TEST REPORT

Report Number. : 13988118-E2V2

Applicant	:	DISH TECHNOLOGIES L.L.C. 90 INVERNESS CIRCLE EAST ENGLEWOOD, CO 80112, UNITED STATES
Model	:	D25
Brand	:	DISH
FCC ID	:	DKNA43KF
EUT Description	:	WHOLE HOME DVR ACCESSORY
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C

Date Of Issue:
November 05, 2021

Prepared by:
UL VERIFICATION SERVICES
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
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CERT #0751.05

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	10/26/2021	Initial Issue	---
V2	11/5/2021	Updated KDB version on page 42	Tina Chu

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	DISH TECHNOLOGIES L.L.C. 90 INVERNESS CIRCLE EAST ENGLEWOOD, CO 80112, UNITED STATES
EUT DESCRIPTION:	WHOLE HOME DVR ACCESSORY
MODEL:	D25
BRAND:	DISH
SERIAL NUMBER:	CONDUCTED: R523122H20024D RADIATED: R522971H20190D
SAMPLE RECEIPT DATE:	OCTOBER 04, 2021
DATE TESTED:	OCTOBER 15, 2021 – OCTOBER 21, 2021

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.

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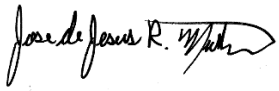
Approved & Released For
UL Verification Services Inc. By:

DAN CORONIA
OPERATIONS LEAD
UL Verification Services Inc.

Prepared By:



JOSE MARTINEZ
TEST ENGINEER
UL Verification Services Inc.

Reviewed By:

TINA CHU
SENIOR PROJECT ENGINEER
UL Verification Services Inc.

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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
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
☐	Building 1: 47173 Benicia Street, Fremont, CA 94538, USA	US0104	2324A	208313
☐	Building 2: 47266 Benicia Street, Fremont, CA 94538, USA	US0104	22541	208313
☒	Building 4: 47658 Kato Rd, Fremont, CA 94538, USA	US0104	2324B	208313

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 Conducted Disturbance, 9KHz to 0.15 MHz	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.84 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB

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

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
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

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Whole Home DVR Accessory with BLE (1Mbps) 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	8.03	6.35
2402 - 2480	Enhanced 8PSK	8.58	7.21
2402 - 2480	Enhanced DQPSK	8.25	6.68

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

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

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

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was BCM 002.001.014.0647.0000.

The test utility software used during testing was cybluetool 0.1.55.1.

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

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6.6. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID/ DoC**
Laptop	HP	EliteBook 740	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	NA	D25-12	Doc
USB-C Drive	SanDisk	SDCZ460	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	two-pin	1	AC	Un-shielded	1	EUT to AC Mains
3	UART	1	USB	Shielded	1.5	EUT to Laptop
4	DC	1	DC	Un-shielded	1	AC Adapter Laptop
5	AC	1	Two Prong	Un-shielded	1	AC adapter to AC Mains

I/O CABLES (RADIATED/ AC POWER LINE CONDUCTD EMISSIONS TEST)						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	two-pin	1	AC	Un-shielded	1	EUT to AC Mains
2	UART	1	USB	Shielded	1.5	EUT to Laptop
3	HDMI	1	HDMI	Shielded	2	EUT to TV Emulator
4	DC	1	DC	Un-shielded	1	AC Adapter Laptop
5	AC	1	Two Prong	Un-shielded	1	AC adapter to AC Mains

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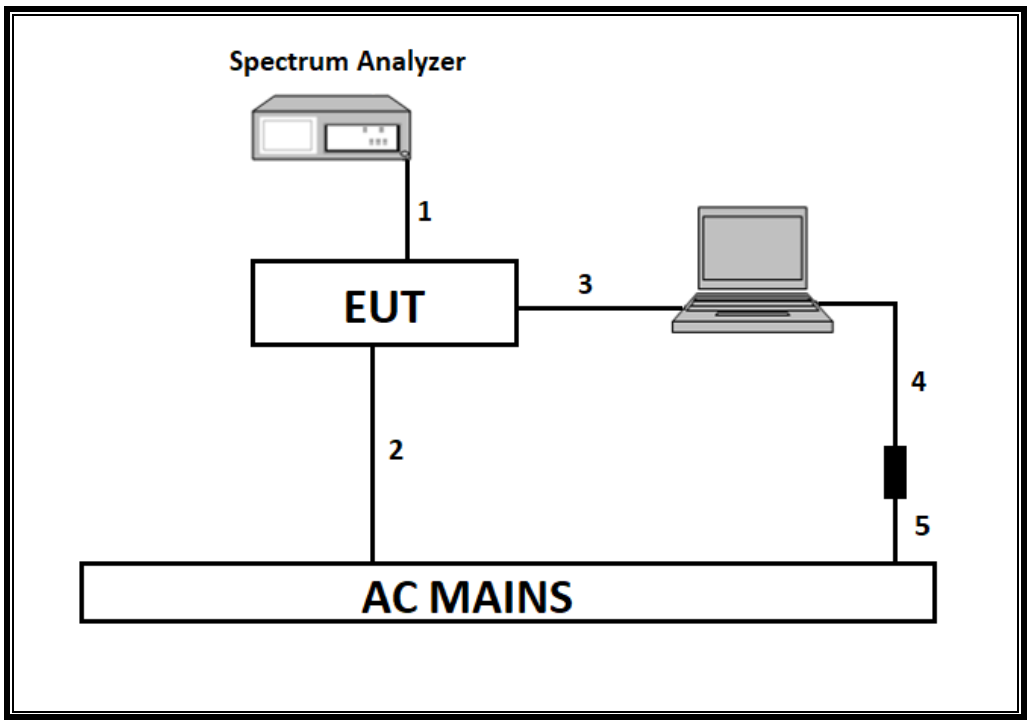
CONDUCTED TEST SETUP DIAGRAM



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.

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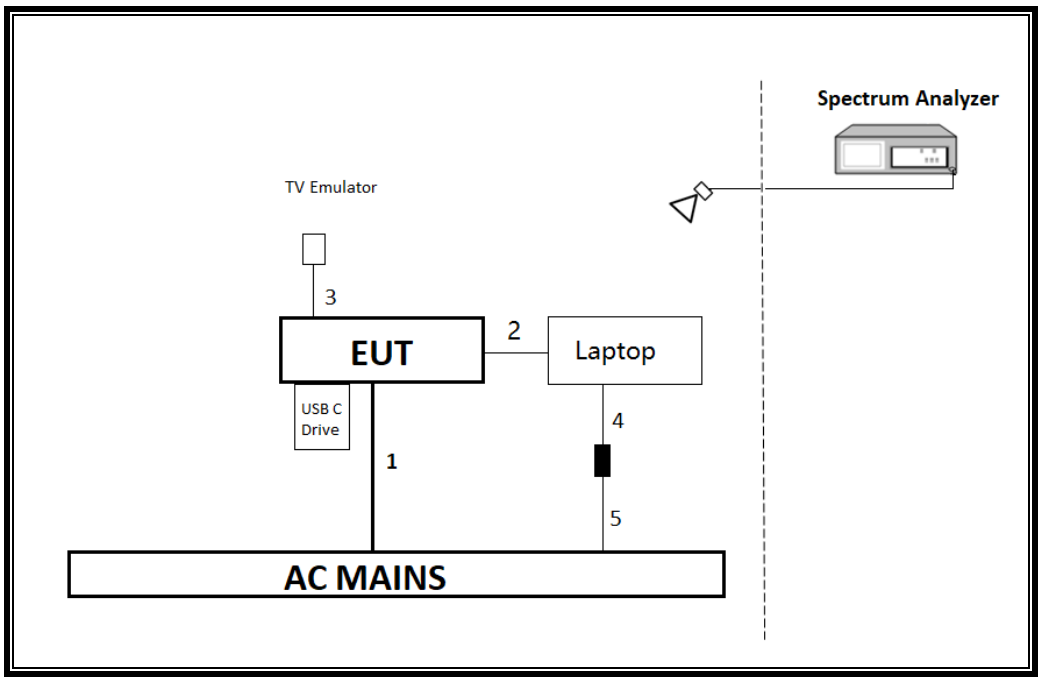
RADIATED/AC POWER LINE CONDUCTD EMISSIONS TEST SETUP DIAGRAM



TEST SETUP

The EUT is connected to support equipment and AC powered. Test software exercised the radio card.

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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**
EMI TEST RECEIVER, with B8 option	Rohde & Schwarz	ESW44	PRE0179377	2/23/2022	2/23/2021
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	T119	5/7/2022	5/7/2021
Amplifier, 1 - 18GHz	MITEQ	AFS42-00101800-25-S-42	T1568	4/9/2022	4/9/2021
Antenna, Broadband Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	PRE0184970 (174373)	12/2/2021	12/2/2020
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310N	T300	4/9/2022	4/9/2021
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO METRICS	EM-6871	PRE0179465	7/29/2022	7/29/2021
Antenna, Passive Loop 100KHz - 30MHz	ELECTRO METRICS	EM-6872	PRE0179467	7/29/2022	7/29/2021
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	T1228	6/17/2022	6/17/2021
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	T1268	1/27/2022	1/27/2021
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T448 (81139)	5/25/2022	5/25/2021
Rf Amplifier, 18-26.5GHz, 60dB gain	AMPLICAL	AMP18G26.5-60	171590	5/21/2022	5/21/2021
Spectrum Analyzer, PSA, 3Hz to 26.5GHz	Keysight Technologies Inc	E4440A	T198	5/13/2022	5/13/2021
AC Line Conducted					
Description	**Manufacturer**	**Model**	**ID Num**	**Cal Due**	**Last Cal**
EMI Test Receiver	Rohde & Schwarz	ESR	93091 (1436)	2/19/2022	2/19/2021
Transient Limiter	TekBox	TBFL1	207996	6/1/2022	6/1/2021
LISN	FCC	50/250	175764 (PRE0186446)	1/20/2022	1/20/2021
Digital Thermometer	FisherBrand	Traceable	170358	3/1/2022	3/1/2021
L.I.S.N	FCC INC.	FCC LISN 50/250	T24	1/20/2022	1/20/2021
Test Software List					
Description	**Manufacturer**	**Model**	**Version**		
Radiated Software	UL	UL EMC	Rev 9.5, Jan 03, 2020		
Antenna Port Software	UL	UL RF	AP2020.12.3/AP 2021.08.27		
AC Line Conducted Software	UL	UL EMC	Rev 9.5, July 07, 2020		

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8. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

Occupied BW (20dB): ANSI C63.10-2013 Section 6.9.2

Carrier Frequency Separation: ANSI C63.10-2013 Section 7.8.2

Number of Hopping Frequencies: ANSI C63.10-2013 Section 7.8.3

Time of Occupancy (Dwell Time): ANSI C63.10-2013 Section 7.8.4

Peak Output Power: ANSI C63.10-2013 Section 7.8.5

Conducted Spurious Emissions: ANSI C63.10-2013 Section 7.8.8

Conducted Band-Edge: ANSI C63.10-2013 Section 6.10.4

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

Radiated Spurious Emissions 30-1000MHz: ANSI C63.10-2013 Section 6.3 and 6.5

Radiated Spurious Emissions above 1GHz: ANSI C63.10-2013 Section 6.3 and 6.6

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5

AC Power-line conducted emissions: ANSI C63.10-2013, Section 6.2.

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9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

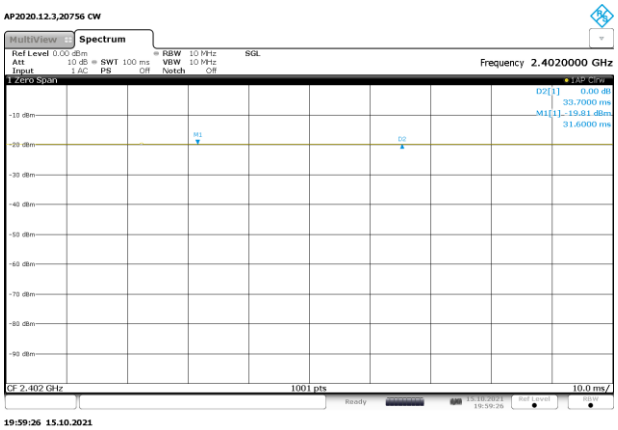
PROCEDURE

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

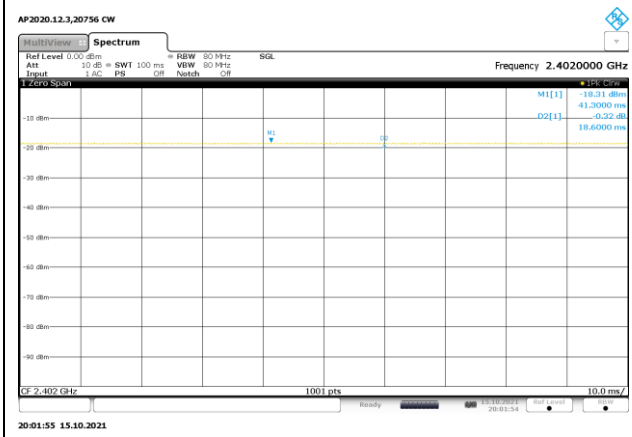
ON TIME AND DUTY CYCLE RESULTS

Test Engineer:	20756 CW

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	33.70	33.70	1.000	100.00	0.00	0.010
Bluetooth 8PSK	18.60	18.60	1.000	100.00	0.00	0.010



BLUETOOTH GFSK



BLUETOOTH 8PSK

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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 ≥ 3x RBW. The sweep time is coupled.

RESULTS

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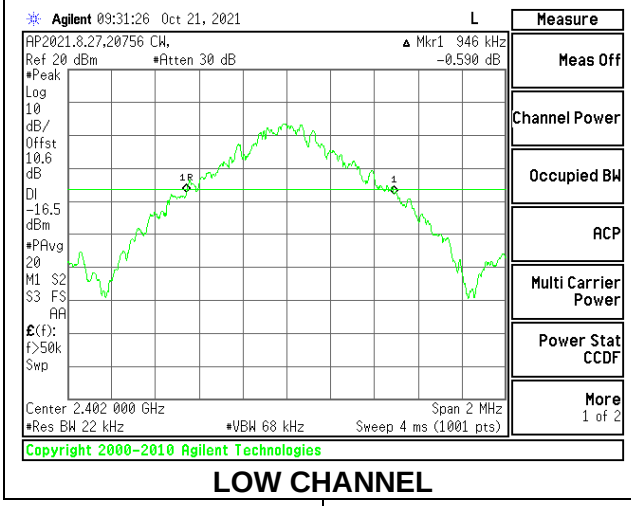
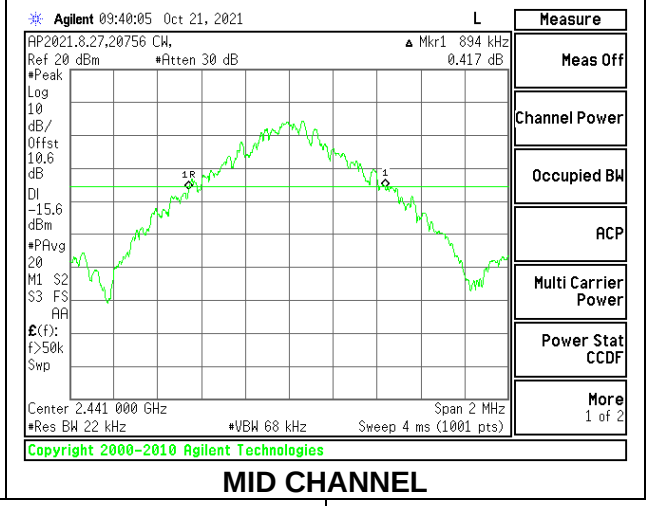
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

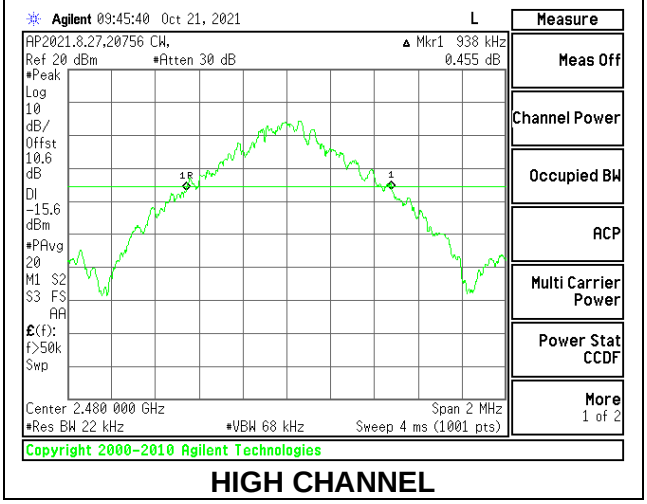
Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	0.946
Mid	2441	0.894
High	2480	0.938



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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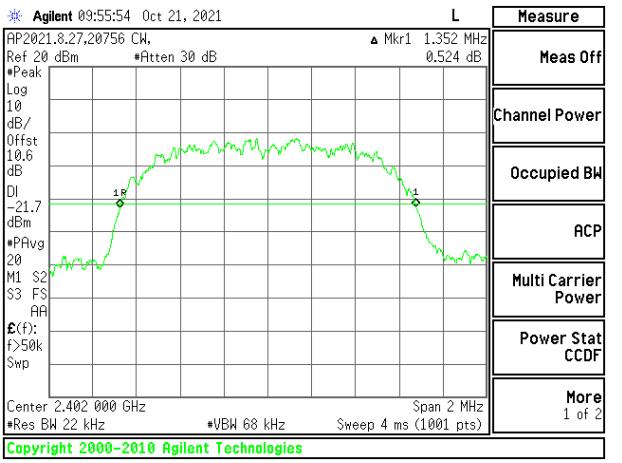
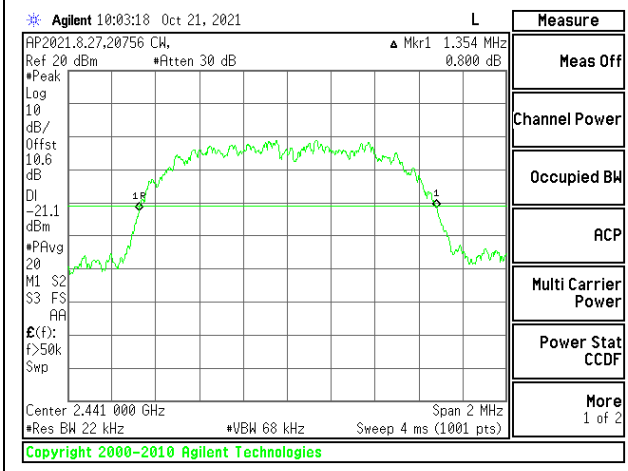
9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

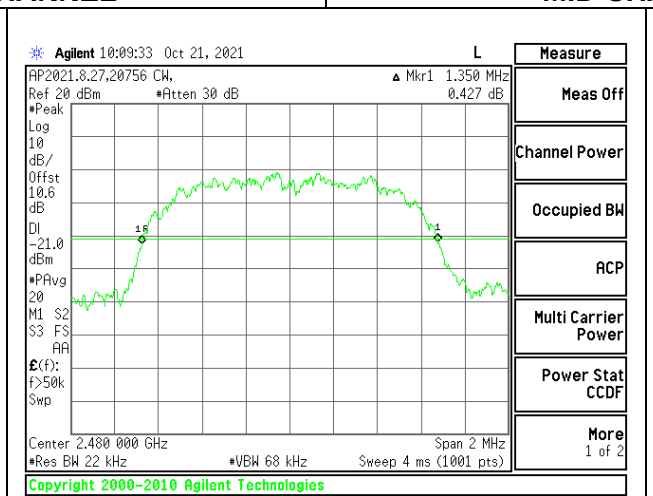
Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	1.352
Mid	2441	1.354
High	2480	1.35



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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9.3. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping 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 >= RBW. The sweep time is coupled.

