

# TEST REPORT

**Report Number. :** 14571599-E2V1

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

**Model :** D25

**Brand :** DISH

**FCC ID :** DKNHRT4

**EUT Description :** WHOLE HOME DVR ACCESSORY

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

**Date Of Issue:**  
2023-01-27

**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	2023-01-27	Initial Issue	---

## TABLE OF CONTENTS

<b>REPORT REVISION HISTORY .....</b>	<b>2</b>
<b>TABLE OF CONTENTS .....</b>	<b>3</b>
<b>1. ATTESTATION OF TEST RESULTS .....</b>	<b>5</b>
<b>2. TEST RESULTS SUMMARY .....</b>	<b>7</b>
<b>3. TEST METHODOLOGY .....</b>	<b>7</b>
<b>4. FACILITIES AND ACCREDITATION .....</b>	<b>7</b>
<b>5. DECISION RULES AND MEASUREMENT UNCERTAINTY .....</b>	<b>8</b>
5.1. METROLOGICAL TRACEABILITY .....	8
5.2. DECISION RULES.....	8
5.3. MEASUREMENT UNCERTAINTY.....	8
5.4. SAMPLE CALCULATION .....	9
<b>6. EQUIPMENT UNDER TEST .....</b>	<b>10</b>
6.1. EUT DESCRIPTION .....	10
6.2. MAXIMUM OUTPUT POWER.....	10
6.3. DESCRIPTION OF AVAILABLE ANTENNAS .....	10
6.4. SOFTWARE AND FIRMWARE.....	10
6.5. WORST-CASE CONFIGURATION AND MODE.....	10
6.6. DESCRIPTION OF TEST SETUP.....	11
<b>7. TEST AND MEASUREMENT EQUIPMENT .....</b>	<b>14</b>
<b>8. MEASUREMENT METHODS .....</b>	<b>15</b>
<b>9. ANTENNA PORT TEST RESULTS .....</b>	<b>16</b>
9.1. ON TIME AND DUTY CYCLE.....	16
9.2. 20 dB BANDWIDTH.....	17
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION .....	17
9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	18
9.3. HOPPING FREQUENCY SEPARATION .....	19
9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION .....	20
9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	21
9.4. NUMBER OF HOPPING CHANNELS.....	22
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION .....	23
9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	25
9.5. AVERAGE TIME OF OCCUPANCY.....	27

---

9.5.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION .....	27
9.5.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	29
9.6.	<i>OUTPUT POWER</i> .....	31
9.6.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION .....	31
9.6.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	32
9.6.3.	BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION .....	32
9.7.	<i>AVERAGE POWER</i> .....	33
9.7.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION .....	33
9.7.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	33
9.7.3.	BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION .....	34
9.8.	<i>CONDUCTED SPURIOUS EMISSIONS</i> .....	35
9.8.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION .....	36
9.8.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	38
<b>10.</b>	<b>RADIATED TEST RESULTS .....</b>	<b>40</b>
10.1.	<i>TRANSMITTER ABOVE 1 GHz</i> .....	42
10.1.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION.....	42
10.1.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION .....	52
10.2.	<i>WORST CASE BELOW 30MHZ</i> .....	62
10.3.	<i>WORST CASE BELOW 1 GHZ</i> .....	64
10.4.	<i>WORST CASE 18-26 GHZ</i> .....	66
<b>11.</b>	<b>AC POWER LINE CONDUCTED EMISSIONS .....</b>	<b>68</b>
<b>12.</b>	<b>SETUP PHOTOS .....</b>	<b>71</b>

# 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** WHOLE HOME DVR ACCESSORY

**MODEL:** D25

**BRAND:** DISH

**SERIAL NUMBER:** CONDUCTED: R525010J20027L  
RADIATED: R525010J20020L

**SAMPLE RECEIPT DATE:** 2023-01-12

**DATE TESTED:** 2023-01-13 TO 2023-01-20


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.

Approved & Released For  
UL Verification Services Inc. By:



---

Staff Engineer  
Consumer Technology Division  
UL Verification Services Inc.

Prepared By:



---

Glenn Escano  
Senior Test Engineer  
Consumer Technology Division  
UL Verification Services Inc.

Reviewed By:



---

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 v05r02, 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 checked="" 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	2324A	550739
<input checked="" type="checkbox"/>	Building 4: 47658 Kato Rd, Fremont, CA 94538	US0104	2324A	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>
Radio Frequency (Spectrum Analyzer)	141.16 Hz
Occupied Bandwidth	1.22%
Power Spectral Density	2.47 dB
RF Power Measurement Direct Method Using Power Meter	1.3 dB (PK) 0.45 dB (AV)
Unwanted Emissions, conducted	1.94 dB
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
Time Domain Measurements	3.39 %

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



---

## 5.4. 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

## 6. EQUIPMENT UNDER TEST

### 6.1. EUT DESCRIPTION

The EUT is a Whole Home DVR Accessory with BLE and BT 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	9.41	8.73
	Enhanced 8PSK	9.58	9.08
	Enhanced DQPSK	9.02	7.98

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 9.7.

### 6.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

The radio utilizes an PCB Inverted F antenna, with a maximum gain of 4.92 dBi.

### 6.4. SOFTWARE AND FIRMWARE

The EUT software/ firmware installed during testing was Anker C.

The test utility software used during testing was RTLBTAPP.

### 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.

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

GFSK mode: DH5

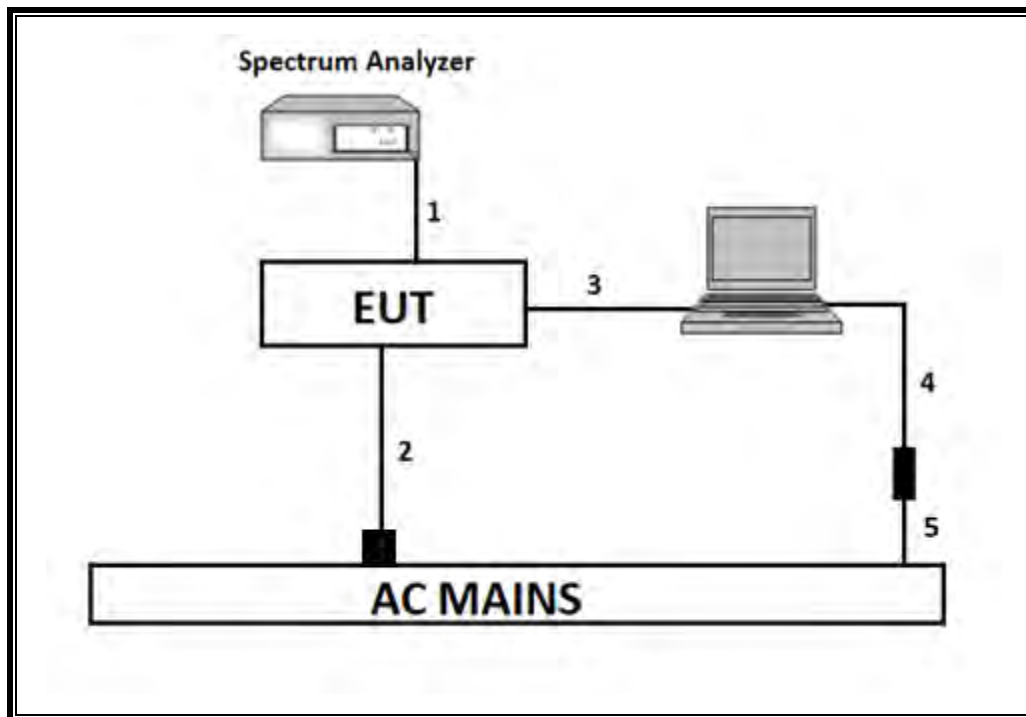
8PSK mode: 3-DH5

## 6.6. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC		
Laptop	HP	EliteBook 8470P	N/A	DoC		
AC/DC Adapter	HP	N/A	N/A	DoC		
USB to UART cable	N/A	N/A	N/A	DoC		
AC/DC Adapter	LITEON	PB-1180-6ES1	ETC2007008933	DoC		
TV Emulator	DISH	TV Emulator	D52-12	DoC		
USB Flash Drive	SanDisk	32 GB	BM200126825Z	DoC		
I/O CABLES (CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	RF	Un-shielded	0.2	To spectrum analyzer
2	DC	1	Barrel	Un-shielded	1.8	EUT to AC/DC adapter Mains
3	UART	1	USB	Un-shielded	2.1	USB adapter to laptop
4	DC	1	AC	Un-shielded	1.7	
5	AC	1	AC	Un-shielded	1.8	
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	1.8	EUT to AC/DC adapter Mains
2	HDMI	1	HDMI	shielded	2.5	EUT to Emulator

**SETUP DIAGRAMS**

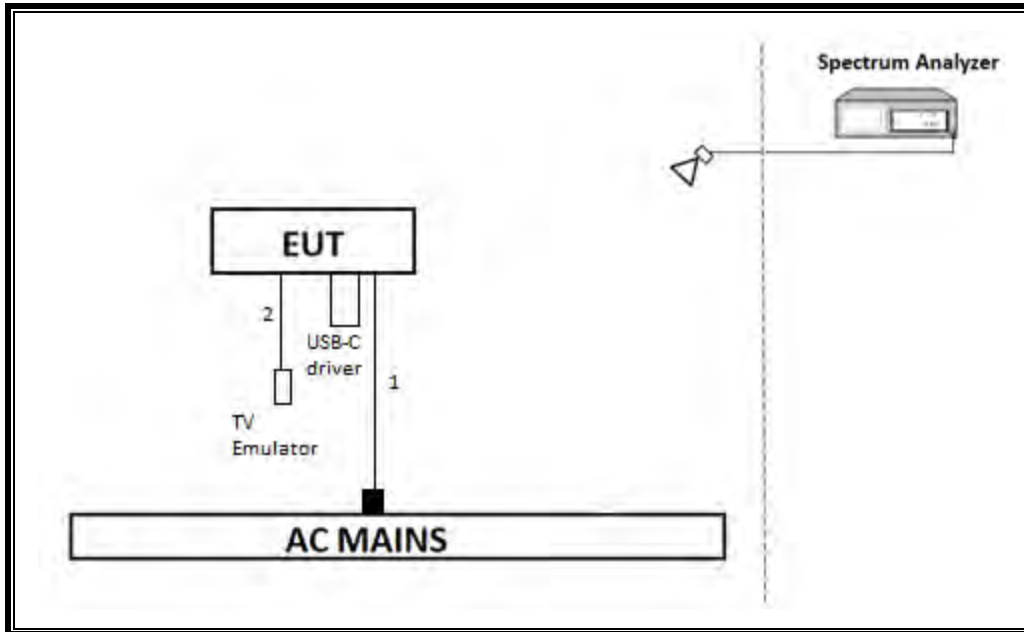
**CONDUCTED TEST SETUP DIAGRAM**



**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 support equipment and AC powered. Test software exercised the radio card, laptop is removed during the test.

## 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, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB1	80293	2023-08-09	2022-08-09
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310N	29654	2023-04-24	2022-04-24
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	206806	2023-10-07	2022-10-07
RF Filter Box, 1-18GHz	FREMONT	SAC-L1	185686	2023-06-24	2022-06-24
EMI TEST RECEIVER, with B8 option	Rohde & Schwarz	ESW44	169937	2023-02-20	2022-02-20
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	169927	2023-02-16	2022-02-16
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	172364	2023-03-08	2022-03-08
Amplifier 18-26.5GHz, +5Vdc, 60dB min	AMPLICAL	AMP18G26.5-60	215705	2023-02-26	2022-02-26
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO METRICS	EM-6871	219909	2023-05-10	2022-05-10
Antenna, Passive Loop 100KHz - 30MHz	ELECTRO METRICS	EM-6872	219911	2023-05-10	2022-05-10
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent Technologies	N9030A	80396	2023-02-01	2022-02-01
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	T1268	2023-02-03	2022-02-03
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	90419	2023-03-02	2022-03-02
10dB Fixed Attenuator	Pasternack Enterprises	PE7087-10	178557	Verified/characterized before use	
AC Line Conducted					
LISN	Fischer Custom Communications, Inc	FCC-LISN-50/250-25-2-01-480V	175765	2023-01-25	2022-01-25
EMI TEST RECEIVER	Rohde & Schwarz	ESR	93091	2023-02-21	2022-02-21
Transient Limiter	Com-Power	TBFL1	207996	2023-07-15	2022-07-15
UL TEST SOFTWARE LIST					
Radiated Software	UL	UL EMC	Ver 2015-12-28, 2020-04-15, 2015-12-29, 2022-10-25, 2021-12-07, 2022-05-18		
Antenna Port Software	UL	UL RF	AP2022-08-16		
AC Line Conducted Software	UL	UL EMC	Rev 9.5, 2022-02-17		

---

## 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.

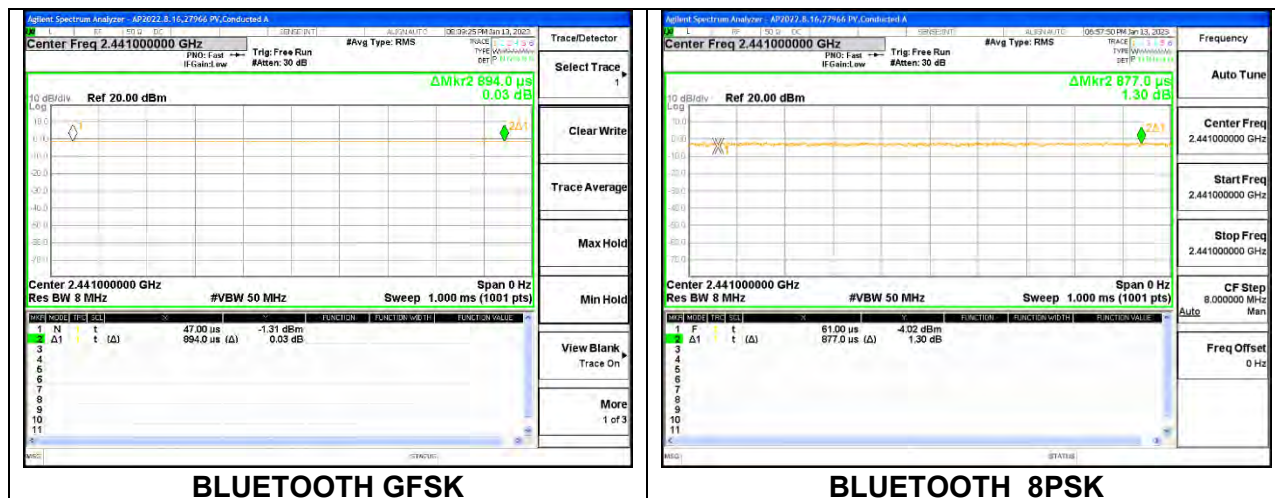
#### PROCEDURE

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	0.894	0.894	1.000	100.00	0.00	0.010
Bluetooth 8PSK	0.877	0.877	1.000	100.00	0.00	0.010

#### DUTY CYCLE PLOTS





## 9.2. 20 dB BANDWIDTH LIMITS

None; for reporting purposes only.

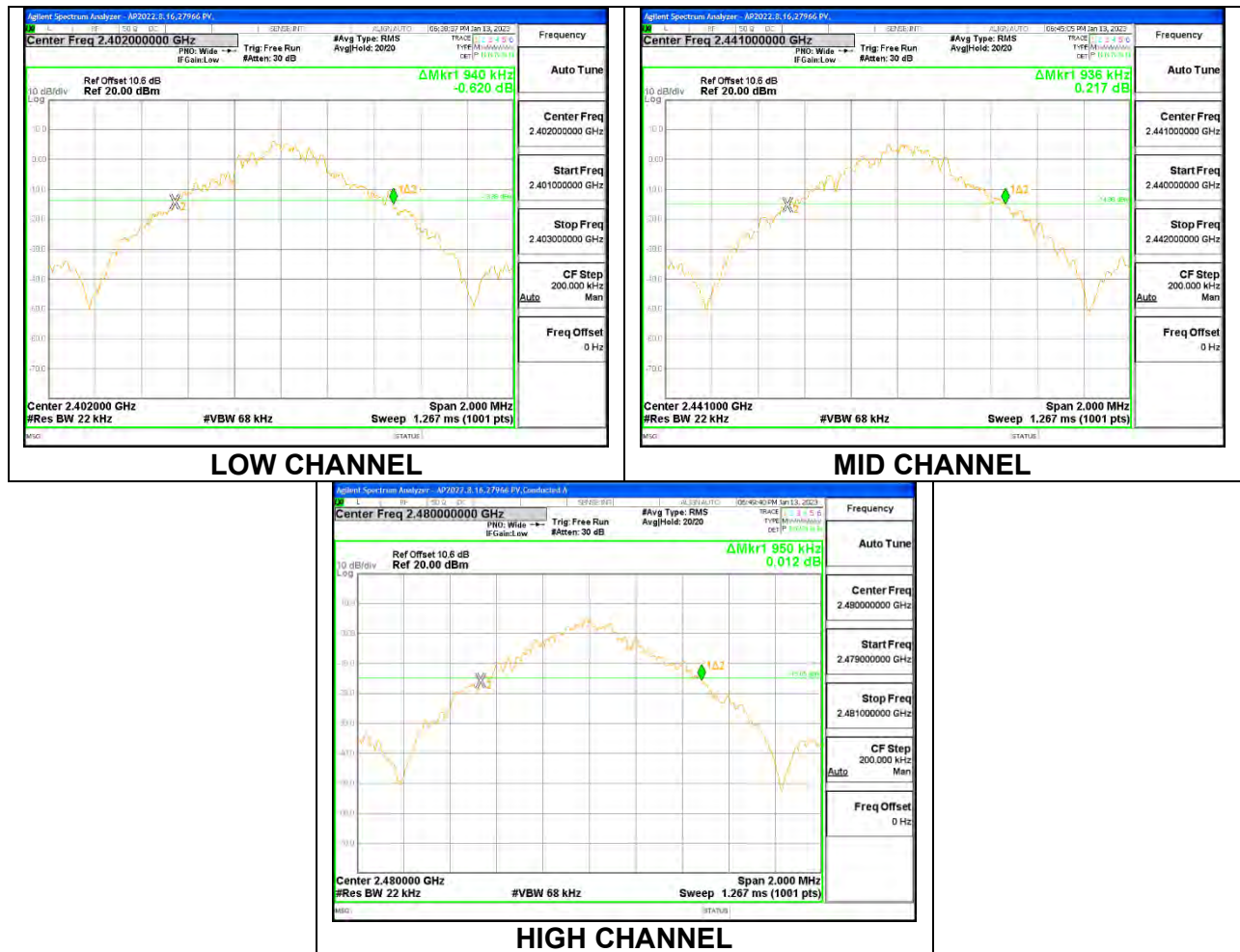
### TEST PROCEDURE

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

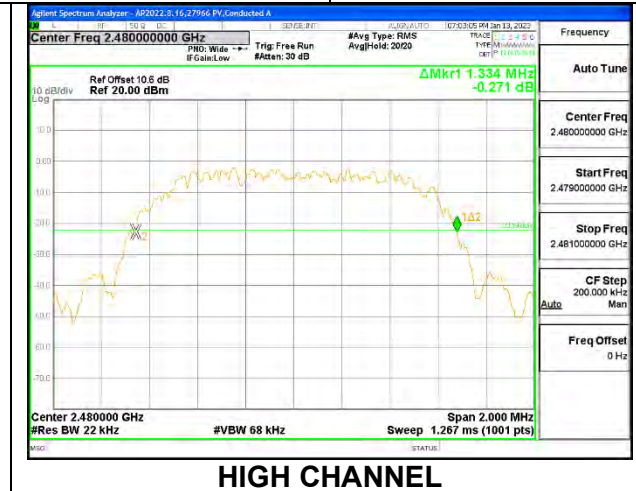
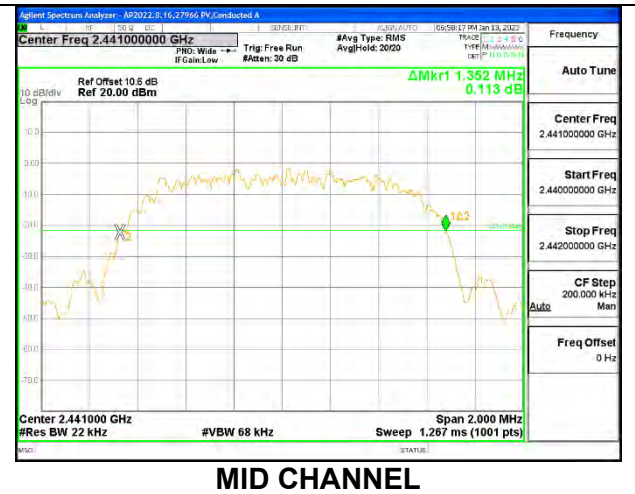
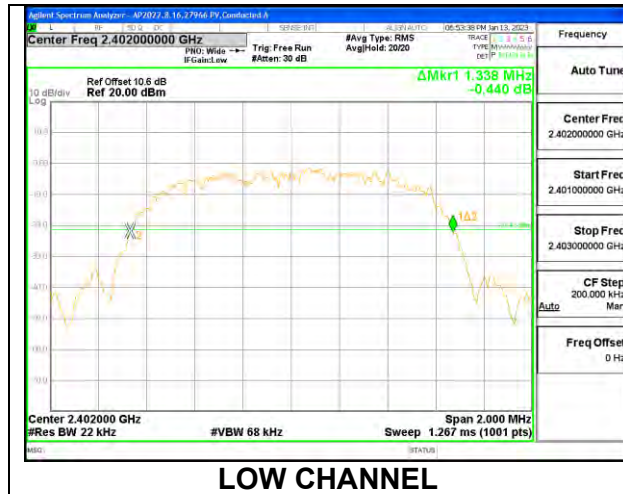
#### 9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	0.94
Mid	2441	0.936
High	2480	0.95



