

TEST REPORT

Report Number. : 14441108-E7V1

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

Model : D45

Brand : DISH

FCC ID : DKNU49F

EUT Description : TV SET TOP BOX

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

Date Of Issue:
2022-10-12

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	2022-10-12	Initial Issue	---

TABLE OF CONTENTS

REPORT REVISION HISTORY	2
TABLE OF CONTENTS	3
1. ATTESTATION OF TEST RESULTS	5
2. TEST RESULT SUMMARY	7
3. TEST METHODOLOGY	8
4. FACILITIES AND ACCREDITATION	8
5. DECISION RULES AND MEASUREMENT UNCERTAINTY	9
5.1. METROLOGICAL TRACEABILITY	9
5.2. DECISION RULES.....	9
5.3. MEASUREMENT UNCERTAINTY.....	9
5.4. SAMPLE CALCULATION	9
6. EQUIPMENT UNDER TEST	10
6.1. EUT DESCRIPTION	10
6.2. INTRODUCTION OF TEST DATA REUSE.....	10
6.3. SPOT CHECK VERIFICATION RESULTS SUMMARY	11
6.4. DESCRIPTION OF AVAILABLE ANTENNAS	12
6.5. SOFTWARE AND FIRMWARE.....	12
6.6. WORST-CASE CONFIGURATION AND MODE.....	12
6.7. DESCRIPTION OF TEST SETUP.....	13
7. MEASUREMENT METHOD.....	15
8. TEST AND MEASUREMENT EQUIPMENT	15
9. RADIATED TEST RESULTS.....	16
9.1. TRANSMITTER ABOVE 1 GHz (BLE)	17
9.2. TRANSMITTER ABOVE 1 GHz (BT)	21
9.3. TRANSMITTER ABOVE 1 GHz (UNII 802.11ac)	25
9.4. TRANSMITTER ABOVE 1 GHz (UNII 802.11ax)	29
9.5. SPURIOUS EMISSIONS FOR CO-LOCATION	33
10. SETUP PHOTOS.....	36

Appendix A - Reference Test Report	37
---	-----------

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: RADIATED: E4EXUH00459D, CONDUCTED: E4EXUJ03008G

SAMPLE RECEIPT DATE: 2022-09-08

DATE TESTED: 2022-09-14 TO 2022-09-28, 2022-10-10

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies
CFR 47 Part 15 Subpart E	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:



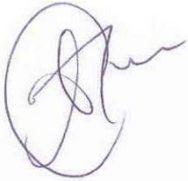
Francisco deAnda
Staff Engineer
Consumer Technology Division
UL Verification Services Inc.

Prepared By:



Gerardo Abrego
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 RESULT 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.

Below is a list of the data provided by the customer:

1. Antenna gain and type (see section 6.4)

BT

FCC Clause	Requirement	Result	Comment
See Comment	Duty Cycle	Not performed	Per ANSI C63.10, Section 11.6.
See Comment	20dB BW	Not performed	ANSI C63.10 Sections 6.9.2 and 6.9.3
15.247 (a)(1)	Hopping Frequency Separation	Not performed	None.
15.247 (a)(1)(iii)	Number of Hopping Channels	Not performed	None.
15.247 (a)(1)(iii)	Average Time of Occupancy	Not performed	None.
15.247 (b)(1)	Output Power	Partial testing performed and complies	None.
See Comment	Average Power	Partial testing performed and complies	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (d)	Conducted Spurious Emissions	Not performed	None.
15.209, 15.205	Radiated Emissions	Partial testing performed and complies	None.
15.207	AC Mains Conducted Emissions	Not performed	None.

BLE/R4CE Zigbee

FCC Clause	Requirement	Result	Comment
See Comment	Duty Cycle	Not performed	ANSI C63.10 Section 11.6.
-	99% OBW	Not performed	ANSI C63.10 Section 6.9.3.
15.247 (a) (2)	6dB BW	Not performed	None.
15.247 (b) (3)	Output Power	Partial testing performed and complies	None.
See Comment	Average power	Partial testing performed and complies	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	PSD	Not performed	None.
15.247 (d)	Conducted Spurious Emissions	Not performed	None.
15.209, 15.205	Radiated Emissions	Partial testing performed and complies	None.
15.207	AC Mains Conducted Emissions	Not performed	None.

UNII

FCC Clause	Requirement	Result	Comment
See Comment	Duty Cycle	Not performed	Per ANSI C63.10, Section 12.2.
See Comment	26dB BW/99% OBW	Not performed	Per ANSI C63.10 Sections 6.9.2 and 6.9.3
15.407 (e)	6 dB BW	Not performed	None.
15.407 (a) (1-3), (h) (1)	Output Power	Partial testing performed and complies	None.
15.407 (a) (1-3)	PSD	Not performed	None.
15.209, 15.205, 15.407 (b)	Radiated Emissions	Partial testing performed and complies	None.
15.207	AC Mains Conducted Emissions	Not performed	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
- KDB 558074 D01 15.247 Meas Guidance v05r02
- FCC KDB 662911 D01 v02r01,D03 v01
- FCC KDB 905462 D02 v02/D03 v01r02/D06 v02
- FCC KDB 789033 D02 v02r01,
- KDB 414788 D01 Radiated Test Site v01r01
- ANSI C63.10-2013
- KDB 484596 D01

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	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 _{Lab}
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 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:

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 TV Set Top Box with RF4CE Zigbee, BLE (2Mbps), BT and 5GHz 802.11a/n/ac/ax radios.

6.2. INTRODUCTION OF TEST DATA REUSE

This application for certification is leveraging the data reuse procedures from KDB 484596 D01 based on reference FCC ID: DKNRW33, to cover FCC ID: DKNU49F.

The major difference between two FCC IDs is FCC ID: DKNU49F is using a new Zigbee radio, all other circuitry and features are identical.

This report covers the BT/BLE/UNII and RF4CE Zigbee radios portion for FCC ID: DKNU49F, where referenced FCC IDs for BT/BLE/UNII data is reused. Verification testing was performed on worst-case modes for colocation and radiated emissions(BE/RSE) from BT/BLE/UNII's previous FCC ID: DKNRW33 to ensure the EUT remains compliant with new RF4CE Zigbee radio, FCC ID: DKNU49F. See reference information as below.

Reference application that contains the reused reference data which is attached to this report in Appendix A.

Equipment Class	Reference FCC ID	Frequency Range	Reference Report	Report Title/Section
DTS	DKNRW33	2402 to 2480 MHz	13619076-E1V2	BLE Report / All sections
FHSS	DKNRW33	2402 to 2480 MHz	13619076-E2V2	BT Report / All sections
NII	DKNRW33	5180 to 5720 MHz	13619076-E4V3	UNII_802.11n_ac modes/All sections
NII	DKNRW33	5180 to 5720 MHz	13619076-E5V3	UNII_802.11ax/ All sections
NII	DKNRW33	5250-5350 MHz, 5470-5725 MHz	13619076-E8V2	UNII WLAN DFS/ All sections

6.3. SPOT CHECK VERIFICATION RESULTS SUMMARY

Test Engineer: 12485 GA				Test Date: 2022-10-10				
FCC ID: DKNU49F SPOT CHECK RESULTS								
Technology	Mode	Test Item	Channel	Original model Output power (dBm)		Spot check model Output power (dBm)		
				D45		D45		
				DKNRW33		DKNU49F		
				Peak	Avg	Peak	Avg	
BLE	BLE	Output power	2402MHz, Low	9.09	8.71	9.2	8.87	
			2480MHz, High	8.32	7.95	8.88	8.13	
BT	GFSK		2402MHz, Low	9.46	9.35	9.59	9.38	
			2441MHz, Mid	9.7	9.6	9.71	9.63	
	8PSK		2480MHz, High	7.98	5.15	7.79	4.99	
UNII	802.11n HT40 CDD 3TX		High (Channel 62, 5310MHz)	--	18.93	--	18.32	
	802.11n HT40 CDD 3TX		Low (Channel 151, 5755MHz)	--	23.97	--	22.55	
	802.11ac VHT80 3TX		Channel 155, 5775MHz	--	26.53	--	23.45	
	802.11ax HE80 OFDMA 3TX		Low (Channel 106, 5530MHz, 26T, index 0)	--	9.96	--	8.18	
	802.11ax HE20 OFDMA 3TX		High (Channel 165, 5825MHz, 26T, index 8)	--	11.34	--	11.7	

FCC ID: DKNU49F SPOT CHECK RESULTS									
Technology	Mode	Test Item	Channel	Original model (Worst margin dB)		Spot check model (Worst margin dB)		Delta (dB)	
				D45		D45			
				DKNRW33		DKNU49F			
				H	V	H	V	H	V
BLE	BLE	RBE	2480MHz, High	-13.32	-14.05	-11.63	-11.64	1.69	2.41
BT	GFSK		2480MHz, High	-13.12	-13.33	-14.07	-14.08	-0.95	-0.75
UNII	802.11n HT40 CDD 3TX		High (Channel 62, 5310MHz)	-1.08	-0.51	-0.96	-1.17	0.12	-0.66
UNII	802.11ax HE80 OFDMA 3TX		Low (Channel 106, 5530MHz, 26T, index 0)	-1.53	-0.48	-1.18	-2.47	0.35	-1.99
				Worst margin (dB)		Worst margin (dB)		Delta (dB)	
BLE	BLE	RSE	2402MHz, Low	-6.56		-9.5		-2.94	
BT	8PSK		2480MHz, High	-5.09		-10.24		-5.15	
UNII	802.11n HT40 CDD 3TX		Low (Channel 151, 5755MHz)	-0.96		-1.84		-0.88	
UNII	802.11ax HE20 OFDMA 3TX		High (Channel 165, 5825MHz, 26T, index 8)	-0.1		-2.82		-2.72	
BT/Zigbee/UNII simultaneous RSE above 1G				-3.84		-1.22		-2.62	

Comparison of the models, deviation is within 3dB range and all tests are under FCC Technical Limits.

6.4. DESCRIPTION OF AVAILABLE ANTENNAS

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

The RF4CE Zigbee radio utilizes a PCB Inverted F antenna, with a maximum gain of 4.1 dBi.
The BT/BLE radio utilizes a PCB Inverted F antenna, with a maximum gain of 4.2 dBi.

