



# TEST REPORT

**Report Number. :** 14160419-E6V2

**Applicant :** DISH TECHNOLOGIES LLC  
90 INVERNESS CIRCLE EAST  
ENGLEWOOD, CO 80112, UNITED STATES

**Model :** D45

**Brand :** DISH

**FCC ID :** DKNHR44

**EUT Description :** TV SET TOP BOX

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C

**Date Of Issue:**  
March 22, 2022

**Prepared by:**  
UL VERIFICATION SERVICES  
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## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	3/17/2022	Initial Issue	---
V2	3/22/2022	Updated Section 6.6 radiated setup description table	Tina Chu

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** DISH TECHNOLOGIES LLC  
90 INVERNESS CIRCLE EAST  
ENGLEWOOD, CO 80112, UNITED STATES

**EUT DESCRIPTION:** TV SET TOP BOX

**MODEL:** D45

**BRAND:** DISH

**SERIAL NUMBER:** CONDUCTED: WJ4P6LB7  
RADIATED: WJ486L88

**SAMPLE RECEIPT DATE:** MARCH 03,2022

**DATE TESTED:** MARCH 04, 2022 TO MARCH 09, 2022

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	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 A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

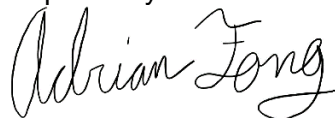
Approved & Released For  
UL Verification Services Inc. By:



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Francisco de Anda  
Staff Engineer  
Consumer Technology Division  
UL Verification Services Inc.

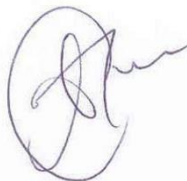
Prepared By:



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Adrian Fong  
Lab Engineer  
Consumer Technology Division  
UL Verification Services Inc.

Reviewed By:



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Tina Chu  
Senior Project Engineer  
Consumer Technology Division  
UL Verification Services Inc.

## 2. TEST RESULTS SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

FCC Clause	Requirement	Result	Comment
See Comment	Duty Cycle	Reporting purposes only	Per ANSI C63.10, Section 11.6.
See Comment	20dB BW	Reporting purposes only	ANSI C63.10 Sections 6.9.2 and 6.9.3
15.247 (a)(1)	Hopping Frequency Separation	Complies	None.
15.247 (a)(1)(iii)	Number of Hopping Channels	Complies	None.
15.247 (a)(1)(iii)	Average Time of Occupancy	Complies	None.
15.247 (b)(1)	Output Power	Complies	None.
See Comment	Average Power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (d)	Conducted Spurious Emissions	Complies	None.
15.209, 15.205	Radiated Emissions	Complies	None.
15.207	AC Mains Conducted Emissions	Complies	None.

## 3. 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 v05r01, KDB 414788 D01 Radiated Test Site v01r01.

## 4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, Certificate Number 0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input type="checkbox"/>	Building 1: 47173 Benicia Street, Fremont, CA 94538	US0104	2324A	550739
<input type="checkbox"/>	Building 2: 47266 Benicia Street, Fremont, CA 94538	US0104	22541	550739
<input checked="" type="checkbox"/>	Building 4: 47658 Kato Rd, Fremont, CA 94538	US0104	2324B	550739

## 5. DECISION RULES AND MEASUREMENT UNCERTAINTY

### 5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

### 5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

### 5.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	U <sub>Lab</sub>
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.84 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB

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

### 5.4. SAMPLE CALCULATION

#### **RADIATED EMISSIONS**

Where relevant, the following sample calculation is provided:

$$\text{Field Strength (dBuV/m)} = \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Preamp Gain (dB)}$$

$$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$$

#### **MAINS CONDUCTED EMISSIONS**

Where relevant, the following sample calculation is provided:

$$\text{Final Voltage (dBuV)} = \text{Measured Voltage (dBuV)} + \text{Cable Loss (dB)} + \text{Limiter Factor (dB)} + \text{LISN Insertion Loss.}$$

$$36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$$



## 6. EQUIPMENT UNDER TEST

### 6.1. EUT DESCRIPTION

The EUT is a TV Set Top Box with RF4CE Zigbee, BLE (1Mbps), BT and 5GHz 802.11a/n/ac/ax radios.

### 6.2. 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	7.97	6.27
2402 - 2480	Enhanced DQPSK	7.82	6.05
2402 - 2480	Enhanced 8PSK	9.05	8.04

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

### 6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna gain(s) and type, as provided by the manufacturer, are as follows:

The radio utilizes a PCB Inverted F antenna, with a maximum gain of 4.2 dBi.

### 6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was BCM 002.001.014.0647.0000

The test utility software used during testing was cybluetool 0.1.55.1.

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## 6.5. 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.

The EUT is a desktop device, therefore, all final radiated testing was performed with the EUT in X orientation.

This EUT supports BLE/BT + Zigbee + WLAN 5GHz simultaneous transmission, radiated emission test was performed, please refer to 14160419-E7 for result.

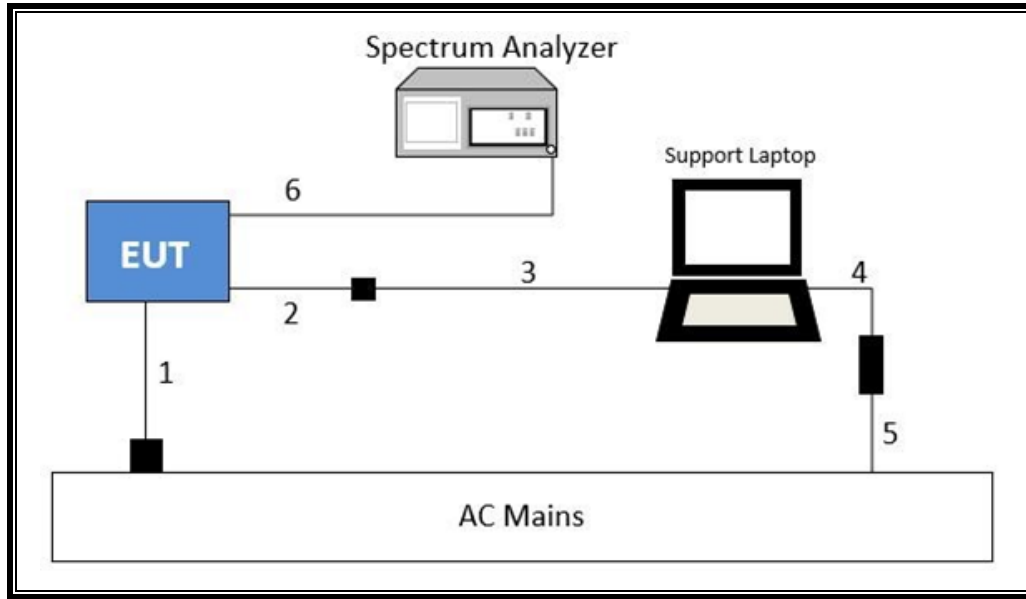
Worst-case data rates as provided by the client were:

GFSK mode: DH5  
8PSK mode: 3-DH5

## 6.6. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC		
AC/DC Adapter(EUT)	NetBit	NBC25A120210VU	222109	DoC		
Router	D-Link	EBR-2310	F311388010596	DoC		
Router Adapter	D-Link	AF0605	LF4R07082717180	DoC		
TV Emulator	DISH	TV Emulator	D52-12			
Laptop: Radiated test	HP	Elitebook 740	N/A	DoC		
AC/DC Adapter(Laptop): Radiated test	HP	N/A	N/A	DoC		
Laptop: conducted test	HP	Elitebook 740	N/A	DoC		
AC/DC Adapter(Laptop): conducted test	HP	N/A	N/A	DoC		
USB Flash Drive	Sandisk	Cruzer Glide 16GB	SDCZ60-016G	Doc		
I/O CABLES (CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	Barrel	Un-shielded	1.5	EUT to AC/DC adapter Mains
2	UART	1	UART	Un-shielded	0.1	EUT to USB adapter
3	UART	1	USB	Un-shielded	3	USB adapter to laptop
4	DC	1	AC	Un-shielded	3	
5	AC	1	AC	Un-shielded	1	
6	Antenna	1	RF	Un-shielded	0.2	To spectrum analyzer
I/O CABLES (RADIATED TEST/AC POWER LINE EMISSIONS)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	Barrel	Un-shielded	1.5	EUT to AC/DC adapter Mains
2	HDMI	1	HDMI	shielded	1	EUT to Emulator
3	RJ45	1	RJ45	Un-shielded	More than 3	EUT to Ethernet Router
4	DC	1	Barrel	Un-shielded	1	Ethernet router to AC/DC Adapter
5	UART	1	UART	Un-shielded	0.1	EUT to USB adapter
6	UART	1	USB	Un-shielded	2	USB adapter to laptop
7	DC	1	DC	Un-shielded	1	AC Adapter Laptop
8	AC	1	Two Prong	Un-shielded	2	AC adapter to AC Mains

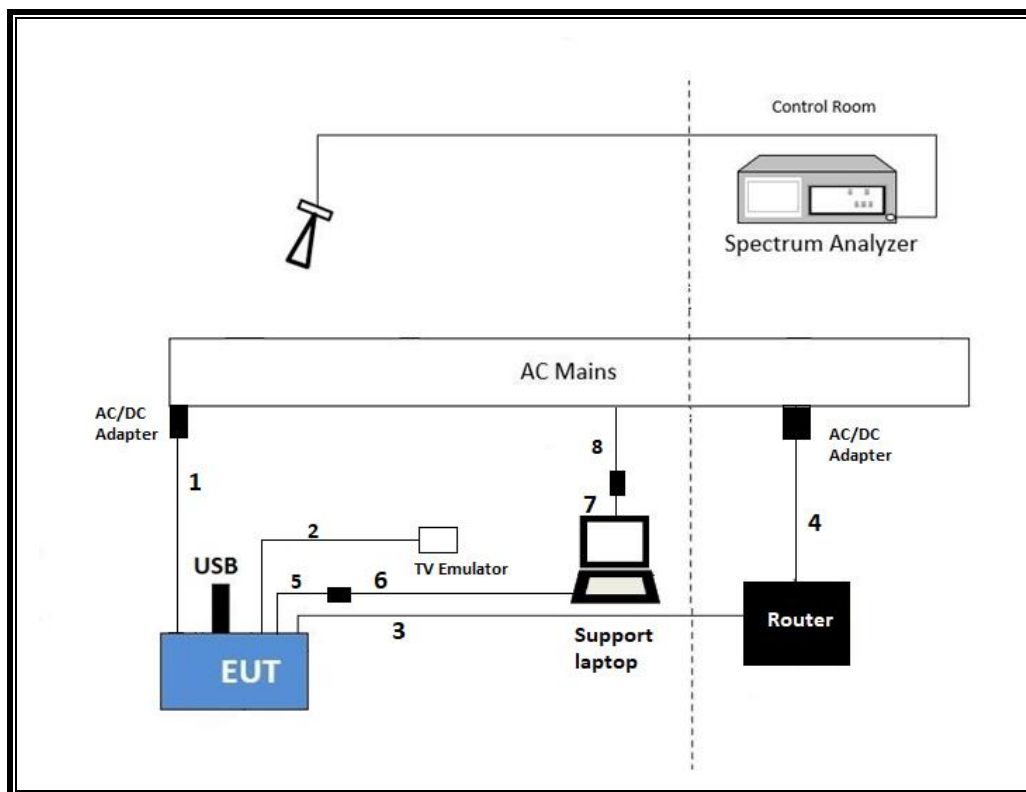
**CONDUCTED TEST SETUP DIAGRAM**



**TEST SETUP**

The EUT is connected to a test laptop by USB to UART cable adapter during the tests. Test software exercised the radio card.

**RADIATED TEST/AC POWER LINE EMISSIONS SETUP DIAGRAM**



**TEST SETUP**

The EUT is connected to a test laptop by USB to UART cable adapter, support equipment and powered by AC/DC adapter during the tests. Test software exercised the radio card.

## 7. 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, Horn 1-18GHz	ETS-Lindgren	3117	T119	05/07/2022	05/07/2021
Amplifier 1-8GHz 30dB gain	L3 Narda	AMF-4D-01000800-30-29P	167495	03/09/2023	03/09/2022
Amplifier, 1 - 18GHz	MITEQ	AFS42-00101800-25-S-42	T1568	03/09/2023	03/09/2022
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310N	T300	04/09/2022	04/09/2021
Amplifier, 1-7GHz, 24dB	AMPLICAL	AMP1G7-24-27	T1607	03/09/2023	03/09/2022
Antenna, BroadBand Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	171862	09/28/2022	09/28/2021
Loop Antenna	ELECTRO METRICS	EM-6871	PRE0179466	06/08/2022	06/08/2021
Loop Antenna	ELECTRO METRICS	EM-6872	PRE0179468	06/08/2022	06/08/2021
EMI TEST RECEIVER, with B8 option	Rohde & Schwarz	ESW44	PRE0179377	02/20/2023	02/20/2022
NSA, Test Site Validation	TDK RF SOLUTIONS INC.	ANSI C63.4 & CISPR 16-1-4	210613	09/18/2022	09/18/2021
Antenna, Horn 18 to 26.5GHz	A.R.A.	MWH-1826/B	81139	05/25/2022	05/25/2021
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight Technologies Inc	8449B	80671	04/19/2022	04/19/2021
Spectrum Analyzer, PSA, 3Hz to 26.5GHz	Keysight Technologies Inc	E4440A	81311	02/03/2023	02/03/2022
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	90715	01/26/2023	01/26/2022
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	81319	01/24/2023	01/24/2022
Thermometer - Digital	Control Company	14-650-118	175731	02/03/2023	02/03/2022
AC Line Conducted					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
LISN	Fischer Custom Communications, Inc	FCC-LISN-50/250-25-2-01-480V	175765	1/26/2023	1/26/2022
LISN	Fischer Custom Communications, Inc	FCC-LISN-50/250-25-2	T24	1/20/2023	1/20/2022
EMI TEST RECEIVER	Rohde & Schwarz	ESR	T1436	2/19/2023	2/19/2022
Transient Limiter	COM-POWER	LIT-930A	T1457	1/20/2023	1/20/2022
Test Software List					
Description	Manufacturer	Model	Version		
Radiated Software	UL	UL EMC	Rev 9.5, April 30, 2020, Oct 21, 2019		
Antenna Port Software	UL	UL RF	AP 2021. /8.27		
AC Line Conducted Software	UL	UL EMC	Rev 9.5, July 07, 2020		

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## 8. 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

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.

## 9. ANTENNA PORT TEST RESULTS

### 9.1. ON TIME AND DUTY CYCLE

#### LIMITS

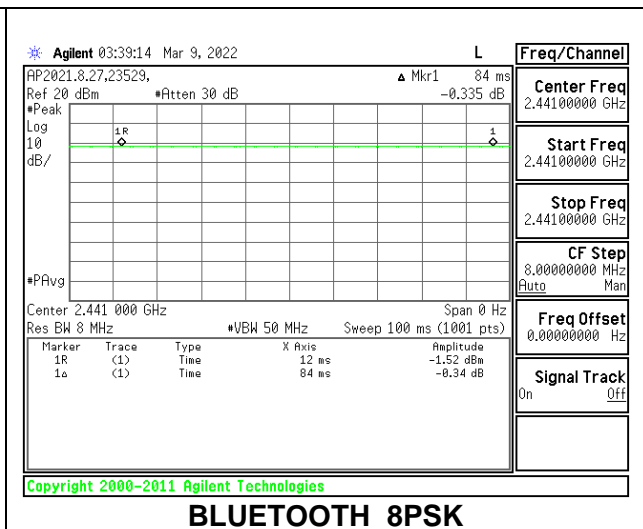
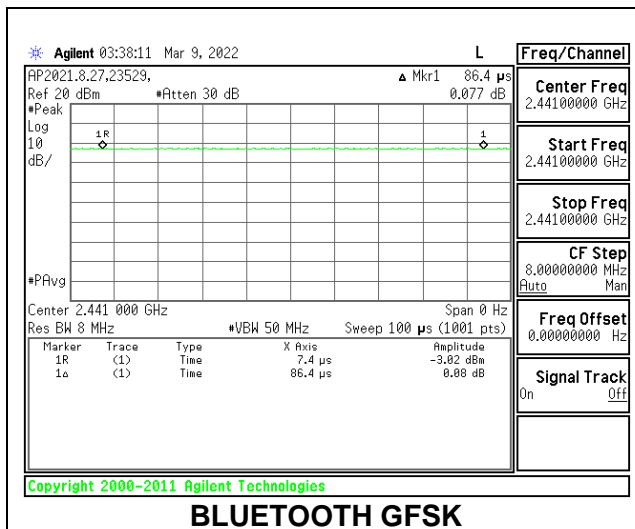
None; for reporting purposes only.

#### 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	0.0864	0.0864	1.000	100.00	0.00	0.010
Bluetooth 8PSK	84.00	84.00	1.000	100.00	0.00	0.010





## **9.2. 20 dB BANDWIDTH**

### **LIMITS**

None; for reporting purposes only.

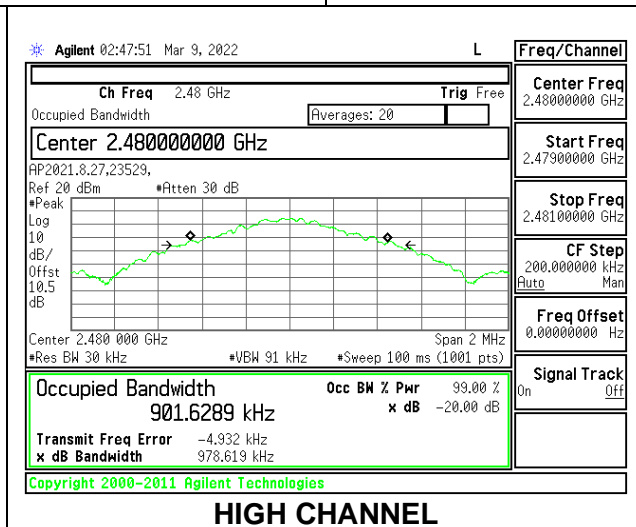
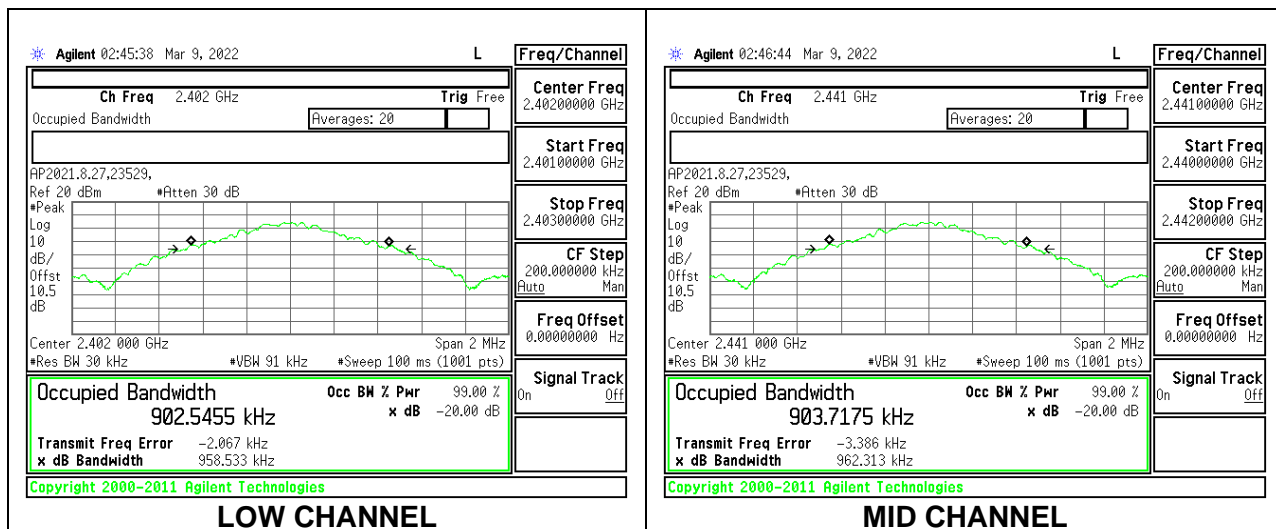
### **TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set in the range of 1% to 5% of the OBW. The VBW is set to  $\geq 3x$  RBW. The sweep time is coupled.

### **RESULTS**

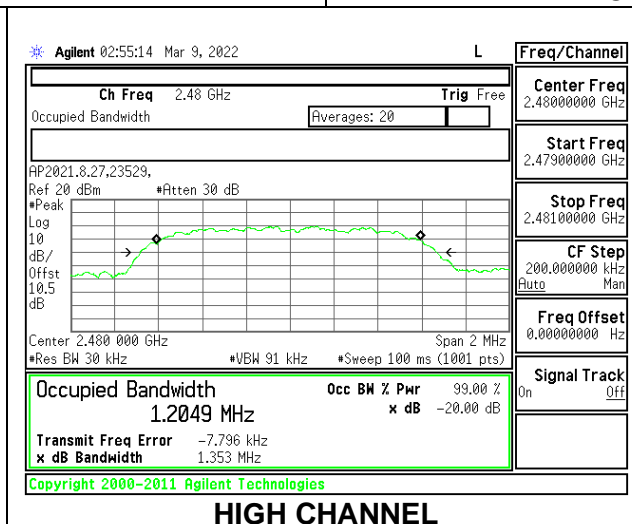
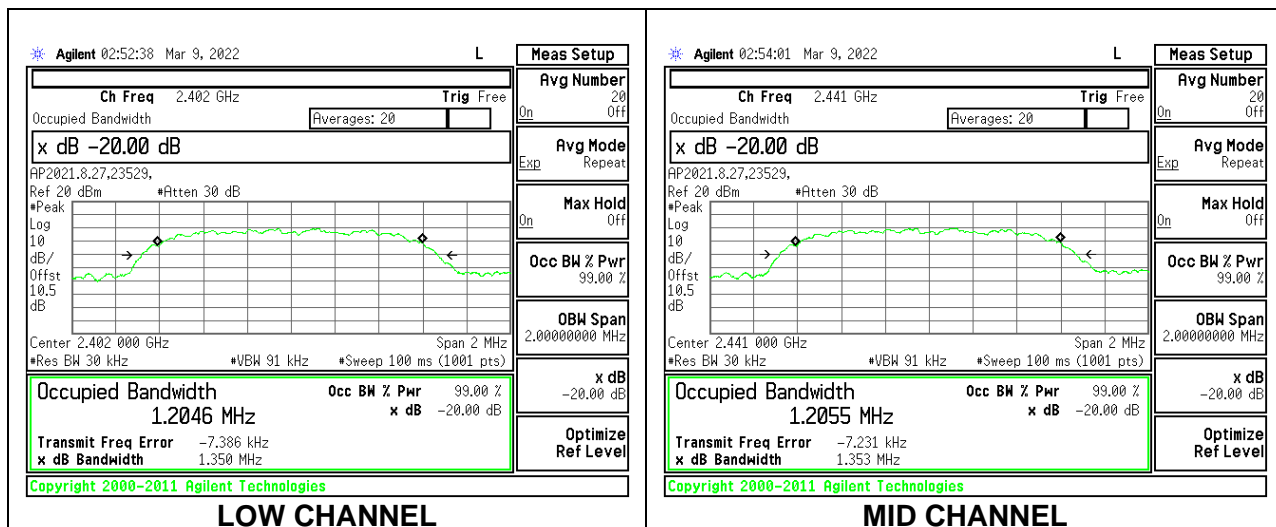
### 9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	0.958533
Mid	2441	0.962313
High	2480	0.978619



### 9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	1.35
Mid	2441	1.353
High	2480	1.353



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### **9.3. HOPPING FREQUENCY SEPARATION**

#### **LIMITS**

FCC §15.247 (a) (1)

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.