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

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	1.338
Mid	2441	1.352
High	2480	1.334



---

### **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.

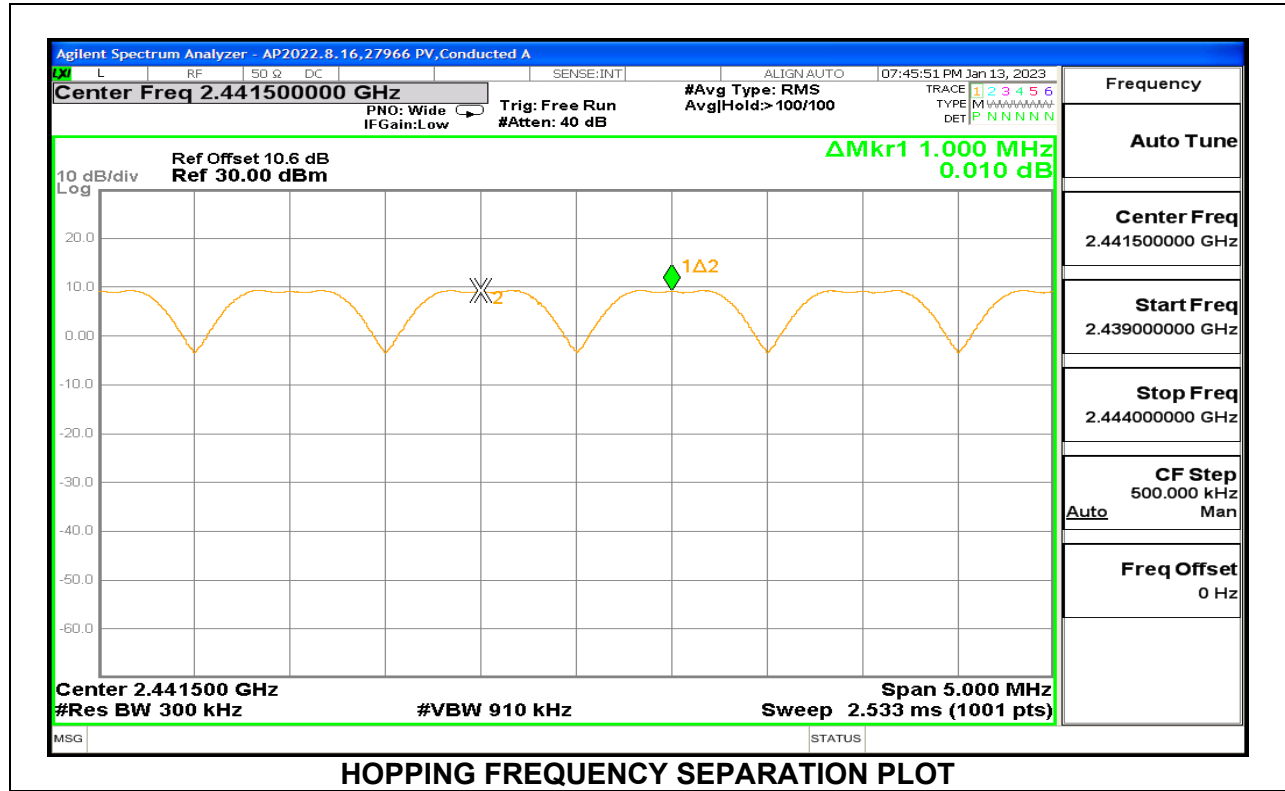
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

#### **TEST PROCEDURE**

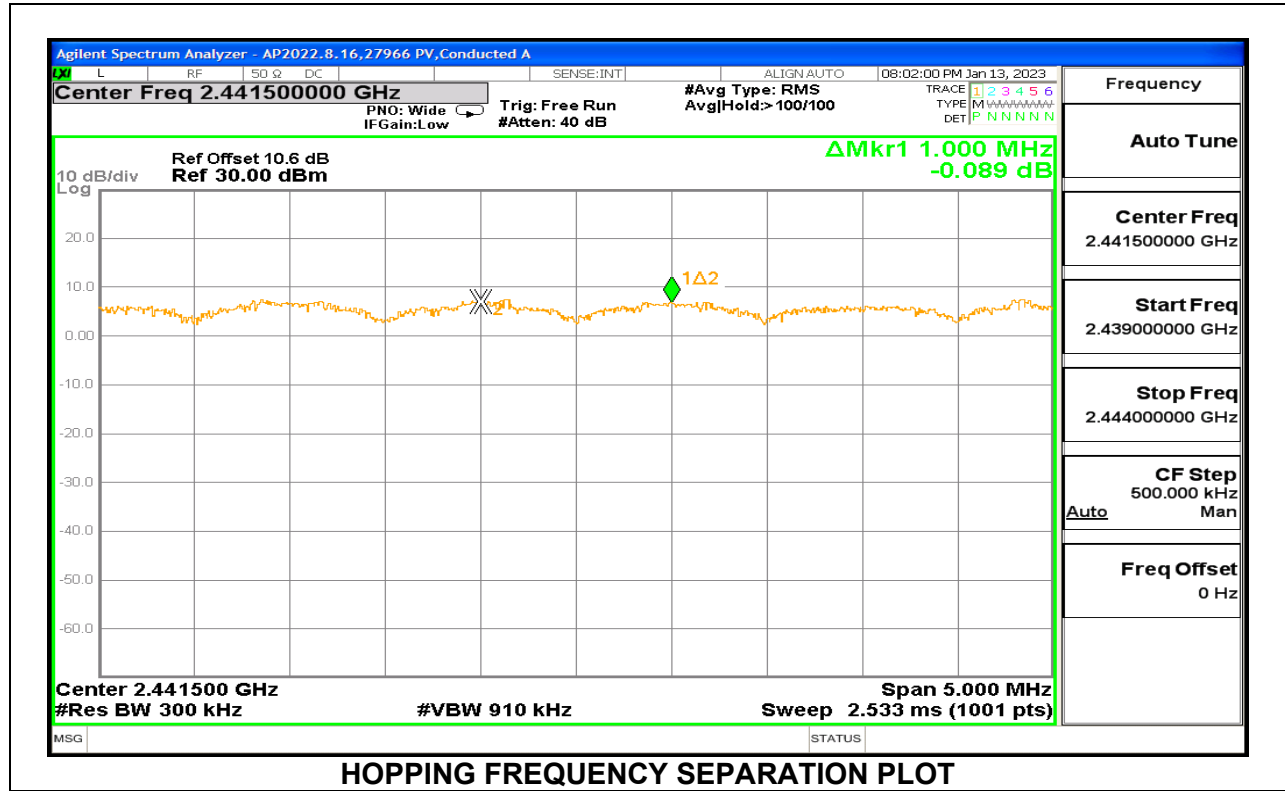
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to  $VBW \geq RBW$ . The sweep time is coupled.

#### **RESULTS**

### 9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



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



## **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.

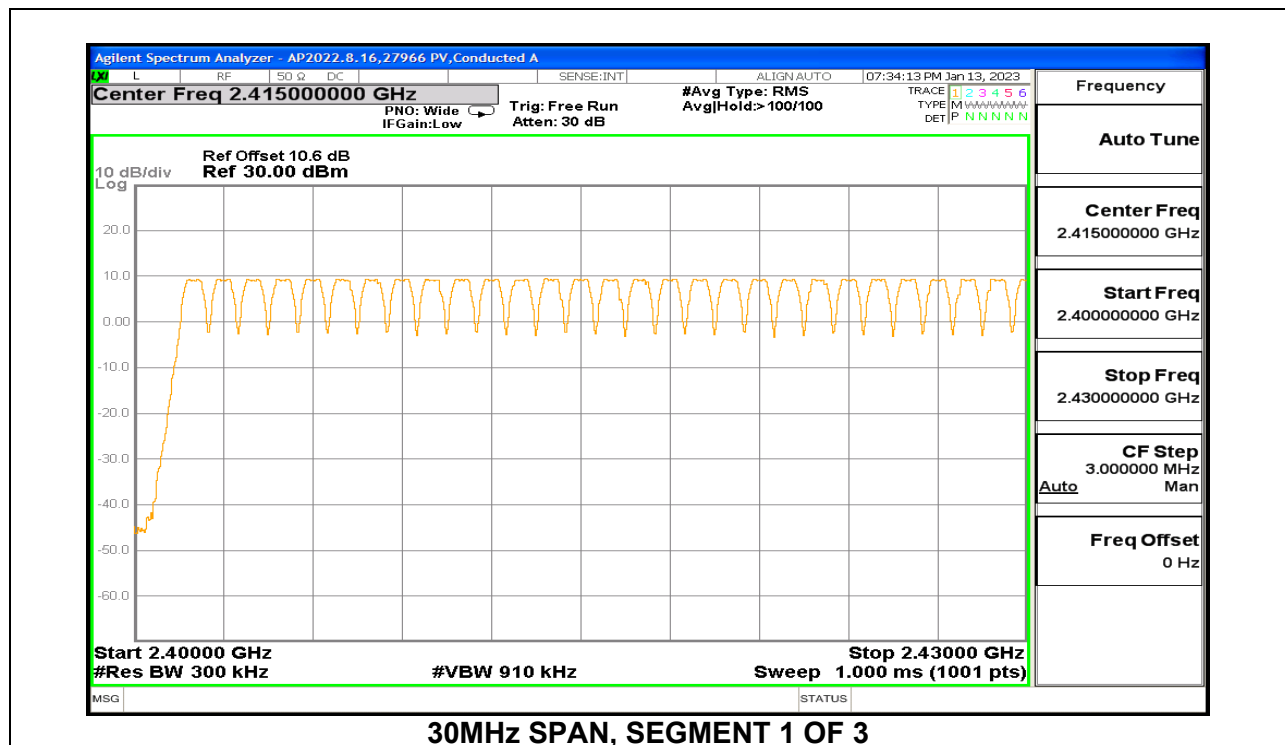
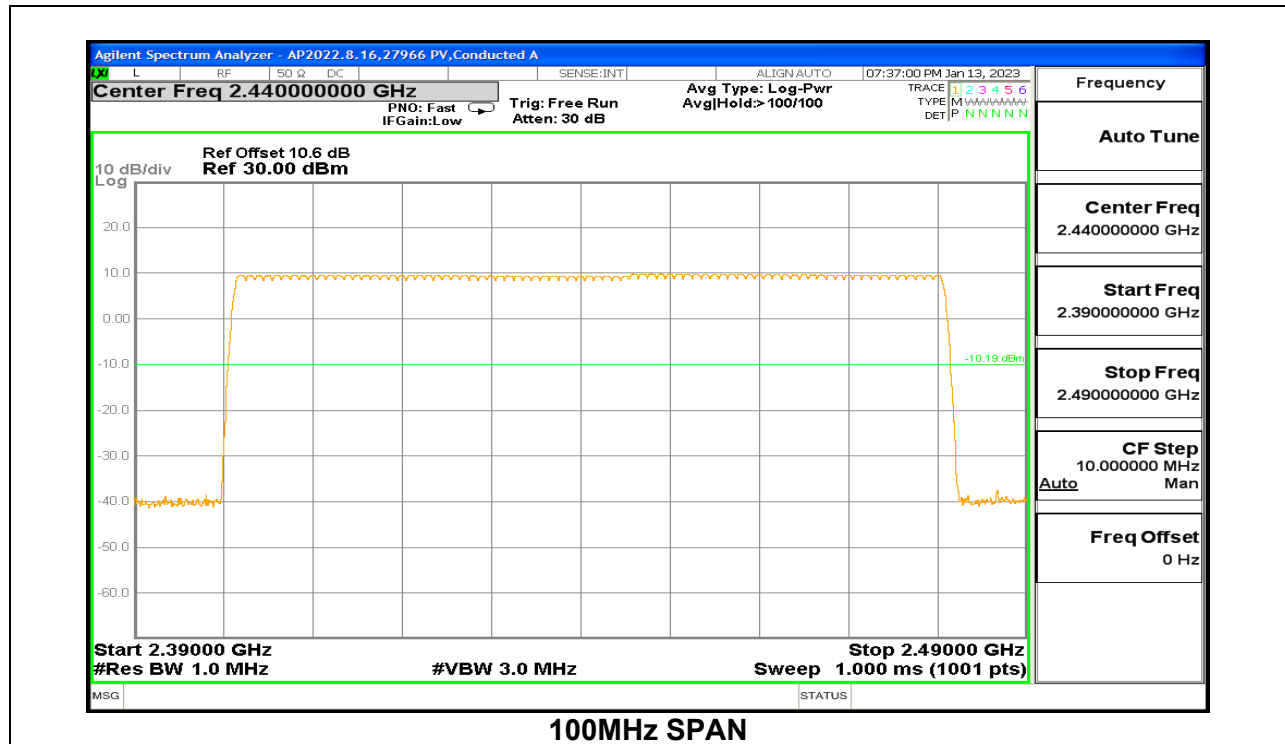
### **TEST PROCEDURE**

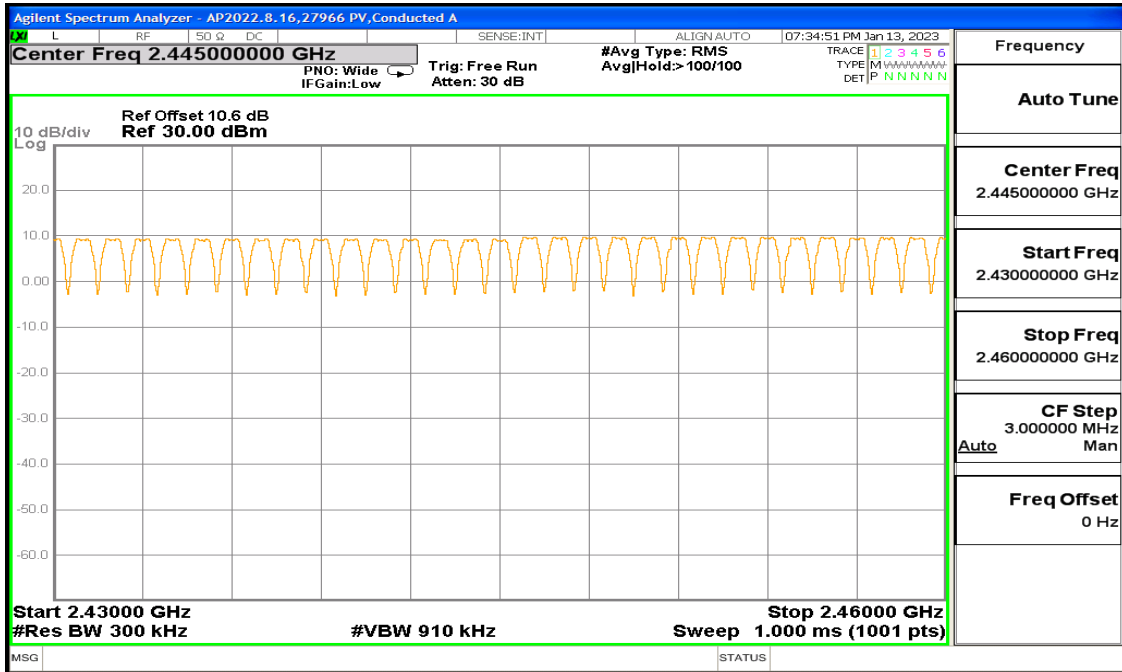
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