According to FCC KDB 662911 D03 v01, a measurement of directional gain of multi-antenna systems is allowed for compliance verification. Antenna gains are approved through manufacturers KDB. KDB reference can be found as part of the original certification.

EUT uses three antennas for 5GHz 3TX MIMO operation. The radio utilizes PCB Inverted F antennas. Below is total gain per operational band;

Frequency Band	Uncorrelated Total Gain	Correlated Total Gain
5.15 to 5.25 GHz	2.5	6.9
5.25 to 5.35 GHz	3.2	7.7
5.47 to 5.725 GHz	3.2	7.8
5.725 to 5.85 GHz	2.9	7.6

6.5. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was :

Zigbee FW: TL8656_V0008

BT/BLE FW: BCM 02.011.0330.0000

Wifi FW: Linux with MFG Driver

The EUT utility installed during testing was:

BT/BLE Utility: cybluetool 0.1.55.1

Wifi Utility: BRDCM MTool 3.2.1.3

6.6. WORST-CASE CONFIGURATION AND MODE

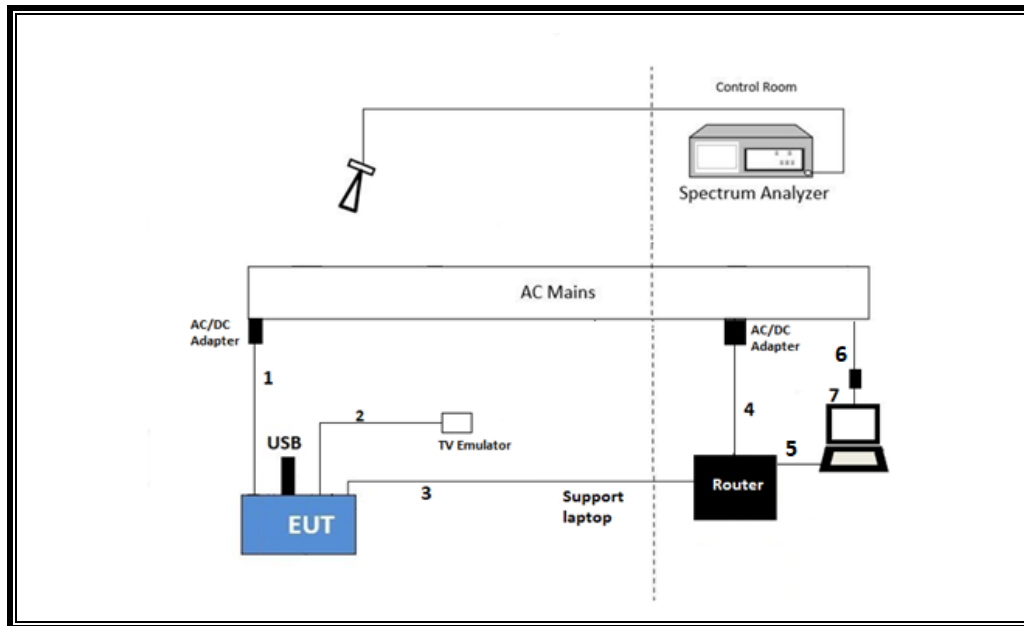
The EUT is a desktop device, therefore, all final radiated testing was performed with the EUT in X orientation.

This EUT supports BLE/BT + Zigbee + WLAN 5GHz simultaneous transmission. Radiated emission test 1GHz to 18GHz , BT/BLE and UNII's previous FCC ID: DKNRW33 worst-case modes were performed on this FCC ID: DKNU49F to ensure the EUT remains compliant with new RF4CE Zigbee radio.

6.7. 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
USB Flash Drive		Sandisk	Cruzer Glide 16GB	SDCZ60-016G		DoC
I/O CABLES (RADIATED 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	HDMI	1	HDMI	shielded	2.5	EUT to Emulator
3	RJ45	1	RJ45	Un-shielded	More than 3	EUT to Ethernet Router
4	DC	1	Barrel	Un-shielded	1.8	Ethernet router to AC/DC Adapter
5	RJ45	1	RJ45	Un-shielded	More than 3	EUT to Ethernet Router
6	AC	1	Two Prong	Un-shielded	2	AC adapter to AC Mains
7	DC	1	DC	Un-shielded	1	AC Adapter Laptop

RF RADIATED TEST SETUP DIAGRAM



TEST SETUP

The EUT is connected to a test laptop by RJ45 cable, support equipment and powered by AC/DC adapter during the tests. BT/BLE/WIFI using test software exercised the radio. Zigbee is using power cycle to switch the test mode.

7. MEASUREMENT METHOD

Unwanted emissions in restricted bands: KDB 789033 D02 v02r01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v02r01, Sections G.3, G.4, and G.5.

8. 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	80403	2023-06-08	2022-06-08
RF Filter Box, 1-18GHz	UL-FR1	NA	171389	2023-05-31	2022-05-31
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	201497	2023-02-18	2022-02-18
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	80402	2023-07-05	2022-07-05
RF Filter Box, 8 port, 1-18GHz	UL-FR1	SAC 8 port rf box 1	197920	2023-04-19	2022-04-19
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	169927	2023-02-16	2022-02-16
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	90388	2023-01-24	2022-01-24
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	90733	2023-01-24	2022-01-24
Test Software List					
Description	Manufacturer	Model	Version		
Radiated Software	UL	UL EMC	Sept 15 2022, Dec 29 2015, Jun 4 2020, Aug 23 2016, Dec 16 2020		

9. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209 -Restricted bands

FCC §15.407(b)(1-3) -Un-Restricted bands

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
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 as applicable for average measurements.

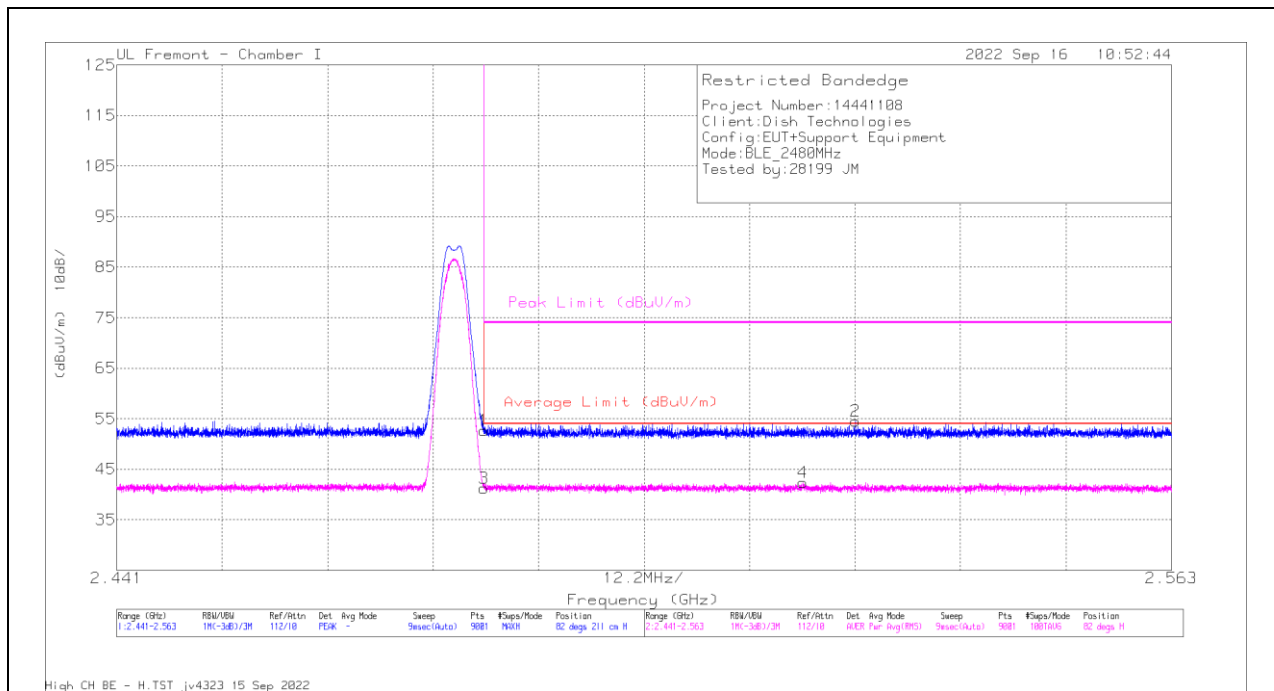
The spectrum from 30 MHz to 1GHz and 18GHz to 40 GHz is investigated with the transmitter set to transmit at the channel with highest output power as worst-case scenario. 1GHz to 18GHz was set to the lowest, middle, and highest channels in the 5 GHz bands.

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.

