



# TEST REPORT

**Report Number.:** 14160419-E3V2

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

**Model :** D35

**Brand :** DISH

**FCC ID :** DKNPF99

**EUT Description :** TV SET TOP BOX CLIENT

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

**Date of Issue:**

March 24, 2022

**Prepared by:**

UL VERIFICATION SERVICES

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## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	3/21/2022	Initial Issue	---
V2	3/24/2022	Added additional spot test data, updated Section 1, Section 6.2, 6.3, 6.6 and Section 7.	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 CLIENT

**MODEL:** D35

**SERIAL NUMBER:** RADIATED: MJ4P6LB8

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

**DATE TESTED:** MARCH 11, 2022 & MARCH 23, 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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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	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	Not performed	None.
See Comment	Average power	Not performed	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	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, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, 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 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)  
 $36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

#### **MAINS CONDUCTED EMISSIONS**

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + 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 Client with RF4CE Zigbee, BLE (1Mbps), and BT 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: DKNBC88, to cover FCC ID: DKNPF99.

The major difference between two FCC IDs is FCC ID: DKNPF99 is using a new BT/BLE radio, all other circuitry and features are identical.

This report is to cover the Zigbee portion, where reference FCC ID Zigbee data is reused, colocation radiated emissions and Zigbee's previous FCC ID: DKNBC88 worst-case modes were performed on this FCC ID: DKNPF99 to ensure the testing remains compliant with new BT/BLE radio. 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 (MHz)	Reference Report	Report Title/Section
DTS	DKNBC88	2425 to 2475	13618993-E3V2	Zigbee Report / All sections

### 6.3. SPOT CHECK VERIFICATION RESULTS SUMMARY

FCC ID: DKNPF99 SPOT CHECK RESULTS											
Technology	Mode	Test Item	Channel	Original model (Worst margin dB)		Spot check model (Worst margin dB)		Delta (dB)			
				D35		D35		H		V	
				DKNBC88		DKNPF99					
				H	V	H	V				
Zigbee	250kbps, O-QPSK	RBE	High	-10.73	-10.79	-13.18	-13.18	-2.45	-2.39		
				Worst margin (dB)		Worst margin (dB)		Delta (dB)			
Zigbee	250kbps, O-QPSK	RSE	Low	-10.63		-13.31		-2.68			
BL/Zigbee simultaneous RSE above 1G				-7.44		-8.06		-0.62			

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



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#### **6.4. 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 4.1 dBi.

#### **6.5. SOFTWARE AND FIRMWARE**

The EUT firmware installed during testing was Dish Agency Build 3.4.

#### **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.

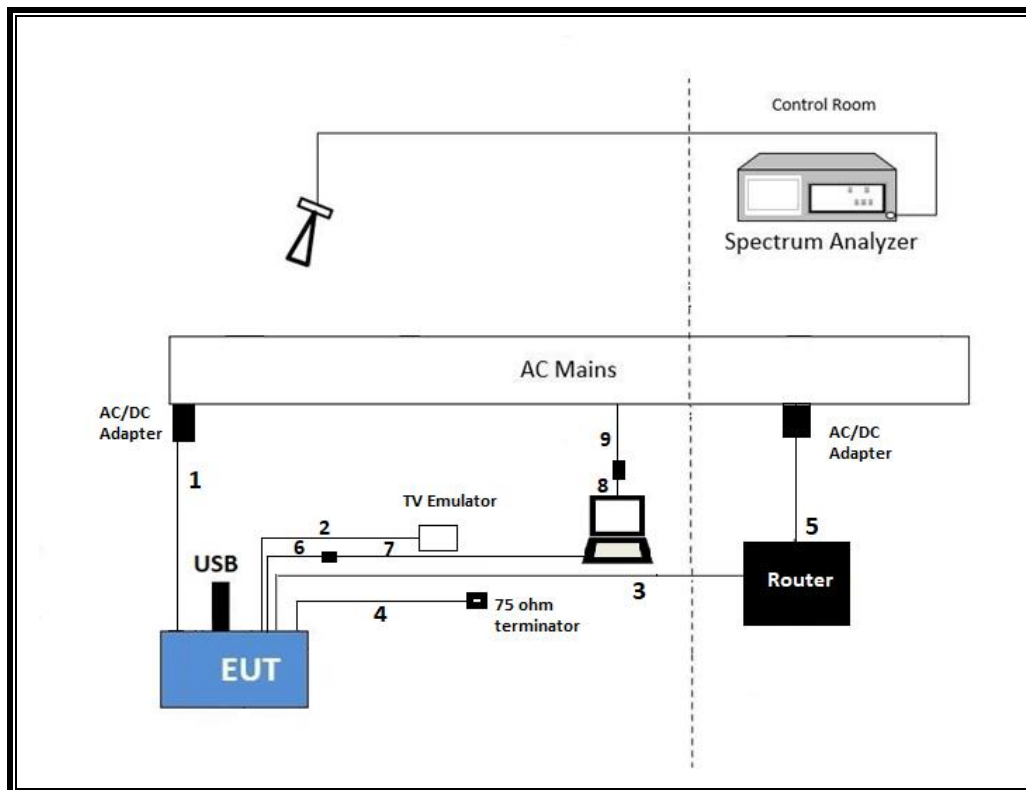
This EUT supports BLE/BT + Zigbee simultaneous transmission, radiated emission test 30MHz to 18GHz and Zigbee's previous FCC ID: DKNBC88 worst-case modes were performed on this FCC ID: DKNPF99 to ensure the testing remains compliant with new BT/BLE radio.