### **RESULTS**

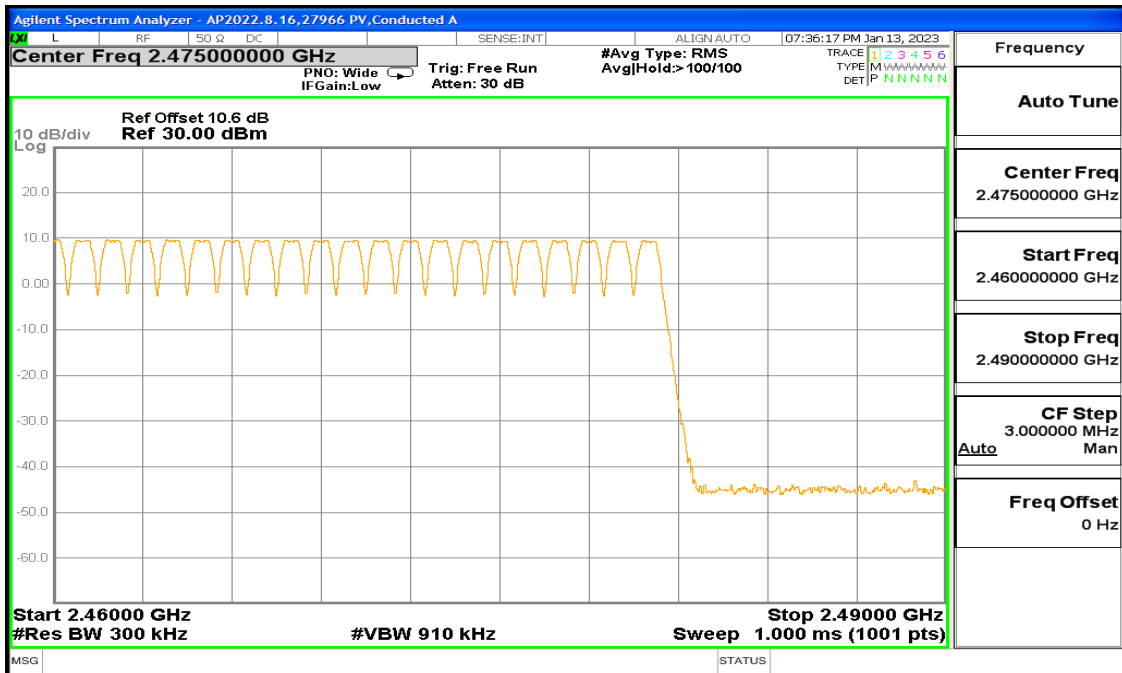
Normal Mode: 79 Channels Observed

### 9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION





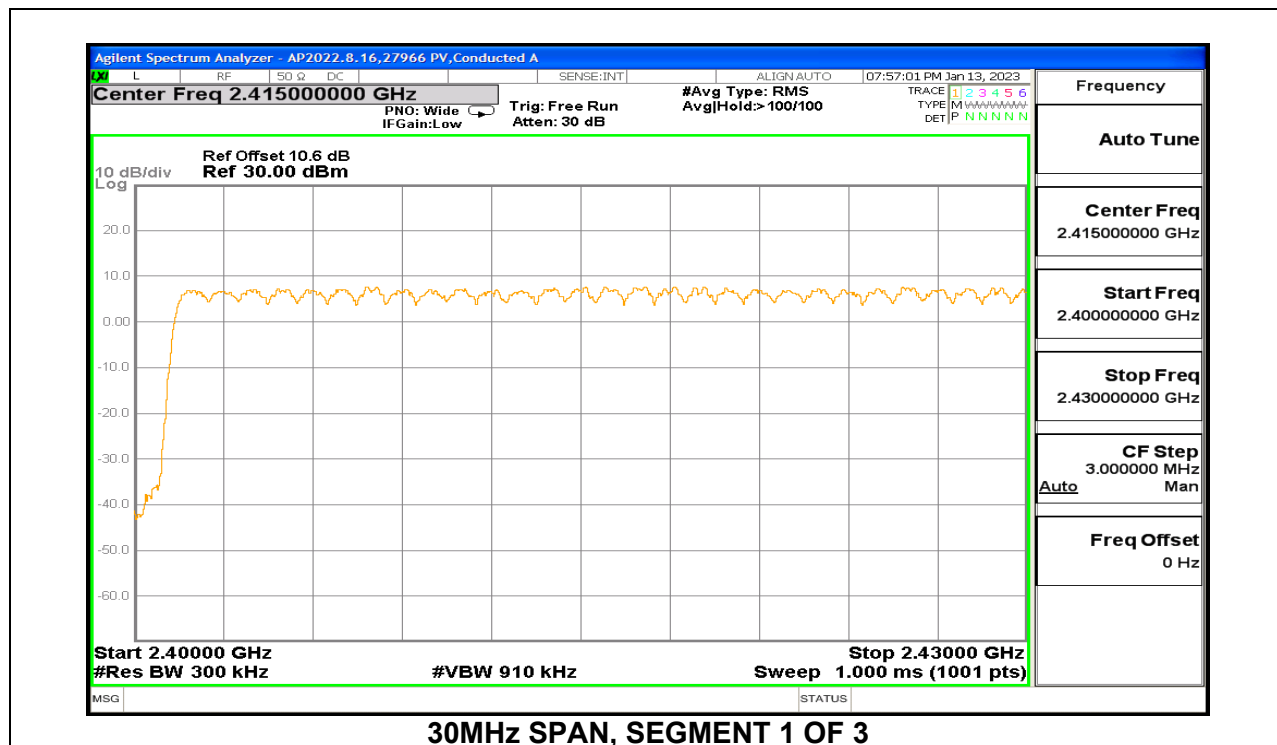
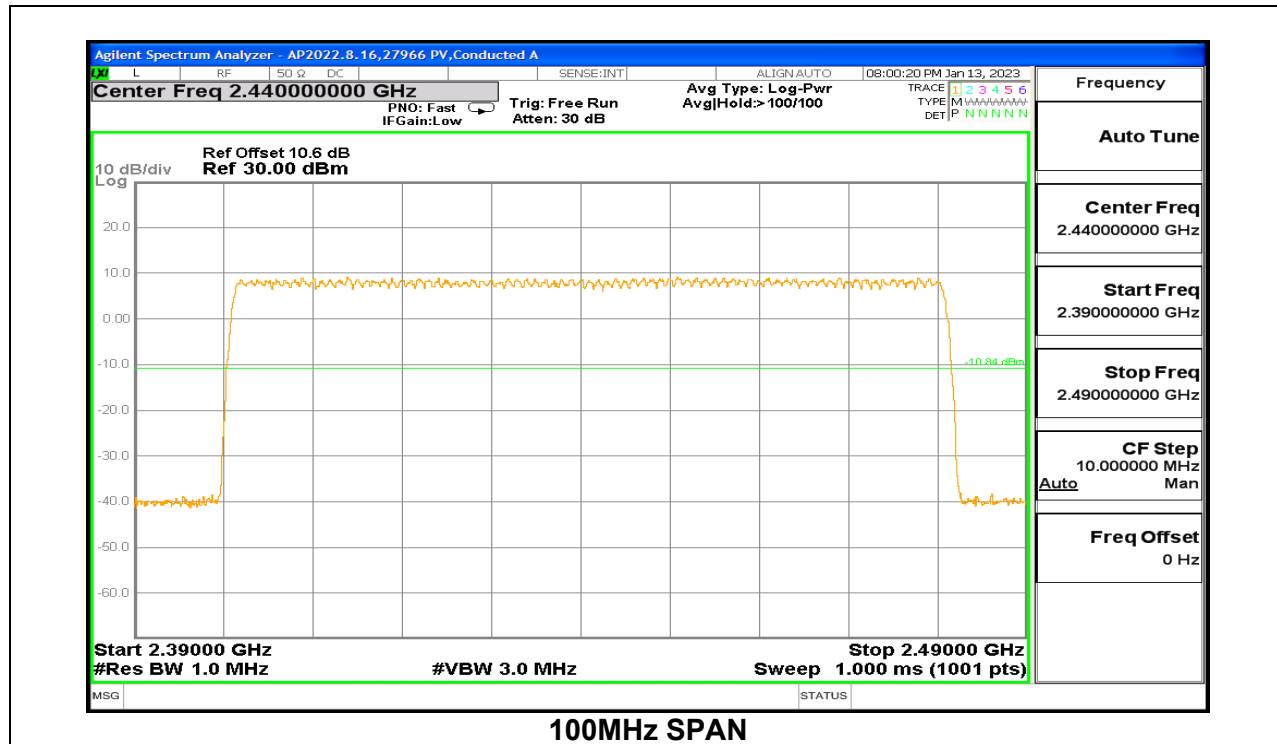
30MHz SPAN, SEGMENT 2 OF 3

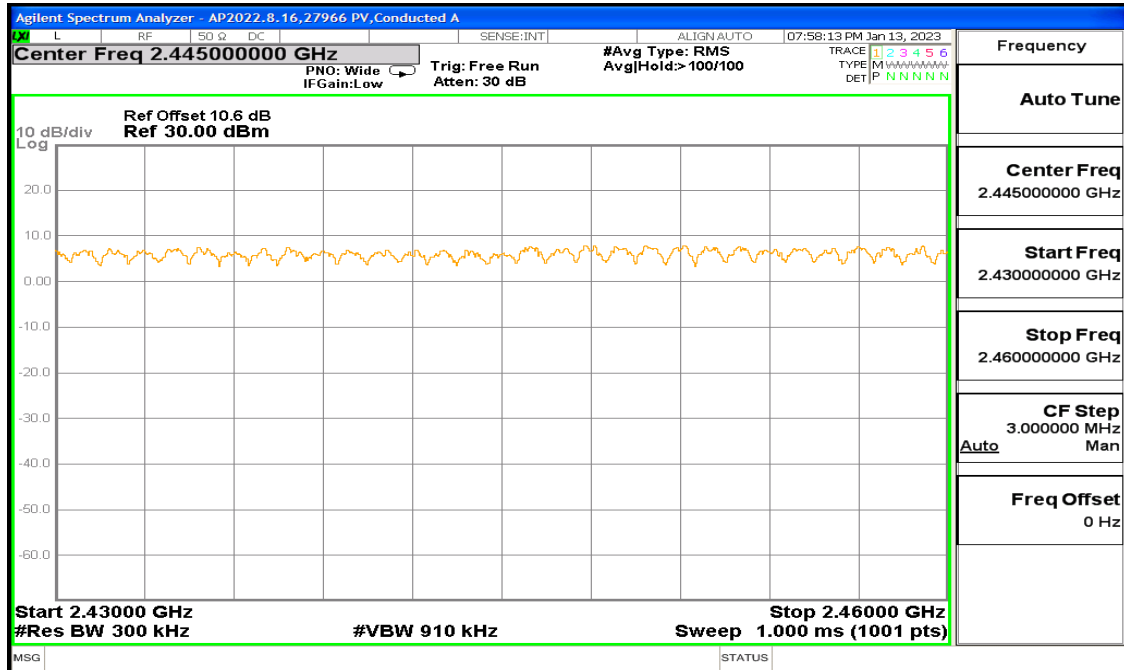


30MHz SPAN, SEGMENT 3 OF 3

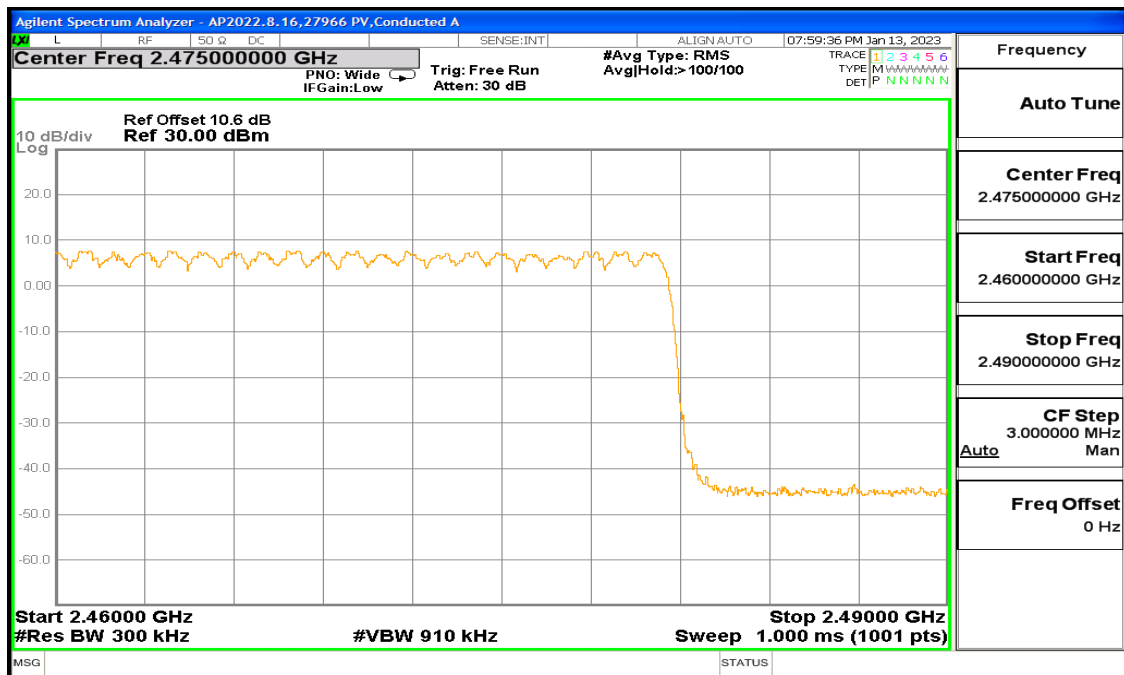


### 9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION





30MHz SPAN, SEGMENT 2 OF 3



30MHz SPAN, SEGMENT 3 OF 3

## 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.

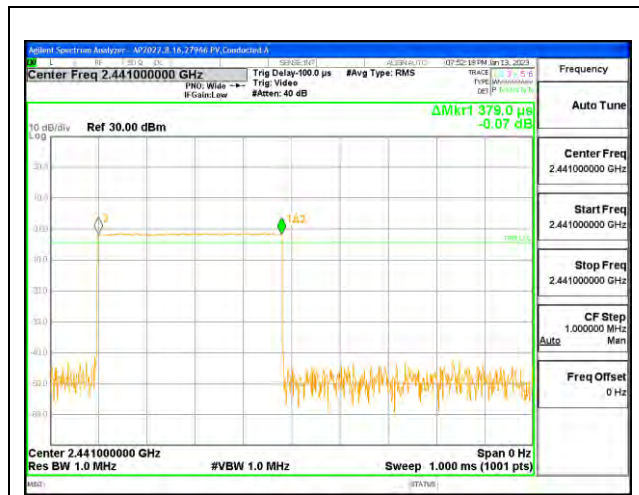
The average time of occupancy in the specified 3.16 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$ .

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

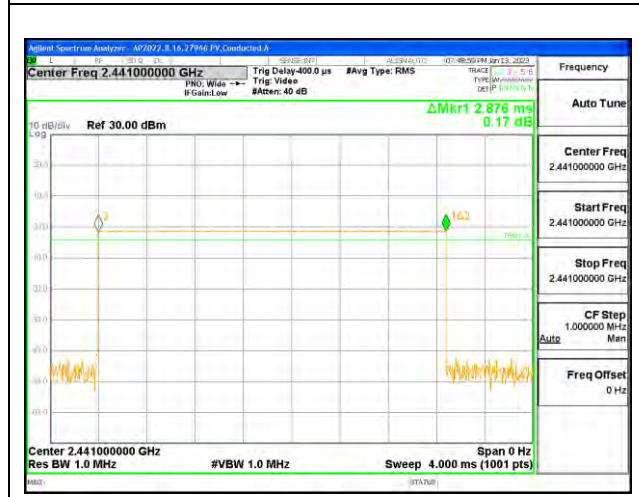
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
<b>GFSK Normal Mode</b>					
DH1	0.379	32	0.1213	0.4	-0.2787
DH3	1.632	13	0.2122	0.4	-0.1878
DH5	2.876	7	0.2013	0.4	-0.1987
<b>GFSK AFH Mode</b>					
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DH1	0.379	8	0.03032	0.4	-0.3697
DH3	1.632	3.25	0.05304	0.4	-0.3470
DH5	2.876	1.75	0.05033	0.4	-0.3497



**PULSE WIDTH – DH1**



**PULSE WIDTH – DH3**



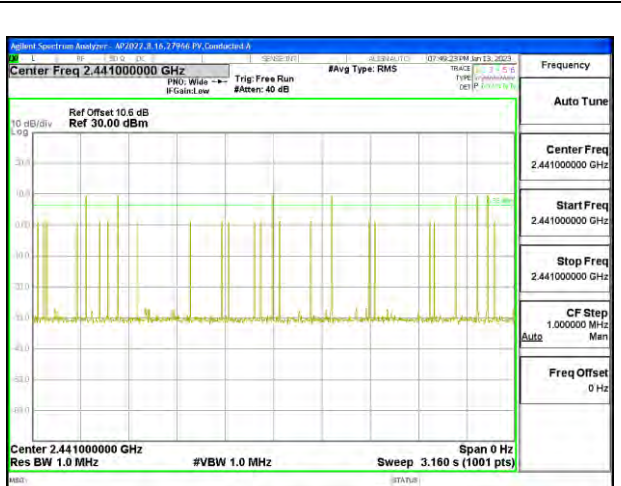
**PULSE WIDTH – DH5**



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



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

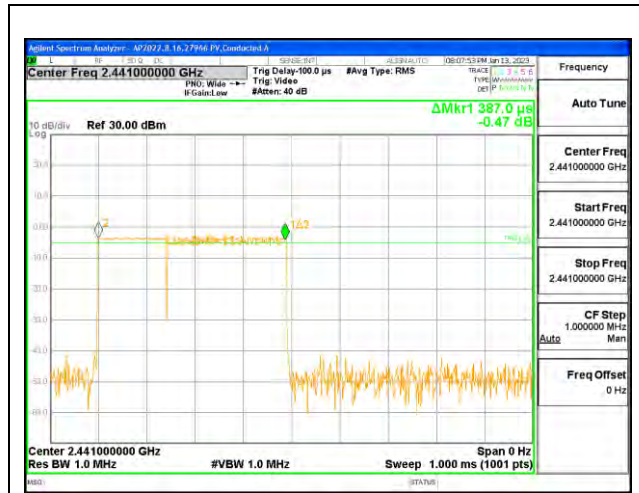


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5**

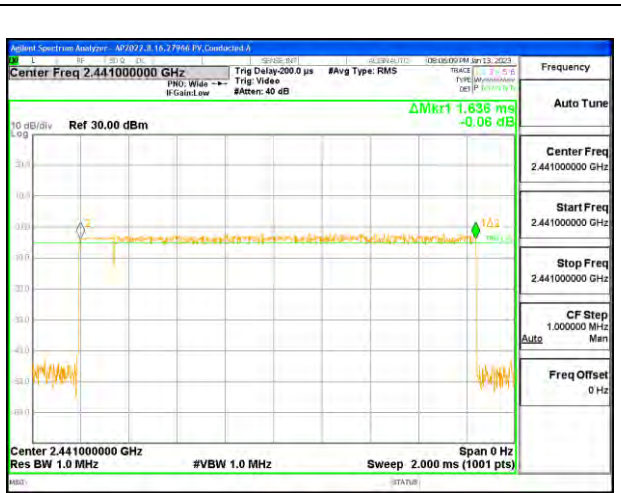
### 9.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

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	0.387	33	0.12771	0.4	-0.2723
3DH3	1.636	18	0.29448	0.4	-0.1055
3DH5	2.88	9	0.2592	0.4	-0.1408

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.



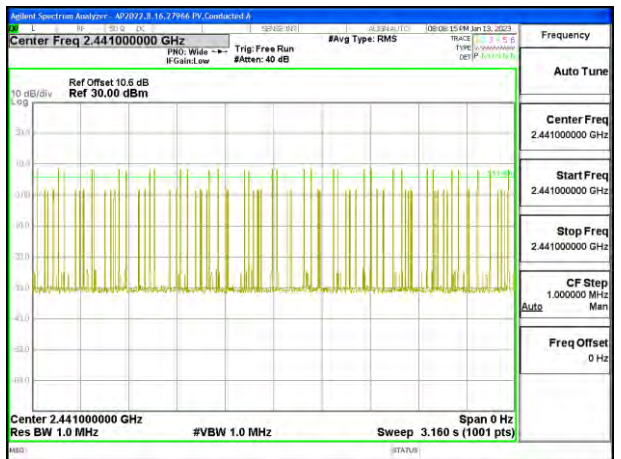
**PULSE WIDTH – 3DH1**



**PULSE WIDTH – 3DH3**



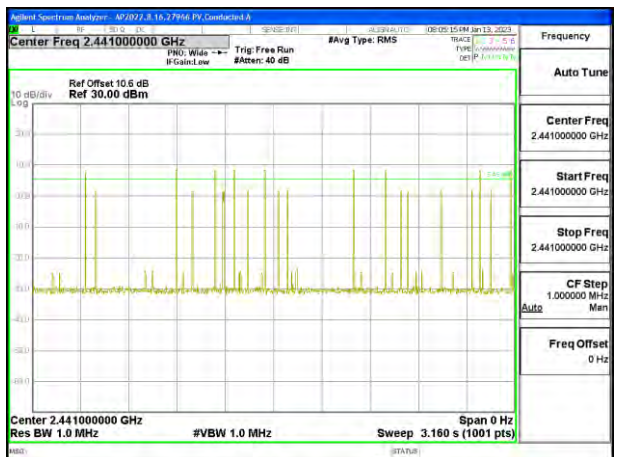
**PULSE WIDTH – 3DH5**



**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

Measurements perform using a wideband gated RF 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 power sensor. Peak output power was read directly from power meter.

### RESULTS

#### 9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	27966 PV
Date:	2023-01-13

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.38	21	-11.62
Middle	2441	9.32	21	-11.68
High	2480	9.41	21	-11.59

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

Tested By:	27966 PV
Date:	2023-01-13

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.39	21	-11.61
Middle	2441	9.5	21	-11.5
High	2480	9.58	21	-11.42

### 9.6.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	27966 PV
Date:	2023-01-13

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.02	21	-11.98
Middle	2441	8.89	21	-12.11
High	2480	9	21	-12



## 9.7. AVERAGE POWER

### LIMITS

None; for reporting purposes only

### TEST PROCEDURE

Measurements perform using a wideband gated RF 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 power sensor. Gated average output power was read directly from power meter.