9.1. TRANSMITTER ABOVE 1 GHz (BLE)

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



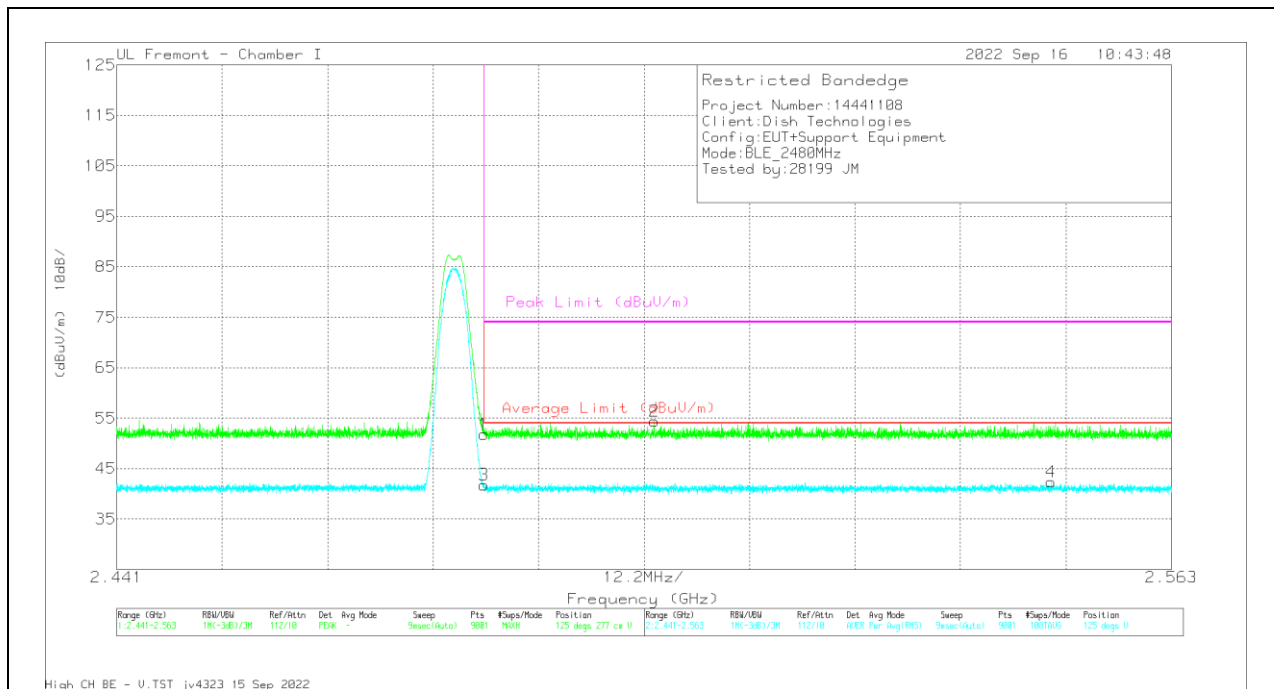
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	Amp/Cbl/Pad (dB)	DC factor (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	41.19	Pk	32.6	-21.1	-	52.69	-	-	74	-21.31	82	211	H
2	2.526443	43.02	Pk	32.6	-21.1	-	54.52	-	-	74	-19.48	82	211	H
3	* 2.4835	29.75	RMS	32.6	-21.1	0	41.25	54	-12.75	-	-	82	211	H
4	2.520384	30.77	RMS	32.6	-21	0	42.37	54	-11.63	-	-	82	211	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 Antenna ACF(dB)	Amp/Cbl/Pad (dB)	DC factor (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	40.26	Pk	32.6	-21.1	-	51.76	-	-	74	-22.24	125	277	V
2	2.503195	42.94	Pk	32.6	-21.1	-	54.44	-	-	74	-19.56	125	277	V
3	* 2.4835	30.28	RMS	32.6	-21.1	0	41.78	54	-12.22	-	-	125	277	V
4	2.549096	30.76	RMS	32.7	-21.1	0	42.36	54	-11.64	-	-	125	277	V

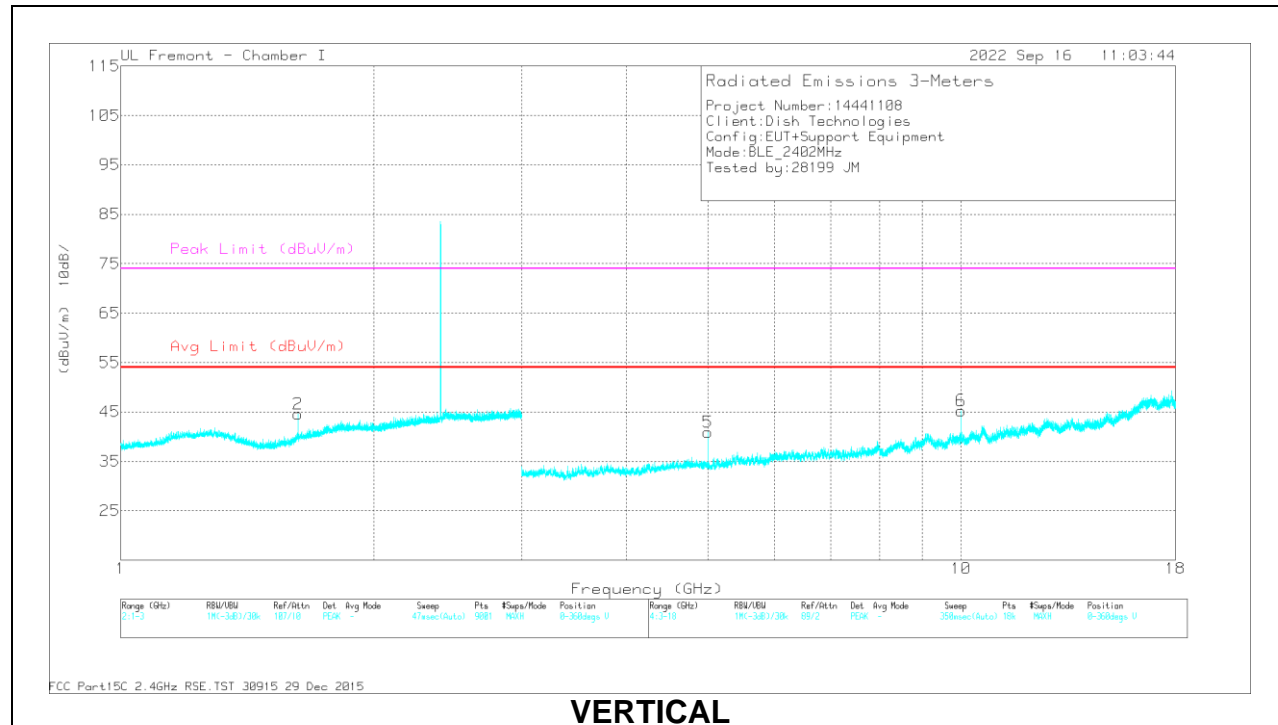
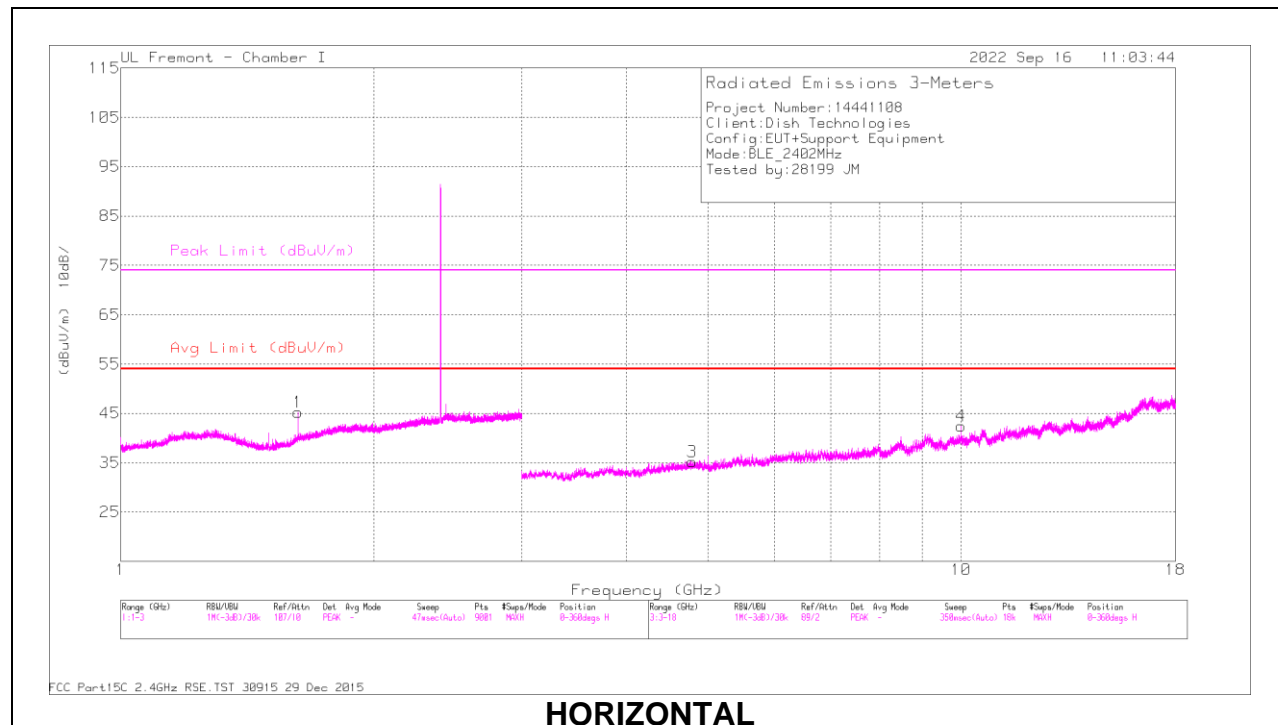
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	Amp/Cbl/Pad (dB)	DC factor (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.62478	43.64	PK2	29.1	-21.8	-	50.94	-	-	74	-23.06	46	103	H
	* 1.62516	37.2	MAv1	29.1	-21.8	0	44.5	54	-9.5	-	-	46	103	H
2	* 1.62516	43.16	PK2	29.1	-21.8	-	50.46	-	-	74	-23.54	66	203	V
	* 1.62516	35.76	MAv1	29.1	-21.8	0	43.06	54	-10.94	-	-	66	203	V
3	* 4.791966	37.52	PK2	34.6	-27.6	-	44.52	-	-	74	-29.48	216	133	H
	* 4.790628	25.65	MAv1	34.7	-27.5	0	32.85	54	-21.15	-	-	216	133	H
4	10.000416	35.73	PK2	37.5	-21.5	-	51.73	-	-	-	-	335	102	H
	10.000124	27.16	MAv1	37.5	-21.5	0	43.16	-	-	-	-	335	102	H
5	* 5.000159	41.98	PK2	34.4	-28.5	-	47.88	-	-	74	-26.12	219	140	V
	* 5.000099	34.83	MAv1	34.4	-28.5	0	40.73	54	-13.27	-	-	219	140	V
6	10.000268	37.12	PK2	37.5	-21.5	-	53.12	-	-	-	-	61	109	V
	10.000245	29.28	MAv1	37.5	-21.5	0	45.28	-	-	-	-	61	109	V