Data rate provided by manufacturer: 250kbps, O-QPSK modulation for 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	1	EUT to Emulator
3	RJ45	1	RJ45	Un-shielded	More than 3	EUT to Ethernet Router
4	Coaxial RF	1	Coaxial RF	shielded	0.2	75 ohm load terminated BNC port on coaxial cable
5	DC	1	Barrel	Un-shielded	1	Ethernet router to AC/DC Adapter
6	UART	1	UART	Un-shielded	0.1	EUT to USB adapter
7	UART	1	USB	Un-shielded	2	USB adapter to laptop
8	DC	1	DC	Un-shielded	1	AC Adapter Laptop
9	AC	1	Two Prong	Un-shielded	2	AC adapter to AC Mains

**RADIATED TEST 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
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
Thermometer - Digital	Control Company	14-650-118	175731	02/03/2023	02/03/2022
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	80404	08/04/2022	08/04/2021
Amplifier, 100MHz-18GHz	AMPLICAL	AMP0.1G18-47-20	185686	04/08/2022	04/08/2021
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	169927	02/16/2023	02/16/2022
NSA, Test Site Validation	TDK RF SOLUTIONS INC.	ANSI C63.4 & CISPR 16-1-4	210429	09/04/2024	09/04/2021
Thermometer - Digital	Control Company	14-650-118	175737	03/30/2022	03/30/2021
Test Software List					
Description	Manufacturer	Model	Version		
Radiated Software	UL	UL EMC	Rev 9.5, April 30, 2020, Oct 21, 2019		

## 8. MEASUREMENT METHOD

Radiated emissions non-restricted frequency bands: ANSI C63.10 Section -11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Section -11.12.1

## 9. RADIATED TEST RESULTS

### 9.1. LIMITS AND PROCEDURE

#### 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.

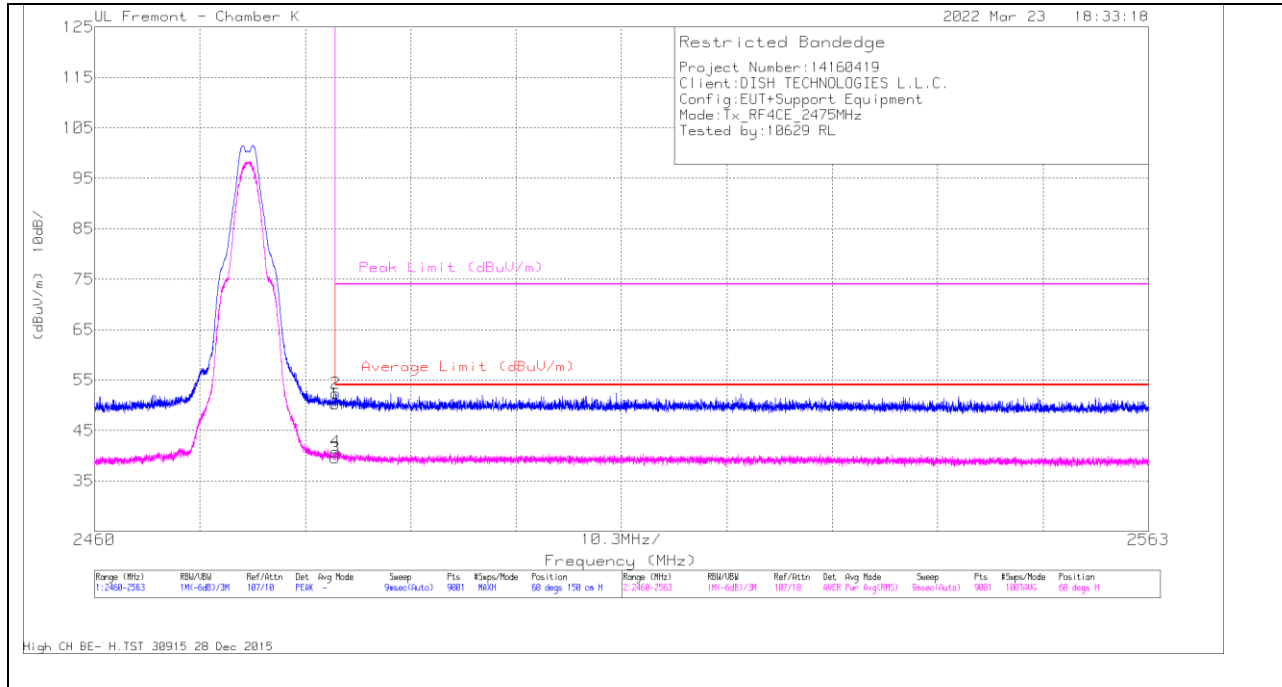
The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

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.

