



CERTIFICATION TEST REPORT

Report Number. : 12681939-E1V3

Applicant : APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

Model : A2084

FCC ID : BCG-A2084

IC : 579C-A2084

EUT Description : Bluetooth Earbud

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 2
ISED RSS-GEN ISSUE 5

Date Of Issue:
October 10, 2019

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

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	9/19/2019	Initial Issue	Chin Pang
V2	10/4/2019	Add below 30MHz radiated emissions scan	Chin Pang
V3	10/08/2019	Add DM1 mode	Chin Pang

TABLE OF CONTENTS

REPORT REVISION HISTORY	2
TABLE OF CONTENTS	3
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. EUT DESCRIPTION	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.....	9
5.6. DESCRIPTION OF TEST SETUP.....	10
6. TEST AND MEASUREMENT EQUIPMENT	15
7. MEASUREMENT METHODS	16
8. ANTENNA PORT TEST RESULTS	17
8.1. ON TIME AND DUTY CYCLE.....	17
8.2. 20 dB AND 99% BANDWIDTH	19
8.2.1. BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION	20
8.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	21
8.3. HOPPING FREQUENCY SEPARATION	22
8.4. NUMBER OF HOPPING CHANNELS.....	23
8.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	24
8.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	25
8.5. AVERAGE TIME OF OCCUPANCY.....	26
8.5.1. BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION	27
8.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	28
8.6. OUTPUT POWER.....	30
8.6.1. BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION	31
8.6.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	31
8.6.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION	31
8.7. AVERAGE POWER.....	32

8.7.1.	BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION	33
8.7.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	33
8.7.3.	BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION	33
8.8.	CONDUCTED SPURIOUS EMISSIONS.....	34
8.8.1.	BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION	35
8.8.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	37
9.	RADIATED TEST RESULTS.....	39
9.1.	TRANSMITTER ABOVE 1 GHz	41
9.1.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION	41
9.1.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	51
9.2.	WORST CASE BELOW 1 GHZ.....	61
9.3.	WORST CASE 18-26 GHZ	63
9.4.	WORST CASE BELOW 30MHz.....	65
10.	AC POWER LINE CONDUCTED EMISSIONS	66
10.1.1.	AC Power Line Host.....	67
10.1.2.	AC Power Line Norm.....	69
11.	SETUP PHOTOS	71

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: Bluetooth Earbud

MODEL: A2084

SERIAL NUMBER: DLC9326004YJQH42W (RADIATED);
DLC9326004XJQH42X (CONDUCTED)

DATE TESTED: AUGUST 30 - SEPTEMBER 5, 2019 & OCTOBER 04-08, 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 By:

Prepared By:



Chin Pang
Senior Engineer
Consumer Technology Division
UL Verification Services Inc.

Tony Li
Test Engineer
Consumer Technology Division
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, KDB 414788 D02 v01r01, 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 Rd.
☐ Chamber A (IC:2324B-1)	☒ Chamber D (IC:22541-1)	☐ Chamber I (IC: 2324A-5)
☐ Chamber B (IC:2324B-2)	☒ Chamber E (IC:22541-2)	☐ Chamber J (IC: 2324A-6)
☐ Chamber C (IC:2324B-3)	☐ Chamber F (IC:22541-3)	☐ Chamber K (IC: 2324A-1)
	☒ Chamber G (IC:22541-4)	☐ Chamber L (IC: 2324A-3)
	☐ Chamber H (IC:22541-5)	

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.

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

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%.

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT, model A2084 is a Bluetooth earbud for the left ear. It has an integral battery, microphone and antenna. It can charge via bottom contacts with charging case. It is designed to work in conjunction with right earbud, A2083

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	12.56	18.03
2402 - 2480	Enhanced DQPSK	12.73	18.75
2402 - 2480	Enhanced 8PSK	12.84	19.23

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. For average power data please refer to section 8.7.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an LDS antenna, with a maximum gain of -2.4 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was version 2A62820o.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions 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.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

Radiated emissions below 30MHz, below 1GHz, 18-26GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario

For below 30MHz there were no emissions found below 30MHz within 20dB of the limit. For AC line conducted emission, test was investigated with AC power adapter and laptop.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X (Flatbed) orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X (Flatbed) orientation.

Radiated emissions were tested at worst case on 100% duty cycle.

Worst-case data rates as provided by the client were:

GFSK mode: DM1
8PSK mode: 3-DH5

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Apple	Macbook Pro	C02P41RZG086	FCC DoC
Laptop AC/DC adapter	Liteon Technology	PA-1450-BA1	B123	NA
EUT AC Adapter	Apple	A1385	D292365CDYADHLHC3	NA
Charger Case	Apple	A1602	DLCYX1FZLKKT	NA

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Shielded	1	N/A
3	AC	1	AC	Un-shielded	2	N/A

I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
NA						

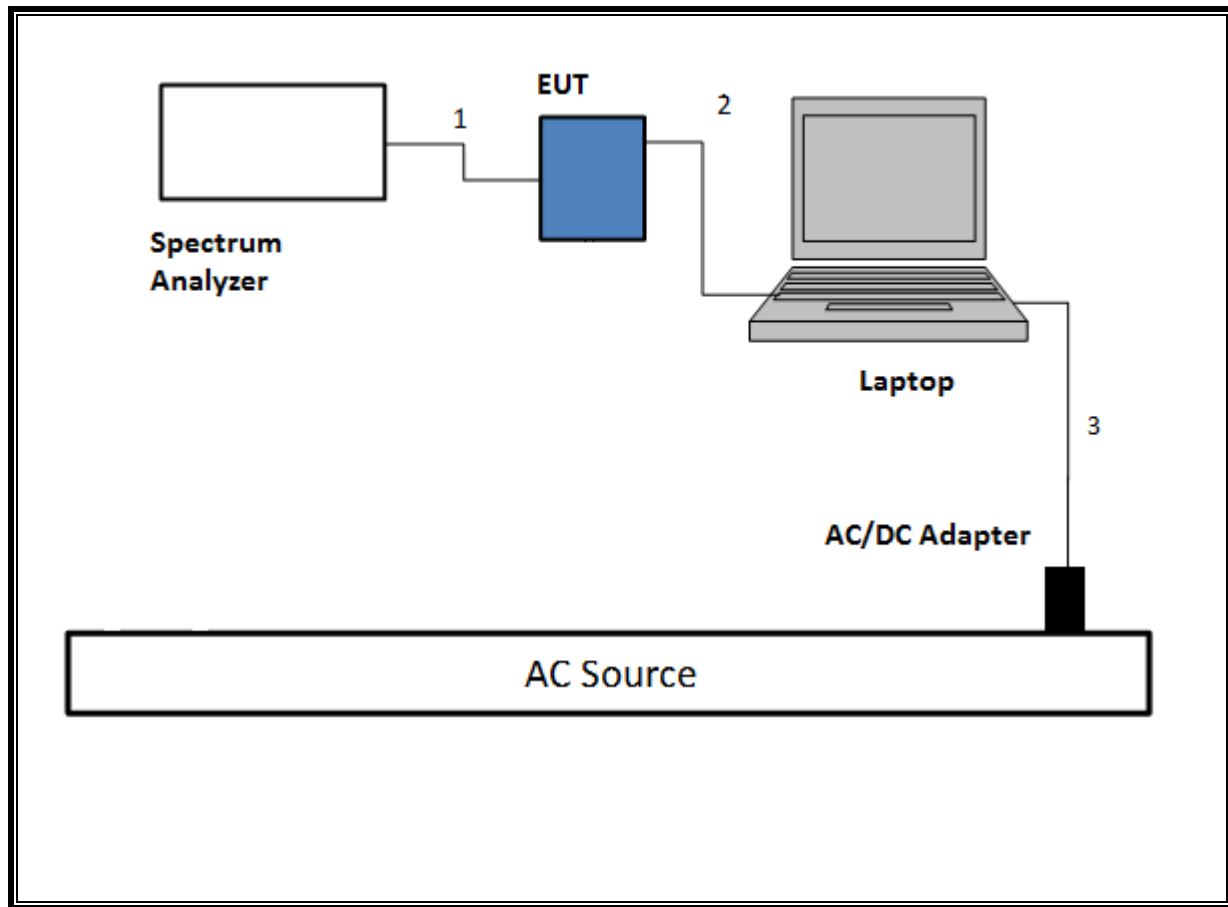
I/O CABLES (BELOW 1GHz AND AC POWER LINE TEST WITH ADAPTER AND LAPTOP)

I/O Cable List						
Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	N/A
2	USB	1	USB	Un-shielded	1	N/A

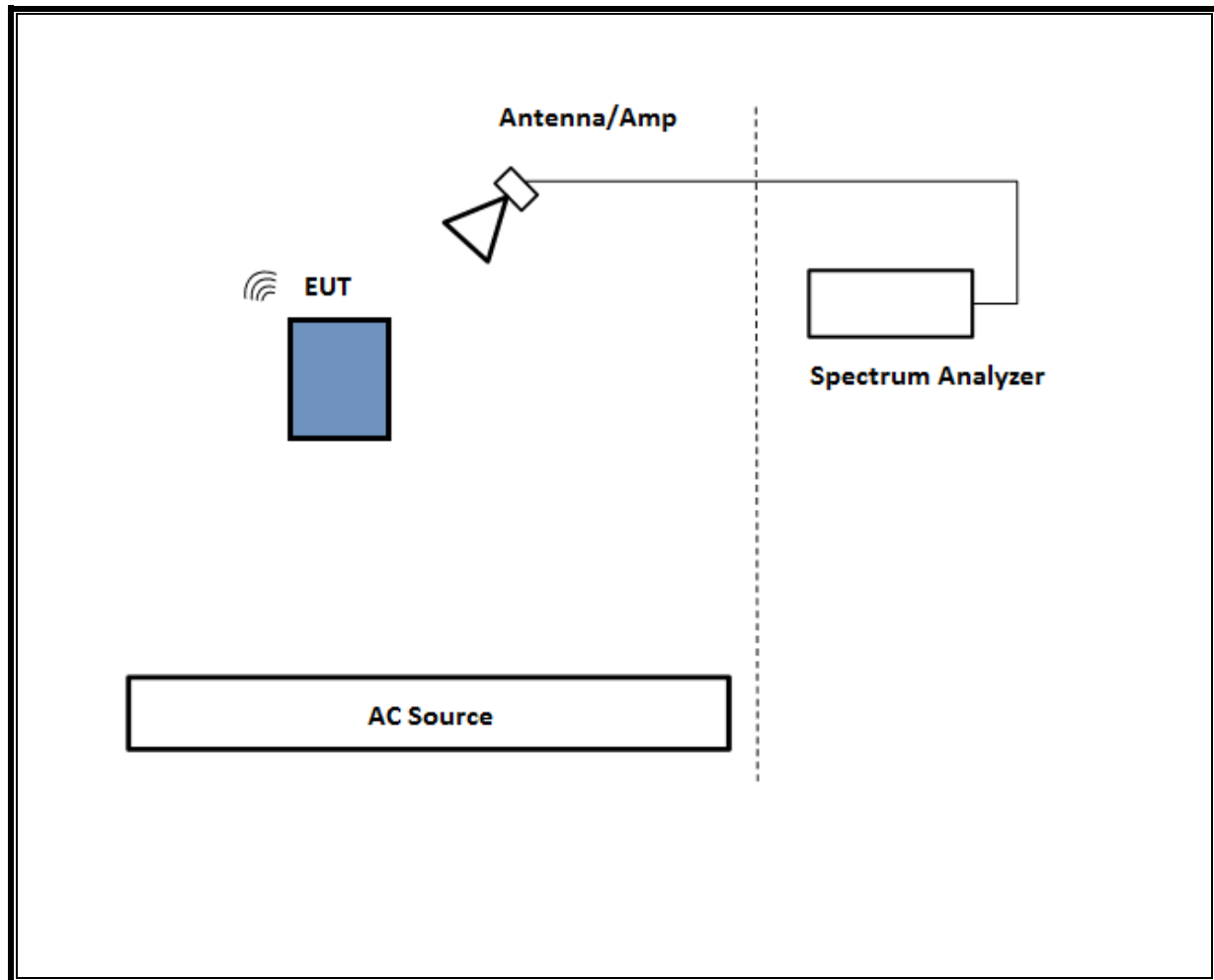
TEST SETUP

The EUT is connected to a test laptop during the tests. Test software exercised the radio card.

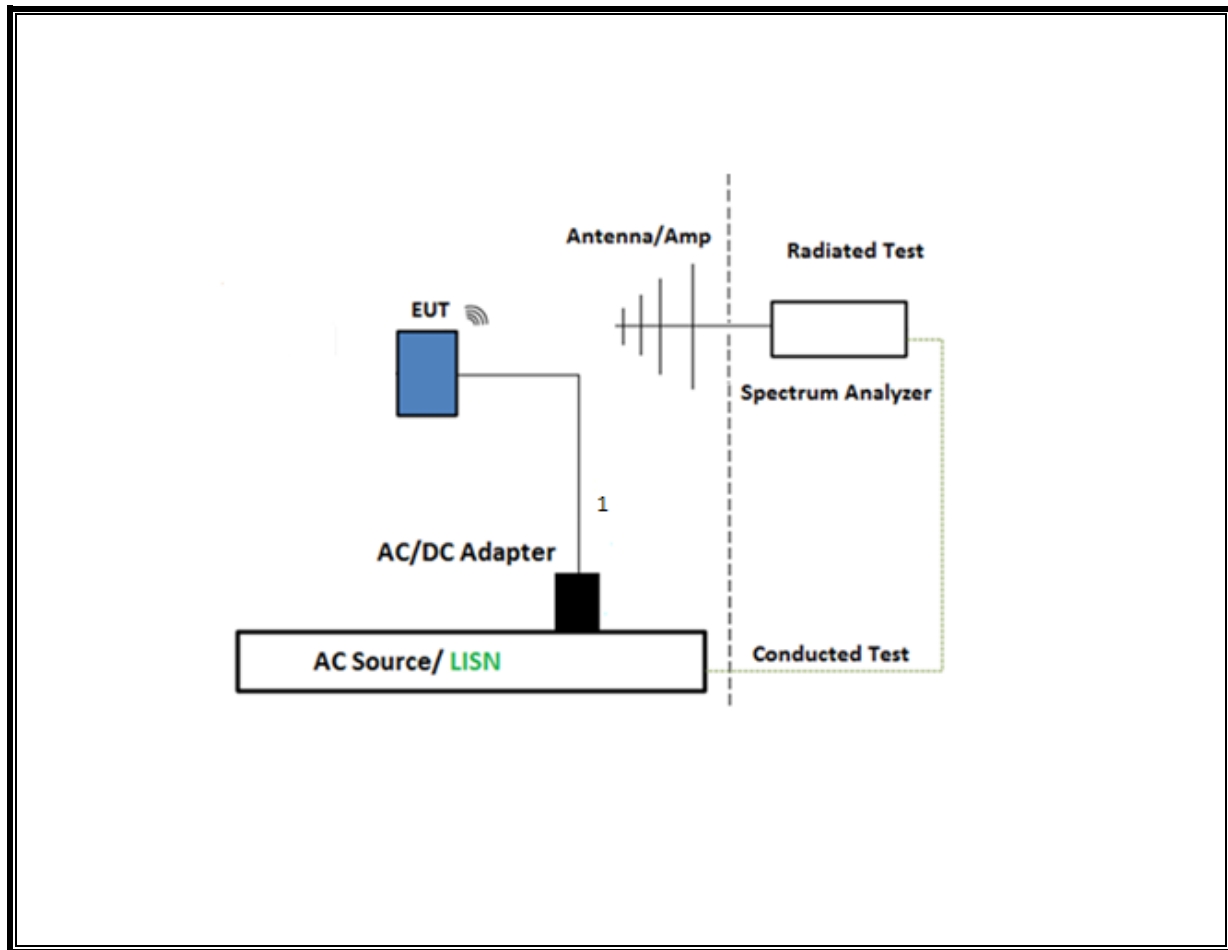
SETUP DIAGRAM FOR CONDUCTED TESTS



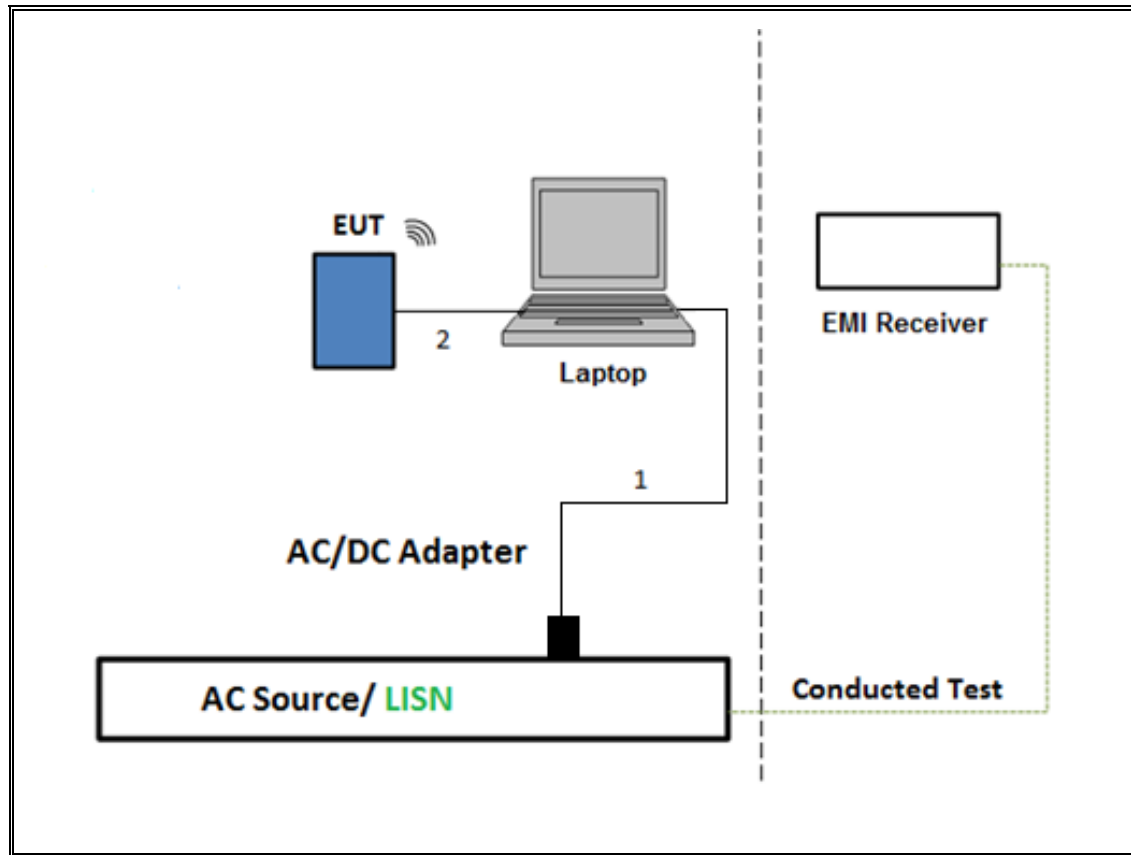
SETUP DIAGRAM FOR RADIATED TESTS ABOVE 1GHz



SETUP DIAGRAM FOR BELOW 1GHz and AC LINE CONDUCTED TEST



TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION



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
Antenna, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T1683	06/06/2020	06/06/2019
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB1	T185	06/06/2020	06/06/2019
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T834	06/01/2020	06/01/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T712	02/26/2020	02/26/2019
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T227	10/29/2019	10/29/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	138301	09/15/2019	09/15/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T907	01/24/2020	01/24/2019
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T119	03/22/2020	03/22/2019
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T740	10/06/2019	10/06/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T906	01/22/2020	01/22/2019
Thermometer - Digital	Control Company	14-650-118	PRE0177862	02/22/2020	02/22/2019
Antenna Horn, 18 to 26GHz	ARA	MWH-1826	T447	08/13/2020	08/13/2019
Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	03/23/2020	03/23/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T342	01/23/2020	01/23/2019

AC Line Conducted					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESCI7	T1436	02/14/2020	02/14/2019
Power Cable, Line Conducted Emissions	UL	PG1	T861	10/19/2019	10/19/2018
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	01/24/2020	01/24/2019
UL AUTOMATION SOFTWARE					
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016		
Conducted Software	UL	UL EMC	Ver 10.1, August 27, 2019		
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015		

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.