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

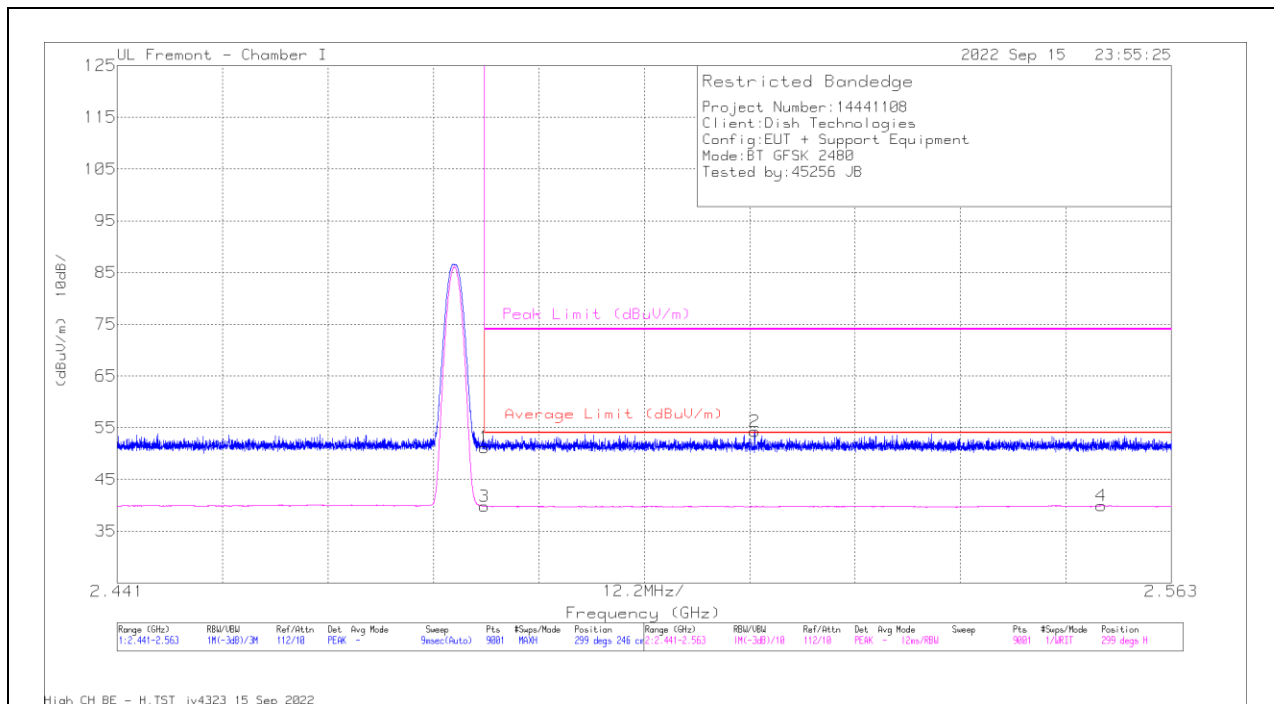
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

9.2. TRANSMITTER ABOVE 1 GHz (BT)

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



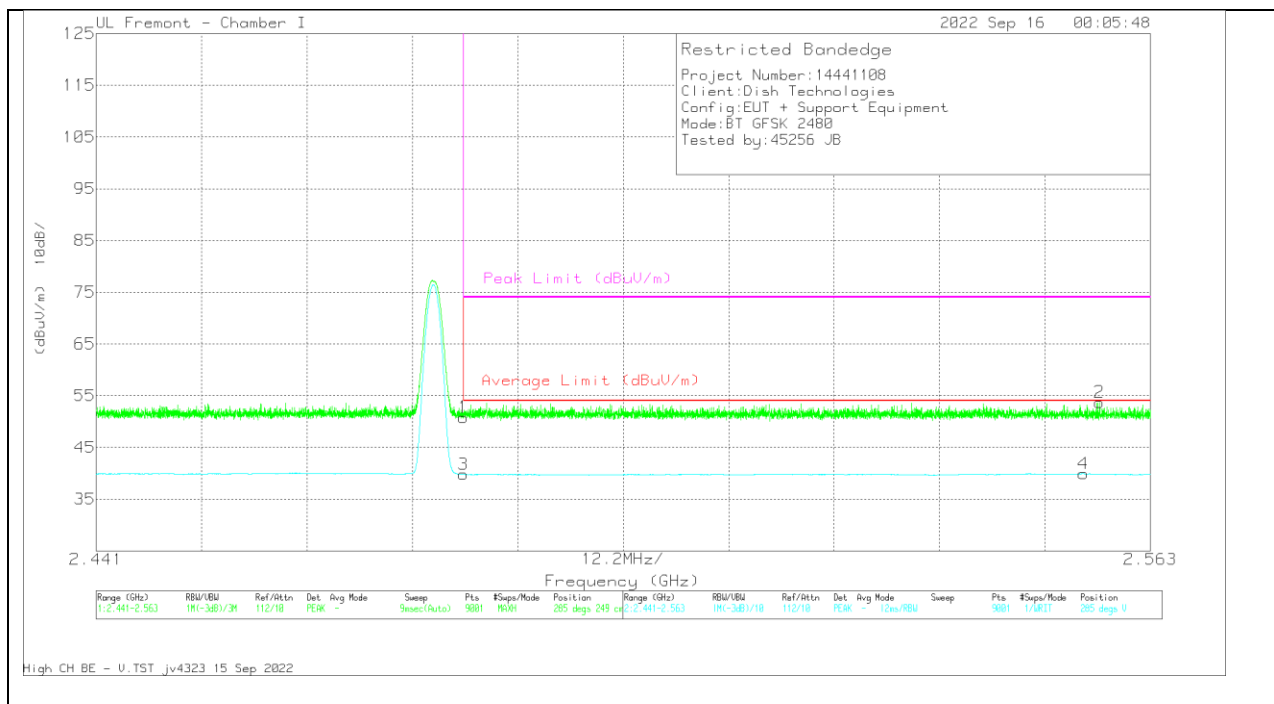
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	39.67	Pk	32.6	-21.1	51.17	-	-	74	-22.83	299	246	H
2	2.514772	42.87	Pk	32.6	-21.2	54.27	-	-	74	-19.73	299	246	H
3	* 2.4835	28.31	VA1T	32.6	-21.1	39.81	54	-14.19	-	-	299	246	H
4	2.554898	28.33	VA1T	32.7	-21.1	39.93	54	-14.07	-	-	299	246	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



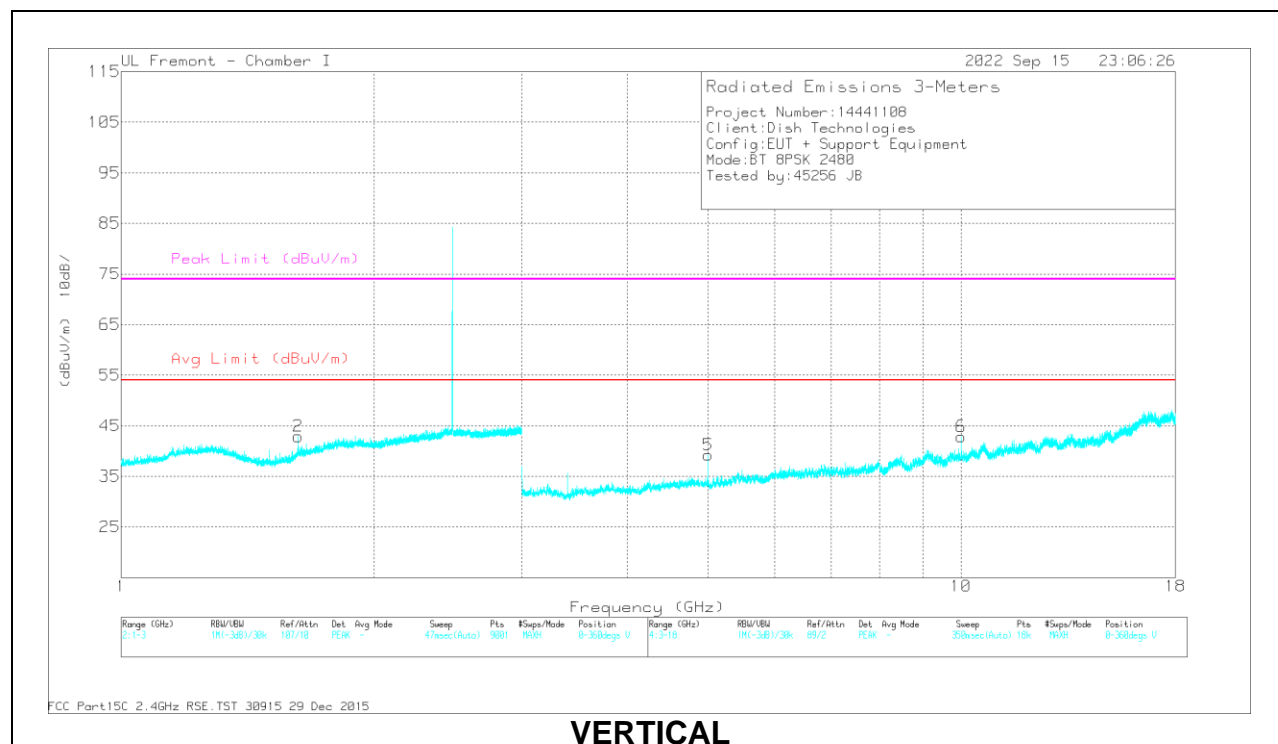
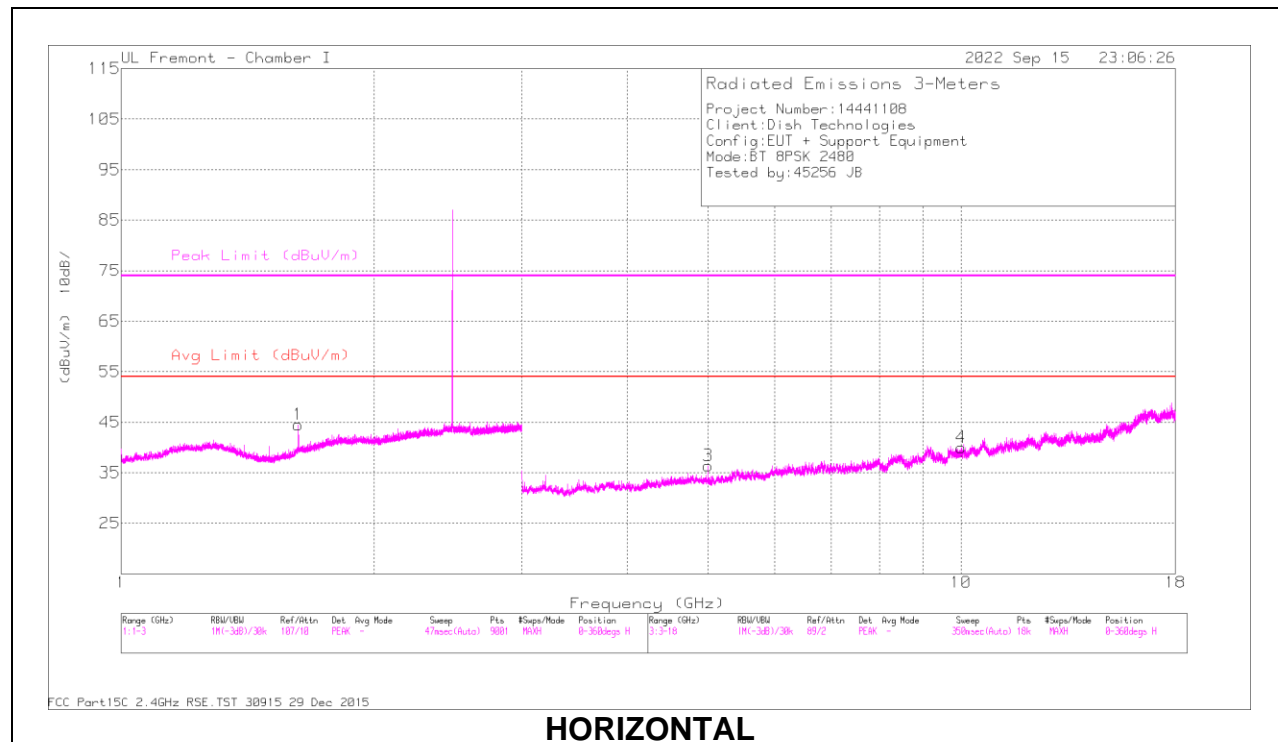
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	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	* 1.625056	43.94	PKFH	29.1	-21.8	51.24	-	-	74	-22.76	66	163	H
	* 1.625027	36.46	VA1T	29.1	-21.8	43.76	54	-10.24	-	-	66	163	H
2	* 1.625116	43.13	PKFH	29.1	-21.8	50.43	-	-	74	-23.57	86	281	V
	* 1.625035	35.65	VA1T	29.1	-21.8	42.95	54	-11.05	-	-	86	281	V
3	* 5.000058	37.4	PKFH	34.4	-28.5	43.3	-	-	74	-30.7	225	131	H
	* 5.000042	27.83	VA1T	34.4	-28.5	33.73	54	-20.27	-	-	225	131	H
4	10.000392	23.98	Pk	37.5	-21.5	39.98	-	-	-	-	0-360	101	H
5	* 5.000092	39.37	PKFH	34.4	-28.5	45.27	-	-	74	-28.73	214	132	V
	* 5.000076	32.05	VA1T	34.4	-28.5	37.95	54	-16.05	-	-	214	132	V
6	10.000392	26.84	Pk	37.5	-21.5	42.84	-	-	-	-	0-360	101	V