RESULTS

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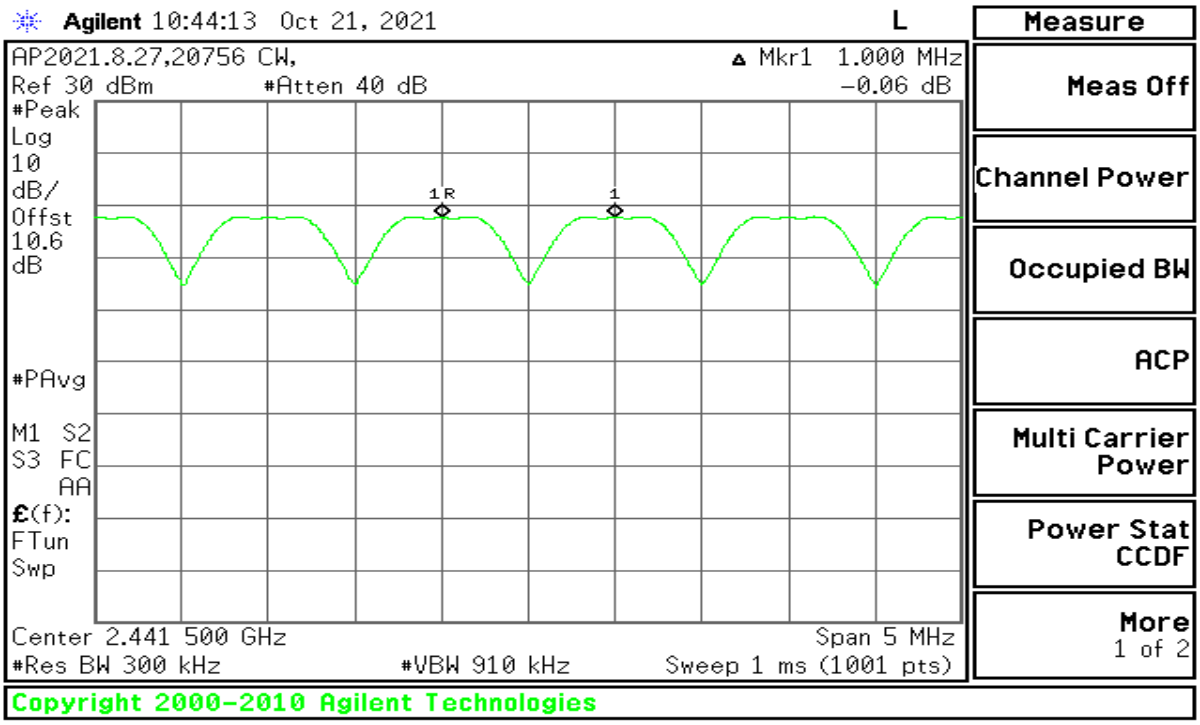
9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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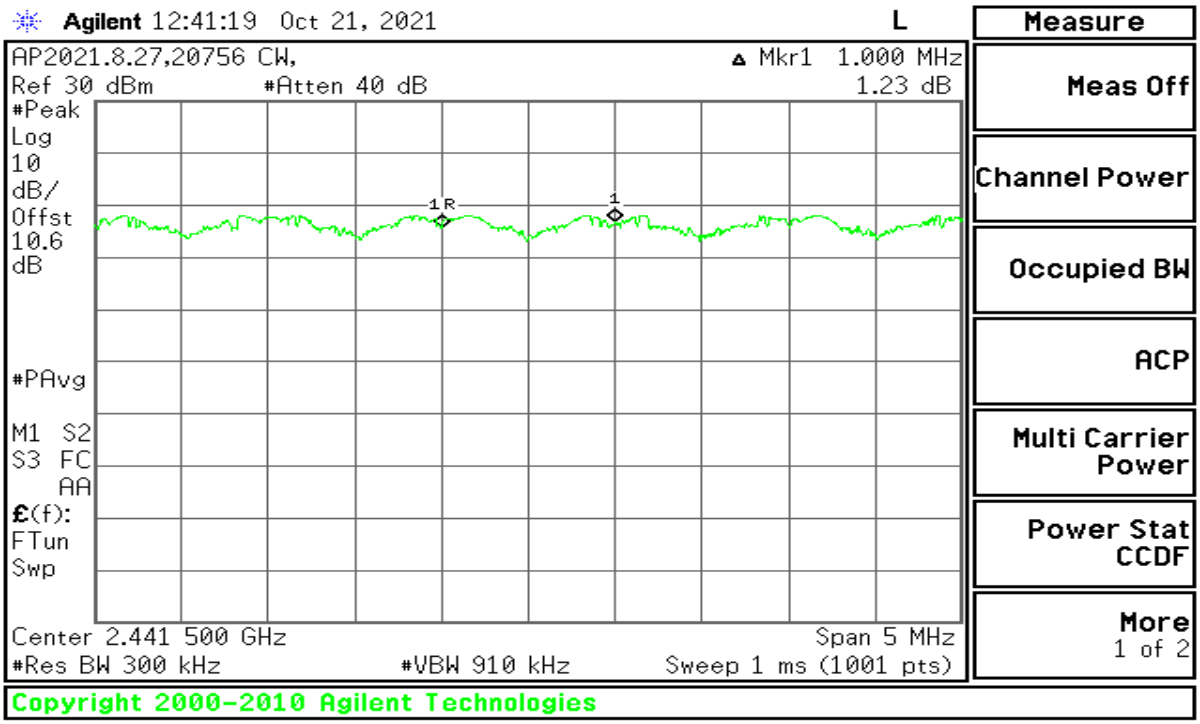
9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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9.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

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

TEST PROCEDURE

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

RESULTS

Normal Mode: 79 Channels Observed

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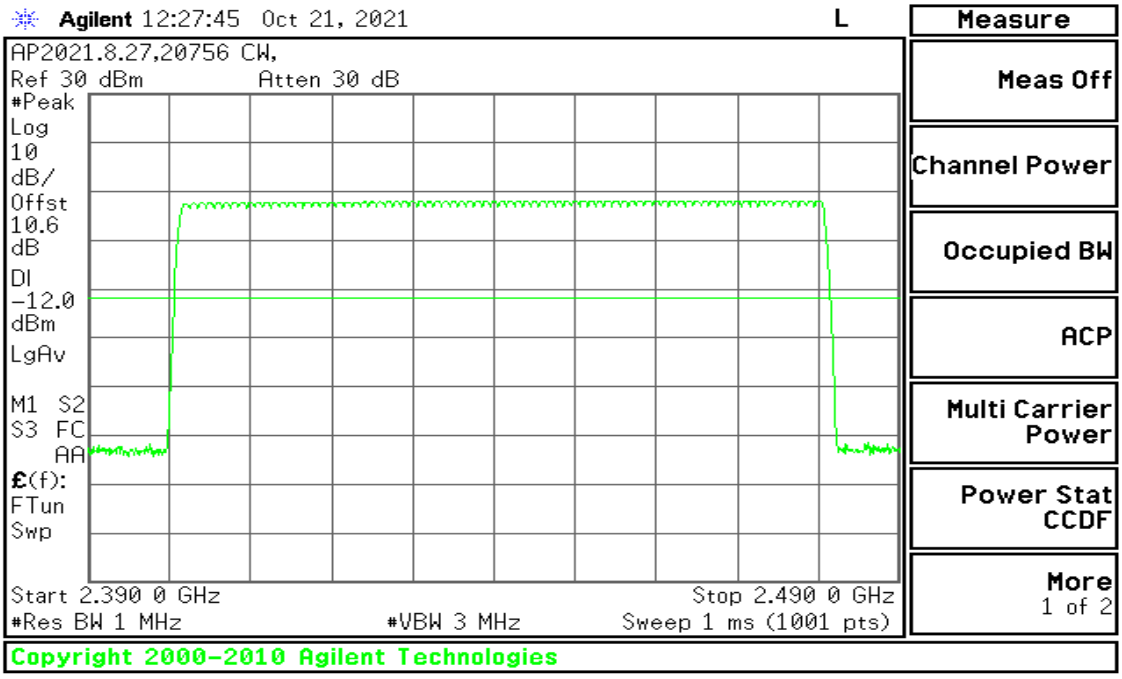
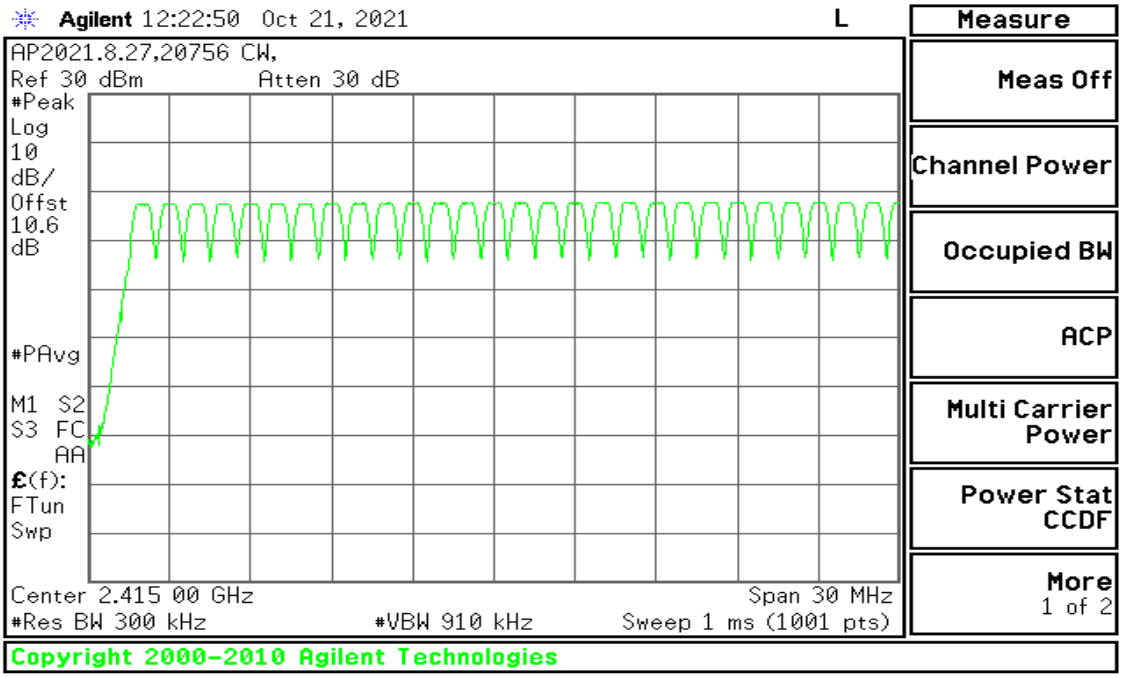
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



100MHz SPAN



30MHz SPAN, SEGMENT 1 OF 3

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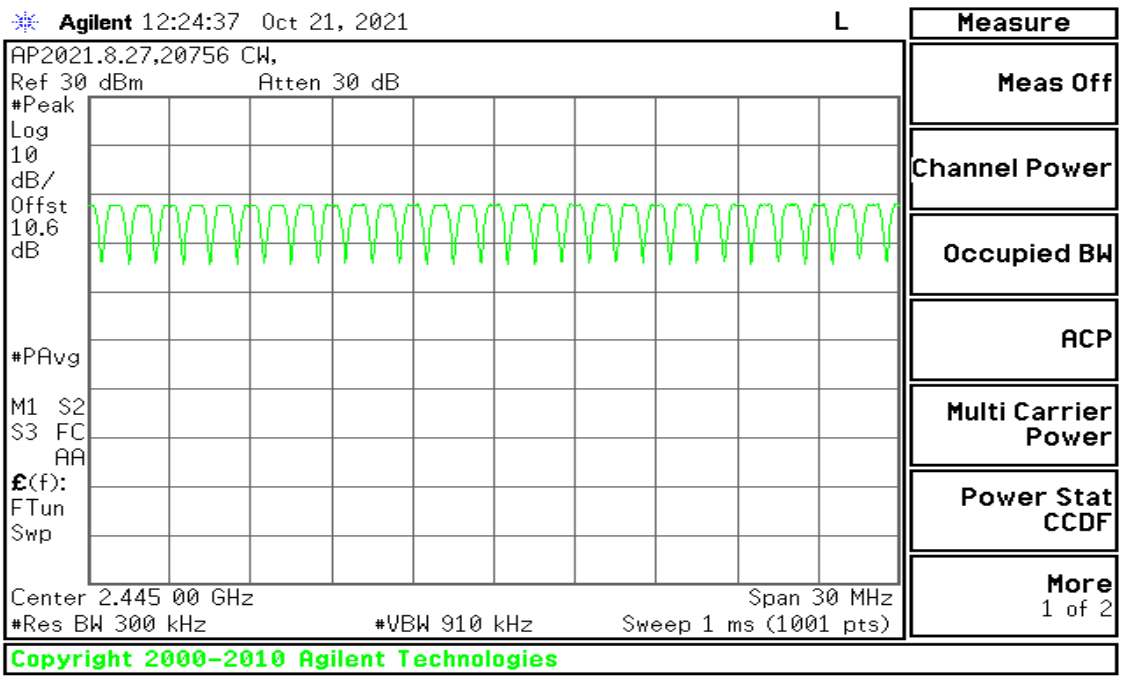
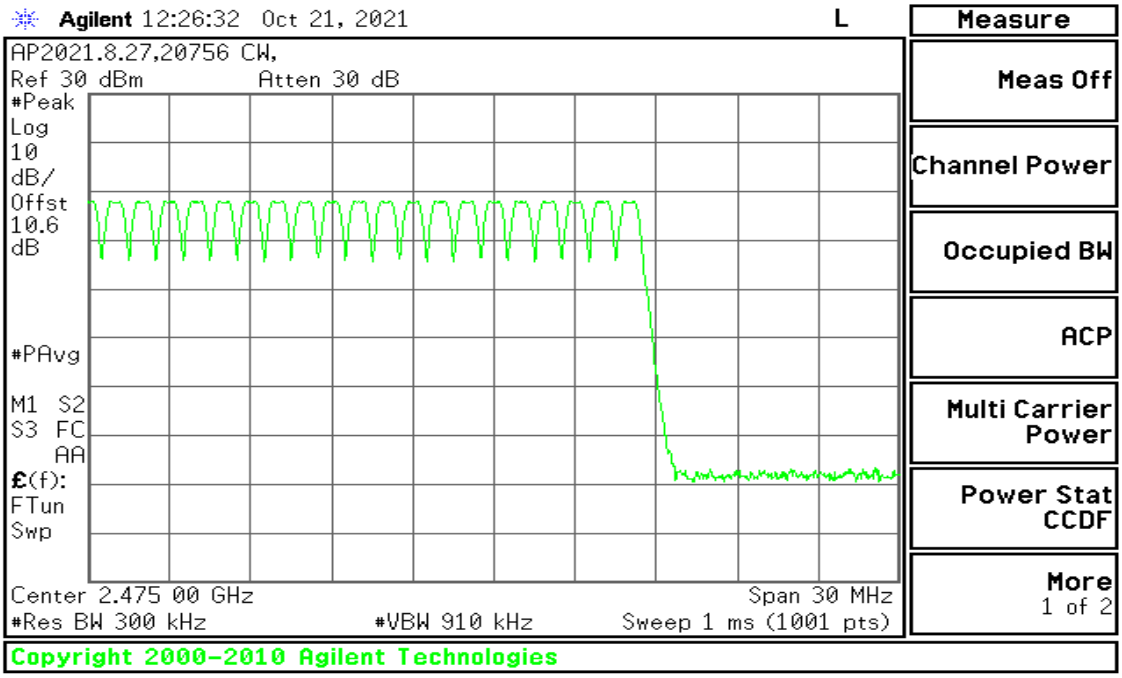


30MHz SPAN, SEGMENT 2 OF 3



30MHz SPAN, SEGMENT 3 OF 3

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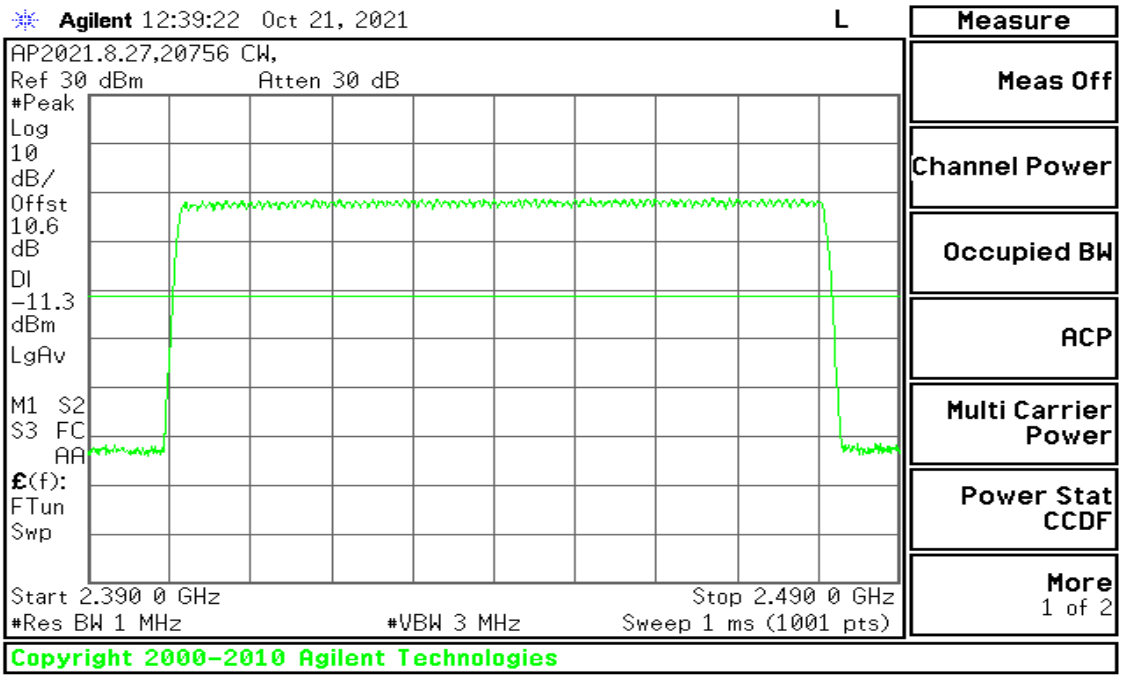
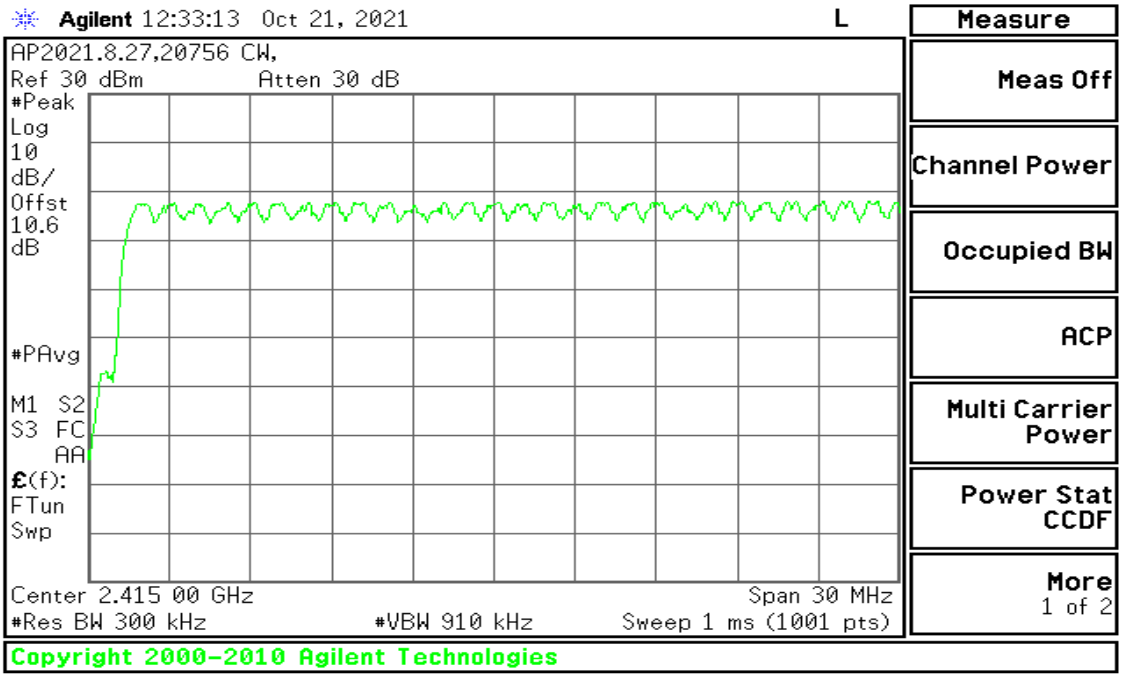
9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