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

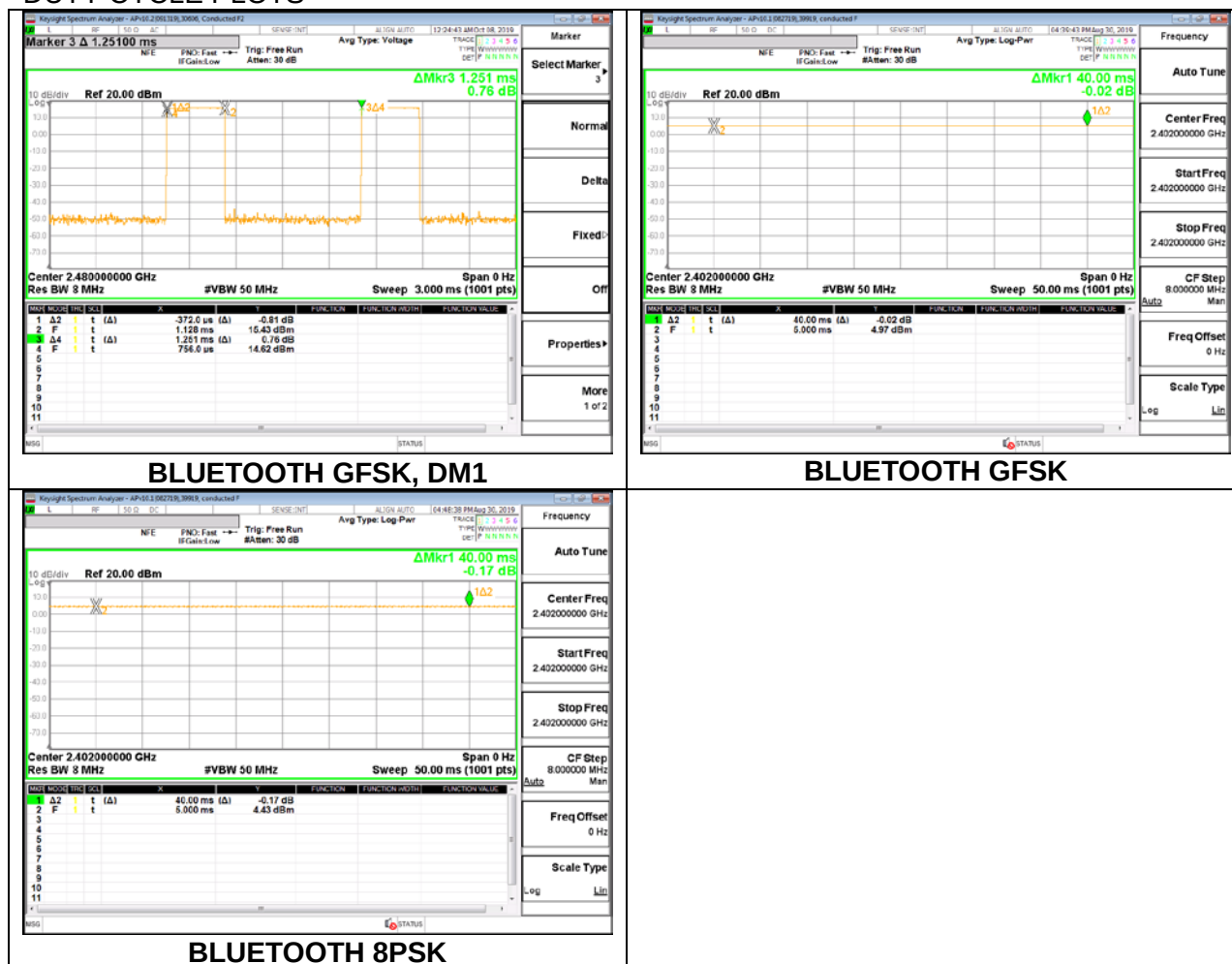
ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

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, DM1	0.37	1.25	0.297	29.7%	5.27	2.688
Bluetooth GFSK,	40.00	40.00	1.000	100.0%	0.00	0.010
Bluetooth 8PSK	40.00	40.00	1.000	100.0%	0.00	0.010

Note: During radiated emission testing, the device was programmed to transmit at 100% duty cycle as show in the plot below. Under normal use the device would operate with a maximum duty cycle of 29.7% therefore radiated emission data in this report is considered to be worst case.

DUTY CYCLE PLOTS



8.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

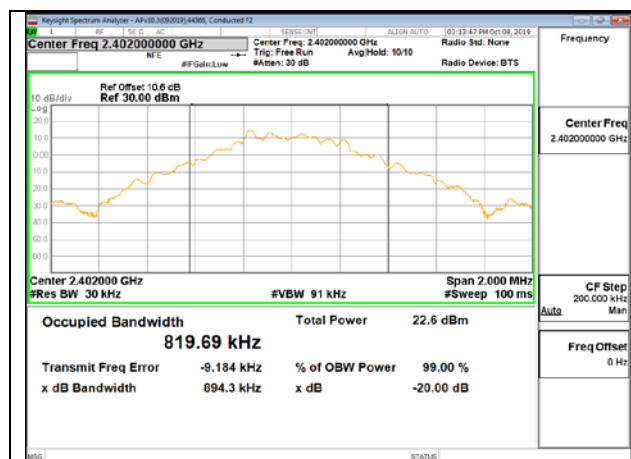
TEST PROCEDURE

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

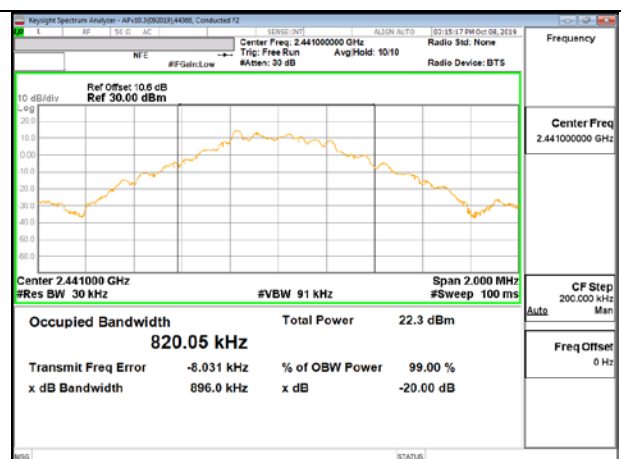
RESULTS

8.2.1. BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION

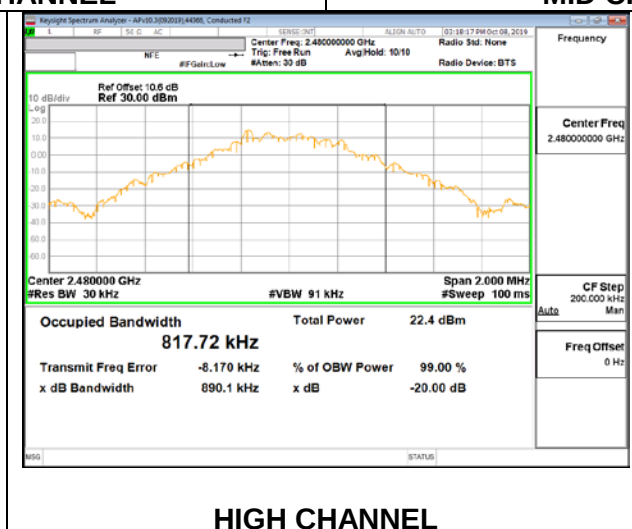
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.894	0.820
Mid	2441	0.896	0.820
High	2480	0.890	0.818



LOW CHANNEL



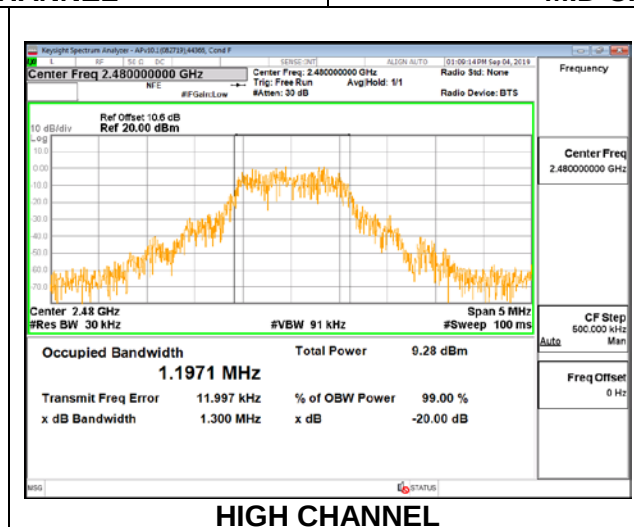
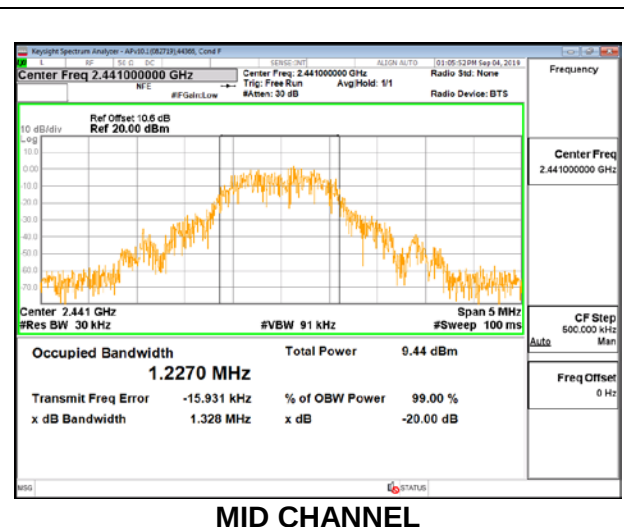
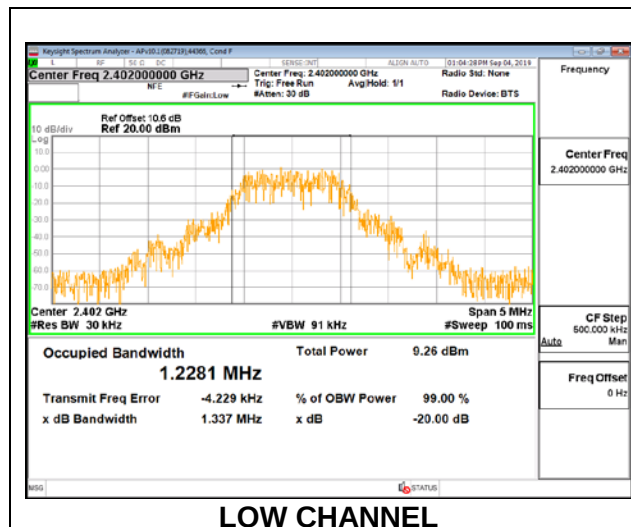
MID CHANNEL



HIGH CHANNEL

8.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.337	1.2281
Mid	2441	1.328	1.2270
High	2480	1.300	1.1971



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 hopping 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.

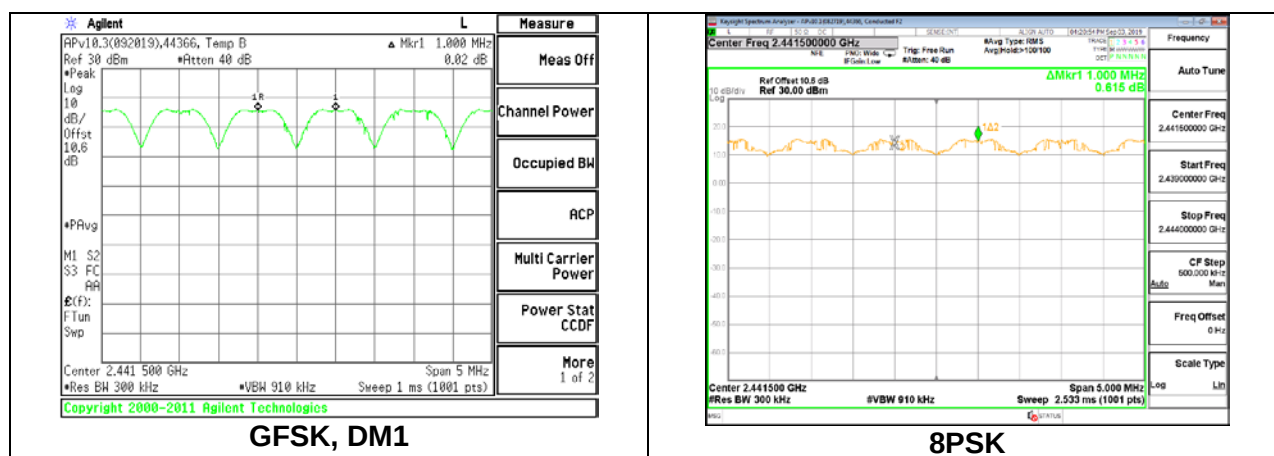
TEST PROCEDURE

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

RESULTS

ID:	44366	Date:	10/07/2019
-----	-------	-------	------------

BLUETOOTH BASIC DATA RATE GFSK DM1 AND 8PSK MODULATION



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.

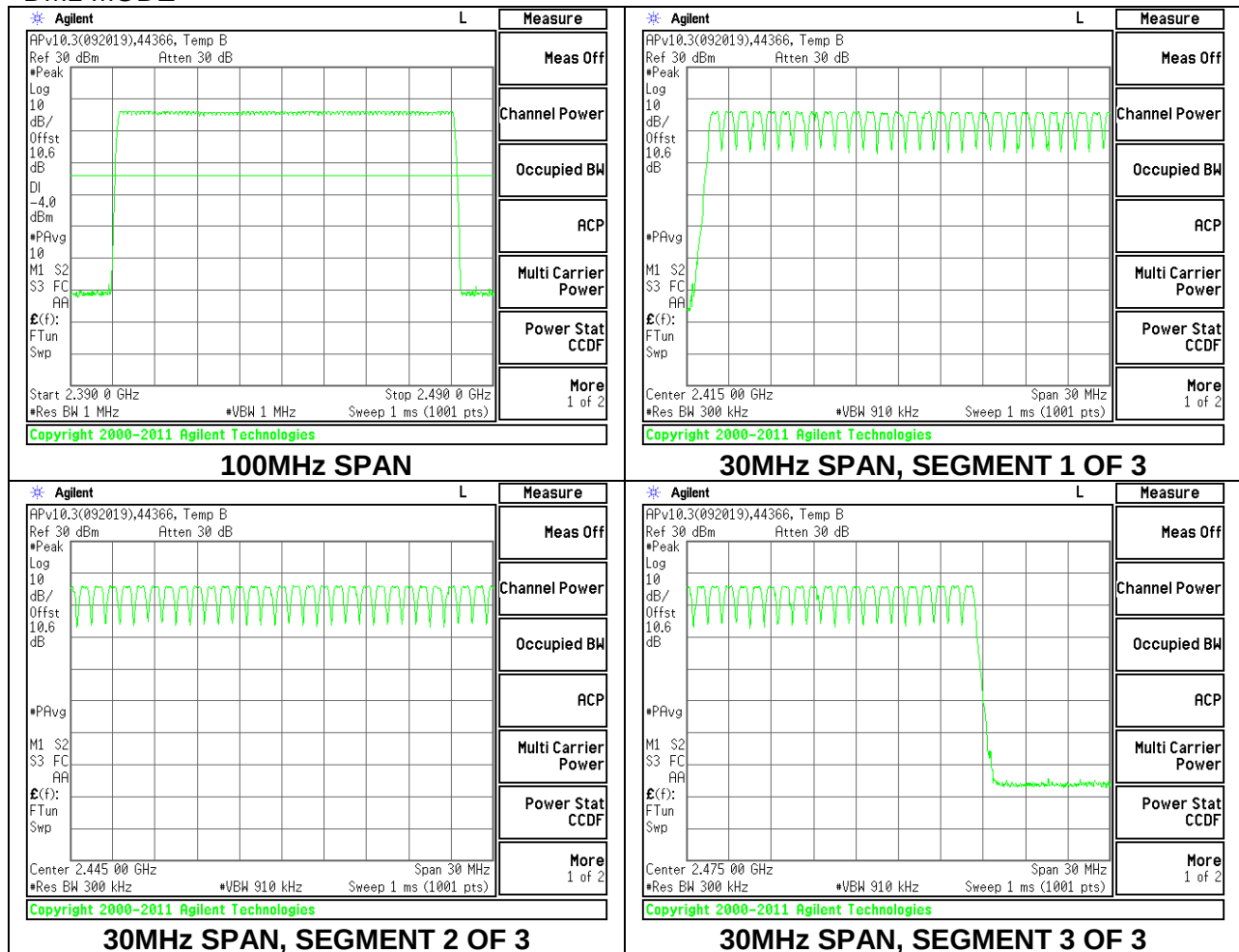
RESULTS

Normal Mode: 79 Channels Observed

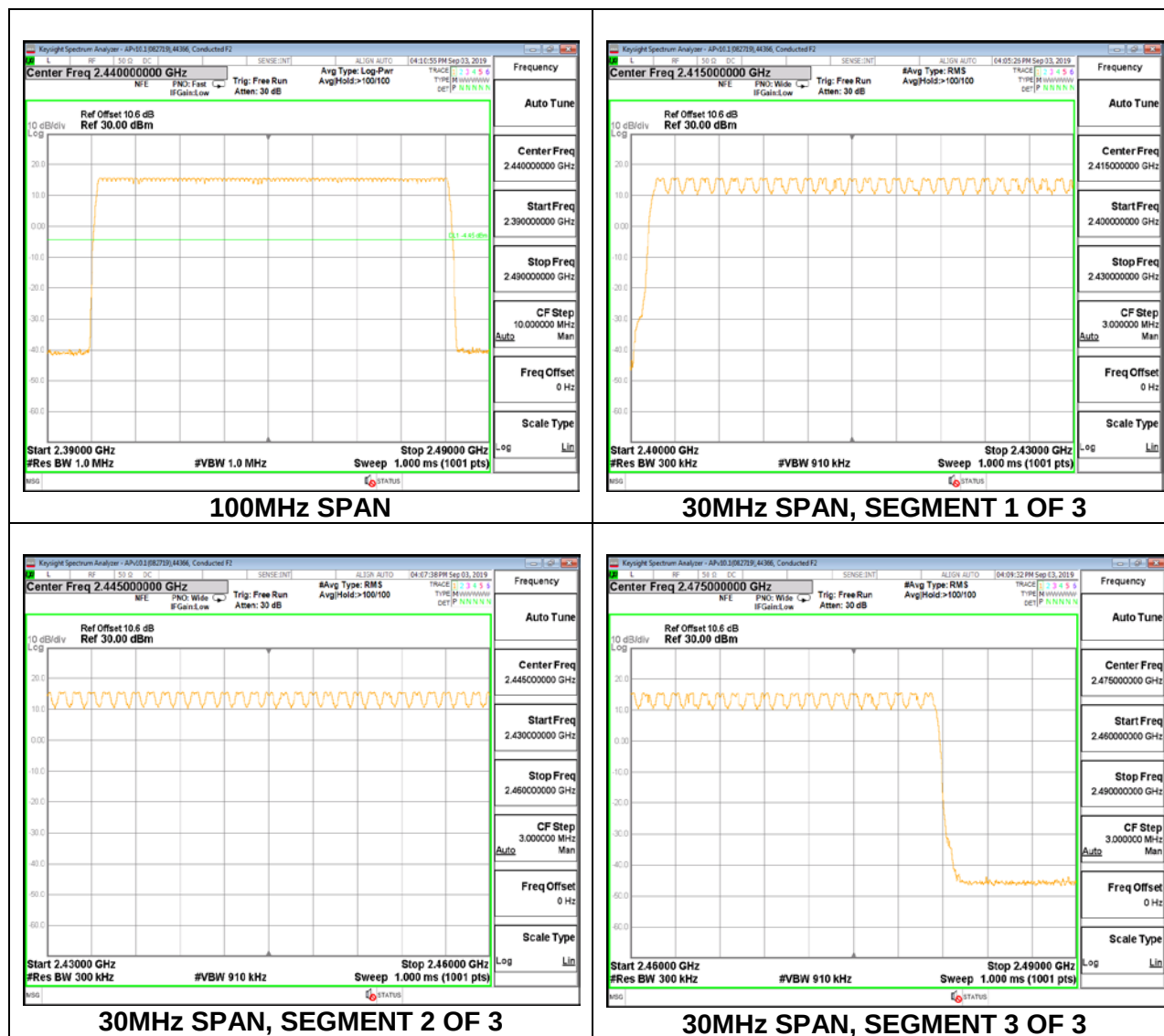
8.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

ID:	44366	Date:	10/07/2019
-----	-------	-------	------------

DM1 MODE



8.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



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 $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

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

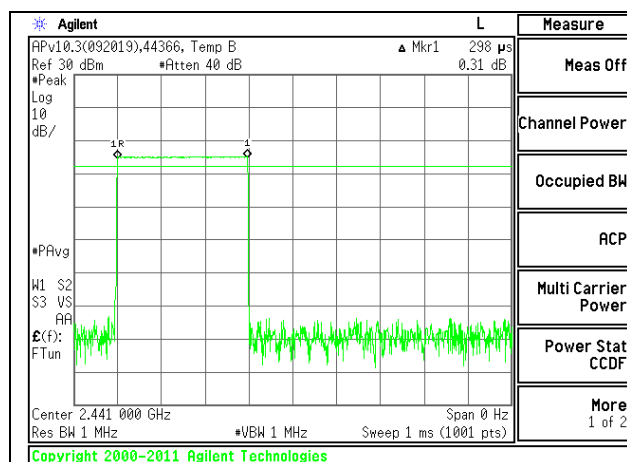
RESULTS

8.5.1. BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION

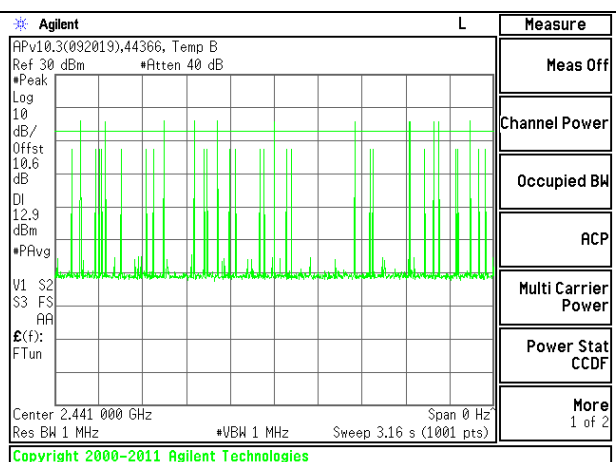
GFSK DM1 MODE

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DM1	0.298	11	0.0328	0.4	-0.3672
GFSK AFH Mode					
DM1	0.298	2.75	0.00820	0.4	-0.3918