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

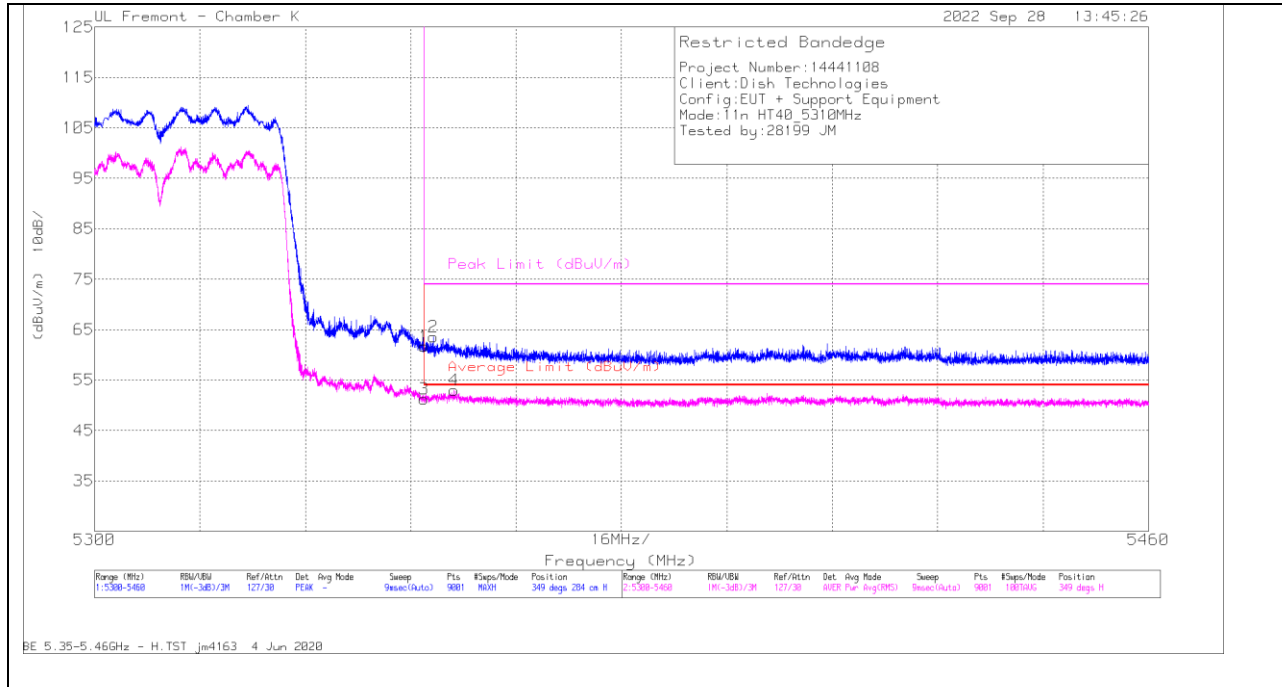
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak

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

9.3. TRANSMITTER ABOVE 1 GHz (UNII 802.11ac)

BANDEDGE (HIGH CHANNEL)

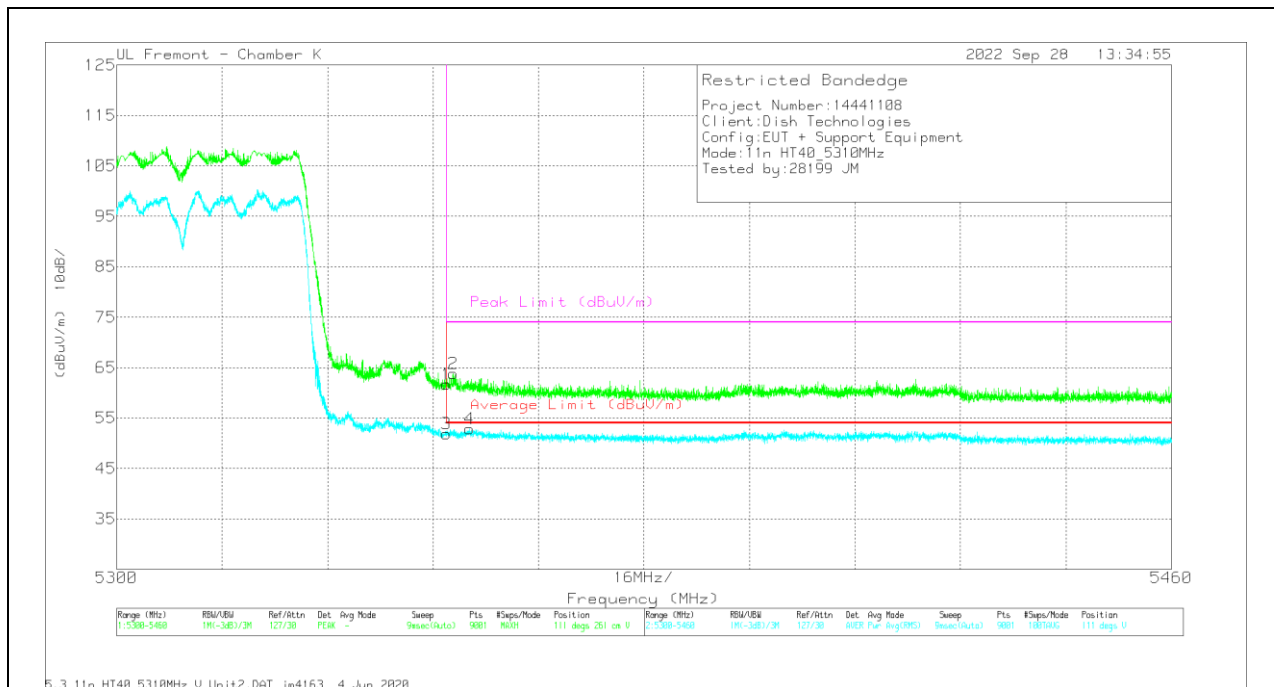
HORIZONTAL RESULT



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	80402 ACF(dB) - 3mH	Amp/Cbl/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 5350	57.72	Pk	34.7	-30.7	0	61.72	-	-	74	-12.28	349	284	H
2	* 5351.467	59.54	Pk	34.7	-30.7	0	63.54	-	-	74	-10.46	349	284	H
3	* 5350	44.59	RMS	34.7	-30.7	2.63	51.22	54	-2.78	-	-	349	284	H
4	* 5354.578	46.41	RMS	34.7	-30.7	2.63	53.04	54	-96	-	-	349	284	H

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

VERTICAL RESULT



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	90402 ACF(dB) - 3mH	Amp/Cbl/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 5350	57.66	Pk	34.7	-30.7	0	61.66	-	-	74	-12.34	111	261	V
2	* 5351.094	58.86	Pk	34.7	-30.7	0	63.86	-	-	74	-10.14	111	261	V
3	* 5350	45.22	RMS	34.7	-30.7	2.63	51.85	54	-2.15	-	-	111	261	V
4	* 5353.565	46.2	RMS	34.7	-30.7	2.63	52.83	54	-1.17	-	-	111	261	V