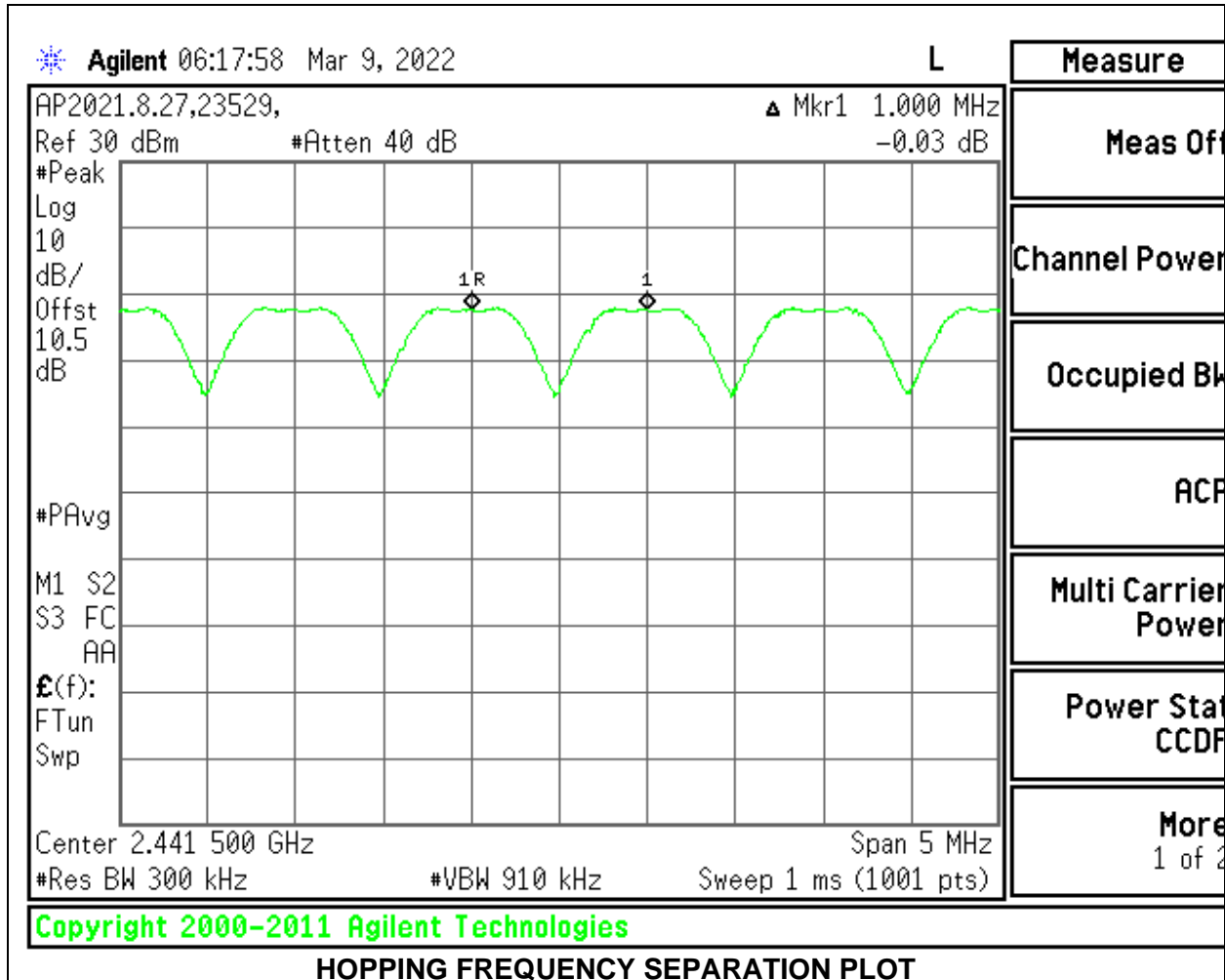
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

#### **TEST PROCEDURE**

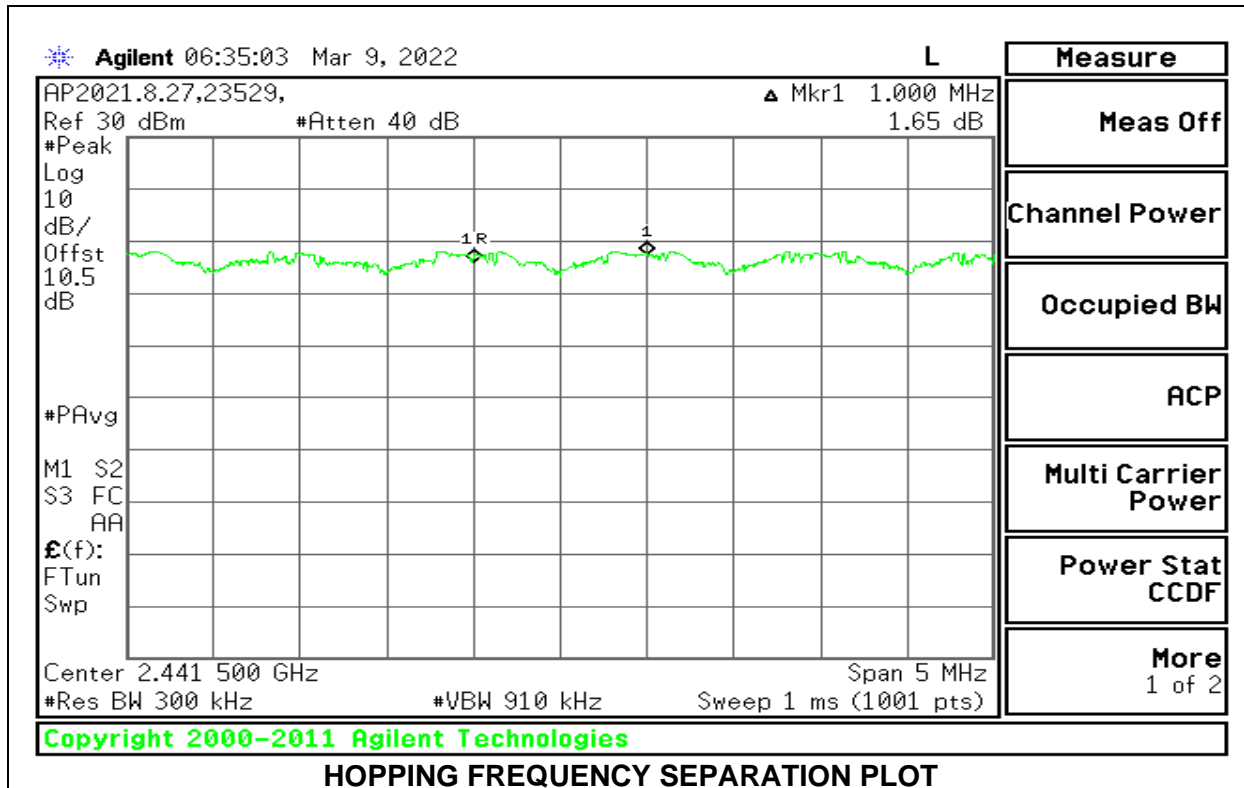
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to  $VBW \geq RBW$ . The sweep time is coupled.

#### **RESULTS**

### 9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



### 9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



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## **9.4. NUMBER OF HOPPING CHANNELS**

### **LIMITS**

FCC §15.247 (a) (1) (iii)

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

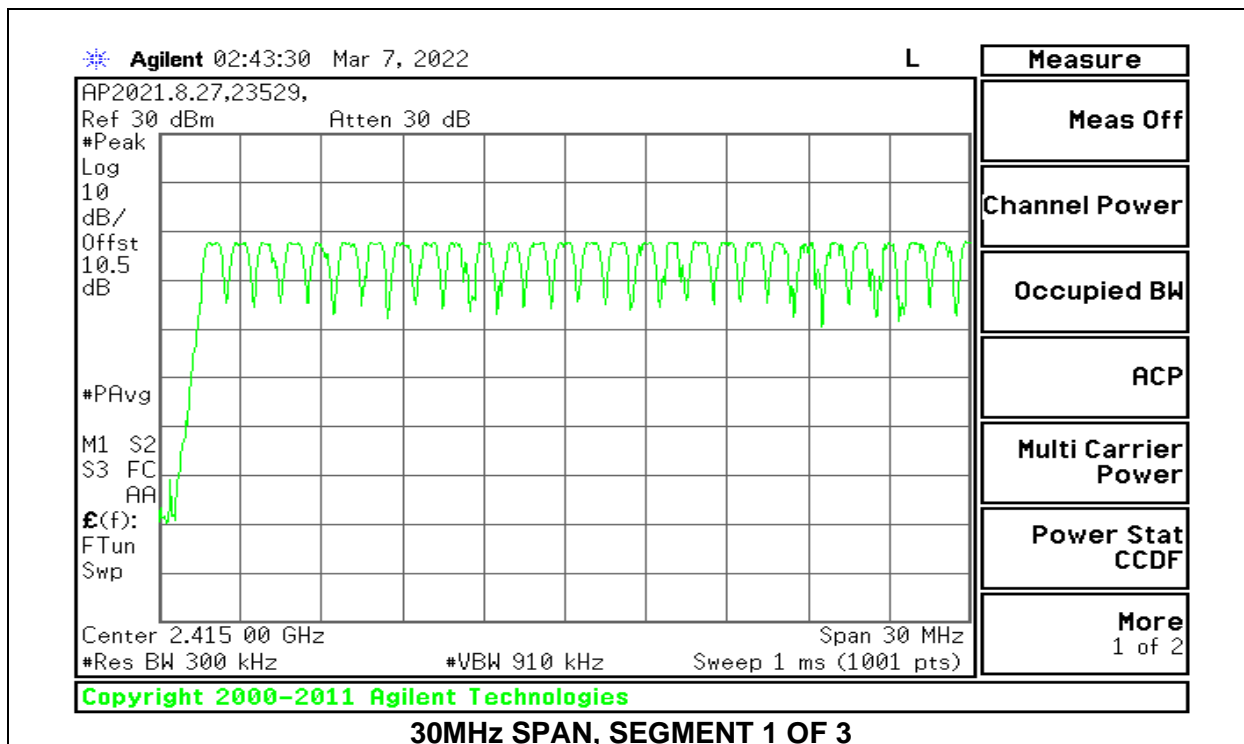
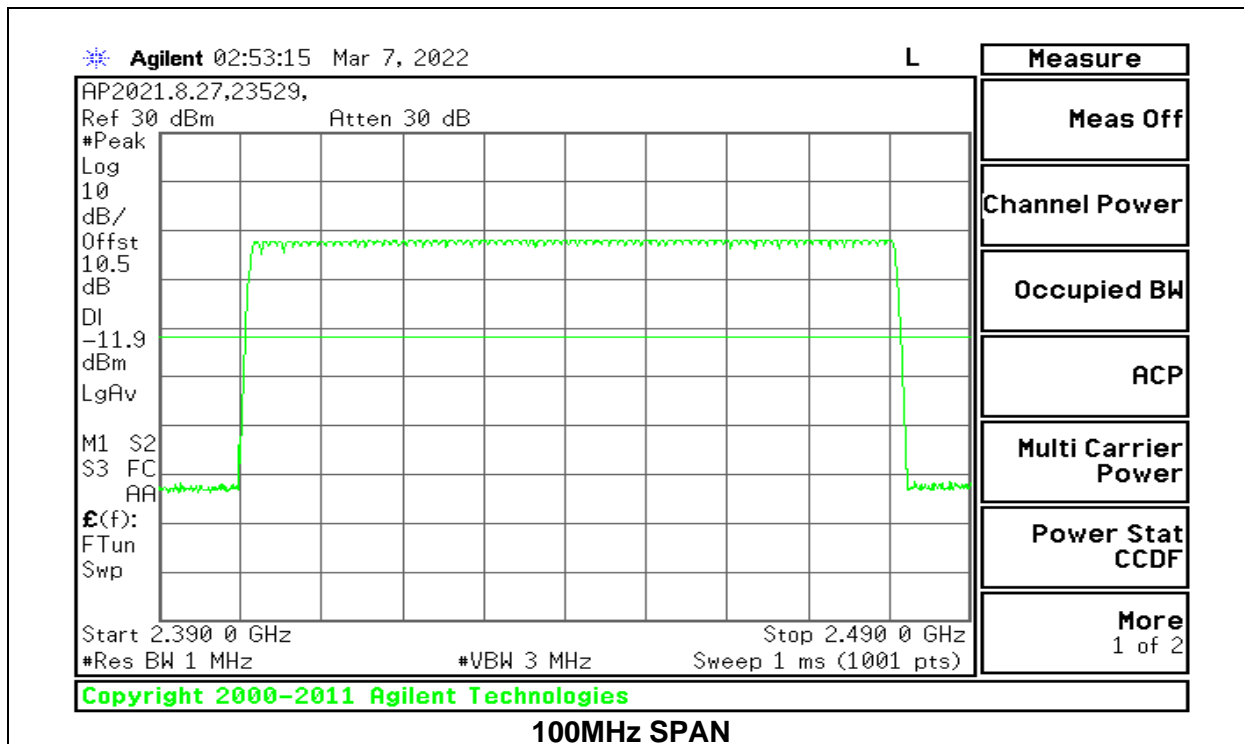
### **TEST PROCEDURE**

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.

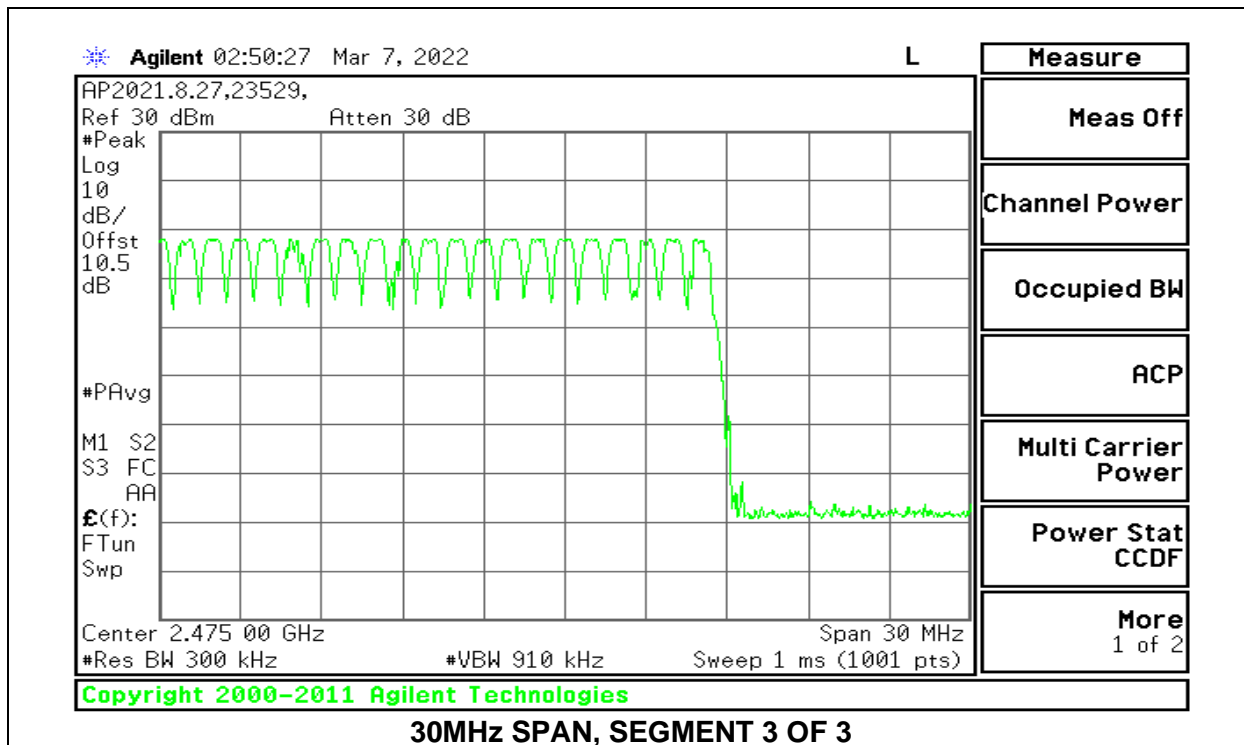
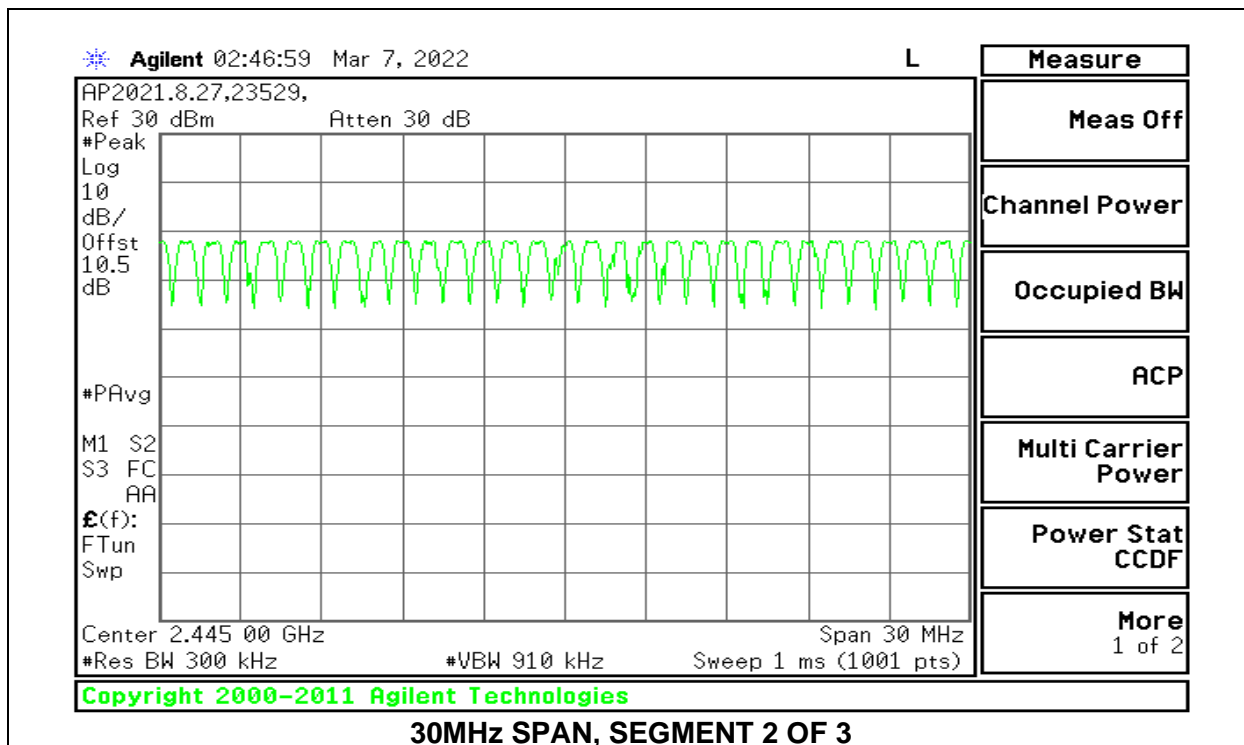
### **RESULTS**

Normal Mode: 79 Channels Observed

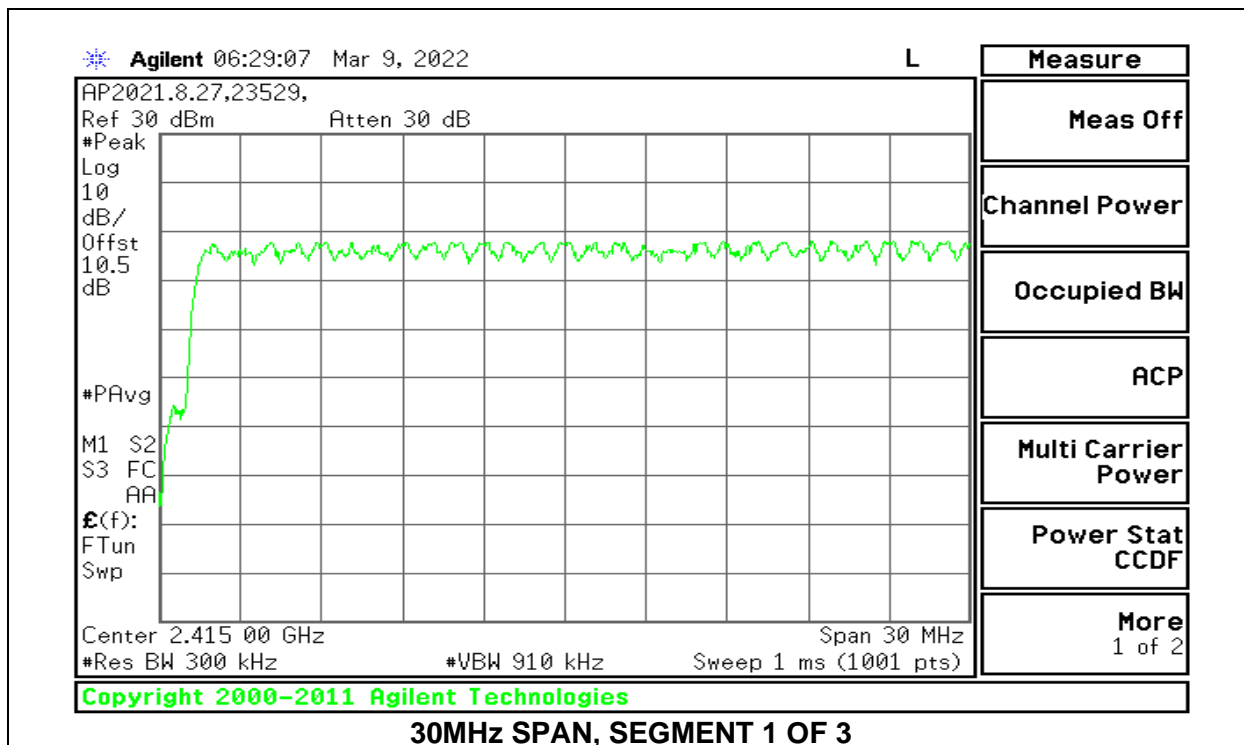
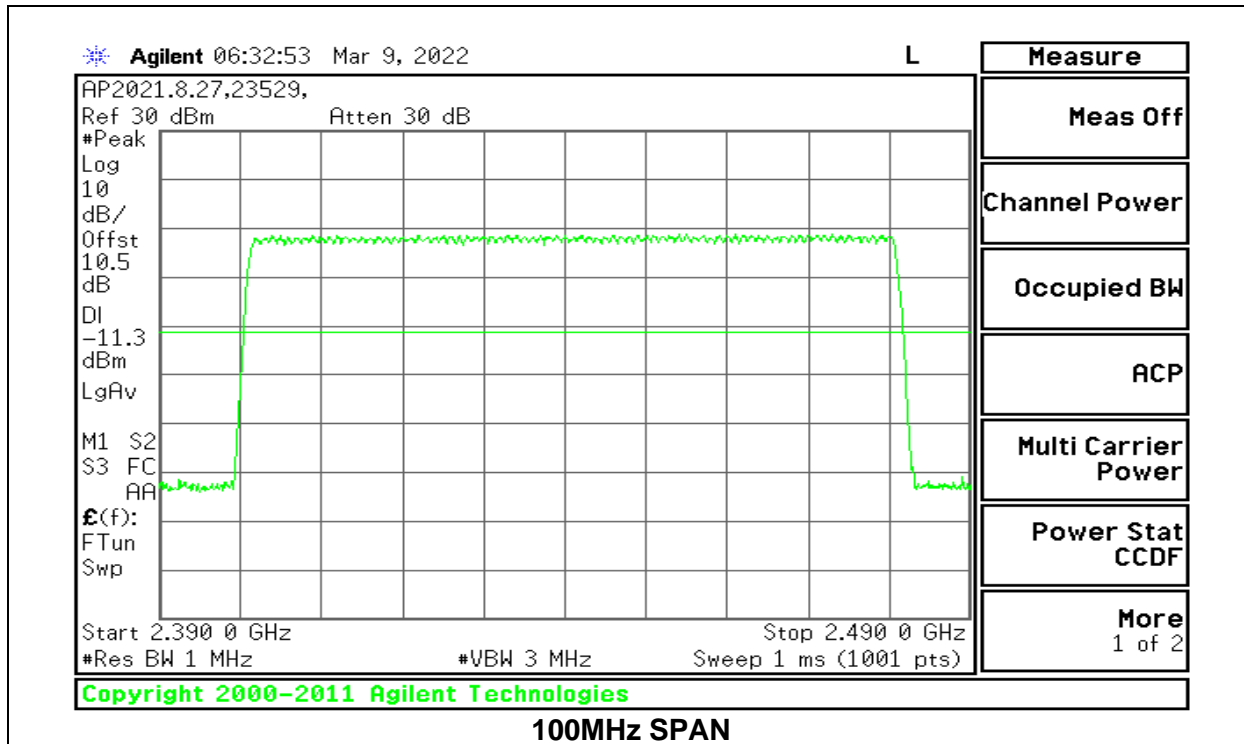
### 9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