ID:	44366	Date:	10/07/2019
-----	-------	-------	------------



PULSE WIDTH – DM1

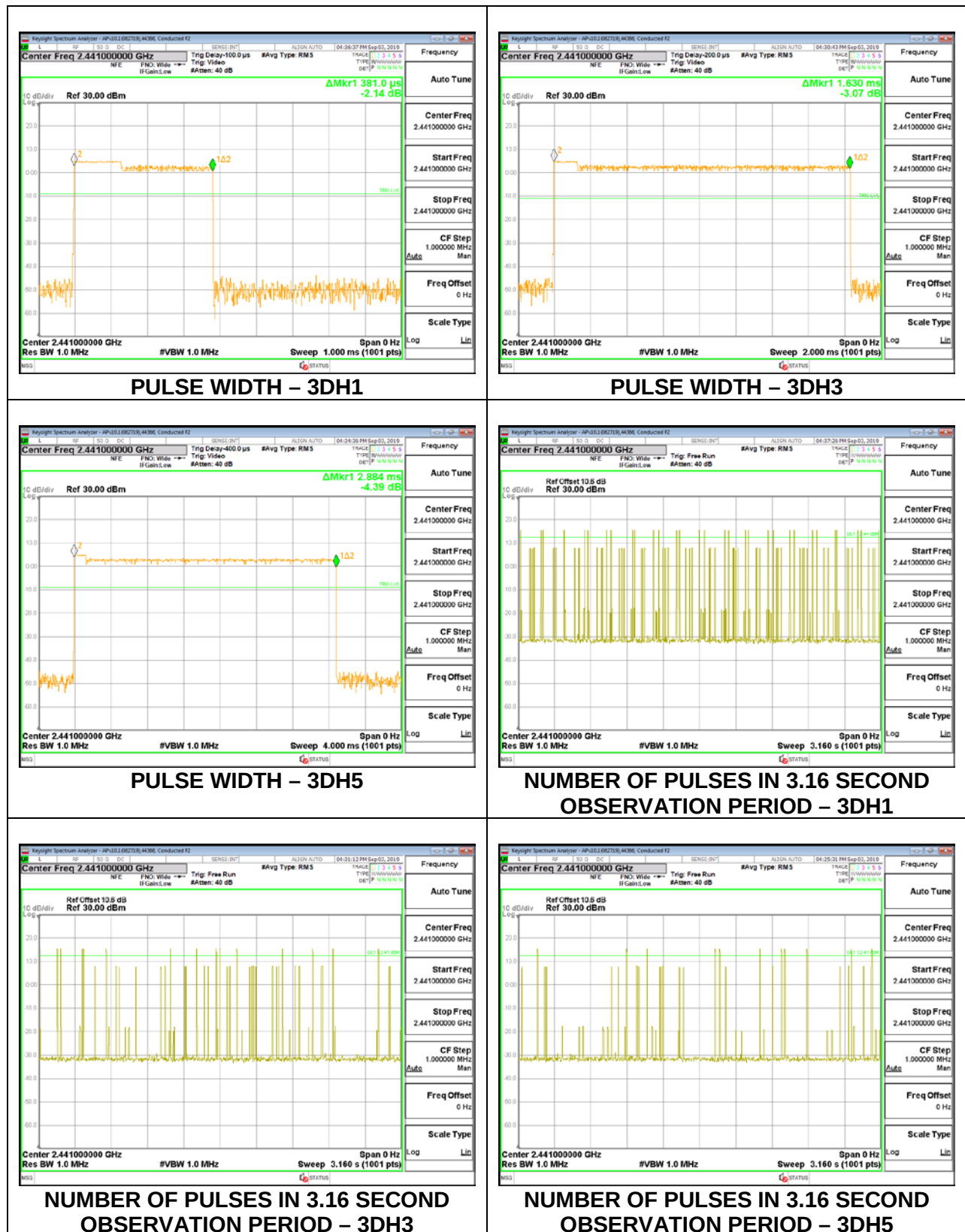


NUMBER OF PULSES – DM1

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 Normal Mode					
3DH1	0.381	31	0.11811	0.4	-0.2819
3DH3	1.63	14	0.2282	0.4	-0.1718
3DH5	2.884	11	0.31724	0.4	-0.0828

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.



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 10.6 dB (including 10 dB pad and 0.6 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

RESULTS

8.6.1. BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION

Tested By:	44366
Date:	10/8/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.55	21	-8.45
Middle	2441	12.39	21	-8.61
High	2480	12.56	21	-8.44

8.6.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	44366
Date:	9/4/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.84	21	-8.16
Middle	2441	12.71	21	-8.29
High	2480	12.78	21	-8.22

8.6.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	44366
Date:	9/4/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.73	21	-8.27
Middle	2441	12.65	21	-8.35
High	2480	12.70	21	-8.3

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 10.6 dB (including 10 dB pad and 0.6 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 DM1 MODULATION

Tested By:	44366
Date	10/8/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	12.44
Middle	2441	12.27
High	2480	12.44

8.7.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	44366
Date	9/4/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.43
Middle	2441	9.34
High	2480	9.40

8.7.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	44366
Date	9/4/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.36
Middle	2441	9.31
High	2480	9.33

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.

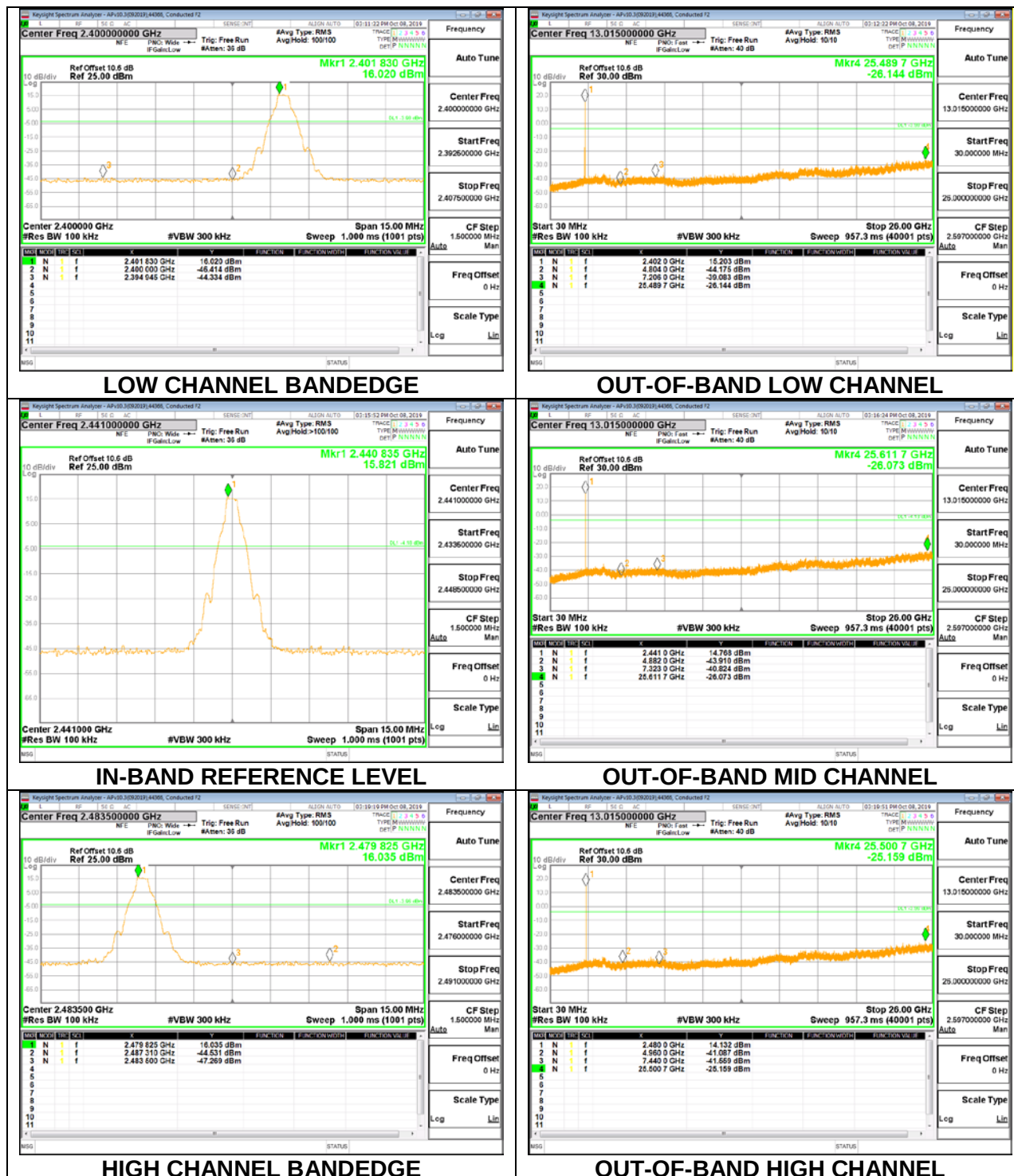
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

RESULTS

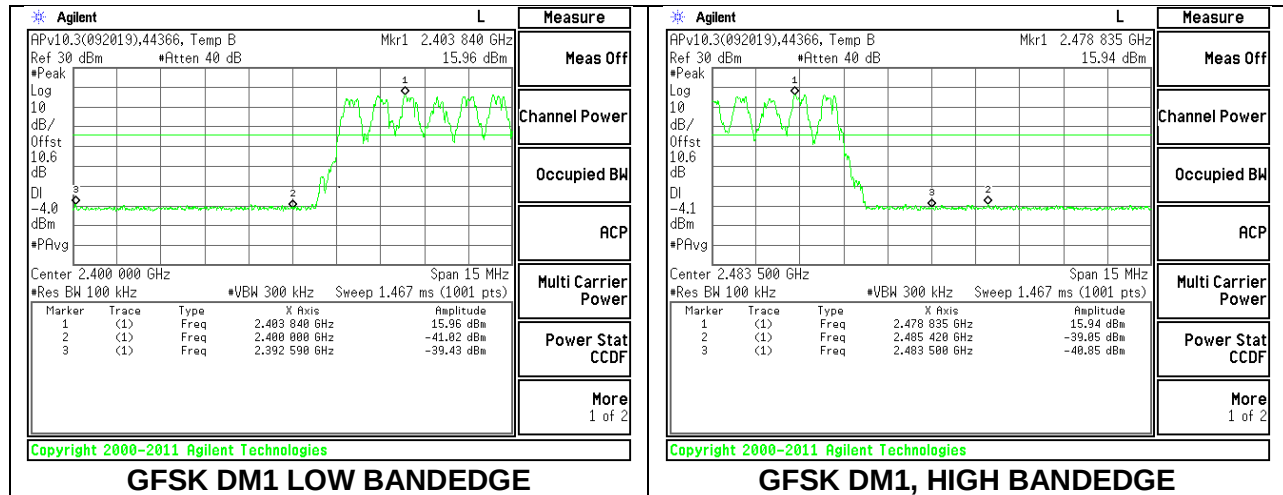
8.8.1. BLUETOOTH BASIC DATA RATE GFSK DM1 MODULATION

SPURIOUS EMISSIONS, NON-HOPPING



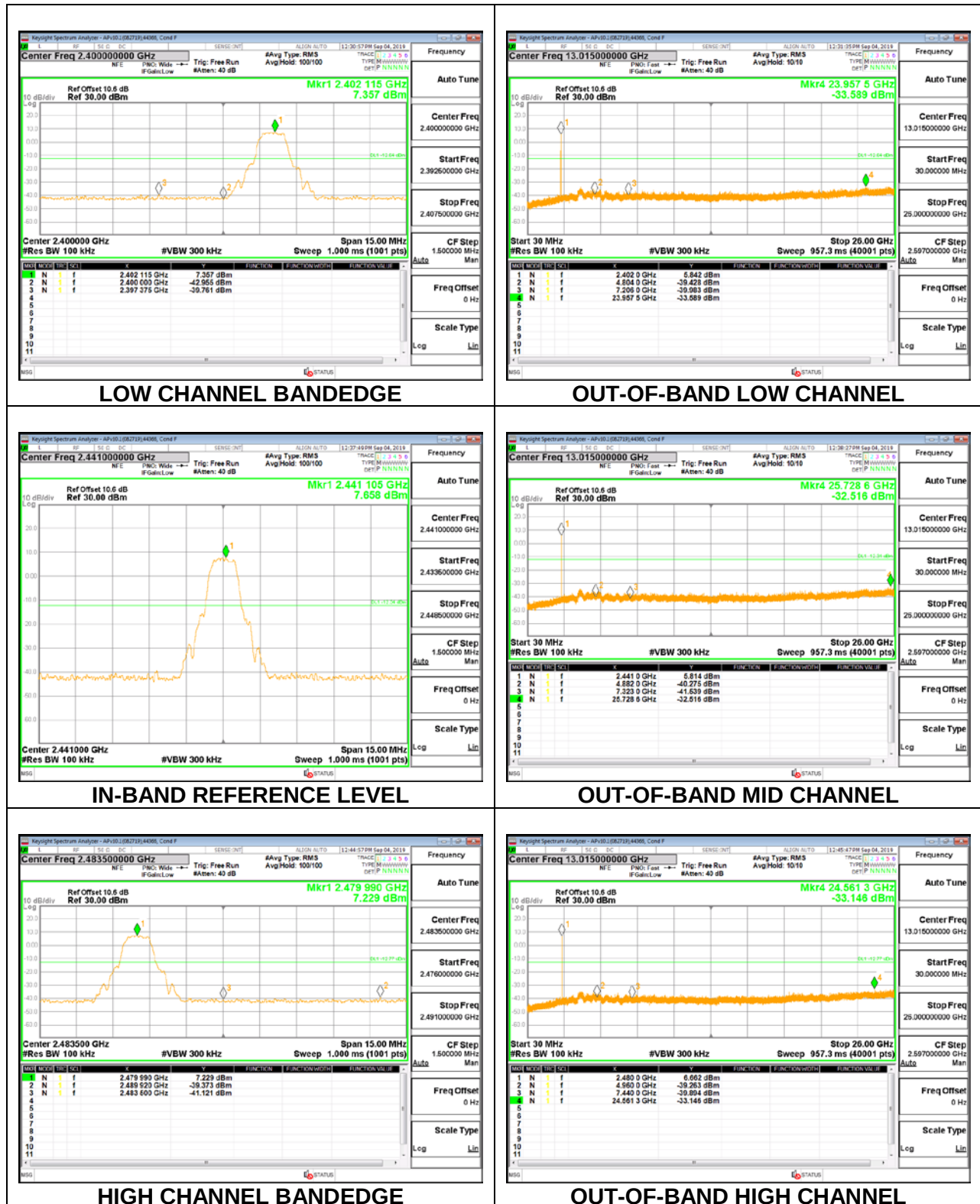
ID:	44366	Date:	10/08/2019
-----	-------	-------	------------

SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

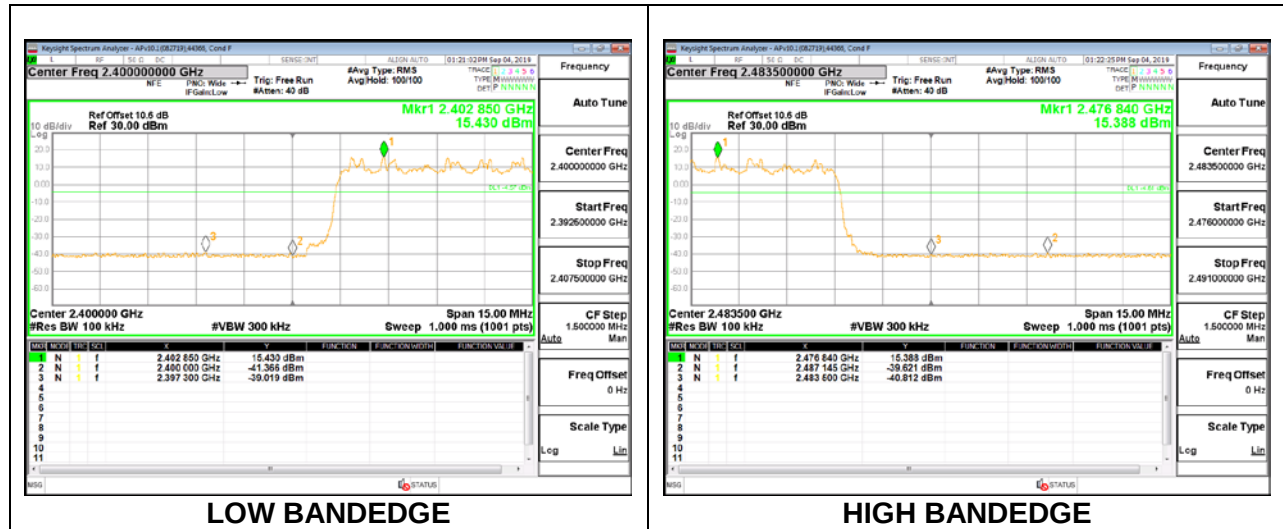


8.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

SPURIOUS EMISSIONS, NON-HOPPING



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



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

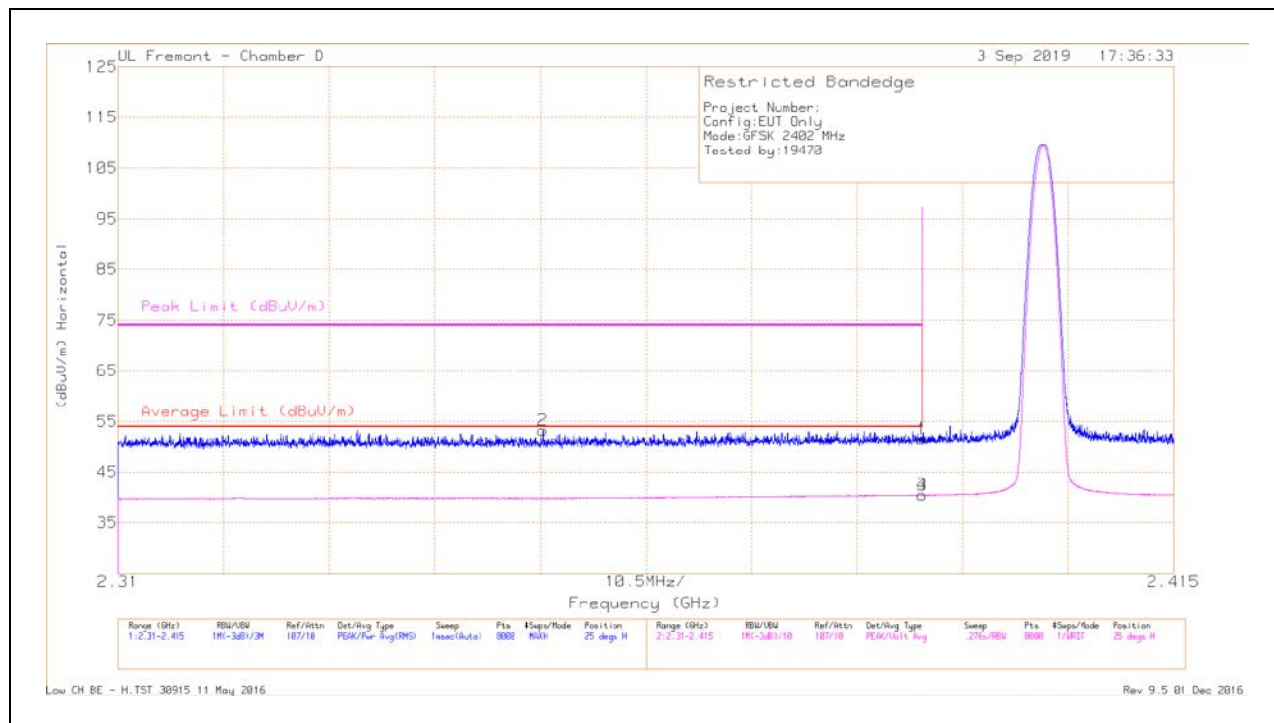
Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can 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.