100MHz SPAN



30MHz SPAN, SEGMENT 1 OF 3

UL VERIFICATION SERVICES
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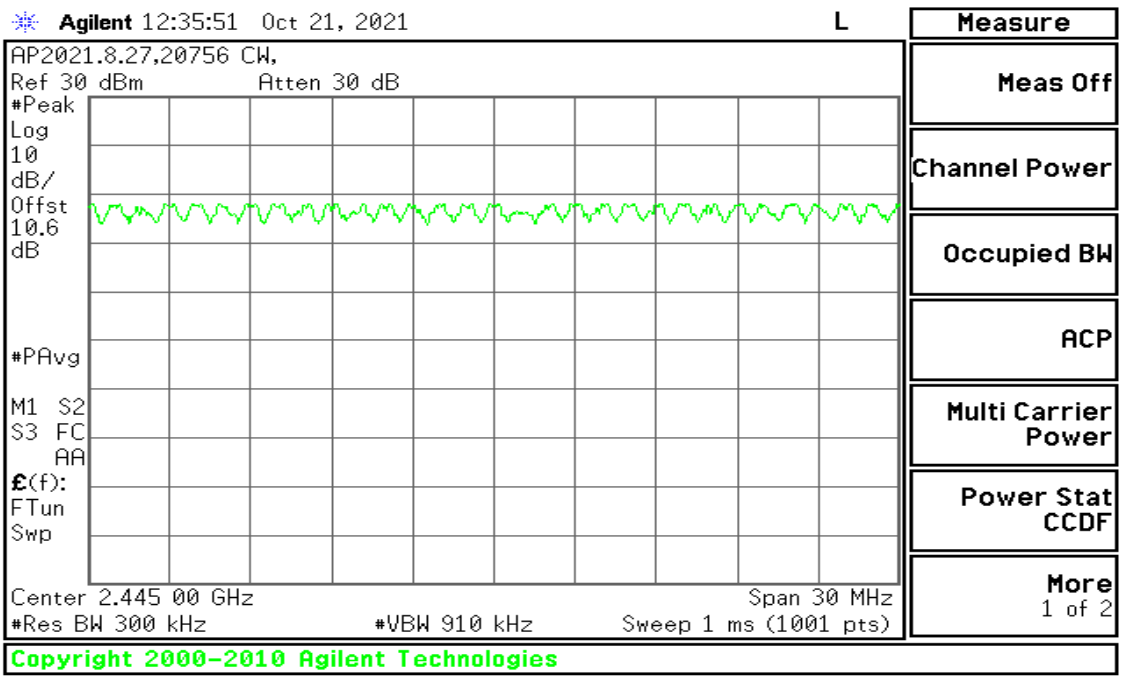
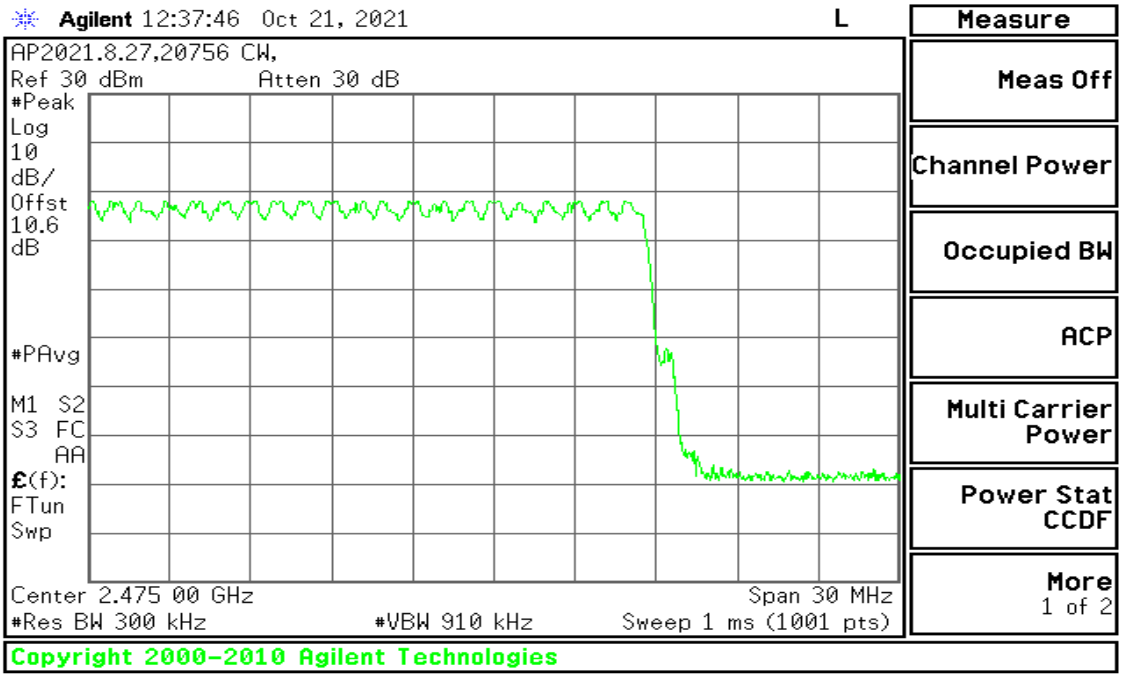


30MHz SPAN, SEGMENT 2 OF 3



30MHz SPAN, SEGMENT 3 OF 3

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9.5. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 3.16 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * 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 * (# of pulses in 0.8 s) * pulse width.

RESULTS

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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)
GFSK Normal Mode					
DH1	0.379	33	0.1251	0.4	-0.2749
DH3	1.634	14	0.2288	0.4	-0.1712
DH5	2.876	9	0.2588	0.4	-0.1412
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.379	8.25	0.03127	0.4	-0.3687
DH3	1.634	3.5	0.05719	0.4	-0.3428
DH5	2.876	2.25	0.06471	0.4	-0.3353

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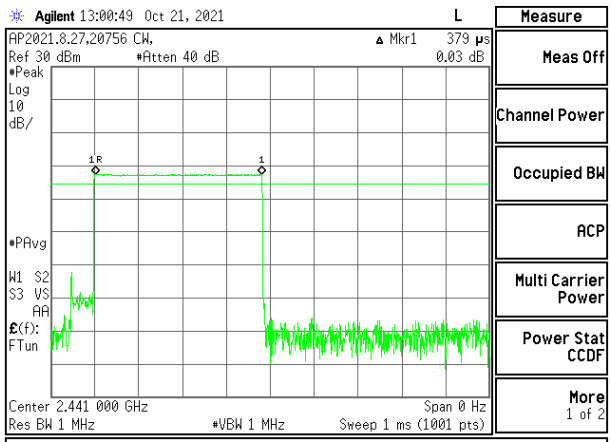
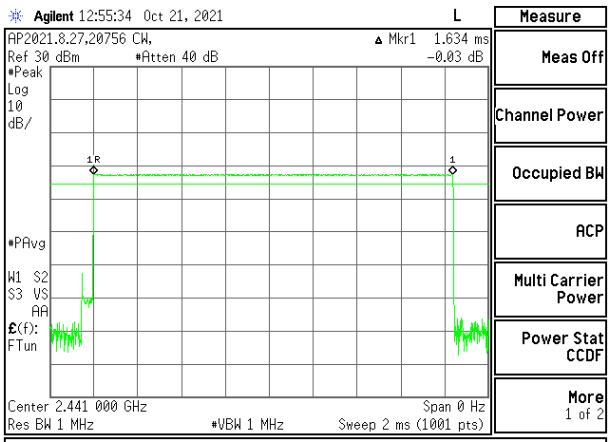
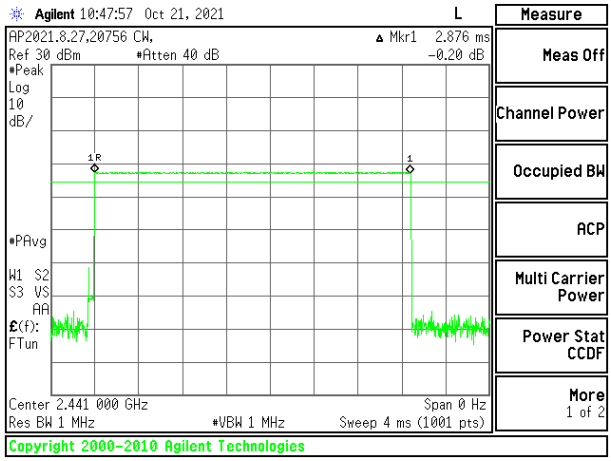


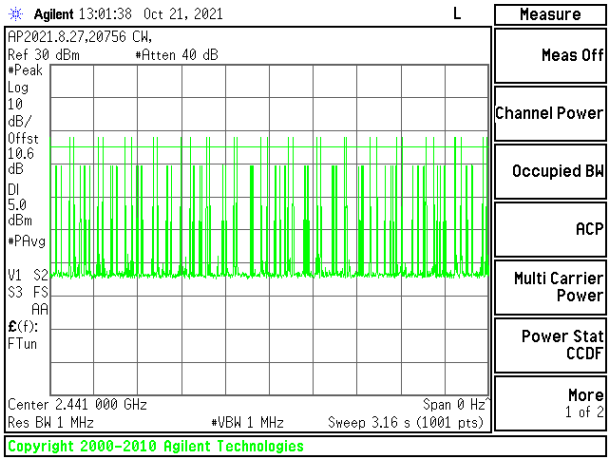
PULSE WIDTH – DH1



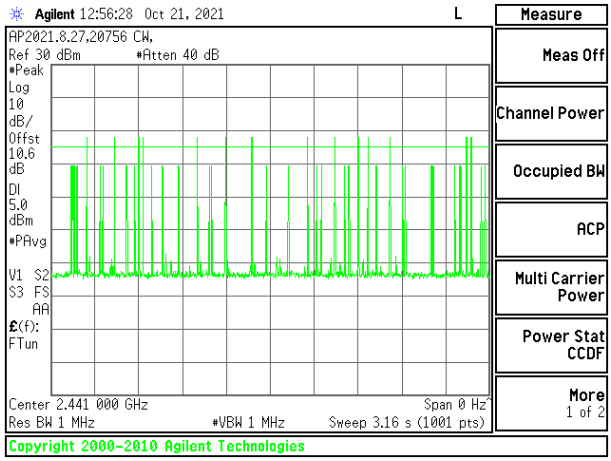
PULSE WIDTH – DH3



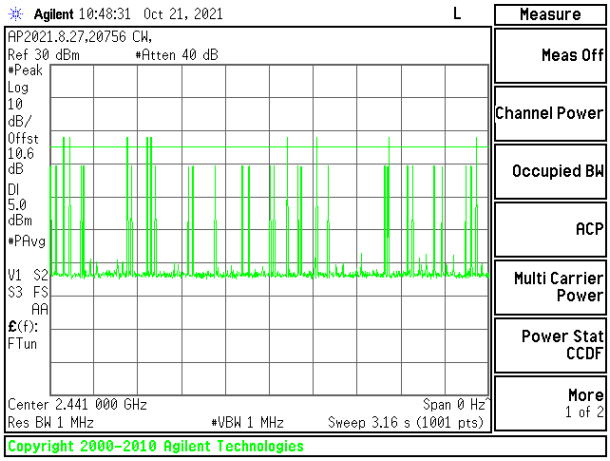
PULSE WIDTH – DH5



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

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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	0.385	32	0.1232	0.4	-0.2768
3DH3	1.632	19	0.31008	0.4	-0.0899
3DH5	2.876	9	0.25884	0.4	-0.1412

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.

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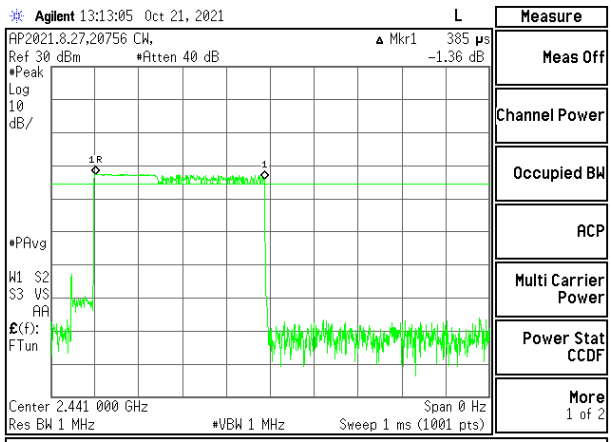
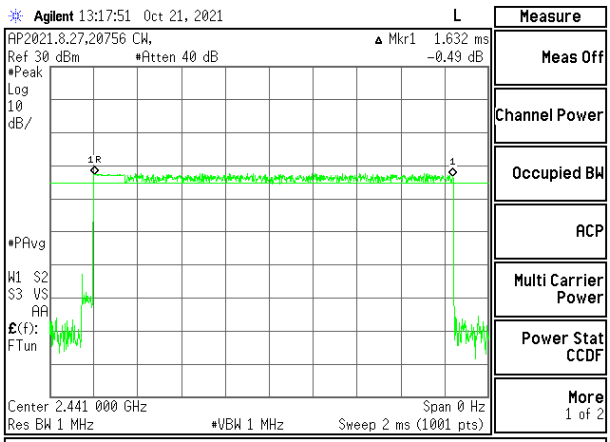
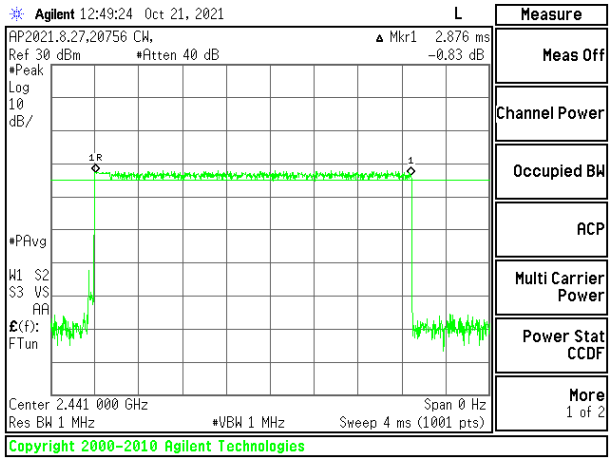


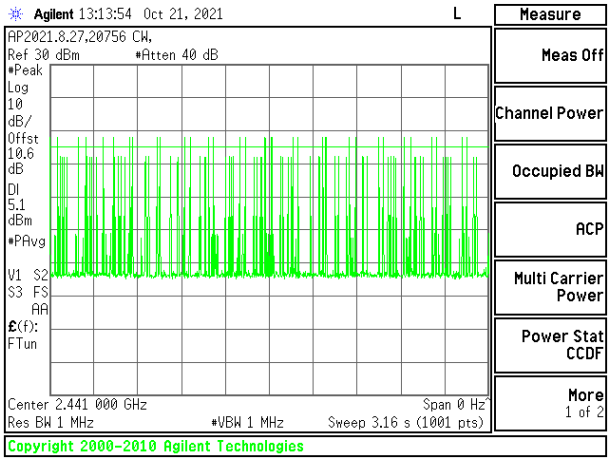
PULSE WIDTH – 3DH1



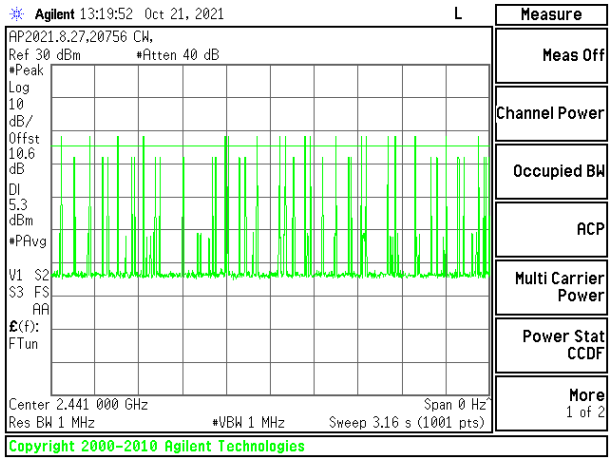
PULSE WIDTH – 3DH3



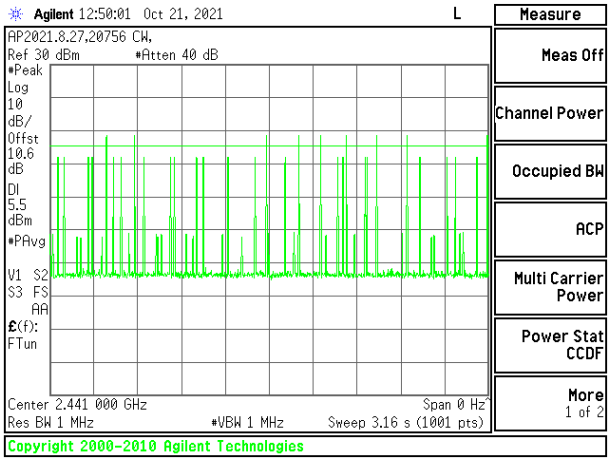
PULSE WIDTH – 3DH5



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

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9.6. OUTPUT POWER

LIMITS

§15.247 (b) (1)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

TEST PROCEDURE

The transmitter output is connected to a power meter.

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

RESULTS

UL VERIFICATION SERVICES
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9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	20756 CW
Date:	10/15/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	7.85	21	-13.15
Middle	2441	8.03	21	-12.97
High	2480	7.99	21	-13.01

9.6.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	20756 CW
Date:	10/15/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	8.48	21	-12.52
Middle	2441	8.58	21	-12.42
High	2480	8.48	21	-12.52

9.6.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	20756 CW
Date:	10/15/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	8.21	21	-12.79
Middle	2441	8.22	21	-12.78
High	2480	8.25	21	-12.75

UL VERIFICATION SERVICES
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9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

The transmitter output is connected to a power meter.

