



TEST REPORT

Report Number.: 13757234-E6V2

Applicant : Magic Leap Inc.
7500 West Sunrise Blvd
Plantation, FL, 33322, US

Model : M1003000, M1004000, M1005000
M1103000, M1104000, M1105000

Brand : Magic Leap Inc.

FCC ID : 2AM5N-ML2M1

IC : 23045-ML2M1

EUT Description : Magic Leap 2 Compute Pack and Headset

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 2
ISED RSS-GEN ISSUE 5 + A1 + A2

Date of Issue:

June 06, 2022

Prepared by:

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	5/18/2022	Initial Issue	---
V2	6/6/2022	Update- page 41. peak detector used for final measurements.	F. de Anda

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Magic Leap Inc
7500 West Sunrise Blvd
Plantation, FL, 33322, US

EUT DESCRIPTION: Magic Leap 2 Compute Pack and Headset

BRAND: Magic Leap Inc.

MODEL: M1003000, M1004000, M1005000
M1103000, M1104000, M1105000

MODEL TESTED: M1003000

SERIAL NUMBER: P552X8E001Q

SAMPLE RECEIPT DATE: AUGUST 10, 2021

DATE TESTED: AUGUST 11 – SEPTEMBER 7, 2021 & FEBRUARY 22, 2022

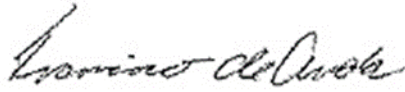
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5 + A1 + A2	Complies

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.

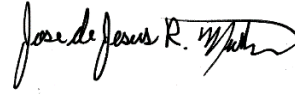
This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This 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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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	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	Per ANSI C63.10, Section 11.6.
See Comment	RSS-GEN 6.7	20dB BW/99% OBW	Reporting purposes only	ANSI C63.10 Sections 6.9.2 and 6.9.3
15.247 (a)(1)	RSS-247 (5.1) (b)	Hopping Frequency Separation	Complies	None.
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Number of Hopping Channels	Complies	None.
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Average Time of Occupancy	Complies	None.
15.247 (b)(1)	RSS-247 (5.4) (b)	Output Power	Complies	None.
See Comment		Average Power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (d)	RSS-247 (5.5)	Conducted Spurious Emissions	Complies	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Complies	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Complies	None.

For Colocation Test results, please refer to UL Verification Services Inc report number 13757234-E13V1.

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, RSS-GEN Issue 5 + A1 + A2, and RSS-247 Issue 2.

The scope of this report covers the bluetooth modes in the 2.4GHz band of Models M1003000, M1004000, M1005000, M1103000, M1104000, M1105000.

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, U.S.A	US0104	2324A	550739
<input type="checkbox"/>	Building 2: 47266 Benicia Street Fremont, CA 94538, U.S.A	US0104	22541	550739
<input checked="" type="checkbox"/>	Building 4: 47658 Kato Rd Fremont, CA 94538, U.S.A	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 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

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

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

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

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

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

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

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

EUT is a spatial AR computing device consists of compute pack and headset. The compute pack includes BT, BLE, 802.11 a/b/g/n/ac/ax radio transceivers.

6.2. MODEL DIFFERENCES

Models M1003000, M1004000, M1005000, M1103000, M1104000, and M1105000 are electronically identical. The model numbers are to differentiate the markets and regions of sale.

6.3. 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	13.85	24.27
2402 - 2480	Enhanced DQPSK	12.85	19.28
2402 - 2480	Enhanced 8PSK	12.73	18.75

Note: GFSK, DQPSK, 8PSK average Power are all investigated, The GFSK peak Power is worst case. DQPSK and 8PSK are same power. Testing is based on these GFSK and 8PSK to show compliance. For average power data please refer to section 9.7.

6.4. DESCRIPTION OF AVAILABLE ANTENNAS

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

The radio utilizes a Dual Band PCB Printed antenna, with a maximum gain of 2.00 dBi.

6.5. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was version PEQ3B.

6.6. 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 fundamental of the EUT was investigated in three orthogonal orientations X, Y, Z, it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

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

GFSK mode: DH5
8PSK mode: 3-DH5

Power was investigated at the lowest and highest ACL transfer rate 1/2/3DH1 and 1/2/3DH5 and power was the same therefore 1DH5 and 3DH5 transfer rate data represents DH1 and DH3 rates.

6.7. DESCRIPTION OF TEST SETUP

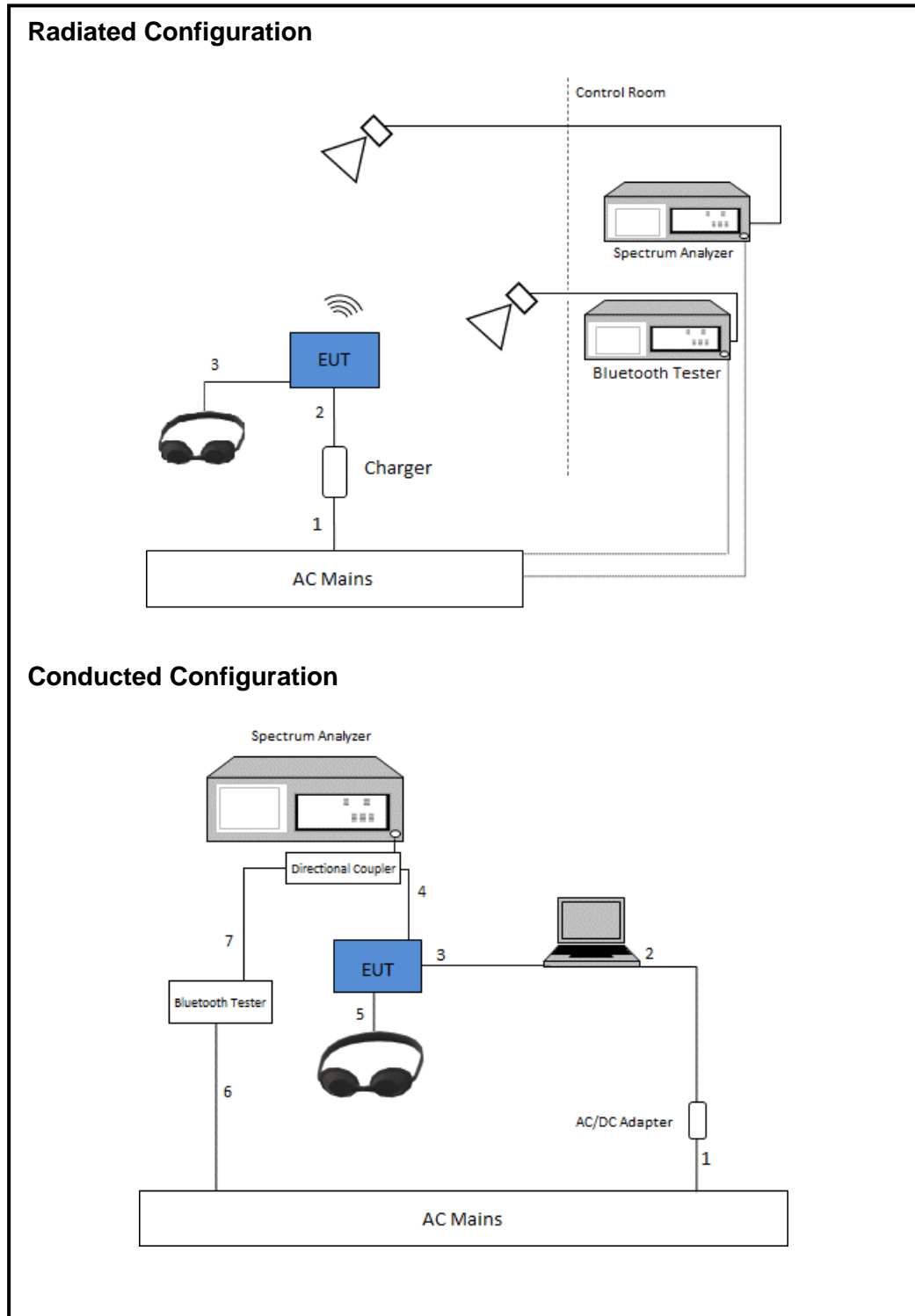
SUPPORT TEST EQUIPMENT						
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC		
Laptop (Radiated)	HP	EliteBook 840 G3	5CG6253DNC	DoC		
Laptop AC Adapter (Radiated)	HP	709986-003	WDHKR0AAR8U467	DoC		
Charger	Magic Leap	M3013	E135498	DoC		
Laptop (Conducted)	HP	EliteBook 840 G3	5CG65235OJ	DoC		
Laptop AC Adapter (Conducted)	HP	854055-002	CTWFTKVOEGC95379	DoC		
I/O CABLES (CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC Power	1	AC (3-prong)	Un-shielded	1.25	AC Mains to DC Power Adapter
2	DC	1	3-pin	Un-shielded	1	Power adapter to laptop
3	USB-C	1	USB Type C	Shielded	0.9	USB-C to EUT USB-C
4	Antenna	1	SMA	Un-shielded	.5	EUT to Coupler
5	A/V, Data	1	Permanent	Shielded	1.25	EUT to headset
6	AC Power	1	AC (3-prong)	Un-shielded	1.25	AC Mains to Bluetooth Tester
7	SMA	2	SMA	Un-shielded	1.25	Bluetooth tester to coupler
I/O CABLES (RADIATED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC Power	1	AC (2-prong)	Un-shielded	1.25	AC Mains to Power Adapter
2	USB-C	1	USB Type C	Shielded	0.9	Power Adapter to EUT
3	A/V Data	1	Permanent	Shielded	1.25	EUT to headset

TEST SETUP

A Bluetooth tester was used to exercise the radio card. For radiated emissions, EUT was powered by AC/DC adapter and for conducted tests the EUT was connected to laptop via USB.

The computer pack and headset are permanently connected.