9.1. TRANSMITTER ABOVE 1 GHz

9.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



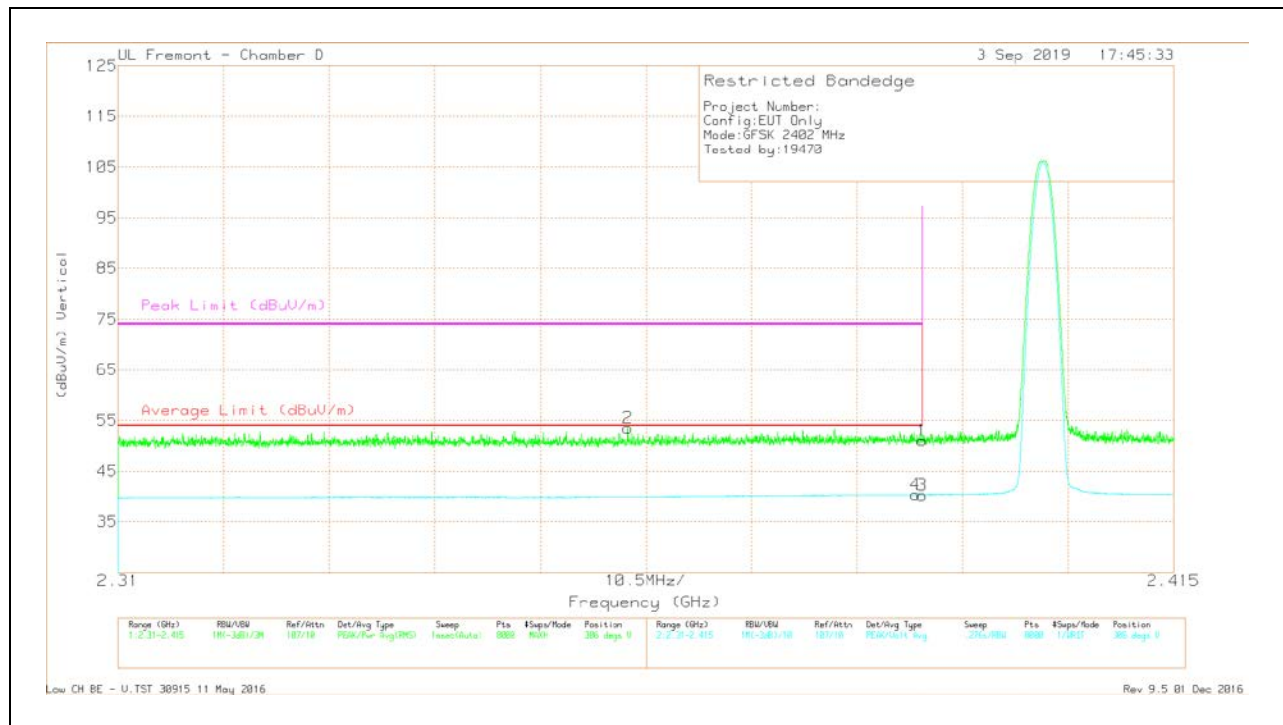
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/P ad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.390	40.09	Pk	32	-20.5	51.59	-	-	74	-22.41	25	294	H
2	* 2.352	42.30	Pk	31.7	-20.7	53.30	-	-	74	-20.70	25	294	H
3	* 2.390	28.94	VA1T	32	-20.5	40.44	54	-13.56	-	-	25	294	H
4	* 2.390	28.93	VA1T	32	-20.5	40.43	54	-13.57	-	-	25	294	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 T712 (dB/m)	Amp/Cbl/Filtr/P ad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.390	39.55	Pk	32	-20.5	51.05	-	-	74	-22.95	306	332	V
2	* 2.361	42.29	Pk	31.8	-20.6	53.49	-	-	74	-20.51	306	332	V
3	* 2.390	28.77	VA1T	32	-20.5	40.27	54	-13.73	-	-	306	331	V
4	* 2.389	28.82	VA1T	32	-20.5	40.32	54	-13.68	-	-	306	331	V

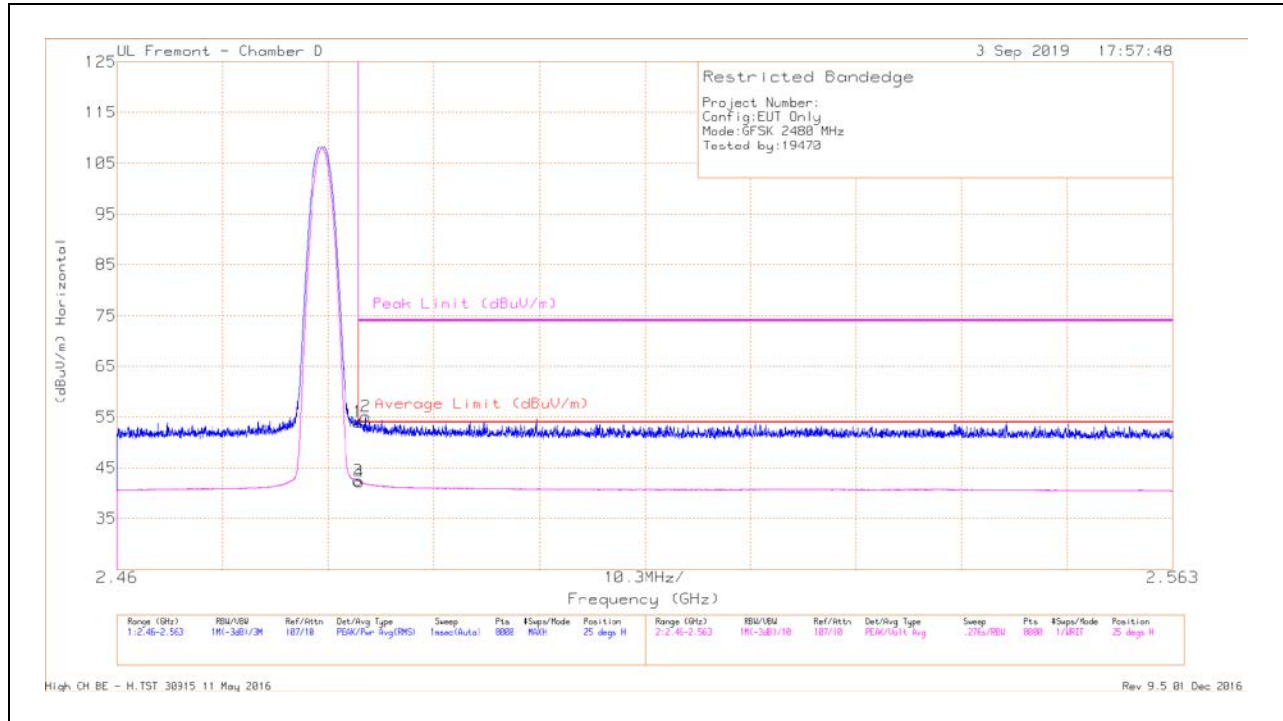
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



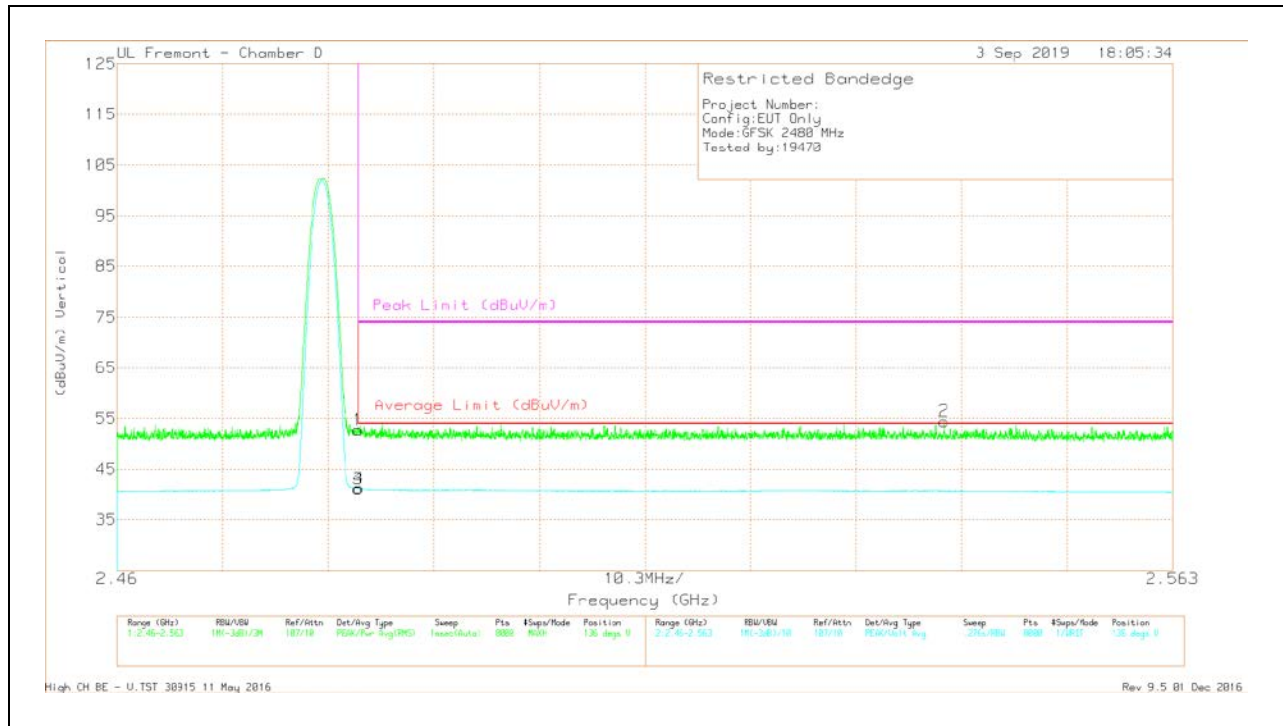
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dBm)	Amp/Cbl/Ftr/P ad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	42.12	Pk	32.4	-20.5	54.02	-	-	74	-19.98	25	310	H
2	* 2.484	43.3	Pk	32.3	-20.5	55.1	-	-	74	-18.90	25	310	H
3	* 2.484	30.55	VA1T	32.4	-20.5	42.45	54	-11.55	-	-	25	310	H
4	* 2.484	30.37	VA1T	32.4	-20.5	42.27	54	-11.73	-	-	25	310	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 T712 (dBm)	Amp/Cbl/Filtr/P ad (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	40.93	Pk	32.4	-20.5	52.83	-	-	74	-21.17	136	399	V
3	* 2.484	29.24	VA1T	32.4	-20.5	41.14	54	-12.86	-	-	136	399	V
4	* 2.484	29.28	VA1T	32.4	-20.5	41.18	54	-12.82	-	-	136	399	V
2	2.541	42.55	Pk	32.2	-20.3	54.45	-	-	74	-19.55	136	399	V

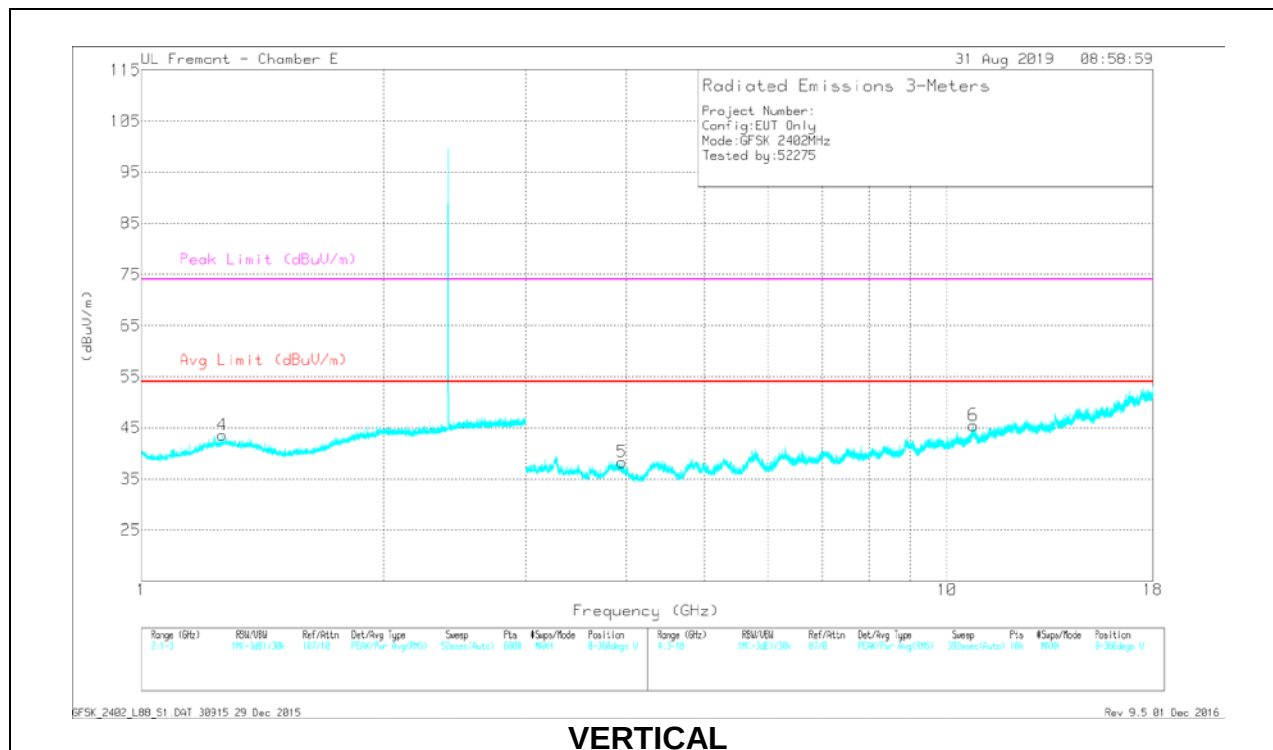
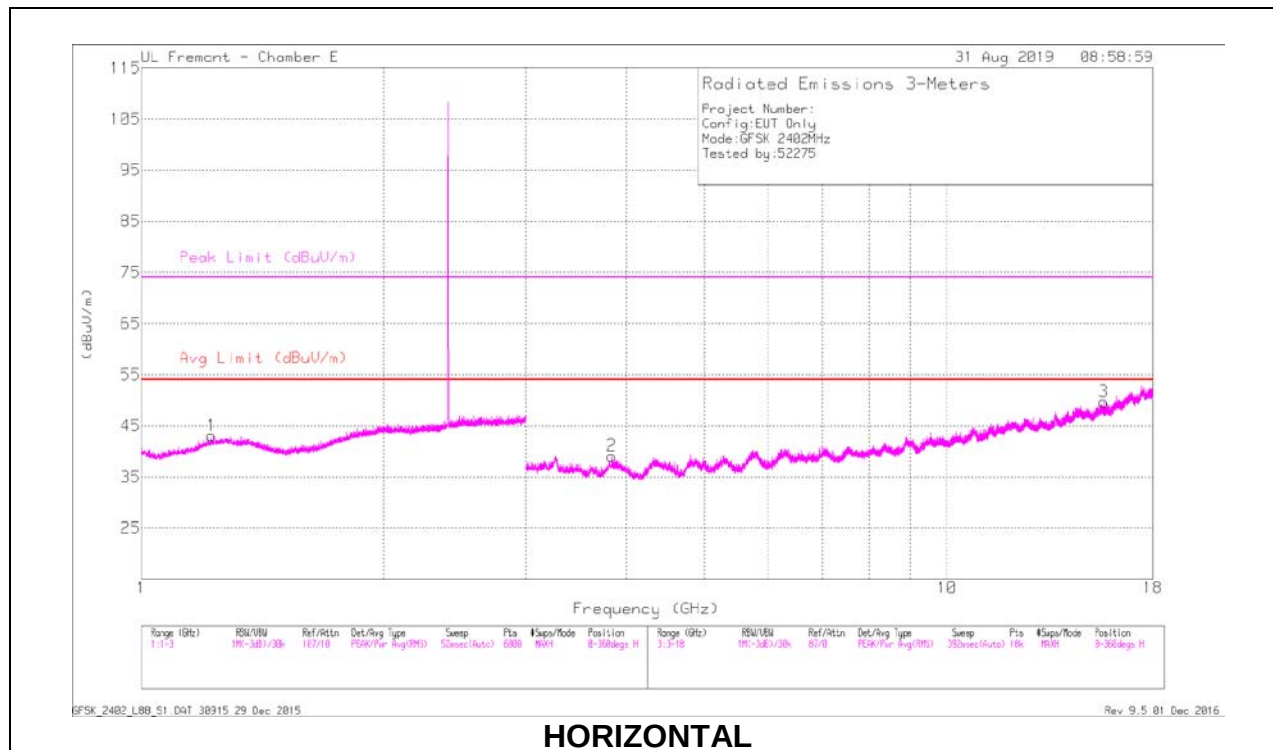
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B = 1/T_{on}$ where: T_{on} is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

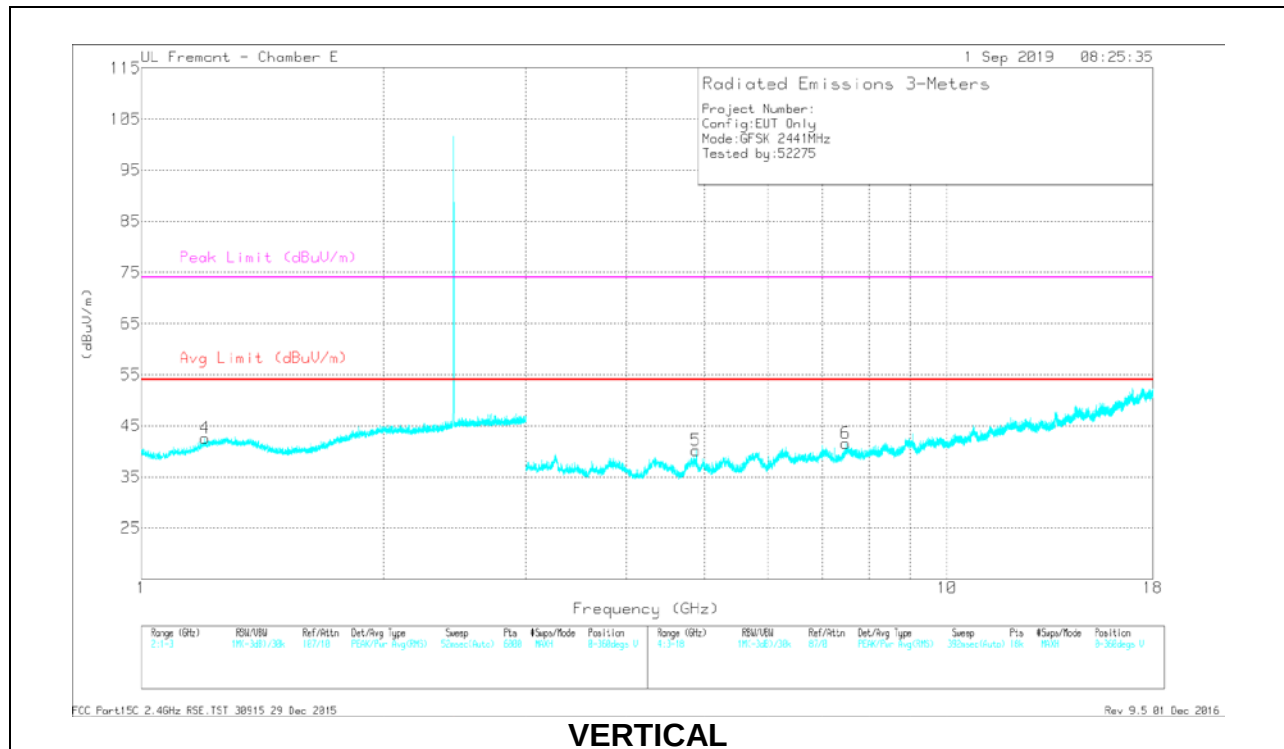
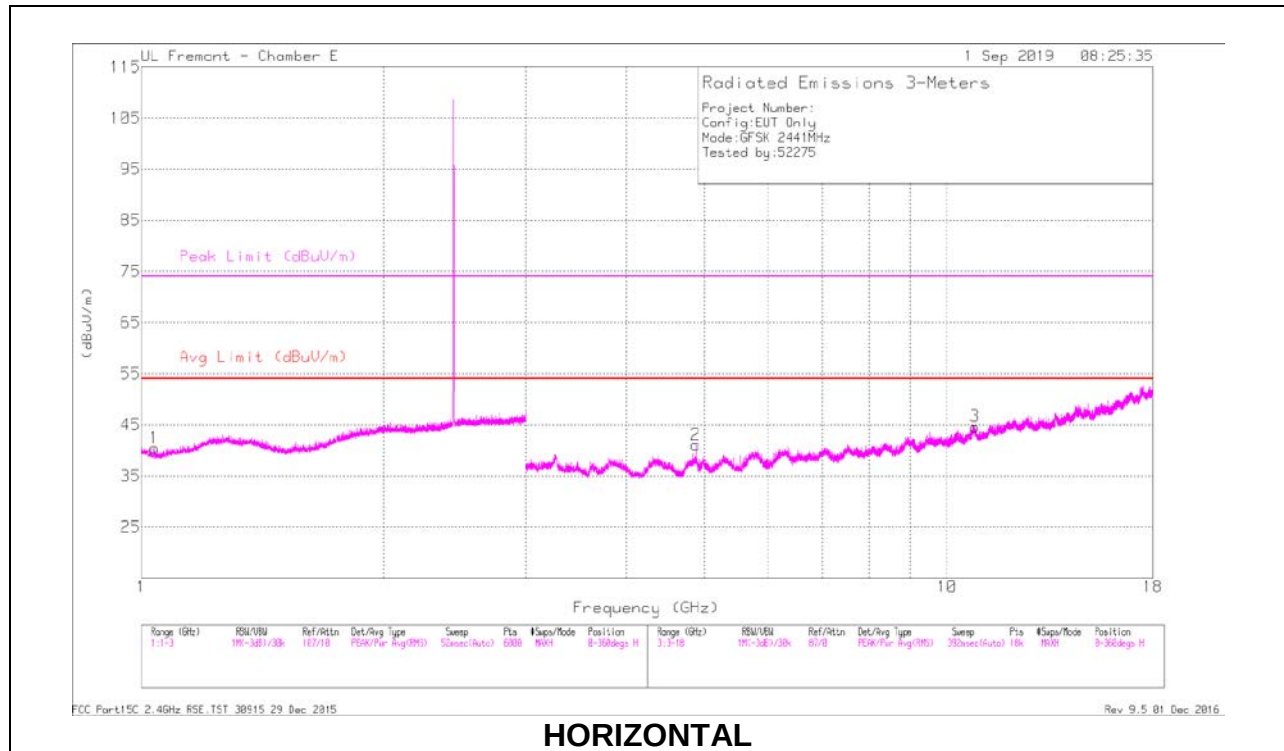
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.225	44.4	PKFH	29.8	-26.1	48.10	-	-	74	-25.9	126	270	H
	* 1.222	32.53	VA1T	29.8	-26.1	36.23	54	-17.77	-	-	126	270	H
4	* 1.261	44.59	PKFH	30	-26.2	48.39	-	-	74	-25.61	230	140	V
	* 1.261	32.66	VA1T	30	-26.2	36.46	54	-17.54	-	-	230	140	V
2	* 3.840	42.5	PKFH	33.4	-30.8	45.10	-	-	74	-28.9	209	127	H
	* 3.838	29.92	VA1T	33.4	-30.8	32.52	54	-21.48	-	-	209	127	H
3	* 15.651	34.72	PKFH	40.3	-20.5	54.52	-	-	74	-19.48	194	153	H
	* 15.652	22.87	VA1T	40.3	-20.5	42.67	54	-11.33	-	-	194	153	H
5	* 3.950	41.37	PKFH	33.4	-31.2	43.57	-	-	74	-30.43	137	208	V
	* 3.951	29.65	VA1T	33.4	-31.2	31.85	54	-22.15	-	-	137	208	V
6	* 10.783	35.83	PKFH	37.9	-23.1	50.63	-	-	74	-23.37	215	122	V
	* 10.782	23.99	VA1T	37.9	-23.1	38.79	54	-15.21	-	-	215	122	V