### RESULTS

#### 9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	27966 PV
Date	2023-01-13

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.19
Middle	2441	9.12
High	2480	9.21

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

Tested By:	27966 PV
Date	2023-01-13

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	6.41
Middle	2441	6.16
High	2480	6.22

### 9.7.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	27966 PV
Date	2023-01-13

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	6.31
Middle	2441	6.14
High	2480	6.21

---

## 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.

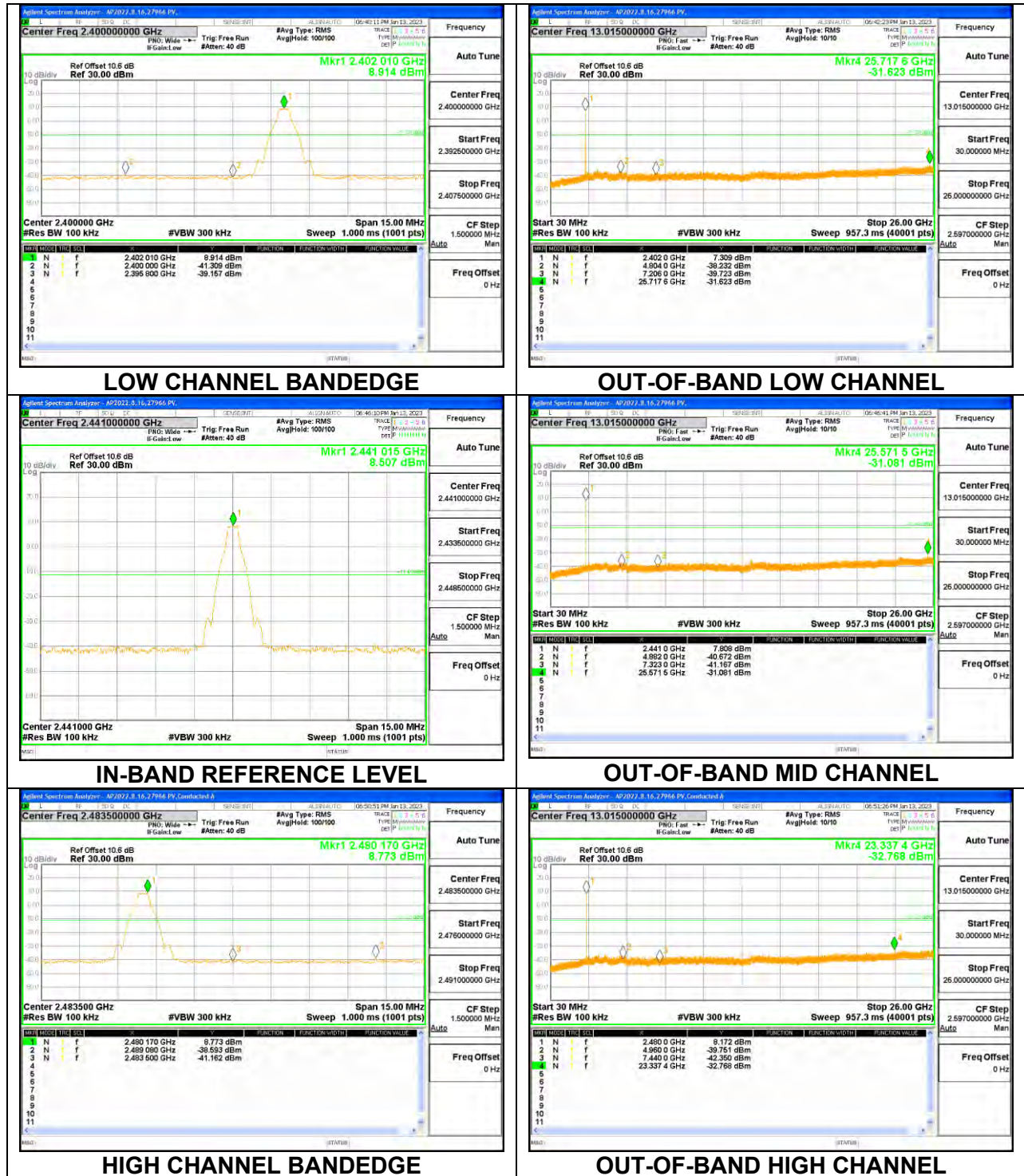
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

### Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING

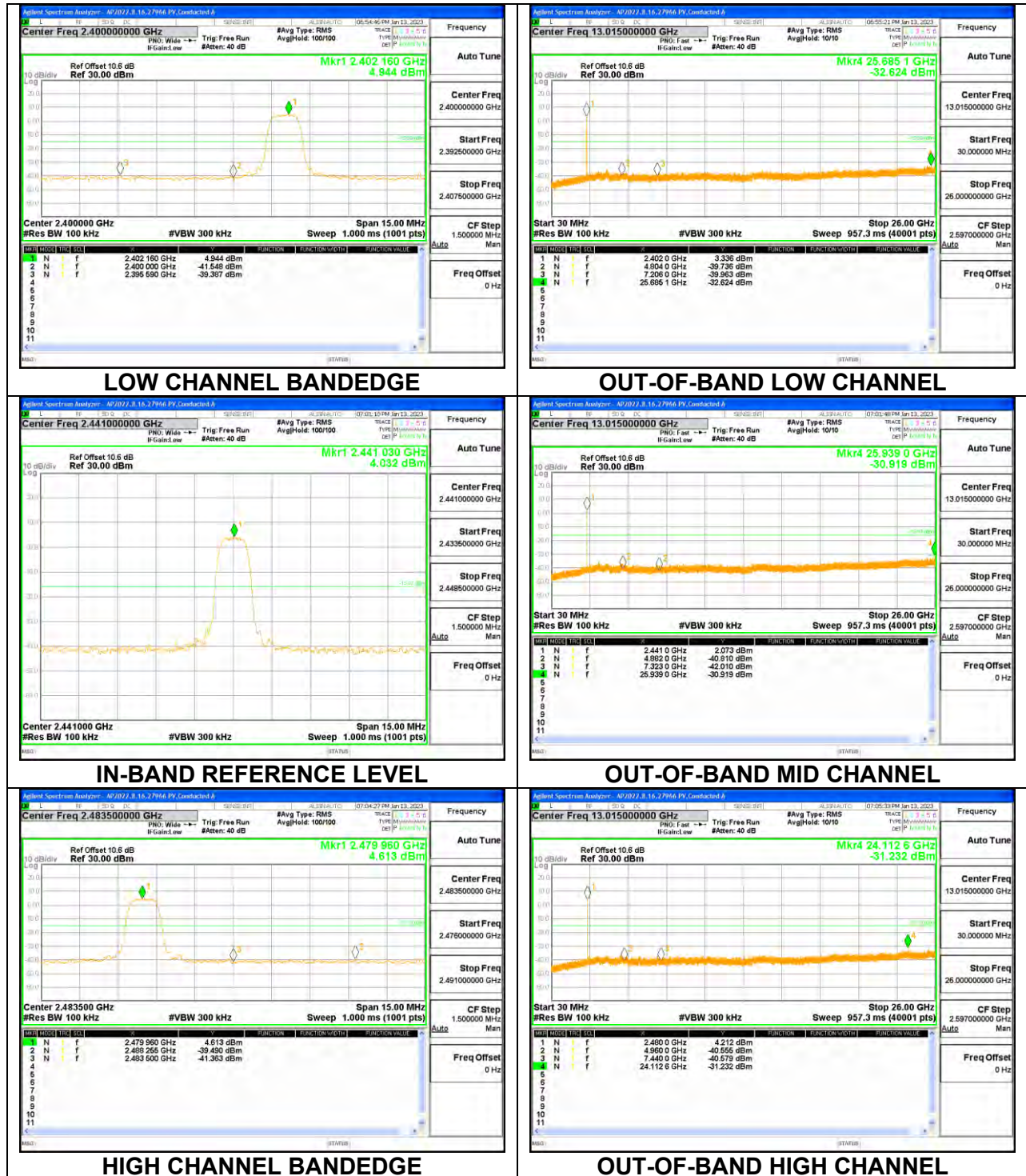


**Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**



## 9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

### Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



**Antenna 1 SPURIOUS BANDEDGE 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**

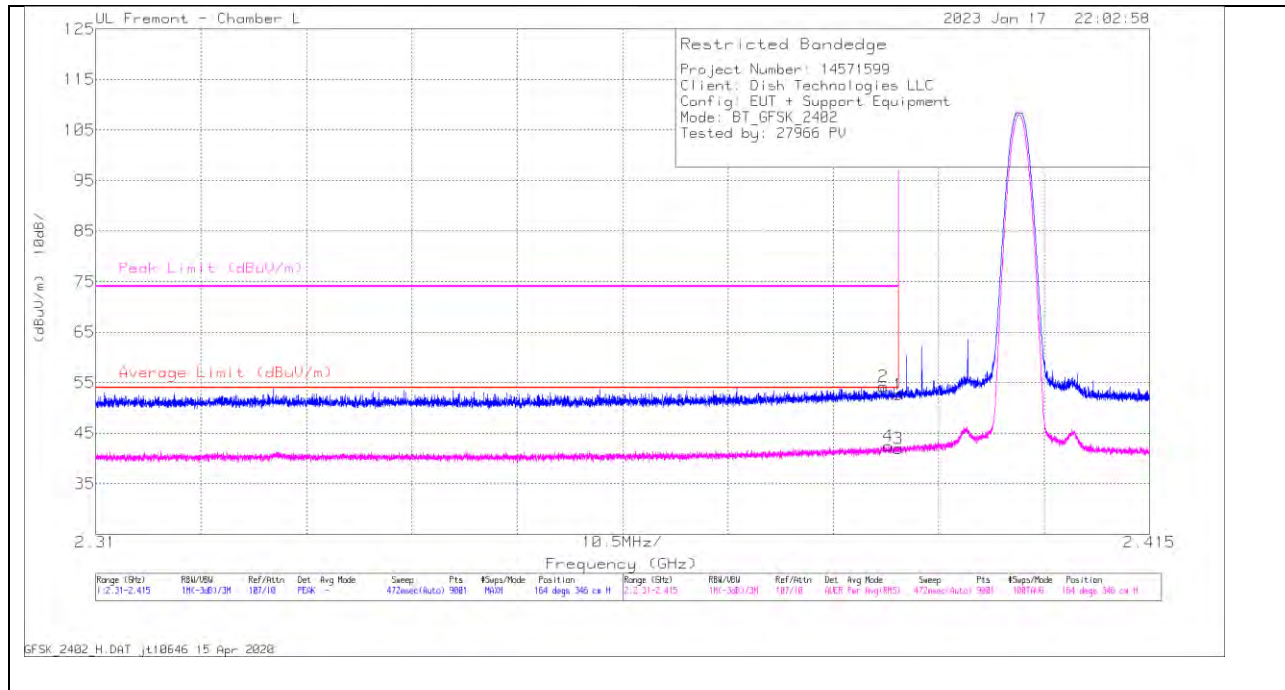
Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can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

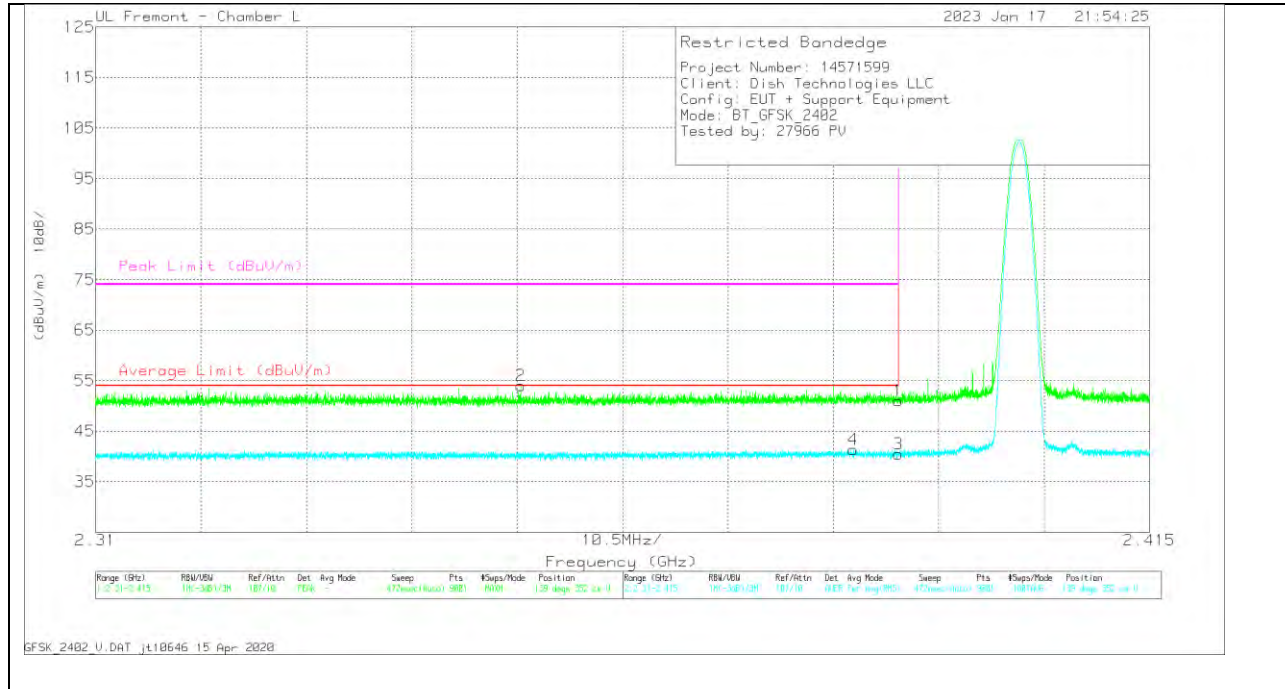
#### HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn 1mH (dB)	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.21	Pk	32.5	-20.1	52.61	-	-	74	-21.39	164	346	H
2	* 2.388496	41.85	Pk	32.5	-20.1	54.25	-	-	74	-19.75	164	346	H
3	* 2.39	29.61	RMS	32.5	-20.1	42.01	54	-11.99	-	-	164	346	H
4	* 2.389009	30.05	RMS	32.5	-20.1	42.45	54	-11.55	-	-	164	346	H

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

### VERTICAL RESULT

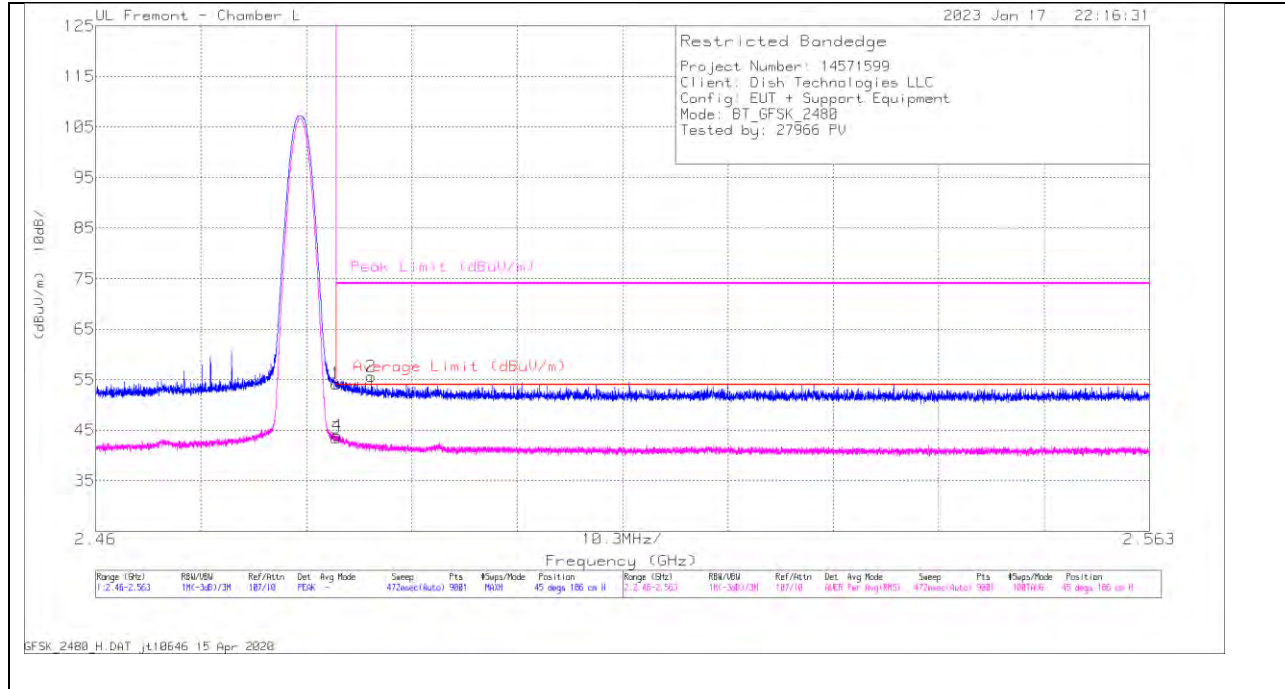


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn 1mH (dB)	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.69	PK	32.5	-20.1	51.09	-	-	74	-22.91	139	352	V
2	* 2.352328	41.69	PK	32.5	-20.2	53.99	-	-	74	-20.01	139	352	V
3	* 2.39	28.14	RMS	32.5	-20.1	40.54	54	-13.46	-	-	139	352	V
4	* 2.385509	28.95	RMS	32.5	-20.1	41.35	54	-12.65	-	-	139	352	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PK - Peak detector  
 RMS - RMS detection

**BANDEDGE (HIGH CHANNEL)**

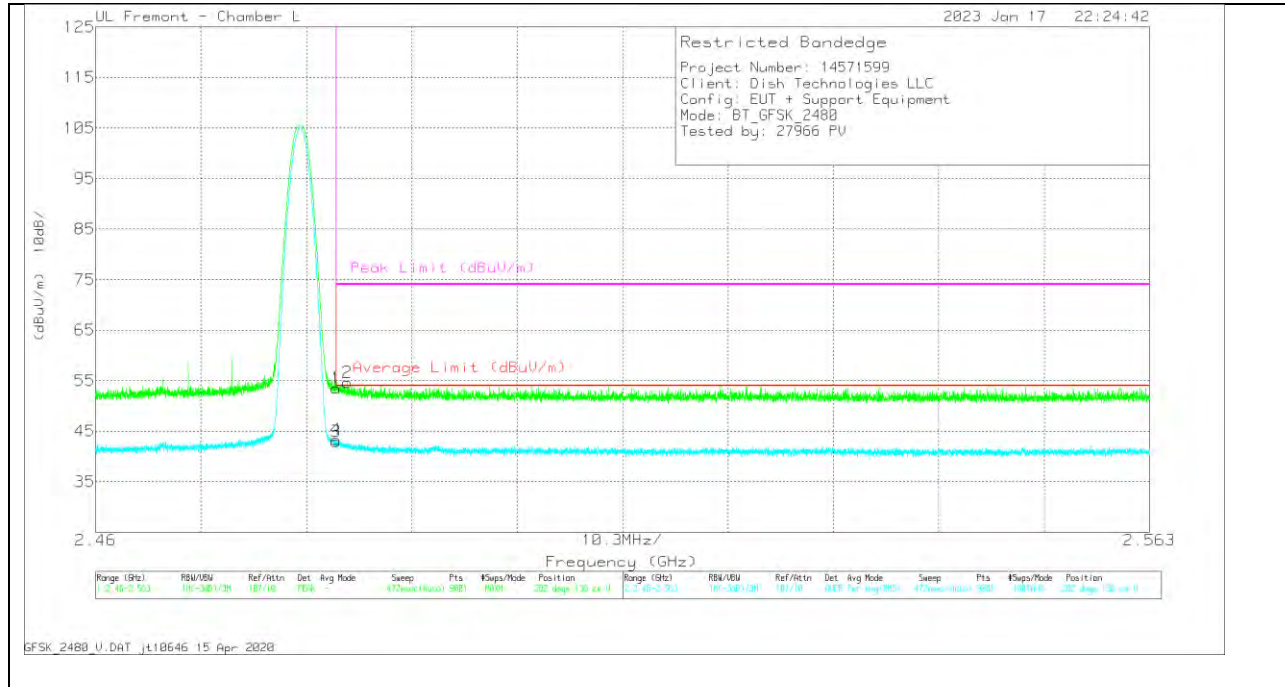
**HORIZONTAL RESULT**



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn 1mH (dB)	Amp/Cbl/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	* 2.4835	41.61	Pk	32.5	-19.9	54.21	-	-	74	-19.79	45	186	H
2	* 2.486939	43.01	Pk	32.5	-19.9	55.61	-	-	74	-18.39	45	186	H
3	* 2.4835	30.88	RMS	32.5	-19.9	43.48	54	-10.52	-	-	45	186	H
4	* 2.483609	31.34	RMS	32.5	-19.9	43.94	54	-10.06	-	-	45	186	H