SETUP DIAGRAMS



7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST (8/22/2021 to 9/7/2021)					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
Antenna, Broadband Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	174373	12/02/2021	12/02/2020
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310N	T300	04/09/2022	04/09/2021
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	T119	05/07/2022	05/07/2021
Amplifier, 1 - 18GHz	MITEQ	AFS42-00101800-25-S-42	T1568	04/09/2022	04/09/2021
EMI TEST RECEIVER, with B8 option	Rohde & Schwarz	ESW44	PRE0179377	02/23/2022	02/23/2021
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T447	09/24/2021	09/24/2020
Rf Amplifier, 18-26.5GHz, 60dB gain	AMPLICAL	AMP18G26.5-60	171590	05/21/2022	05/21/2021
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO METRICS	EM-6871	SC-8015	05/24/2022	05/24/2021
Antenna, Passive Loop 100KHz - 30MHz	ELECTRO METRICS	EM-6872	SC-8014	05/24/2022	05/24/2021
Spectrum Analyzer, PSA, 3Hz to 44GHz	Keysight Technologies Inc	E4446A	T123	01/22/2022	01/22/2021
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	T1269	01/25/2022	01/25/2021
Power Sensor, P-series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	T1223	06/17/2022	06/17/2021
Bluetooth Tester	Rohde & Schwarz (Koeln) GmbH & Co. KG	CBT	T258	03/01/2022	03/01/2021
Antenna, Horn 1-12GHz	L3 Narda	PNR 1-12-440EM-NF	PRE0181258	Connection Purposes Only	Connection Purposes Only
Directional Coupler	Mini-Circuits	ZUDC10-183+	PRE0181621	09/16/2021	09/16/2020
AC Line Conducted					
LISN	Fischer Custom Communications, Inc	FCC-LISN-50/250-25-2-01-480V	PRE0186446	01/20/2022	01/20/2021
EMI TEST RECEIVER	Rohde & Schwarz	ESR	T1436	02/19/2022	02/19/2021
Transient Limiter	TE	TBFL1	207996	06/01/2022	06/01/2021
UL TEST SOFTWARE LIST					
Radiated Software	UL	UL EMC	Rev 9.5, Apr 30, 2020 / Oct., 20 2019		
Antenna Port Software	UL	UL RF	Ver 2021.08.11		
AC Line Conducted Software	UL	UL EMC	Rev 9.5, 07 Jul 2020		

TEST EQUIPMENT LIST (2/22/2022)					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	90719	01/24/2023	01/24/2022
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	81319	01/24/2023	01/24/2022
Bluetooth Tester	Rohde & Schwarz (Koeln) GmbH & Co. KG	CBT	T258	03/01/2022	03/01/2021
Directional Coupler	Mini-Circuits	ZUDC10-183+	T1136	09/23/2022	09/23/2021

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

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

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

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

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

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

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

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

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

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

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

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

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

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

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

ON TIME AND DUTY CYCLE RESULTS

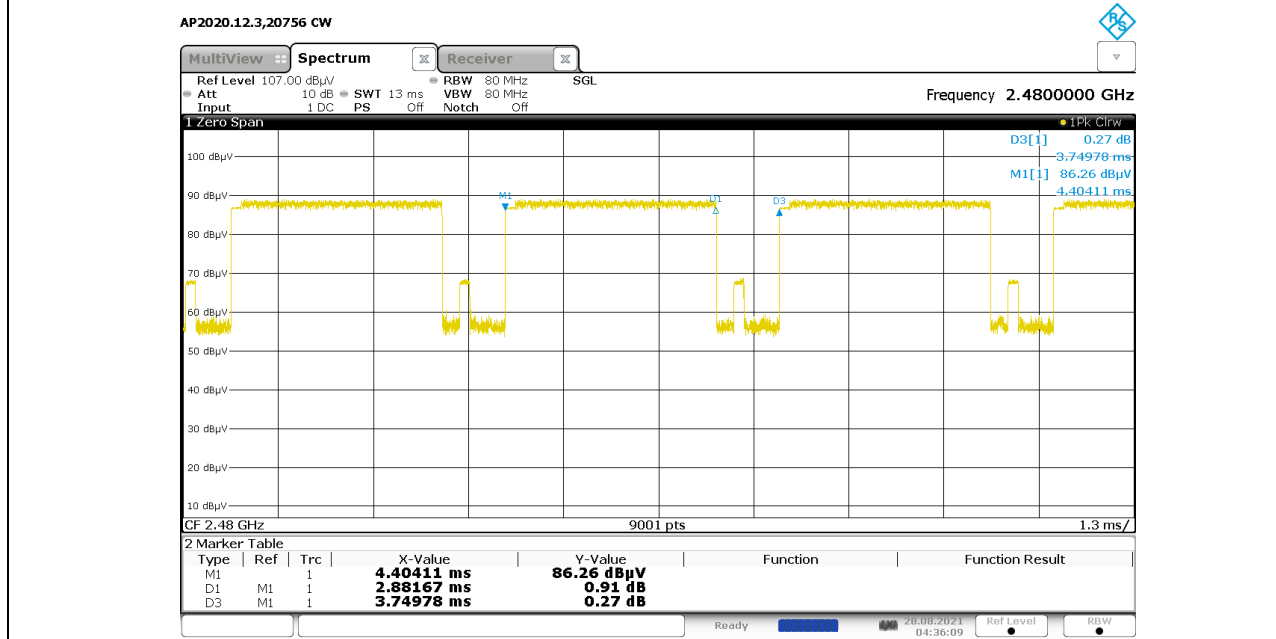
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
Bluetooth GFSK	2.886	3.757	0.768	76.82	1.15	0.347
Bluetooth 8PSK	2.882	3.750	0.768	76.85	1.14	0.347

DUTY CYCLE PLOTS



02:03:47 28.08.2021

Bluetooth GFSK



04:36:10 28.08.2021

Bluetooth 8PSK

9.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

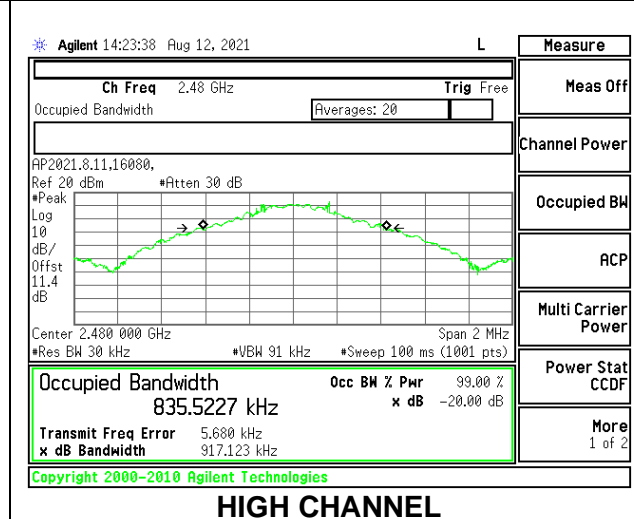
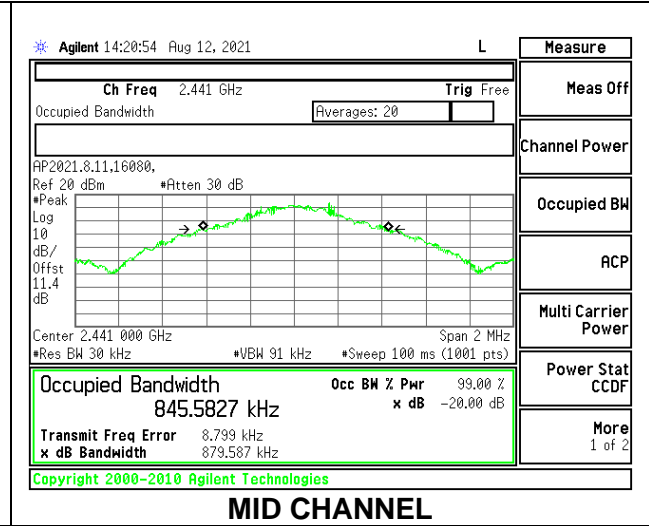
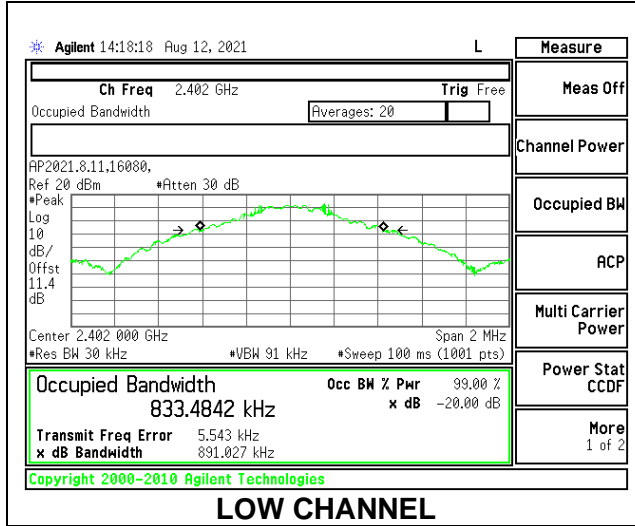
The transmitter output is connected to a spectrum analyzer. The RBW is set in the range of 1% to 5% of the OBW. The VBW is set to $\geq 3x$ RBW. The sweep time is coupled.