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

MID CHANNEL RESULTS



RADIATED EMISSIONS

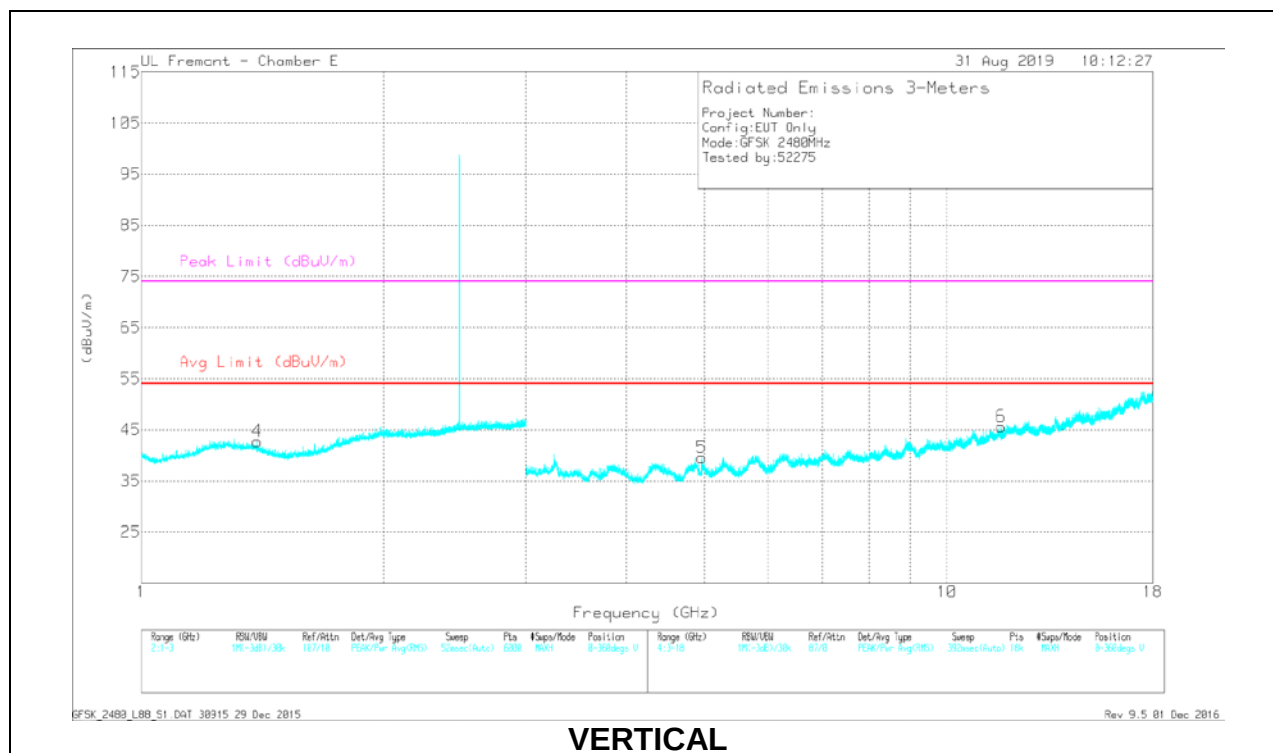
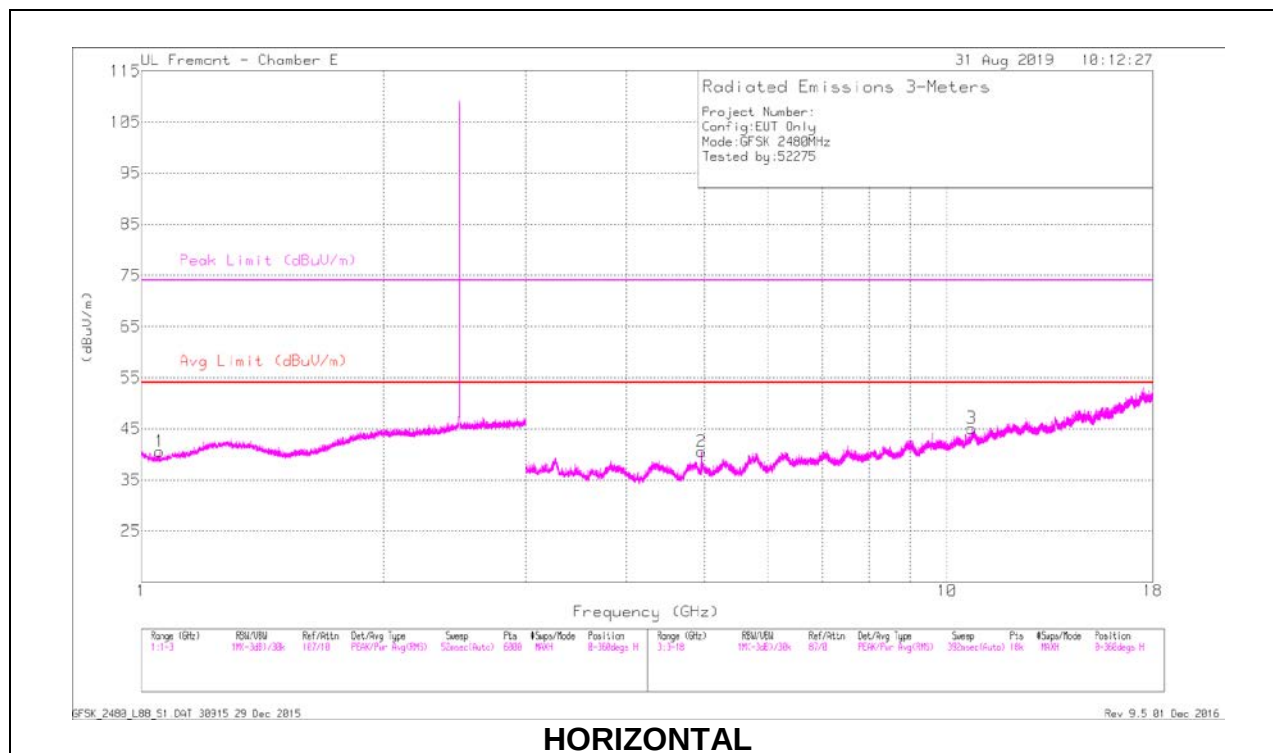
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Filt/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.037	45.20	PKFH	27.1	-25.7	46.60	-	-	74	-27.40	116	280	H
	* 1.040	32.25	VA1T	27	-25.8	33.45	54	-20.55	-	-	116	280	H
4	* 1.199	44.73	PKFH	29.5	-26.1	48.13	-	-	74	-25.87	168	334	V
	* 1.199	32.61	VA1T	29.5	-26.1	36.01	54	-17.99	-	-	168	334	V
2	* 4.882	43.13	PKFH	34	-30	47.13	-	-	74	-26.87	0	198	H
	* 4.882	33.25	VA1T	34	-30	37.25	54	-16.75	-	-	0	198	H
3	* 10.840	36.42	PKFH	37.9	-23.8	50.52	-	-	74	-23.48	287	273	H
	* 10.843	24.18	VA1T	37.9	-23.8	38.28	54	-15.72	-	-	287	273	H
5	* 4.883	41.87	PKFH	34	-30	45.87	-	-	74	-28.13	63	150	V
	* 4.882	32.81	VA1T	34	-30	36.81	54	-17.19	-	-	63	150	V
6	* 7.491	37.40	PKFH	35.8	-26.8	46.40	-	-	74	-27.60	351	119	V
	* 7.490	25.74	VA1T	35.7	-26.8	34.64	54	-19.36	-	-	351	119	V

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

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Filt/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	* 1.055	44.19	PKFH	27.1	-25.8	45.49	-	-	74	-28.51	172	119	H
	* 1.056	32.29	VA1T	27.1	-25.8	33.59	54	-20.41	-	-	172	119	H
4	* 1.394	44.45	PKFH	29.2	-26.2	47.45	-	-	74	-26.55	119	229	V
	* 1.395	32.8	VA1T	29.2	-26.2	35.8	54	-18.20	-	-	119	229	V
2	* 4.961	40.31	PKFH	34	-30.3	44.01	-	-	74	-29.99	298	292	H
	* 4.959	28.69	VA1T	34	-30.3	32.39	54	-21.61	-	-	298	292	H
3	* 10.732	36.43	PKFH	37.9	-23.9	50.43	-	-	74	-23.57	202	331	H
	* 10.73	24.23	VA1T	37.9	-24	38.13	54	-15.87	-	-	202	331	H
5	* 4.961	40.36	PKFH	34	-30.3	44.06	-	-	74	-29.94	176	215	V
	* 4.960	28.69	VA1T	34	-30.3	32.39	54	-21.61	-	-	176	215	V
6	* 11.663	35.08	PKFH	38.8	-22.9	50.98	-	-	74	-23.02	264	112	V
	* 11.662	23.13	VA1T	38.8	-22.9	39.03	54	-14.97	-	-	264	112	V

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

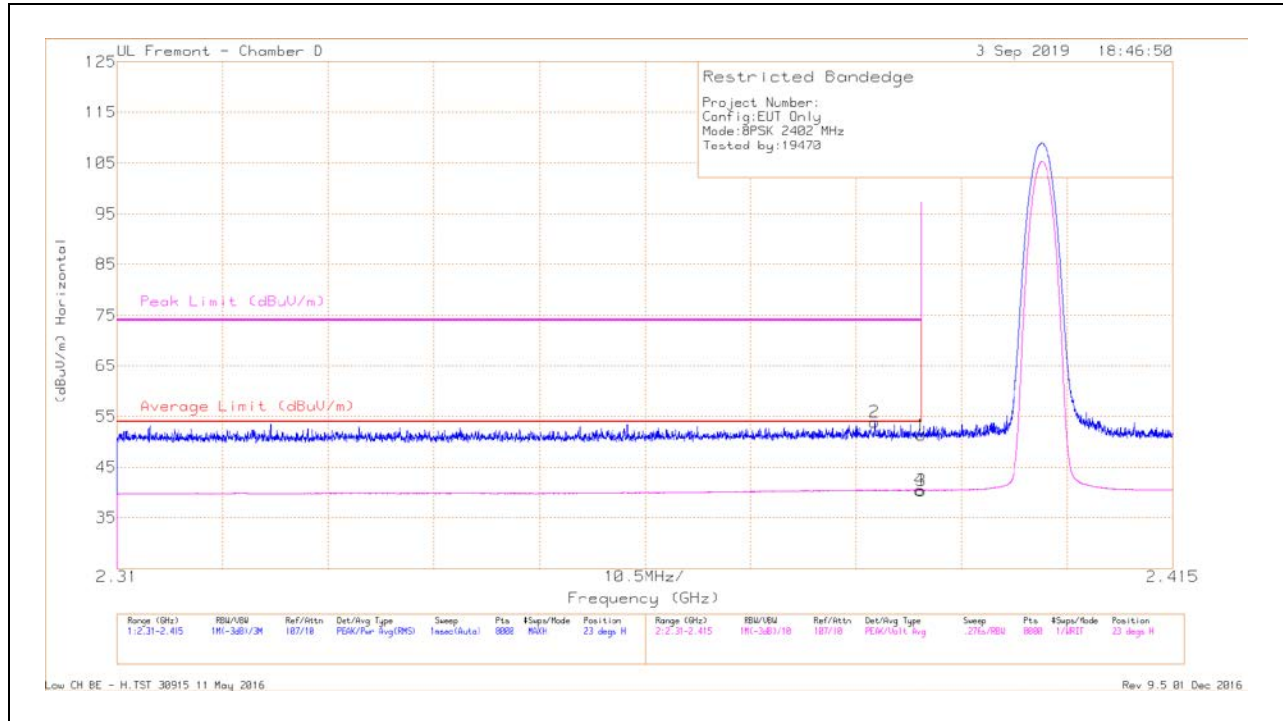
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

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

9.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



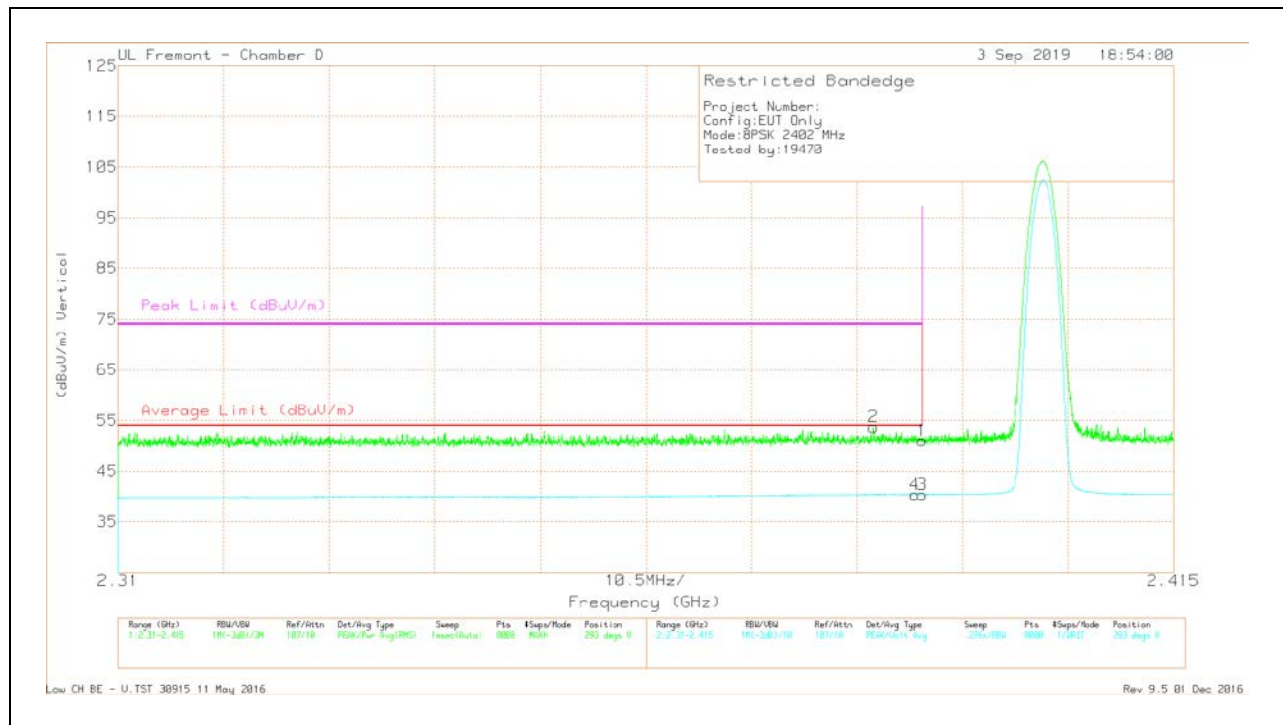
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fitr/P ad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.385	42.44	Pk	32	-20.6	53.84	-	-	74	-20.16	23	292	H
1	* 2.390	39.82	Pk	32	-20.5	51.32	-	-	74	-22.68	23	292	H
3	* 2.390	28.91	VA1T	32	-20.5	40.41	54	-13.59	-	-	23	292	H
4	* 2.390	28.96	VA1T	32	-20.5	40.46	54	-13.54	-	-	23	292	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B = 1/T_{on}$ where: T_{on} is transmit duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/P ad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.385	42.31	Pk	32	-20.6	53.71	-	-	74	-20.29	293	331	V
4	* 2.389	28.85	VA1T	32	-20.5	40.35	54	-13.65	-	-	293	331	V
1	* 2.390	39.53	Pk	32	-20.5	51.03	-	-	74	-22.97	293	331	V
3	* 2.390	28.83	VA1T	32	-20.5	40.33	54	-13.67	-	-	293	331	V

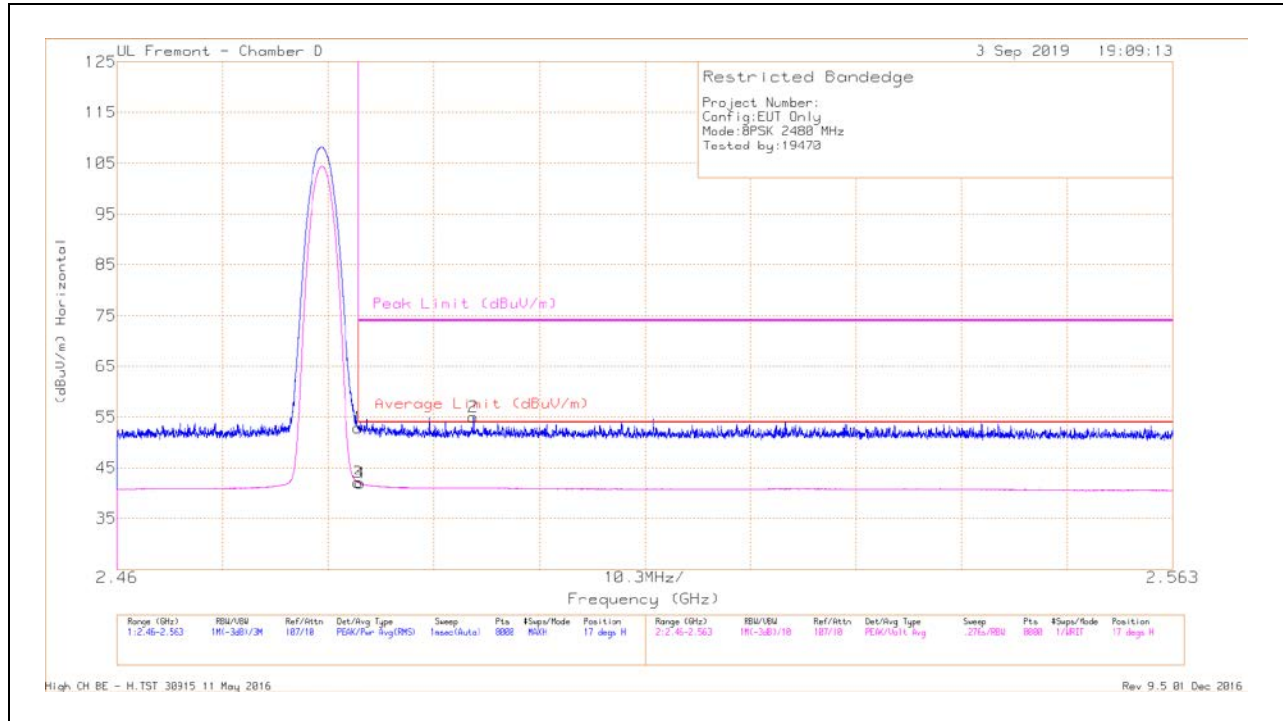
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