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

RESULTS

UL VERIFICATION SERVICES
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	20756 CW
Date	10/15/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	7.36
Middle	2441	7.46
High	2480	7.51

9.7.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	20756 CW
Date	10/15/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	5.67
Middle	2441	6.15
High	2480	6.23

9.7.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	20756 CW
Date	10/15/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	5.61
Middle	2441	6.08
High	2480	6.09

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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

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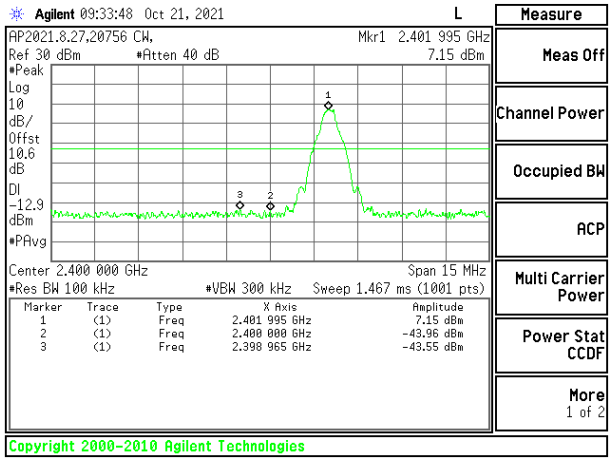
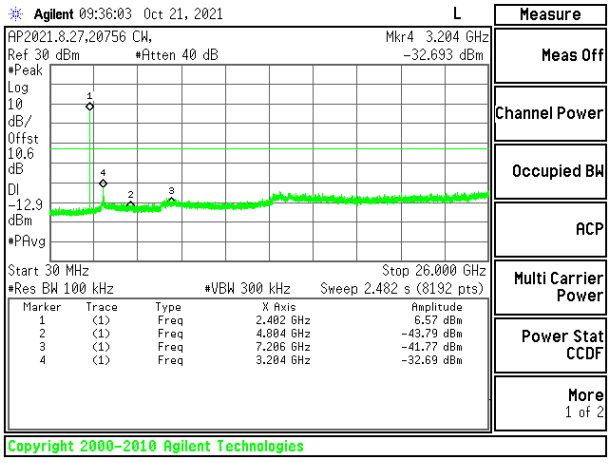
9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

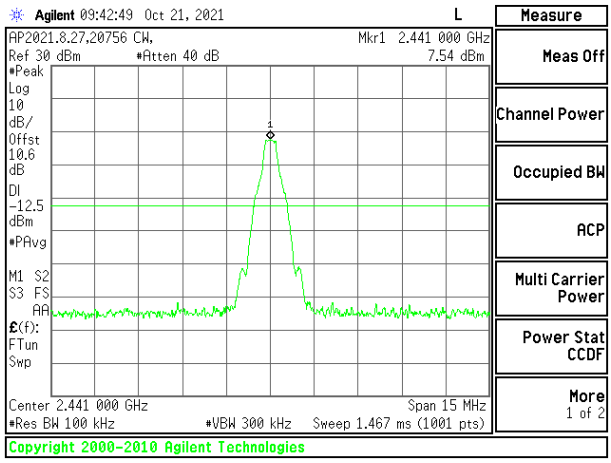
SPURIOUS EMISSIONS, NON-HOPPING



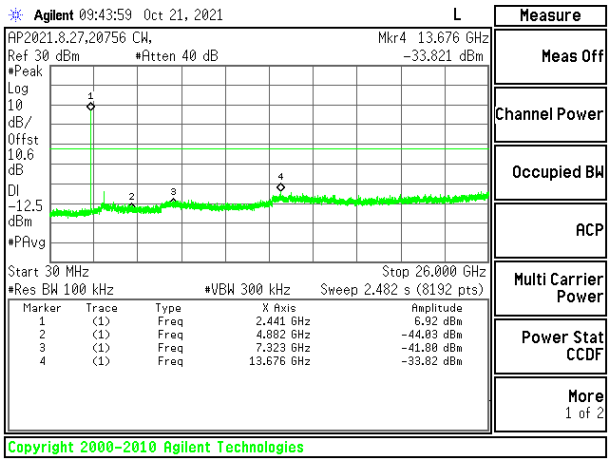
LOW CHANNEL BANDEDGE



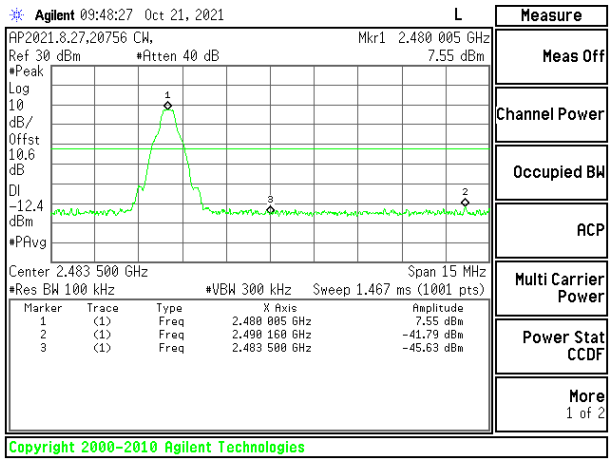
OUT-OF-BAND LOW CHANNEL



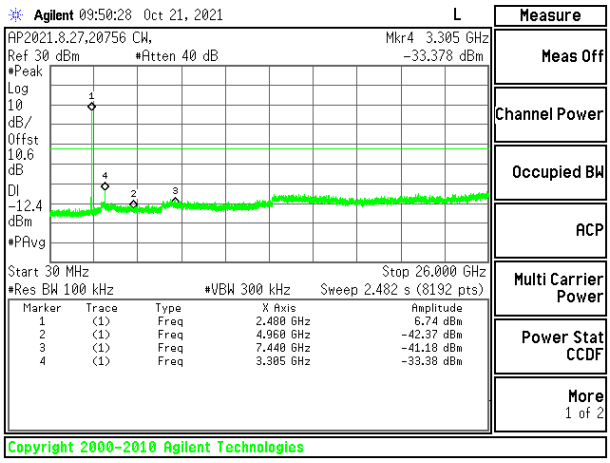
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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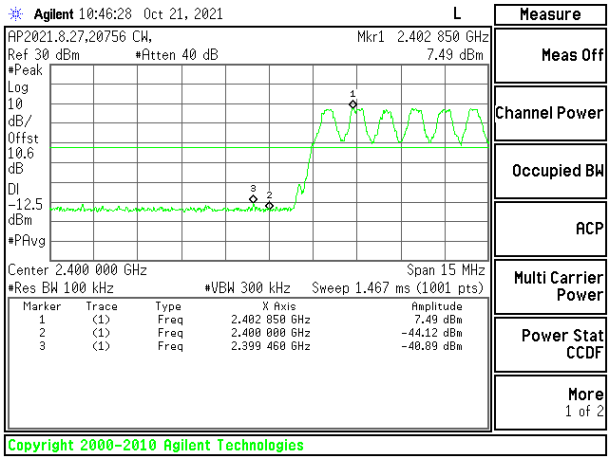
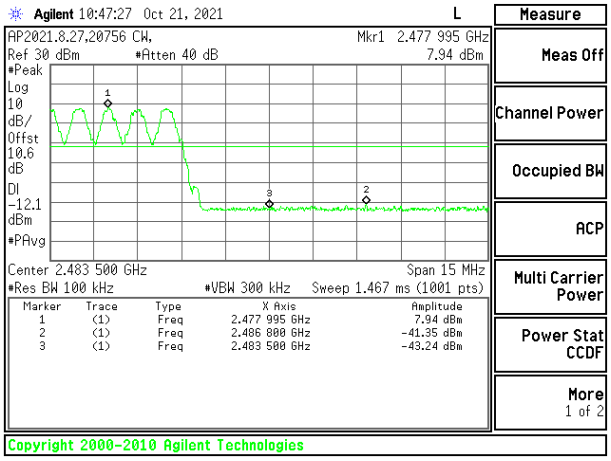
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

UL VERIFICATION SERVICES
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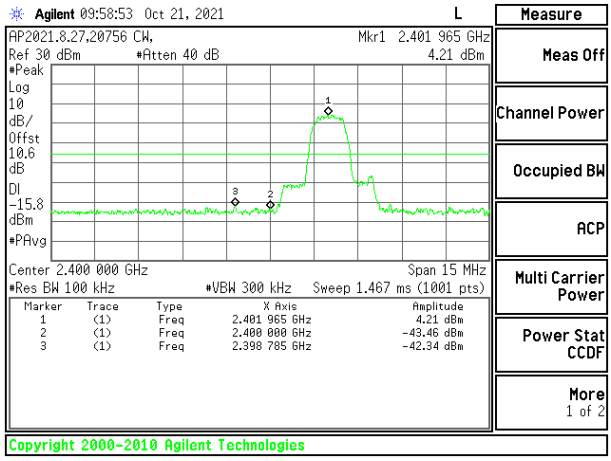
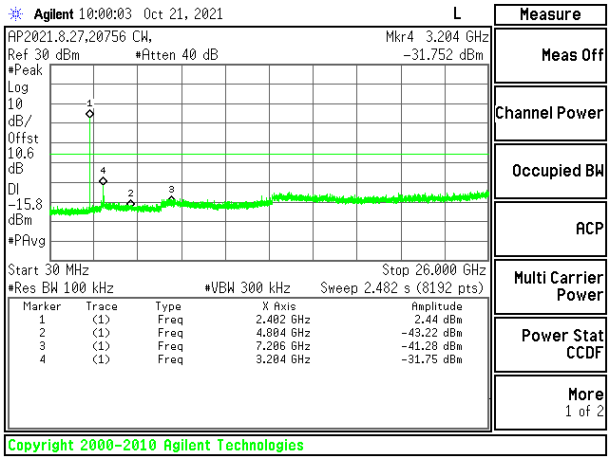
9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

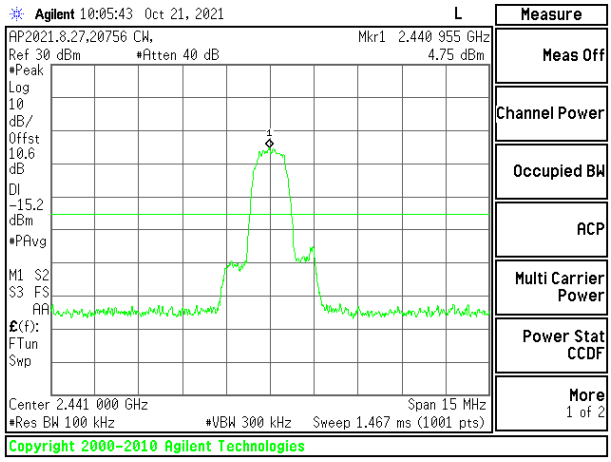
SPURIOUS EMISSIONS, NON-HOPPING



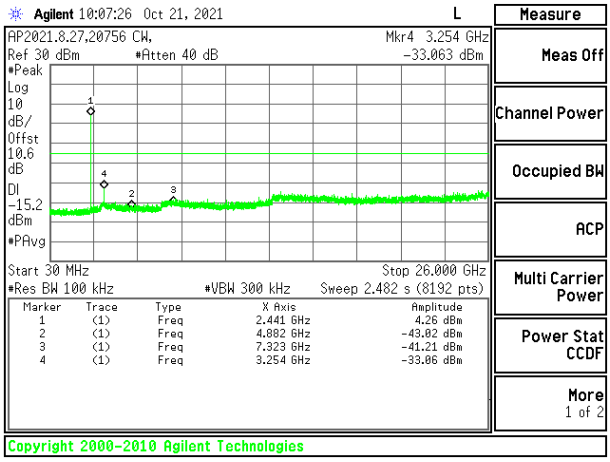
LOW CHANNEL BANDEDGE



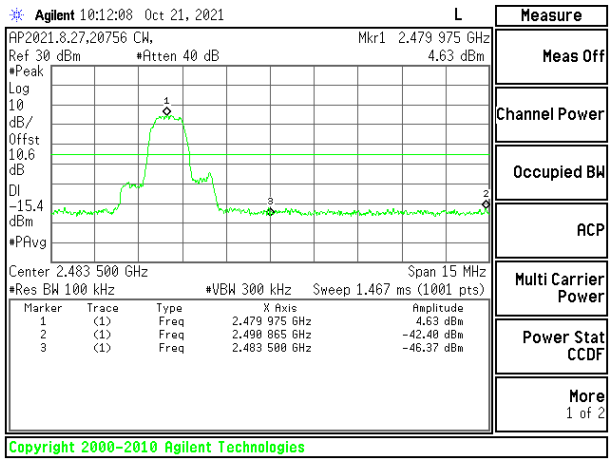
OUT-OF-BAND LOW CHANNEL



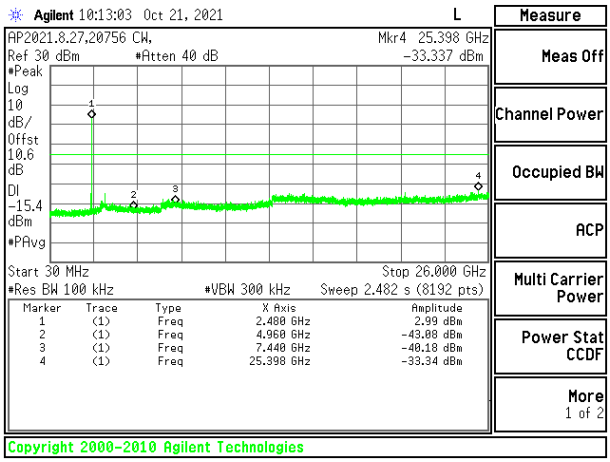
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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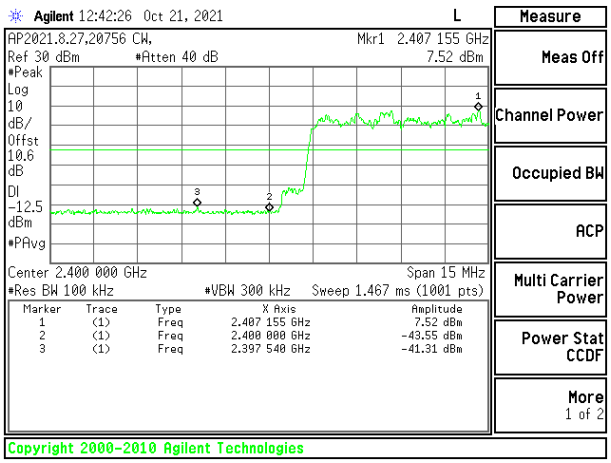
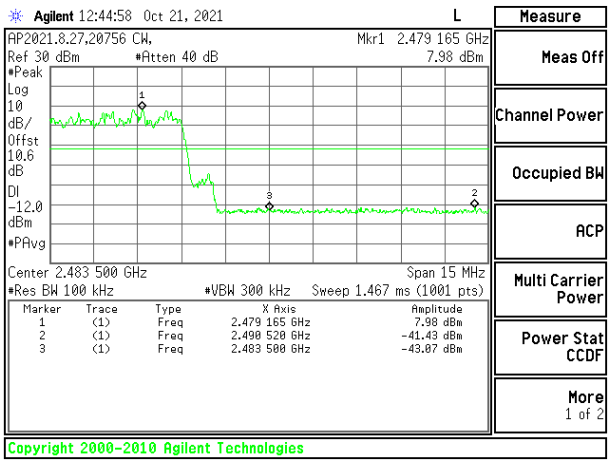
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

UL VERIFICATION SERVICES
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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.

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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.

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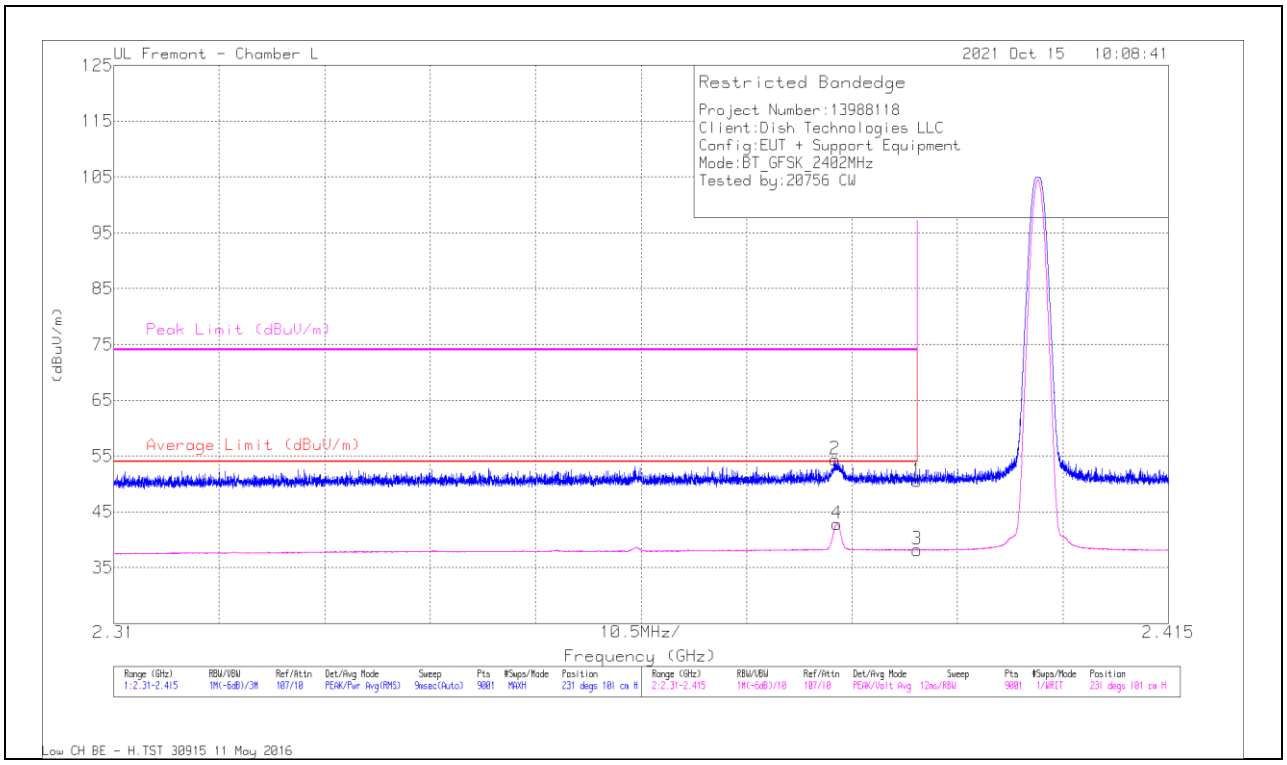
10.1. TRANSMITTER ABOVE 1 GHz

10.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 2.38999	37.8	Pk	32	-19.3	50.5	-	-	74	-23.5	231	101	H
2	* 2.38182	41.71	Pk	32.1	-19.4	54.41	-	-	74	-19.59	231	101	H
3	* 2.38999	25.49	VA1T	32	-19.3	38.19	54	-15.81	-	-	231	101	H
4	* 2.38202	30.17	VA1T	32.1	-19.4	42.87	54	-11.13	-	-	231	101	H

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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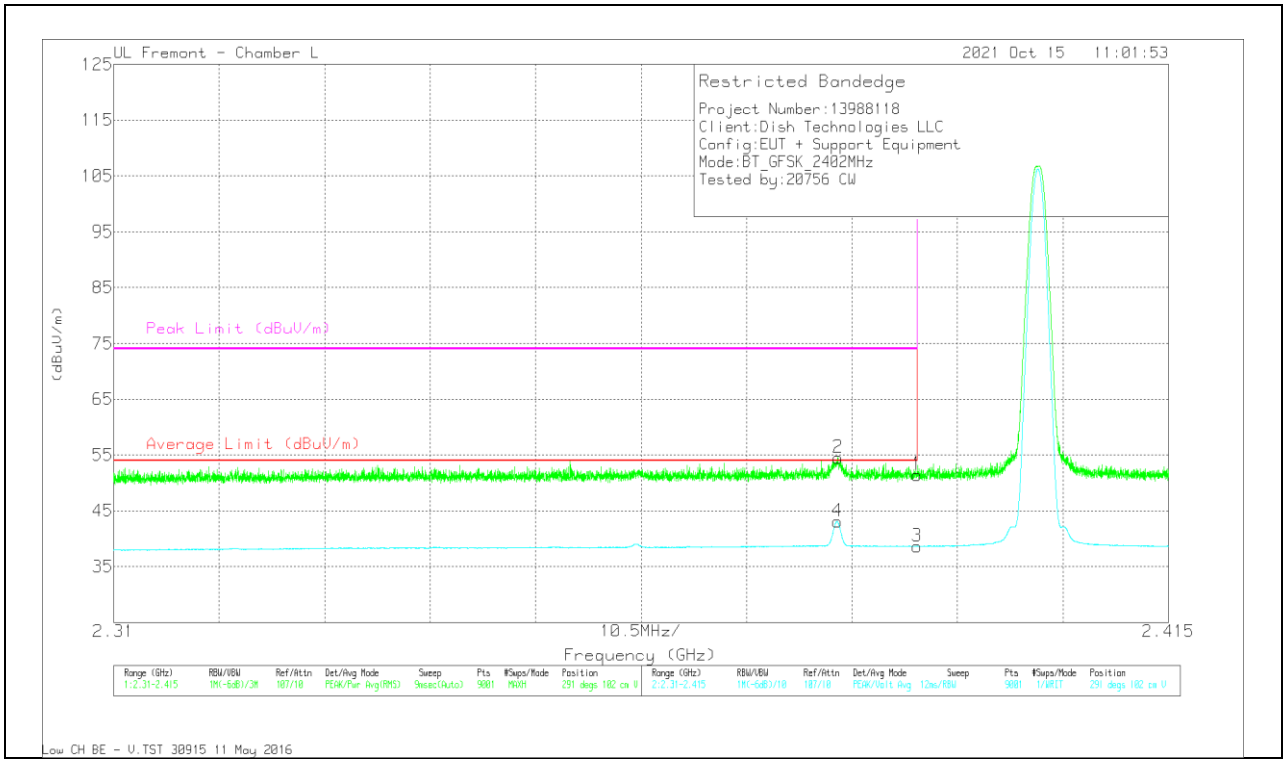
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 2.38999	38.77	Pk	32	-19.3	51.47	-	-	74	-22.53	291	102	V
2	* 2.38214	41.85	Pk	32.1	-19.4	54.55	-	-	74	-19.45	291	102	V
3	* 2.38999	25.96	VA1T	32	-19.3	38.66	54	-15.34	-	-	291	102	V
4	* 2.38203	30.35	VA1T	32.1	-19.4	43.05	54	-10.95	-	-	291	102	V