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

RESULTS

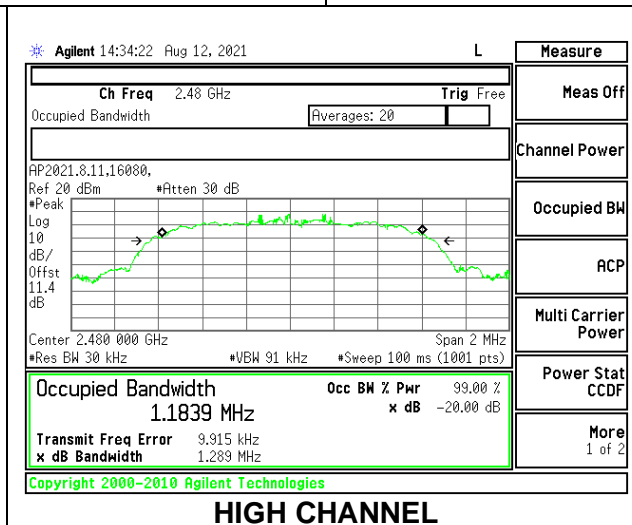
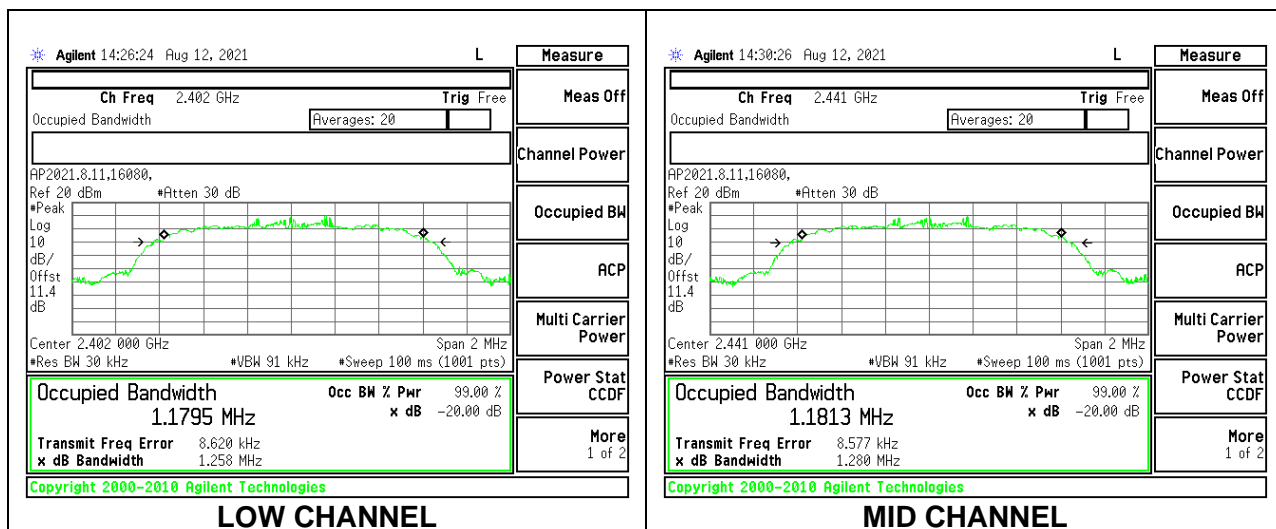
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.891	0.833
Mid	2441	0.880	0.846
High	2480	0.917	0.836



9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.258	1.1795
Mid	2441	1.280	1.1813
High	2480	1.289	1.1839



9.3. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

RSS-247 (5.1) (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

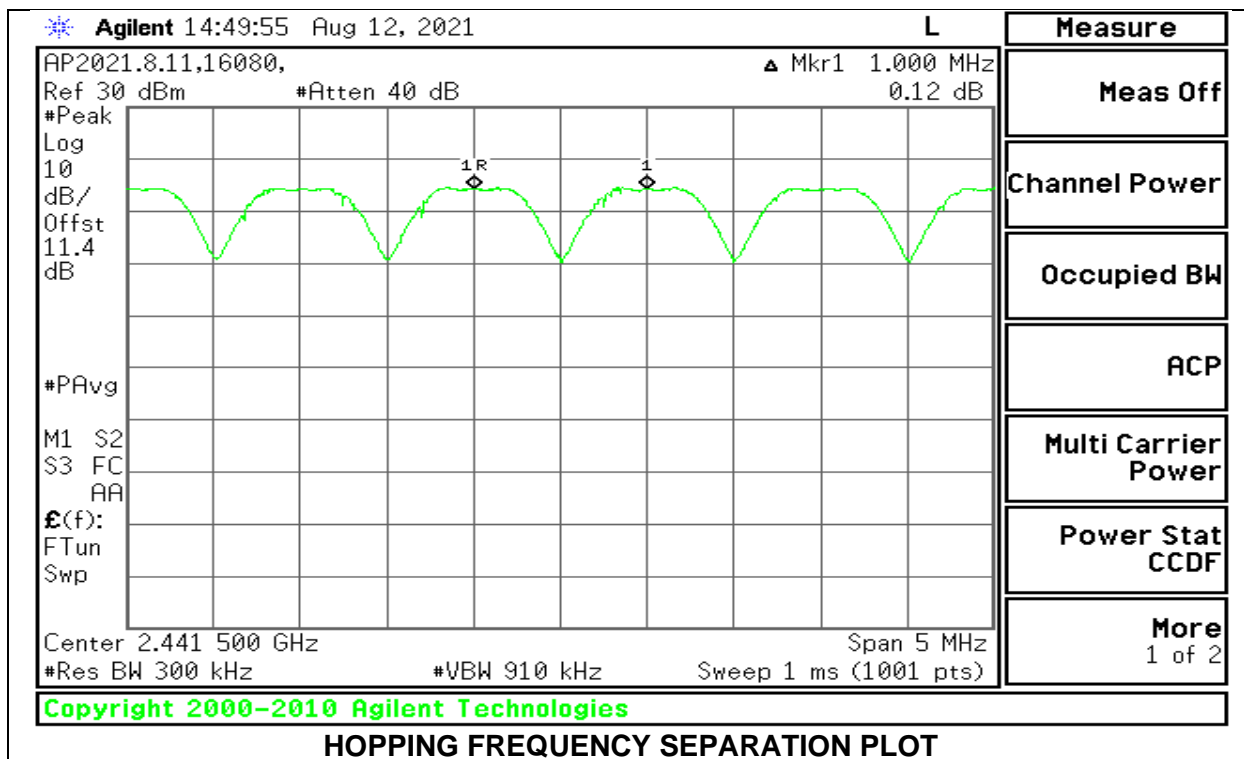
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

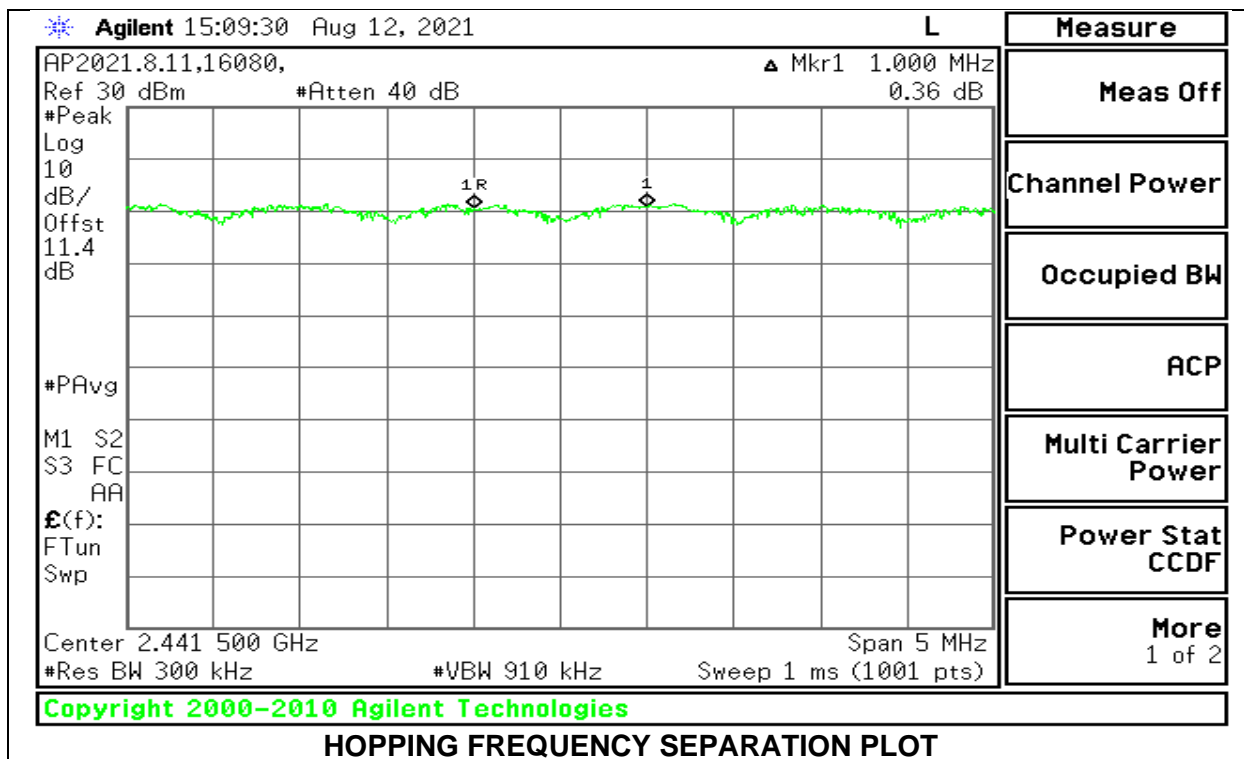
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to $VBW \geq RBW$. The sweep time is coupled.