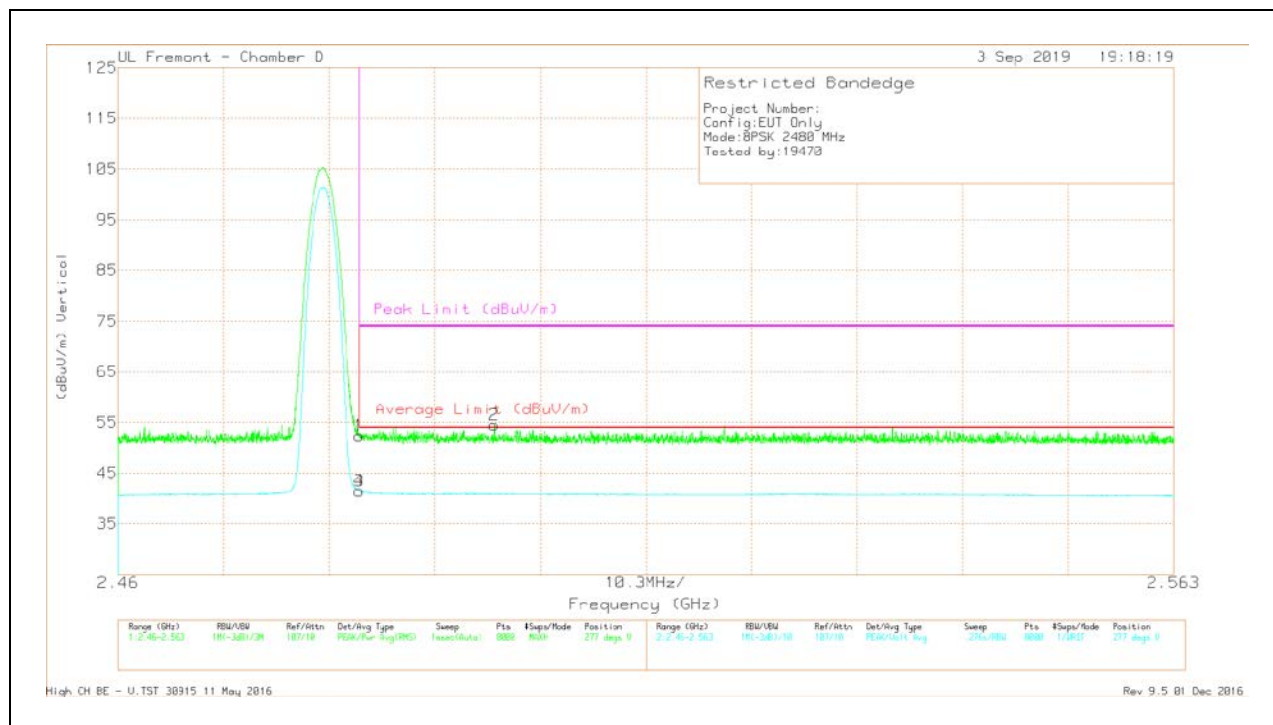
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dBm)	Ampl/Cbl/Filtr/P ad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41.01	Pk	32.4	-20.5	52.91	-	-	74	-21.09	17	310	H
3	* 2.484	30.21	VA1T	32.4	-20.5	42.11	54	-11.89	-	-	17	310	H
4	* 2.484	30.03	VA1T	32.4	-20.5	41.93	54	-12.07	-	-	17	310	H
2	* 2.495	43.06	Pk	32.4	-20.4	55.06	-	-	74	-18.94	17	310	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 T712 (dBm)	Amp/Cbl/Filtr/P ad (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	40.52	Pk	32.4	-20.5	52.42	-	-	74	-21.58	277	398	V
3	* 2.484	29.60	VA1T	32.4	-20.5	41.50	54	-12.50	-	-	277	397	V
4	* 2.484	29.56	VA1T	32.4	-20.5	41.46	54	-12.54	-	-	277	397	V
2	* 2.497	42.65	Pk	32.3	-20.4	54.55	-	-	74	-19.45	277	398	V

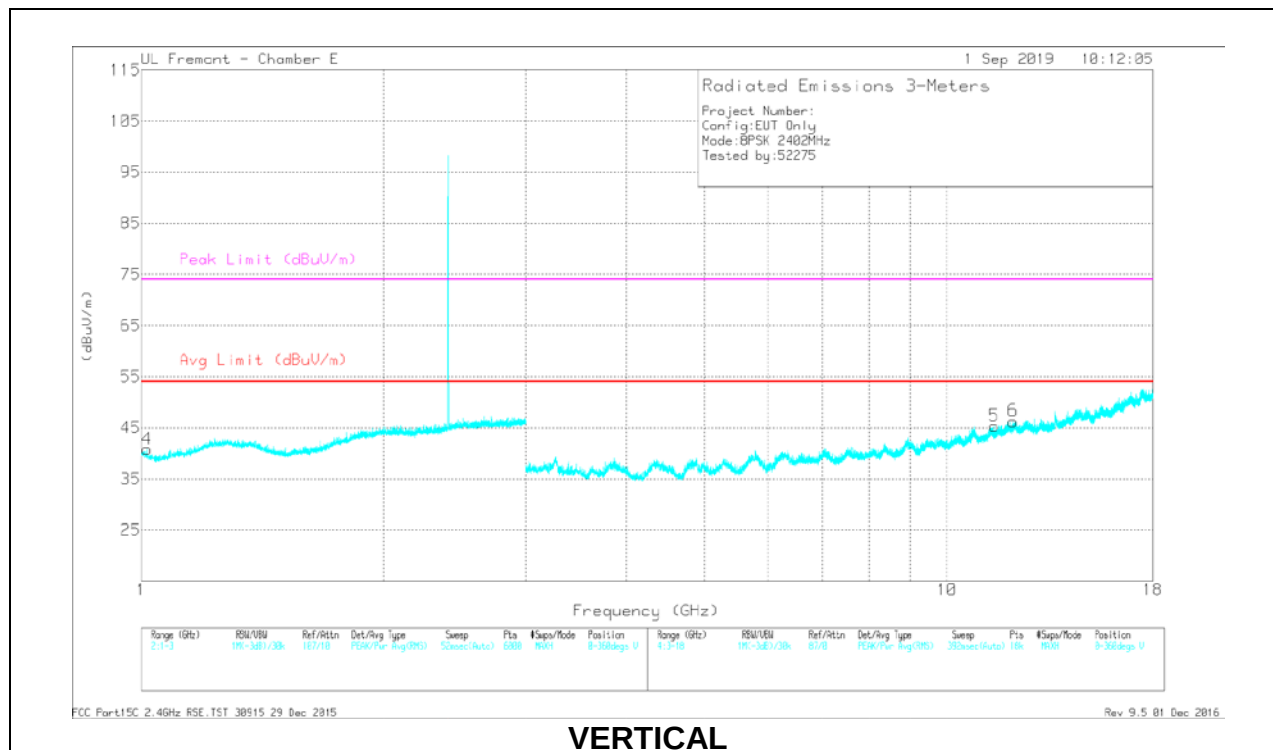
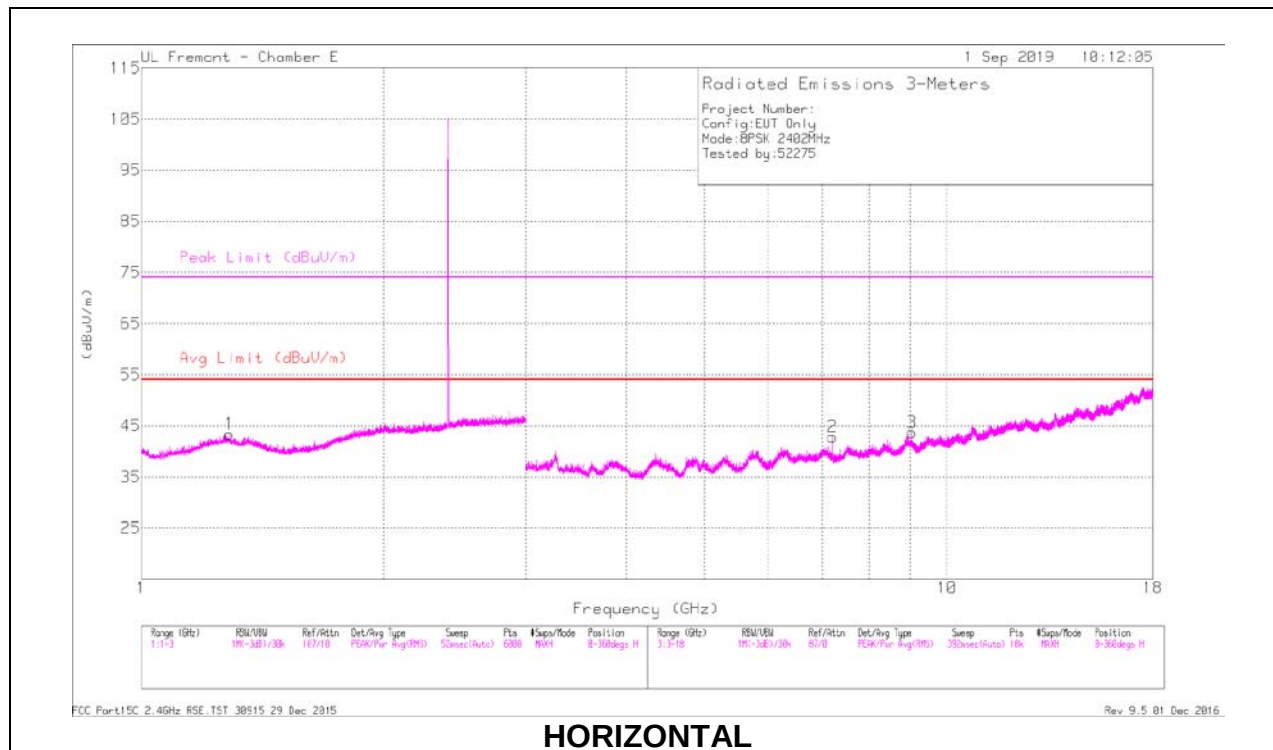
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

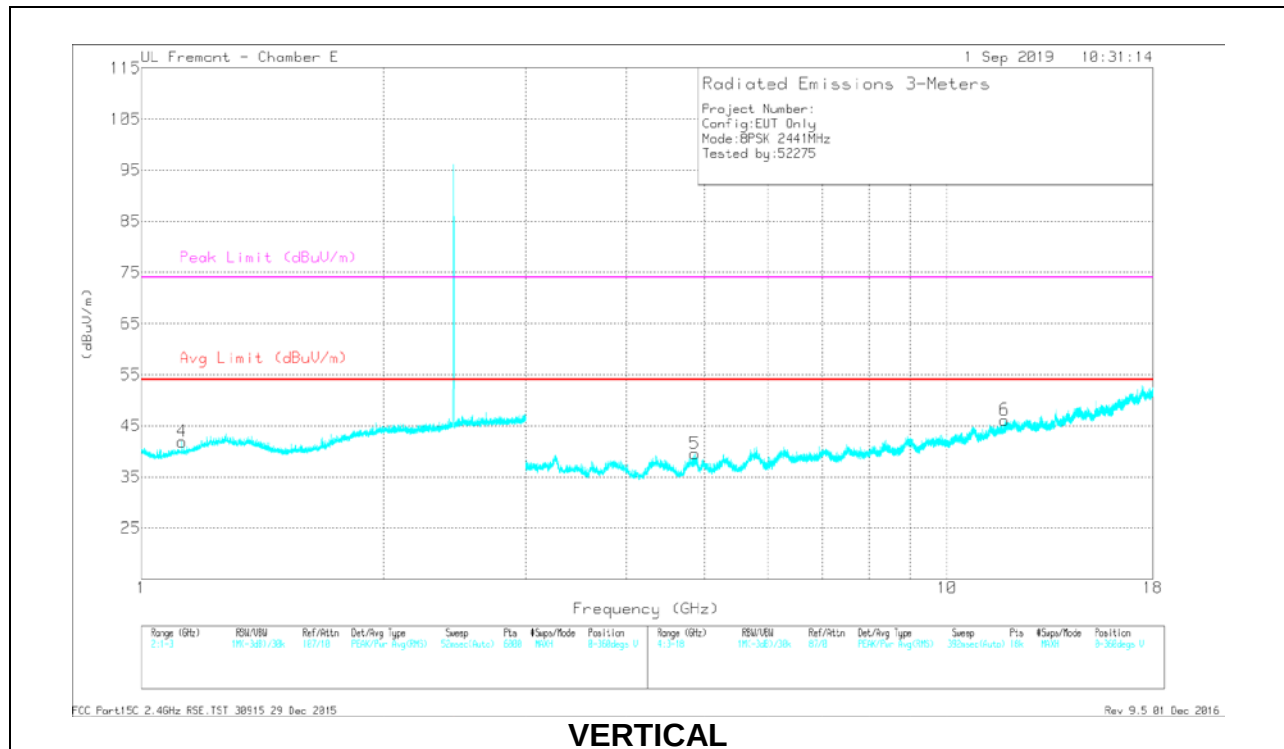
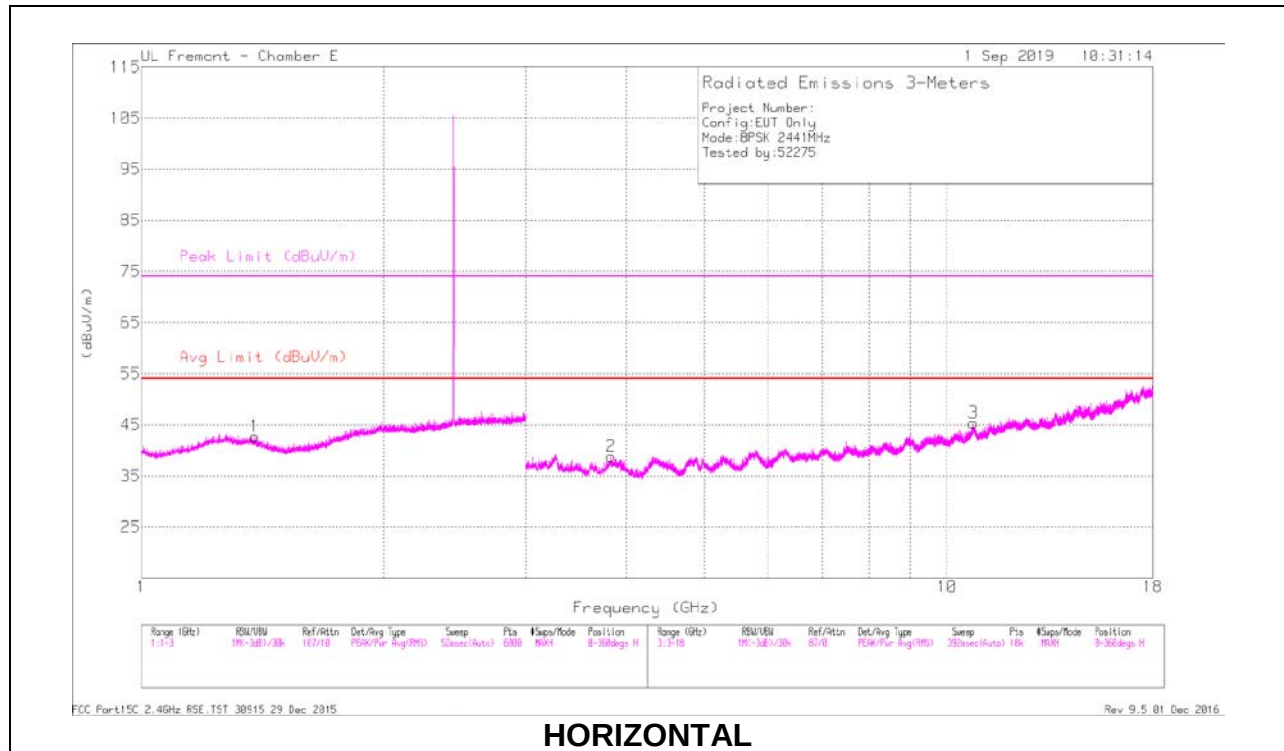
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Filt/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.29	44.49	PKFH	30	-26.2	48.29	-	-	74	-25.71	206	244	H
	* 1.288	32.76	VA1T	30	-26.2	36.56	54	-17.44	-	-	206	244	H
4	* 1.018	43.86	PKFH	27.5	-25.7	45.66	-	-	74	-28.34	132	230	V
	* 1.019	32.22	VA1T	27.5	-25.7	34.02	54	-19.98	-	-	132	230	V
3	* 9.050	36.96	PKFH	36.2	-24.1	49.06	-	-	74	-24.94	304	200	H
	* 9.049	24.39	VA1T	36.2	-24.1	36.49	54	-17.51	-	-	304	200	H
5	* 11.446	36.35	PKFH	38.3	-23.2	51.45	-	-	74	-22.55	176	210	V
	* 11.448	23.38	VA1T	38.3	-23.2	38.48	54	-15.52	-	-	176	210	V
6	* 12.065	34.29	PKFH	39	-21.7	51.59	-	-	74	-22.41	217	186	V
	* 12.068	22.7	VA1T	39	-21.8	39.90	54	-14.10	-	-	217	186	V
2	7.206	39.32	PKFH	35.6	-28.1	46.82	-	-	-	-	176	101	H
	7.206	28.88	VA1T	35.6	-28.1	36.38	-	-	-	-	176	101	H

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

MID CHANNEL RESULTS



RADIATED EMISSIONS

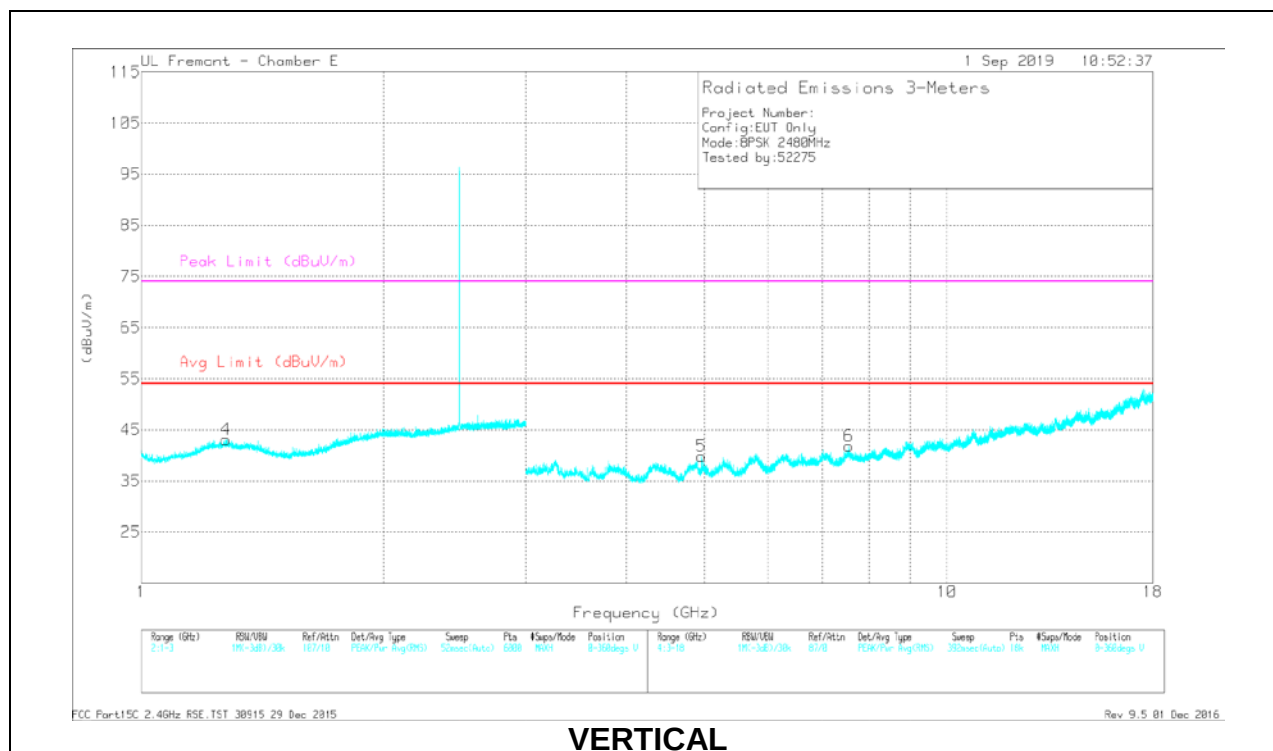
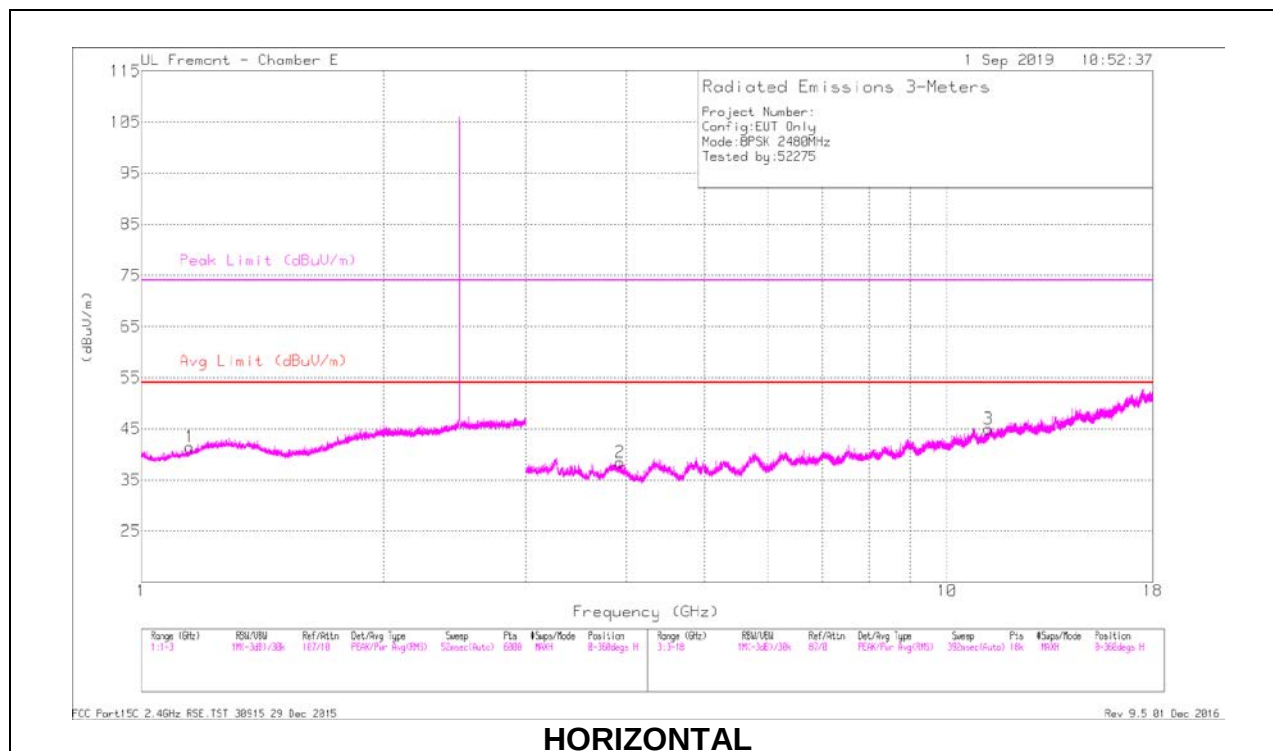
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Filt/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.385	44.91	PKFH	29.4	-26.2	48.11	-	-	74	-25.89	240	190	H
	* 1.384	32.8	VA1T	29.5	-26.2	36.10	54	-17.90	-	-	240	190	H
4	* 1.122	44.52	PKFH	28	-25.9	46.62	-	-	74	-27.38	228	272	V
	* 1.124	32.47	VA1T	28	-26.0	34.47	54	-19.53	-	-	228	272	V
2	* 3.832	41.61	PKFH	33.4	-30.9	44.11	-	-	74	-29.89	132	149	H
	* 3.830	30	VA1T	33.4	-30.9	32.5	54	-21.50	-	-	132	149	H
3	* 10.781	36.56	PKFH	37.9	-23.1	51.36	-	-	74	-22.64	277	341	H
	* 10.779	24.12	VA1T	37.9	-23.2	38.82	54	-15.18	-	-	277	341	H
5	* 4.860	40.12	PKFH	34.1	-29.9	44.32	-	-	74	-29.68	184	351	V
	* 4.863	28.58	VA1T	34	-29.9	32.68	54	-21.32	-	-	184	351	V
6	* 11.798	34.42	PKFH	38.9	-22.5	50.82	-	-	74	-23.18	189	243	V
	* 11.795	22.9	VA1T	38.9	-22.5	39.3	54	-14.70	-	-	189	243	V