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

### VERTICAL RESULT

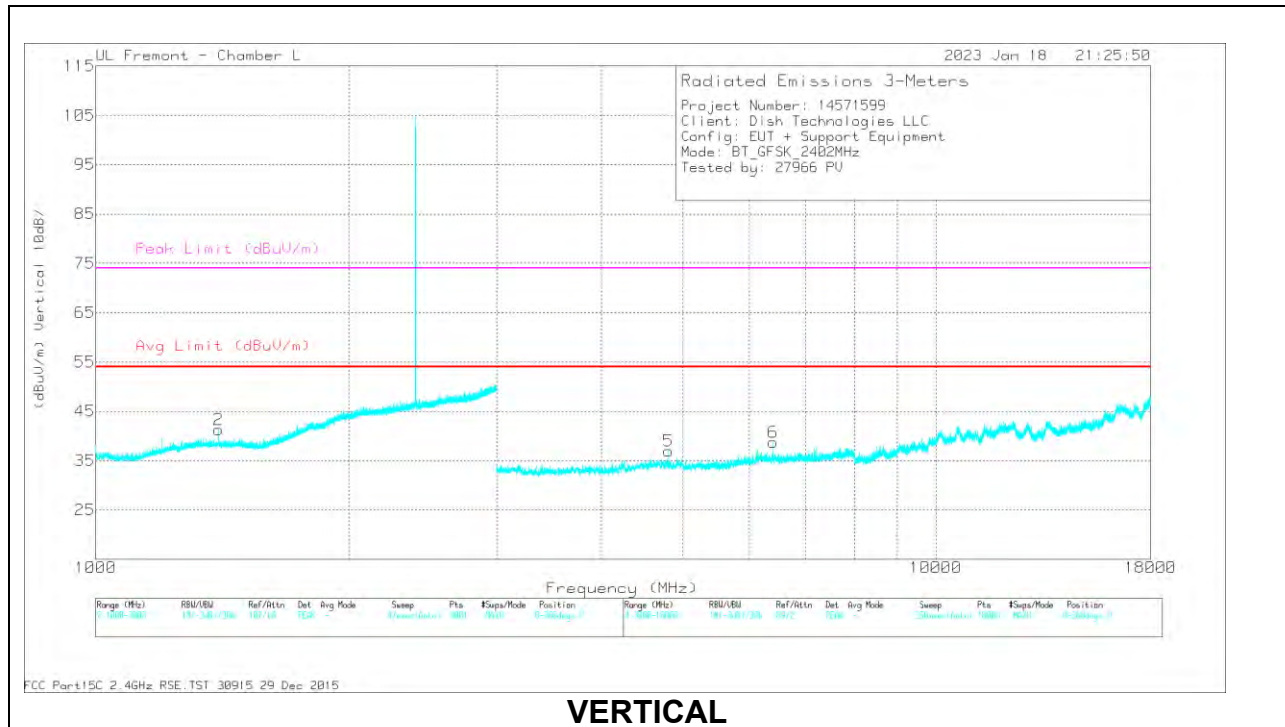
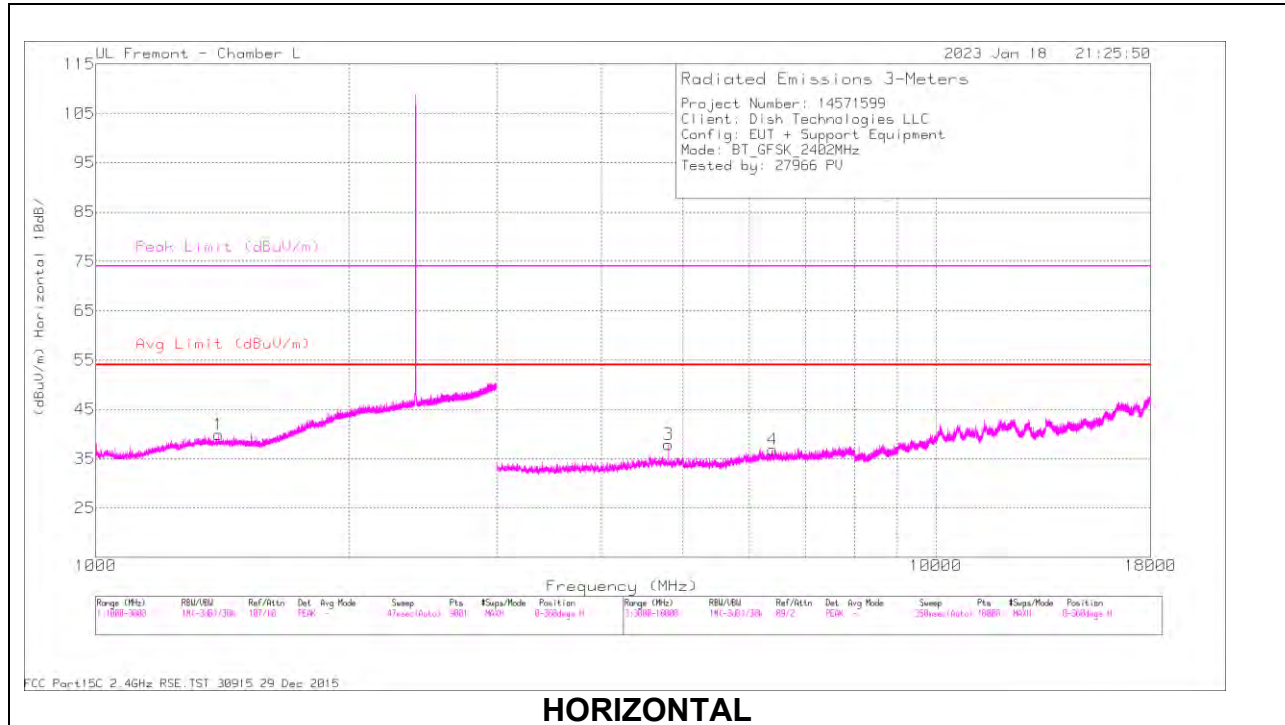


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn 1mH (dB)	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.9	PK	32.5	-19.9	53.5	-	-	74	-20.5	282	136	V
2	* 2.484582	42.08	PK	32.5	-19.9	54.68	-	-	74	-19.32	282	136	V
3	* 2.4835	30.4	RMS	32.5	-19.9	43	54	-11	-	-	282	136	V
4	* 2.483506	30.77	RMS	32.5	-19.9	43.37	54	-10.63	-	-	282	136	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PK - Peak detector  
 RMS - RMS detection

# HARMONICS AND SPURIOUS EMISSIONS

## LOW CHANNEL RESULTS

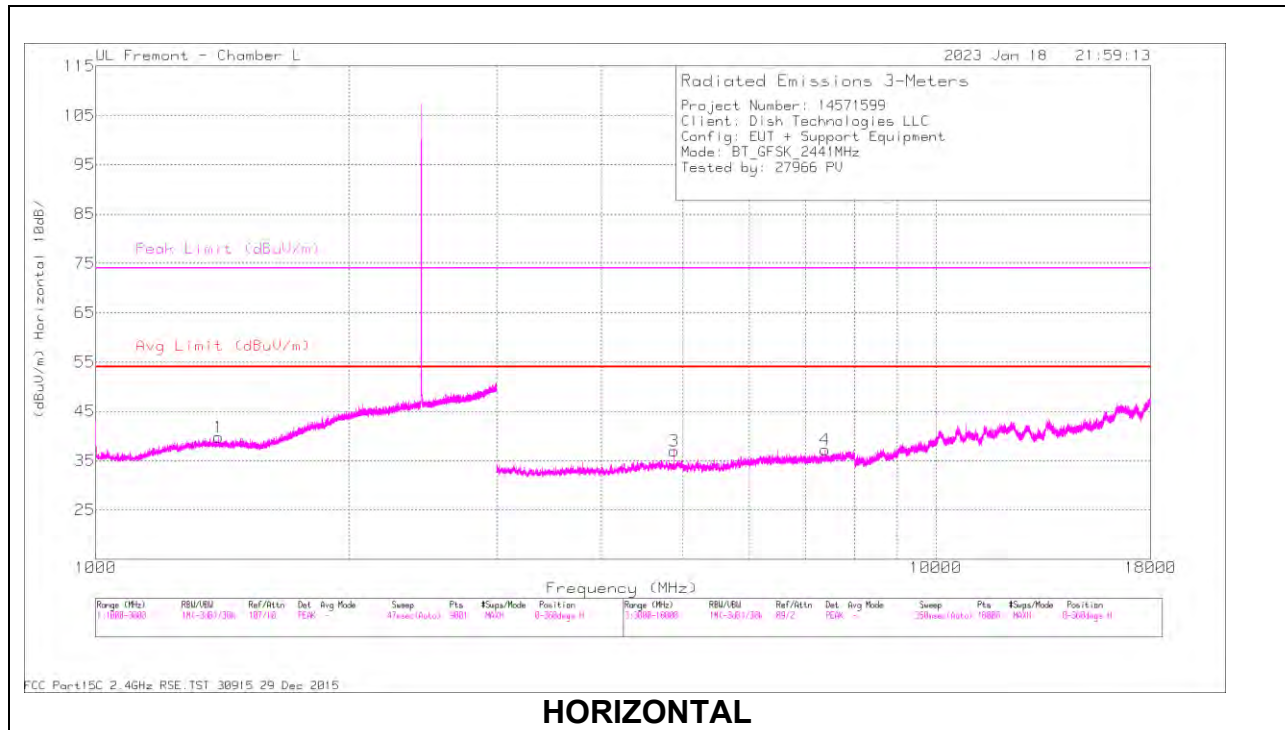


**RADIATED EMISSIONS**

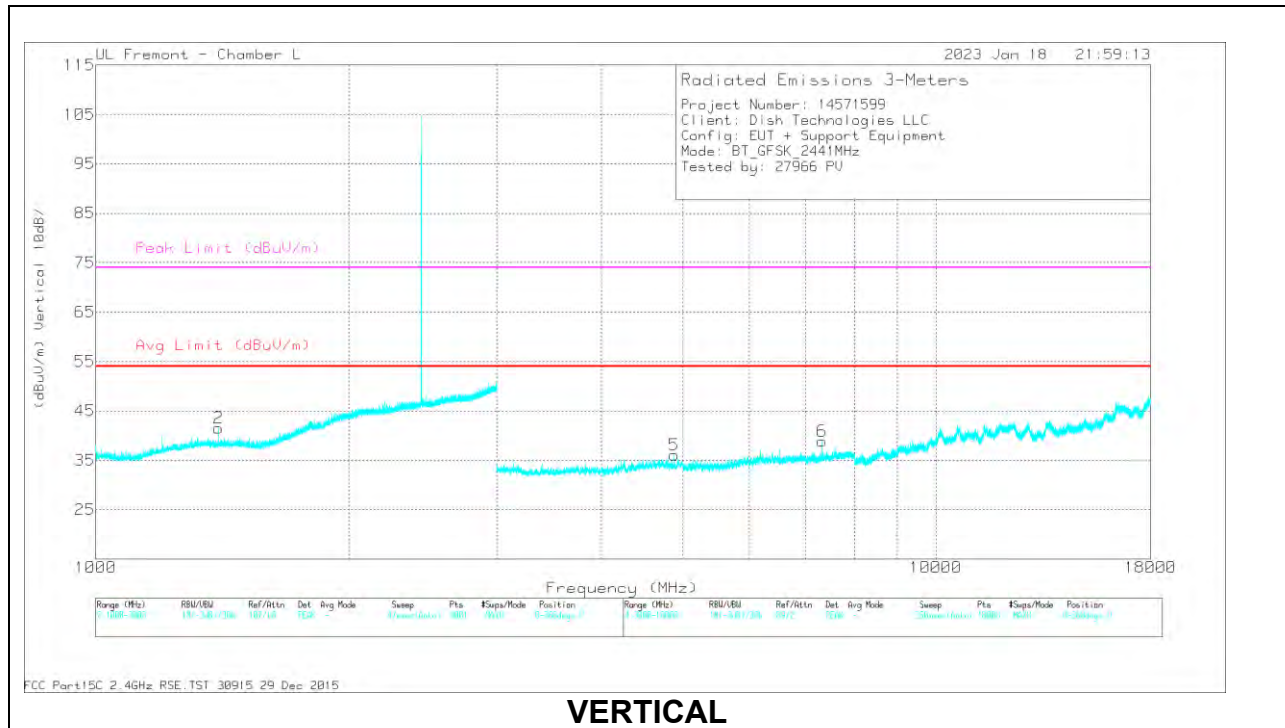
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF(dB) 1mH	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1401.241	33.86	PKFH	28.9	-16.1	46.66	-	-	74	-27.34	112	262	H
	* 1399.998	21.09	VA1T	28.9	-16.1	33.89	54	-20.11	-	-	112	262	H
2	* 1401.913	35.37	PKFH	28.9	-16.1	48.17	-	-	74	-25.83	182	362	V
	* 1399.957	23.87	VA1T	28.9	-16.1	36.67	54	-17.33	-	-	182	362	V
3	* 4804.463	35.44	PKFH	34.5	-26.5	43.44	-	-	74	-30.56	194	178	H
	* 4803.967	24.16	VA1T	34.5	-26.5	32.16	54	-21.84	-	-	194	178	H
4	6389.752	32.82	PKFH	35.8	-24	44.62	-	-	-	-	11	393	H
	6389.564	18.4	VA1T	35.8	-24	30.2	-	-	-	-	11	393	H
5	* 4804.543	35.66	PKFH	34.5	-26.5	43.66	-	-	74	-30.34	227	185	V
	* 4803.984	24.25	VA1T	34.5	-26.5	32.25	54	-21.75	-	-	227	185	V
6	6405.198	32.62	PKFH	35.8	-24	44.42	-	-	-	-	196	323	V
	6405.218	19.63	VA1T	35.8	-24	31.43	-	-	-	-	196	323	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**

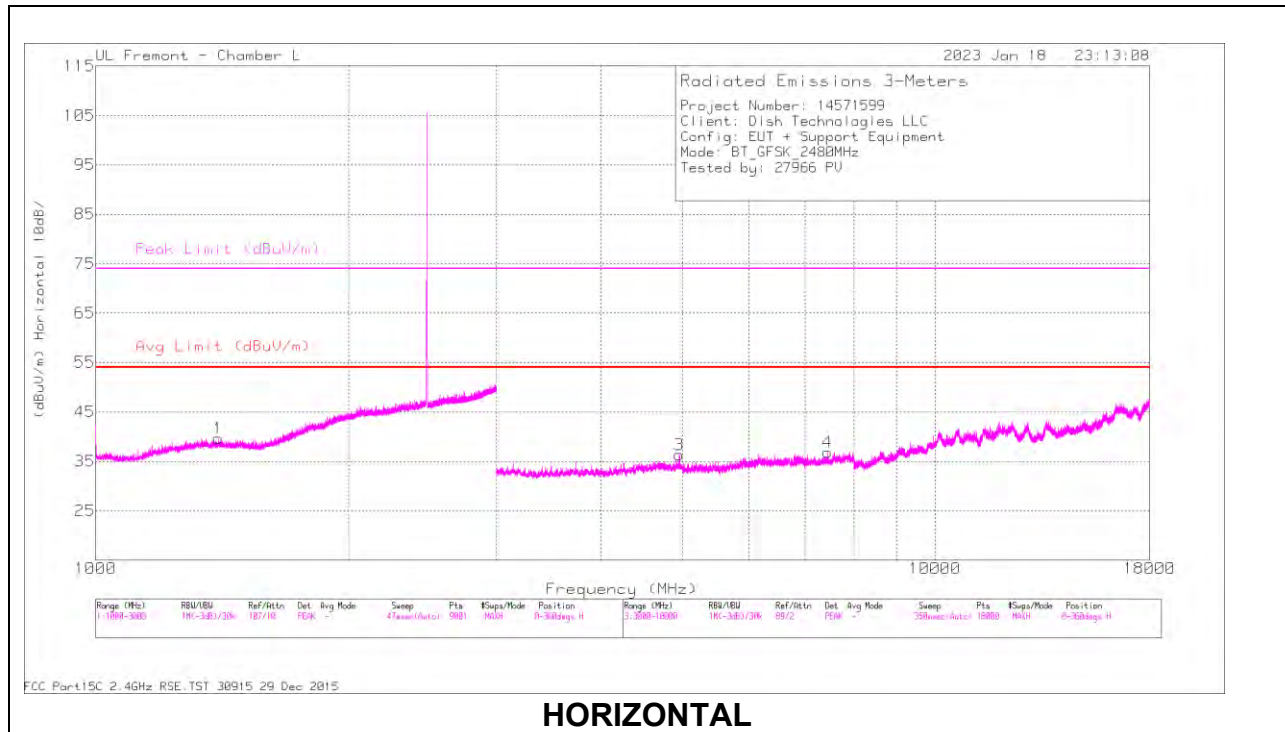


**RADIATED EMISSIONS**

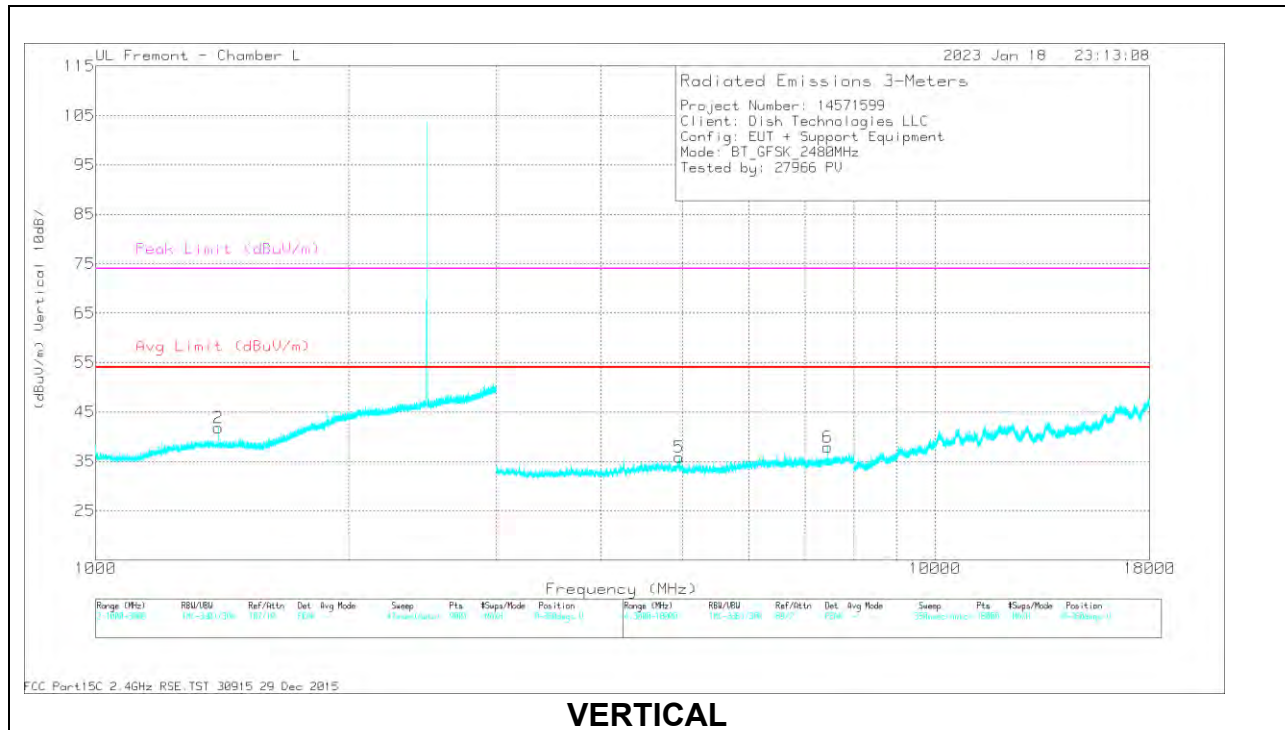
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF(dB) 1mH	Amp/Cbl/ Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1400.171	35.44	PKFH	28.9	-16.1	48.24	-	-	74	-25.76	118	111	H
	* 1400.003	21.91	VA1T	28.9	-16.1	34.71	54	-19.29	-	-	118	111	H
2	* 1399.041	34.41	PKFH	28.9	-16.1	47.21	-	-	74	-26.79	46	132	V
	* 1399.988	23.11	VA1T	28.9	-16.1	35.91	54	-18.09	-	-	46	132	V
3	* 4881.69	35.71	PKFH	34.4	-26.4	43.71	-	-	74	-30.29	9	185	H
	* 4881.942	23.82	VA1T	34.4	-26.4	31.82	54	-22.18	-	-	9	185	H
4	* 7376.103	30.45	PKFH	35.9	-22.6	43.75	-	-	74	-30.25	262	105	H
	* 7374.509	17.24	VA1T	35.9	-22.6	30.54	54	-23.46	-	-	262	105	H
5	* 4882.043	36.31	PKFH	34.4	-26.4	44.31	-	-	74	-29.69	102	105	V
	* 4881.978	24.57	VA1T	34.4	-26.4	32.57	54	-21.43	-	-	102	105	V
6	* 7323.063	32.39	PKFH	35.9	-22.7	45.59	-	-	74	-28.41	115	109	V
	* 7322.936	21.3	VA1T	35.9	-22.7	34.5	54	-19.5	-	-	115	109	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**