## 9.2. TRANSMITTER ABOVE 1 GHz

### BANDEDGE (HIGH CHANNEL)

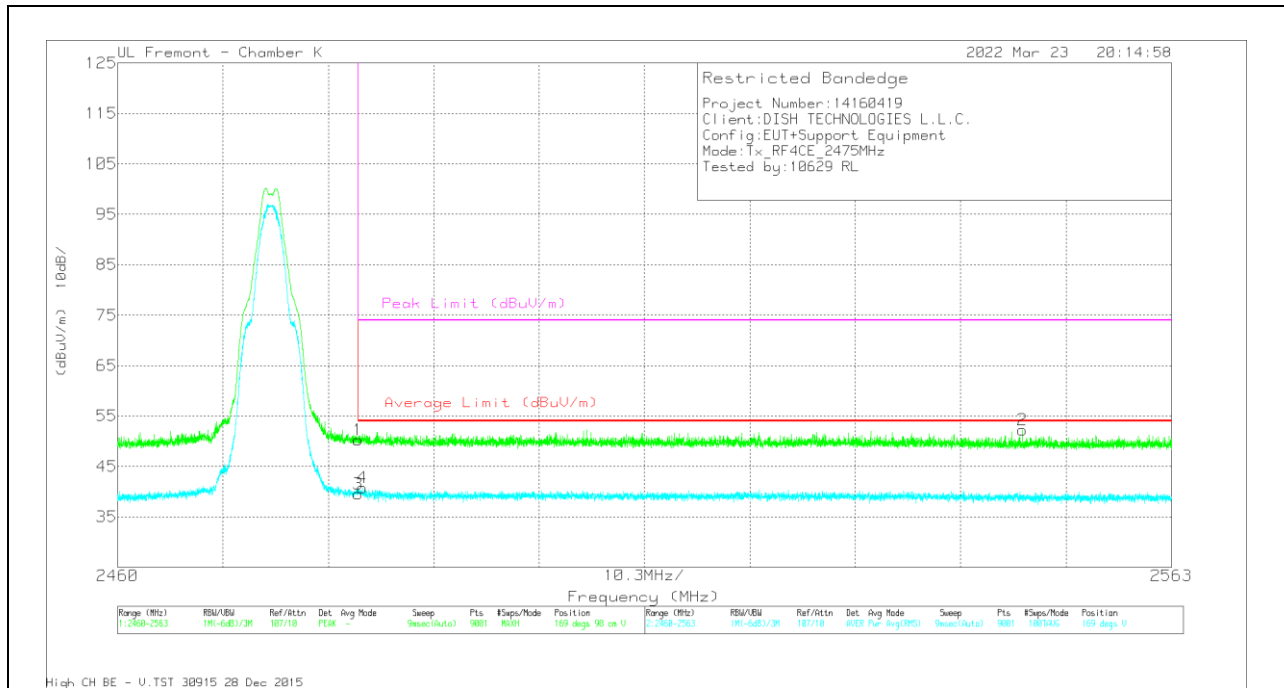
#### HORIZONTAL RESULT



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cbl/Filtr/Par 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	* 2483.5	51.55	PK	32.7	-34	50.25	-	-	74	-23.75	60	150	H
2	* 2483.586	53.71	PK	32.7	-34	52.41	-	-	74	-21.59	60	150	H
3	* 2483.5	40.87	RMS	32.7	-34	39.57	54	-14.43	-	-	60	150	H
4	* 2483.586	42.12	RMS	32.7	-34	40.82	54	-13.18	-	-	60	150	H