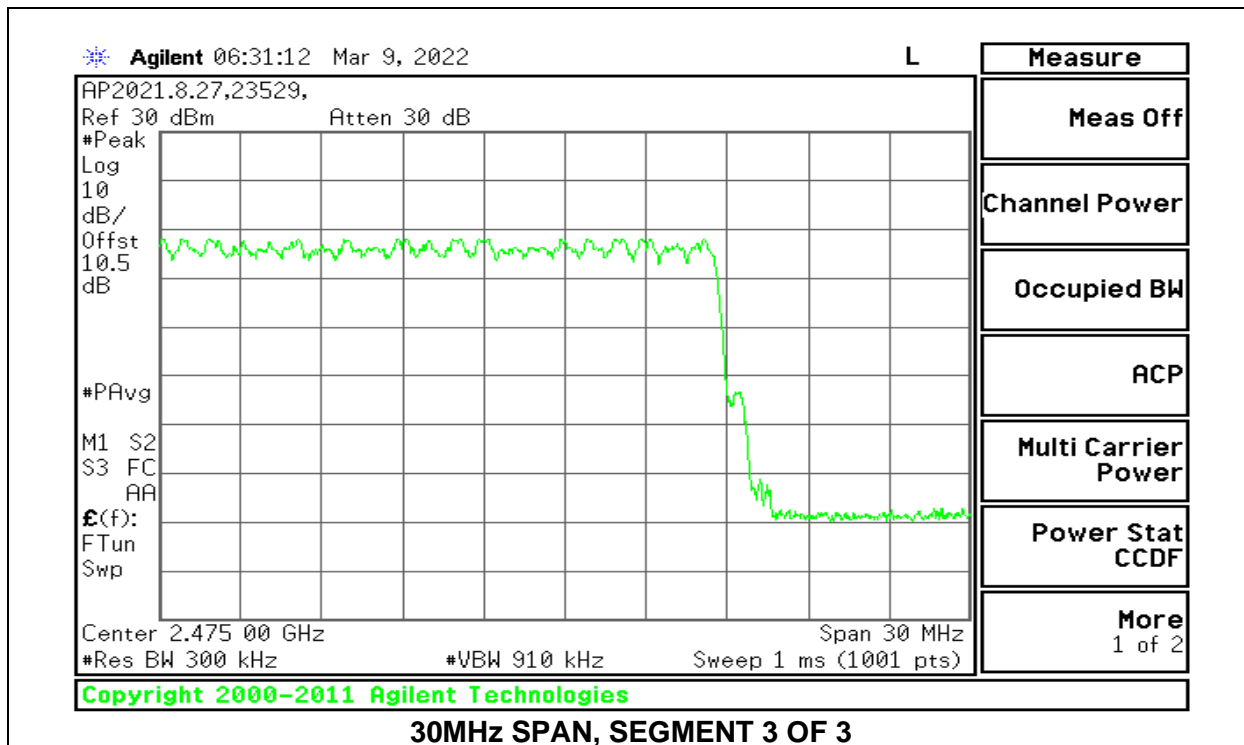
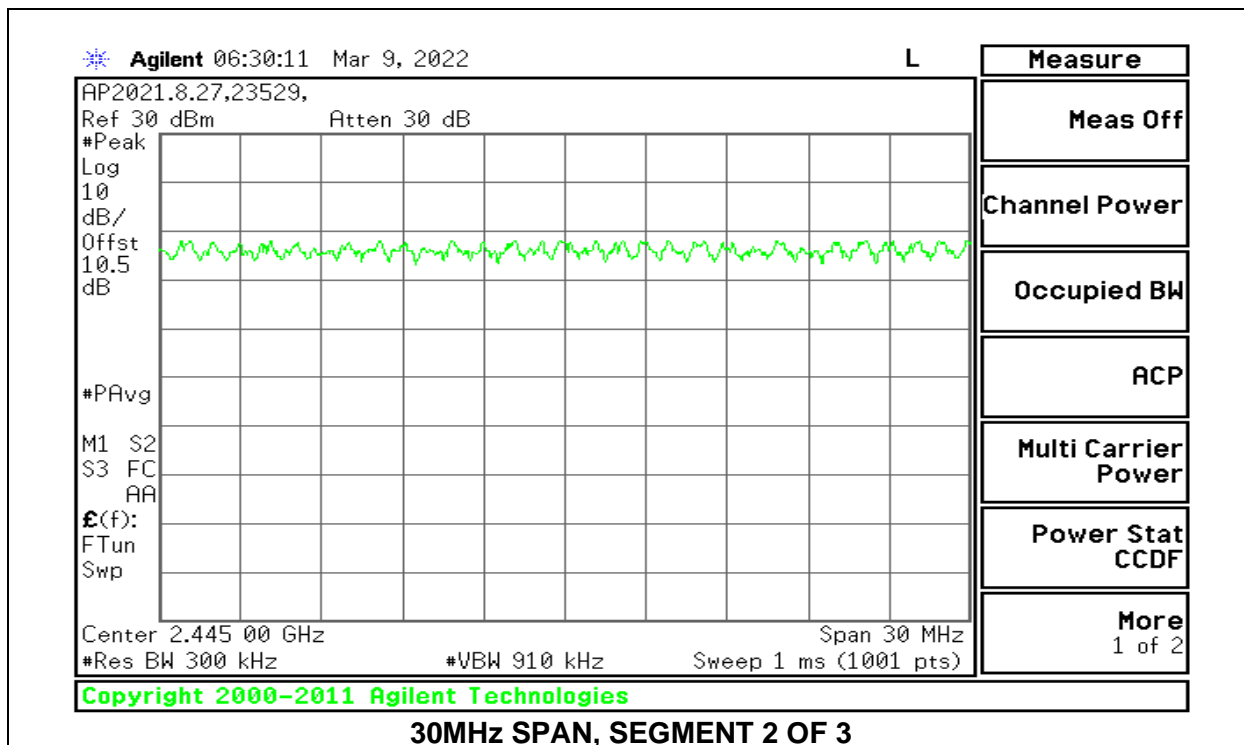






### 9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION





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## 9.5. AVERAGE TIME OF OCCUPANCY

### LIMITS

FCC §15.247 (a) (1) (iii)

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.

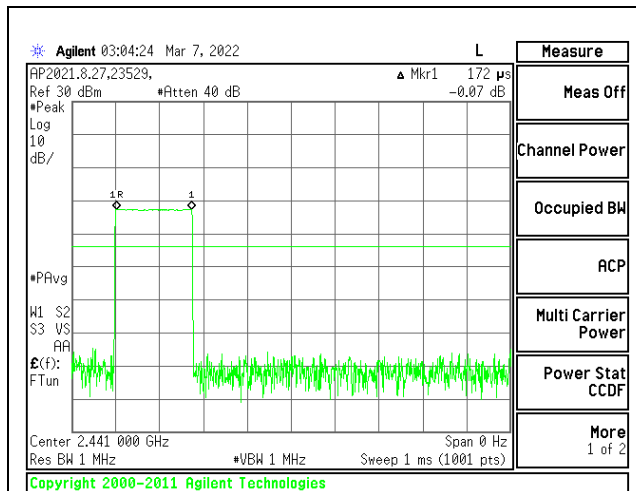
The average time of occupancy in the specified 3.16 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$ .

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

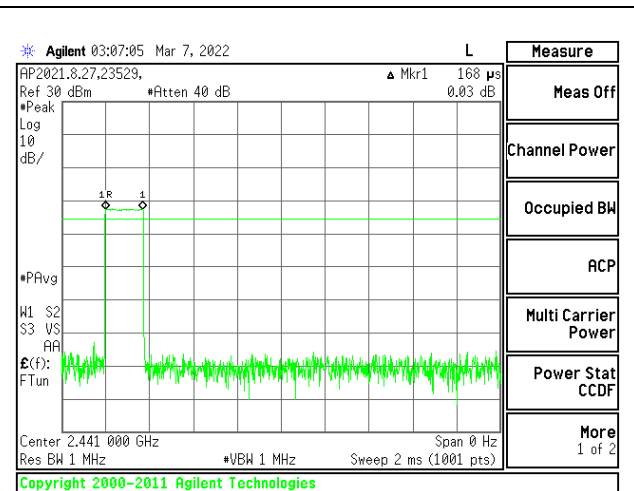
### RESULTS

### 9.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

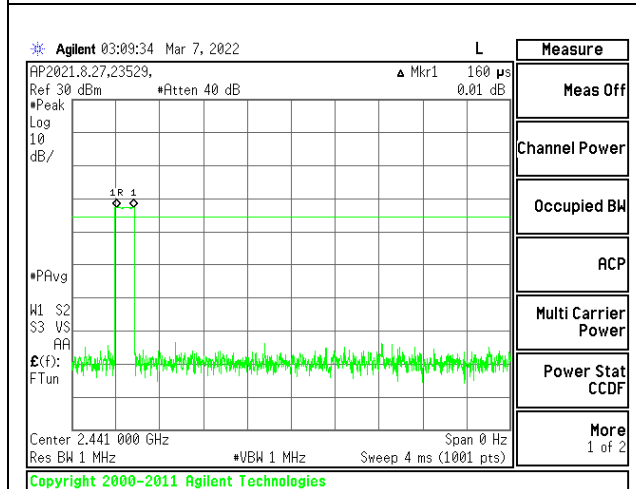
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
<b>GFSK Normal Mode</b>					
DH1	0.172	12	0.0206	0.4	-0.3794
DH3	0.168	14	0.0235	0.4	-0.3765
DH5	0.16	14	0.0224	0.4	-0.3776
<b>GFSK AFH Mode</b>					
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DH1	0.172	3	0.00516	0.4	-0.3948
DH3	0.168	3.5	0.00588	0.4	-0.3941
DH5	0.16	3.5	0.00560	0.4	-0.3944



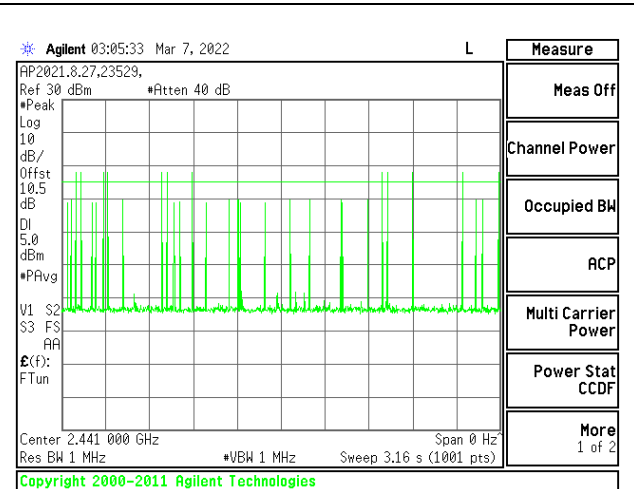
**PULSE WIDTH – DH1**



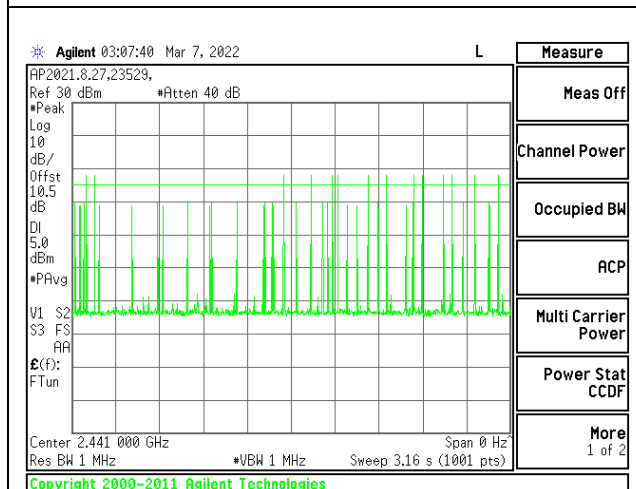
**PULSE WIDTH – DH3**



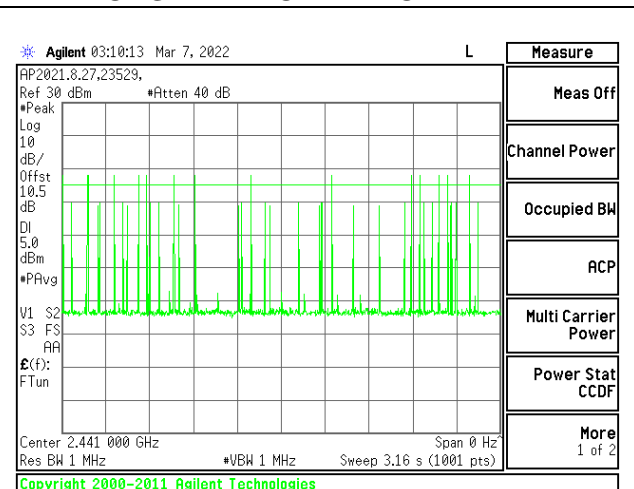
**PULSE WIDTH – DH5**



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1**



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3**

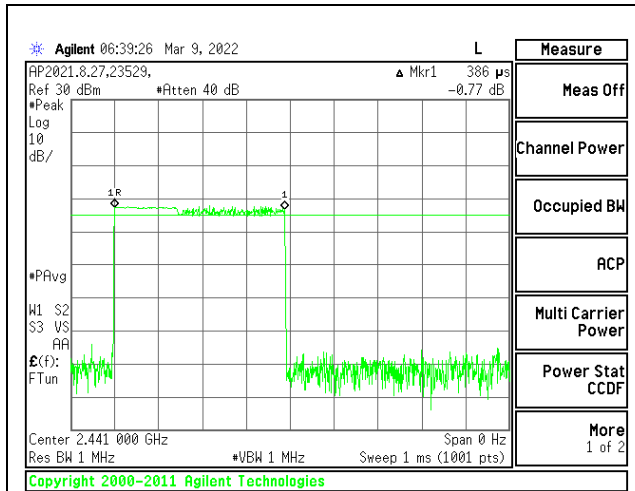


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5**

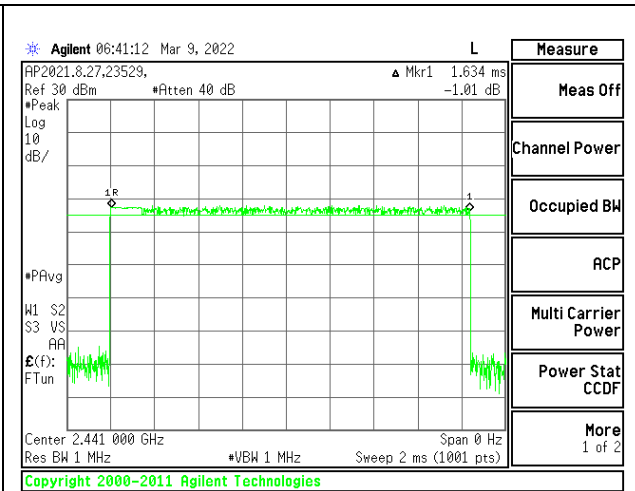
### 9.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

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	0.386	32	0.12352	0.4	-0.27648
3DH3	1.634	18	0.29412	0.4	-0.10588
3DH5	2.88	8	0.2304	0.4	-0.1696

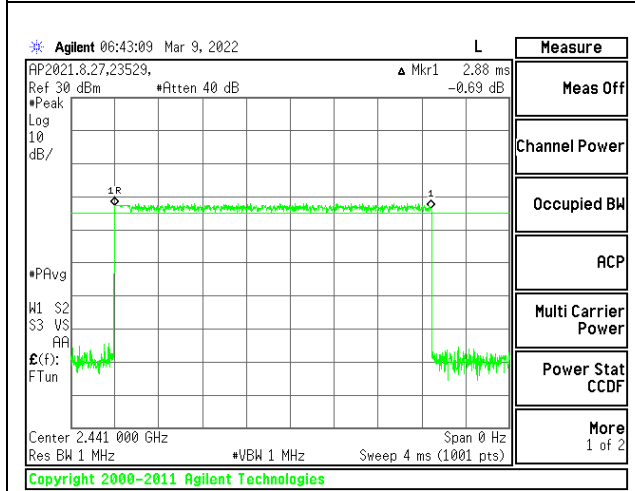
Note: for AFH(8PSK) mode, please refer to the results of AFH(GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate demonstrates compliance with channel occupancy when AFH is employed.



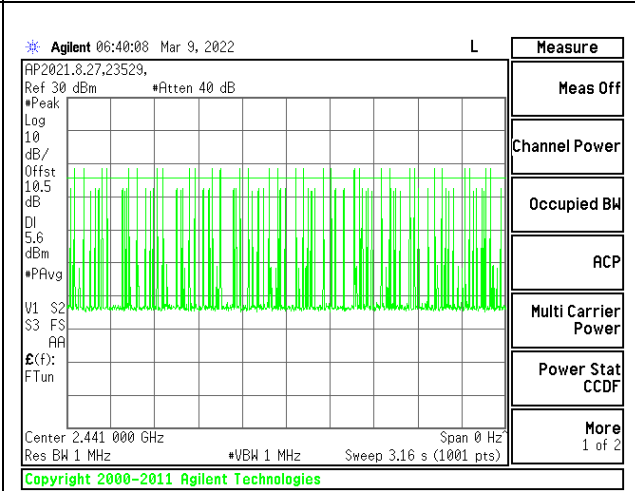
**PULSE WIDTH – 3DH1**



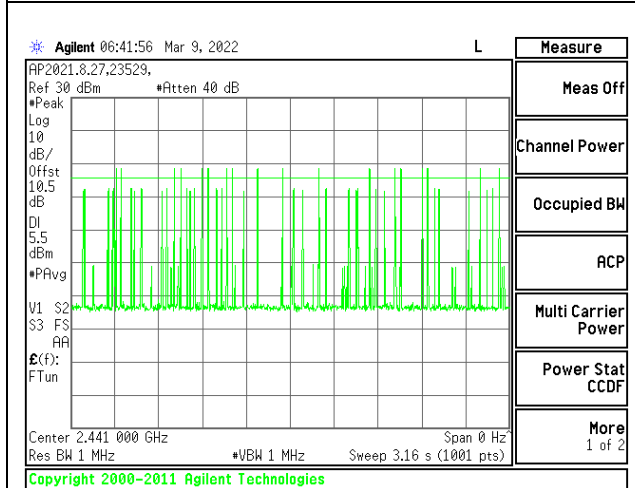
**PULSE WIDTH – 3DH3**



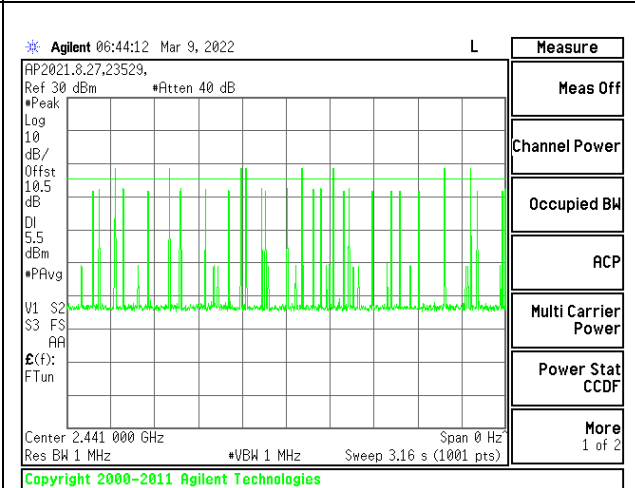
**PULSE WIDTH – 3DH5**



**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**



## **9.6. OUTPUT POWER**

### **LIMITS**

§15.247 (b) (1)

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**

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband peak power sensor. Peak output power was read directly from power meter.

### **RESULTS**

### 9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	23529 QL/19497 AF
Date:	3/4/2022

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	7.65	21	-13.35
Middle	2441	7.96	21	-13.04
High	2480	7.97	21	-13.03

### 9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	23529 QL/19497 AF
Date:	3/4/2022

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	7.60	21	-13.4
Middle	2441	7.81	21	-13.19
High	2480	7.82	21	-13.18

### 9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	23529 QL/19497 AF
Date:	3/4/2022

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	8.78	21	-12.22
Middle	2441	9.01	21	-11.99
High	2480	9.05	21	-11.95

## **9.7. AVERAGE POWER**

### **LIMITS**

None; for reporting purposes only

### **TEST PROCEDURE**

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

### **RESULTS**

### 9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	23529 QL/19497 AF
Date	3/4/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	7.42
Middle	2441	7.74
High	2480	7.76

### 9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	23529 QL/19497 AF
Date	3/4/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	5.97
Middle	2441	6.32
High	2480	6.34

### 9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	23529 QL/19497 AF
Date	3/4/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	5.96
Middle	2441	6.31
High	2480	6.33

---

## **9.8. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

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.