RESULTS

9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



9.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

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

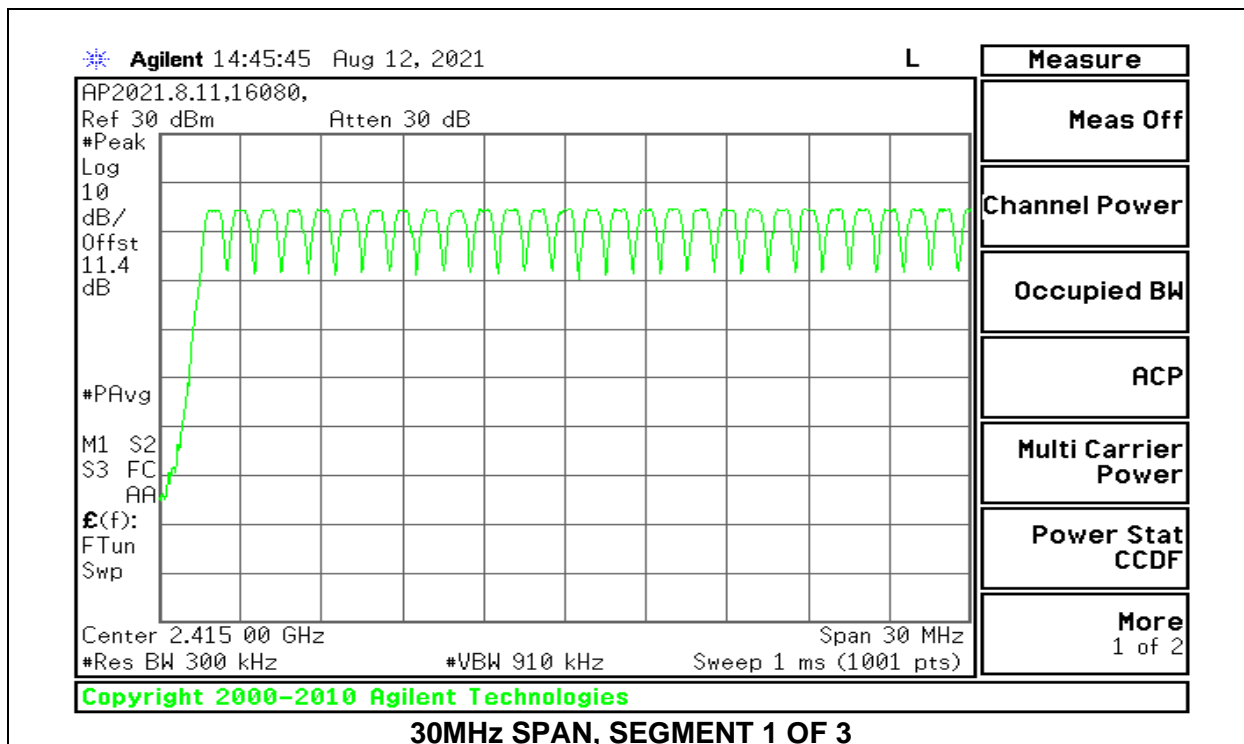
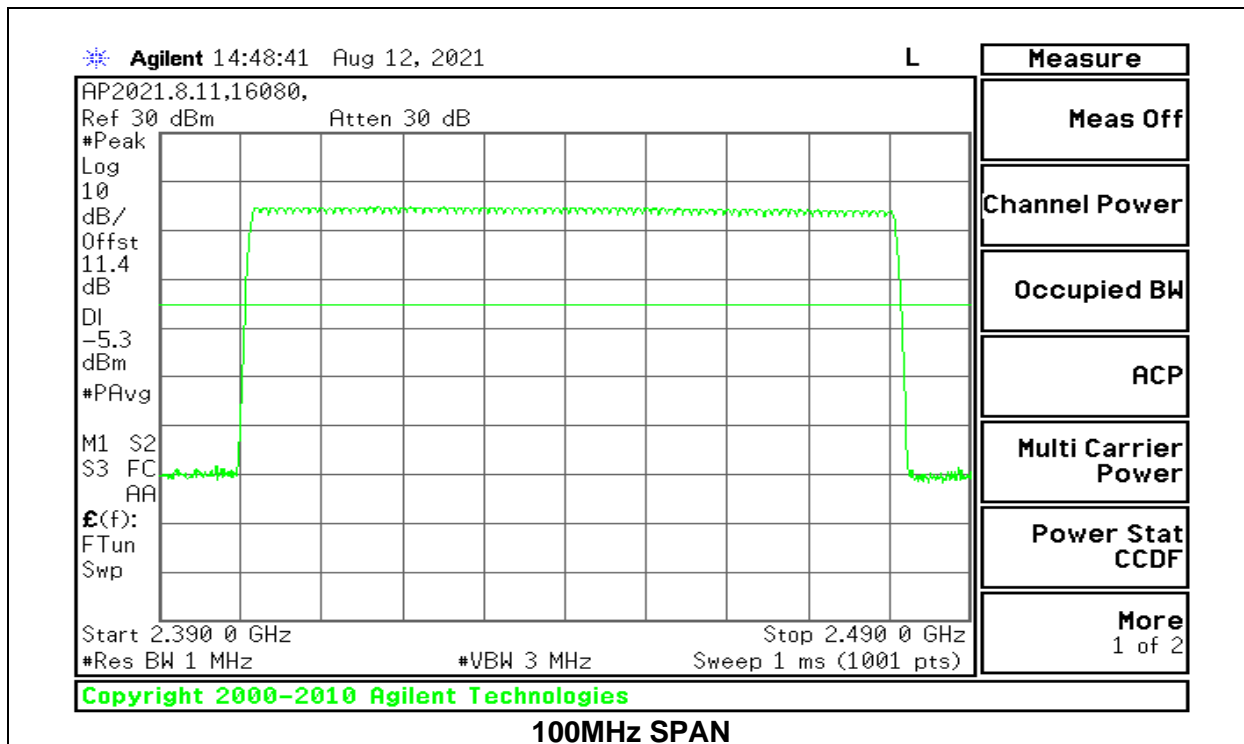
TEST PROCEDURE

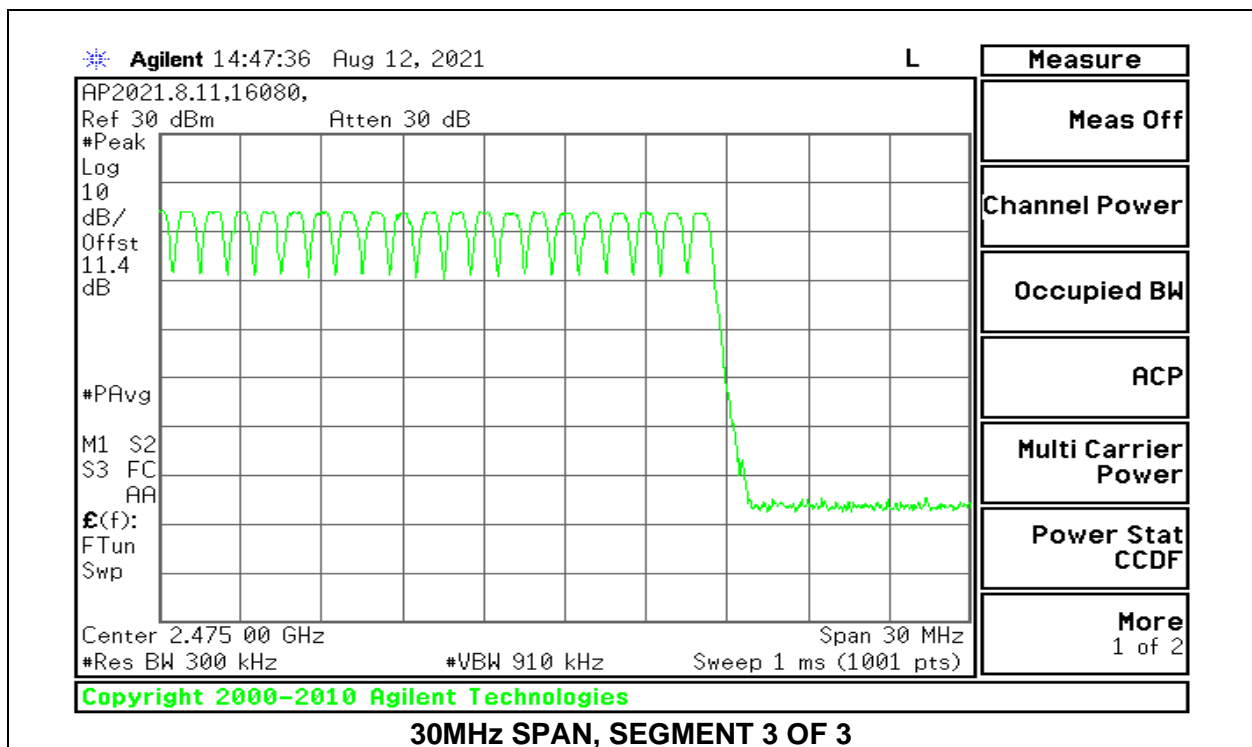
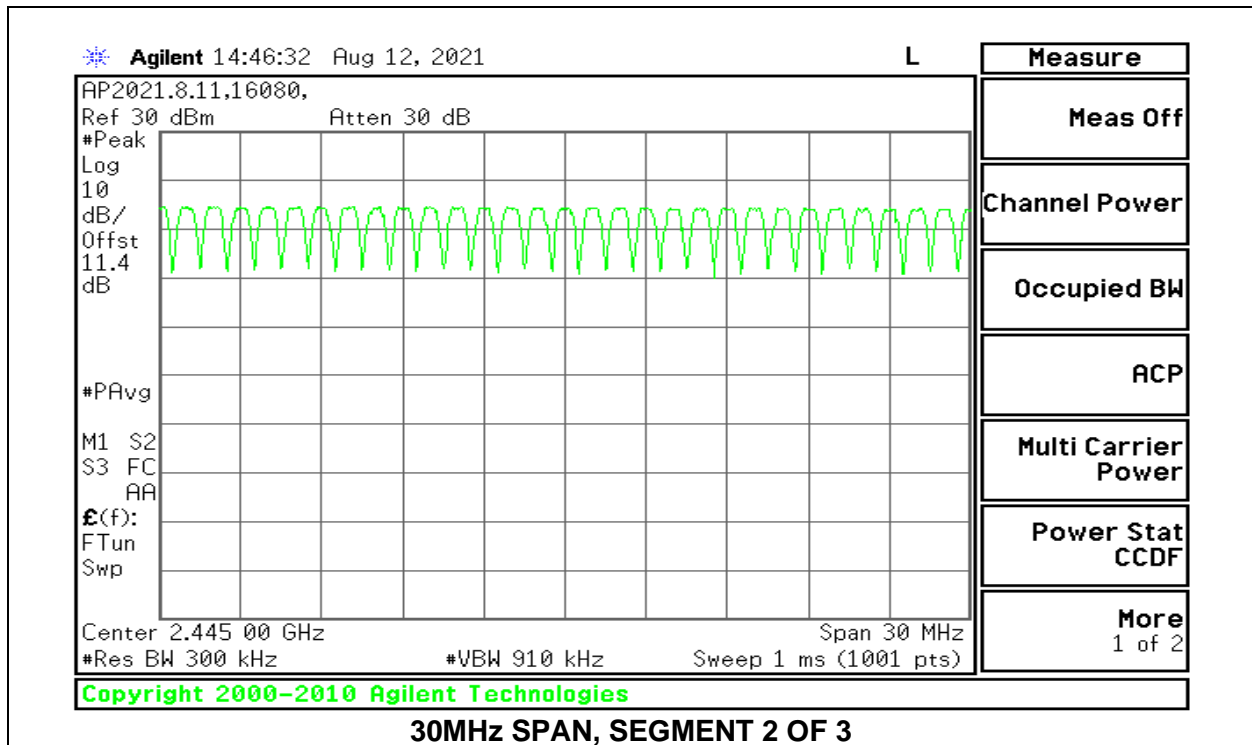
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