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

### VERTICAL RESULT

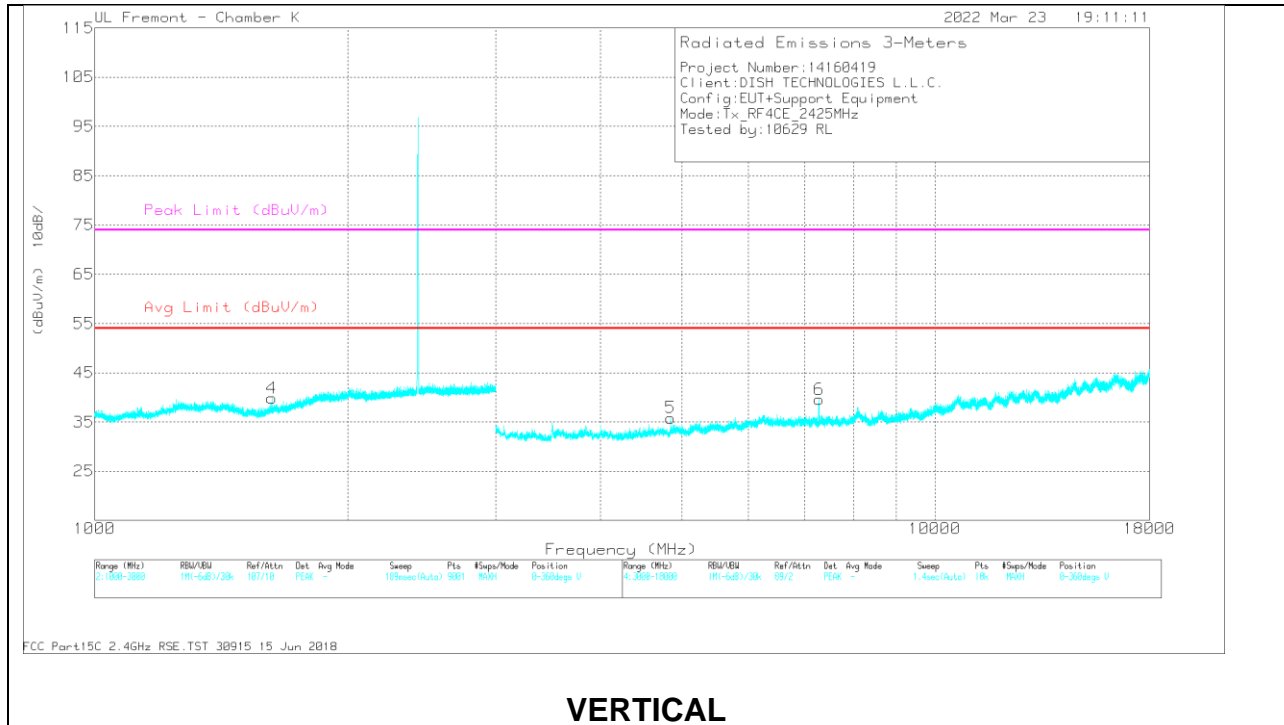
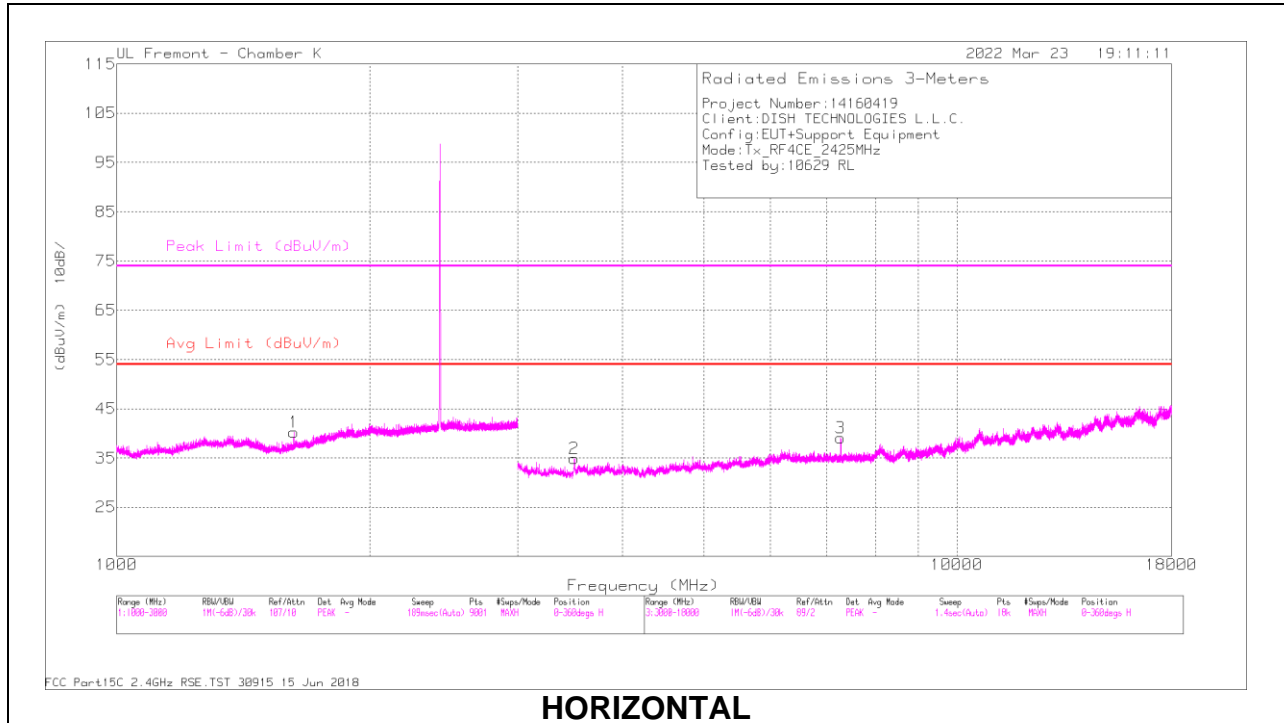