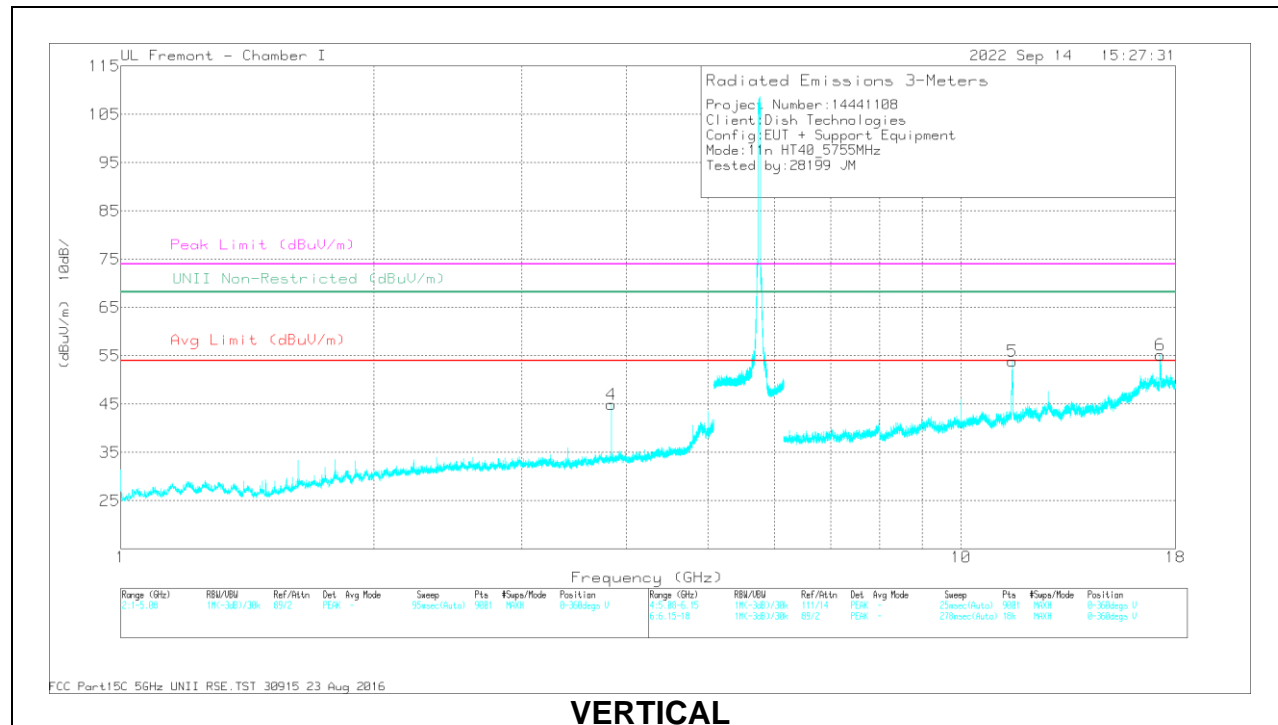
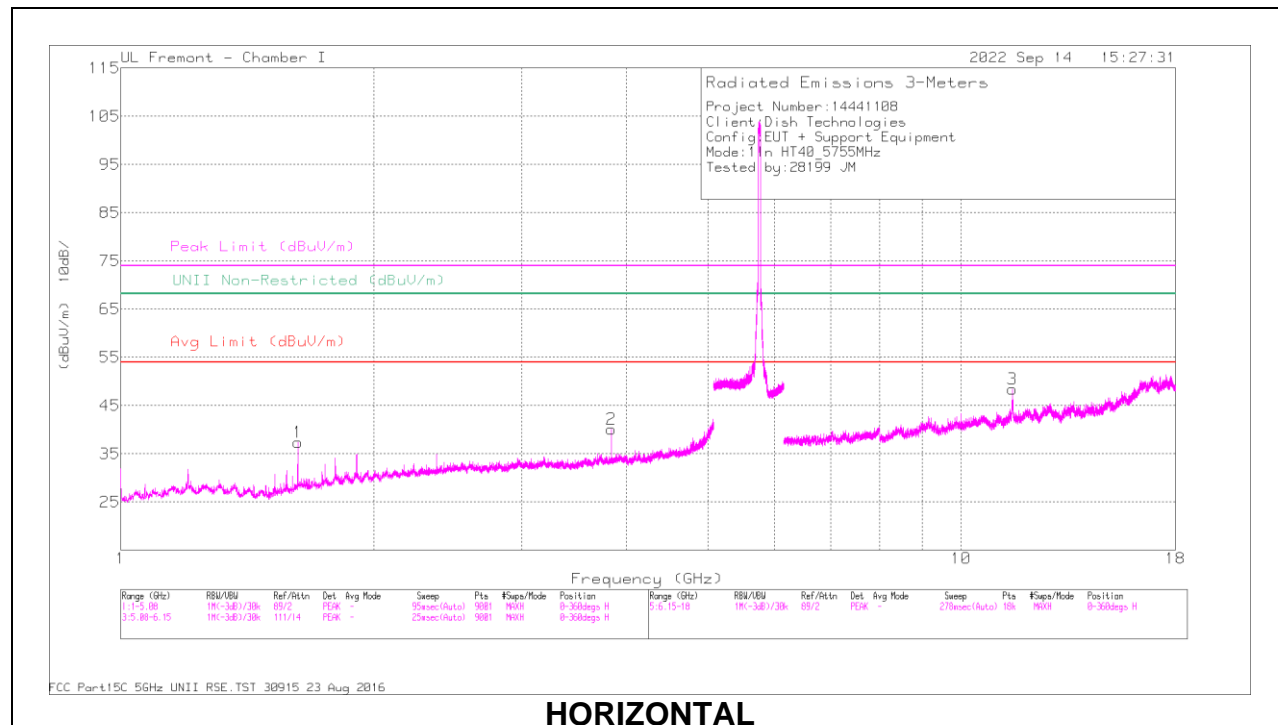
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

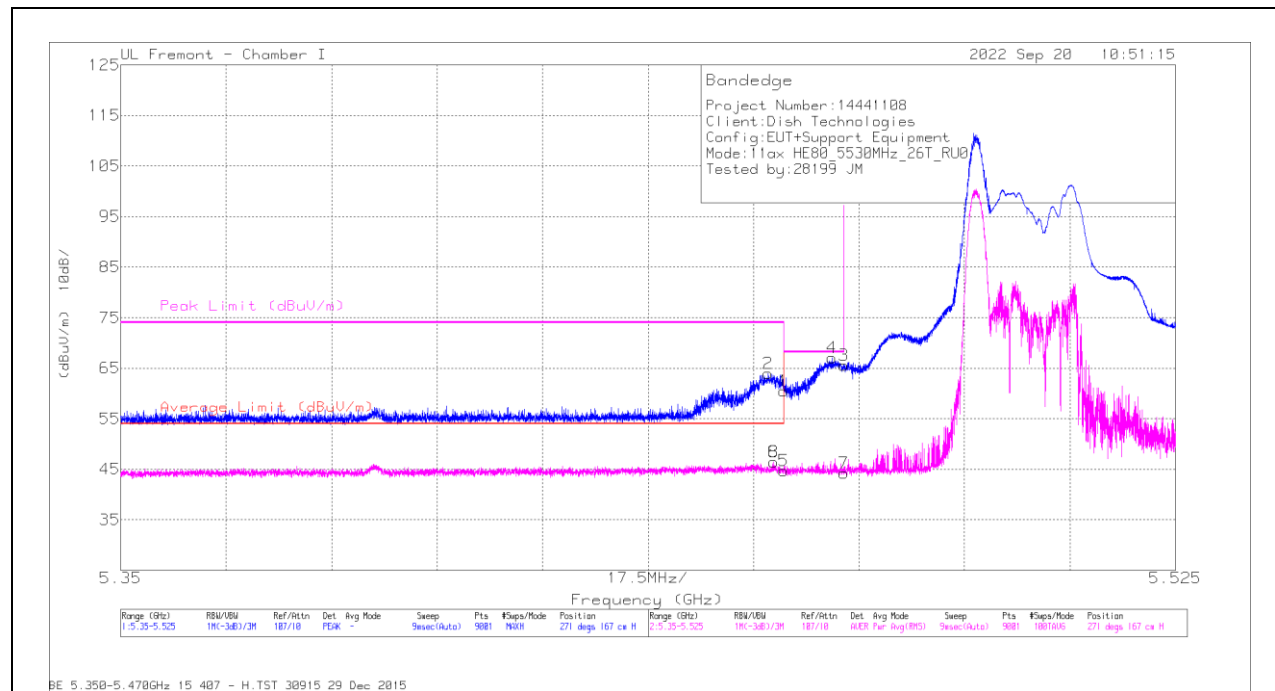
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	Amp/Cbl/Fitter (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.62516	46.41	PK-U	29.1	-32.3	0	43.21	-	-	74	-30.79	-	-	51	195	H
	* 1.62516	39.93	ADR	29.1	-32.3	2.63	39.36	54	-14.64	-	-	-	-	51	195	H
2	* 3.836453	42.76	PK-U	33.8	-29.8	0	46.76	-	-	74	-27.24	-	-	355	137	H
	* 3.836577	35.59	ADR	33.8	-29.8	2.63	42.22	54	-11.78	-	-	-	-	355	137	H
3	* 3.836658	44.75	PK-U	33.8	-29.8	0	48.75	-	-	74	-25.25	-	-	191	214	V
	* 3.836614	39.86	ADR	33.8	-29.8	2.63	46.49	54	-7.51	-	-	-	-	191	214	V
4	* 11.509484	39.71	PK-U	38.6	-18.8	0	59.51	-	-	74	-14.49	-	-	162	106	H
	* 11.510951	25.12	ADR	38.6	-19	2.63	47.35	54	-6.65	-	-	-	-	162	106	H
5	* 11.509468	44.1	PK-U	38.6	-18.8	0	63.9	-	-	74	-10.1	-	-	260	102	V
	* 11.511067	29.93	ADR	38.6	-19	2.63	52.16	54	-1.84	-	-	-	-	260	102	V
6	17.260595	36.87	PK-U	41.6	-13.9	0	64.57	-	-	-	-	68.2	-3.63	321	103	V
	17.258933	23.45	ADR	41.6	-13.9	2.63	53.78	-	-	-	-	-	-	321	103	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U - U-NII: Maximum Peak
ADR - U-NII AD primary method, RMS average