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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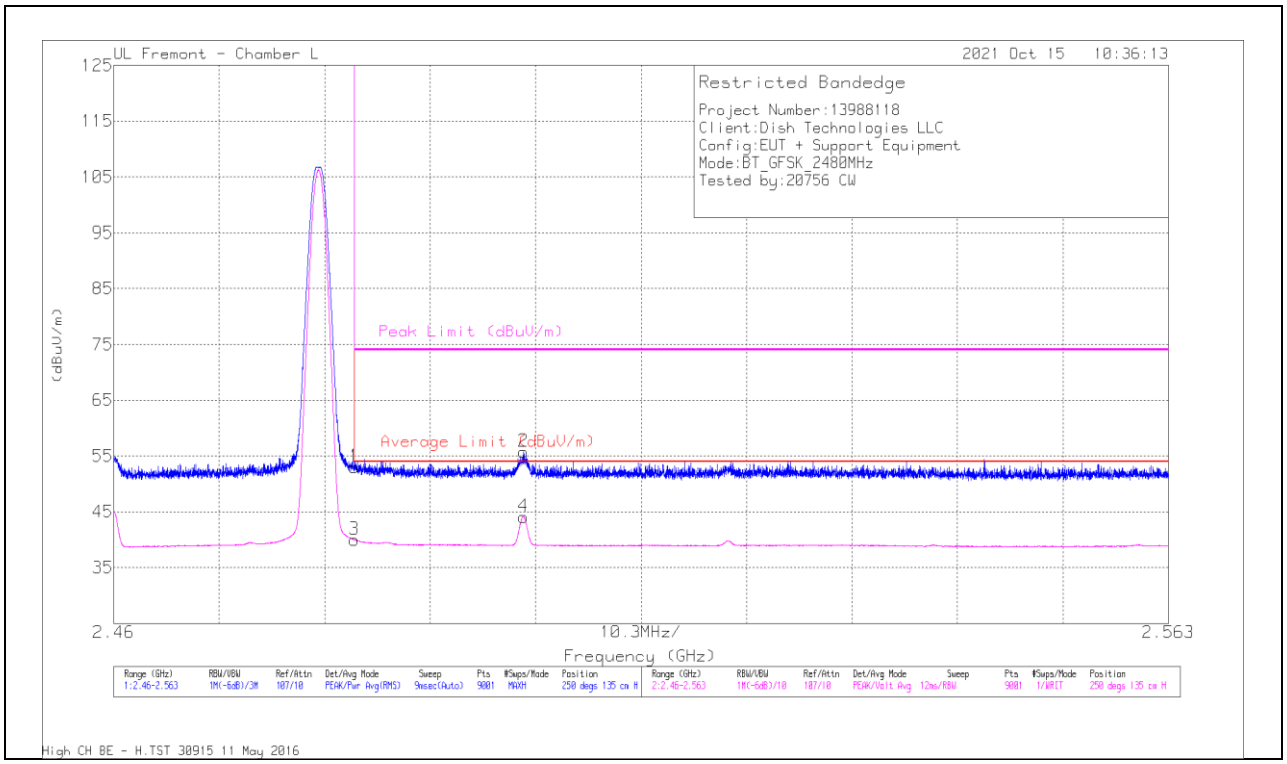
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 2.48351	39.72	Pk	32.3	-19	53.02	-	-	74	-20.98	250	135	H
2	2.50004	42.4	Pk	32.4	-19.1	55.7	-	-	74	-18.3	250	135	H
3	* 2.48351	26.68	VA1T	32.3	-19	39.98	54	-14.02	-	-	250	135	H
4	2.50001	30.83	VA1T	32.4	-19.1	44.13	54	-9.87	-	-	250	135	H

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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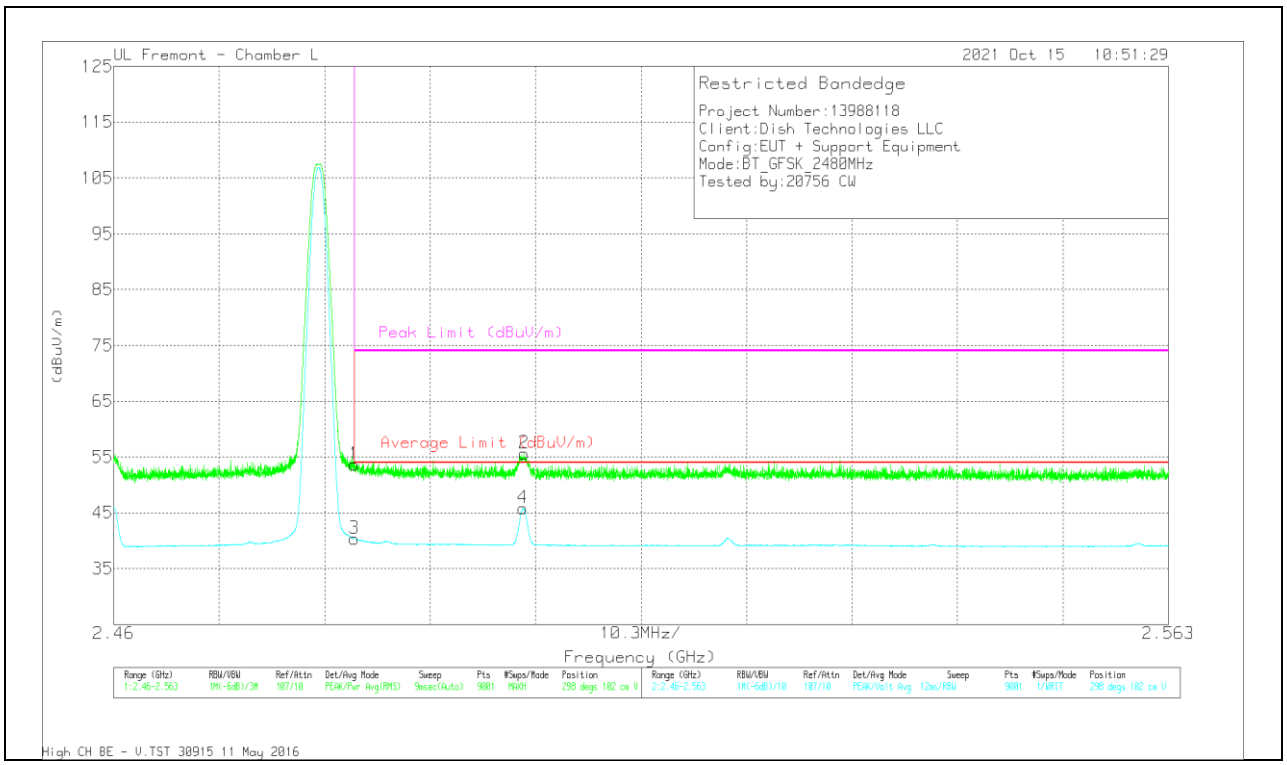
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 2.48351	40.35	Pk	32.3	-19	53.65	-	-	74	-20.35	298	102	V
2	2.5001	42.38	Pk	32.4	-19.1	55.68	-	-	74	-18.32	298	102	V
3	* 2.48351	27.04	VA1T	32.3	-19	40.34	54	-13.66	-	-	298	102	V
4	* 2.49999	32.5	VA1T	32.4	-19.1	45.8	54	-8.2	-	-	298	102	V

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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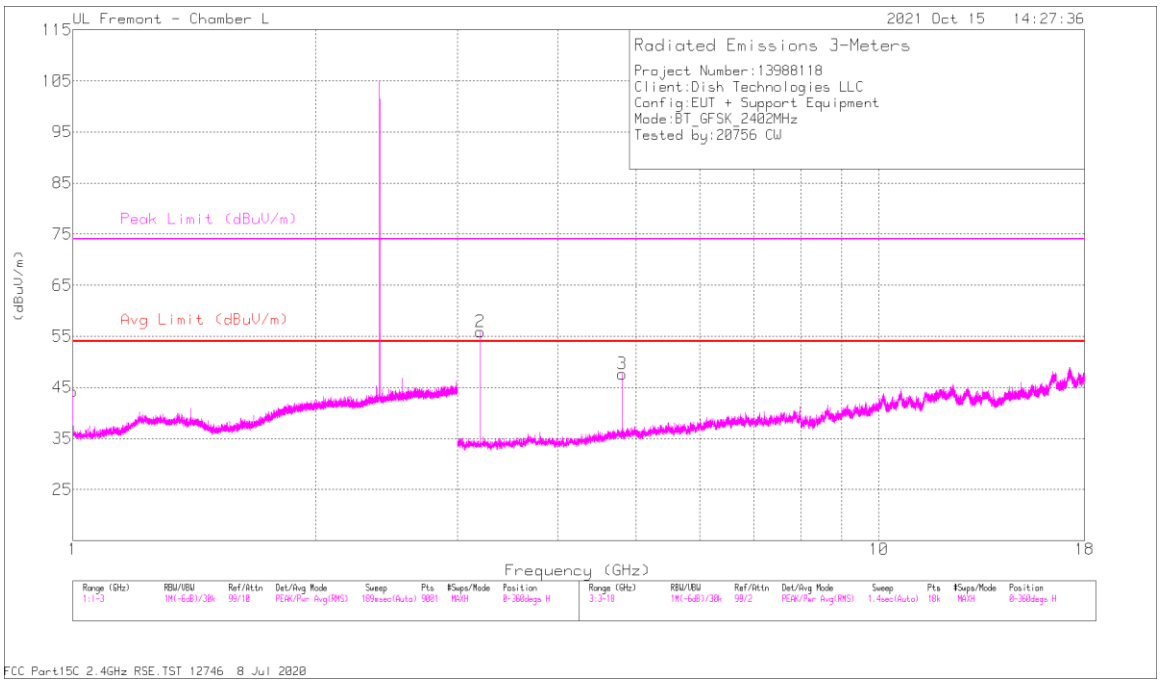
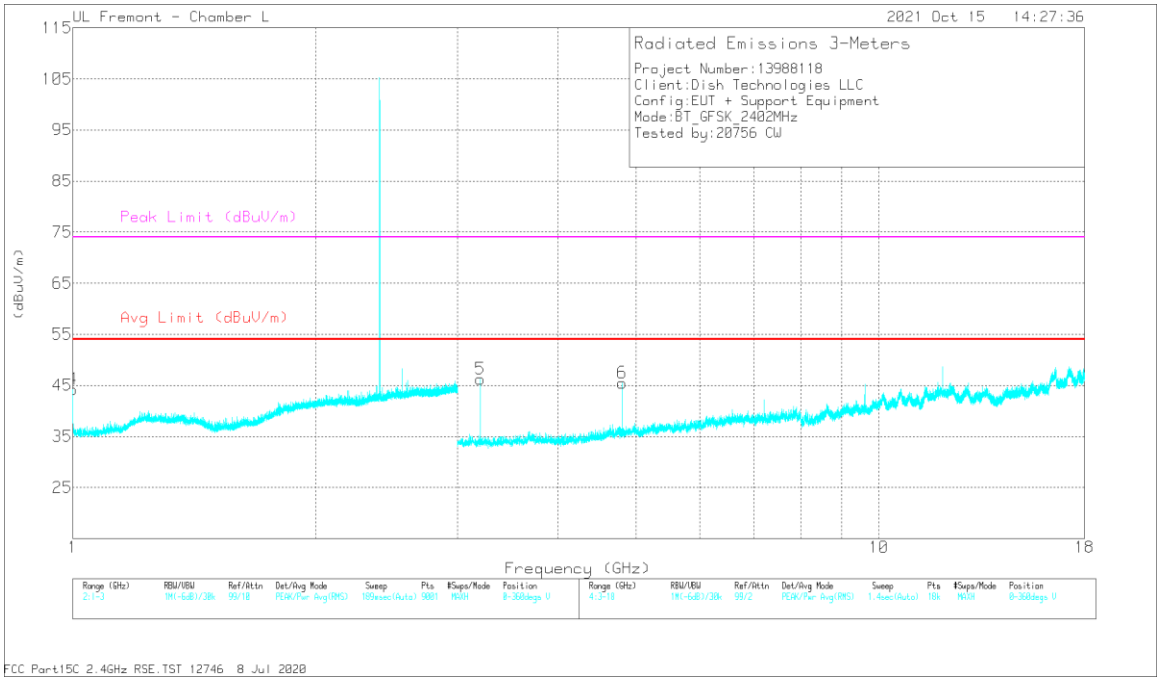
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 1.00003	45.38	PKFH	27.5	-23.8	49.08	-	-	74	-24.92	192	202	H
	* 1.00003	39.5	VA1T	27.5	-23.8	43.2	54	-10.8	-	-	192	202	H
4	* 1.00001	45.3	PKFH	27.5	-23.8	49	-	-	74	-25	269	235	V
	* 1.00001	39.89	VA1T	27.5	-23.8	43.59	54	-10.41	-	-	269	235	V
2	3.20267	51.34	PKFH	32.9	-26.6	57.64	-	-	-	-	258	101	H
	3.20265	49.96	VA1T	32.9	-26.6	56.26	-	-	-	-	258	101	H
3	* 4.80347	41.64	PKFH	34.1	-24.5	51.24	-	-	74	-22.76	265	104	H
	* 4.80363	34.54	VA1T	34.1	-24.5	44.14	54	-9.86	-	-	265	104	H
5	3.20268	44.96	PKFH	32.9	-26.6	51.26	-	-	-	-	283	101	V
	3.20265	42.32	VA1T	32.9	-26.6	48.62	-	-	-	-	283	101	V
6	* 4.8036	42.52	PKFH	34.1	-24.5	52.12	-	-	74	-21.88	255	101	V
	* 4.80363	35.32	VA1T	34.1	-24.5	44.92	54	-9.08	-	-	255	101	V

* - indicates frequency in CFR47 Pt 15
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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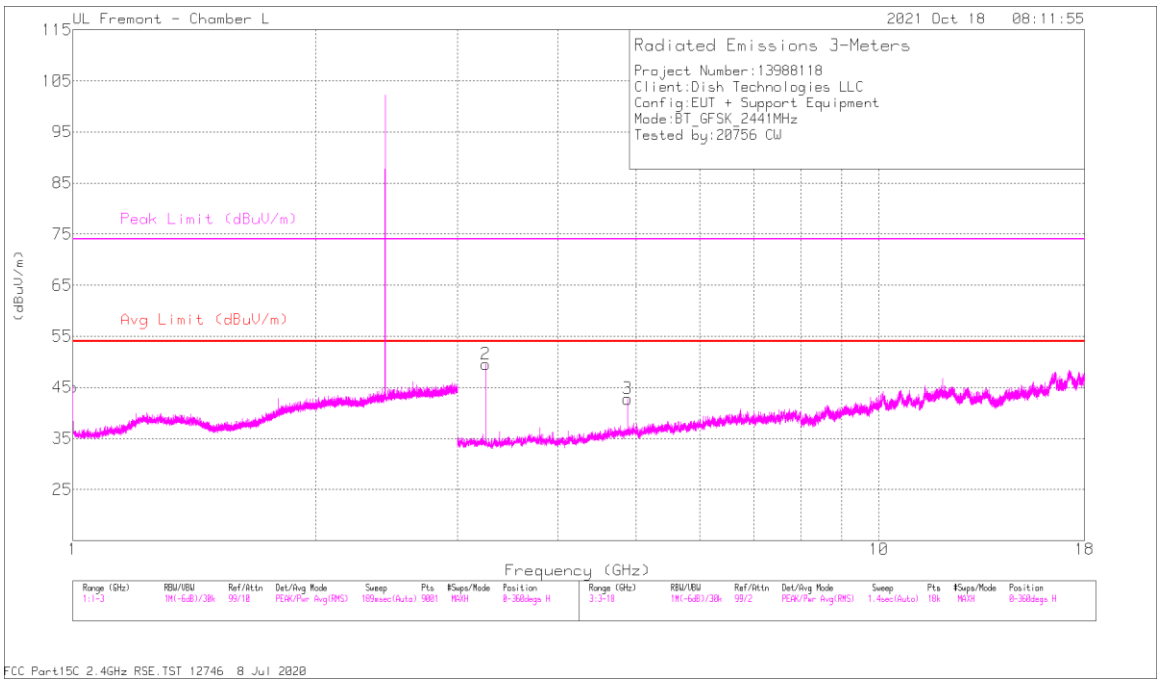
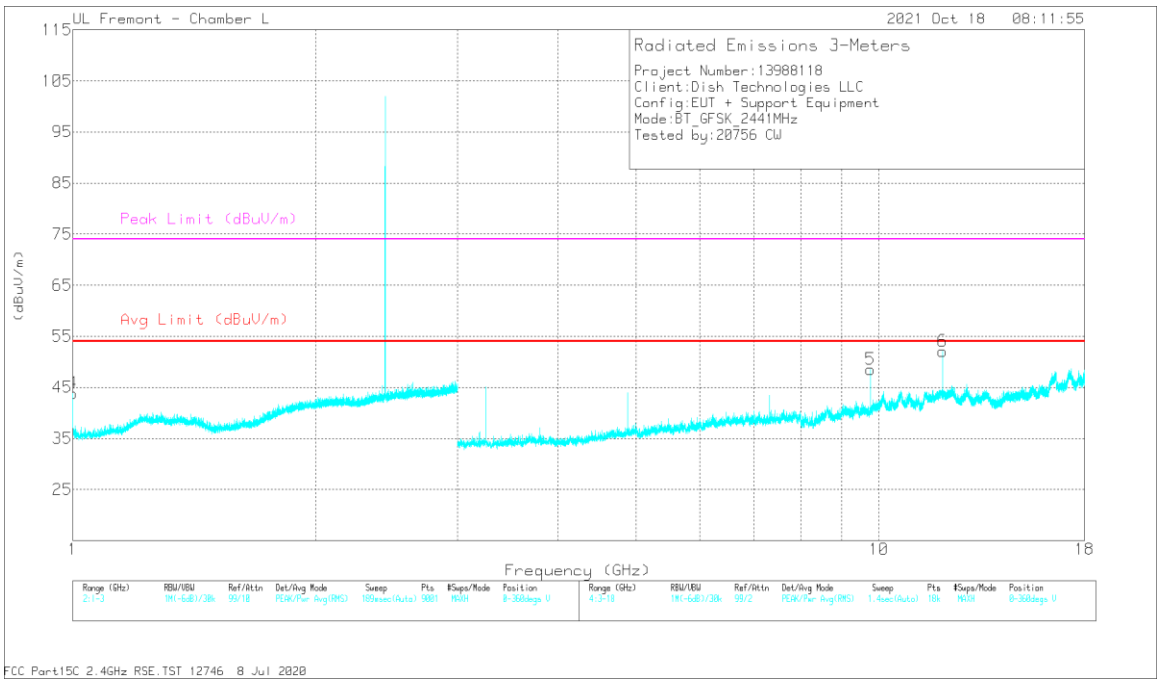
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 1.00001	45.95	PKFH	27.5	-23.8	49.65	-	-	74	-24.35	51	280	H
	* 1.00002	41.09	VA1T	27.5	-23.8	44.79	54	-9.21	-	-	51	280	H
4	* 1.00002	45	PKFH	27.5	-23.8	48.7	-	-	74	-25.3	276	189	V
	* 1.00001	39.17	VA1T	27.5	-23.8	42.87	54	-11.13	-	-	276	189	V
2	3.25472	45.4	PKFH	33.1	-26.9	51.6	-	-	-	-	254	115	H
	3.25465	42.17	VA1T	33.1	-26.9	48.37	-	-	-	-	254	115	H
3	* 4.88157	39.34	PKFH	34.2	-24.3	49.24	-	-	74	-24.76	30	109	H
	* 4.88196	31.99	VA1T	34.2	-24.3	41.89	54	-12.11	-	-	30	109	H
5	9.76406	33.71	PKFH	37	-17.1	53.61	-	-	-	-	222	102	V
	9.76395	26.25	VA1T	37	-17.1	46.15	-	-	-	-	222	102	V
6	* 11.99975	32.28	PKFH	39.2	-16.3	55.18	-	-	74	-18.82	175	102	V
	* 11.99987	25.82	VA1T	39.2	-16.3	48.72	54	-5.28	-	-	175	102	V