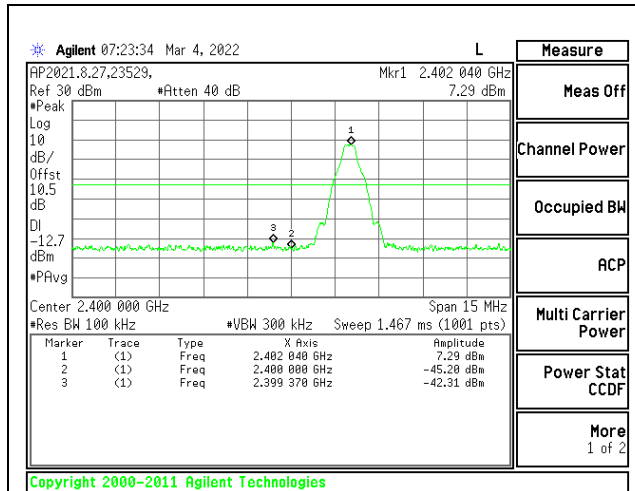
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

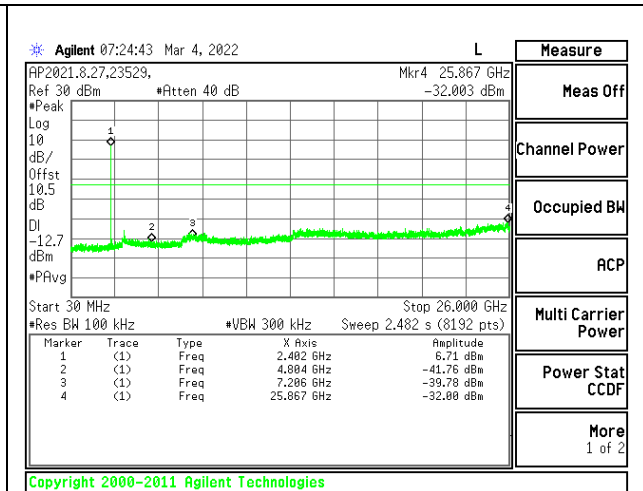
### **RESULTS**

### 9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

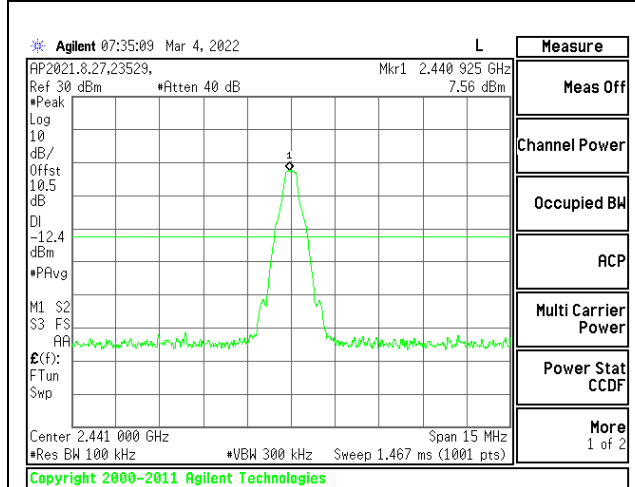
#### SPURIOUS EMISSIONS, NON-HOPPING



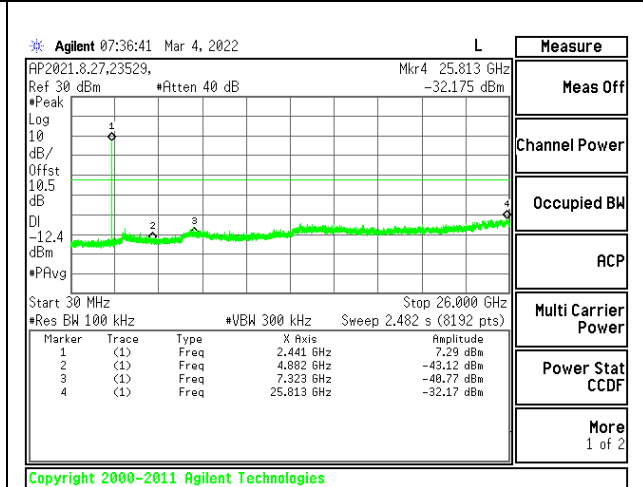
**LOW CHANNEL BANDEDGE**



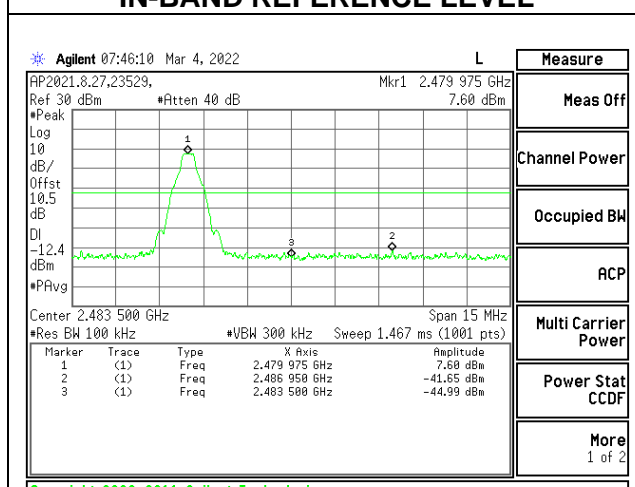
**OUT-OF-BAND LOW CHANNEL**



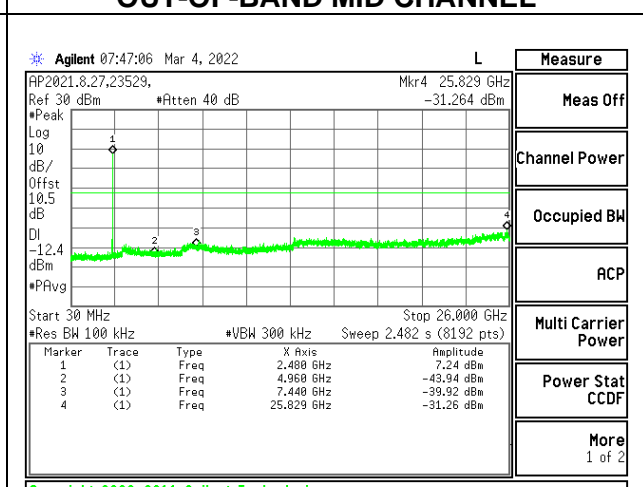
**IN-BAND REFERENCE LEVEL**



**OUT-OF-BAND MID CHANNEL**

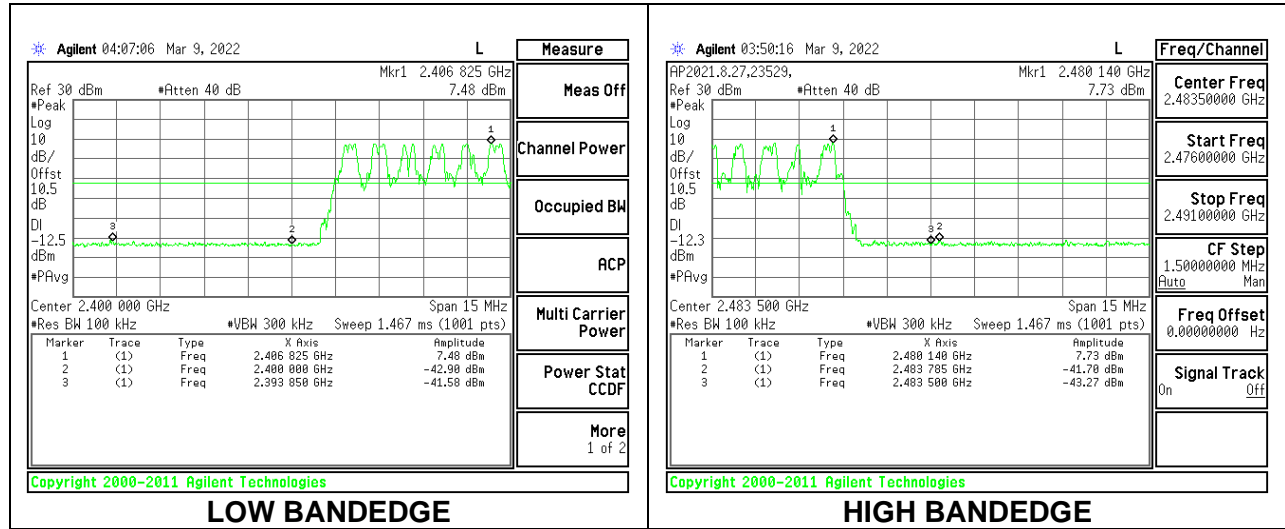


**HIGH CHANNEL BANDEDGE**



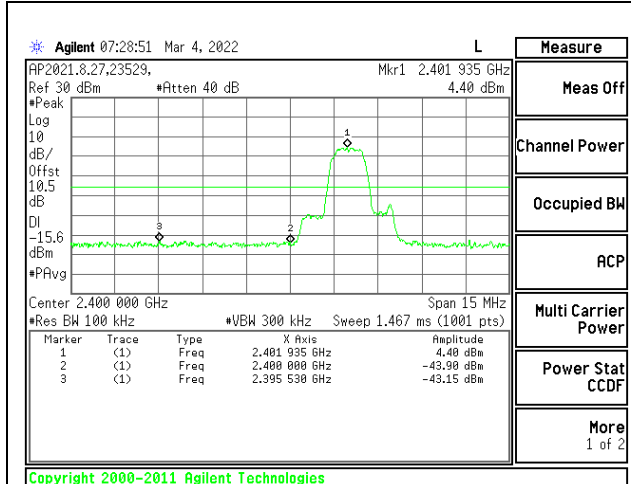
**OUT-OF-BAND HIGH CHANNEL**

**SPURIOUS BANDEGE EMISSIONS WITH HOPPING ON**

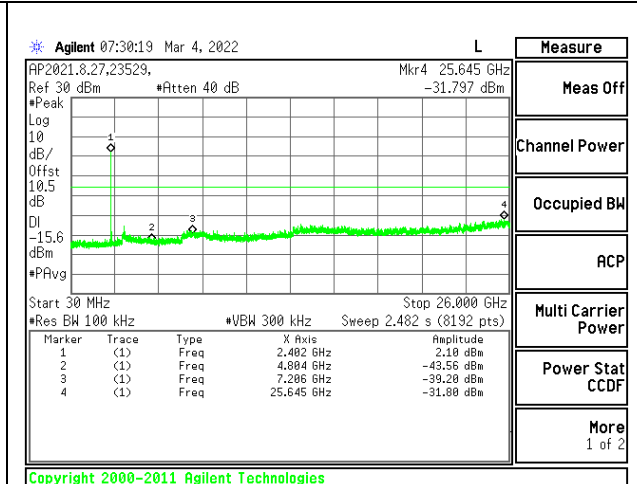


## 9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

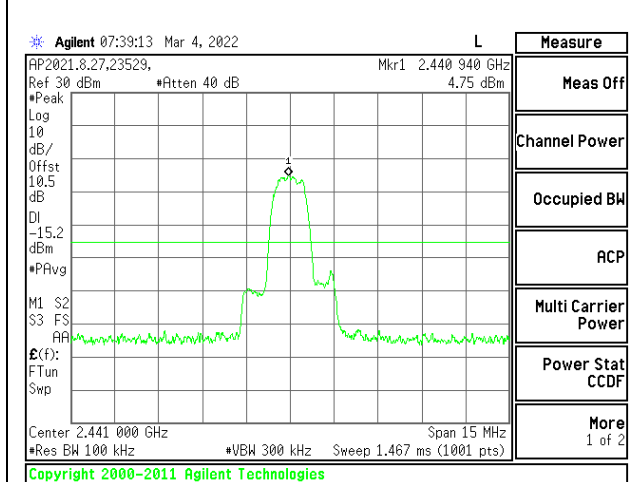
### SPURIOUS EMISSIONS, NON-HOPPING



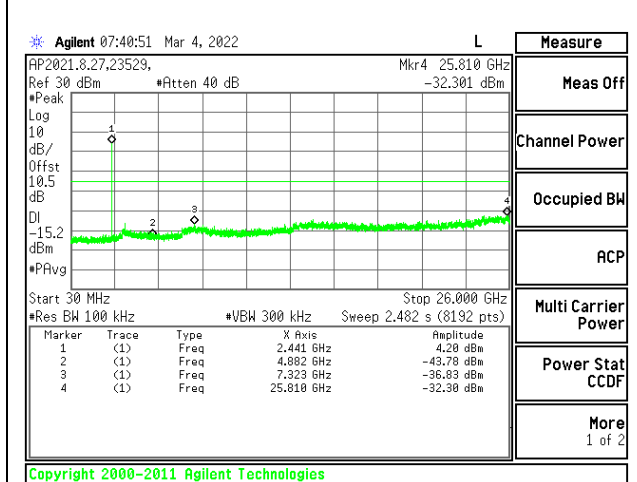
**LOW CHANNEL BANDEDGE**



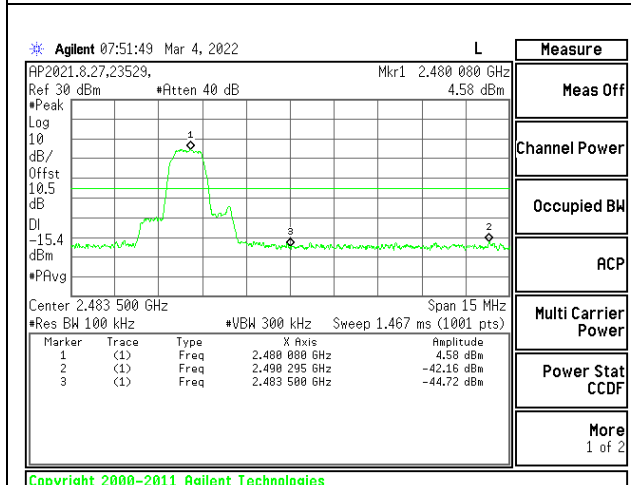
**OUT-OF-BAND LOW CHANNEL**



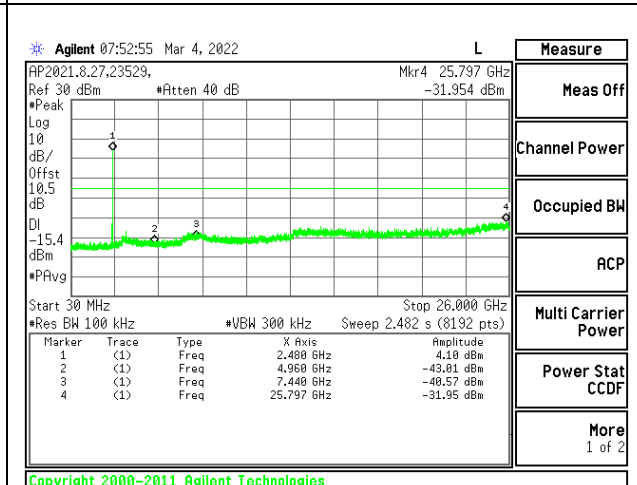
**IN-BAND REFERENCE LEVEL**



**OUT-OF-BAND MID CHANNEL**



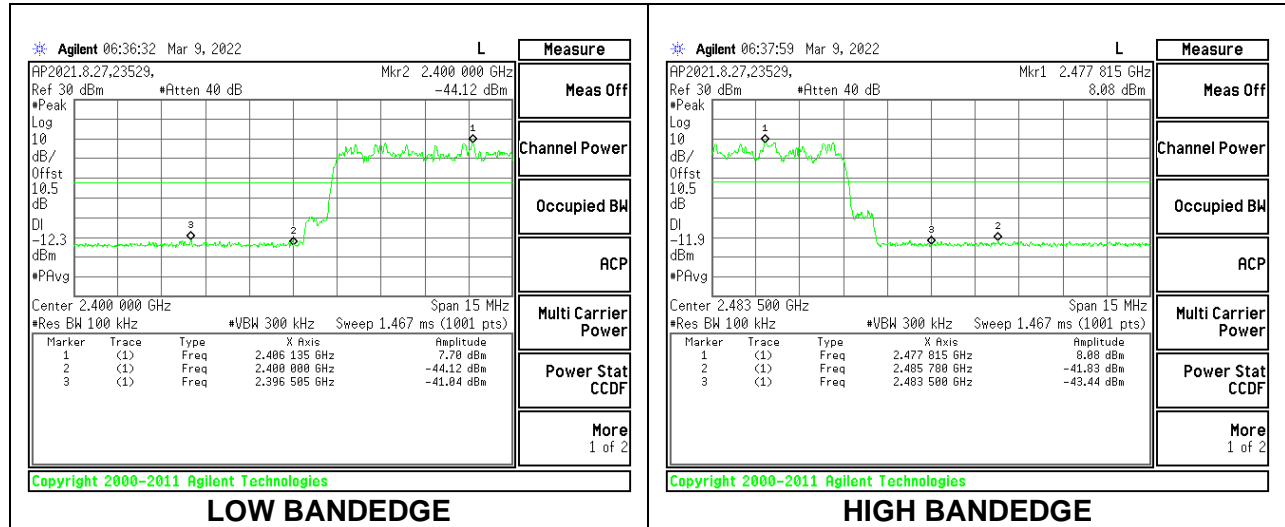
**HIGH CHANNEL BANDEDGE**



**OUT-OF-BAND HIGH CHANNEL**



**SPURIOUS BANDEGE EMISSIONS WITH HOPPING ON**



## 10. RADIATED TEST RESULTS

### LIMITS

FCC §15.205 and §15.209

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 in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. Peak detection is used unless otherwise noted as quasi-peak or average (9-90kHz and 110-490kHz).

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. Blue color trace on plots: Parallel orientation. Green color trace on plots: Perpendicular orientation.

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.

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

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**

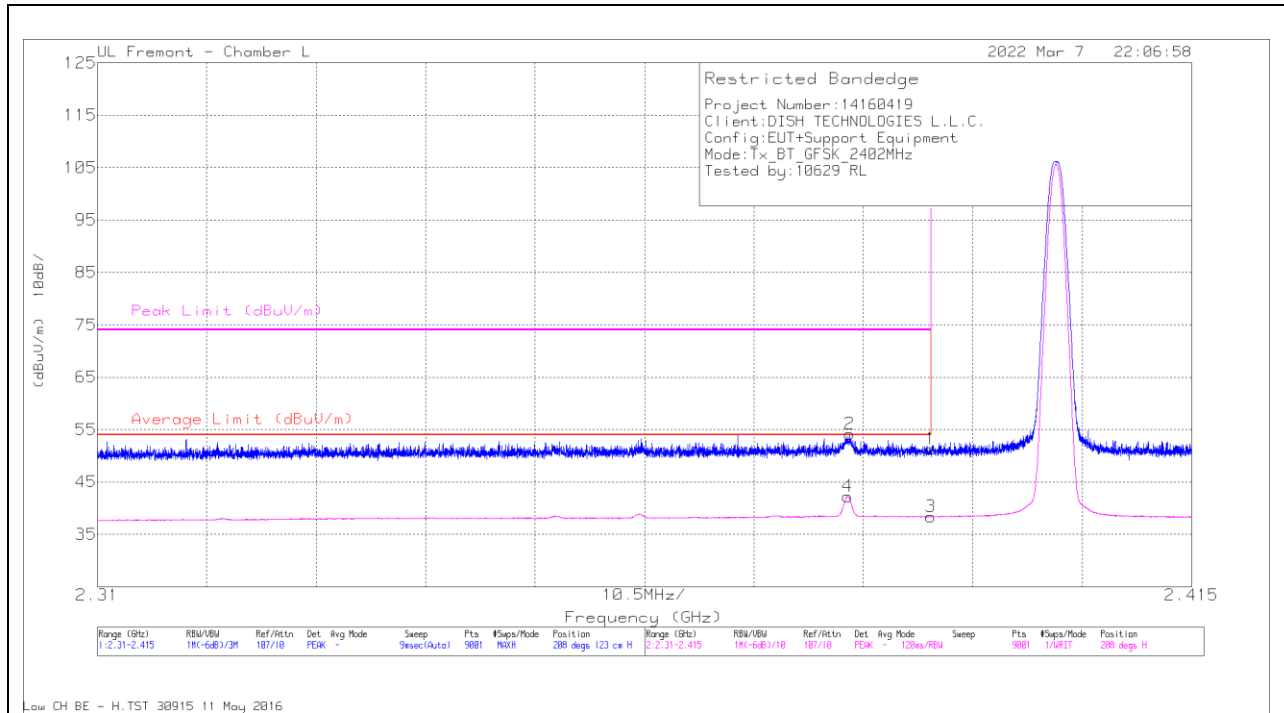
Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can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

## 10.1. TRANSMITTER ABOVE 1 GHz

### 10.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

#### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



#### Trace Markers

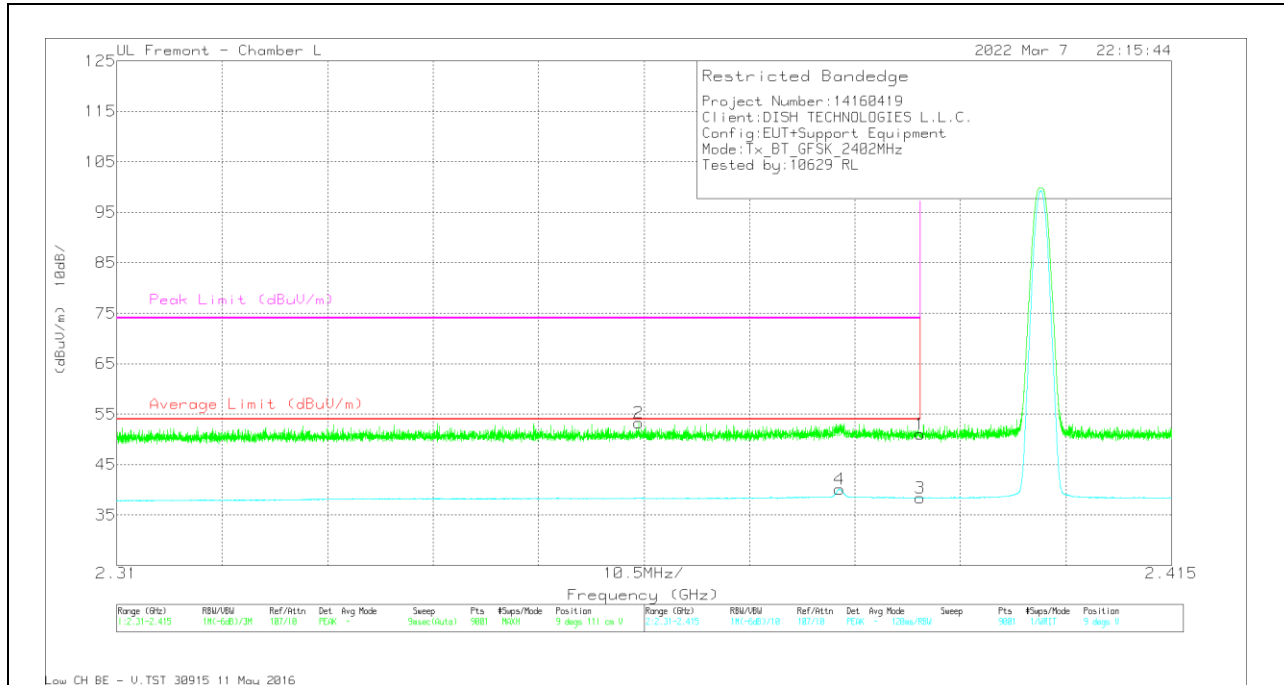
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.55	Pk	32	-19.3	51.25	-	-	74	-22.75	208	123	H
2	* 2.382195	41.46	Pk	32.1	-19.4	54.16	-	-	74	-19.84	208	123	H
3	* 2.39	25.62	VA1T	32	-19.3	38.32	54	-15.68	-	-	208	123	H
4	* 2.381997	29.57	VA1T	32.1	-19.4	42.27	54	-11.73	-	-	208	123	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