9.4. TRANSMITTER ABOVE 1 GHz (UNII 802.11ax)

BANDEDGE (LOW CHANNEL)

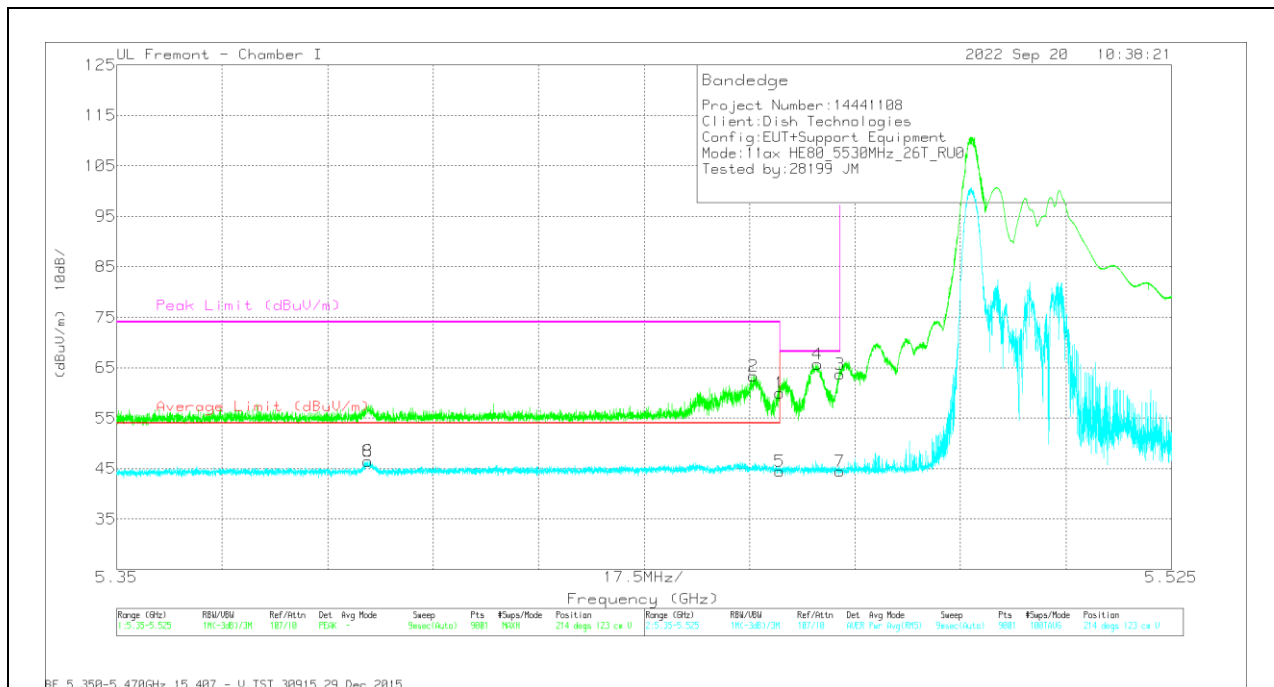
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	Amp/Cb/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 5.46	42.7	PK	35.1	-17.3	0	60.5	-	-	68.2	-7.7	271	167	H
2	* 5.45737	46.03	PK	35.1	-17.2	0	63.93	-	-	74	-10.07	271	167	H
3	5.47	47.69	PK	35.1	-17.2	0	65.59	-	-	68.2	-2.61	271	167	H
4	5.468006	49.22	PK	35.1	-17.3	0	67.02	-	-	68.2	-1.18	271	167	H
5	* 5.46	26.79	RMS	35.1	-17.3	.13	44.72	54	-9.28	-	-	271	167	H
6	* 5.458342	28.39	RMS	35.1	-17.2	.13	46.42	54	-7.58	-	-	271	167	H
7	5.47	26.2	RMS	35.1	-17.2	.13	44.23	-	-	-	-	271	167	H
8	* 5.458342	28.39	RMS	35.1	-17.2	.13	46.42	54	-7.58	-	-	271	167	H

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

VERTICAL RESULT

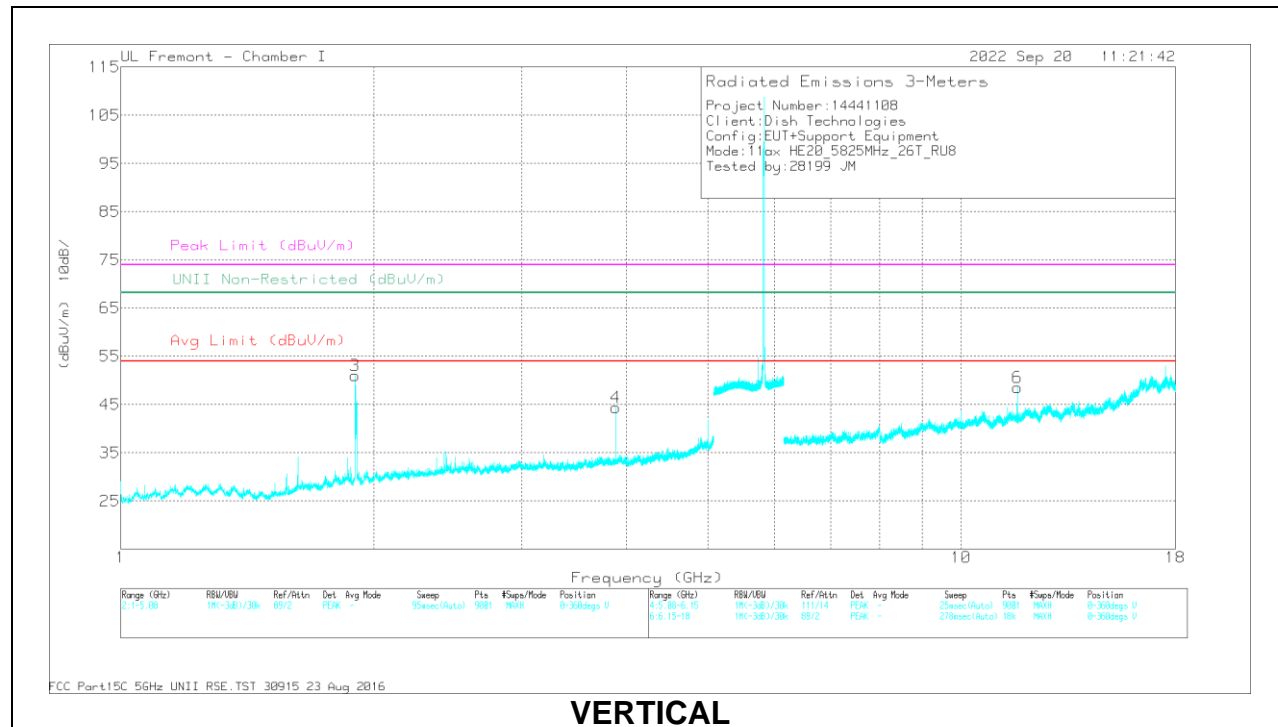
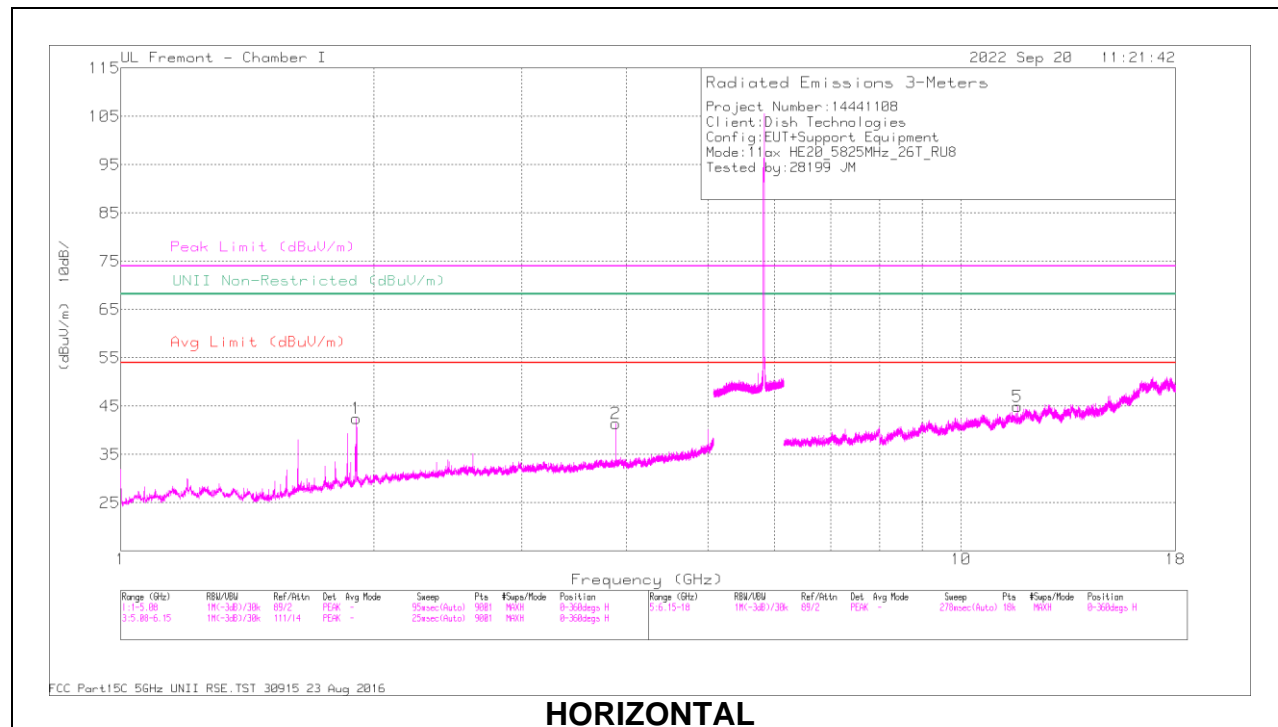