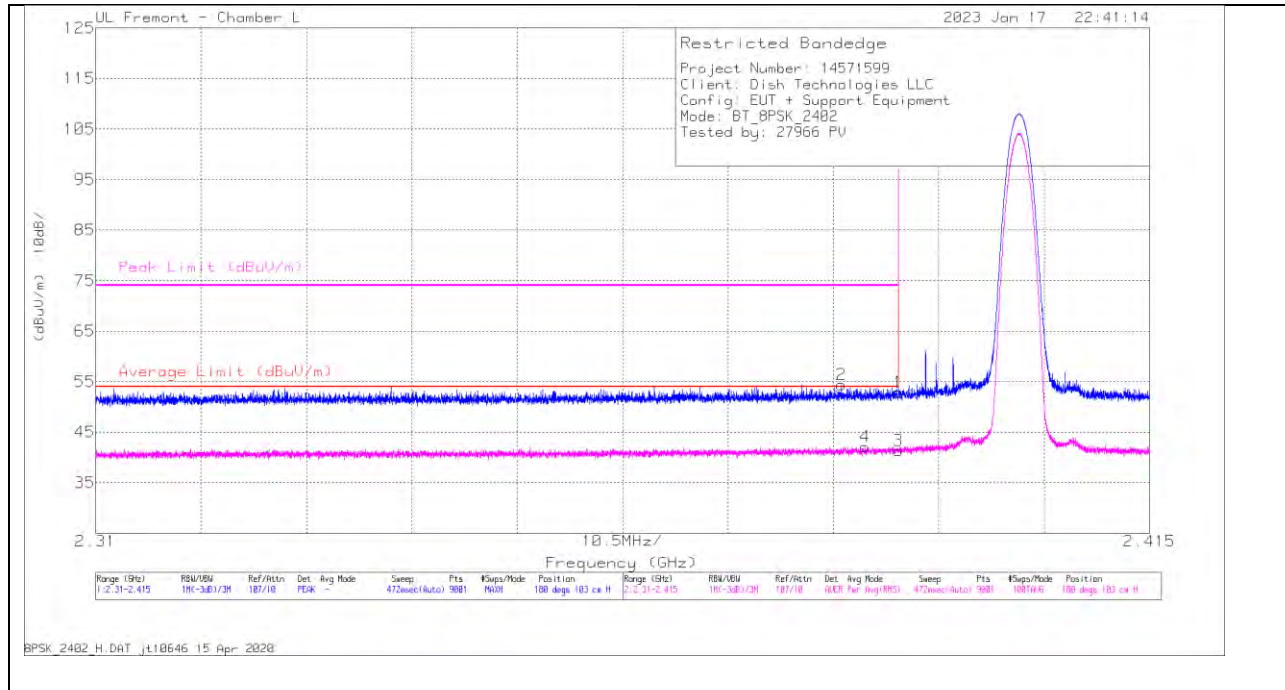
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF(dB) 1mH	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1401.252	35.18	PKFH	28.9	-16.1	47.98	-	-	74	-26.02	97	221	H
	* 1399.977	21.42	VA1T	28.9	-16.1	34.22	54	-19.78	-	-	97	221	H
2	* 1399.591	35.32	PKFH	28.9	-16.1	48.12	-	-	74	-25.88	186	124	V
	* 1400.054	24.69	VA1T	28.9	-16.1	37.49	54	-16.51	-	-	186	124	V
3	* 4960.601	34.68	PKFH	34.4	-25.4	43.68	-	-	74	-30.32	0	187	H
	* 4959.949	22.78	VA1T	34.4	-25.4	31.78	54	-22.22	-	-	0	187	H
4	* 7440.236	31.86	PKFH	36	-22.5	45.36	-	-	74	-28.64	107	102	H
	* 7439.95	19.99	VA1T	36	-22.5	33.49	54	-20.51	-	-	107	102	H
5	* 4960.29	34.49	PKFH	34.4	-25.4	43.49	-	-	74	-30.51	108	103	V
	* 4959.963	23.58	VA1T	34.4	-25.4	32.58	54	-21.42	-	-	108	103	V
6	* 7439.144	31.24	PKFH	36	-22.5	44.74	-	-	74	-29.26	118	334	V
	* 7440.032	19.76	VA1T	36	-22.5	33.26	54	-20.74	-	-	118	334	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)

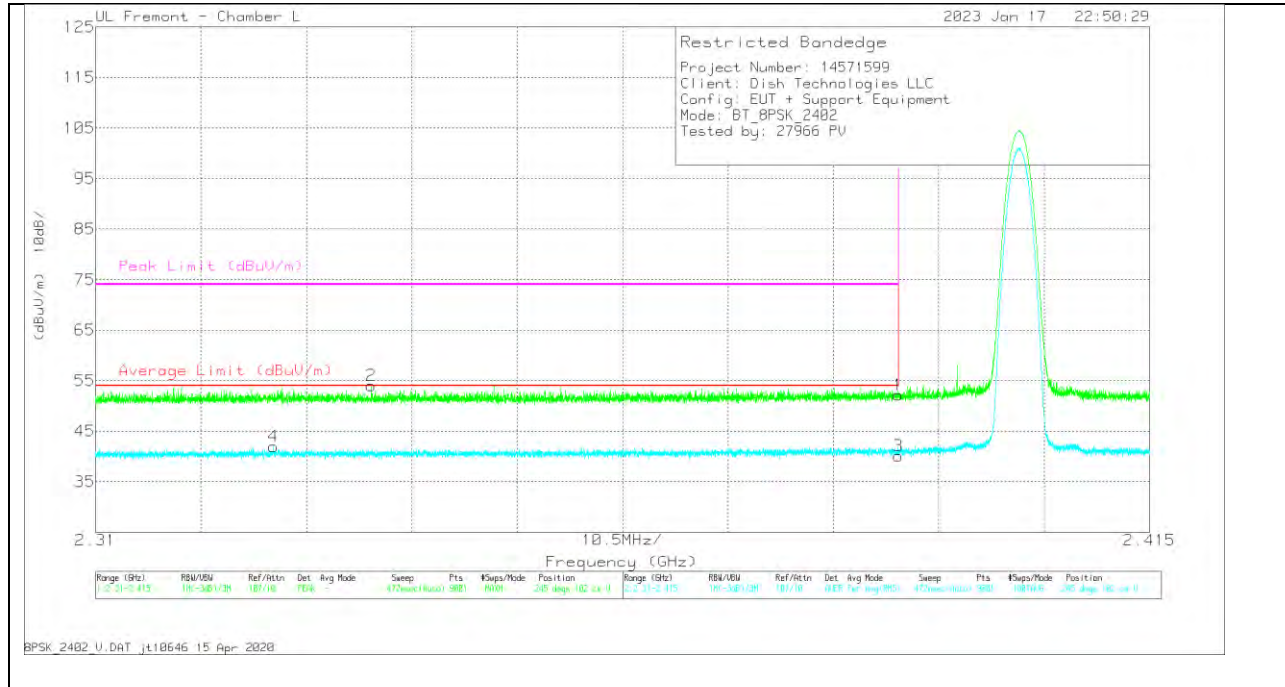
### HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn 1mH	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.48	PK	32.5	-20.1	52.88	-	-	74	-21.12	180	103	H
2	* 2.384307	41.92	PK	32.5	-20	54.42	-	-	74	-19.58	180	103	H
3	* 2.39	28.97	RMS	32.5	-20.1	41.37	54	-12.63	-	-	180	103	H
4	* 2.386687	29.75	RMS	32.5	-20.1	42.15	54	-11.85	-	-	180	103	H

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

### VERTICAL RESULT

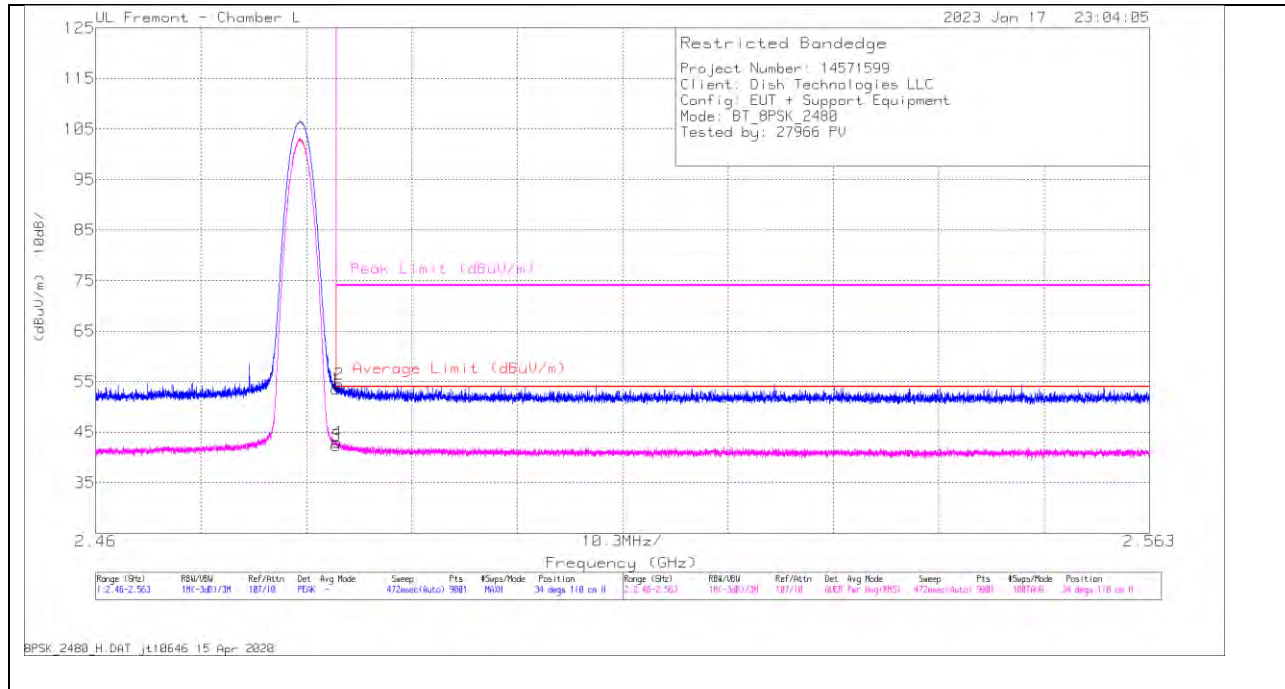


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn 1mH	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.7	PK	32.5	-20.1	52.1	-	-	74	-21.9	245	102	V
2	* 2.337464	41.96	PK	32.4	-20.3	54.06	-	-	74	-19.94	245	102	V
3	* 2.39	27.73	RMS	32.5	-20.1	40.13	54	-13.87	-	-	245	102	V
4	* 2.327699	29.76	RMS	32.4	-20.2	41.96	54	-12.04	-	-	245	102	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PK - Peak detector  
 RMS - RMS detection

**BANDEDGE (HIGH CHANNEL)**

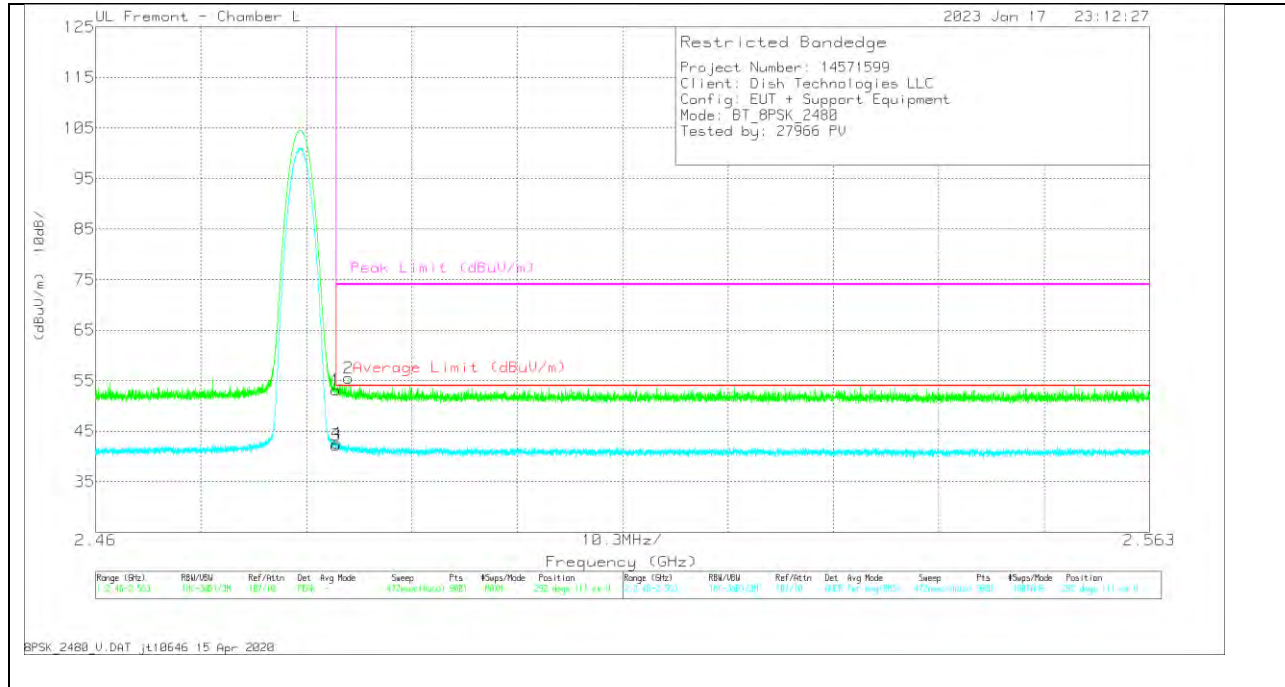
**HORIZONTAL RESULT**



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn 1mH	Amp/Cbl/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	* 2.4835	40.93	Pk	32.5	-19.9	53.53	-	-	74	-20.47	34	110	H
2	* 2.483792	41.94	Pk	32.5	-19.9	54.54	-	-	74	-19.46	34	110	H
3	* 2.4835	29.74	RMS	32.5	-19.9	42.34	54	-11.66	-	-	34	110	H
4	* 2.483586	30.32	RMS	32.5	-19.9	42.92	54	-11.08	-	-	34	110	H

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

### VERTICAL RESULT

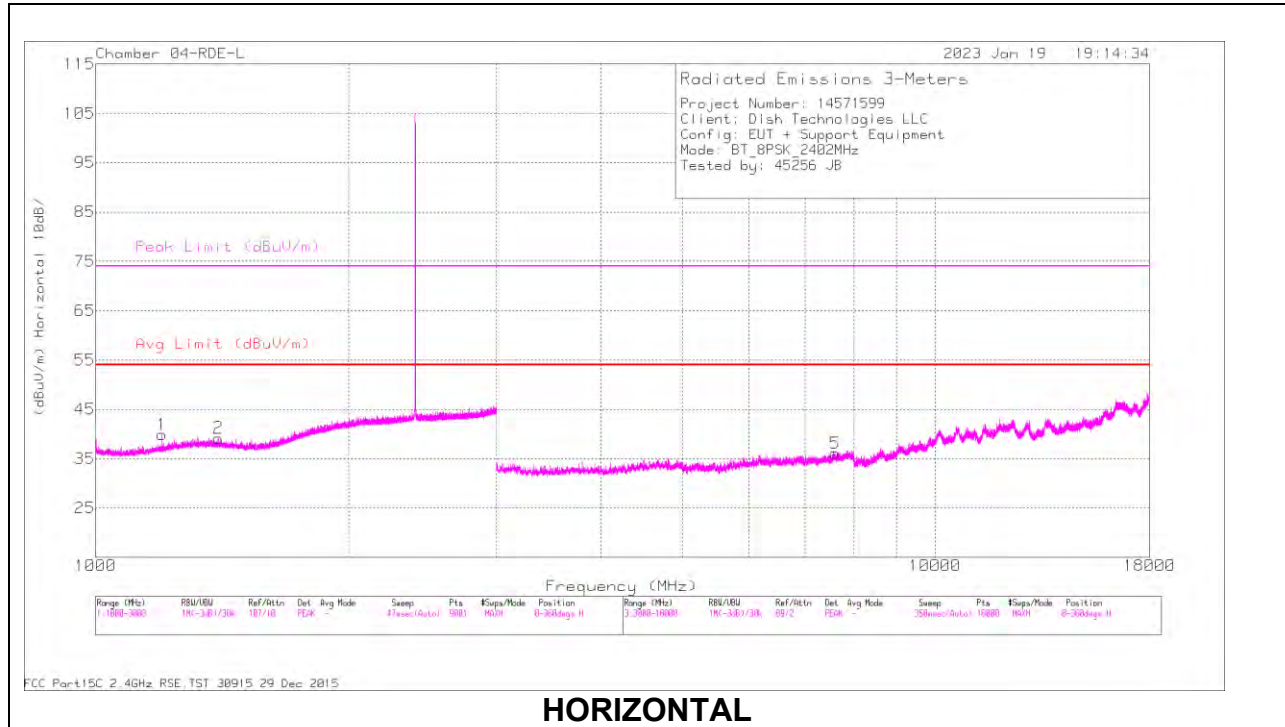


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn 1mH	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.54	PK	32.5	-19.9	53.14	-	-	74	-20.86	292	111	V
2	* 2.484708	42.85	PK	32.5	-19.9	55.45	-	-	74	-18.55	292	111	V
3	* 2.4835	29.62	RMS	32.5	-19.9	42.22	54	-11.78	-	-	292	111	V
4	* 2.48354	30.05	RMS	32.5	-19.9	42.65	54	-11.35	-	-	292	111	V

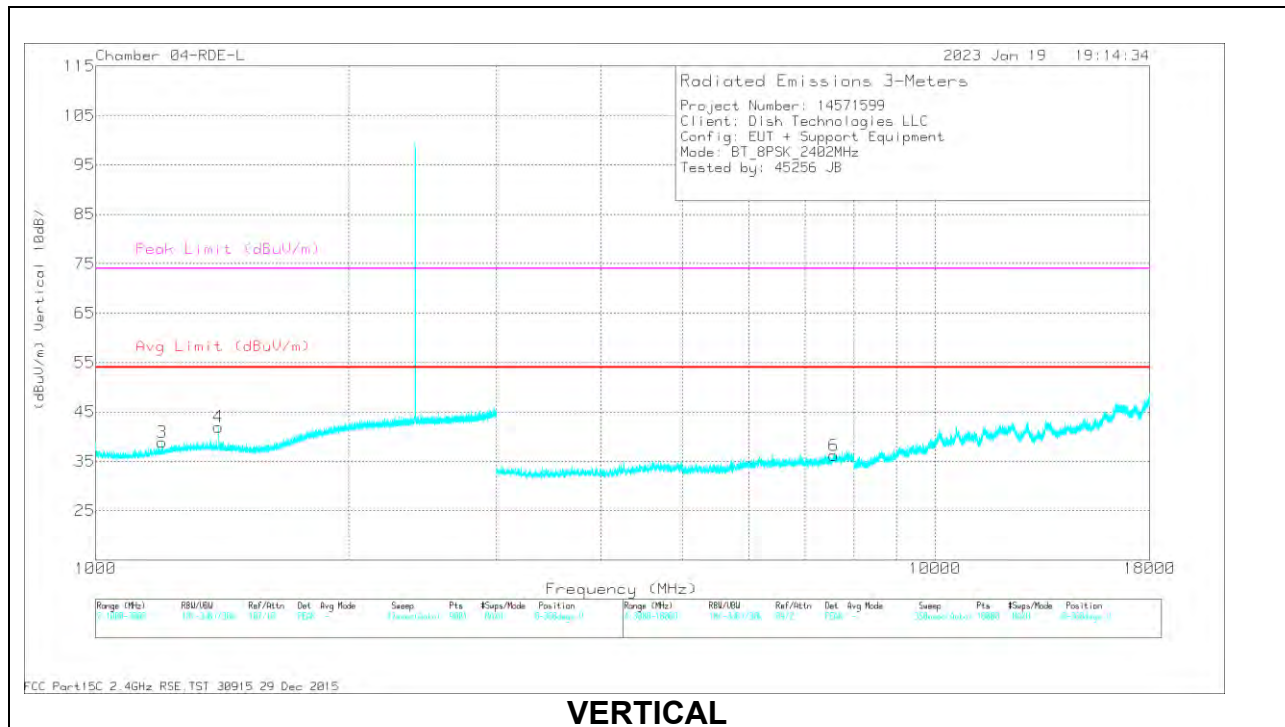
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PK - Peak detector  
 RMS - RMS detection