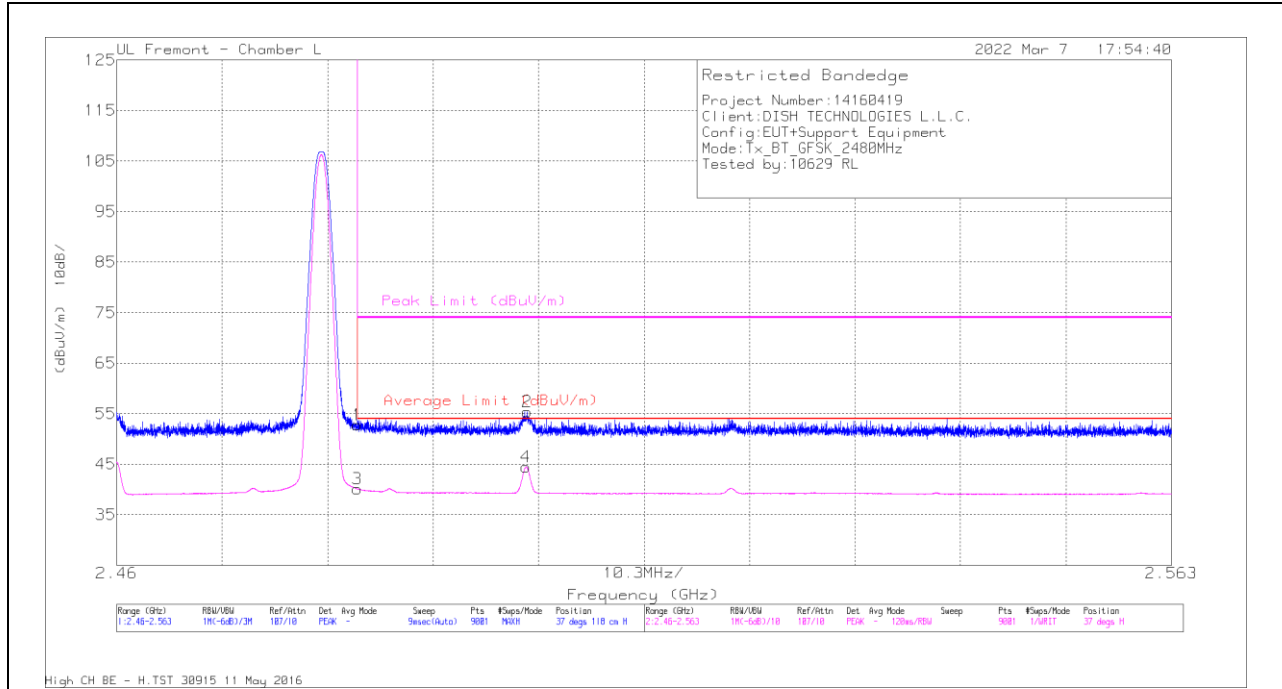
### Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AFT119 (dB/m)	Amp/Cb/Filtr/PS 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	* 2.39	38.33	Pk	32	-19.3	51.03	-	-	74	-22.97	9	111	V
2	* 2.361976	40.7	Pk	32	-19.4	53.3	-	-	74	-20.7	9	111	V
3	* 2.39	25.7	VA1T	32	-19.3	38.4	54	-15.6	-	-	9	111	V
4	* 2.381962	27.41	VA1T	32.1	-19.4	40.11	54	-13.89	-	-	9	111	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**

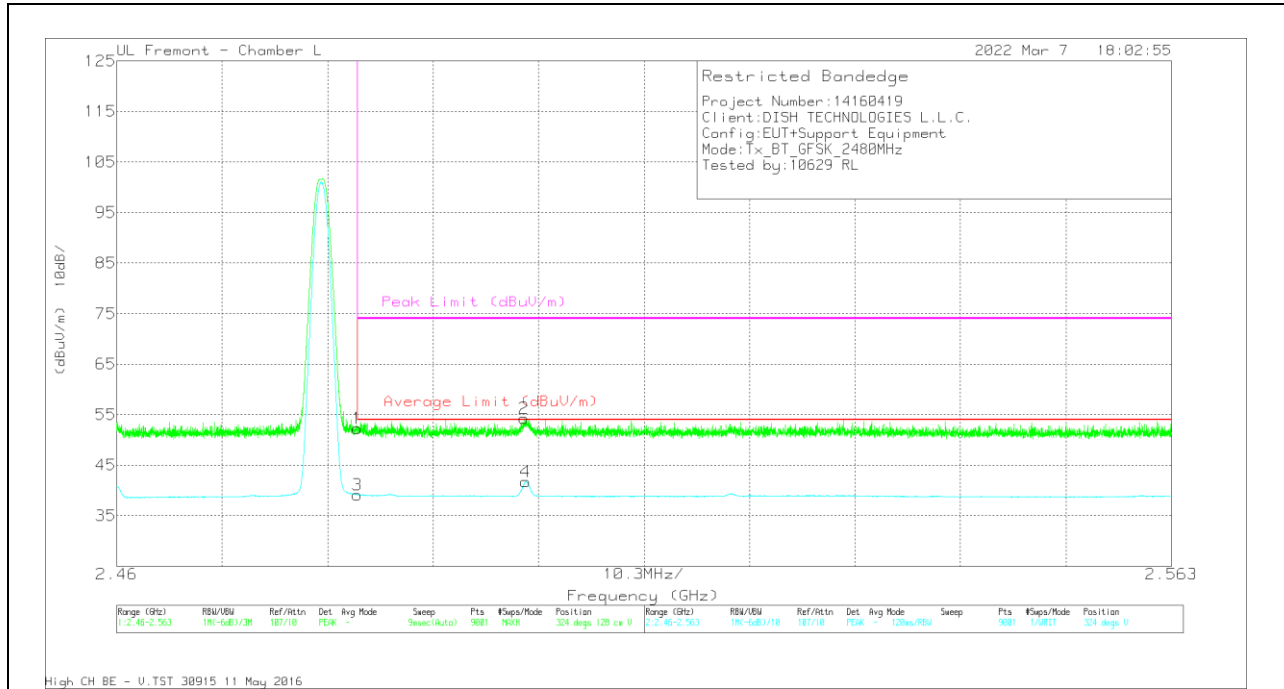


**Trace Markers**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/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	* 2.4835	39.43	Pk	32.3	-19	52.73	-	-	74	-21.27	37	118	H
2	2.500054	42.11	Pk	32.4	-19.1	55.41	-	-	74	-18.59	37	118	H
3	* 2.4835	26.79	VA1T	32.3	-19	40.09	54	-13.91	-	-	37	118	H
4	* 2.499951	31.13	VA1T	32.4	-19.1	44.43	54	-9.57	-	-	37	118	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



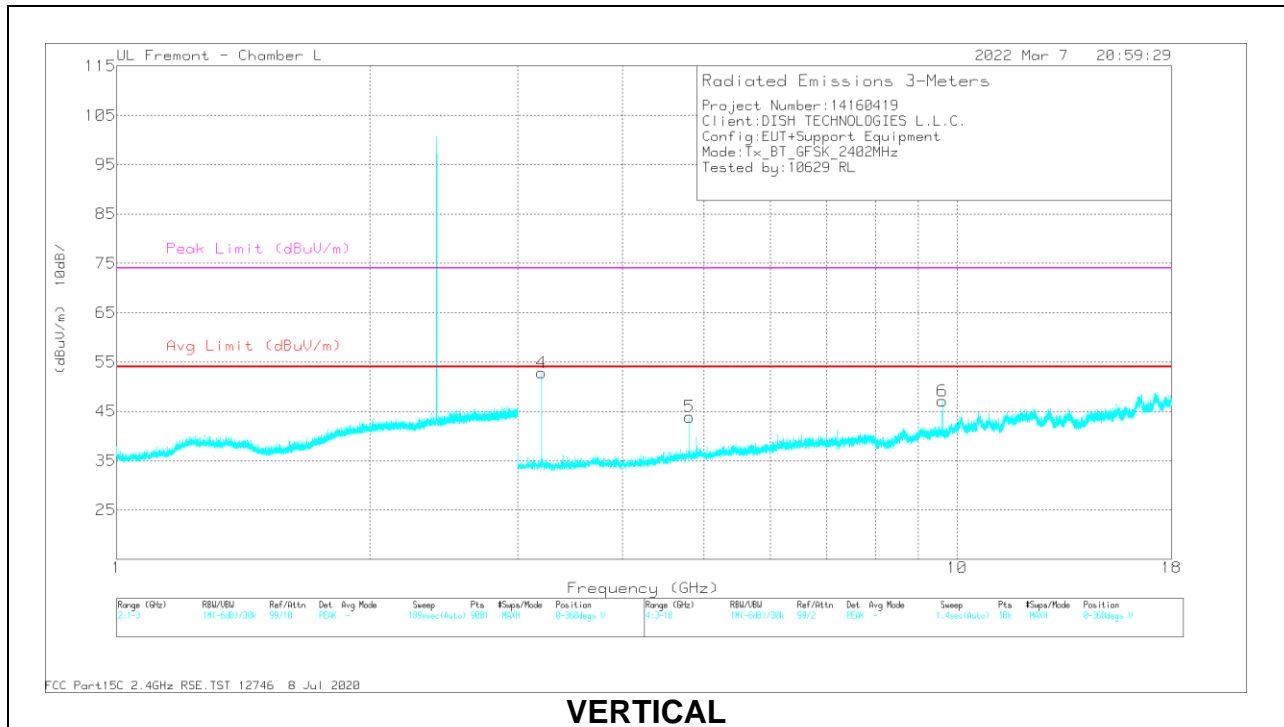
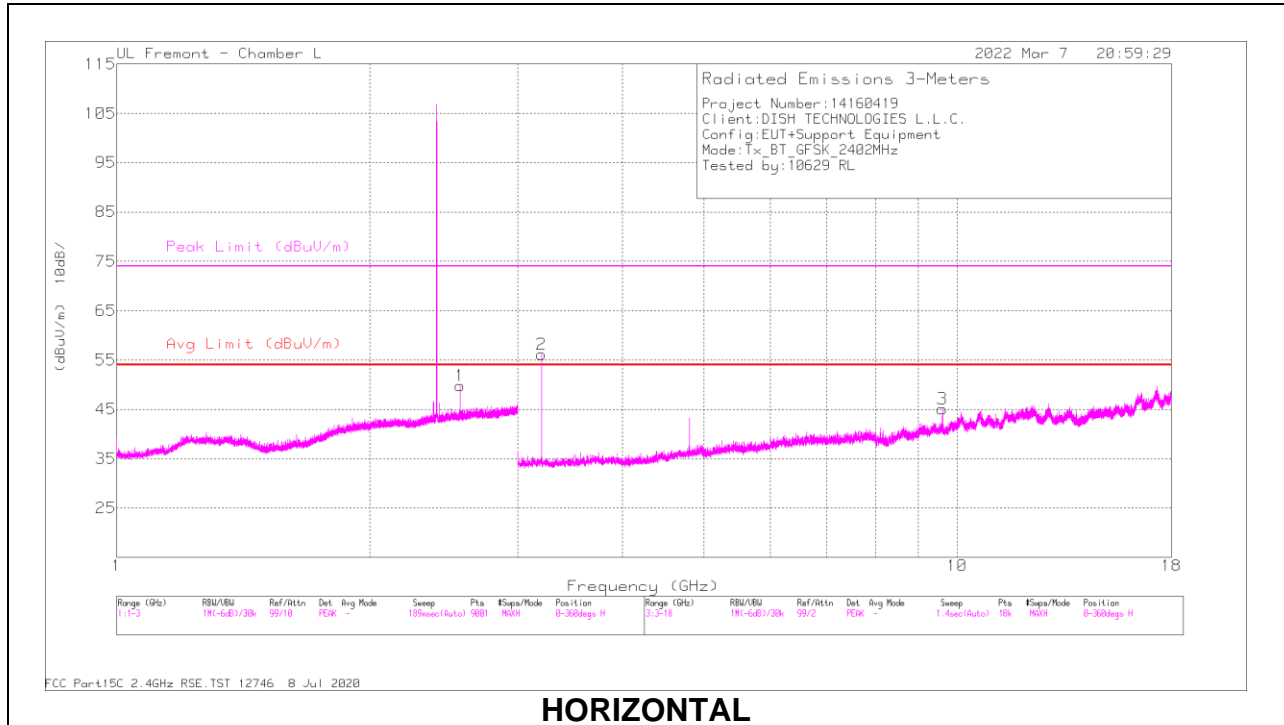
### Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AFT119 (dB/m)	Amp/Cb/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	* 2.4835	38.92	Pk	32.3	-19	52.22	-	-	74	-21.78	324	128	V
2	* 2.499768	41.02	Pk	32.4	-19.1	54.32	-	-	74	-19.68	324	128	V
3	* 2.4835	25.82	VA1T	32.3	-19	39.12	54	-14.88	-	-	324	128	V
4	* 2.499928	28.44	VA1T	32.4	-19.1	41.74	54	-12.26	-	-	324	128	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**



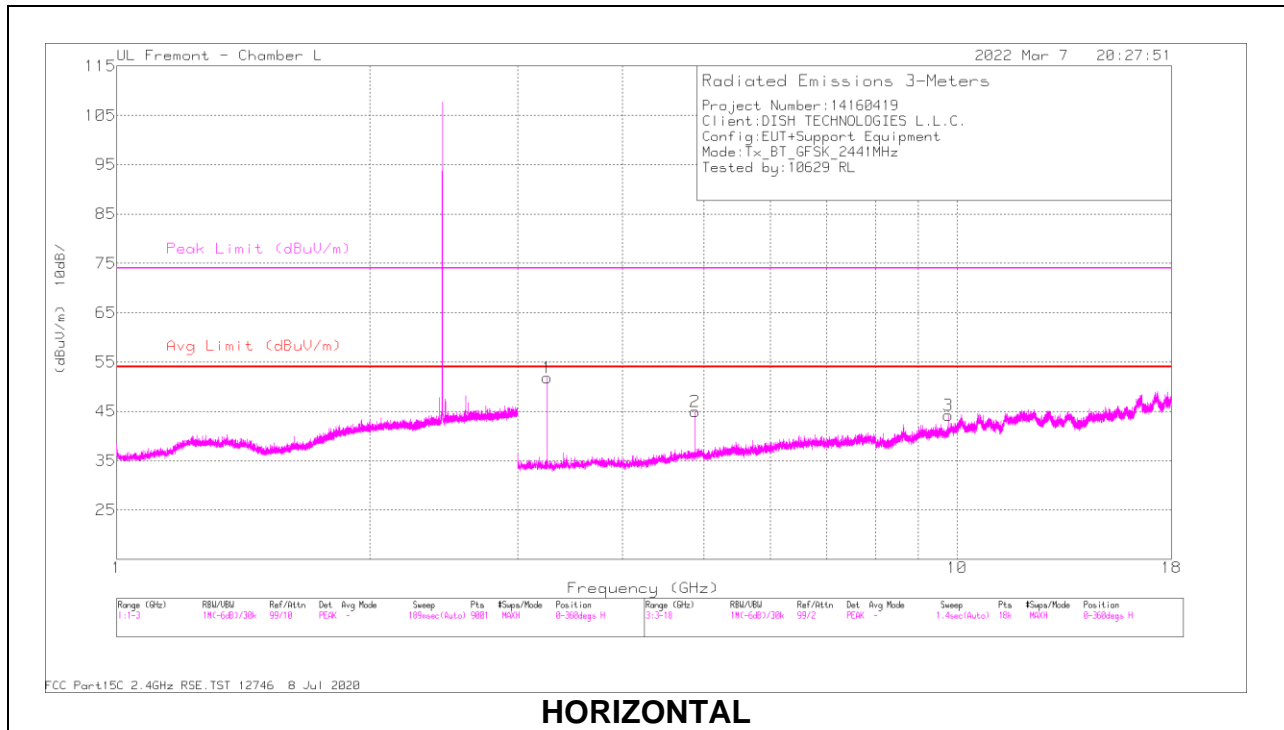


**RADIATED EMISSIONS**

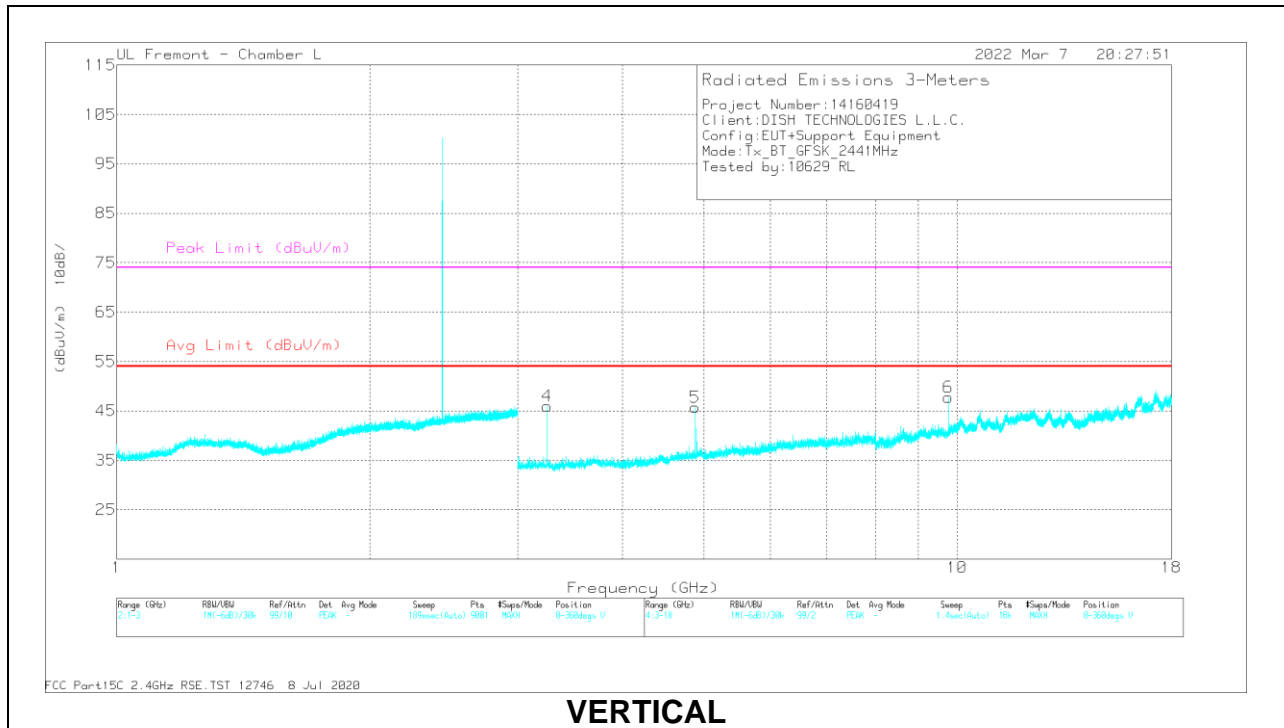
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Par d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.561948	41.95	PKFH	32.2	-18.9	55.25	-	-	-	-	191	188	H
	2.561948	34.58	VA1T	32.2	-18.9	47.88	-	-	-	-	191	188	H
2	3.202651	51.28	PKFH	32.9	-26.6	57.58	-	-	-	-	170	103	H
	3.202641	49.82	VA1T	32.9	-26.6	56.12	-	-	-	-	170	103	H
3	9.60758	30.63	PKFH	36.8	-16.3	51.13	-	-	-	-	63	103	H
	9.60792	19.18	VA1T	36.8	-16.3	39.68	-	-	-	-	63	103	H
4	3.202591	48.59	PKFH	32.9	-26.6	54.89	-	-	-	-	253	101	V
	3.202641	46.54	VA1T	32.9	-26.6	52.84	-	-	-	-	253	101	V
5	* 4.803694	41.12	PKFH	34.1	-24.5	50.72	-	-	74	-23.28	297	101	V
	* 4.803963	34.35	VA1T	34.1	-24.5	43.95	54	-10.05	-	-	297	101	V
6	9.60782	34.23	PKFH	36.8	-16.3	54.73	-	-	-	-	118	103	V
	9.60792	25.64	VA1T	36.8	-16.3	46.14	-	-	-	-	118	103	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak  
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