* - indicates frequency in CFR47 Pt 15
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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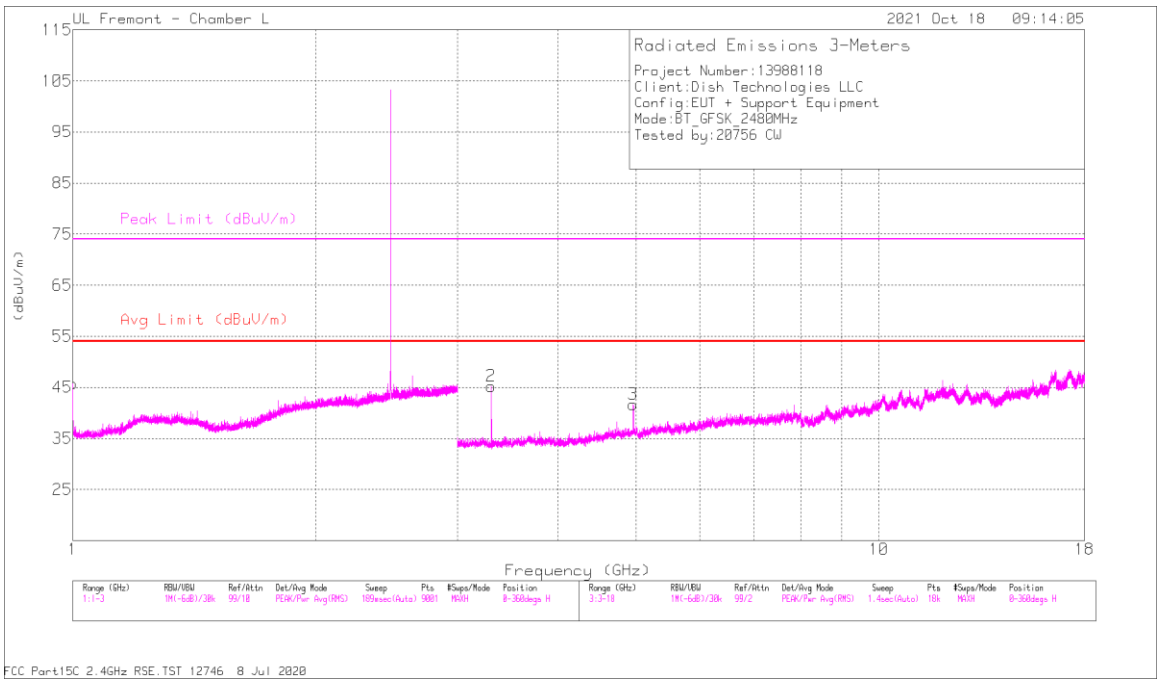
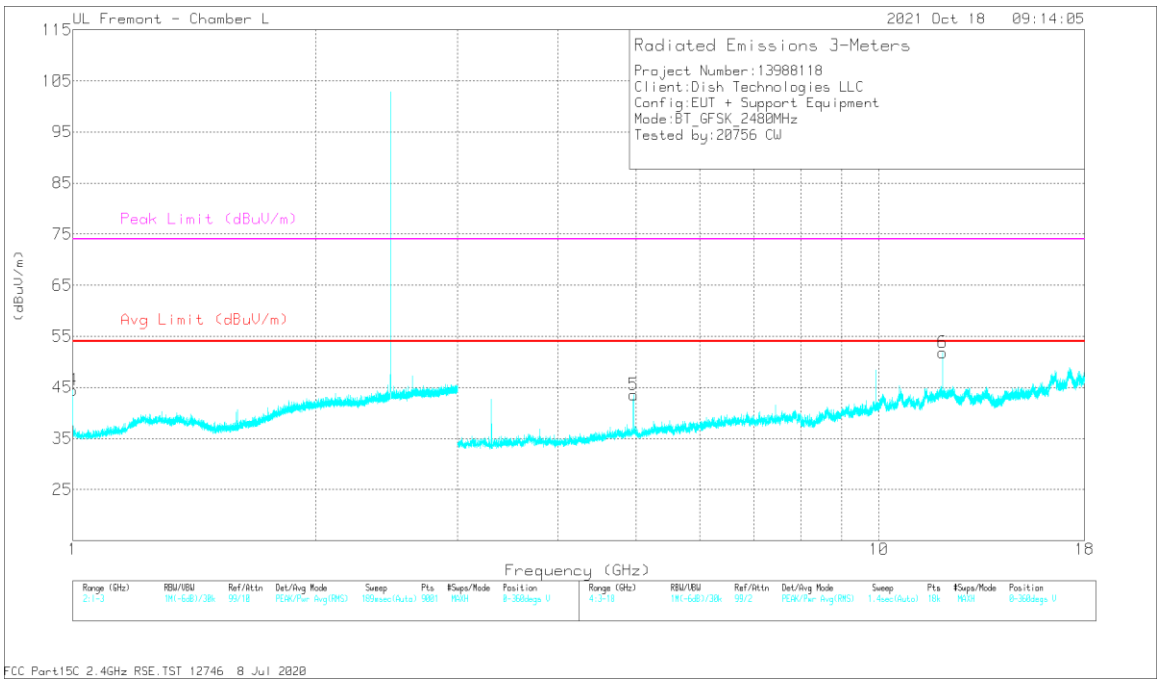
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 1.00008	46.83	PKFH	27.5	-23.8	50.53	-	-	74	-23.47	80	117	H
	* 1.00002	42.54	VA1T	27.5	-23.8	46.24	54	-7.76	-	-	80	117	H
4	* 1.00017	44.98	PKFH	27.5	-23.8	48.68	-	-	74	-25.32	280	195	V
	* 1.00001	39.36	VA1T	27.5	-23.8	43.06	54	-10.94	-	-	280	195	V
2	3.30675	42.58	PKFH	32.5	-26.5	48.58	-	-	-	-	216	101	H
	3.30665	38.3	VA1T	32.5	-26.5	44.3	-	-	-	-	216	101	H
3	* 4.95939	35.17	PKFH	34.2	-23.2	46.17	-	-	74	-27.83	272	104	H
	* 4.95948	24.37	VA1T	34.2	-23.2	35.37	54	-18.63	-	-	272	104	H
5	* 4.96042	37.14	PKFH	34.2	-23.2	48.14	-	-	74	-25.86	93	107	V
	* 4.95998	29.14	VA1T	34.2	-23.2	40.14	54	-13.86	-	-	93	107	V
6	* 12.00028	32.5	PKFH	39.2	-16.3	55.4	-	-	74	-18.6	169	102	V
	* 12.00006	26.68	VA1T	39.2	-16.3	49.58	54	-4.42	-	-	169	102	V

* - indicates frequency in CFR47 Pt 15
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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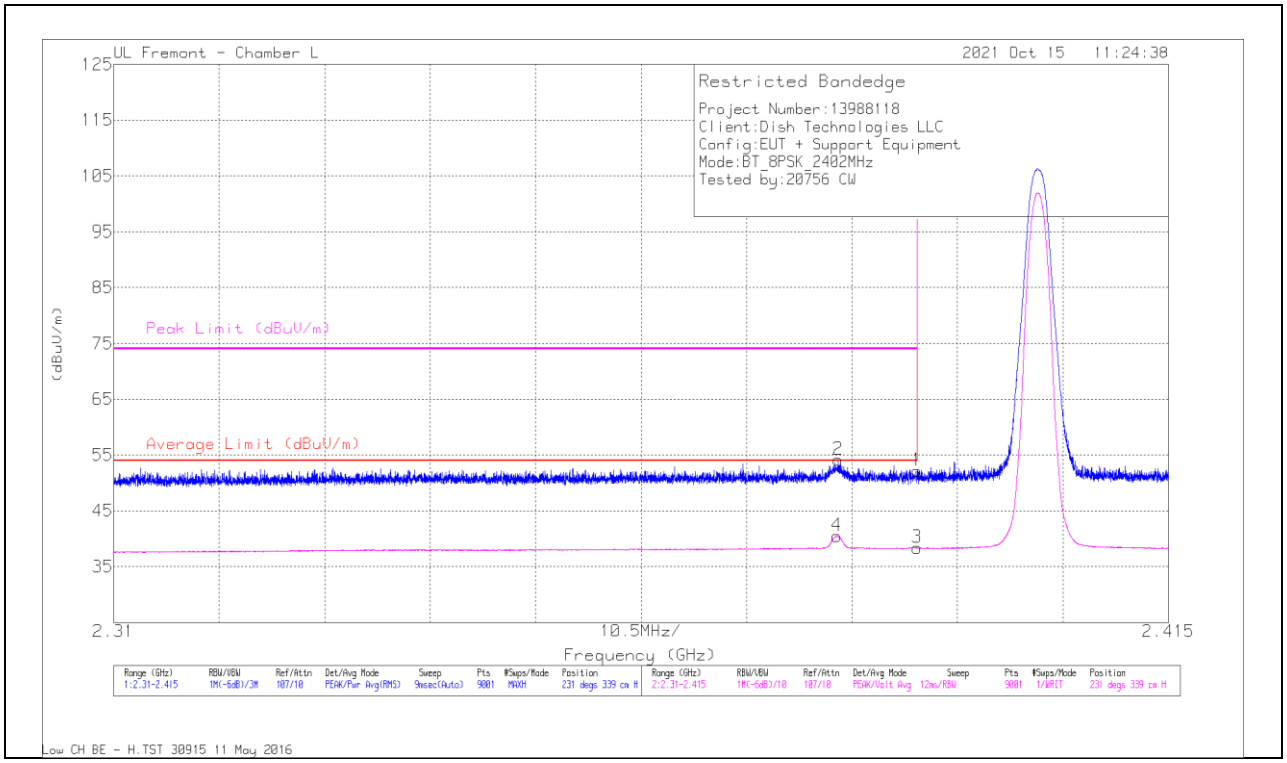
10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 2.38999	39.45	Pk	32	-19.3	52.15	-	-	74	-21.85	231	339	H
2	* 2.38213	41.45	Pk	32.1	-19.4	54.15	-	-	74	-19.85	231	339	H
3	* 2.38999	25.65	VA1T	32	-19.3	38.35	54	-15.65	-	-	231	339	H
4	* 2.382	27.78	VA1T	32.1	-19.4	40.48	54	-13.52	-	-	231	339	H

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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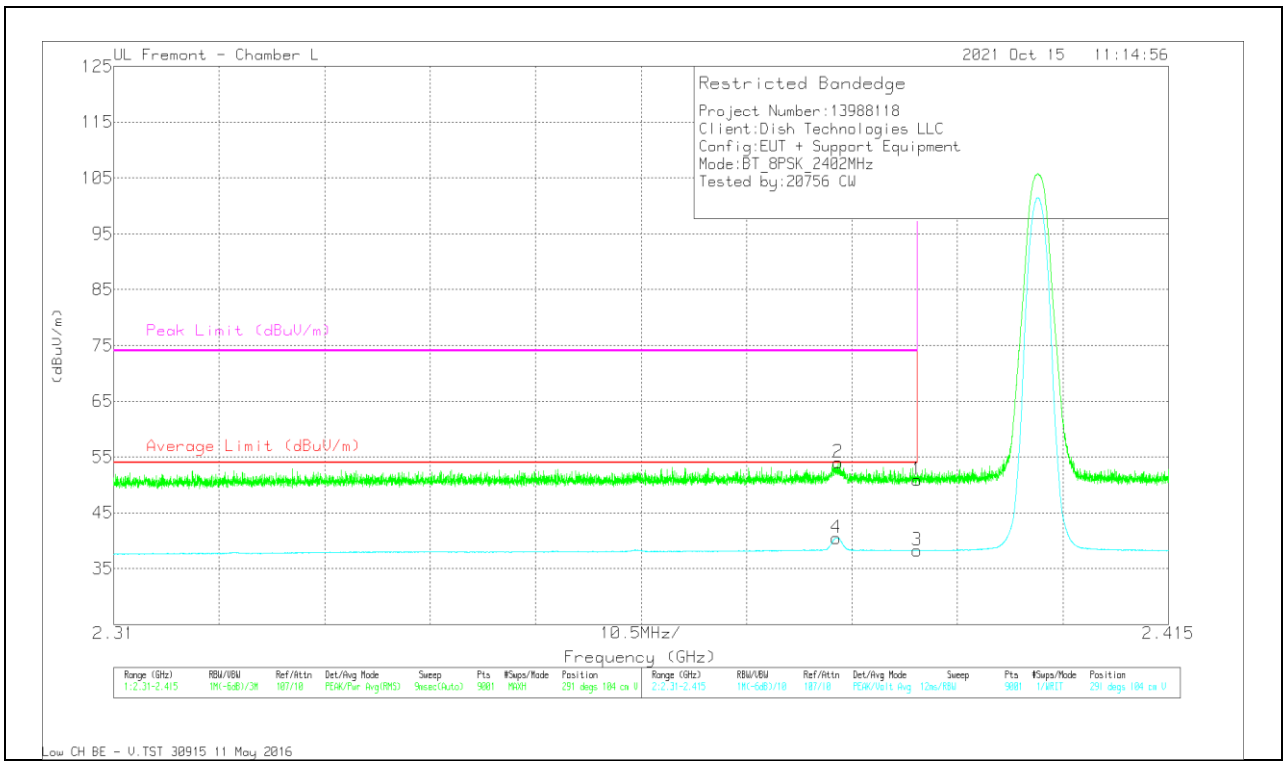
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 2.38999	38.24	Pk	32	-19.3	50.94	-	-	74	-23.06	291	104	V
2	* 2.38213	41.37	Pk	32.1	-19.4	54.07	-	-	74	-19.93	291	104	V
3	* 2.38999	25.52	VA1T	32	-19.3	38.22	54	-15.78	-	-	291	104	V
4	* 2.38194	27.78	VA1T	32.1	-19.4	40.48	54	-13.52	-	-	291	104	V

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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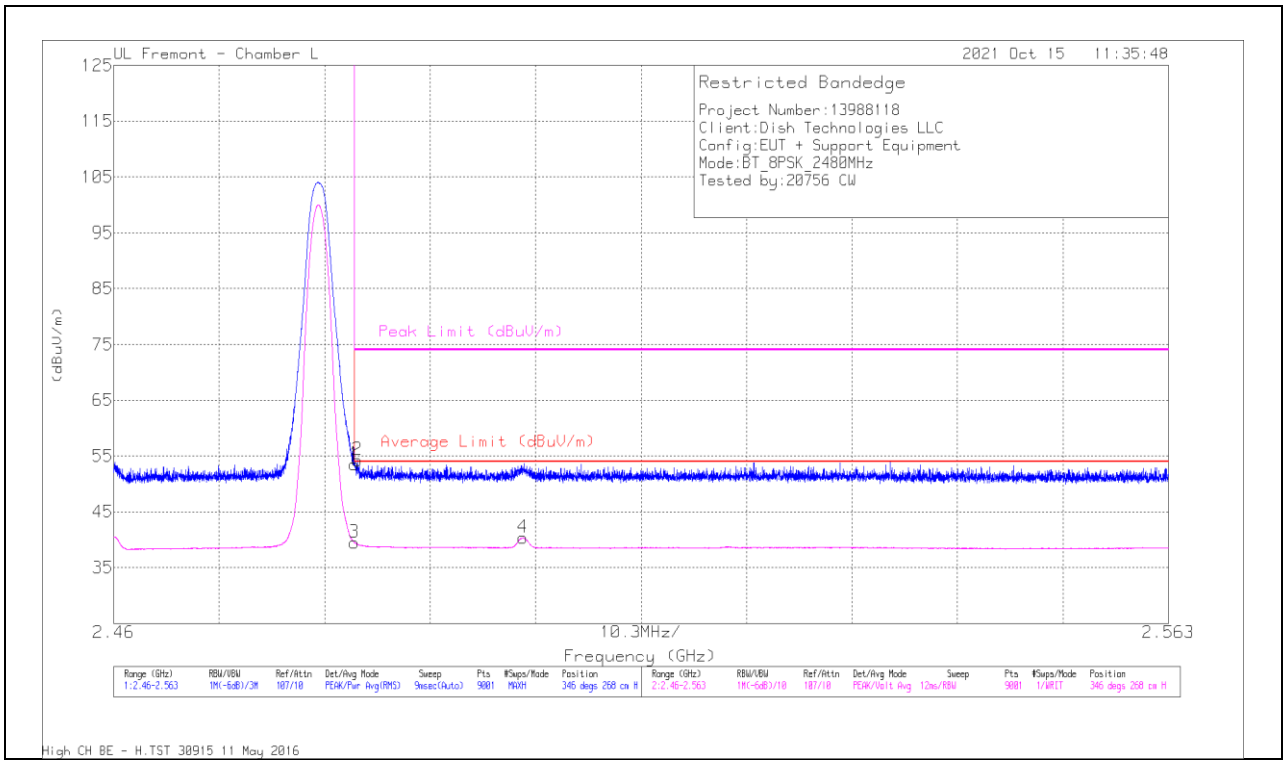
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 2.48351	40.24	Pk	32.3	-19	53.54	-	-	74	-20.46	346	268	H
2	* 2.48378	41.02	Pk	32.3	-19	54.32	-	-	74	-19.68	346	268	H
3	* 2.48351	26.17	VA1T	32.3	-19	39.47	54	-14.53	-	-	346	268	H
4	* 2.49996	27.04	VA1T	32.4	-19.1	40.34	54	-13.66	-	-	346	268	H

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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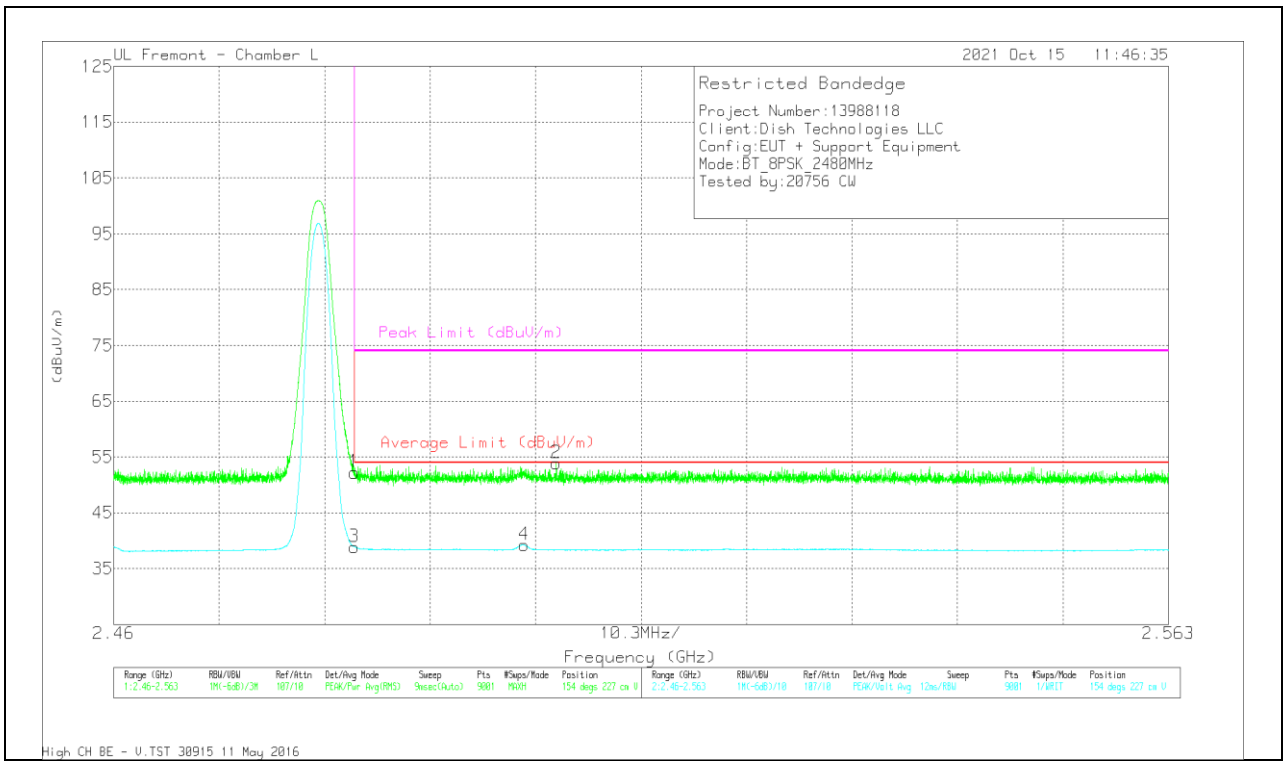
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 2.48351	38.92	Pk	32.3	-19	52.22	-	-	74	-21.78	154	227	V
2	2.50322	40.62	Pk	32.4	-19.1	53.92	-	-	74	-20.08	154	227	V
3	* 2.48351	25.6	VA1T	32.3	-19	38.9	54	-15.1	-	-	154	227	V
4	2.50009	25.94	VA1T	32.4	-19.1	39.24	54	-14.76	-	-	154	227	V