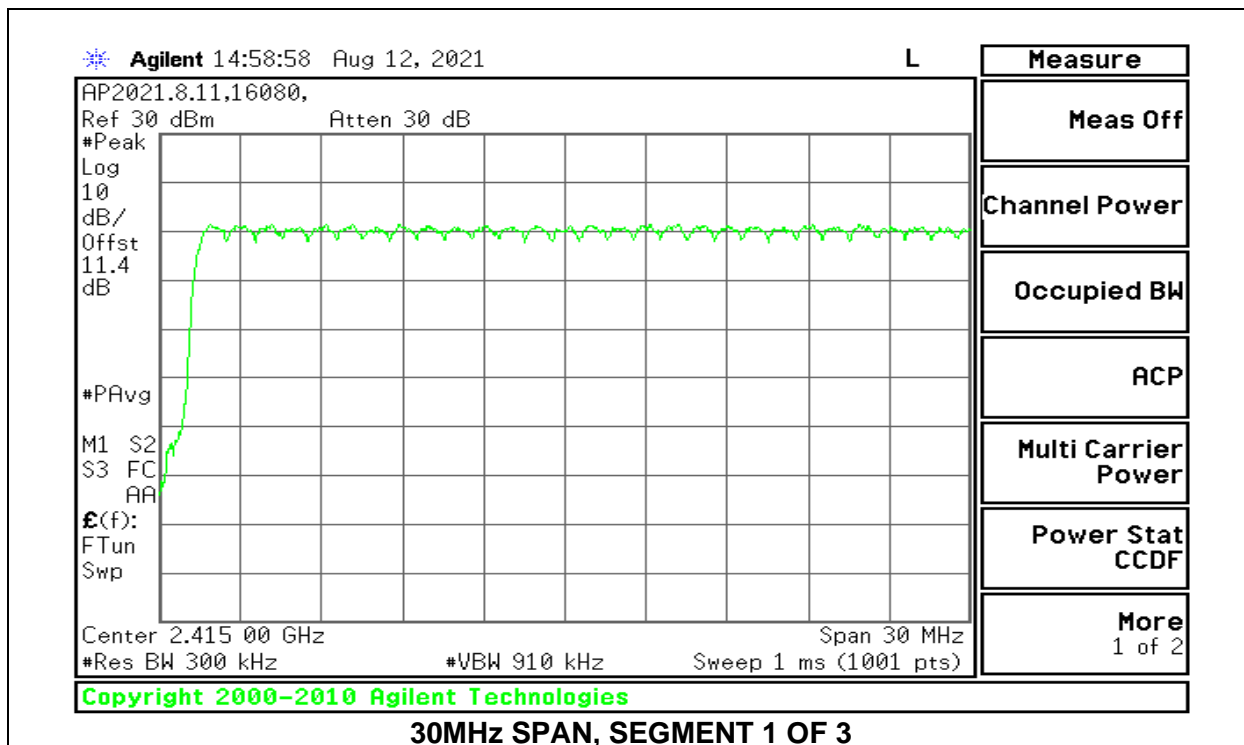
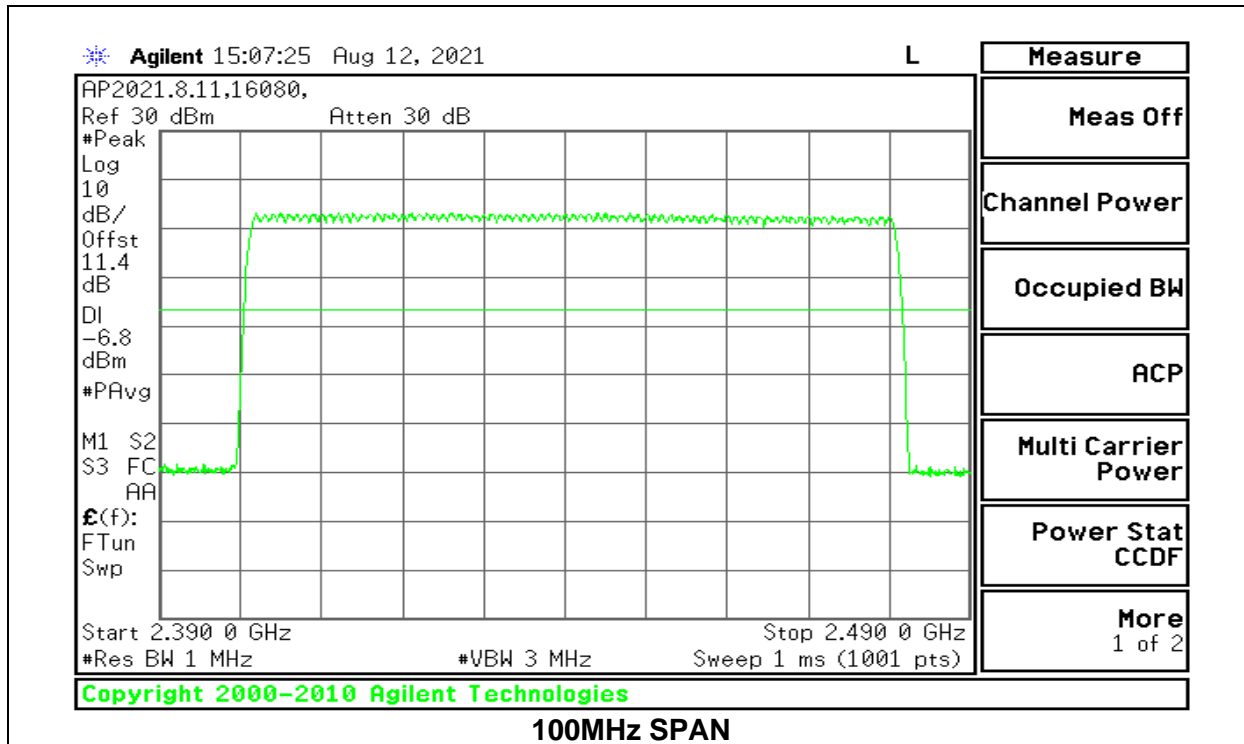
Normal Mode: 79 Channels Observed

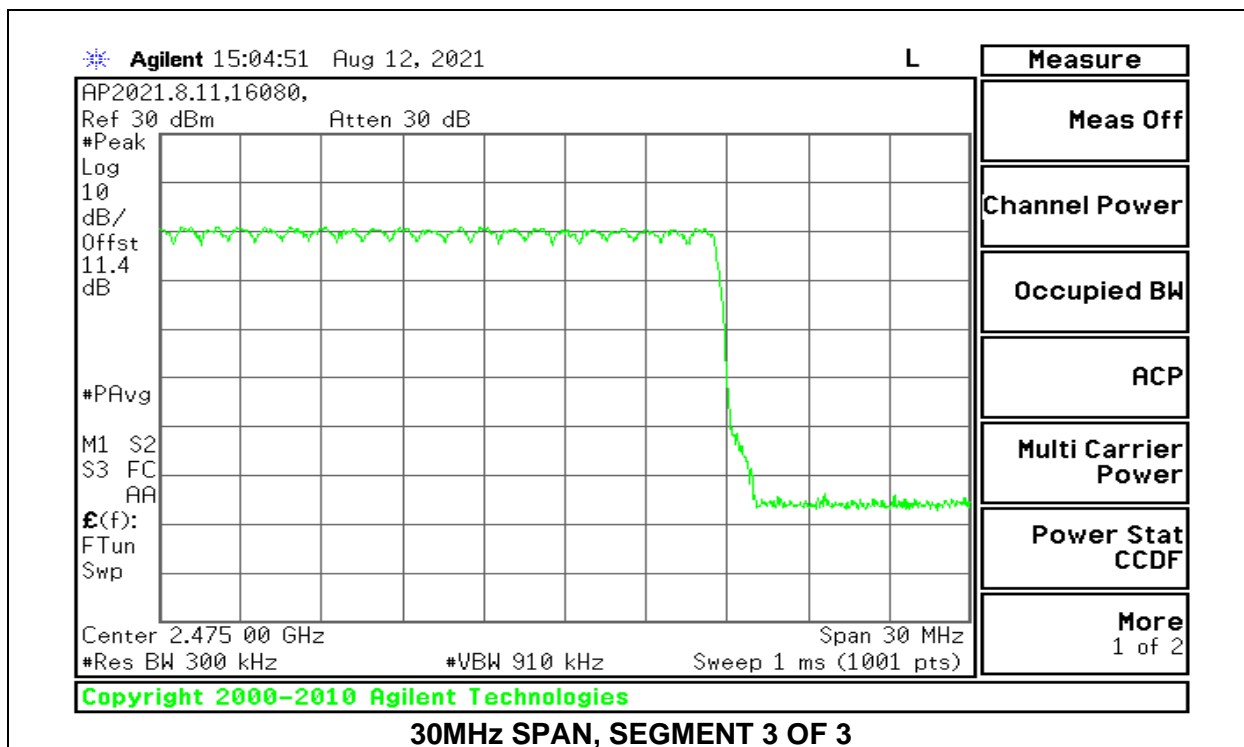
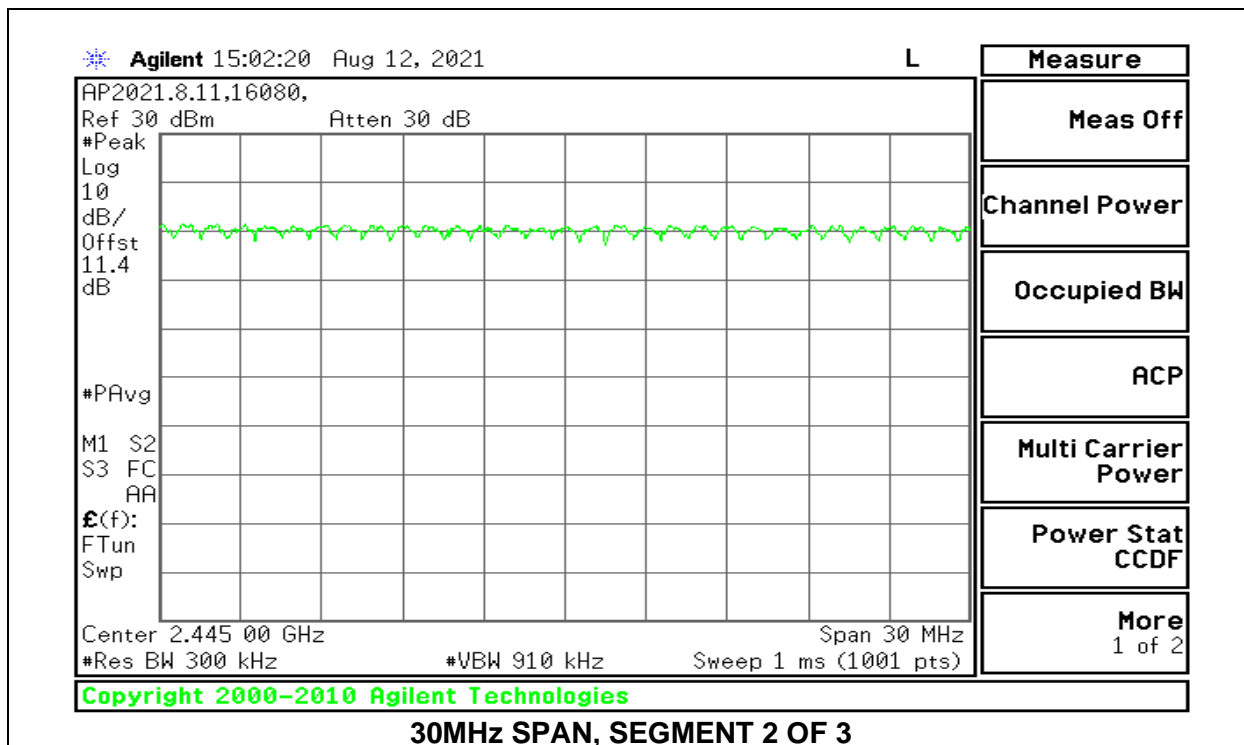
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION





9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION





9.5. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

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

TEST PROCEDURE

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

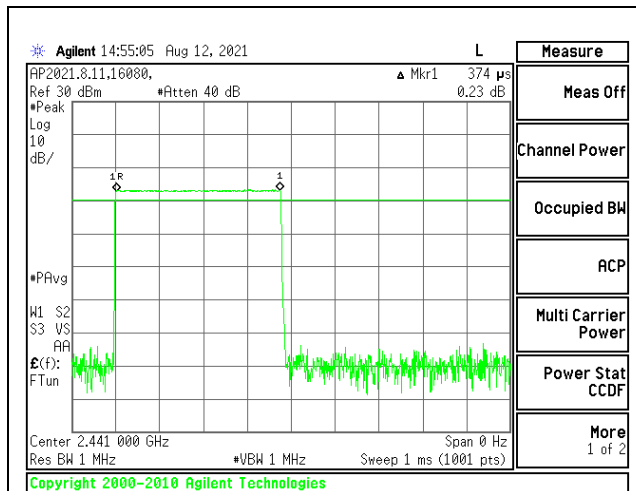
The average time of occupancy in the specified 3.16 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$.

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

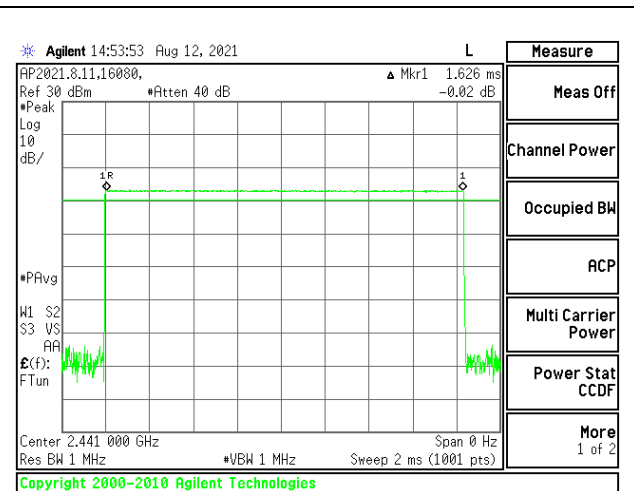
RESULTS

9.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

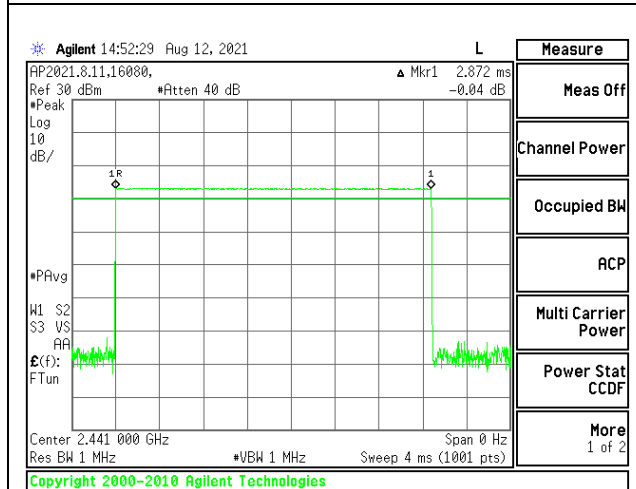
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.374	31	0.1159	0.4	-0.2841
DH3	1.626	9	0.1463	0.4	-0.2537
DH5	2.872	9	0.2585	0.4	-0.1415
GFSK AFH Mode					
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DH1	0.374	7.75	0.02899	0.4	-0.3710
DH3	1.626	2.25	0.03659	0.4	-0.3634
DH5	2.872	2.25	0.06462	0.4	-0.3354



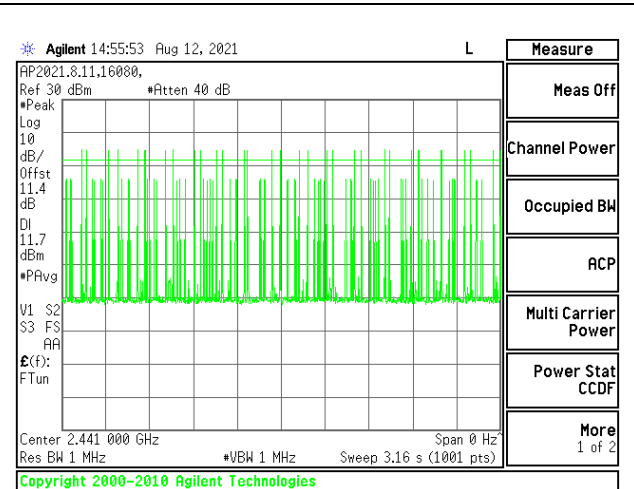
PULSE WIDTH – DH1



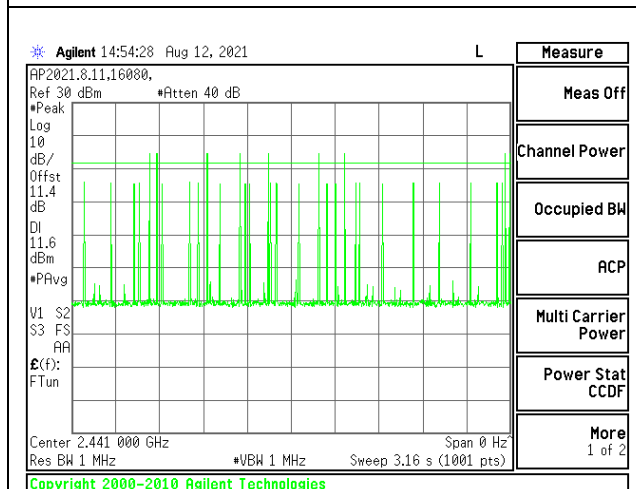
PULSE WIDTH – DH3



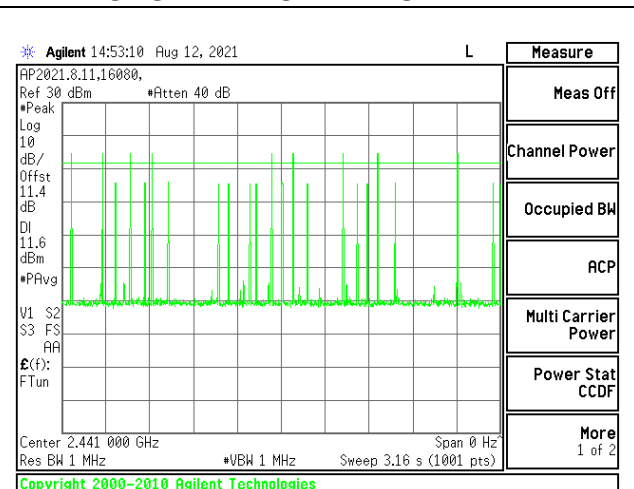
PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3

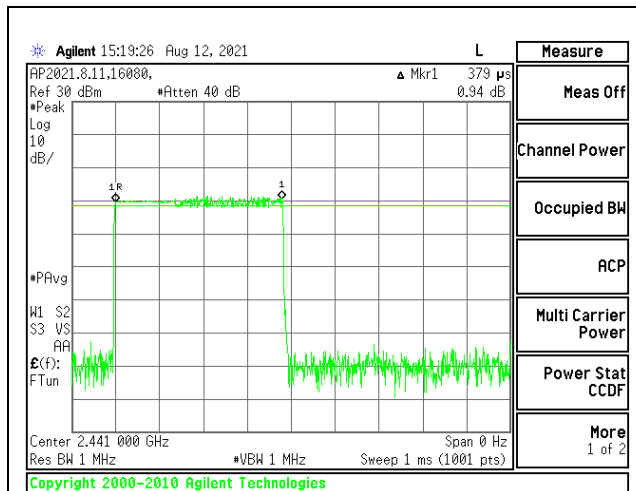


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5

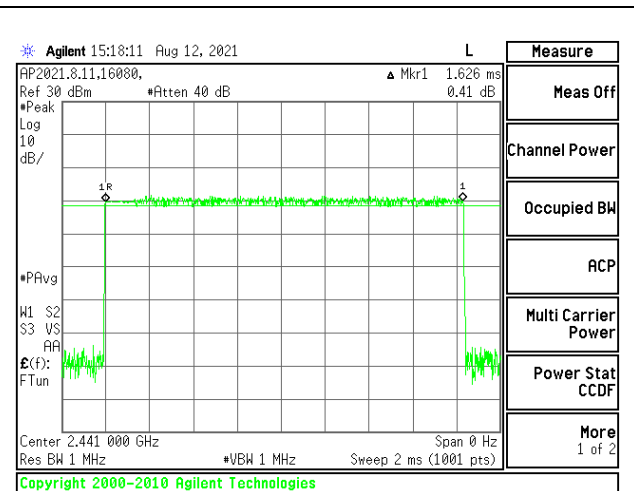
9.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
8PSK Normal Mode					
3DH1	0.379	32	0.12128	0.4	-0.2787
3DH3	1.626	9	0.14634	0.4	-0.2537
3DH5	2.872	7	0.20104	0.4	-0.199

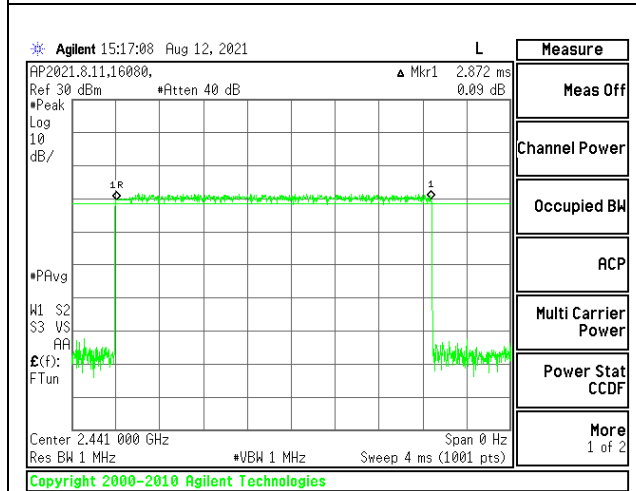
Note: for AFH(8PSK) mode, please refer to the results of AFH (GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate demonstrates compliance with channel occupancy when AFH is employed.