### MID CHANNEL RESULTS



**HORIZONTAL**



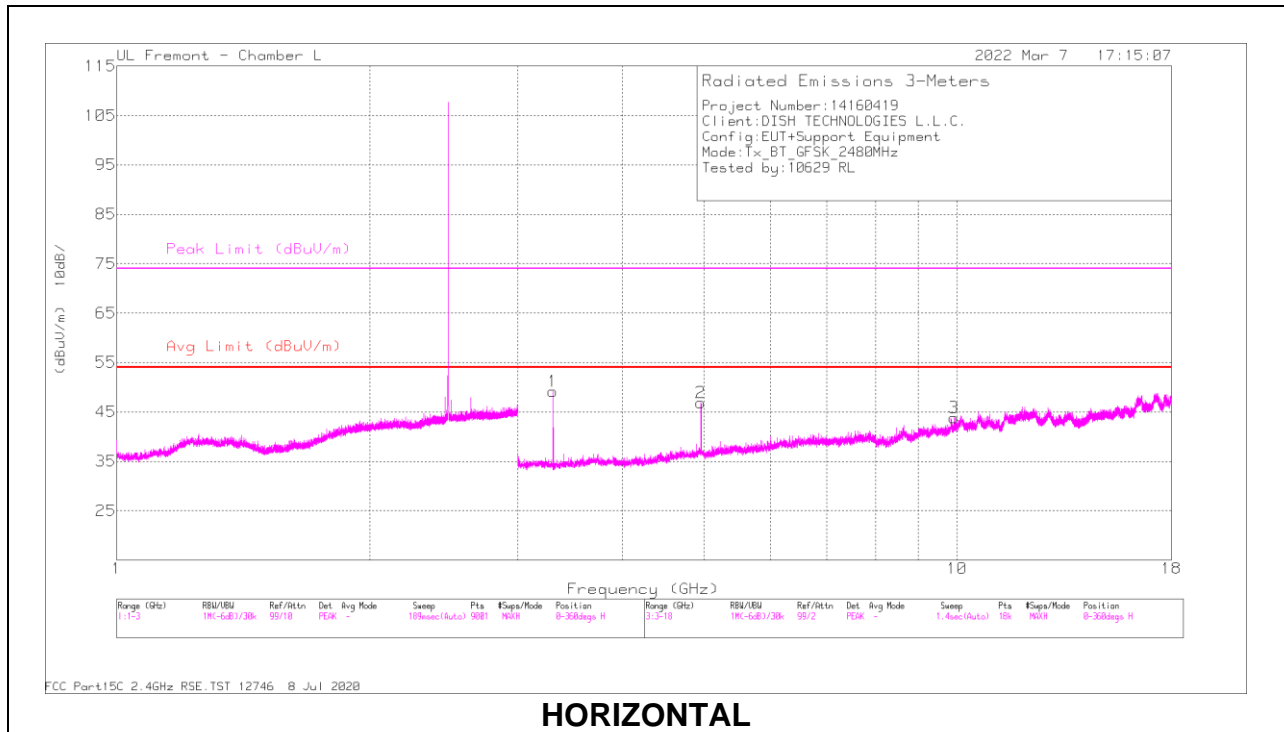
**VERTICAL**

**RADIATED EMISSIONS**

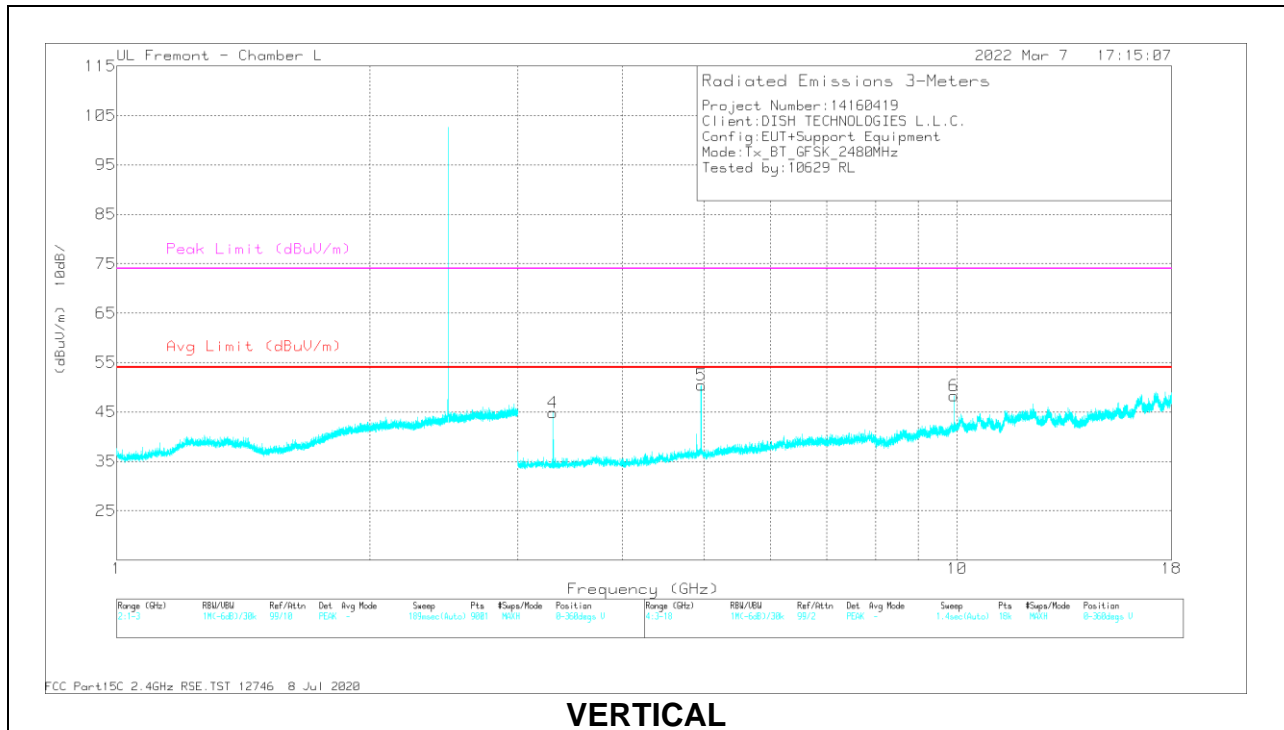
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fitr/Pa d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.254511	48.48	PKFH	33.1	-26.9	54.68	-	-	-	-	183	106	H
	3.254631	46.34	VA1T	33.1	-26.9	52.54	-	-	-	-	183	106	H
	* 4.881992	41.78	PKFH	34.2	-24.3	51.68	-	-	74	-22.32	48	102	H
2	* 4.881972	34.84	VA1T	34.2	-24.3	44.74	54	-9.26	-	-	48	102	H
	9.764231	33.46	PKFH	37	-17.1	53.36	-	-	-	-	74	109	H
	9.763912	23.19	VA1T	37	-17.1	43.09	-	-	-	-	74	109	H
3	3.25476	45.34	PKFH	33.1	-26.9	51.54	-	-	-	-	247	107	V
	3.254641	41.65	VA1T	33.1	-26.9	47.85	-	-	-	-	247	107	V
	* 4.881932	41.69	PKFH	34.2	-24.3	51.59	-	-	74	-22.41	33	110	V
4	* 4.881952	35.62	VA1T	34.2	-24.3	45.52	54	-8.48	-	-	33	110	V
	9.764002	35.66	PKFH	37	-17.1	55.56	-	-	-	-	113	102	V
	9.763912	27.86	VA1T	37	-17.1	47.76	-	-	-	-	113	102	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak  
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

### HIGH CHANNEL RESULTS



**HORIZONTAL**



**VERTICAL**

**RADIATED EMISSIONS**

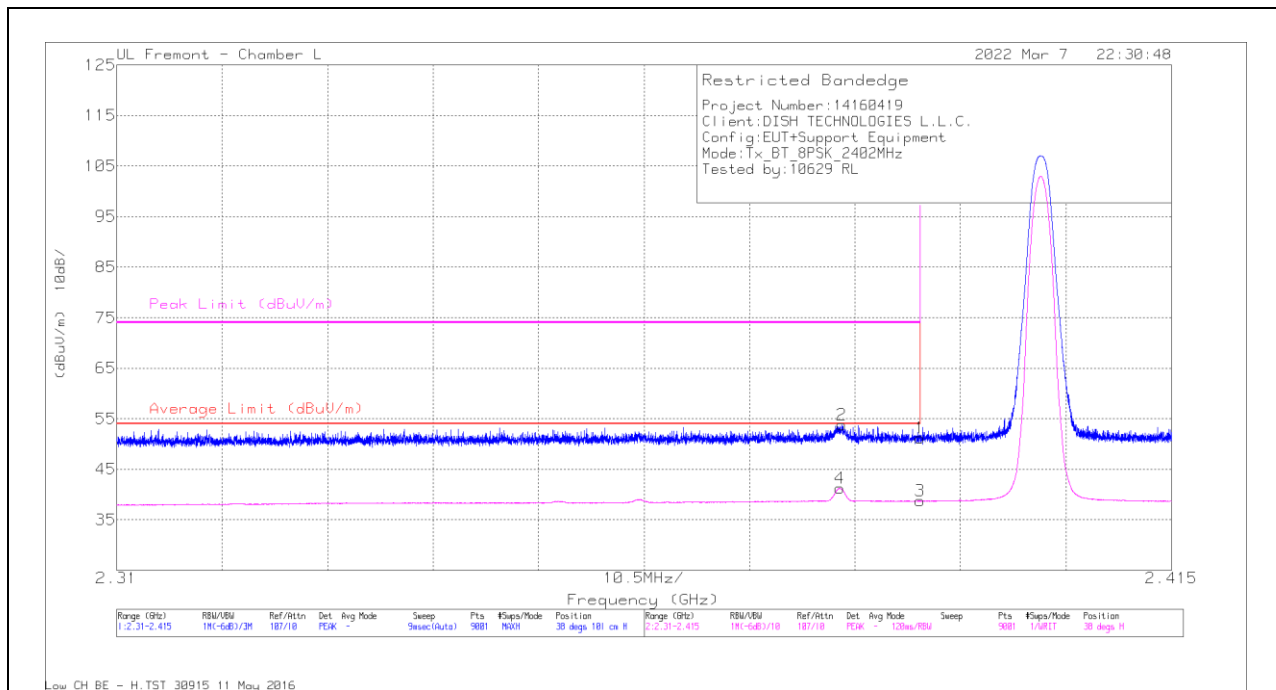
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dBm)	Amp/Cbl/Ftr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.306764	45.98	PKFH	32.5	-26.5	0	51.98	-	-	-	-	184	102	H
	3.306544	42.36	VA1T	32.5	-26.5	0	48.36	-	-	-	-	184	102	H
2	* 4.959866	40.66	PKFH	34.2	-23.2	0	51.66	-	-	74	-22.34	246	101	H
	* 4.959855	34.32	VA1T	34.2	-23.2	0	45.32	54	-8.68	-	-	246	101	H
3	9.920348	31.37	PKFH	37.1	-16.5	0	51.97	-	-	-	-	310	127	H
	9.919928	20.59	VA1T	37.1	-16.5	0	41.19	-	-	-	-	310	127	H
4	3.306714	43.58	PKFH	32.5	-26.5	0	49.58	-	-	-	-	244	101	V
	3.306624	39.42	VA1T	32.5	-26.5	0	46.42	-	-	-	-	244	101	V
5	* 4.95984	42.28	PKFH	34.2	-23.2	0	53.28	-	-	74	-20.72	220	130	V
	* 4.95986	37.31	VA1T	34.2	-23.2	0	48.31	54	-5.69	-	-	220	130	V
6	9.919984	35.43	PKFH	37.1	-16.5	0	56.03	-	-	-	-	116	102	V
	9.919924	26.45	VA1T	37.1	-16.5	0	47.05	-	-	-	-	116	102	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak  
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## 10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

### BANDEDGE (LOW CHANNEL)

### HORIZONTAL RESULT

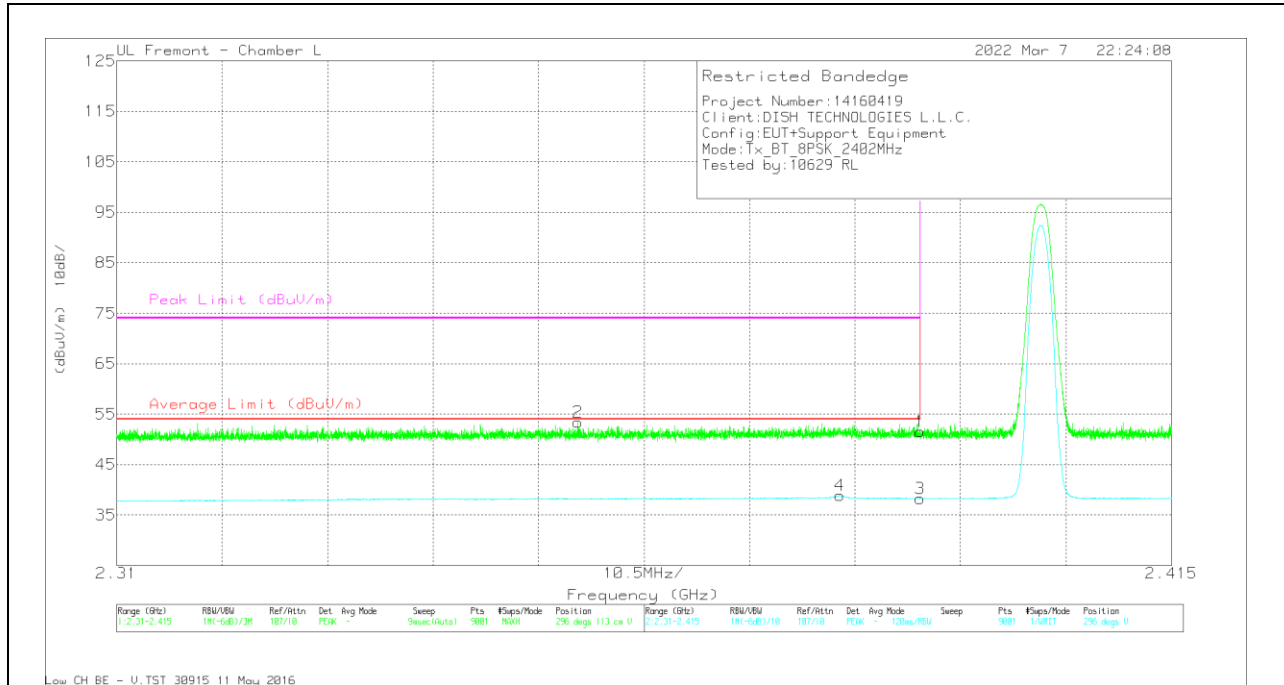


### Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb1/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	* 2.39	38.46	Pk	32	-19.3	51.16	-	-	74	-22.84	38	101	H
2	* 2.38216	41.08	Pk	32.1	-19.4	53.78	-	-	74	-20.22	38	101	H
3	* 2.39	26	VA1T	32	-19.3	38.7	54	-15.3	-	-	38	101	H
4	* 2.381985	28.49	VA1T	32.1	-19.4	41.19	54	-12.81	-	-	38	101	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**

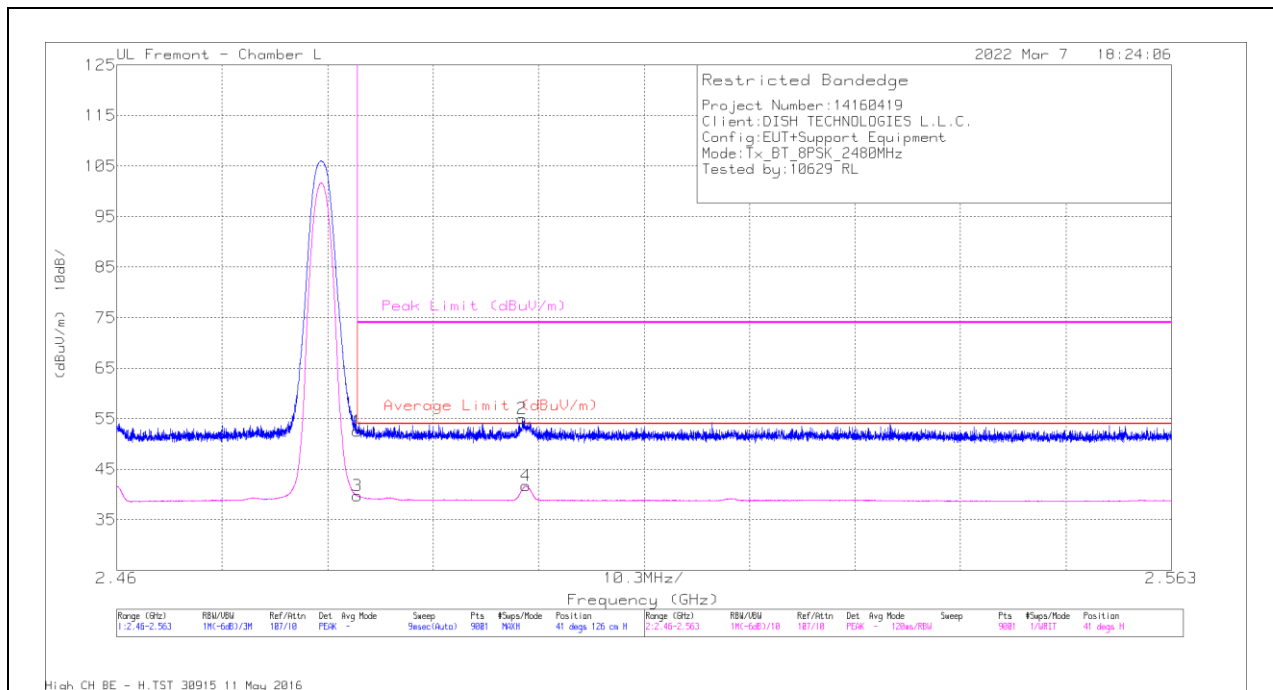


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fitr/P ad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.8	Pk	32	-19.3	51.5	-	-	74	-22.5	296	113	V
2	* 2.356886	40.74	Pk	32	-19.4	53.34	-	-	74	-20.66	296	113	V
3	* 2.39	25.6	VA1T	32	-19.3	38.3	54	-15.7	-	-	296	113	V
4	* 2.381974	26.13	VA1T	32.1	-19.4	38.83	54	-15.17	-	-	296	113	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



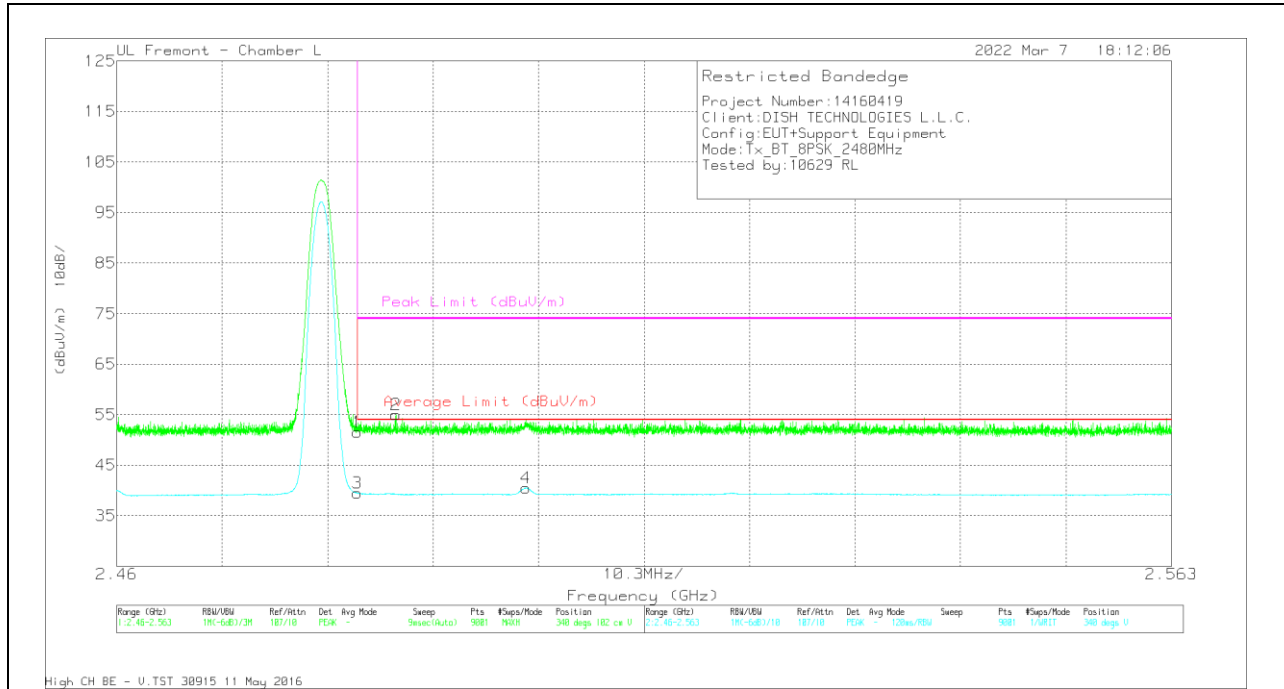
### Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (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	* 2.4835	39.25	Pk	32.3	-19	52.55	-	-	74	-21.45	41	126	H
2	* 2.499619	41.67	Pk	32.4	-19.1	54.97	-	-	74	-19.03	41	126	H
3	* 2.4835	26.46	VA1T	32.3	-19	39.76	54	-14.24	-	-	41	126	H
4	* 2.499985	28.37	VA1T	32.4	-19.1	41.67	54	-12.33	-	-	41	126	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