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

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Filt/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	* 1.147	44.78	PKFH	28.2	-26.0	46.98	-	-	74	-27.02	191	351	H
	* 1.148	32.55	VA1T	28.2	-26.0	34.75	54	-19.25	-	-	191	351	H
4	* 1.275	45.32	PKFH	30.2	-26.2	49.32	-	-	74	-24.68	164	246	V
	* 1.274	32.74	VA1T	30.2	-26.2	36.74	54	-17.26	-	-	164	246	V
2	* 3.932	41.78	PKFH	33.4	-30.9	44.28	-	-	74	-29.72	112	308	H
	* 3.934	29.71	VA1T	33.4	-30.9	32.21	54	-21.79	-	-	112	308	H
3	* 11.256	35.52	PKFH	38	-22.9	50.62	-	-	74	-23.38	285	265	H
	* 11.256	23.31	VA1T	38	-22.9	38.41	54	-15.59	-	-	285	265	H
5	* 4.960	42.40	PKFH	34	-30.3	46.1	-	-	74	-27.90	168	211	V
	* 4.960	31.61	VA1T	34	-30.3	35.31	54	-18.69	-	-	168	211	V
6	* 7.547	37.70	PKFH	35.8	-26.2	47.3	-	-	74	-26.70	337	116	V
	* 7.548	25.58	VA1T	35.8	-26.3	35.08	54	-18.92	-	-	337	116	V

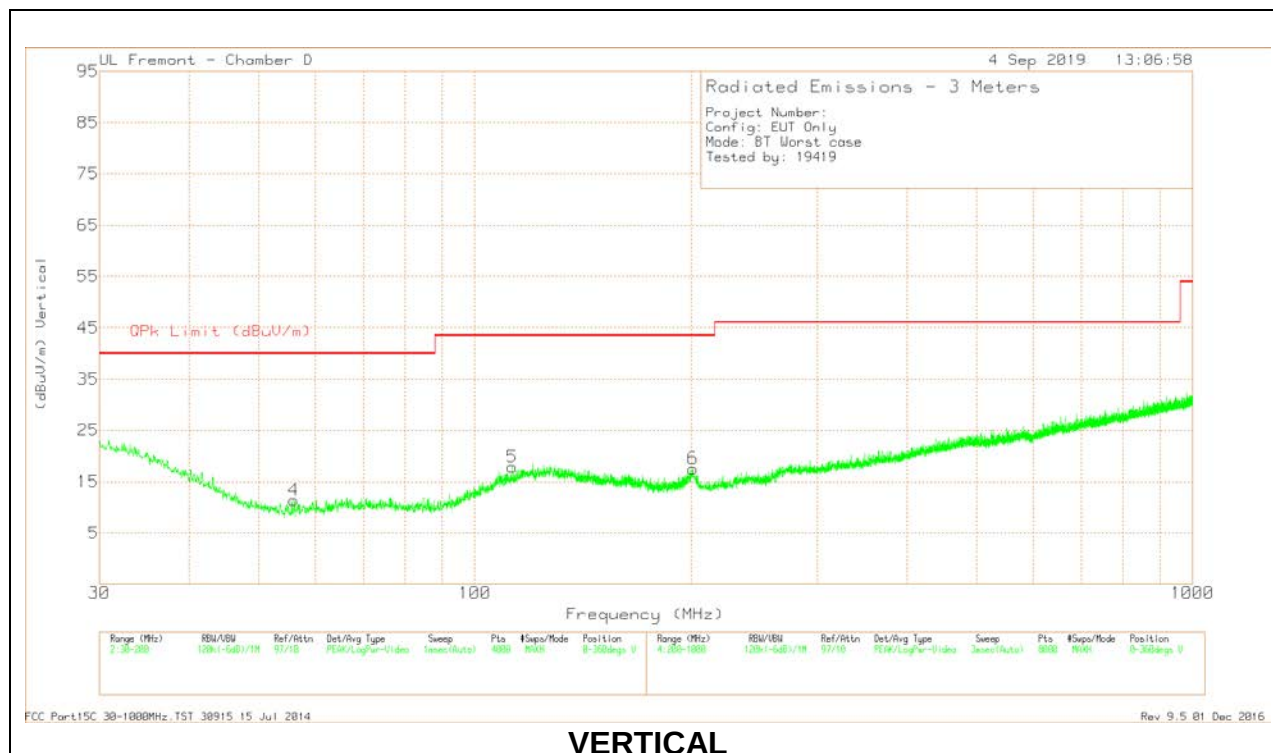
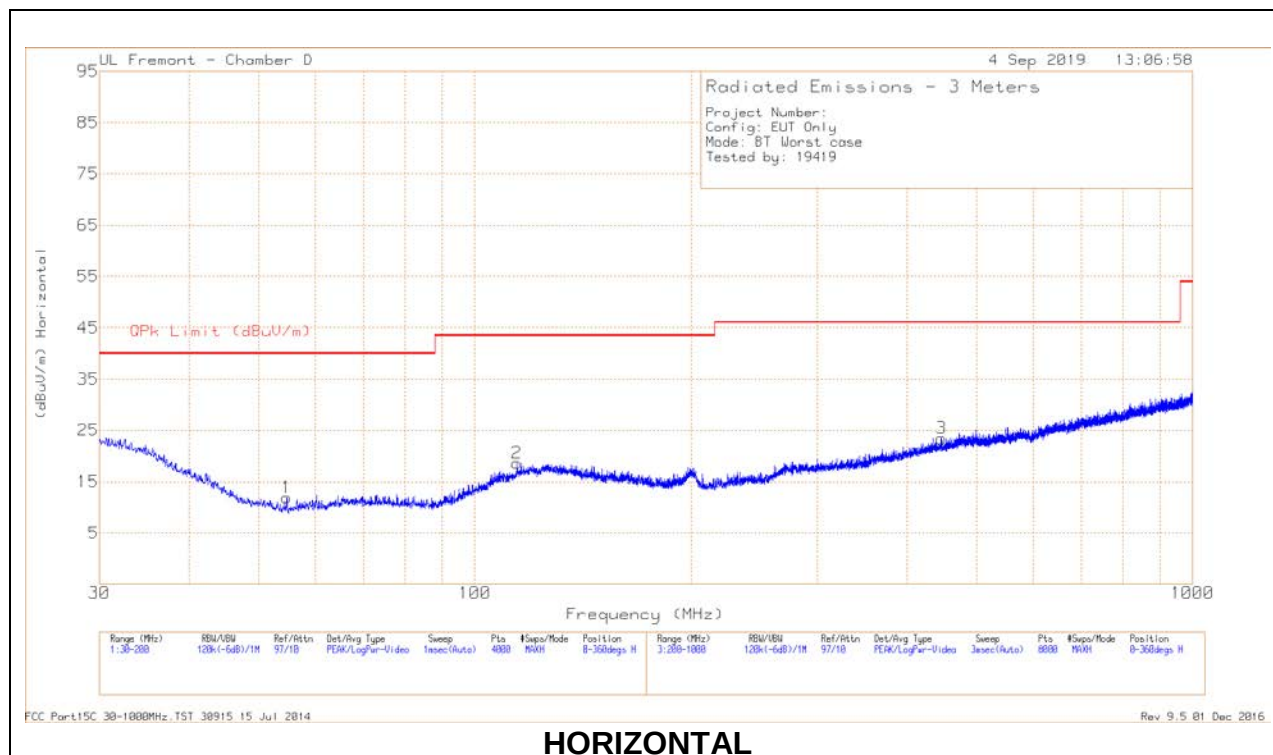
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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

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

9.2. WORST CASE BELOW 1 GHZ

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



Below 1GHz Data

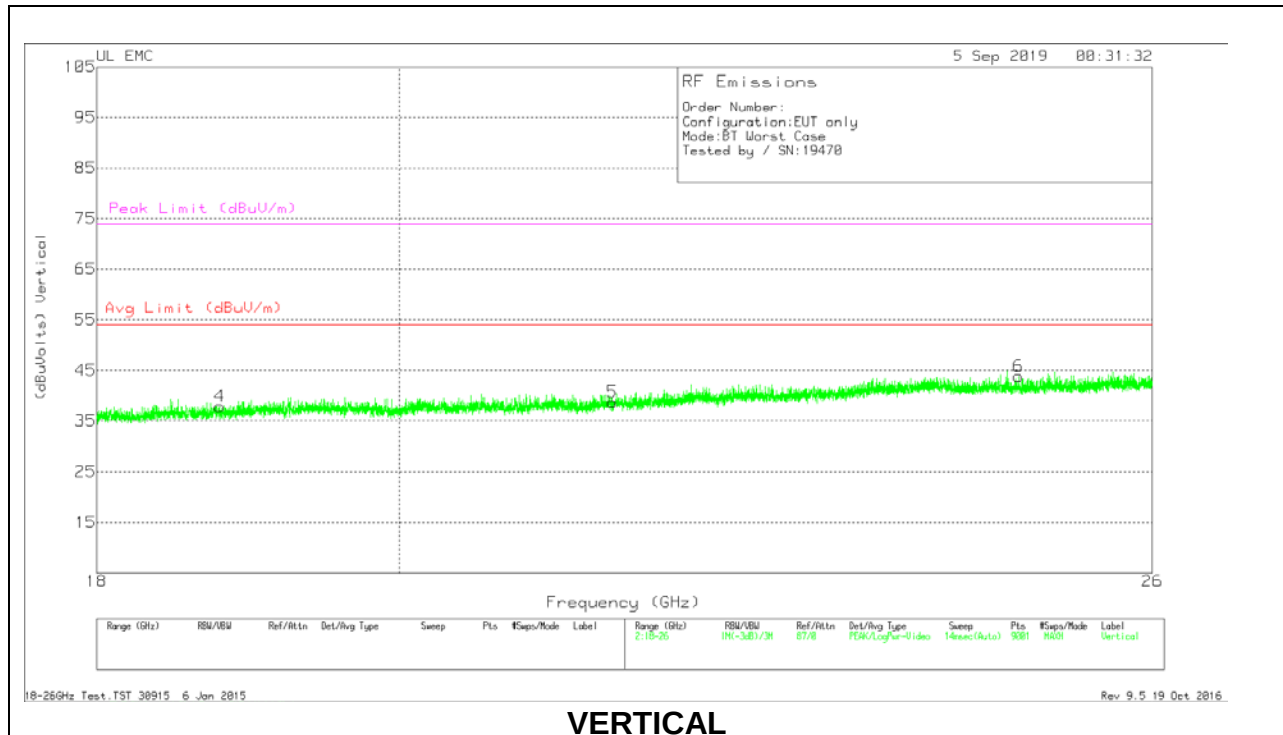
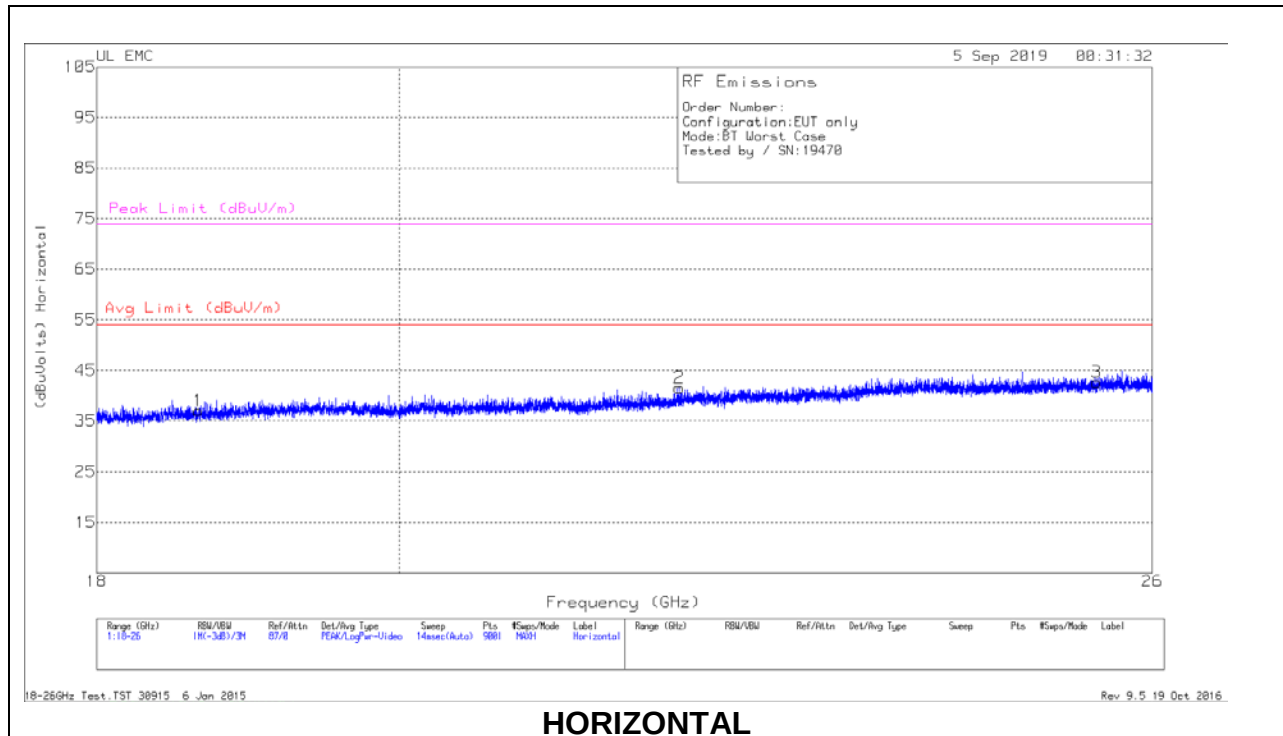
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 114.4063	23.67	Qp	19.2	-30.9	11.97	43.52	-31.55	296	181	H
5	* 112.7978	23.52	Qp	19.0	-30.9	11.62	43.52	-31.90	265	123	V
1	54.8087	23.77	Qp	12.9	-31.4	5.27	40.00	-34.73	330	199	H
4	56.0835	23.92	Qp	12.9	-31.4	5.42	40.00	-34.58	212	100	V
6	201.5455	23.40	Qp	18.6	-30.2	11.80	43.52	-31.72	58	234	V
3	447.2118	23.25	Qp	22.7	-28.9	17.05	46.02	-28.97	198	256	H

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

Qp - Quasi-Peak detector

9.3. WORST CASE 18-26 GHZ

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



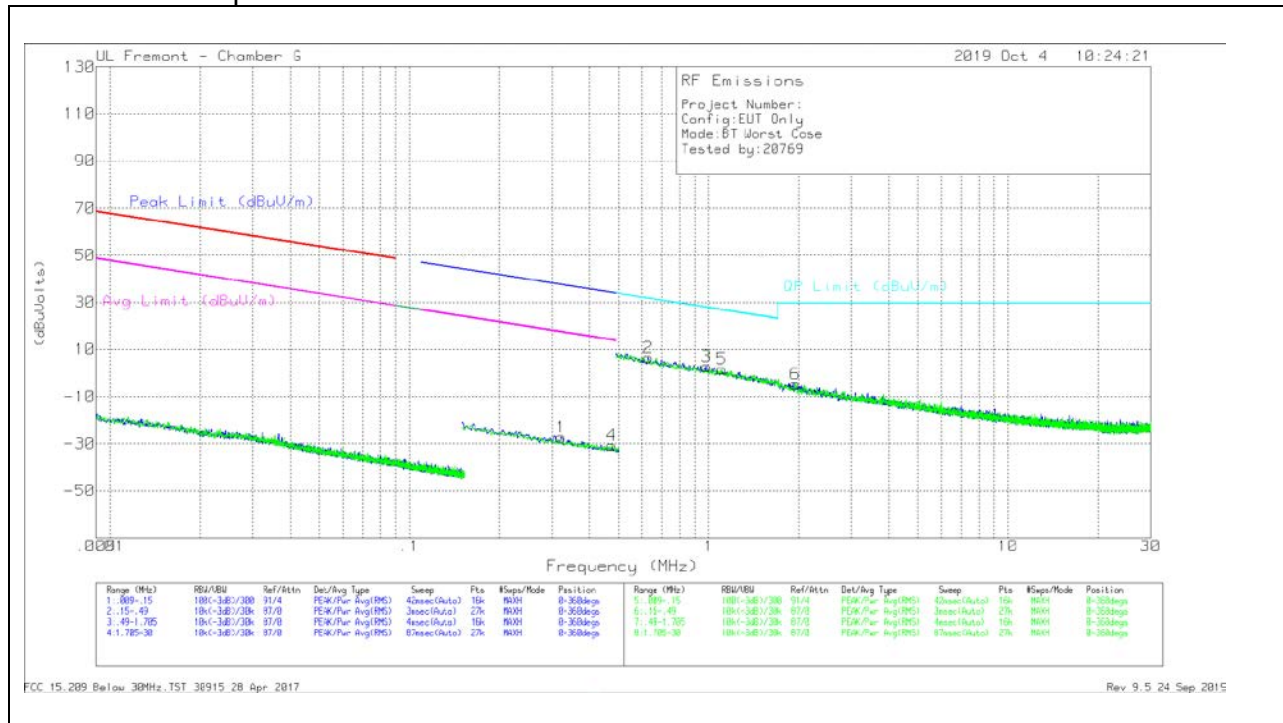
18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T447 AF (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	18.648	35.95	Pk	32.4	-21.8	-9.5	37.05	54	-16.95	74	-36.95
2	22.05	38.38	Pk	33.3	-20.6	-9.5	41.58	54	-12.42	74	-32.42
3	25.50	37.58	Pk	34.5	-19.9	-9.5	42.68	54	-11.32	74	-31.32
4	18.788	36.89	Pk	32.4	-21.9	-9.5	37.89	54	-16.11	74	-36.11
5	21.544	36.23	Pk	33.1	-21.1	-9.5	38.73	54	-15.27	74	-35.27
6	24.817	38.34	Pk	34.4	-19.4	-9.5	43.84	54	-10.16	74	-30.16

Pk - Peak detector

9.4. WORST CASE BELOW 30MHz

Parallel and Perpendicular



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dBm)	Cables (dB)	Dist Corr 300m	Corrected Reading (dBuV/Its)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.32219	41.77	Pk	10.9	.1	-80	-27.23	37.45	-64.68	17.45	-44.68	0-360
4	.47536	38	Pk	11.1	.1	-80	-30.8	34.06	-64.86	14.06	-44.86	0-360

Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dBm)	Cables (dB)	Dist Corr 30m	Corrected Reading (dBuV/Its)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
2	.62729	35.34	Pk	11	.1	-40	6.44	31.66	-25.22	0-360
3	.98248	31.46	Pk	11.3	.1	-40	2.86	27.77	-24.91	0-360
5	1.10921	30.3	Pk	11.3	.1	-40	1.7	26.72	-25.02	0-360
6	1.94656	23.87	Pk	11.3	.2	-40	-4.63	29.5	-34.13	0-360

Pk - Peak detector

FCC 15.209 Below 30MHz.TST 30915 28 Apr 2017
Rev 9.5 24 Sep 2019

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	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.