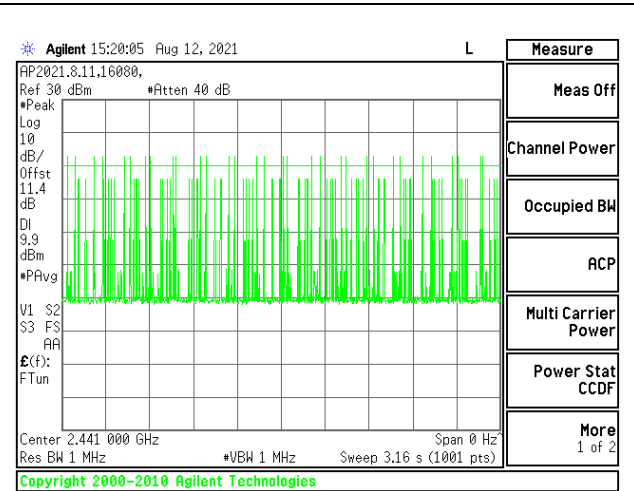
PULSE WIDTH – 3DH1



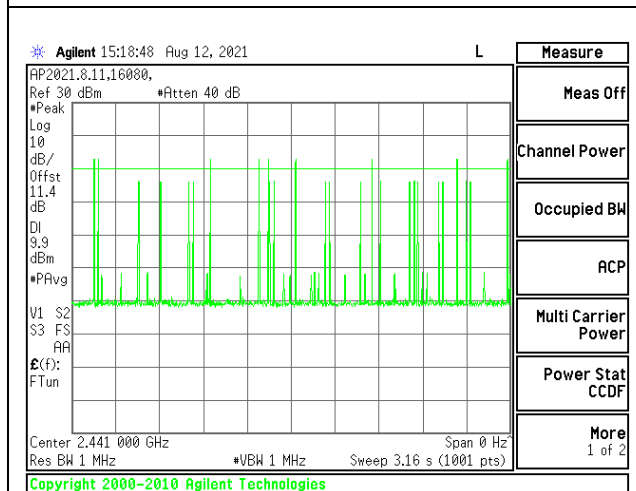
PULSE WIDTH – 3DH3



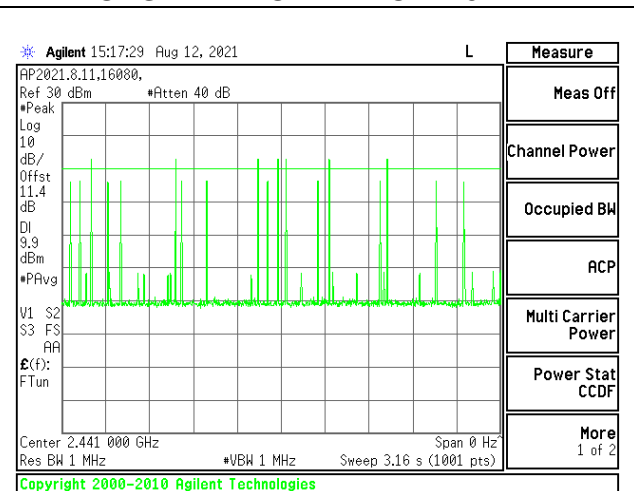
PULSE WIDTH – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5

9.6. PEAK OUTPUT POWER

LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

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

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

TEST PROCEDURE

The transmitter output is connected to a power meter.

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

RESULTS

9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	16080 ZS
Date:	2/22/2022

Channel	Frequency (MHz)	Peak Output Power (dBm)	Peak Output Power Limit (dBm)	Margin (dB)
Low	2402	13.85	21	-7.15
Middle	2441	13.68	21	-7.32
High	2480	13.28	21	-7.72

9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	16080 ZS
Date:	2/22/2022

Channel	Frequency (MHz)	Peak Output Power (dBm)	Peak Output Power Limit (dBm)	Margin (dB)
Low	2402	12.85	21	-8.15
Middle	2441	12.7	21	-8.3
High	2480	12.3	21	-8.7

9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	16080 ZS
Date:	2/22/2022

Channel	Frequency (MHz)	Peak Output Power (dBm)	Peak Output Power Limit (dBm)	Margin (dB)
Low	2402	12.73	21	-8.27
Middle	2441	12.03	21	-8.97
High	2480	11.44	21	-9.56

9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

The transmitter output is connected to a power meter.

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

RESULTS

9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	16080 ZS
Date	2/22/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	13.58
Middle	2441	13.34
High	2480	12.95

9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	16080 ZS
Date	2/22/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	10.2
Middle	2441	10.04
High	2480	9.62

9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	16080 ZS
Date	2/22/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	10
Middle	2441	9.93
High	2480	9.53

9.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

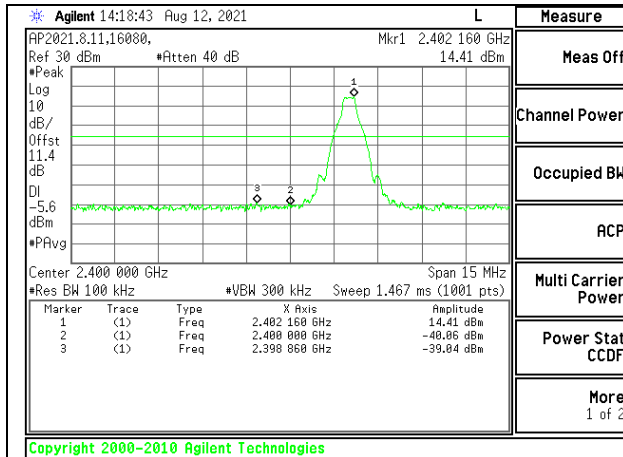
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

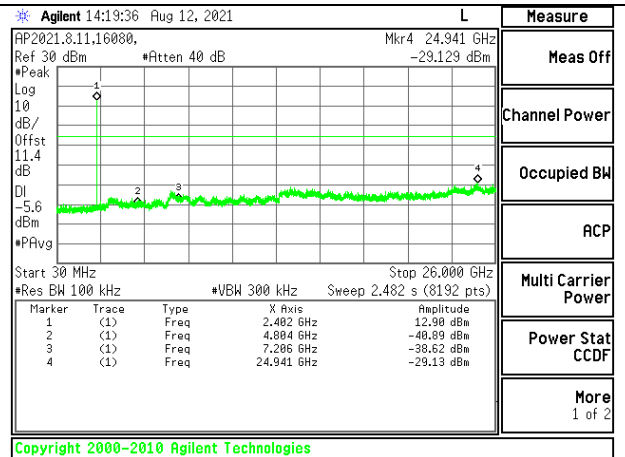
RESULTS

9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

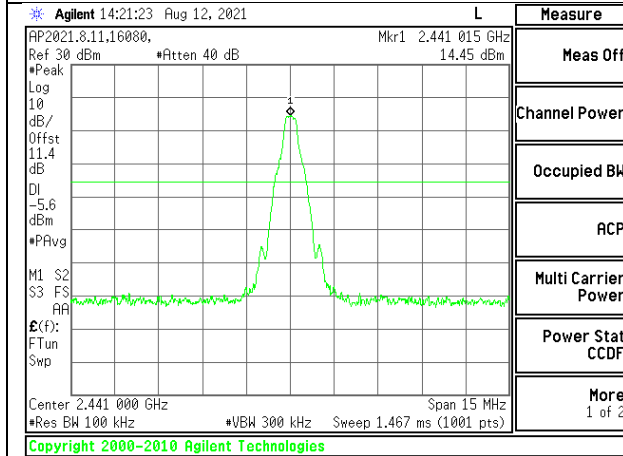
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