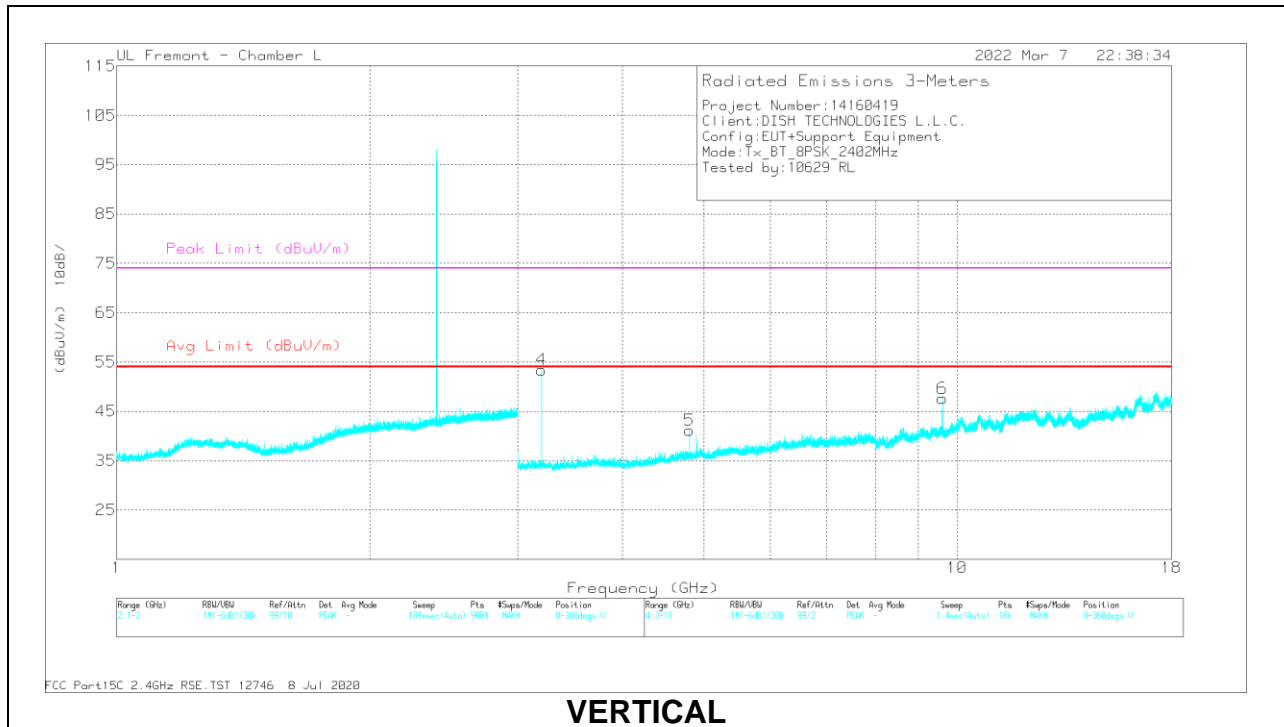
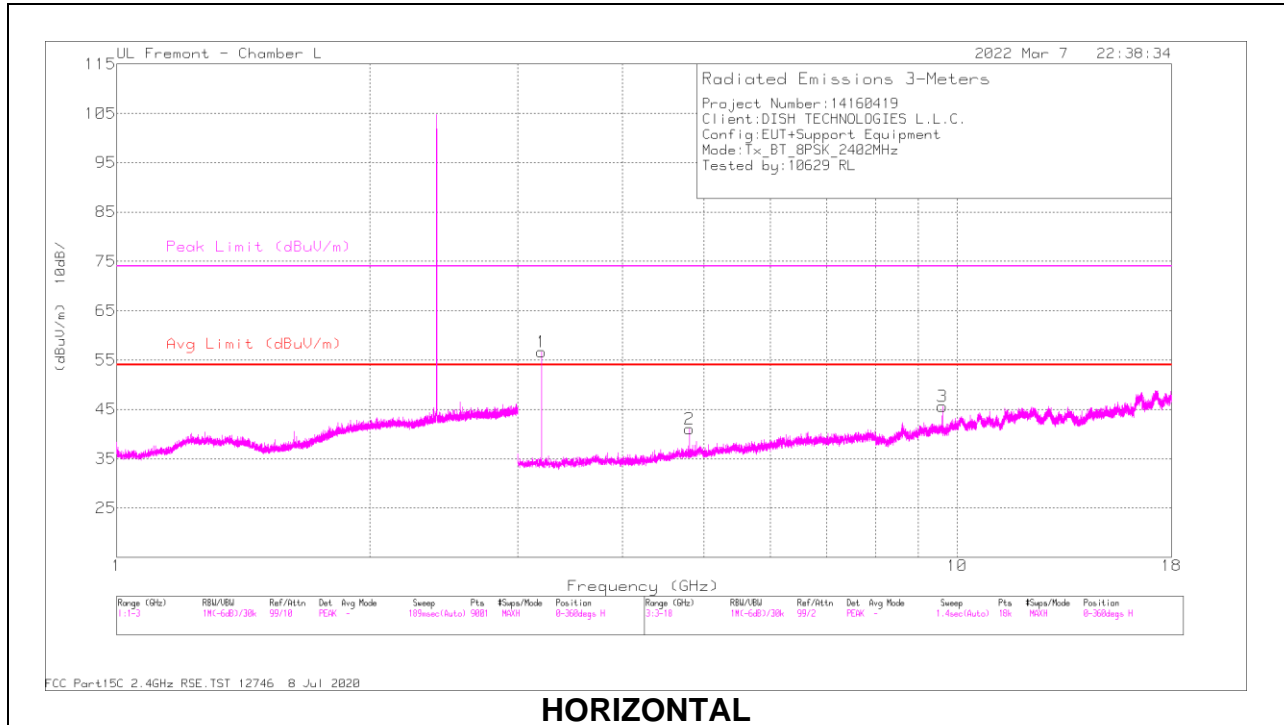
### Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Chl/Filt/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	38.22	Pk	32.3	-19	51.52	-	-	74	-22.48	340	102	V
2	* 2.48726	41.83	Pk	32.3	-19.1	55.03	-	-	74	-18.97	340	102	V
3	* 2.4835	26.15	VA1T	32.3	-19	39.45	54	-14.55	-	-	340	102	V
4	* 2.49994	27.17	VA1T	32.4	-19.1	40.47	54	-13.53	-	-	340	102	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**

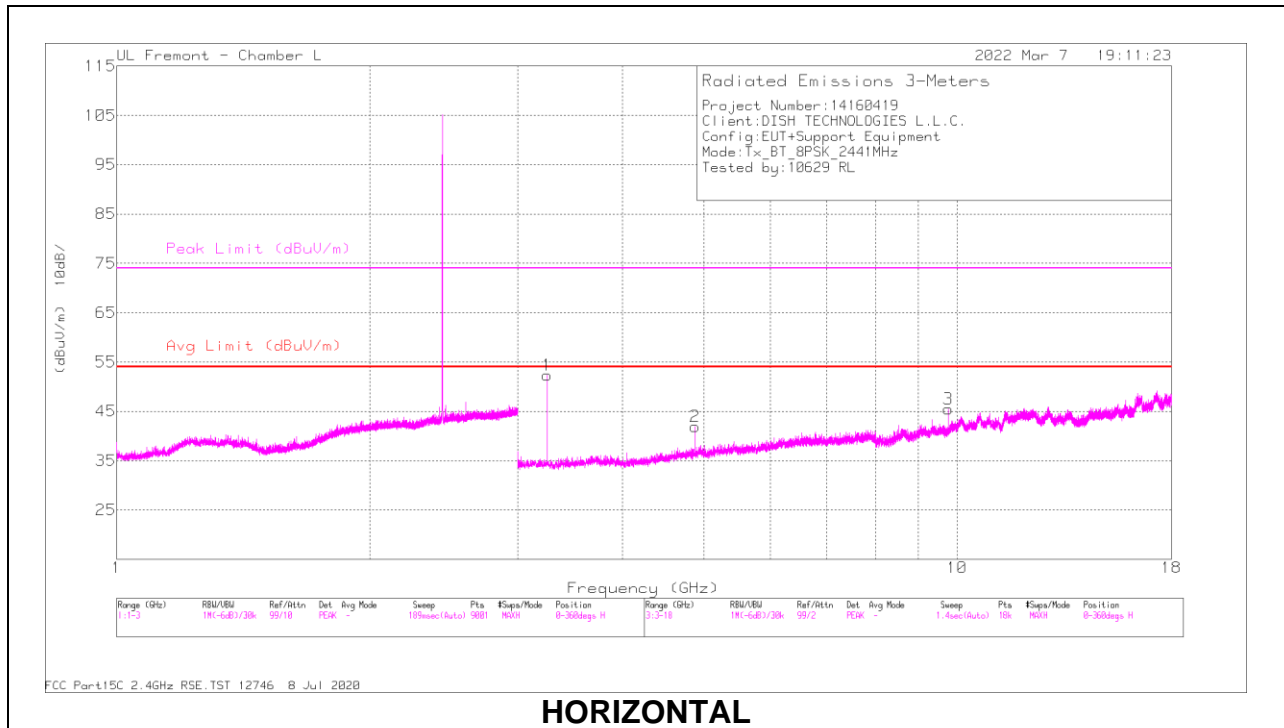


**RADIATED EMISSIONS**

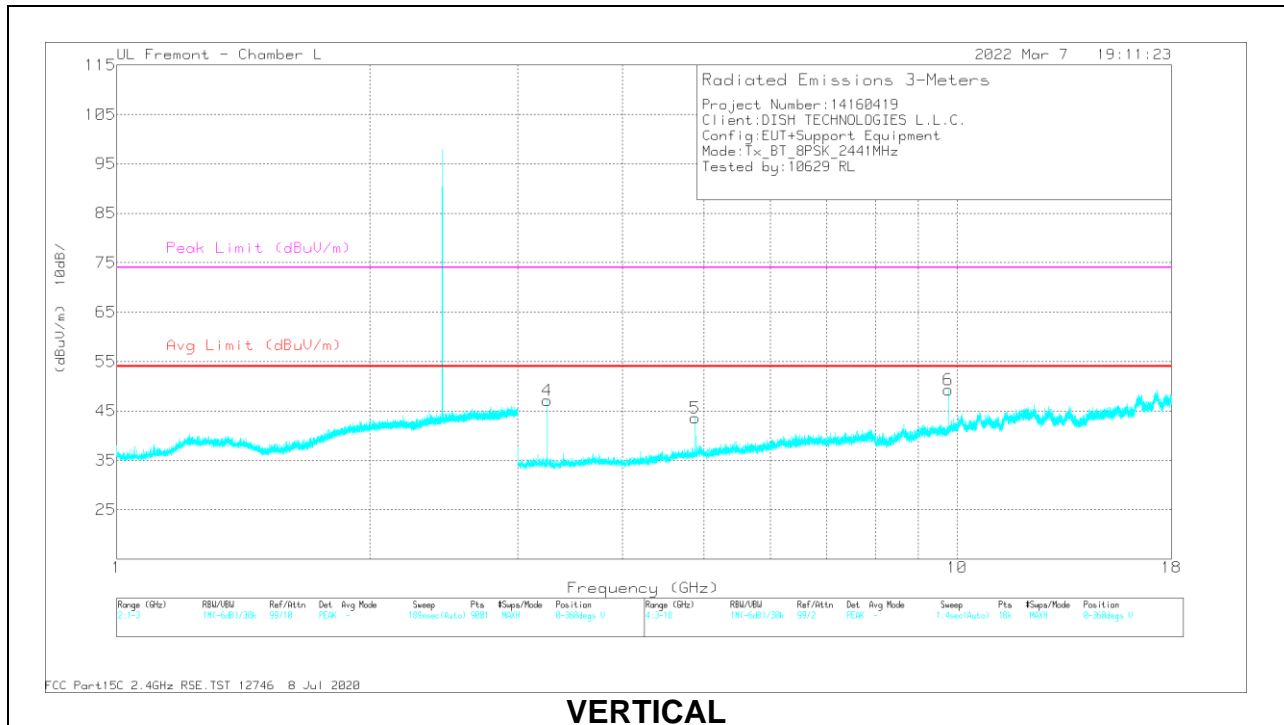
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fitr/Pa d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.202671	52.04	PKFH	32.9	-26.6	58.34	-	-	-	-	167	101	H
	3.202641	50.48	VA1T	32.9	-26.6	56.78	-	-	-	-	167	101	H
2	* 4.804303	39.76	PKFH	34.1	-24.5	49.36	-	-	74	-24.64	238	101	H
	* 4.803924	28.97	VA1T	34.1	-24.5	38.57	54	-15.43	-	-	238	101	H
3	9.60809	32.35	PKFH	36.8	-16.3	52.85	-	-	-	-	319	103	H
	9.60792	23.38	VA1T	36.8	-16.3	43.88	-	-	-	-	319	103	H
4	3.202631	49.15	PKFH	32.9	-26.6	55.45	-	-	-	-	255	101	V
	3.202641	47.17	VA1T	32.9	-26.6	53.47	-	-	-	-	255	101	V
5	* 4.803914	40.57	PKFH	34.1	-24.5	50.17	-	-	74	-23.83	298	101	V
	* 4.803953	29.58	VA1T	34.1	-24.5	39.18	54	-14.82	-	-	298	101	V
6	9.60792	33.07	PKFH	36.8	-16.3	53.57	-	-	-	-	120	103	V
	9.60793	25.88	VA1T	36.8	-16.3	46.38	-	-	-	-	120	103	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak  
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

### MID CHANNEL RESULTS



**HORIZONTAL**



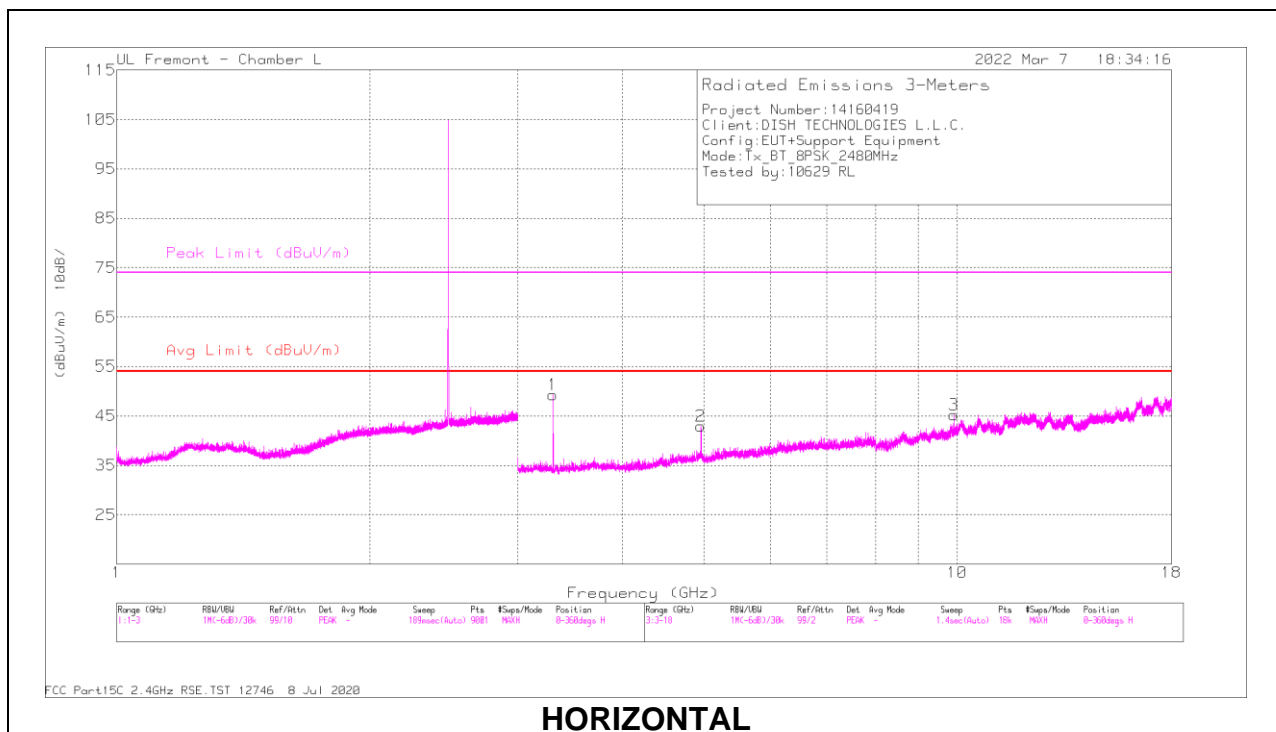
**VERTICAL**

**RADIATED EMISSIONS**

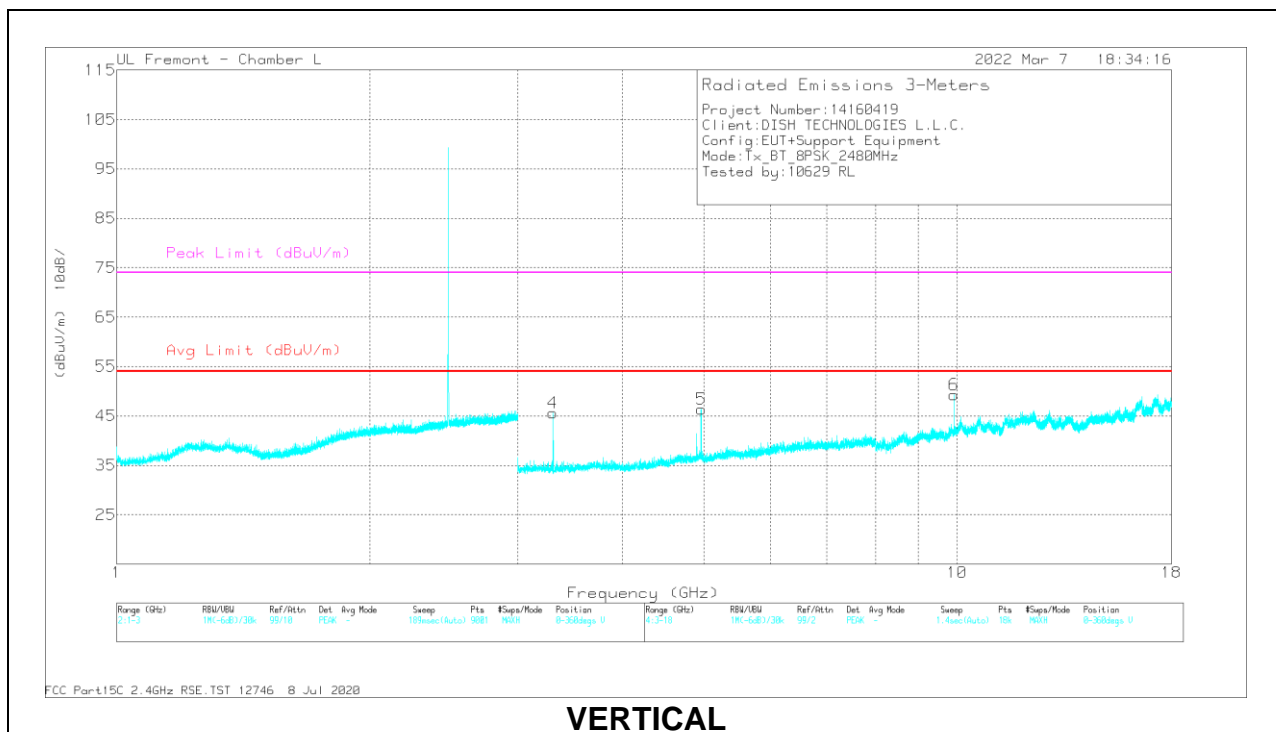
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.254661	49.48	PKFH	33.1	-26.9	55.68	-	-	-	-	182	110	H
	3.254641	47.19	VA1T	33.1	-26.9	53.39	-	-	-	-	182	110	H
2	* 4.881852	40.91	PKFH	34.2	-24.3	50.81	-	-	74	-23.19	72	101	H
	* 4.881962	30.86	VA1T	34.2	-24.3	40.56	54	-13.44	-	-	72	101	H
3	9.763662	32.71	PKFH	37	-17.1	52.61	-	-	-	-	320	101	H
	9.763912	23.97	VA1T	37	-17.1	43.87	-	-	-	-	320	101	H
4	3.254621	44.77	PKFH	33.1	-26.9	50.97	-	-	-	-	254	124	V
	3.254641	40.92	VA1T	33.1	-26.9	47.12	-	-	-	-	254	124	V
5	* 4.882232	41.57	PKFH	34.2	-24.3	51.47	-	-	74	-22.53	34	102	V
	* 4.881902	32.01	VA1T	34.2	-24.3	41.91	54	-12.09	-	-	34	102	V
6	9.763732	35.4	PKFH	37	-17.1	55.3	-	-	-	-	117	102	V
	9.763932	28.63	VA1T	37	-17.1	48.53	-	-	-	-	117	102	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak  
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

### HIGH CHANNEL RESULTS



**HORIZONTAL**



**VERTICAL**

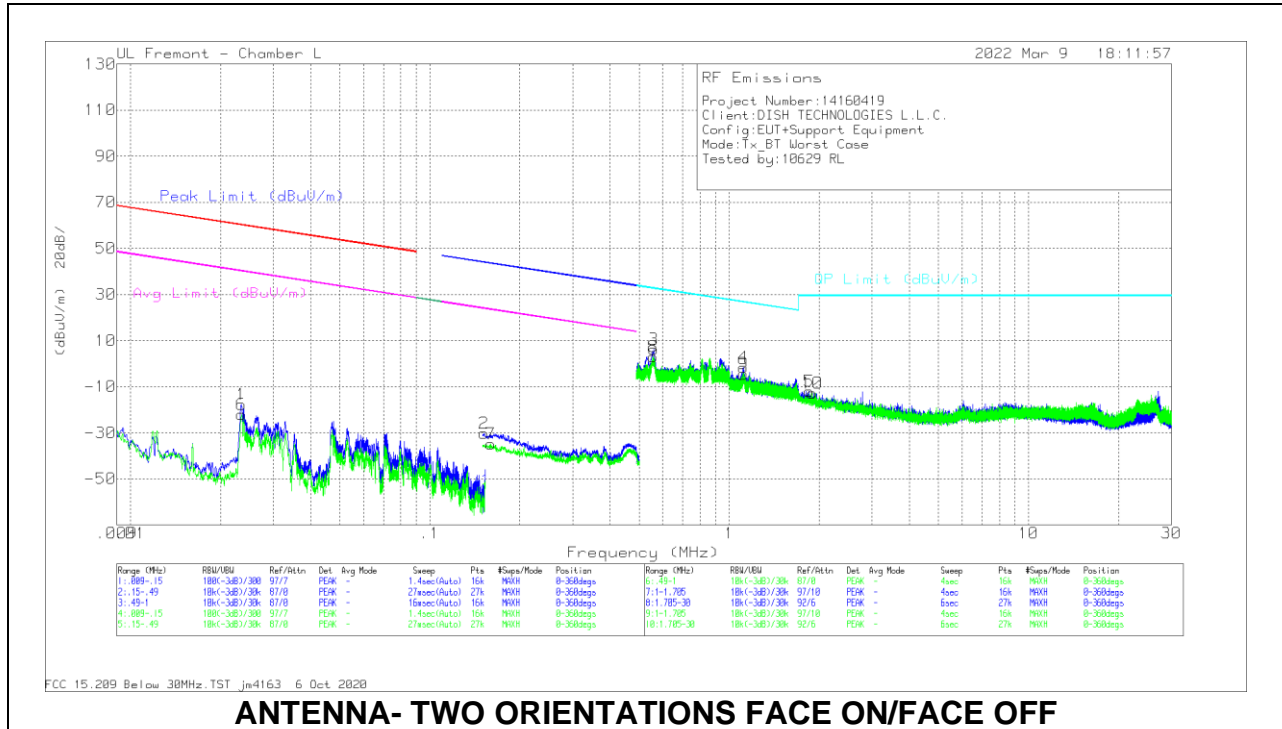
**RADIATED EMISSIONS**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.306619	46.41	PKFH	32.5	-26.5	52.41	-	-	-	-	182	102	H
	3.306619	43.48	VA1T	32.5	-26.5	49.48	-	-	-	-	182	102	H
2	* 4.960095	39.62	PKFH	34.2	-23.2	50.62	-	-	74	-23.38	246	101	H
	* 4.959925	29.69	VA1T	34.2	-23.2	40.69	54	-13.31	-	-	246	101	H
3	9.919874	32.85	PKFH	37.1	-16.5	53.45	-	-	-	-	321	112	H
	9.919904	21.32	VA1T	37.1	-16.5	41.92	-	-	-	-	321	112	H
4	3.306569	43.97	PKFH	32.5	-26.5	49.97	-	-	-	-	246	102	V
	3.306649	39.86	VA1T	32.5	-26.5	45.86	-	-	-	-	246	102	V
5	* 4.95976	42.42	PKFH	34.2	-23.2	53.42	-	-	74	-20.58	33	113	V
	* 4.95994	32.66	VA1T	34.2	-23.2	43.66	54	-10.34	-	-	33	113	V
6	9.919928	35.45	PKFH	37.1	-16.5	56.05	-	-	-	-	114	101	V
	9.919898	26.62	VA1T	37.1	-16.5	47.22	-	-	-	-	114	101	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak  
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## 10.2. 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)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.0234	34.8	Pk	58.7	-31.3	-80	-17.8	60.19	-77.99	40.19	-57.99	0-360
2	.1518	25.7	Pk	56	-32	-80	-30.3	44	-74.3	24	-54.3	0-360
6	.0235	30.48	Pk	58.7	-31.3	-80	-22.12	60.17	-82.29	40.17	-62.29	0-360
7	.1597	21.17	Pk	56	-32	-80	-34.83	43.56	-78.39	23.56	-58.39	0-360

