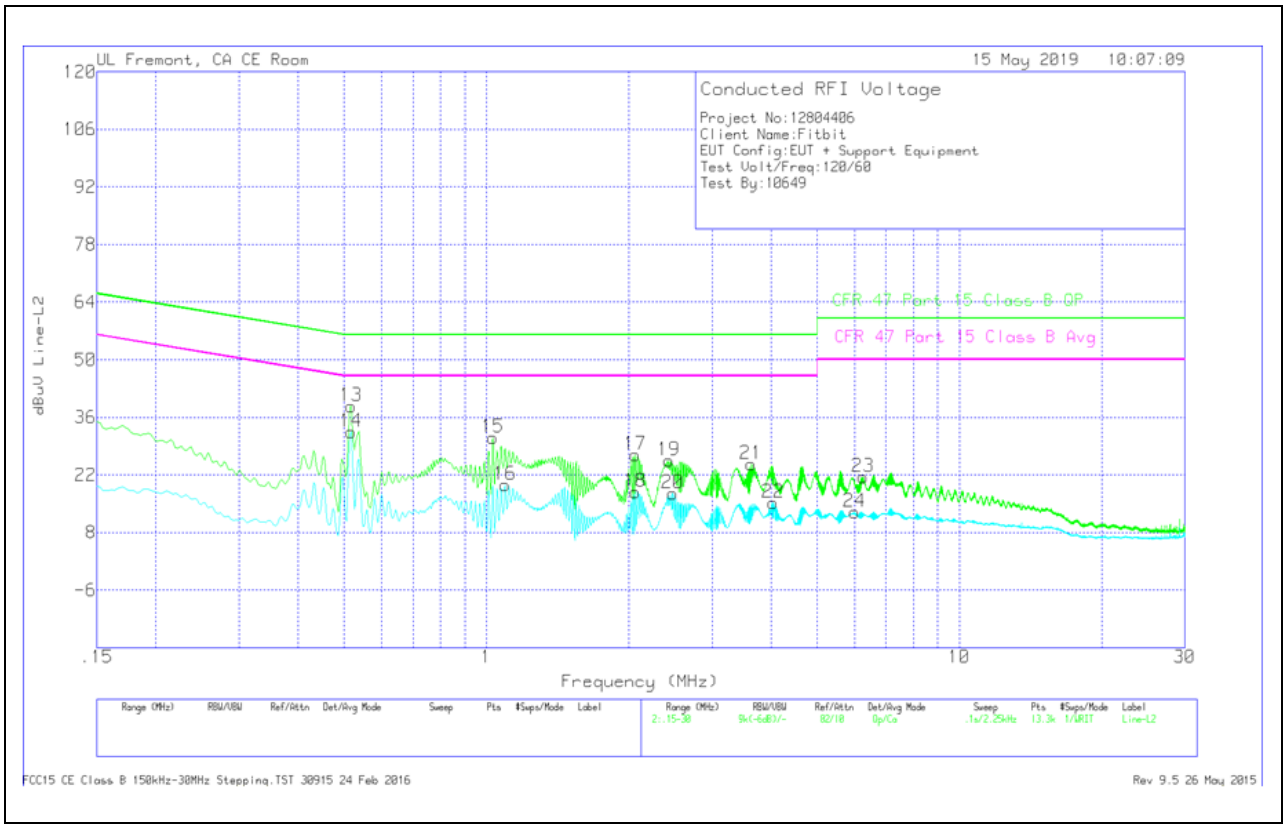


Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
1	.51675	29.74	Qp	0	0	10.1	39.84	56	-16.16	-	-
2	.51675	22.92	Ca	0	0	10.1	33.02	-	-	46	-12.98
3	1.1175	17.5	Qp	0	.1	10.1	27.7	56	-28.3	-	-
4	1.095	10.26	Ca	0	.1	10.1	20.46	-	-	46	-25.54
5	2.50125	17.31	Qp	0	.1	10.1	27.51	56	-28.49	-	-
6	2.47875	8.92	Ca	0	.1	10.1	19.12	-	-	46	-26.88
7	3.51375	15.16	Qp	0	.1	10.1	25.36	56	-30.64	-	-
8	3.4485	6.8	Ca	0	.1	10.1	17	-	-	46	-29
9	5.10675	13.07	Qp	0	.1	10.1	23.27	60	-36.73	-	-
10	5.03925	5.01	Ca	0	.1	10.1	15.21	-	-	50	-34.79
11	7.152	10.44	Qp	0	.2	10.2	20.84	60	-39.16	-	-
12	7.044	2.26	Ca	0	.2	10.2	12.66	-	-	50	-37.34

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	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)
13	.51675	28.58	Qp	0	0	10.1	38.68	56	-17.32	-	-
14	.51675	22.35	Ca	0	0	10.1	32.45	-	-	46	-13.55
15	1.032	20.91	Qp	0	.1	10.1	31.11	56	-24.89	-	-
16	1.095	9.41	Ca	0	.1	10.1	19.61	-	-	46	-26.39
17	2.0625	16.62	Qp	0	.1	10.1	26.82	56	-29.18	-	-
18	2.06475	7.72	Ca	0	.1	10.1	17.92	-	-	46	-28.08
19	2.4315	15.36	Qp	0	.1	10.1	25.56	56	-30.44	-	-
20	2.47538	7.23	Ca	0	.1	10.1	17.43	-	-	46	-28.57
21	3.63075	14.37	Qp	0	.1	10.1	24.57	56	-31.43	-	-
22	4.0425	5.06	Ca	0	.1	10.1	15.26	-	-	46	-30.74
23	6.252	11.05	Qp	0	.2	10.2	21.45	60	-38.55	-	-
24	6.00225	2.55	Ca	0	.2	10.2	12.95	-	-	50	-37.05

Qp - Quasi-Peak detector

Ca - CISPR average detection