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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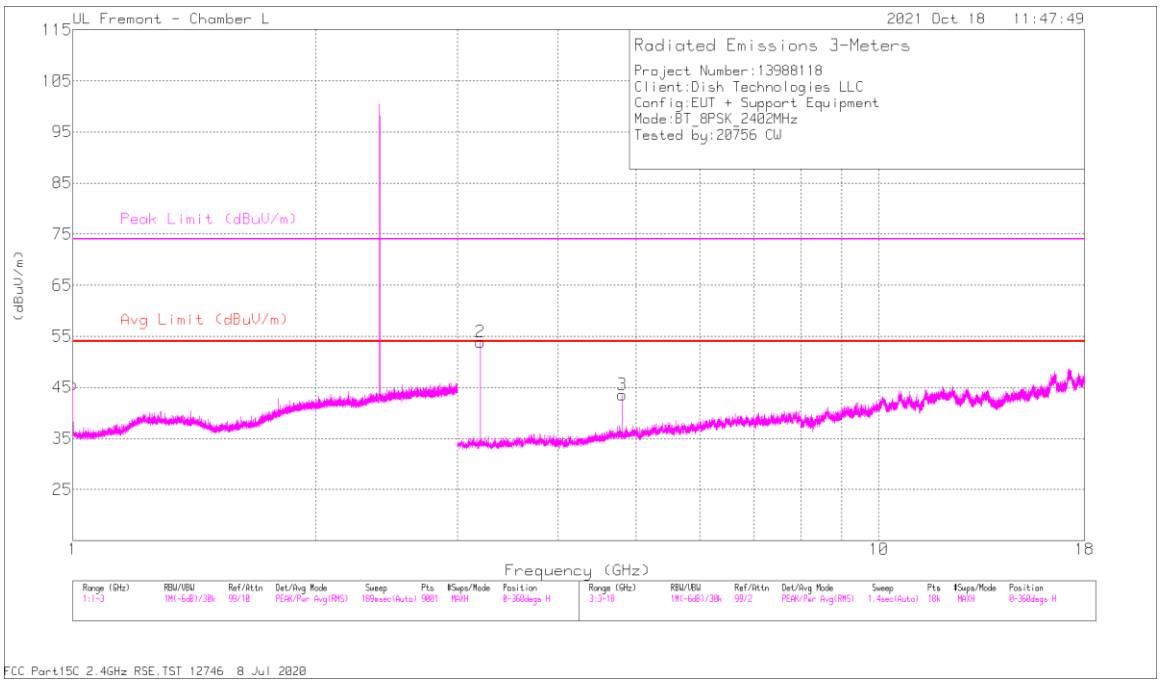
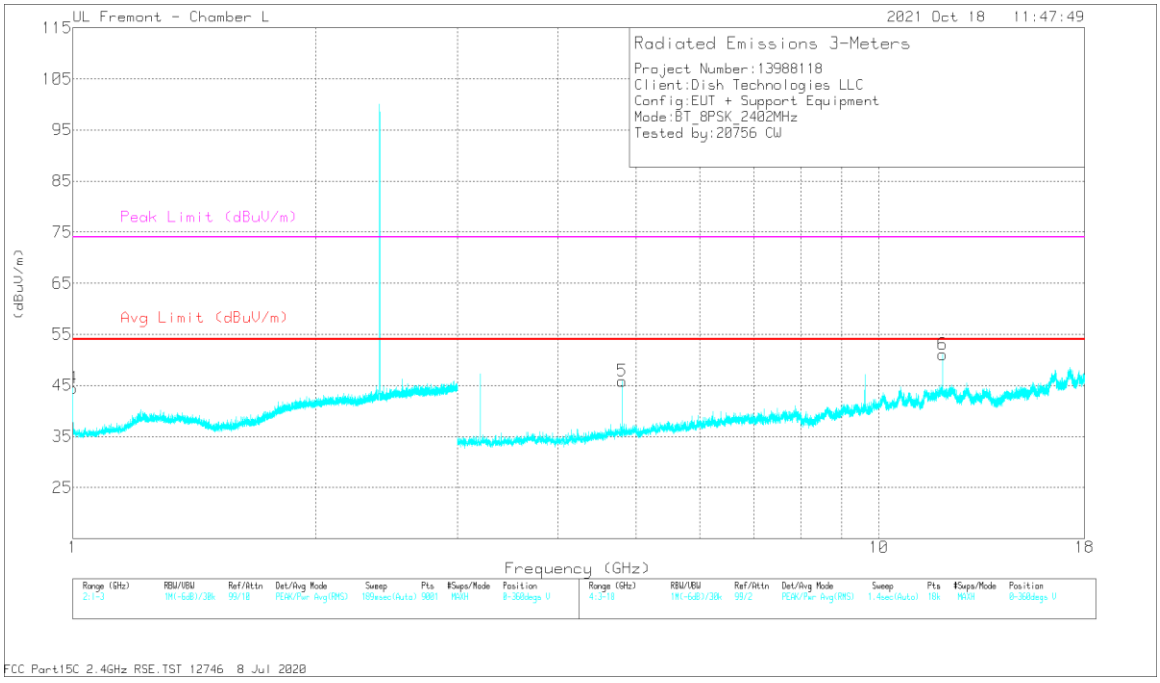
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

UL VERIFICATION SERVICES
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 1.00005	46.81	PKFH	27.5	-23.8	50.51	-	-	74	-23.49	83	114	H
	* 1.00004	42.14	VA1T	27.5	-23.8	45.84	54	-8.16	-	-	83	114	H
4	* 1.00001	45.02	PKFH	27.5	-23.8	48.72	-	-	74	-25.28	285	294	V
	* 1.00004	39.36	VA1T	27.5	-23.8	43.06	54	-10.94	-	-	285	294	V
2	3.20261	48.64	PKFH	32.9	-26.6	54.94	-	-	-	-	256	105	H
	3.20266	46.49	VA1T	32.9	-26.6	52.79	-	-	-	-	256	105	H
3	* 4.80345	40.34	PKFH	34.1	-24.5	49.94	-	-	74	-24.06	38	106	H
	* 4.80363	30.6	VA1T	34.1	-24.5	40.2	54	-13.8	-	-	38	106	H
5	* 4.80412	42.65	PKFH	34.1	-24.5	52.25	-	-	74	-21.75	98	105	V
	* 4.80395	33.9	VA1T	34.1	-24.5	43.5	54	-10.5	-	-	98	105	V
6	* 12.00035	31.24	PKFH	39.2	-16.3	54.14	-	-	74	-19.86	168	115	V
	* 12.0003	24.51	VA1T	39.2	-16.3	47.41	54	-6.59	-	-	168	115	V

* - indicates frequency in CFR47 Pt 15
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES
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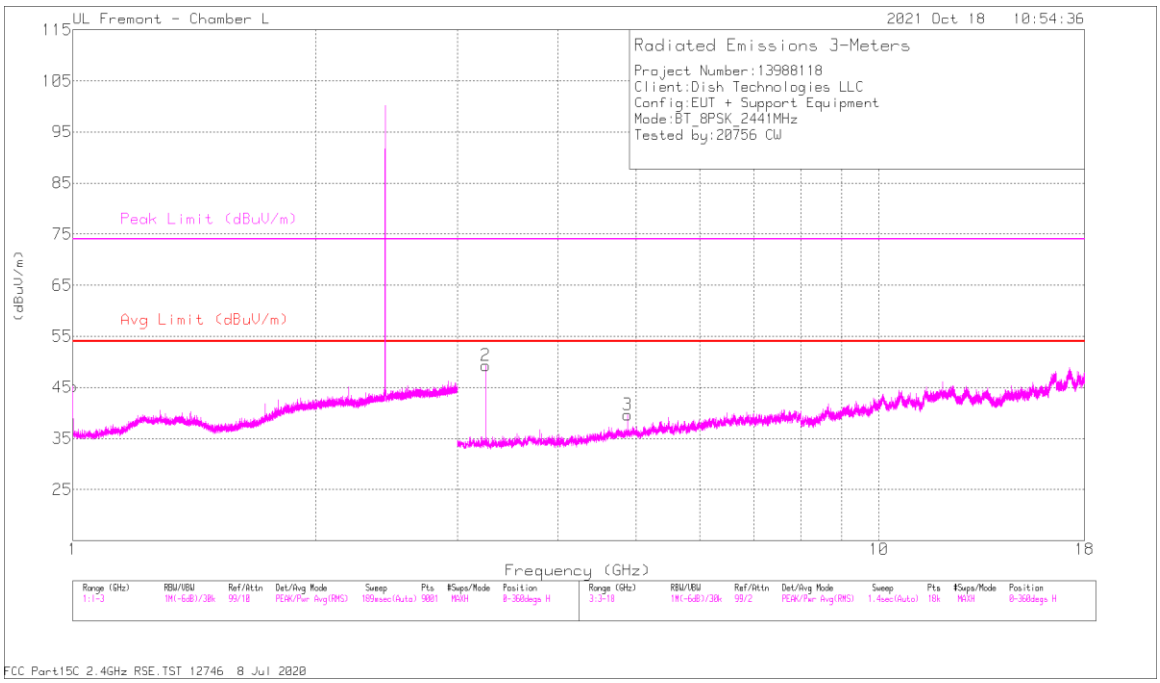
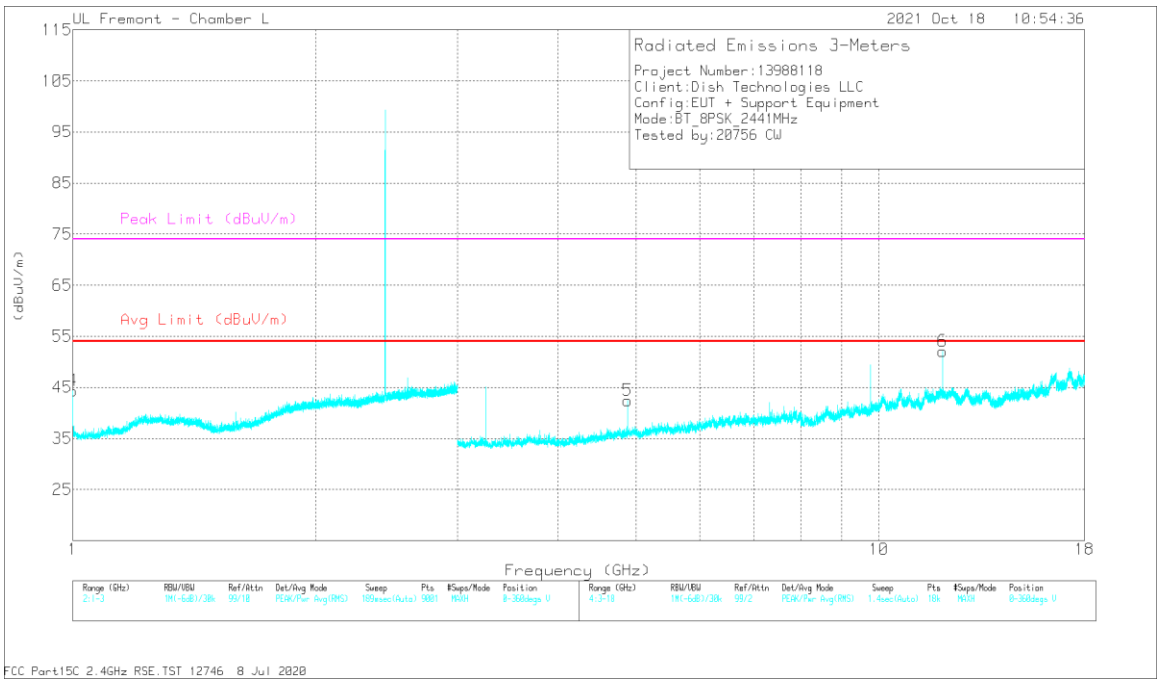
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

UL VERIFICATION SERVICES
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

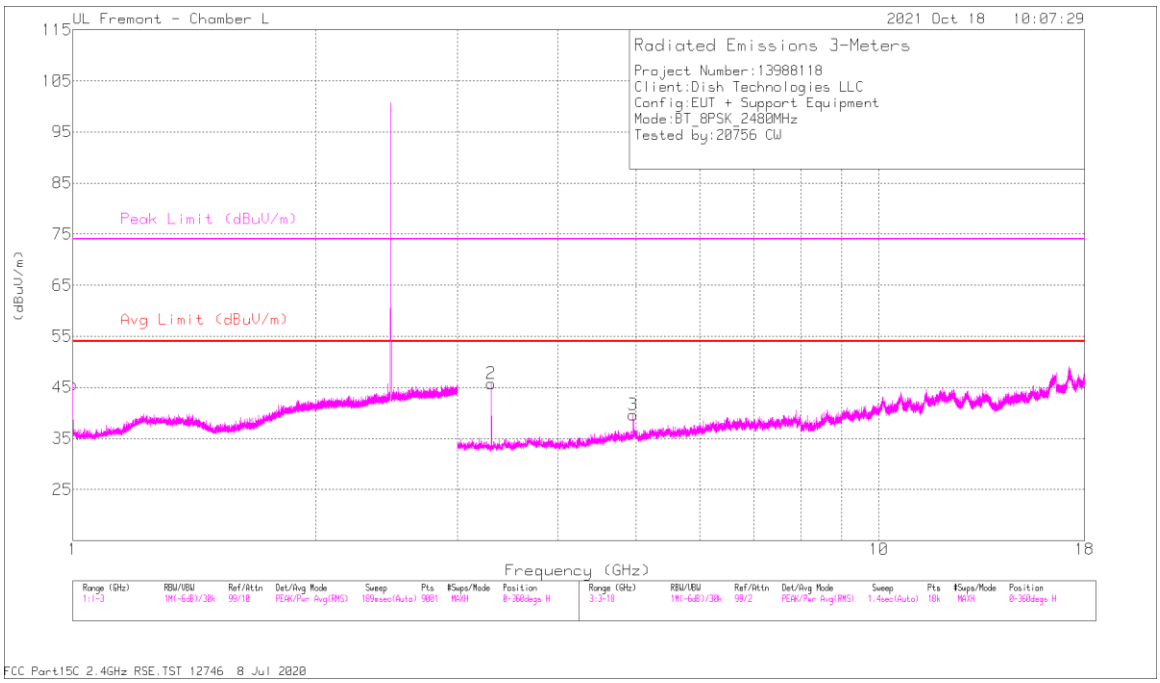
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 1.00009	46.62	PKFH	27.5	-23.8	50.32	-	-	74	-23.68	80	116	H
	* 1.00004	42.2	VA1T	27.5	-23.8	45.9	54	-8.1	-	-	80	116	H
4	* 1.00001	44.43	PKFH	27.5	-23.8	48.13	-	-	74	-25.87	274	196	V
	* 1	39.02	VA1T	27.5	-23.8	42.72	54	-11.28	-	-	274	196	V
2	3.25462	45.4	PKFH	33.1	-26.9	51.6	-	-	-	-	253	142	H
	3.25465	42.79	VA1T	33.1	-26.9	48.99	-	-	-	-	253	142	H
3	* 4.8819	37.72	PKFH	34.2	-24.3	47.62	-	-	74	-26.38	30	109	H
	* 4.88196	27.47	VA1T	34.2	-24.3	37.37	54	-16.63	-	-	30	109	H
5	* 4.88152	38.88	PKFH	34.2	-24.3	48.78	-	-	74	-25.22	270	101	V
	* 4.8819	29.07	VA1T	34.2	-24.3	38.97	54	-15.03	-	-	270	101	V
6	* 12.00031	32.28	PKFH	39.2	-16.3	55.18	-	-	74	-18.82	282	136	V
	* 12.00031	26.02	VA1T	39.2	-16.3	48.92	54	-5.08	-	-	282	136	V

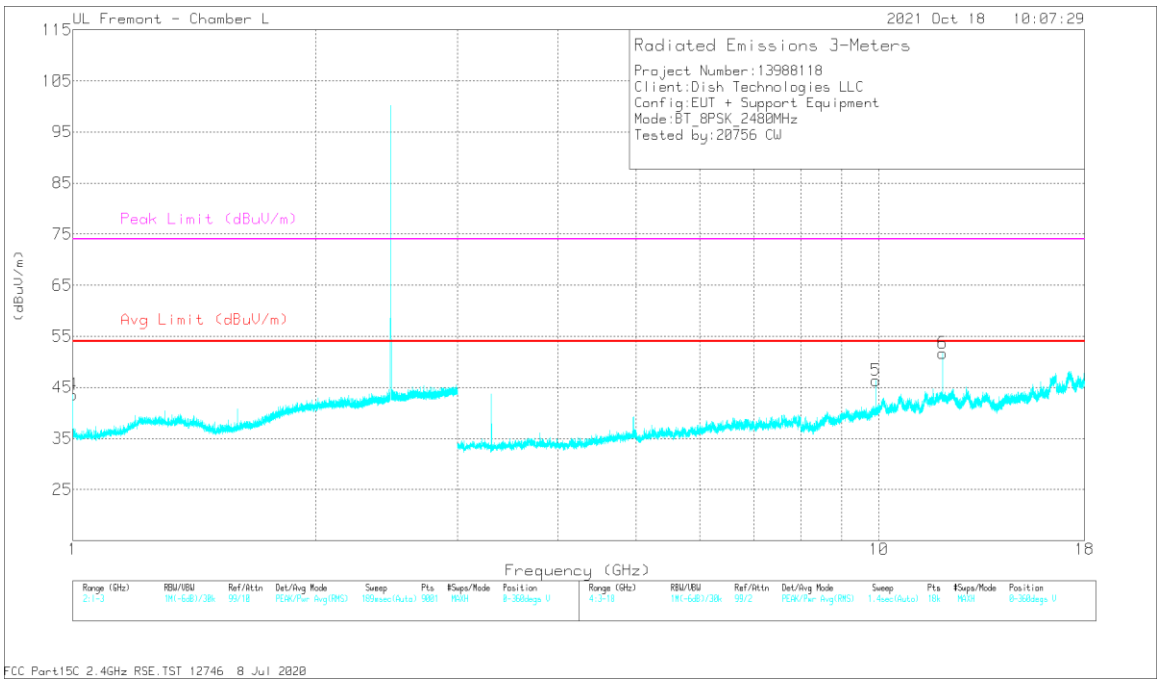
* - indicates frequency in CFR47 Pt 15
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

UL VERIFICATION SERVICES
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	* 1.00005	46.53	PKFH	27.5	-23.8	50.23	-	-	74	-23.77	111	206	H
	* 1.00003	41.97	VA1T	27.5	-23.8	45.67	54	-8.33	-	-	111	206	H
4	* 1.00015	45.7	PKFH	27.5	-23.8	49.4	-	-	74	-24.6	281	193	V
	* 1.00001	39.33	VA1T	27.5	-23.8	43.03	54	-10.97	-	-	281	193	V
2	3.30653	42.99	PKFH	32.5	-26.5	48.99	-	-	-	-	224	102	H
	3.30665	39.33	VA1T	32.5	-26.5	45.33	-	-	-	-	224	102	H
3	* 4.95939	33.76	PKFH	34.2	-23.2	44.76	-	-	74	-29.24	303	125	H
	* 4.95946	22.81	VA1T	34.2	-23.2	33.81	54	-20.19	-	-	303	125	H
5	9.91986	32.92	PKFH	37.1	-16.5	53.52	-	-	-	-	228	102	V
	9.91996	25.27	VA1T	37.1	-16.5	45.87	-	-	-	-	228	102	V
6	* 12.00004	33.23	PKFH	39.2	-16.3	56.13	-	-	74	-17.87	171	101	V
	* 12.00007	28.19	VA1T	39.2	-16.3	51.09	54	-2.91	-	-	171	101	V

* - indicates frequency in CFR47 Pt 15
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