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cb1/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2483.5	51.57	Pk	32.7	-34	50.27	-	-	74	-23.73	169	98	V
2	2548.416	53.3	Pk	32.7	-33.8	52.2	-	-	74	-21.8	169	98	V
3	* 2483.5	40.81	RMS	32.7	-34	39.51	54	-14.49	-	-	169	98	V
4	* 2483.929	42.12	RMS	32.7	-34	40.82	54	-13.18	-	-	169	98	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	AF 80404 (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	* 1624.917	56.89	PK2	28.6	-36	49.49	-	-	74	-24.51	171	242	H
	* 1625.025	46.36	MAV1	28.6	-36	38.96	54	-15.04	-	-	171	242	H
4	* 1624.902	56.05	PK2	28.6	-36	48.65	-	-	74	-25.35	169	98	V
	* 1625.034	45.83	MAV1	28.6	-36	38.43	54	-15.57	-	-	169	98	V
2	* 3502.288	52.06	PK2	34.2	-41.5	44.76	-	-	74	-29.24	180	213	H
	* 3500.115	40.39	MAV1	34.1	-41.5	32.99	54	-21.01	-	-	180	213	H
3	* 7273.52	51.29	PK2	35.8	-37.6	49.49	-	-	74	-24.51	308	102	H
	* 7273.55	42.33	MAV1	35.8	-37.6	40.53	54	-13.47	-	-	308	102	H
5	* 4849.969	50.85	PK2	34.2	-39.8	45.25	-	-	74	-28.75	17	110	V
	* 4850.129	41.14	MAV1	34.2	-39.8	35.54	54	-18.46	-	-	17	110	V
6	* 7273.455	51.07	PK2	35.8	-37.6	49.27	-	-	74	-24.73	87	240	V
	* 7273.514	42.49	MAV1	35.8	-37.6	40.69	54	-13.31	-	-	87	240	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PK2 - KDB558074 Method: Maximum Peak  
 MAV1 - KDB558074 Option 1 Maximum RMS Average

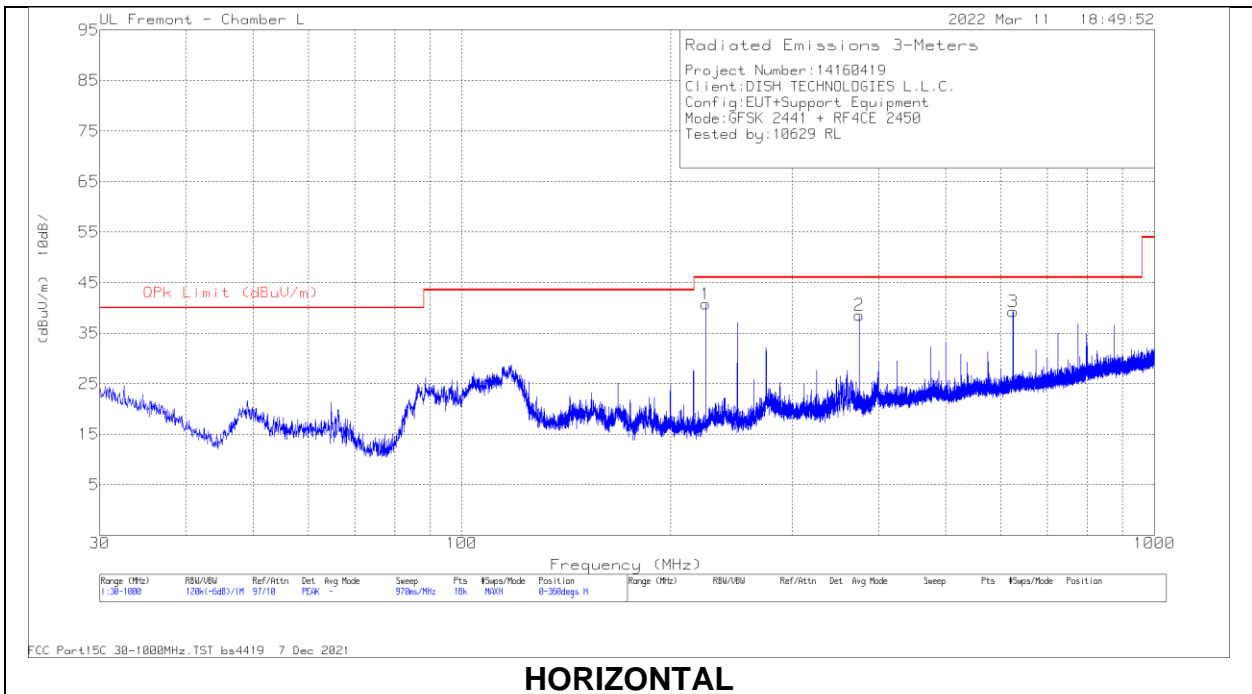
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### 9.3. SPURIOUS EMISSIONS FOR CO-LOCATION