# HARMONICS AND SPURIOUS EMISSIONS

## LOW CHANNEL RESULTS



**HORIZONTAL**



**VERTICAL**

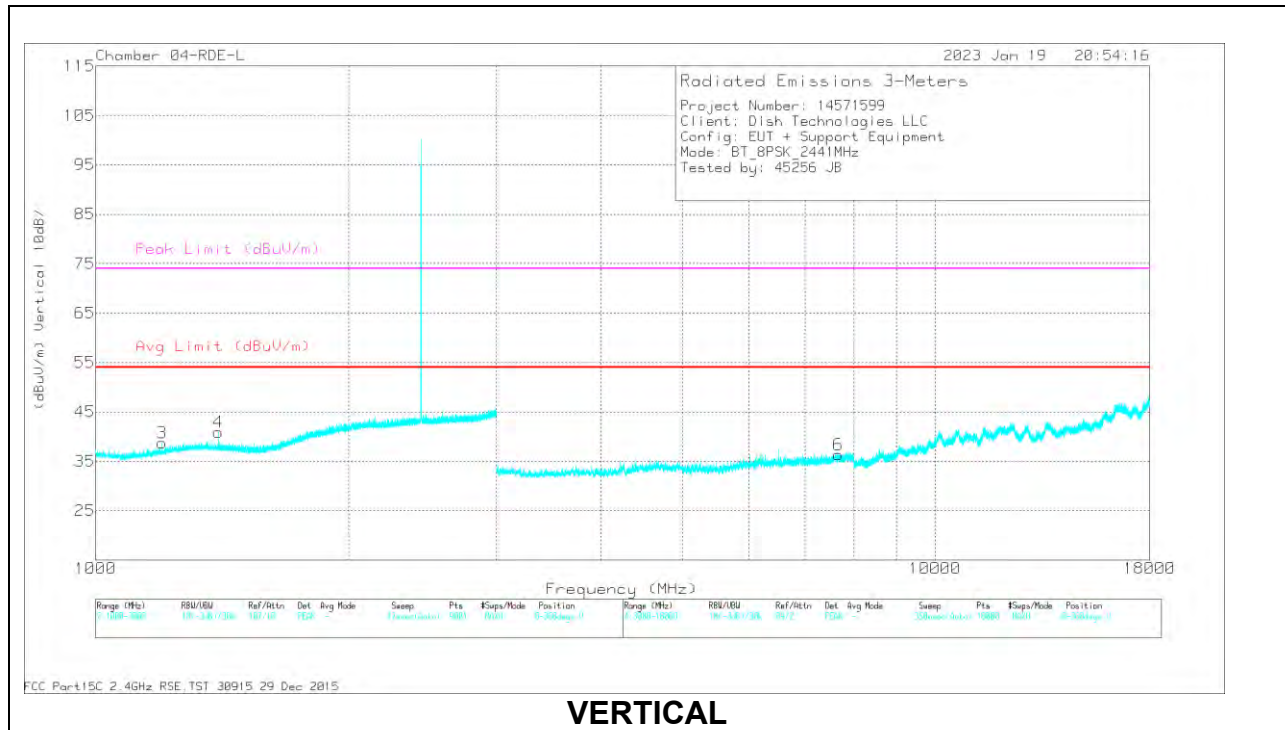
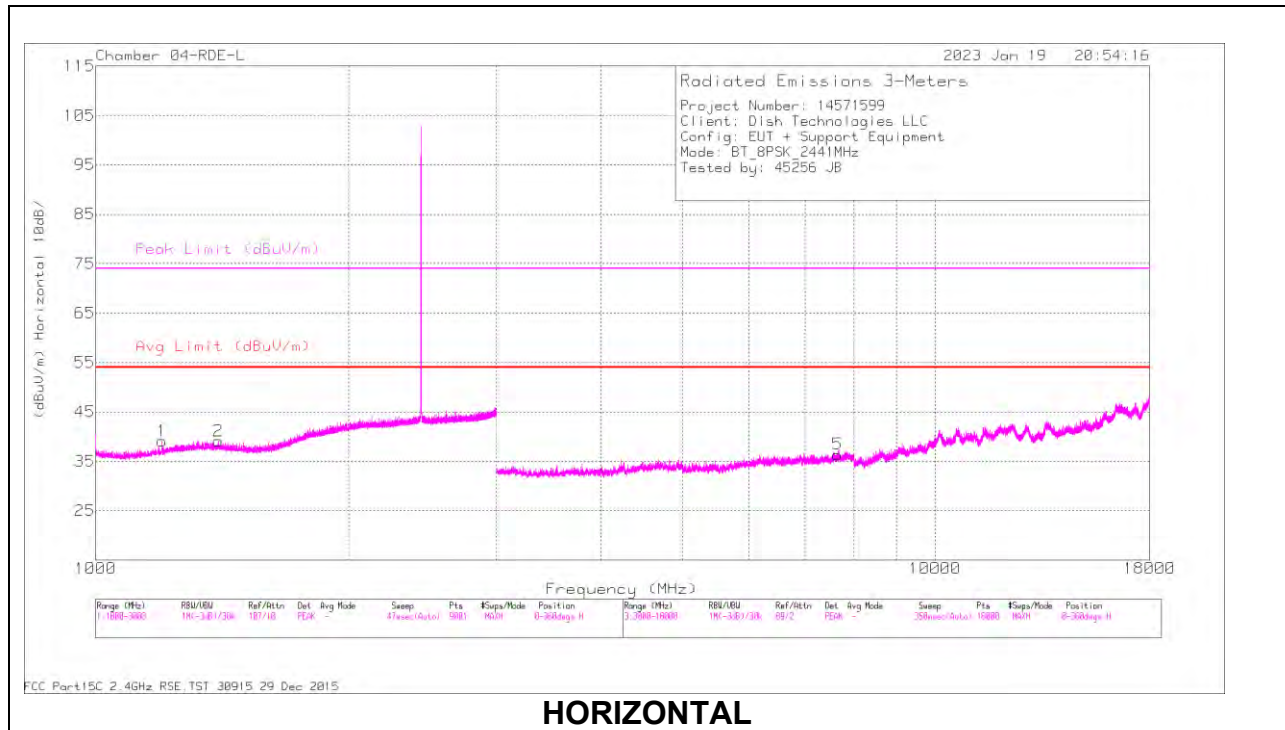


**RADIATED EMISSIONS**

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Horn 1mH	Amp/Cbl/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	* 1200.595	41.51	PKFH	28.4	-23.5	46.41	-	-	74	-27.59	114	163	H
	* 1200.044	30.6	VA1T	28.4	-23.5	35.5	54	-18.5	-	-	114	163	H
2	* 1398.847	41.62	PKFH	28.9	-22.9	47.62	-	-	74	-26.38	114	209	H
	* 1400.004	29.01	VA1T	28.9	-22.8	35.11	54	-18.89	-	-	114	209	H
3	* 1199.577	41.92	PKFH	28.3	-23.5	46.72	-	-	74	-27.28	145	130	V
	* 1199.957	30.94	VA1T	28.3	-23.5	35.74	54	-18.26	-	-	145	130	V
4	* 1399.991	42.56	PKFH	28.9	-22.9	48.56	-	-	74	-25.44	145	101	V
	* 1399.999	32.75	VA1T	28.9	-22.9	38.75	54	-15.25	-	-	145	101	V
5	* 7605.786	29.6	PKFH	36	-21.7	43.9	-	-	74	-30.1	1	180	H
	* 7604.434	16.21	VA1T	36	-21.7	30.51	54	-23.49	-	-	1	180	H
6	* 7570.651	29.88	PKFH	36.1	-22	43.98	-	-	74	-30.02	194	291	V
	* 7572.664	16.99	VA1T	36.1	-22	31.09	54	-22.91	-	-	194	291	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

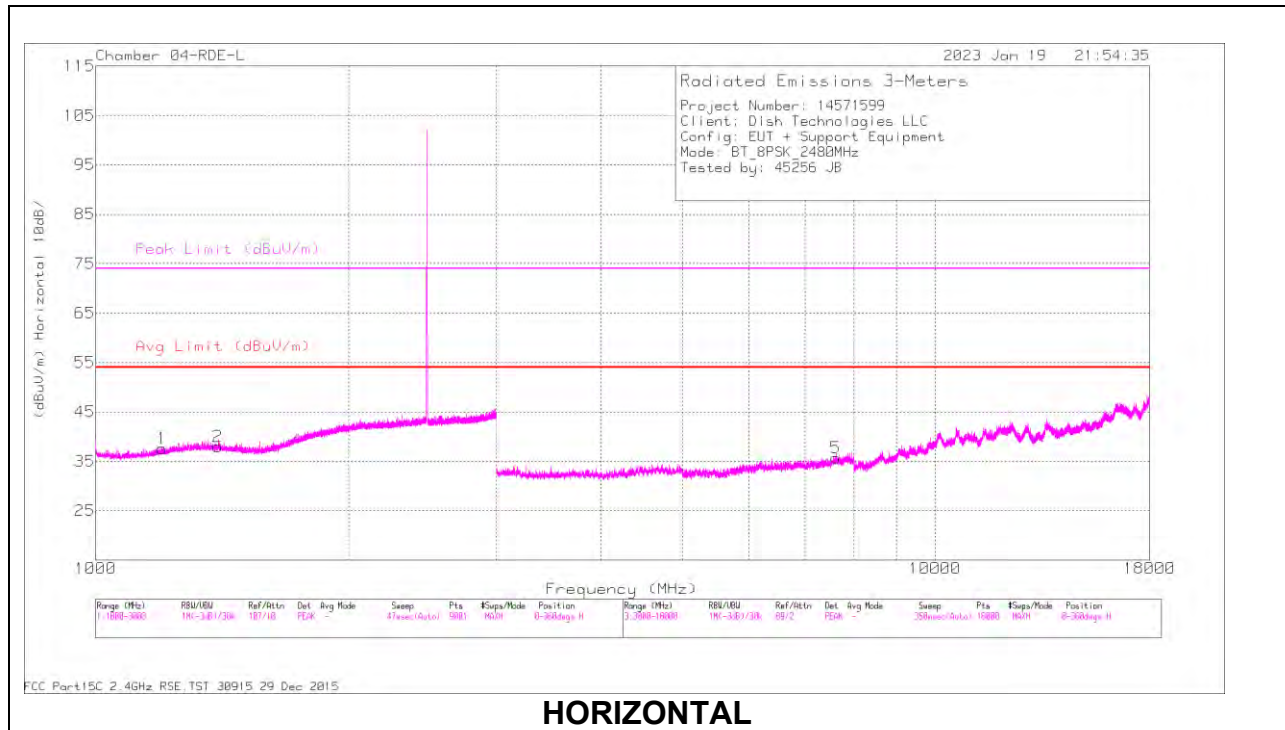


**RADIATED EMISSIONS**

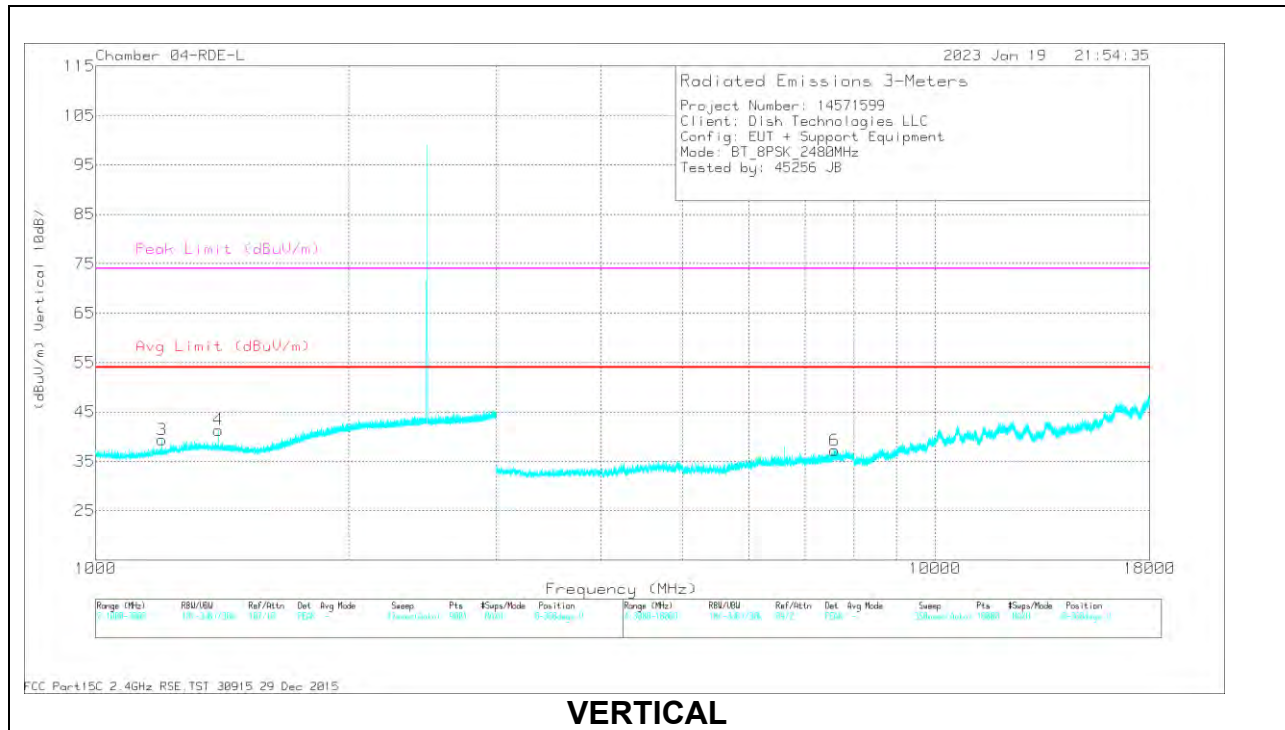
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Horn 1mH	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1200.428	42.14	PKFH	28.4	-23.5	47.04	-	-	74	-26.96	49	108	H
	* 1200.021	30.09	VA1T	28.4	-23.5	34.99	54	-19.01	-	-	49	108	H
2	* 1400.327	41.64	PKFH	28.9	-22.8	47.74	-	-	74	-26.26	298	193	H
	* 1400.018	28.99	VA1T	28.9	-22.8	35.09	54	-18.91	-	-	298	193	H
3	* 1200.313	42.44	PKFH	28.4	-23.5	47.34	-	-	74	-26.66	167	221	V
	* 1199.964	30.75	VA1T	28.3	-23.5	35.55	54	-18.45	-	-	167	221	V
4	* 1400.003	42.29	PKFH	28.9	-22.8	48.39	-	-	74	-25.61	145	121	V
	* 1400.001	31.58	VA1T	28.9	-22.8	37.68	54	-16.32	-	-	145	121	V
5	* 7653.569	30.61	PKFH	36.1	-21.8	44.91	-	-	74	-29.09	253	104	H
	* 7653.845	16.85	VA1T	36.1	-21.9	31.05	54	-22.95	-	-	253	104	H
6	* 7669.899	28.29	PKFH	36.1	-21.7	42.69	-	-	74	-31.31	331	123	V
	* 7671.979	14.79	VA1T	36.1	-21.6	29.29	54	-24.71	-	-	331	123	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**

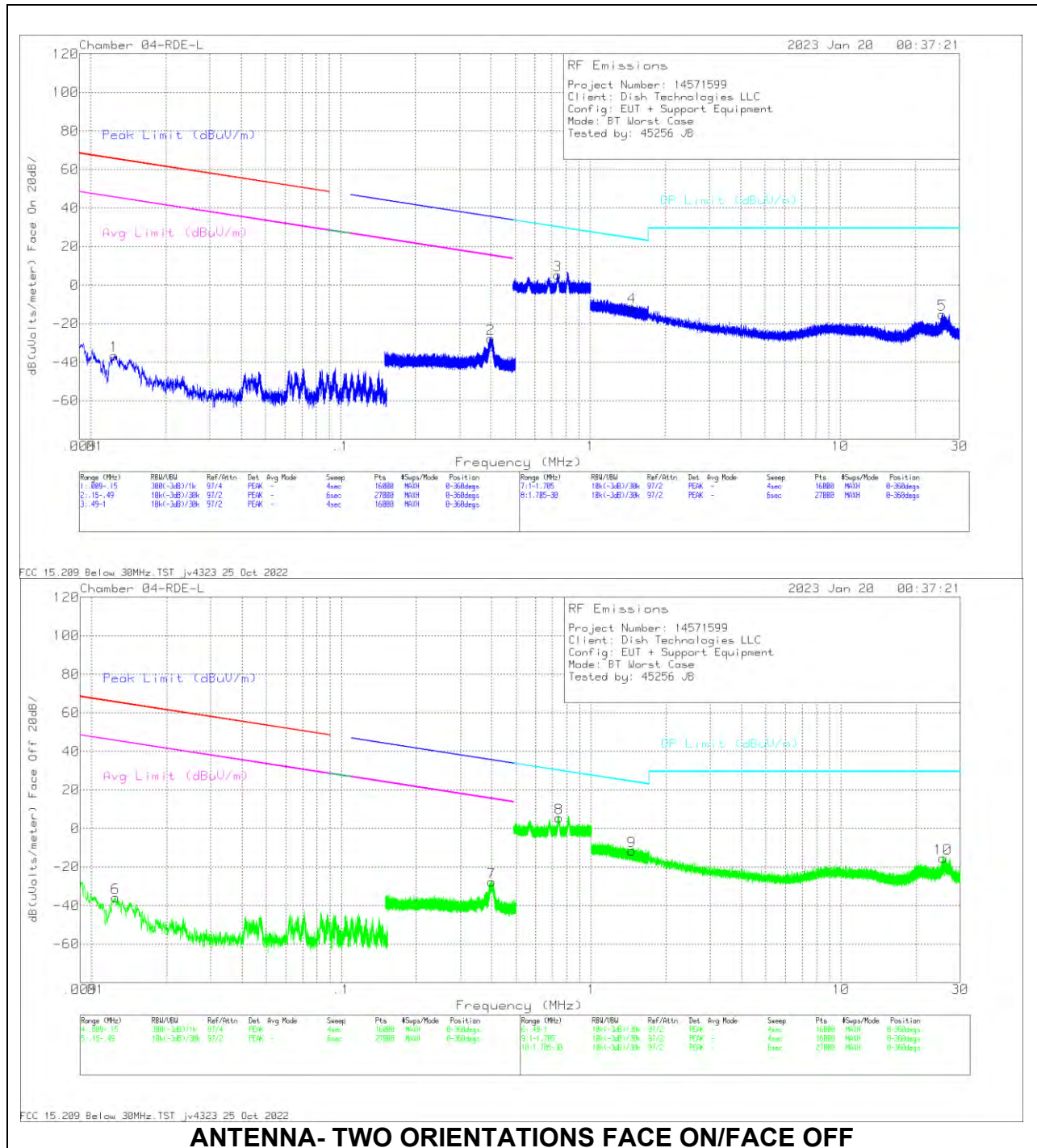
**RADIATED EMISSIONS**

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Horn 1mH	Amp/Cbl/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	* 1199.601	41.38	PKFH	28.3	-23.5	46.18	-	-	74	-27.82	35	153	H
	* 1200.027	29.26	VA1T	28.4	-23.5	34.16	54	-19.84	-	-	35	153	H
2	* 1394.952	41.38	PKFH	28.9	-22.9	47.38	-	-	74	-26.62	112	366	H
	* 1395.28	27.06	VA1T	28.9	-22.9	33.06	54	-20.94	-	-	112	366	H
3	* 1200.09	41.86	PKFH	28.4	-23.5	46.76	-	-	74	-27.24	148	102	V
	* 1399.996	32.08	VA1T	28.9	-22.9	38.08	54	-15.92	-	-	140	108	V
4	* 1399.203	42.53	PKFH	28.9	-22.9	48.53	-	-	74	-25.47	140	108	V
	* 1199.982	31.63	VA1T	28.3	-23.5	36.43	54	-17.57	-	-	148	102	V
5	* 7615.233	29	PKFH	36	-21.5	43.5	-	-	74	-30.5	196	119	H
	* 7616.915	15.7	VA1T	36	-21.5	30.2	54	-23.8	-	-	196	119	H
6	* 7587.534	27.74	PKFH	36.1	-22	41.84	-	-	74	-32.16	223	113	V
	* 7588.393	14.48	VA1T	36.1	-22	28.58	54	-25.42	-	-	223	113	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)