UL VERIFICATION SERVICES
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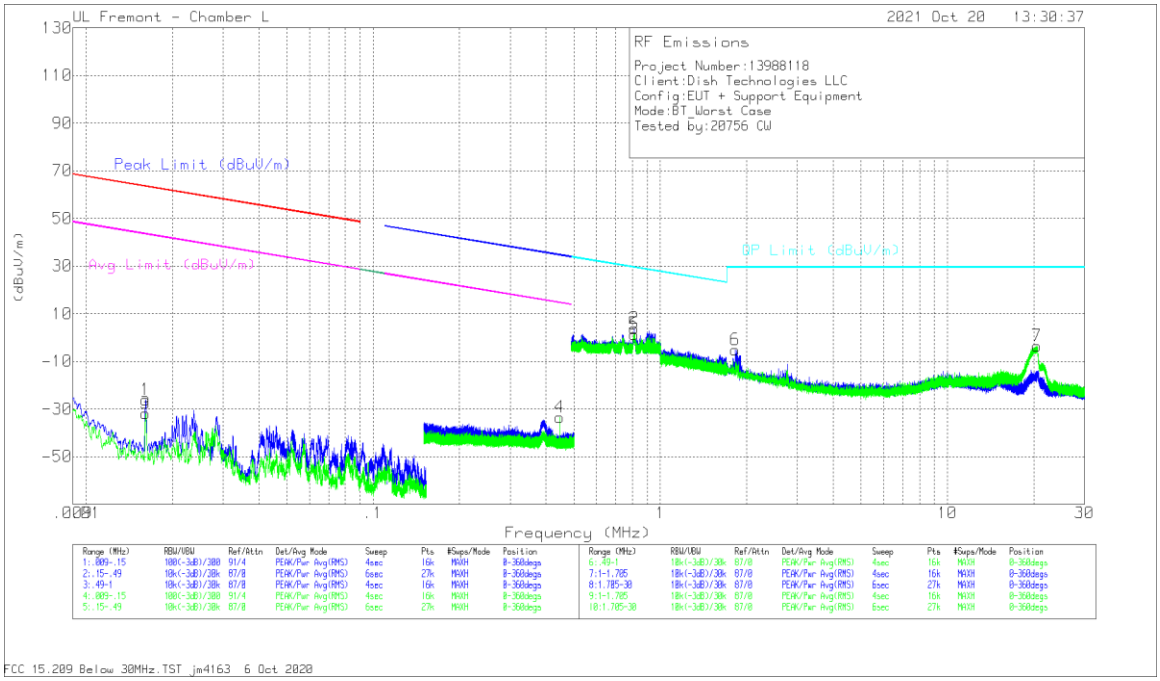
10.2. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

UL VERIFICATION SERVICES
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Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.01614	24.75	Pk	59.5	-30.4	-80	-26.15	63.43	-89.58	43.43	-69.58	-	-	-	-	0-360
3	.01614	19.1	Pk	59.5	-30.4	-80	-31.8	63.43	-95.23	43.43	-75.23	-	-	-	-	0-360
4	.44617	22.2	Pk	56.2	-32	-80	-33.6	-	-	-	-	34.62	-68.22	14.62	-48.22	0-360

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuV/m)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
2	.81157	19.4	Pk	56.2	-31.9	-40	3.7	29.43	-25.73	0-360
5	.81102	17.18	Pk	56.2	-31.9	-40	1.48	29.44	-27.96	0-360
6	1.82552	24.2	Pk	42.5	-31.9	-40	-5.2	29.5	-34.7	0-360
7	20.50088	33.33	Pk	34.4	-31.4	-40	-3.67	29.5	-33.17	0-360

Pk - Peak detector

UL VERIFICATION SERVICES
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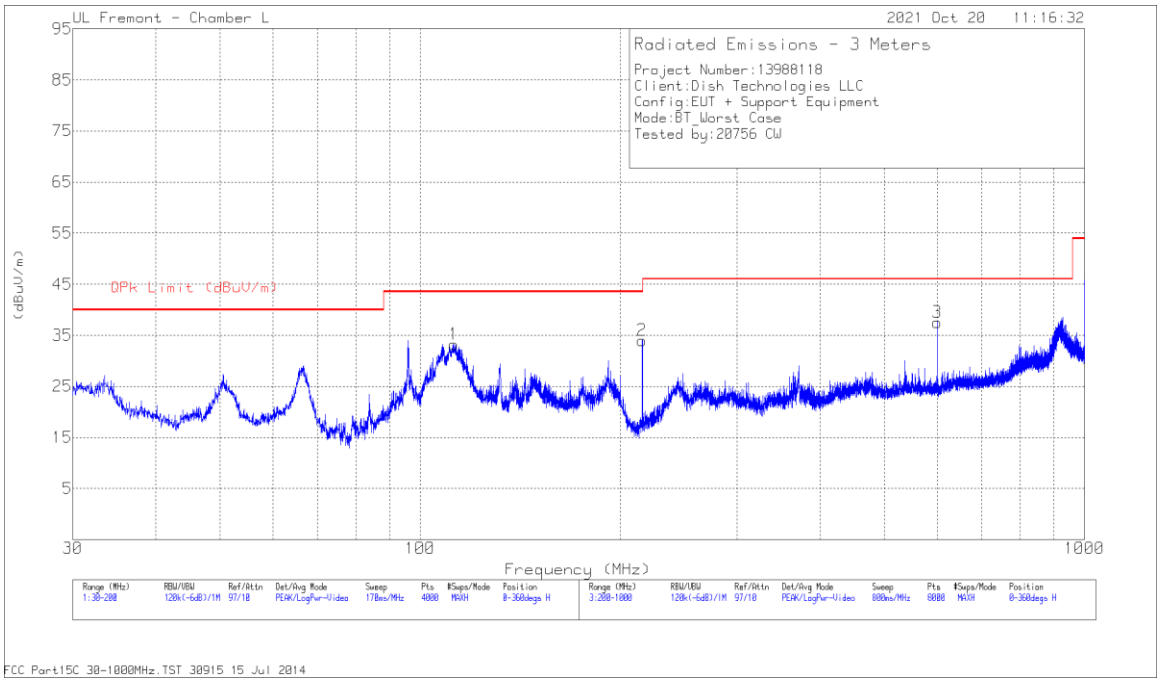
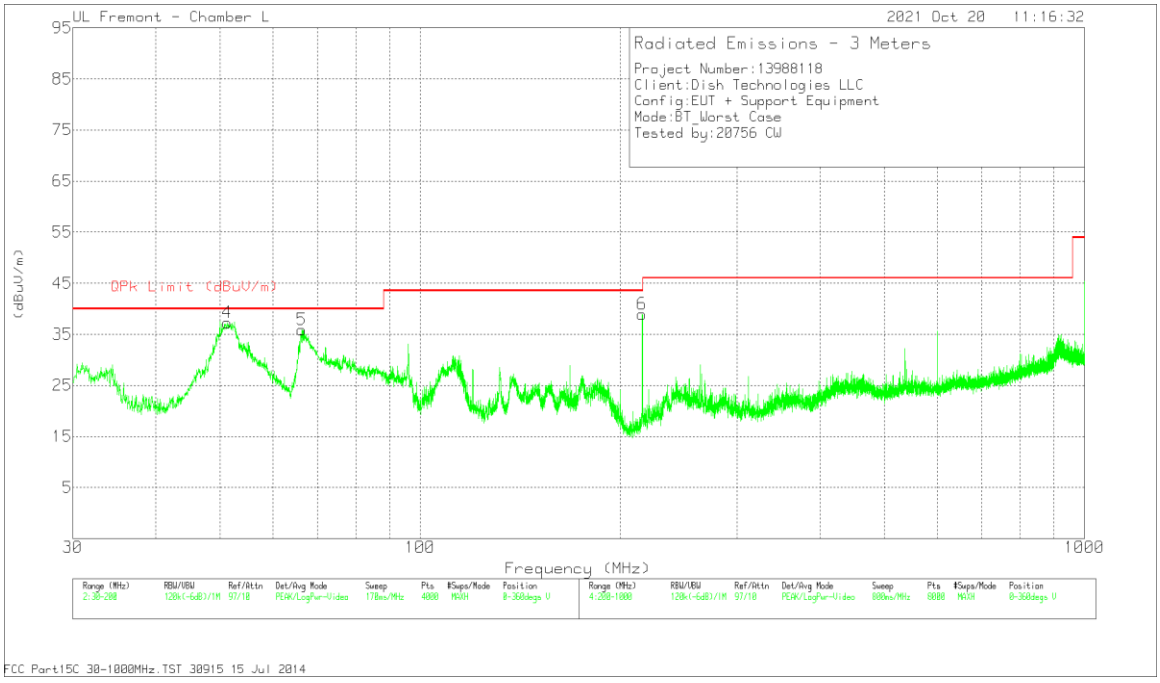
10.3. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



VERTICAL

UL VERIFICATION SERVICES
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF 174373 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 112.3013	45.06	Pk	18.8	-30.6	33.26	43.52	-10.26	0-360	299	H
4	50.6165	51.12	Qp	13.8	-31.2	33.72	40	-6.28	251	131	V
5	66.5726	48.73	Qp	13.8	-31	31.53	40	-8.47	325	112	V
2	215.9021	47.56	Pk	16.4	-30	33.96	43.52	-9.56	0-360	199	H
3	600.052	41.78	Pk	24.1	-28.3	37.58	46.02	-8.44	0-360	101	H
6	216.0071	52.22	Qp	16.4	-30	38.62	46.02	-7.4	174	101	V

* - indicates frequency in CFR47 Pt 15
Pk - Peak detector
Qp - Quasi-Peak detector

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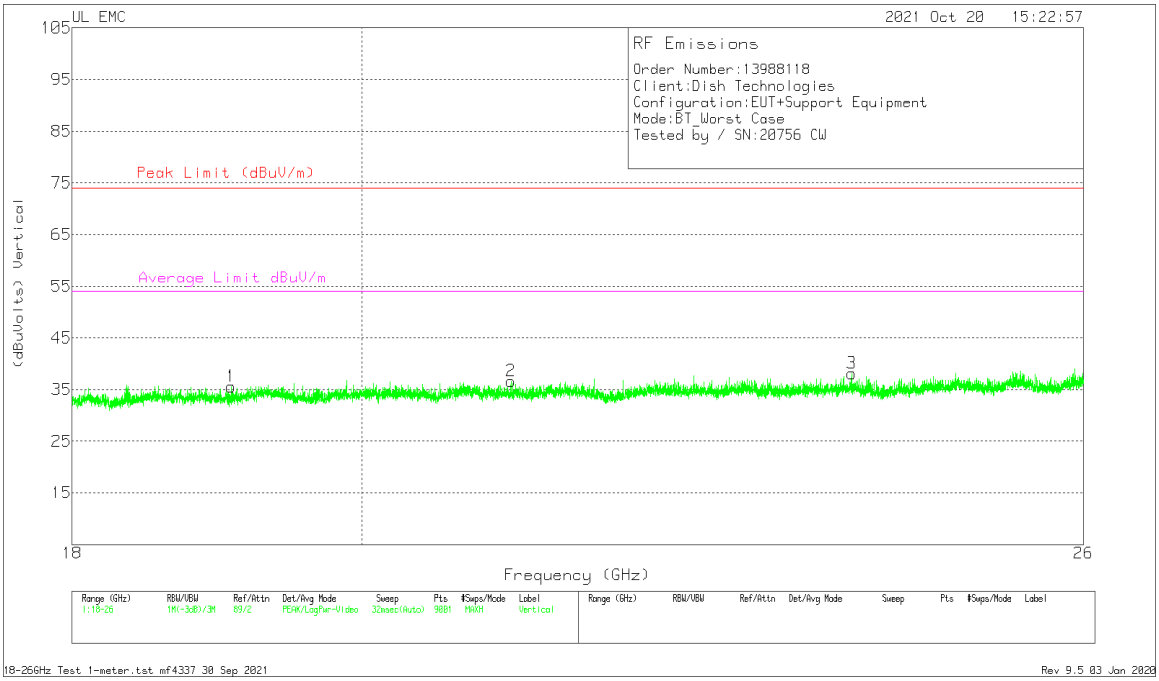
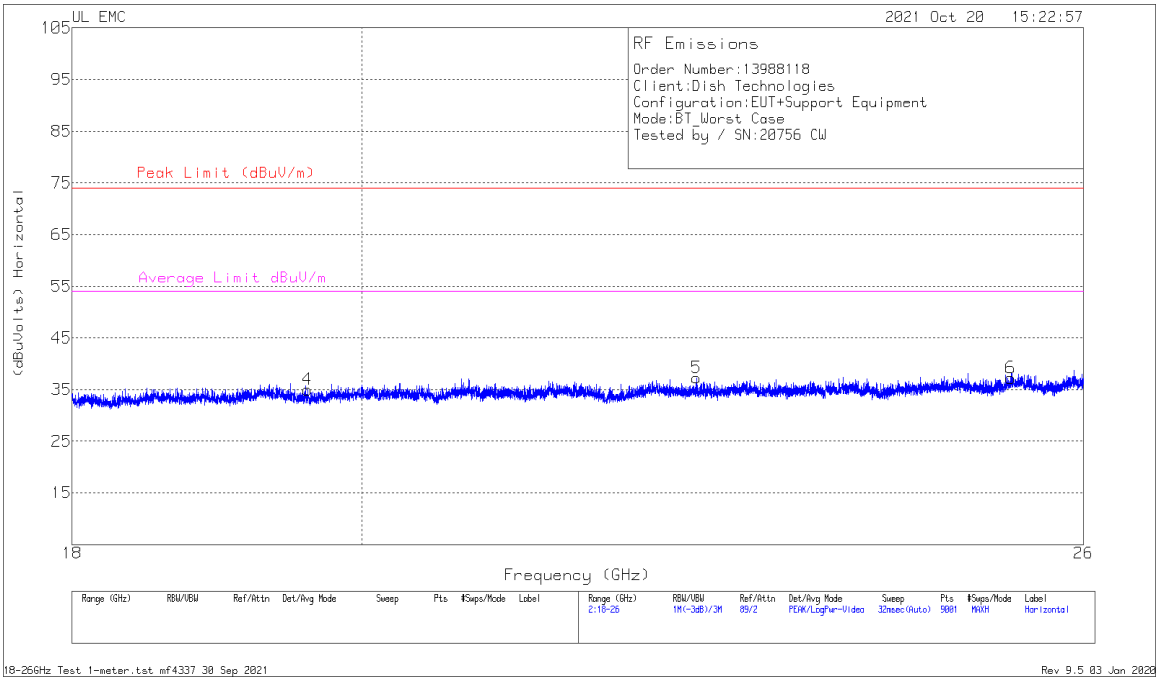
10.4. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

UL VERIFICATION SERVICES
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

18 – 26GHz Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 81139 (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	PK Margin (dB)	Average Limit dBuV/m	Margin (dB)
1	19.072	69.45	Pk	33.3	-57.7	-9.5	35.55	74	-38.45	54	-18.45
2	21.11378	69.12	Pk	33.8	-56.8	-9.5	36.62	74	-37.38	54	-17.38
3	23.89956	70.21	Pk	34.5	-57.1	-9.5	38.11	74	-35.89	54	-15.89
4	19.608	68.09	Pk	33.3	-56.9	-9.5	34.99	74	-39.01	54	-19.01
5	22.58578	70.08	Pk	34.2	-57.5	-9.5	37.28	74	-36.72	54	-16.72
6	25.32	67.1	Pk	35	-55.4	-9.5	37.2	74	-36.8	54	-16.8

Pk - Peak detector

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11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

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

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

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

RESULTS

UL VERIFICATION SERVICES
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

LINE 1 RESULTS

Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L1	LC Cables C1&C3 dB	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
2	.39075	34.94	Ca	0	0	9.3	44.24	-	-	48.05	-3.81
4	.78	11.08	Ca	0	.1	9.3	20.48	-	-	46	-25.52
6	1.56075	12.46	Ca	0	.1	9.3	21.86	-	-	46	-24.14
8	3.12225	9.33	Ca	0	.1	9.3	18.73	-	-	46	-27.27
10	10.1445	12.2	Ca	0	.2	9.3	21.7	-	-	50	-28.3
12	10.92525	12.2	Ca	0	.2	9.3	21.7	-	-	50	-28.3
1	.3885	37.72	Qp	0	0	9.3	47.02	58.1	-11.08	-	-
3	.78	14.54	Qp	0	.1	9.3	23.94	56	-32.06	-	-
5	1.56075	17.12	Qp	0	.1	9.3	26.52	56	-29.48	-	-
7	3.12225	15.17	Qp	0	.1	9.3	24.57	56	-31.43	-	-
9	10.1445	16.41	Qp	0	.2	9.3	25.91	60	-34.09	-	-
11	10.92525	16.44	Qp	0	.2	9.3	25.94	60	-34.06	-	-

Qp - Quasi-Peak detector
Ca - CISPR average detection

UL VERIFICATION SERVICES
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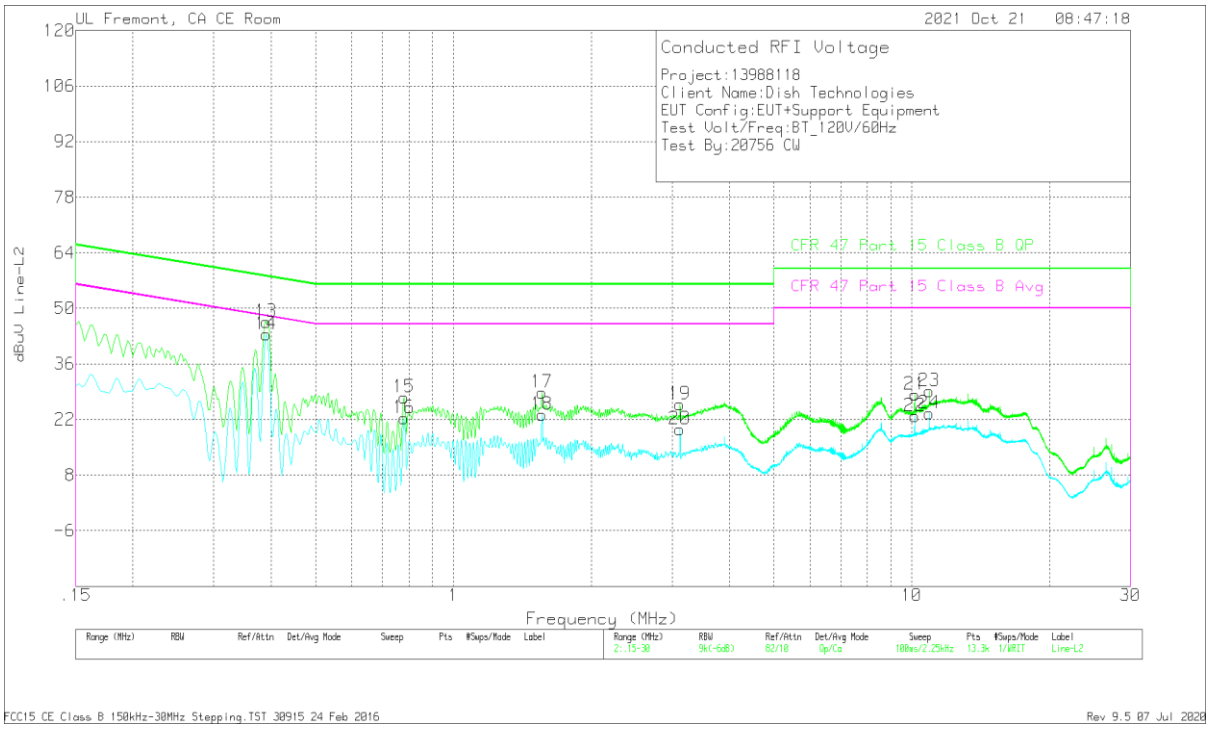
LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L2	LC Cables C2&C3 dB	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
14	.39075	34.19	Ca	0	0	9.3	43.49	-	-	48.05	-4.56
16	.78	12.96	Ca	0	0	9.3	22.26	-	-	46	-23.74
18	1.56075	13.75	Ca	0	.1	9.3	23.15	-	-	46	-22.85
20	3.12	10.08	Ca	0	.1	9.3	19.48	-	-	46	-26.52
22	10.14225	13.43	Ca	0	.2	9.3	22.93	-	-	50	-27.07
24	10.923	14.02	Ca	0	.2	9.3	23.52	-	-	50	-26.48
13	.39075	37.33	Qp	0	0	9.3	46.63	58.05	-11.42	-	-
15	.78	18.21	Qp	0	0	9.3	27.51	56	-28.49	-	-
17	1.56075	19.32	Qp	0	.1	9.3	28.72	56	-27.28	-	-
19	3.12225	16.42	Qp	0	.1	9.3	25.82	56	-30.18	-	-
21	10.1445	18.74	Qp	0	.2	9.3	28.24	60	-31.76	-	-
23	10.923	19.58	Qp	0	.2	9.3	29.08	60	-30.92	-	-

Qp - Quasi-Peak detector
Ca - CISPR average detection

UL VERIFICATION SERVICES
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