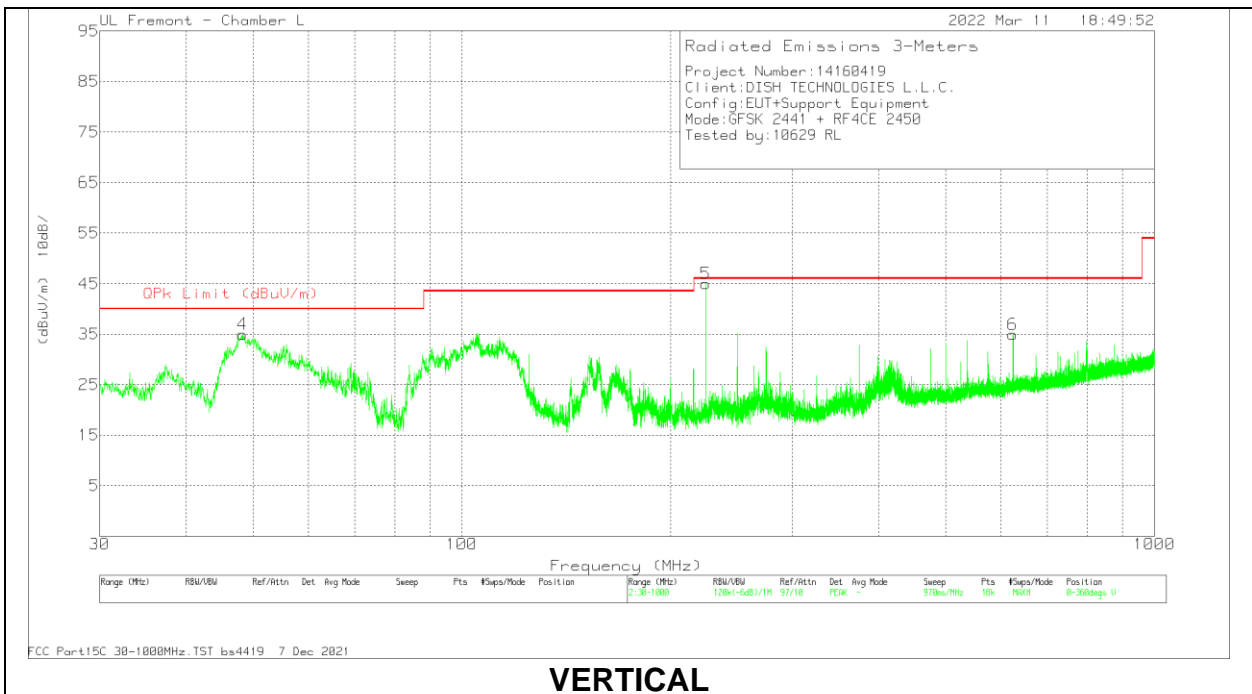
#### TEST-CASE CONDITIONS

Mode	Frequency (MHz)
BT GFSK	2441
Zigbee	2450

### HARMONICS AND SPURIOUS EMISSIONS 30MHz TO 1GHz



**HORIZONTAL**



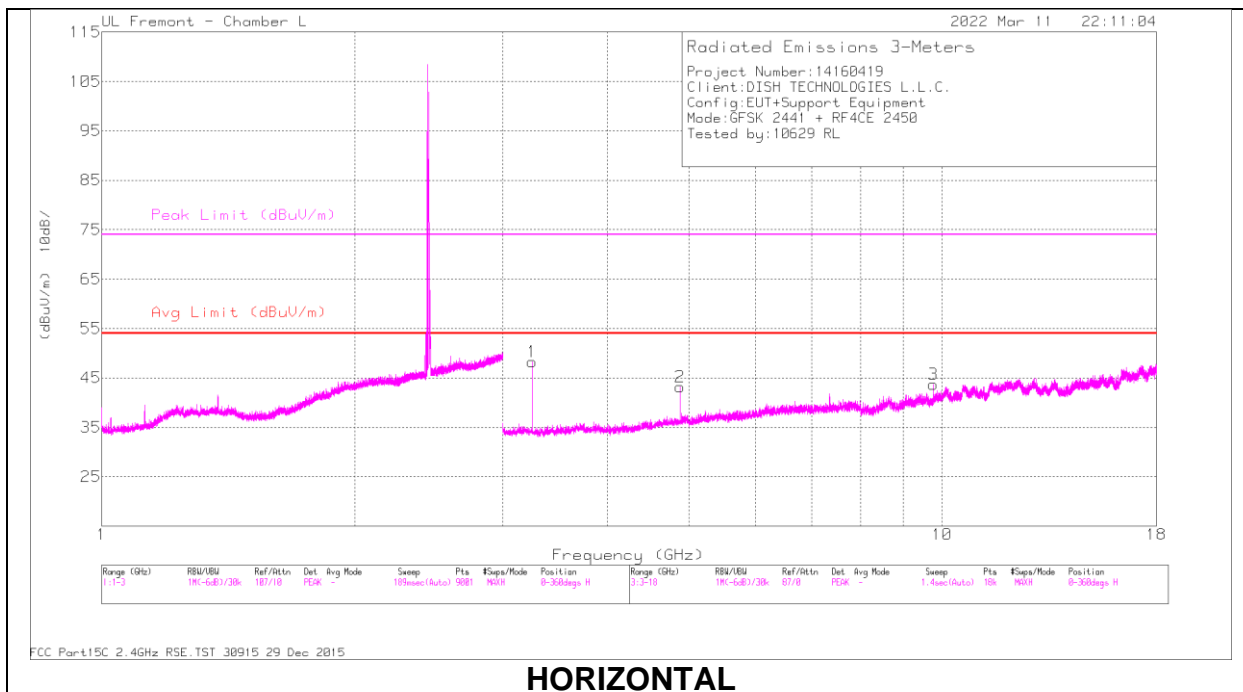
**VERTICAL**

**Radiated Emissions**

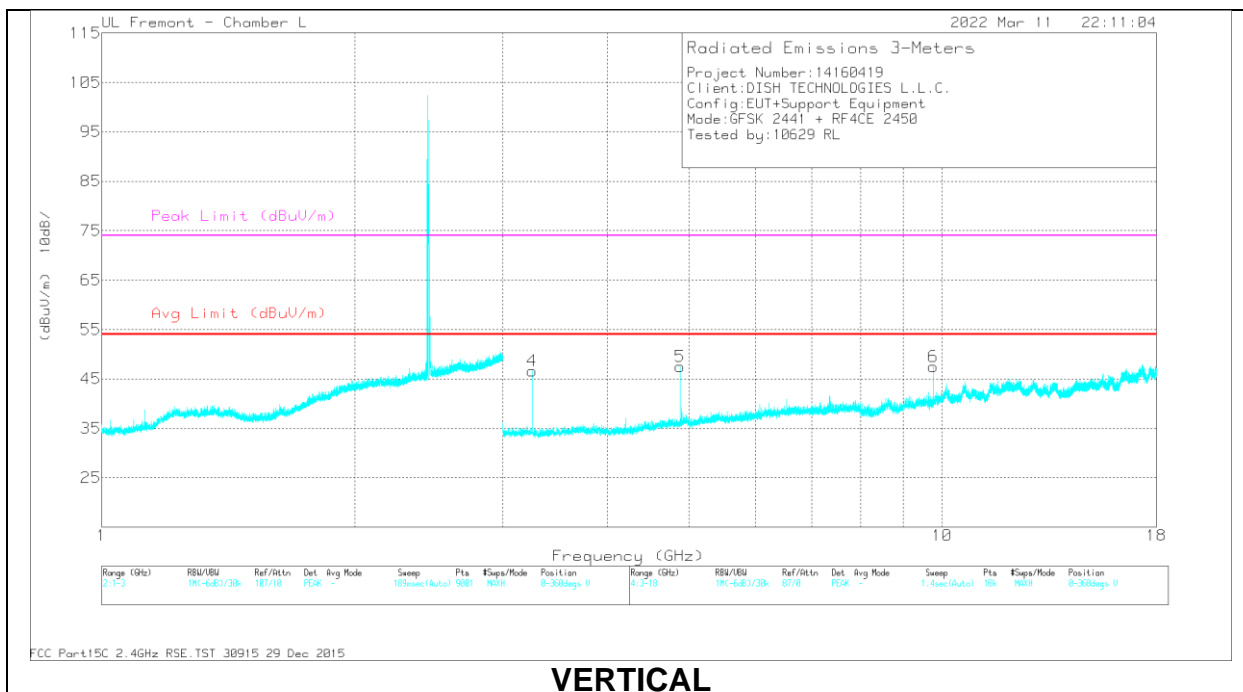
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	171862 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	224.97	54.07	Pk	16.6	-29.9	40.77	46.02	-5.25	0-360	101	H
	224.998	54.32	Qp	16.6	-29.9	41.02	46.02	-5	86	113	H
2	374.997	46.8	Pk	20.8	-29	38.6	46.02	-7.42	0-360	101	H
	625.042	42.44	Pk	25.2	-28.4	39.24	46.02	-6.78	0-360	101	H
4	48.2684	51.8	Pk	14.4	-31.2	35	40	-5	0-360	101	V
	48.4432	49.31	Qp	14.3	-31.2	32.41	40	-7.59	158	111	V
5	224.97	58.33	Pk	16.6	-29.9	45.03	46.02	-9.99	0-360	101	V
	225.004	57.94	Qp	16.6	-30	44.54	46.02	-1.48	186	102	V
6	624.988	38.16	Pk	25.2	-28.4	34.96	46.02	-11.06	0-360	199	V