**Below 30MHz Data**

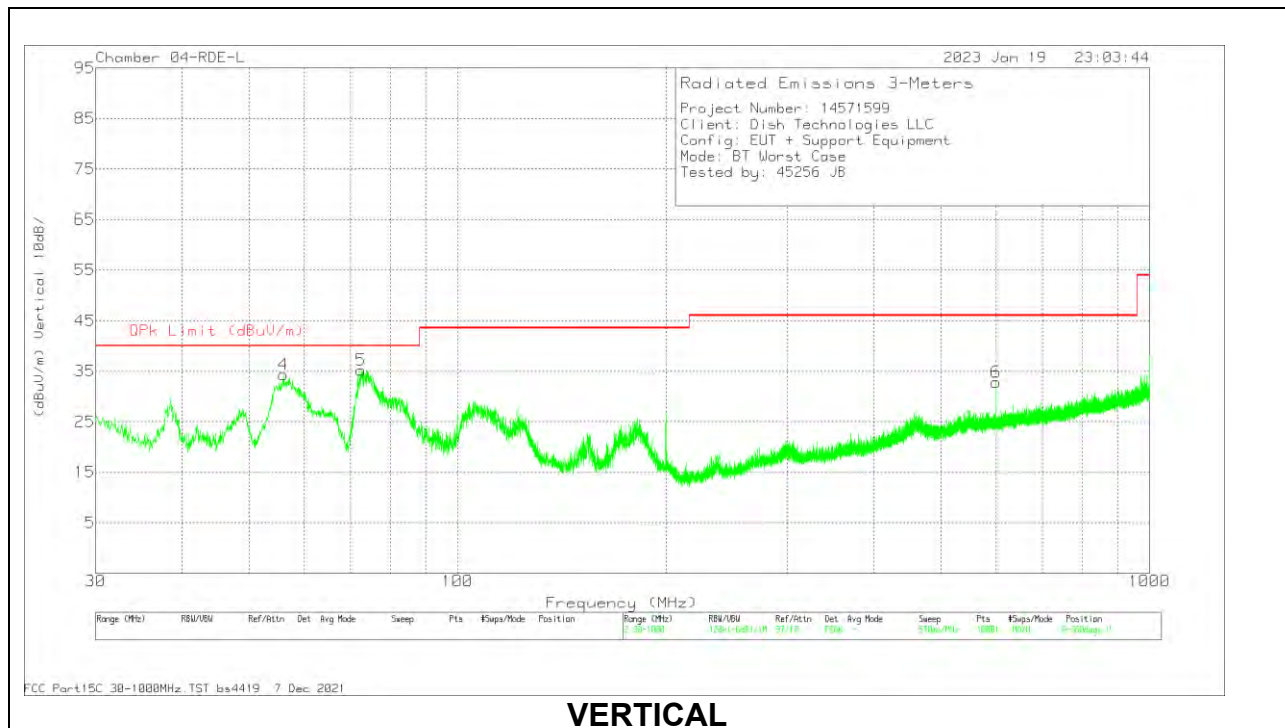
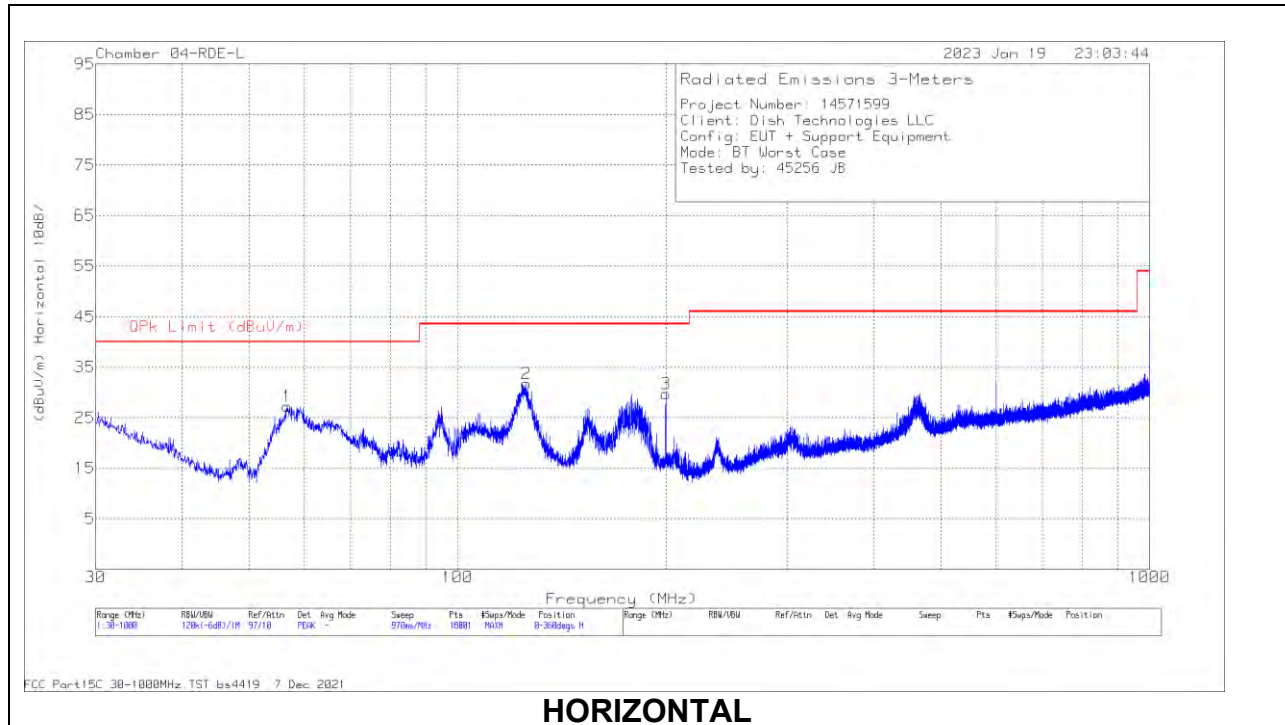
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna E(ACF)	Amp/Cbl (dB)	Dist Corr 300m (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)
1	.0124	13.05	Pk	60	-29.6	-80	-36.55	65.68	-102.23	45.68	-82.23
2	.3993	28.31	Pk	56.1	-32	-80	-27.59	35.58	-63.17	15.58	-43.17
6	.0125	13.81	Pk	60	-29.6	-80	-35.79	65.68	-101.47	45.68	-81.47
7	.3994	28.26	Pk	56.1	-32	-80	-27.64	35.58	-63.22	15.58	-43.22

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)
3	.7399	20.82	Pk	56.2	-31.9	-40	5.12	30.23	-25.11
8	.7436	21.32	Pk	56.2	-31.9	-40	5.62	30.19	-24.57
4	1.4675	16.03	Pk	44.5	-31.9	-40	-11.37	24.3	-35.67
5	25.571	23.05	Pk	33.3	-31.4	-40	-15.05	29.5	-44.55
9	1.4534	15.8	Pk	44.5	-31.9	-40	-11.6	24.38	-35.98
10	25.578	22.76	Pk	33.3	-31.4	-40	-15.34	29.5	-44.84

Pk - Peak detector

### 10.3. WORST CASE BELOW 1 GHZ

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





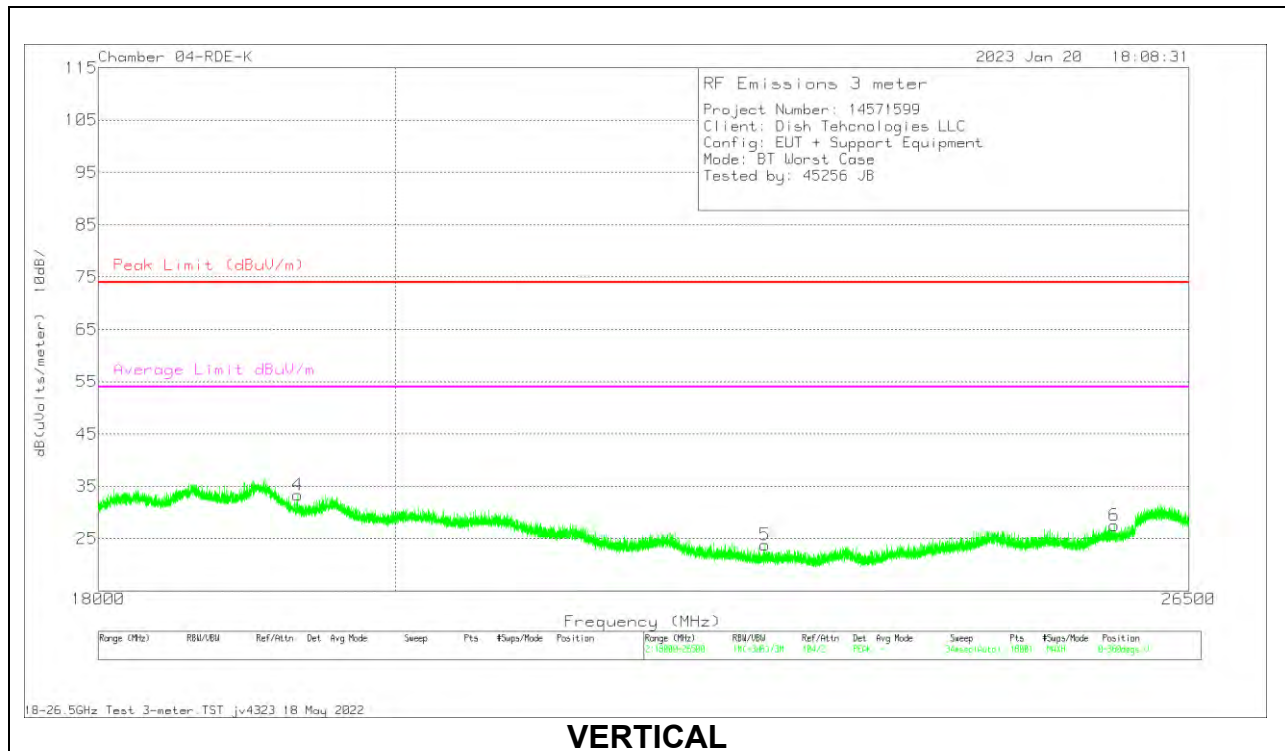
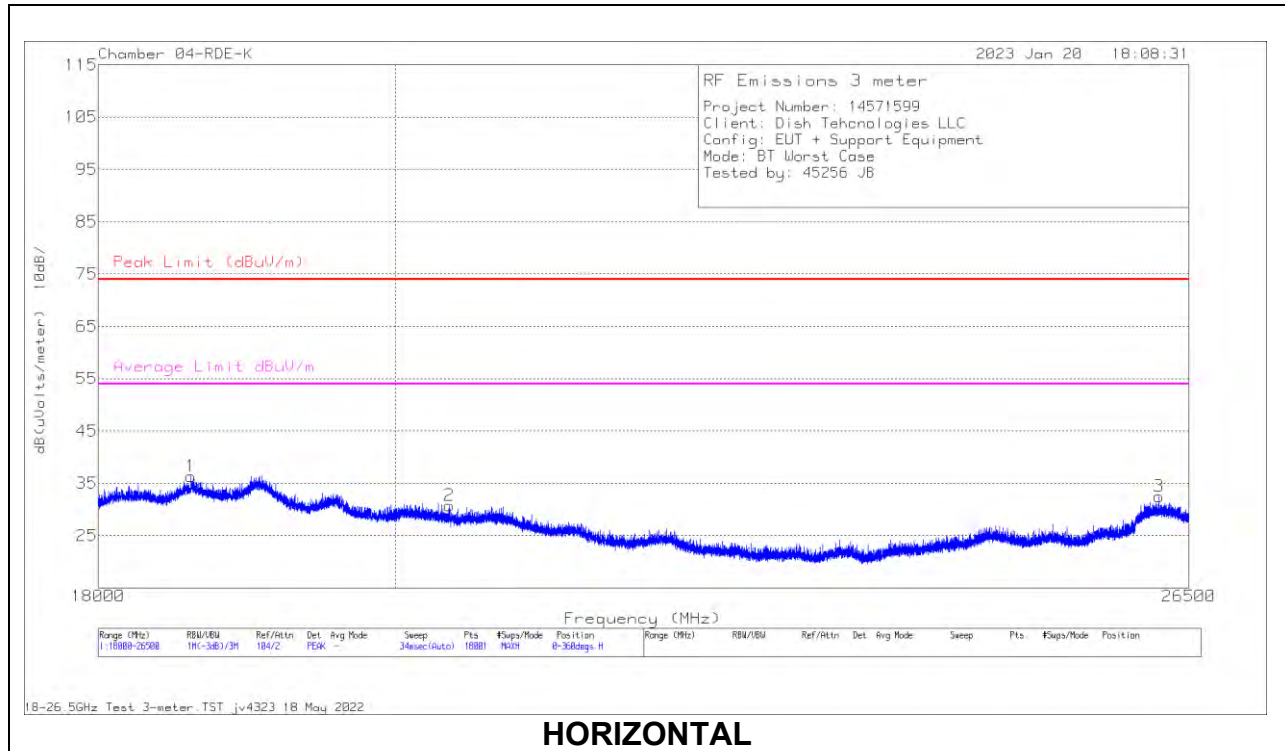
**Below 1GHz Data**

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	80293 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	56.7828	44.98	Pk	13.4	-31.1	27.28	40	-12.72	0-360	399	H
2	125.653	41.95	Pk	20.3	-30.5	31.75	43.52	-11.77	0-360	199	H
3	200.02	40.41	Pk	19.4	-30.1	29.71	43.52	-13.81	0-360	99	H
4	56.0823	52.01	Pk	13.4	-31.1	34.31	40	-5.69	0-360	101	V
	55.2388	47.58	Qp	13.5	-31.1	29.98	40	-10.02	2	160	V
5	72.5184	51.84	Pk	14.3	-30.9	35.24	40	-4.76	0-360	101	V
	73.5907	48.41	Qp	14.3	-30.9	31.81	40	-8.19	91	140	V
6	600.038	35.79	Pk	25.2	-28.2	32.79	46.02	-13.23	0-360	101	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 (MHz)	Meter Reading (dBuV)	Det	172364 AF (dB)	216708 amp/ctd (dB)	Cables (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Average Limit dBuV/m	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 18600.194	46.41	Pk	32.6	-60.6	17.9	36.31	74	-37.69	54	-17.69	0-360	101	H
2	* 20388.027	38.82	Pk	33.1	-59.8	18.6	30.72	74	-43.28	54	-23.28	0-360	101	H
3	26218.552	37.31	Pk	34.7	-60.8	21.3	32.51	74	-41.49	54	-21.49	0-360	101	H
4	* 19317.972	43.21	Pk	32.9	-61	18.2	33.31	74	-40.69	54	-20.69	0-360	101	V
5	* 22801.553	31.28	Pk	33.7	-60.9	19.7	23.76	74	-50.24	54	-30.24	0-360	199	V
6	25808.191	32.95	Pk	34.4	-60.9	21	27.45	74	-46.55	54	-26.55	0-360	199	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 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 C63.4.

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

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

### RESULTS

### LINE 1 RESULTS



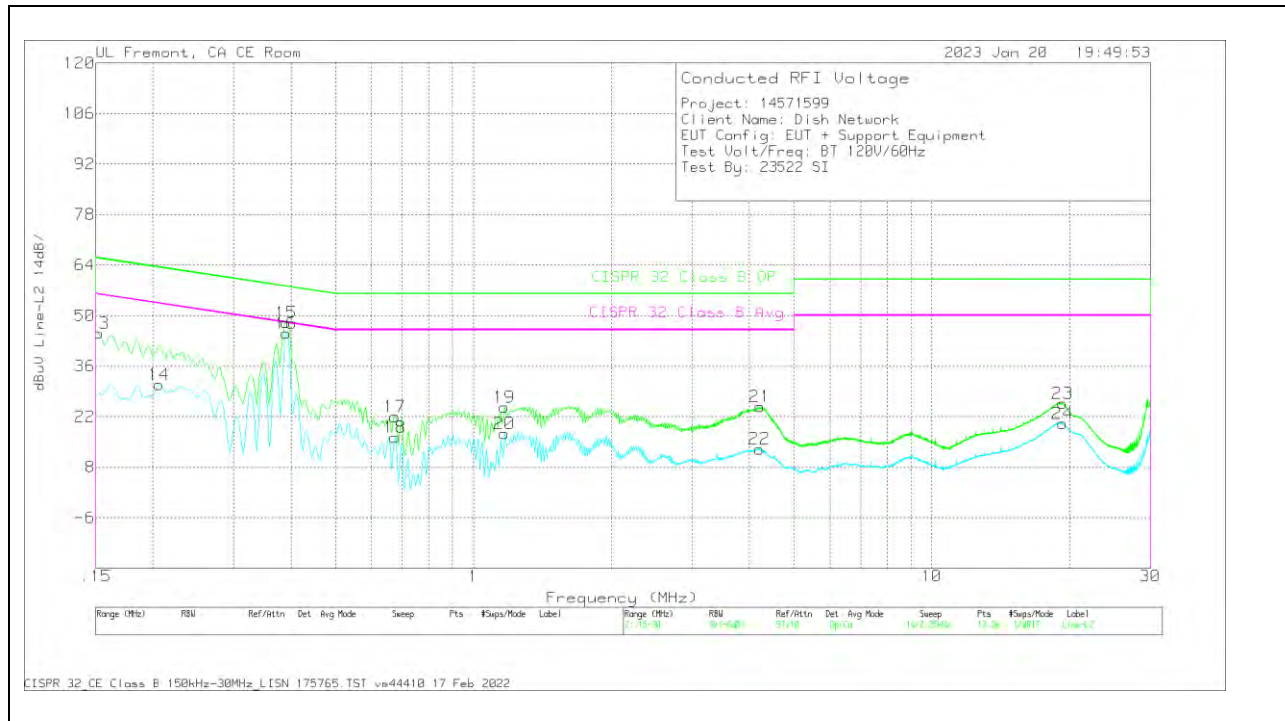
Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	175765 LISN L1	C1&C3 cable path loss	207996 Limiter with short cabl	Corrected Reading dBuV	CISPR 32 Class B QP	Margin (dB)	CISPR 32 Class B Avg	Margin (dB)
2	.1635	23.36	Ca	.1	0	9.4	32.86	-	-	55.28	-22.42
4	.3908	36.52	Ca	0	.1	9.3	45.92	-	-	48.05	-2.13
6	.6968	12.62	Ca	0	.1	9.3	22.02	-	-	46	-23.98
8	1.2503	11.91	Ca	0	.1	9.3	21.31	-	-	46	-24.69
10	4.1494	4.81	Ca	0	.1	9.3	14.21	-	-	46	-31.79
12	19.5045	9.24	Ca	.1	.3	9.3	18.94	-	-	50	-31.06
1	.1523	36.21	Qp	.1	0	9.4	45.71	65.88	-20.17	-	-
3	.3908	39.63	Qp	0	.1	9.3	49.03	58.05	-9.02	-	-
5	.6968	17.06	Qp	0	.1	9.3	26.46	56	-29.54	-	-
7	1.275	18.75	Qp	0	.1	9.3	28.15	56	-27.85	-	-
9	4.1415	15.4	Qp	0	.1	9.3	24.8	56	-31.2	-	-
11	19.509	14.58	Qp	.1	.3	9.3	24.28	60	-35.72	-	-

Qp - Quasi-Peak detector

Ca - CISPR average detection

NOTE: CISPR 32 limit is the same as FCC15.207

### LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	175765 LISN L2	C2&C3 cable path loss	207996 Limiter with short cabl	Corrected Reading dBuV	CISPR 32 Class B QP	Margin (dB)	CISPR 32 Class B Avg	Margin (dB)
14	.2063	21.53	Ca	0	0	9.4	30.93	-	-	53.35	-22.42
16	.3908	35.69	Ca	0	.1	9.3	45.09	-	-	48.05	-2.96
18	.6743	6.92	Ca	0	.1	9.3	16.32	-	-	46	-29.68
20	1.1693	7.87	Ca	0	.1	9.3	17.27	-	-	46	-28.73
22	4.2023	3.66	Ca	0	.1	9.3	13.06	-	-	46	-32.94
24	19.2885	10.47	Ca	.1	.3	9.3	20.17	-	-	50	-29.83
13	.1523	35.7	Qp	.1	0	9.4	45.2	65.88	-20.68	-	-
15	.3908	38.63	Qp	0	.1	9.3	48.03	58.05	-10.02	-	-
17	.6743	12.69	Qp	0	.1	9.3	22.09	56	-33.91	-	-
19	1.1693	15.2	Qp	0	.1	9.3	24.6	56	-31.4	-	-
21	4.2203	15.38	Qp	0	.1	9.3	24.78	56	-31.22	-	-
23	19.2795	15.91	Qp	.1	.3	9.3	25.61	60	-34.39	-	-

Qp - Quasi-Peak detector

Ca - CISPR average detection

NOTE: CISPR 32 limit is the same as FCC15.207