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	Amp/Cbl/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 5.46	42.13	Pk	35.1	-17.3	0	59.93	-	-	68.2	-8.27	214	123	V
2	* 5.45639	45.44	Pk	35.1	-17.2	0	63.34	-	-	74	-10.66	214	123	V
3	5.47	45.81	Pk	35.1	-17.2	0	63.71	-	-	68.2	-4.49	214	123	V
4	5.466295	47.93	Pk	35.1	-17.3	0	65.73	-	-	68.2	-2.47	214	123	V
5	* 5.46	26.54	RMS	35.1	-17.3	.13	44.47	54	-9.53	-	-	214	123	V
6	* 5.391688	28.77	RMS	34.9	-17.3	.13	46.5	54	-7.5	-	-	214	123	V
7	5.47	26.43	RMS	35.1	-17.2	.13	44.46	-	-	-	-	214	123	V
8	* 5.391688	28.77	RMS	34.9	-17.3	.13	46.5	54	-7.5	-	-	214	123	V

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

HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna AC5(dB)	Amp/Cbl/Fitter (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.908679	53.45	PK-U	31.2	-32	0	52.65	-	-	-	-	68.2	-15.55	52	397	H
	1.908563	30.16	ADR	31.2	-32	.13	29.49	-	-	-	-	-	-	52	397	H
2	* 3.883142	41.62	PK-U	33.7	-28.9	0	46.42	-	-	74	-27.58	-	-	345	103	H
	* 3.88325	34.97	ADR	33.7	-28.9	.13	39.9	54	-14.1	-	-	-	-	345	103	H
3	1.902591	66.38	PK-U	31.1	-32.1	0	65.38	-	-	-	-	68.2	-2.82	62	284	V
	1.899394	29.11	ADR	31.1	-32.2	.13	28.14	-	-	-	-	-	-	62	284	V
4	* 3.88345	43.92	PK-U	33.7	-28.9	0	48.72	-	-	74	-25.28	-	-	194	240	V
	* 3.883314	38.82	ADR	33.7	-28.9	.13	43.75	54	-10.25	-	-	-	-	194	240	V
5	* 11.66606	40.4	PK-U	38.8	-18.4	0	60.8	-	-	74	-13.2	-	-	122	104	H
	* 11.666564	24.82	ADR	38.8	-18.4	.13	45.35	54	-8.65	-	-	-	-	122	104	H
6	* 11.667215	44.88	PK-U	38.8	-18.5	0	65.18	-	-	74	-8.82	-	-	260	104	V
	* 11.667235	28.7	ADR	38.8	-18.5	.13	49.13	54	-4.87	-	-	-	-	260	104	V

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

PK-U - U-NII: Maximum Peak

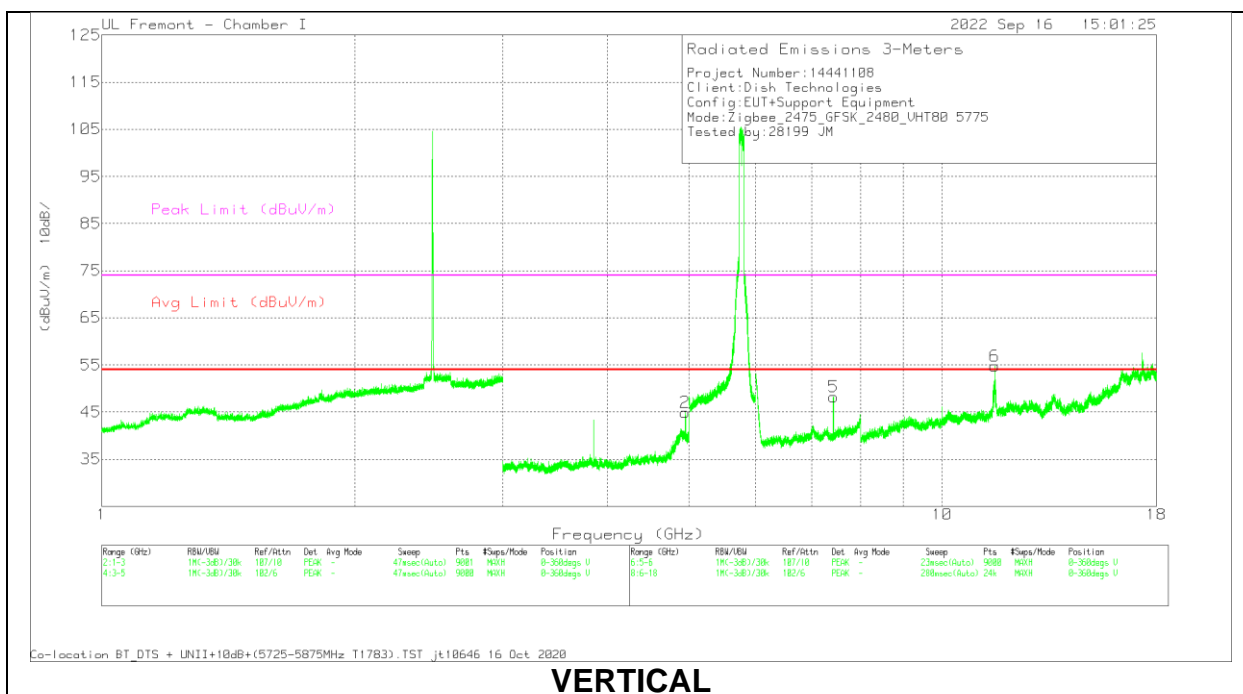
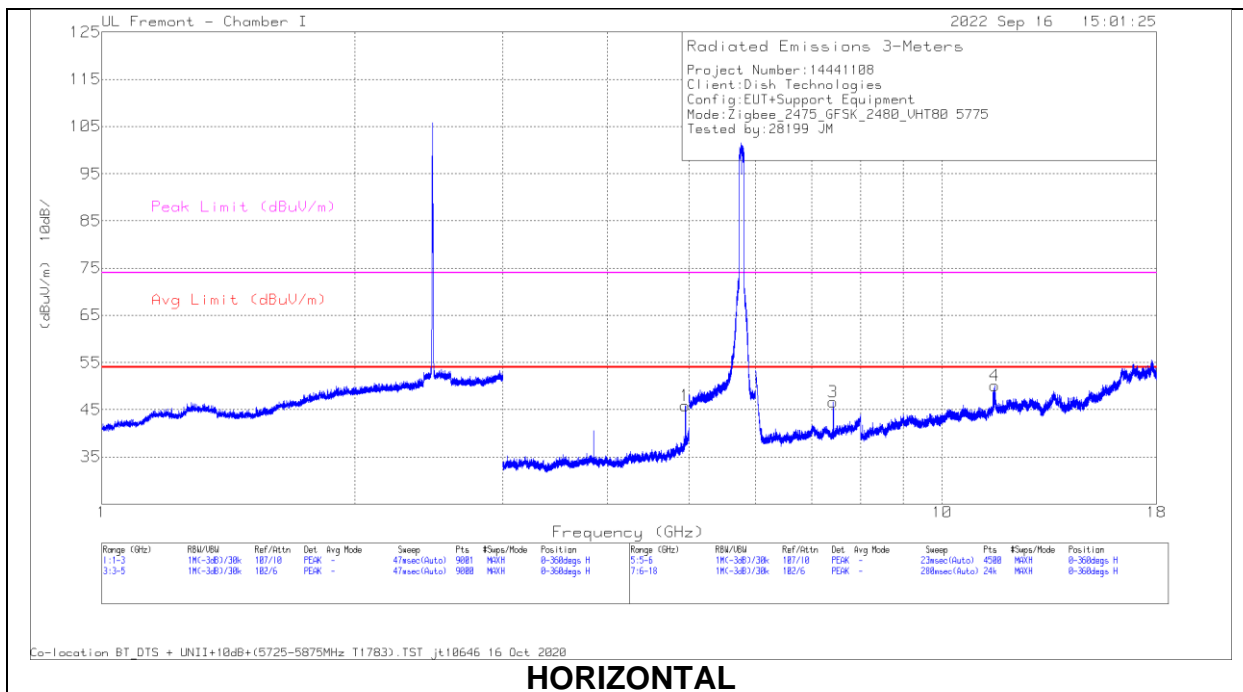
ADR - U-NII AD primary method, RMS average

9.5. SPURIOUS EMISSIONS FOR CO-LOCATION

TEST-CASE CONDITIONS

Mode	Frequency (MHz)
BT GFSK	2480
Zigbee	2475
UNII	VHT80 5775MHz

HARMONICS AND SPURIOUS EMISSIONS ABOVE 1GHz



Radiated Emissions

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	Amp/Cbl/Fitr (dB)	BRF 5725-5875MHz T1783 1-18GHz	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	* 4.950986	45.68	PK-U	34.5	-28.5	.4	0	52.08	-	-	74	-21.92	223	103	H
	* 4.950895	37.69	ADR	34.5	-28.5	.4	.97	45.06	54	-8.94	-	-	223	103	H
2	* 4.949068	46.21	PK-U	34.5	-28.5	.4	0	52.61	-	-	74	-21.39	70	109	V
	* 4.949148	37.49	ADR	34.5	-28.5	.4	.97	44.86	54	-9.14	-	-	70	109	V

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn Antenna ACF(dB)	Amp/Cbl/Fitr (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
3	* 7.423616	31.67	ADR	36	-21.7	.97	46.94	54	-7.06	-	-	114	112	H
	* 7.423496	40.05	PK-U	36	-21.7	0	54.35	-	-	74	-19.65	114	112	H
4	* 11.561441	29.01	ADR	38.6	-18.3	.97	50.28	54	-3.72	-	-	161	101	H
	* 11.561301	40.02	PK-U	38.6	-18.3	0	60.32	-	-	74	-13.68	161	101	H
5	* 7.42646	33.28	ADR	36	-21.6	.97	48.65	54	-5.35	-	-	79	194	V
	* 7.426544	41.1	PK-U	36	-21.6	0	55.5	-	-	74	-18.5	79	194	V
6	* 11.55918	31.41	ADR	38.7	-18.3	.97	52.78	54	-1.22	-	-	258	106	V
	* 11.561039	42.62	PK-U	38.6	-18.2	0	63.02	-	-	74	-10.98	258	106	V

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

PK-U - U-NII: Maximum Peak

ADR - U-NII AD primary method, RMS average