Pk - Peak detector  
 Qp - Quasi-Peak detector

### HARMONICS AND SPURIOUS EMISSIONS ABOVE 1GHz



**HORIZONTAL**



**VERTICAL**

**Radiated Emissions**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Filtr/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	3.254631	45.21	PKFH	33.1	-26.9	51.41	-	-	-	-	178	101	H
	3.254651	42.01	VA1T	33.1	-26.9	48.21	-	-	-	-	178	101	H
2	* 4.881982	39.79	PKFH	34.2	-24.3	49.69	-	-	74	-24.31	234	101	H
	* 4.881972	31.56	VA1T	34.2	-24.3	41.46	54	-12.54	-	-	234	101	H
3	9.763912	30.27	PKFH	37	-17.1	50.17	-	-	-	-	326	218	H
	9.763972	20.67	VA1T	37	-17.1	40.57	-	-	-	-	326	218	H
4	3.25472	43.8	PKFH	33.1	-26.9	50	-	-	-	-	244	108	V
	3.254661	39.91	VA1T	33.1	-26.9	46.11	-	-	-	-	244	108	V
5	* 4.882272	41.5	PKFH	34.2	-24.3	51.4	-	-	74	-22.6	22	101	V
	* 4.881972	36.04	VA1T	34.2	-24.3	45.94	54	-8.06	-	-	22	101	V
6	9.763962	34.06	PKFH	37	-17.1	53.96	-	-	-	-	90	101	V
	9.763982	27.13	VA1T	37	-17.1	47.03	-	-	-	-	90	101	V

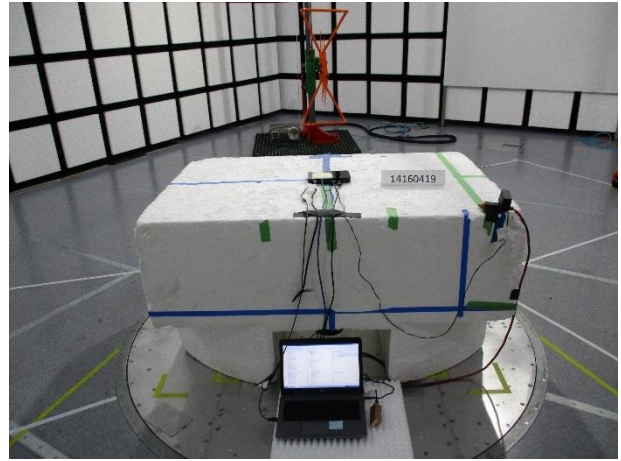
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak  
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration  
 Note: no emissions above 18GHz were seen.

## 10. SETUP PHOTOS

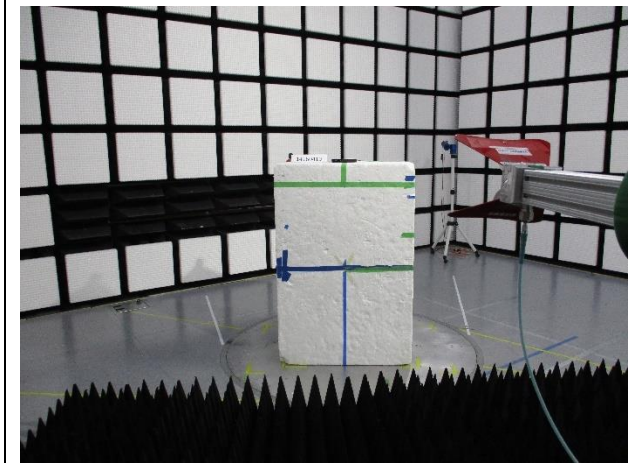
### RADIATED RF MEASUREMENT SETUP



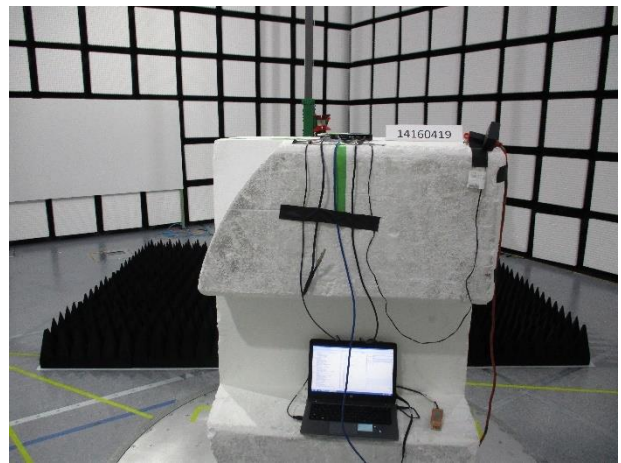
**BELOW 1GHz (FRONT)**



**BELOW 1GHz (BACK)**



**ABOVE 1GHz (FRONT)**



**ABOVE 1GHz (BACK)**

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## Appendix A - Reference Test Report

Attached is the test report number containing the reference data of the reference reports as indicated on Section 6.2 reports.

**END OF REPORT**