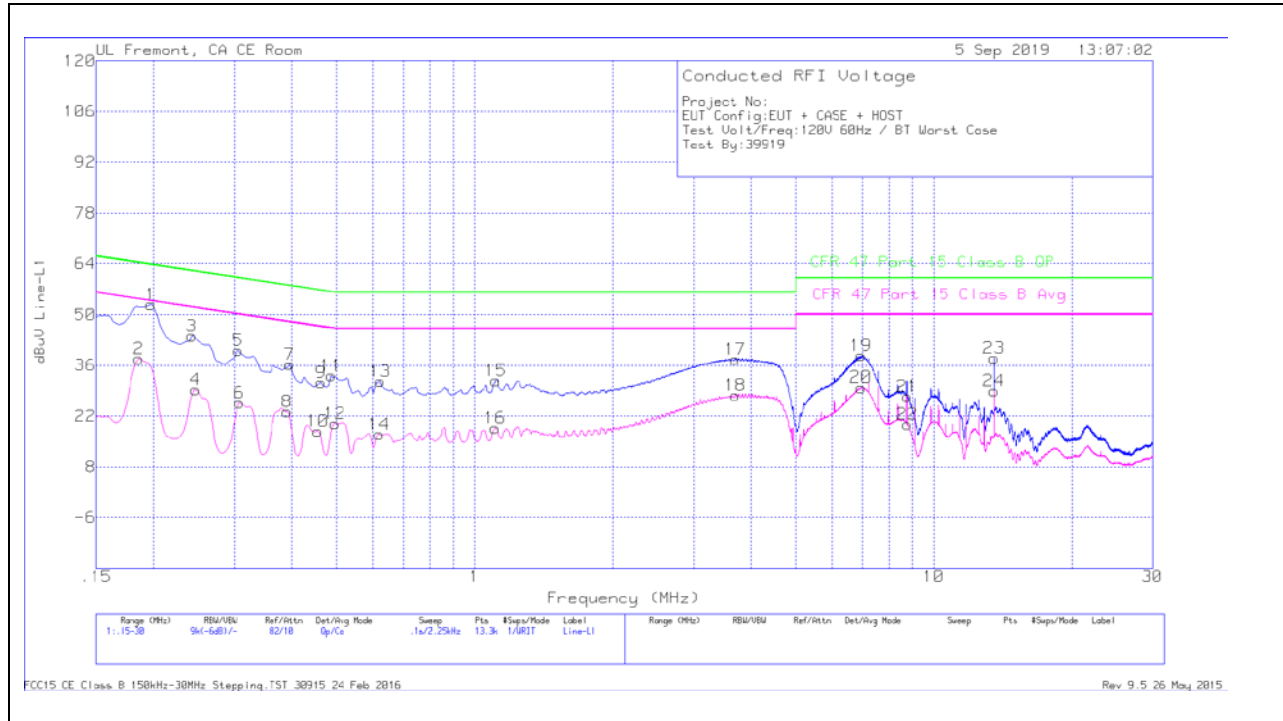
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

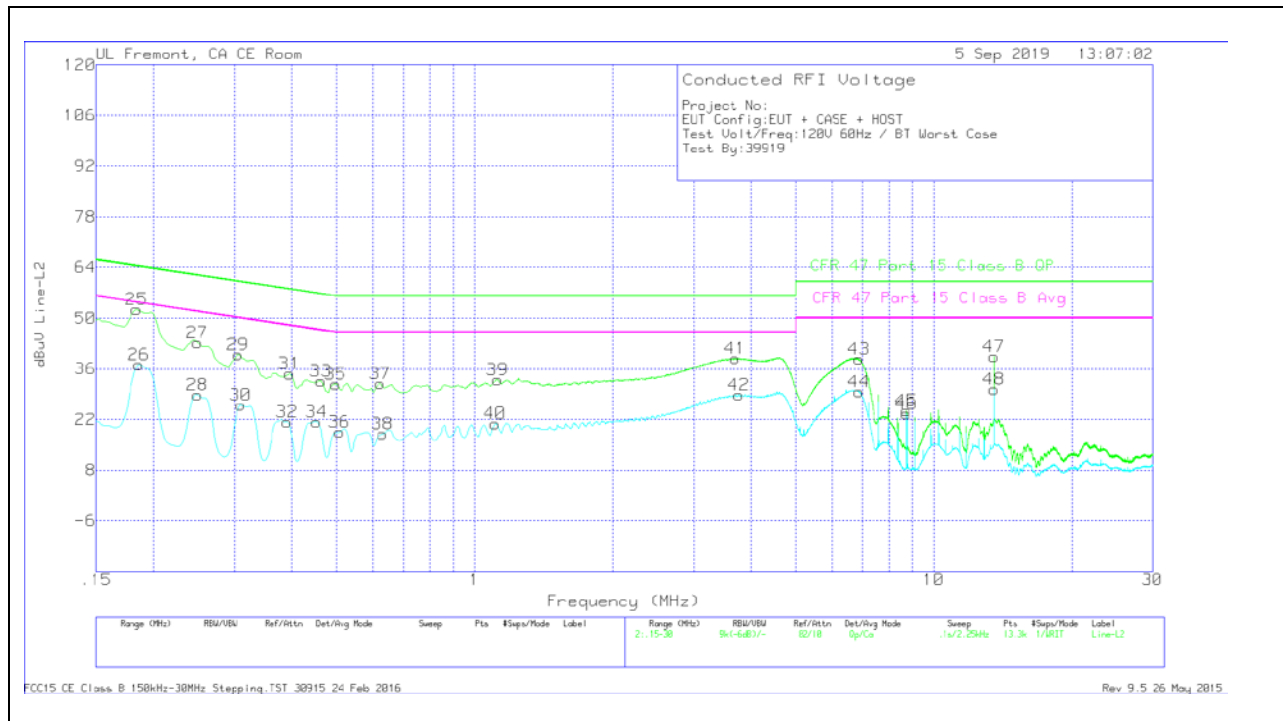
RESULTS

10.1.1. AC Power Line Host

LINE 1 RESULTS



LINE 2 RESULTS



AC LINE DATA

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	0.19725	42.71	Qp	0	0	10.1	52.81	63.73	-10.92	-	-
2	0.186	27.7	Ca	0	0	10.1	37.80	-	-	54.21	-16.41
3	0.24225	33.98	Qp	0	0	10.1	44.08	62.02	-17.94	-	-
4	0.24675	19.25	Ca	0	0	10.1	29.35	-	-	51.87	-22.52
5	0.30525	29.97	Qp	0	0	10.1	40.07	60.10	-20.03	-	-
6	0.3075	15.63	Ca	0	0	10.1	25.73	-	-	50.04	-24.31
7	0.39525	26.11	Qp	0	0	10.1	36.21	57.95	-21.74	-	-
8	0.39075	13.16	Ca	0	0	10.1	23.26	-	-	48.05	-24.79
9	0.46275	21.1	Qp	0	0	10.1	31.20	56.64	-25.44	-	-
10	0.4560	7.77	Ca	0	0	10.1	17.87	-	-	46.77	-28.9
11	0.4875	23.02	Qp	0	0	10.1	33.12	56.21	-23.09	-	-
12	0.4965	9.8	Ca	0	0	10.1	19.9	-	-	46.06	-26.16
13	0.6225	21.47	Qp	0	0	10.1	31.57	56	-24.43	-	-
14	0.62025	6.84	Ca	0	0	10.1	16.94	-	-	46	-29.06
15	1.113	21.57	Qp	0	.1	10.1	31.77	56	-24.23	-	-
16	1.11075	8.49	Ca	0	.1	10.1	18.69	-	-	46	-27.31
17	3.696	27.47	Qp	0	.1	10.1	37.67	56	-18.33	-	-
18	3.69825	17.56	Ca	0	.1	10.1	27.76	-	-	46	-18.24
19	6.94275	28.23	Qp	0	.2	10.2	38.63	60	-21.37	-	-
20	6.94838	19.52	Ca	0	.2	10.2	29.92	-	-	50	-20.08
21	8.772	16.96	Qp	0	.2	10.2	27.36	60	-32.64	-	-
22	8.77763	9.28	Ca	0	.2	10.2	19.68	-	-	50	-30.32
*23	13.56	27.52	Qp	.1	.2	10.2	38.02	60	-21.98	-	-
*24	13.56	18.44	Ca	.1	.2	10.2	28.94	-	-	50	-21.06

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)
25	0.18375	42.32	Qp	0	0	10.1	52.42	64.31	-11.89	-	-
26	0.186	27.10	Ca	0	0	10.1	37.20	-	-	54.21	-17.01
27	0.249	33.15	Qp	0	0	10.1	43.25	61.79	-18.54	-	-
28	0.249	18.77	Ca	0	0	10.1	28.87	-	-	51.79	-22.92
29	0.30525	29.83	Qp	0	0	10.1	39.93	60.1	-20.17	-	-
30	0.30975	15.90	Ca	0	0	10.1	26.00	-	-	49.98	-23.98
31	0.39525	24.52	Qp	0	0	10.1	34.62	57.95	-23.33	-	-
32	0.39075	11.16	Ca	0	0	10.1	21.26	-	-	48.05	-26.79
33	0.46275	22.58	Qp	0	0	10.1	32.68	56.64	-23.96	-	-
34	0.45375	11.27	Ca	0	0	10.1	21.37	-	-	46.81	-25.44
35	0.49875	21.70	Qp	0	0	10.1	31.80	56.02	-24.22	-	-
36	0.50775	8.38	Ca	0	0	10.1	18.48	-	-	46	-27.52
37	0.6225	21.75	Qp	0	0	10.1	31.85	56	-24.15	-	-
38	0.6315	7.87	Ca	0	0	10.1	17.97	-	-	46	-28.03
39	1.122	22.8	Qp	0	.1	10.1	33.00	56	-23	-	-
40	1.11075	10.68	Ca	0	.1	10.1	20.88	-	-	46	-25.12
41	3.7005	28.68	Qp	0	.1	10.1	38.88	56	-17.12	-	-
42	3.76575	18.65	Ca	0	.1	10.1	28.85	-	-	46	-17.15
43	6.88875	28.37	Qp	0	.2	10.2	38.77	60	-21.23	-	-
44	6.88875	19.25	Ca	0	.2	10.2	29.65	-	-	50	-20.35
45	8.72925	13.99	Qp	0	.2	10.2	24.39	60	-35.61	-	-
46	8.72925	13.15	Ca	0	.2	10.2	23.55	-	-	50	-26.45
*47	13.56	28.88	Qp	.1	.2	10.2	39.38	60	-20.62	-	-
*48	13.56	19.78	Ca	.1	.2	10.2	30.28	-	-	50	-19.72

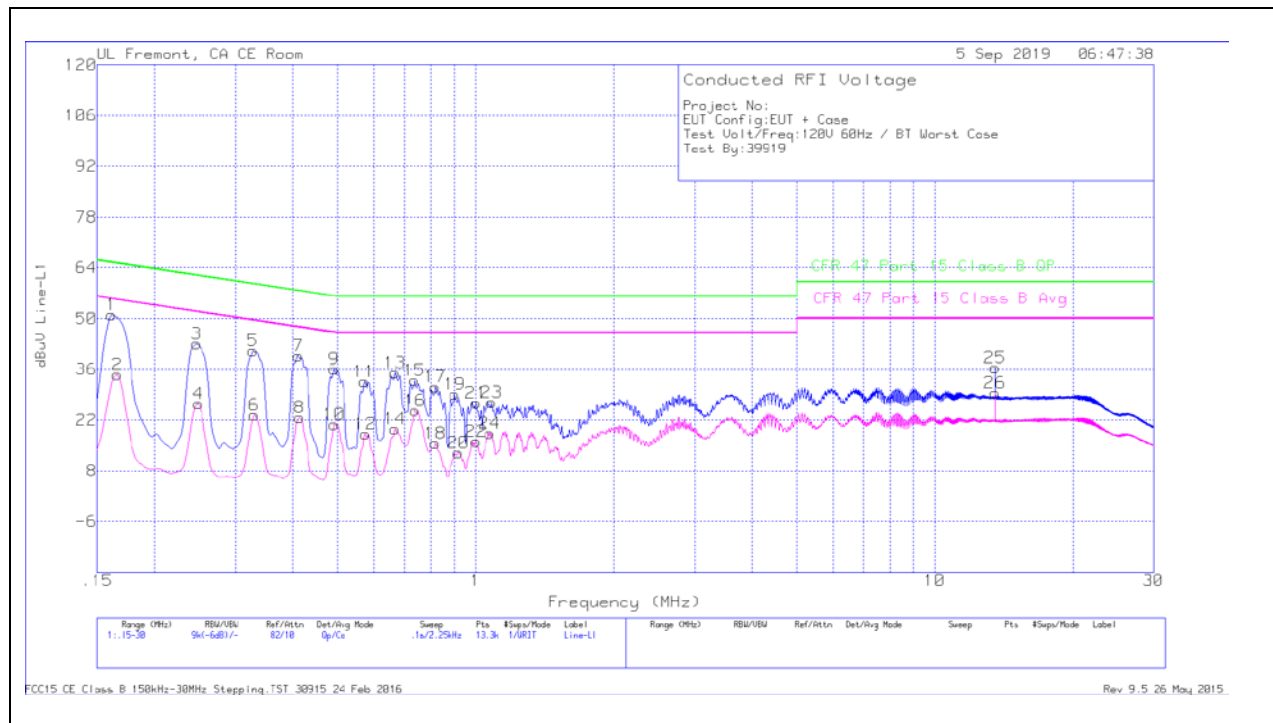
Qp - Quasi-Peak detector

Ca - CISPR average detection

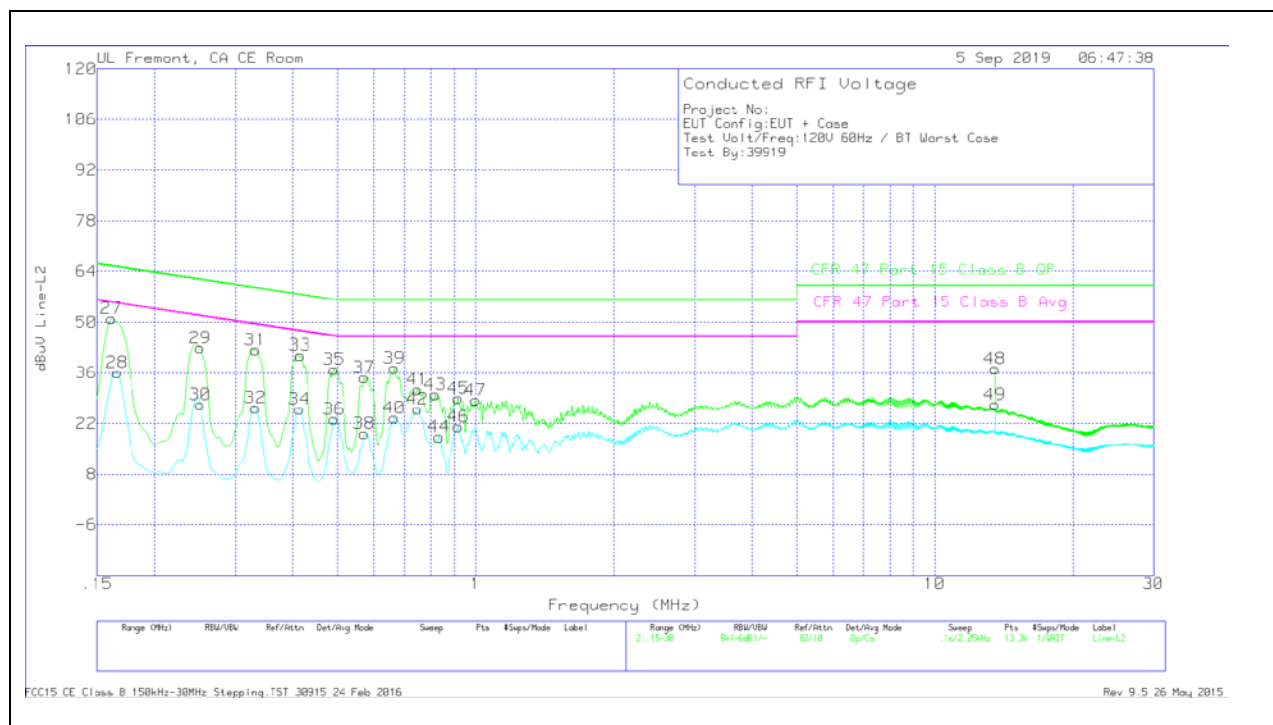
*Indicates UL RFID signal. Not from device.

10.1.2. AC Power Line Norm

LINE 1 RESULTS



LINE 2 RESULTS



AC LINE DATA

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	0.16125	40.82	Qp	.1	0	10.1	51.02	65.4	-14.38	-	-
2	0.16575	24.27	Ca	.1	0	10.1	34.47	-	-	55.17	-20.70
3	0.24675	32.92	Qp	0	0	10.1	43.02	61.87	-18.85	-	-
4	0.2490	16.49	Ca	0	0	10.1	26.59	-	-	51.79	-25.20
5	0.32775	31.07	Qp	0	0	10.1	41.17	59.51	-18.34	-	-
6	0.3300	13.28	Ca	0	0	10.1	23.38	-	-	49.45	-26.07
7	0.4110	29.65	Qp	0	0	10.1	39.75	57.63	-17.88	-	-
8	0.41325	12.58	Ca	0	0	10.1	22.68	-	-	47.58	-24.90
9	0.4920	26.02	Qp	0	0	10.1	36.12	56.13	-20.01	-	-
10	0.4920	10.68	Ca	0	0	10.1	20.78	-	-	46.13	-25.35
11	0.5730	22.48	Qp	0	0	10.1	32.58	56	-23.42	-	-
12	0.57525	8.10	Ca	0	0	10.1	18.20	-	-	46	-27.80
13	0.6675	24.98	Qp	0	0	10.1	35.08	56	-20.92	-	-
14	0.6675	9.40	Ca	0	0	10.1	19.50	-	-	46	-26.50
15	0.73725	22.81	Qp	0	0	10.1	32.91	56	-23.09	-	-
16	0.7395	14.52	Ca	0	0	10.1	24.62	-	-	46	-21.38
17	0.81825	21.04	Qp	0	0	10.1	31.14	56	-24.86	-	-
18	0.81825	5.44	Ca	0	0	10.1	15.54	-	-	46	-30.46
19	0.9015	19.09	Qp	0	0	10.1	29.19	56	-26.81	-	-
20	0.91725	2.90	Ca	0	0	10.1	13.00	-	-	46	-33.00
21	1.00275	16.50	Qp	0	.1	10.1	26.70	56	-29.30	-	-
22	1.00275	5.89	Ca	0	.1	10.1	16.09	-	-	46	-29.91
23	1.086	16.67	Qp	0	.1	10.1	26.87	56	-29.13	-	-
24	1.07475	8.24	Ca	0	.1	10.1	18.44	-	-	46	-27.56
*25	13.56	25.92	Qp	.1	.2	10.2	36.42	60	-23.58	-	-
*26	13.56	18.99	Ca	.1	.2	10.2	29.49	-	-	50	-20.51

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)
27	0.16125	40.88	Qp	.1	0	10.1	51.08	65.4	-14.32	-	-
28	0.16575	25.82	Ca	.1	0	10.1	36.02	-	-	55.17	-19.15
29	0.25125	32.77	Qp	0	0	10.1	42.87	61.72	-18.85	-	-
30	0.25125	17.16	Ca	0	0	10.1	27.26	-	-	51.72	-24.46
31	0.33225	32.31	Qp	0	0	10.1	42.41	59.39	-16.98	-	-
32	0.33225	16.32	Ca	0	0	10.1	26.42	-	-	49.39	-22.97
33	0.4155	30.77	Qp	0	0	10.1	40.87	57.54	-16.67	-	-
34	0.41325	15.92	Ca	0	0	10.1	26.02	-	-	47.58	-21.56
35	0.4920	26.83	Qp	0	0	10.1	36.93	56.13	-19.20	-	-
36	0.4920	13.08	Ca	0	0	10.1	23.18	-	-	46.13	-22.95
37	0.5730	24.64	Qp	0	0	10.1	34.74	56	-21.26	-	-
38	0.5730	9.12	Ca	0	0	10.1	19.22	-	-	46	-26.78
39	0.66525	27.23	Qp	0	0	10.1	37.33	56	-18.67	-	-
40	0.66525	13.51	Ca	0	0	10.1	23.61	-	-	46	-22.39
41	0.7485	21.36	Qp	0	0	10.1	31.46	56	-24.54	-	-
42	0.7485	15.88	Ca	0	0	10.1	25.98	-	-	46	-20.02
43	0.81825	19.95	Qp	0	0	10.1	30.05	56	-25.95	-	-
44	0.83175	8.18	Ca	0	0	10.1	18.28	-	-	46	-27.72
45	0.91725	18.73	Qp	0	.1	10.1	28.93	56	-27.07	-	-
46	0.91725	10.97	Ca	0	.1	10.1	21.17	-	-	46	-24.83
47	1.0005	18.17	Qp	0	.1	10.1	28.37	56	-27.63	-	-
*48	13.56	26.57	Qp	.1	.2	10.2	37.07	60	-22.93	-	-
*49	13.56	16.78	Ca	.1	.2	10.2	27.28	-	-	50	-22.72

Qp - Quasi-Peak detector

Ca - CISPR average detection

*Indicates UL RFID signal. Not from device.

11. SETUP PHOTOS

Please refer to 12681939-EP1V1 for setup photos

END OF TEST REPORT