Pk - Peak detector

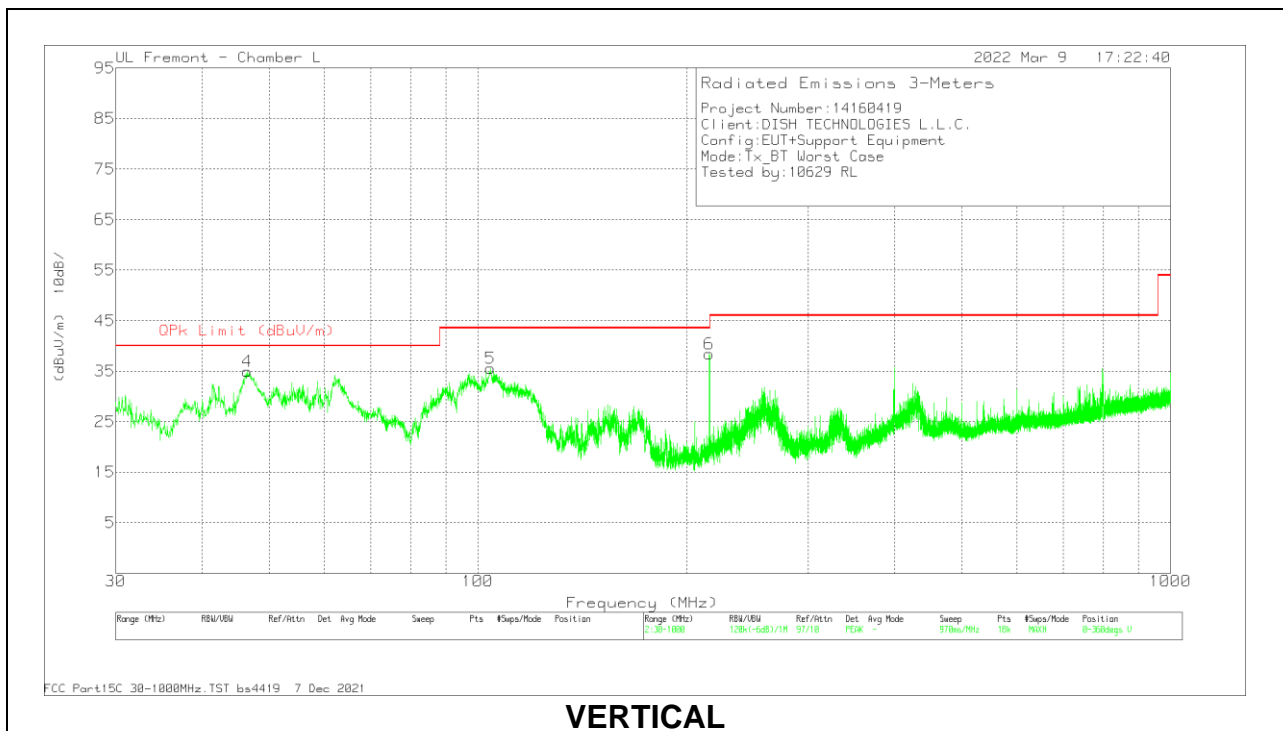
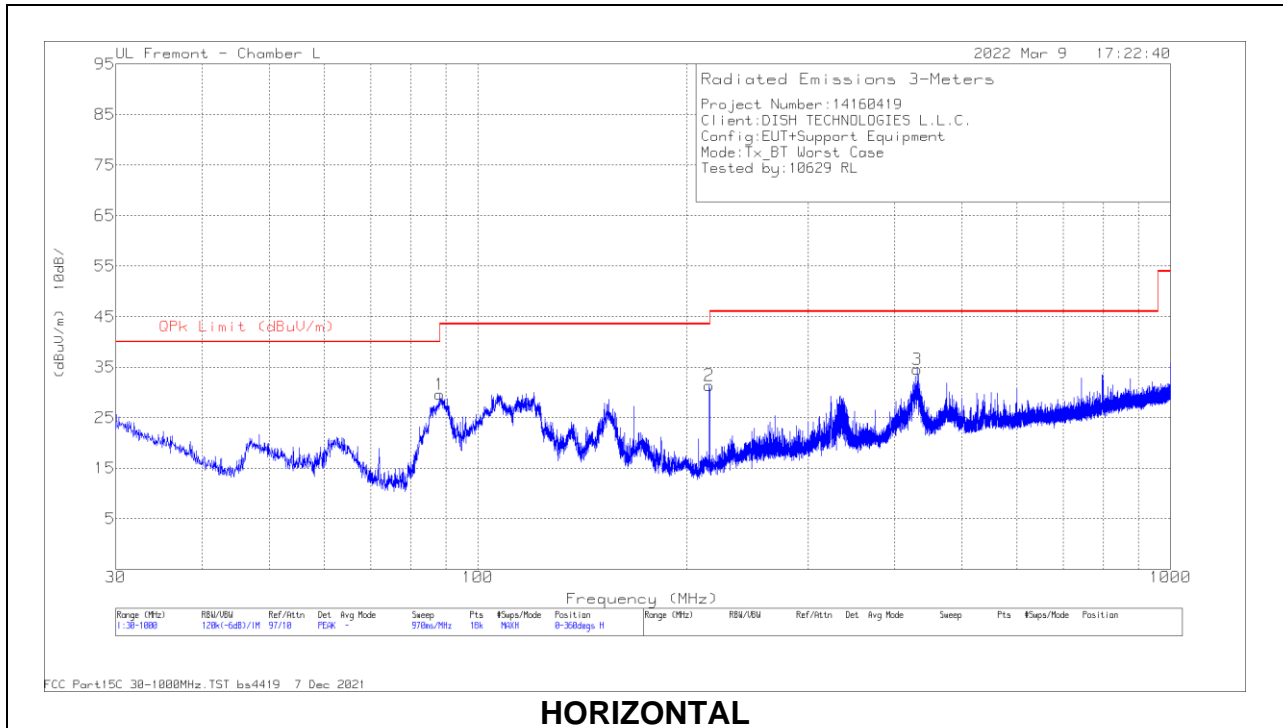
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuV/m)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	.5595	21.93	Pk	56.2	-31.9	-40	6.23	32.65	-26.42	0-360
8	.5567	18.58	Pk	56.2	-31.9	-40	2.88	32.69	-29.81	0-360
4	1.1159	23.97	Pk	46.3	-31.9	-40	-1.63	26.67	-28.3	0-360
5	1.8507	17.63	Pk	42.4	-31.9	-40	-11.87	29.5	-41.37	0-360
9	1.1158	21.11	Pk	46.3	-31.9	-40	-4.49	26.67	-31.16	0-360
10	1.8968	17.07	Pk	42.1	-31.9	-40	-12.73	29.5	-42.23	0-360

Pk - Peak detector



### 10.3. WORST CASE BELOW 1 GHZ

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



**Below 1GHz Data**

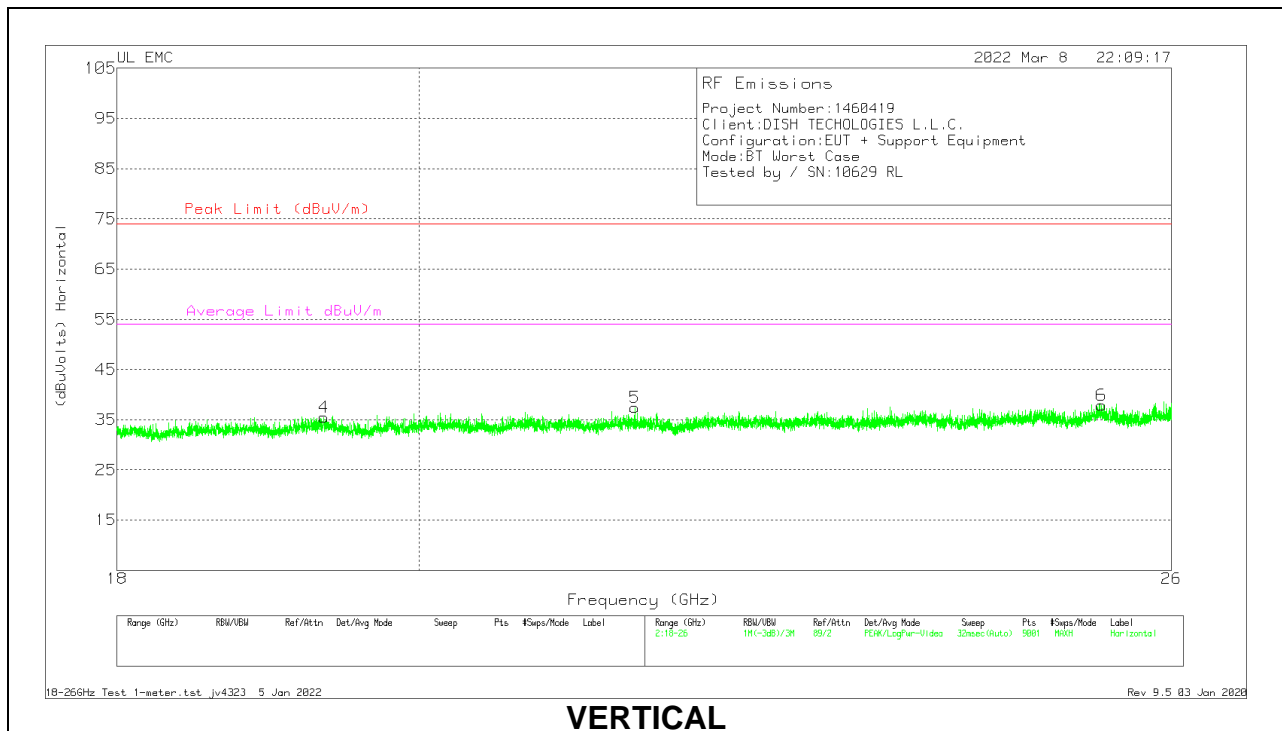
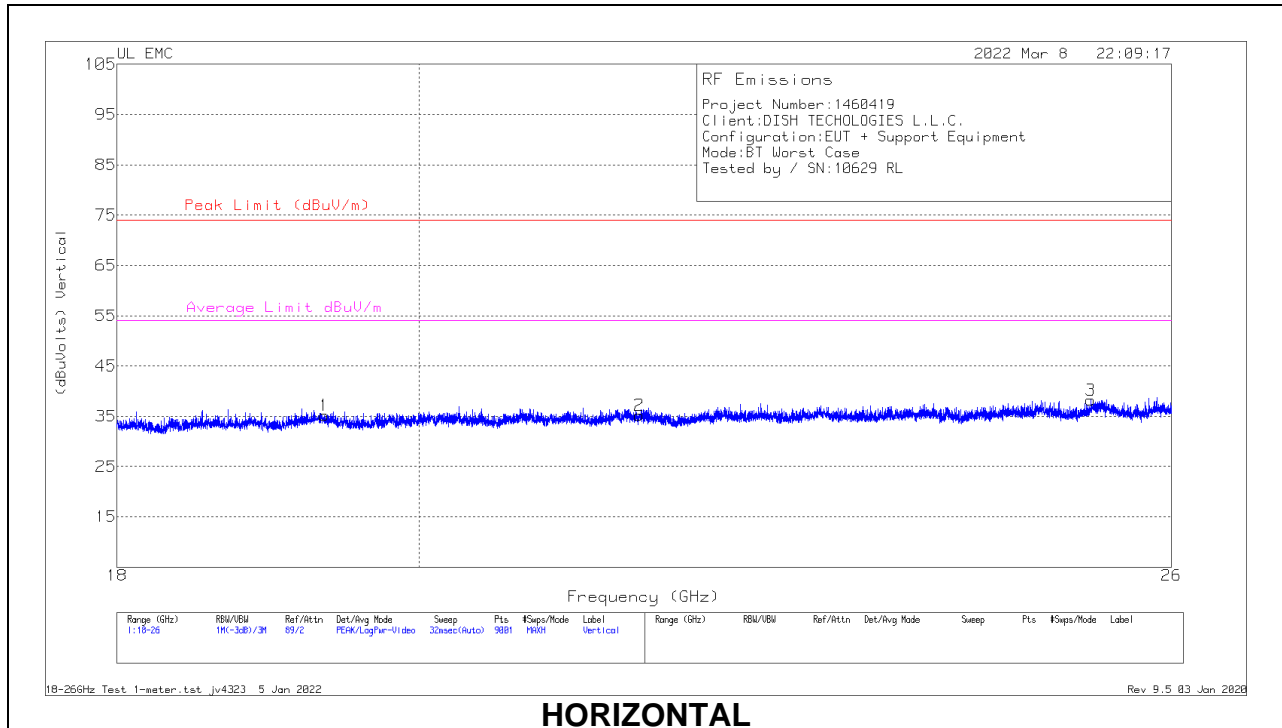
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	171862 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	88.0385	47.25	Pk	13.2	-30.8	29.65	43.52	-13.87	0-360	199	H
2	215.971	45	Pk	16.4	-30	31.4	43.52	-12.12	0-360	101	H
3	430.988	41.26	Pk	22.3	-29	34.56	46.02	-11.46	0-360	101	H
4	47.1244	53.29	Pk	14.9	-31.2	36.99	40	-3.01	178	103	V
	47.1244	48.19	Qp	14.9	-31.2	31.89	40	-8.11	178	103	V
5	104.313	48.82	Pk	17.4	-30.7	35.52	43.52	-8	0-360	101	V
6	215.996	52.84	Pk	16.4	-30	39.24	43.52	-4.28	151	103	V
	215.996	51.57	Qp	16.4	-30	37.97	43.52	-5.55	151	103	V

Pk - Peak detector

Qp - Quasi-Peak detector

### 10.4. WORST CASE 18-26 GHZ

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



**18 – 26GHz Data**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 81139 (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	PK Margin (dB)	Average Limit dBuV/m	Margin (dB)
1	19.34933	68.29	Pk	33.5	-57.1	-9.5	35.19	74	-38.81	54	-18.81
2	21.59467	68.12	Pk	33.9	-57.3	-9.5	35.22	74	-38.78	54	-18.78
3	25.27822	68.12	Pk	35	-55.4	-9.5	38.22	74	-35.78	54	-15.78
4	19.34667	68.56	Pk	33.5	-57.1	-9.5	35.46	74	-38.54	54	-18.54
5	21.56178	70.21	Pk	33.9	-57.2	-9.5	37.41	74	-36.59	54	-16.59
6	25.37333	67.58	Pk	35	-55.2	-9.5	37.88	74	-36.12	54	-16.12

Pk - Peak detector

## 11. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dB $\mu$ V)	
	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

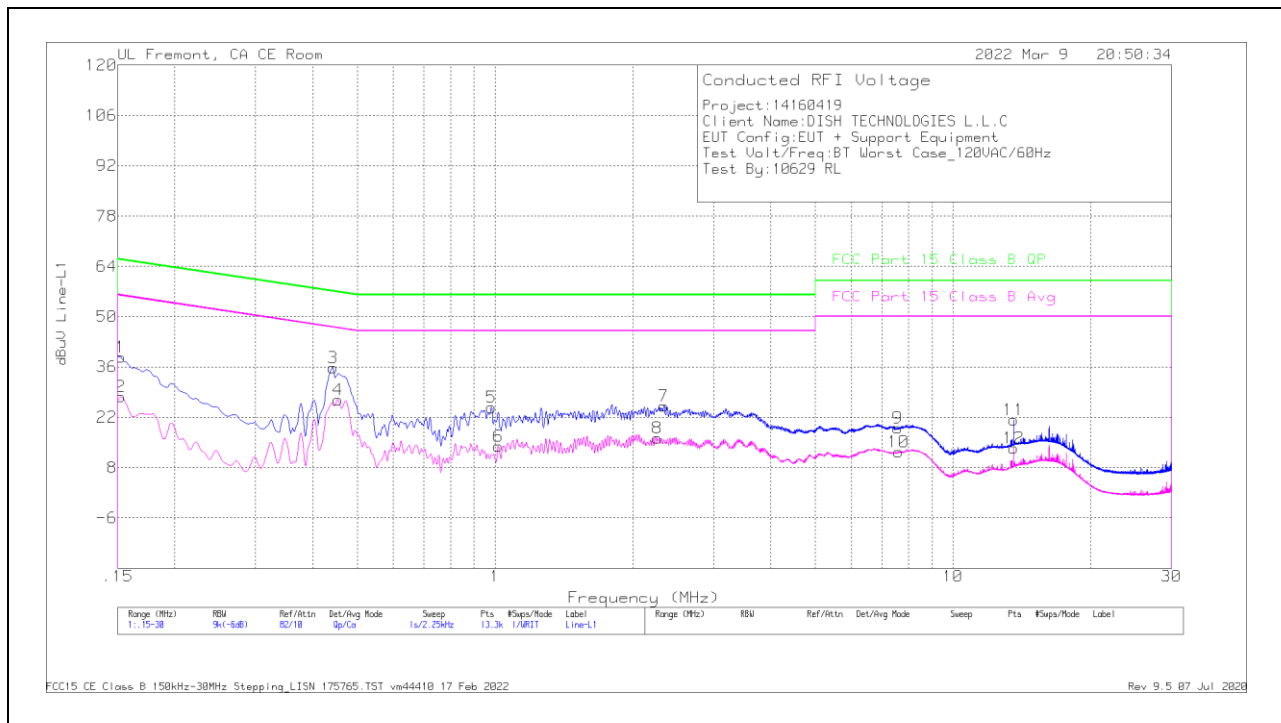
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

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

### LINE 1 RESULTS

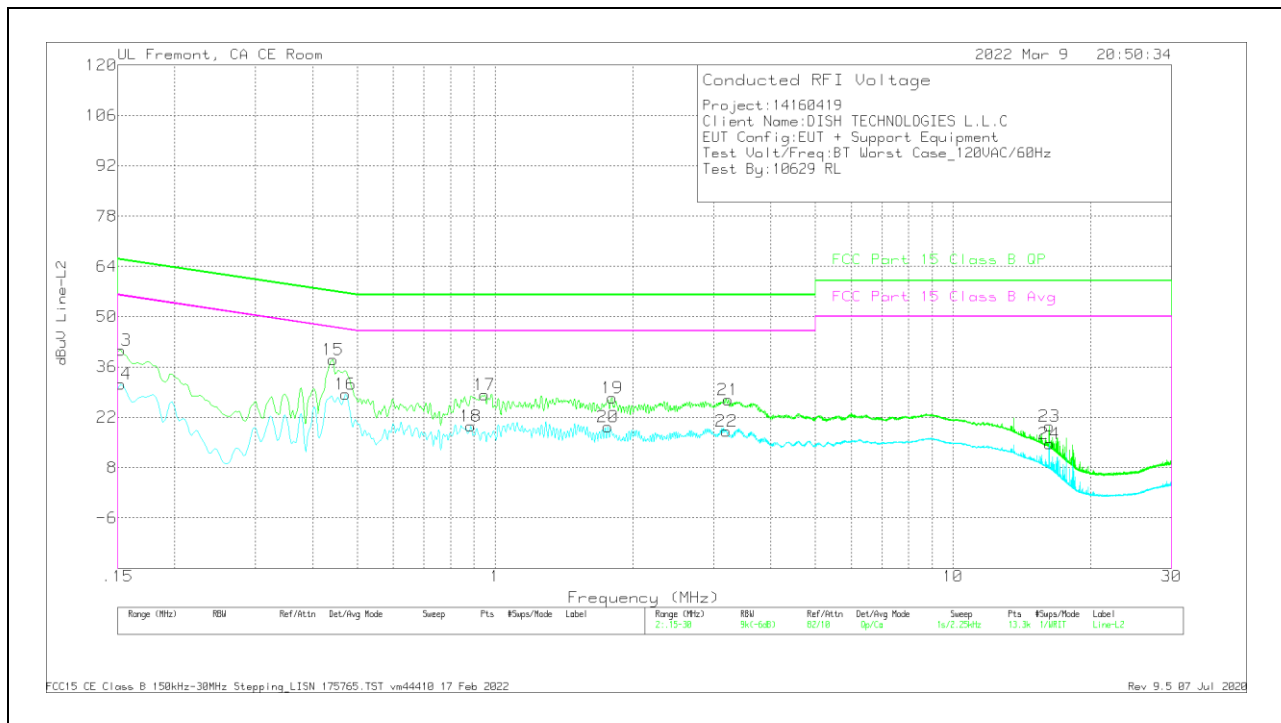


Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	175765 LISN L1	C1&C3 cable	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	FCC Part 15 Class B QP	QP Margin (dB)	FCC Part 15 Class B Avg	Av(CISPR)Margin (dB)
2	.15225	18.29	Ca	.1	0	9.4	27.79	-	-	55.88	-28.09
4	.45375	17.56	Ca	0	0	9.3	26.86	-	-	46.81	-19.95
6	1.01625	4.51	Ca	0	.1	9.3	13.91	-	-	46	-32.09
8	2.2605	6.83	Ca	0	.1	9.3	16.23	-	-	46	-29.77
10	7.593	3.03	Ca	0	.1	9.3	12.43	-	-	50	-37.57
12	13.56	3.89	Ca	.1	.2	9.3	13.49	-	-	50	-36.51
1	.15225	29.29	Qp	.1	0	9.4	38.79	65.88	-27.09	-	-
3	.4425	26.53	Qp	0	0	9.3	35.83	57.01	-21.18	-	-
5	.9825	15.3	Qp	0	.1	9.3	24.7	56	-31.3	-	-
7	2.337	15.77	Qp	0	.1	9.3	25.17	56	-30.83	-	-
9	7.58625	9.59	Qp	0	.1	9.3	18.99	60	-41.01	-	-
11	13.56	11.62	Qp	.1	.2	9.3	21.22	60	-38.78	-	-

Qp - Quasi-Peak detector  
 Ca - CISPR average detection

### LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	175765 LISN L2	C2&C3 cable	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	FCC Part 15 Class B QP	QP Margin (dB)	FCC Part 15 Class B Avg	Av(CISPR)Margin (dB)
14	.15225	21.82	Ca	.1	0	9.4	31.32	-	-	55.88	-24.56
16	.47175	19.17	Ca	0	0	9.3	28.47	-	-	46.48	-18.01
18	.88575	10.12	Ca	0	.1	9.3	19.52	-	-	46	-26.48
20	1.7655	10.02	Ca	0	.1	9.3	19.42	-	-	46	-26.58
22	3.20325	8.71	Ca	0	.1	9.3	18.11	-	-	46	-27.89
24	16.2285	5	Ca	.1	.2	9.3	14.6	-	-	50	-35.4
13	.15225	31.14	Qp	.1	0	9.4	40.64	65.88	-25.24	-	-
15	.4425	28.78	Qp	0	0	9.3	38.08	57.01	-18.93	-	-
17	.94875	18.82	Qp	0	.1	9.3	28.22	56	-27.78	-	-
19	1.8015	18.04	Qp	0	.1	9.3	27.44	56	-28.56	-	-
21	3.2325	17.46	Qp	0	.1	9.3	26.86	56	-29.14	-	-
23	16.2285	9.93	Qp	.1	.2	9.3	19.53	60	-40.47	-	-

Qp - Quasi-Peak detector  
 Ca - CISPR average detection