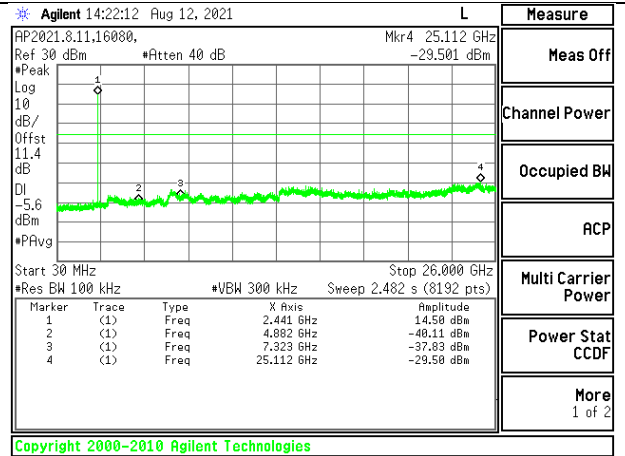
LOW CHANNEL BANDEDGE



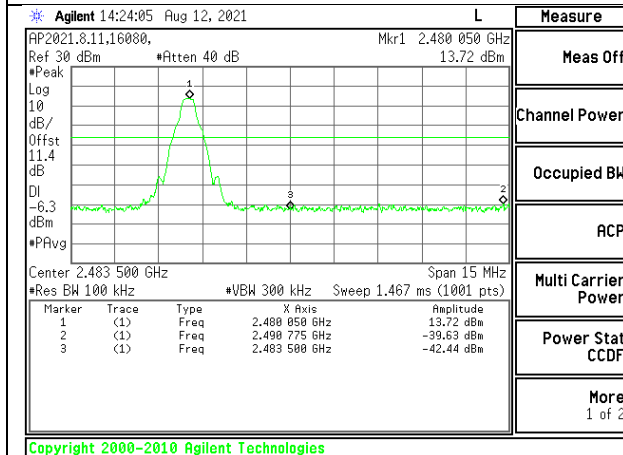
OUT-OF-BAND LOW CHANNEL



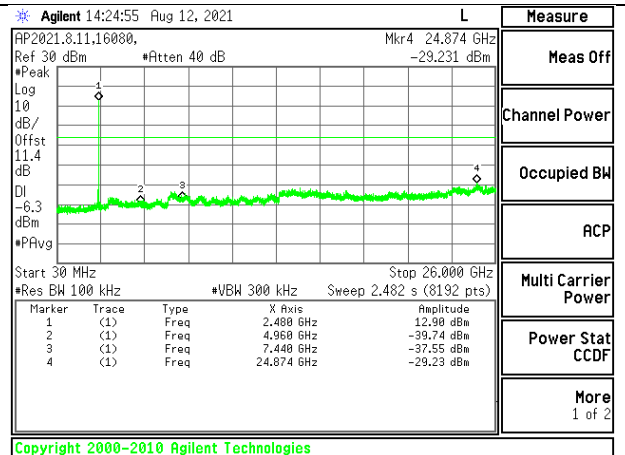
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

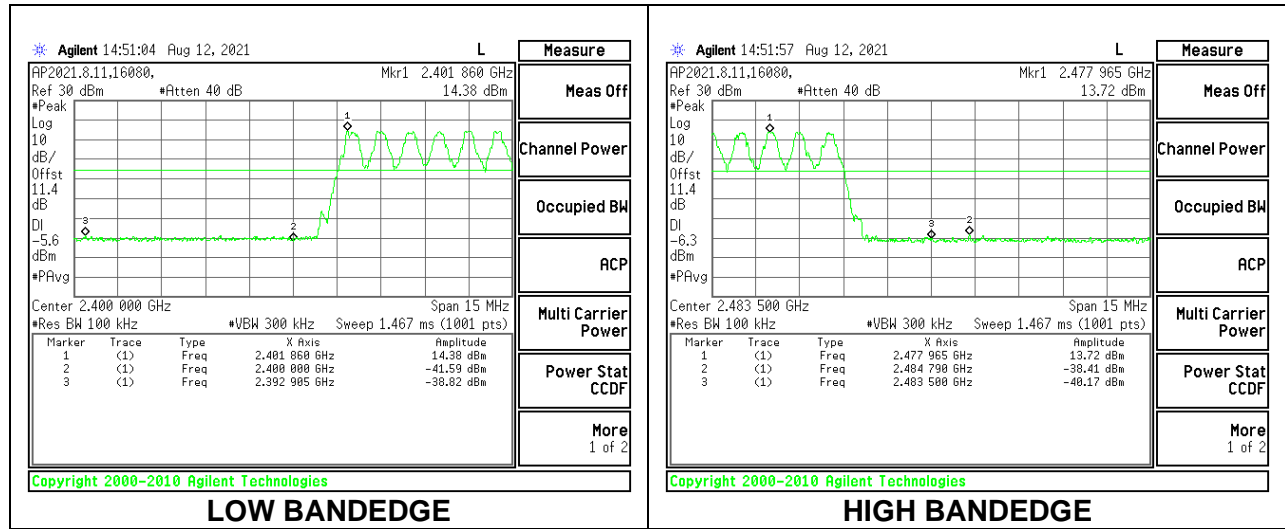


HIGH CHANNEL BANDEDGE



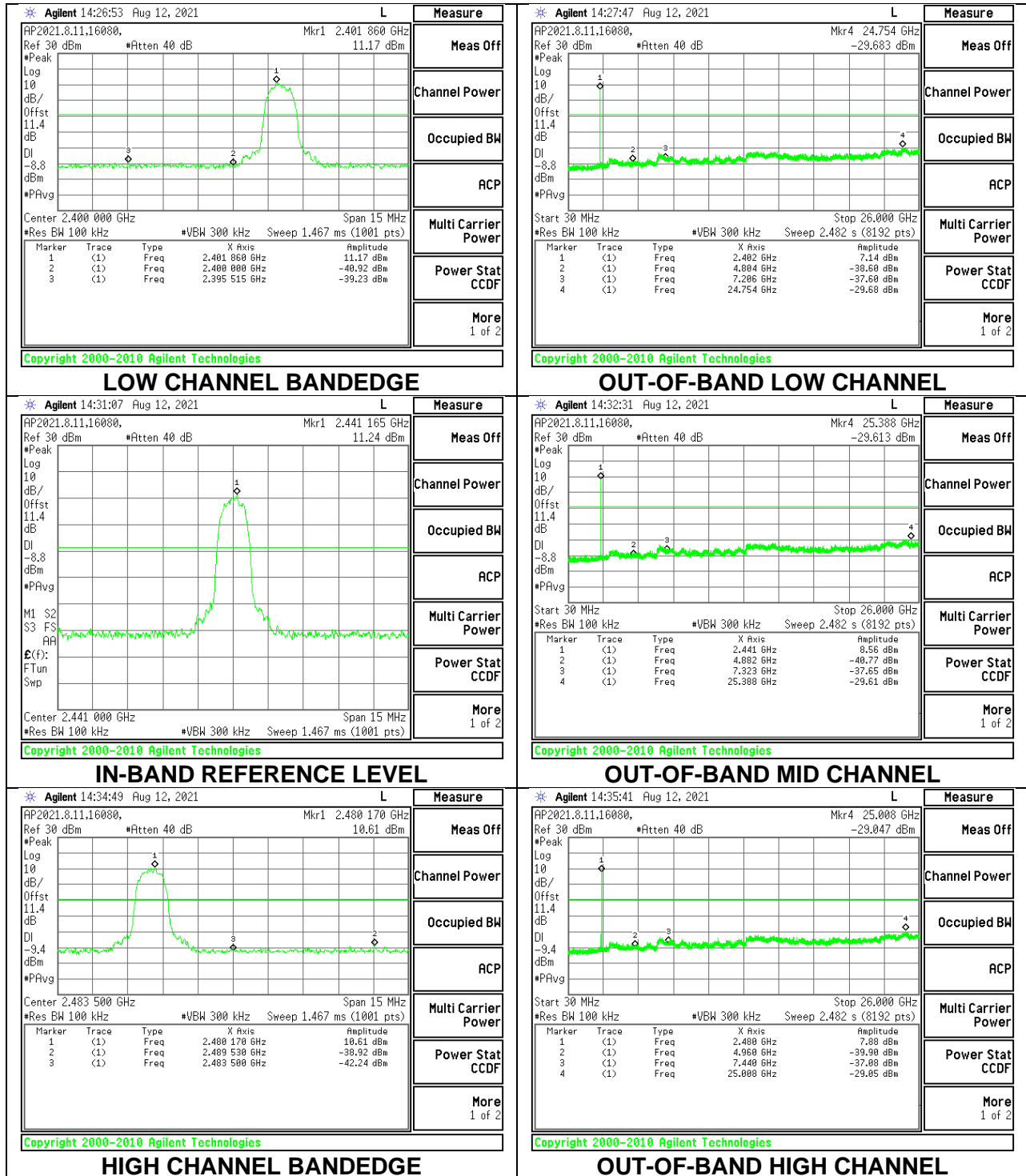
OUT-OF-BAND HIGH CHANNEL

Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

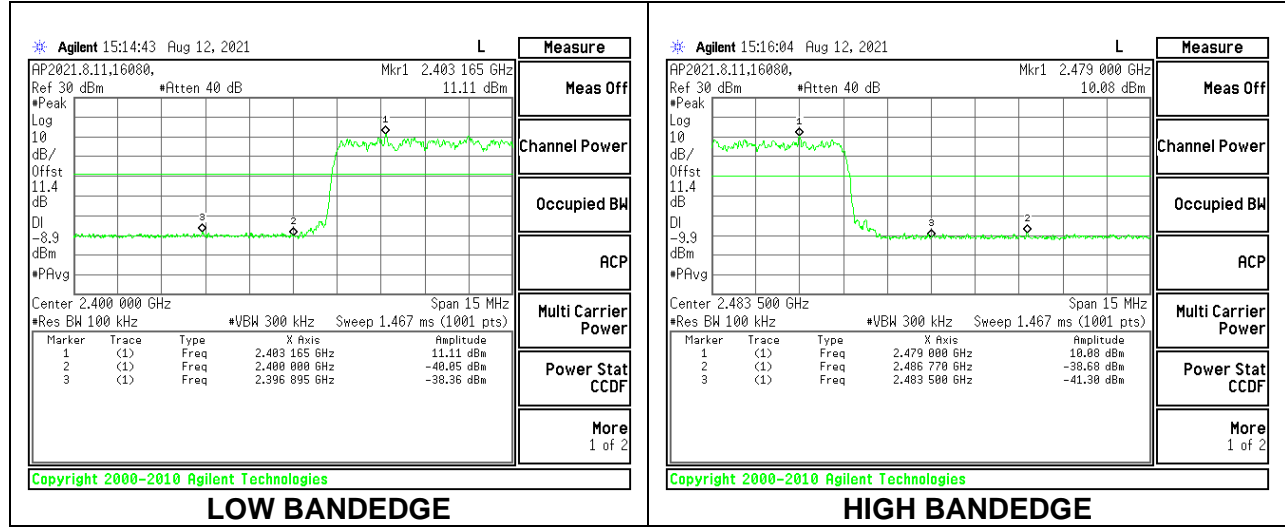


9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



10. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

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 peak detector used. See note on page 43.

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 30MHz, 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.

2D antenna use - 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.

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.

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table), using the free space impedance of 377 Ohms. For example, the measurement at frequency X kHz resulted in a level of Y dBuV/m, which is equivalent to $Y - 51.5 = Z$ dBuA/m, which has the same margin, W dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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.

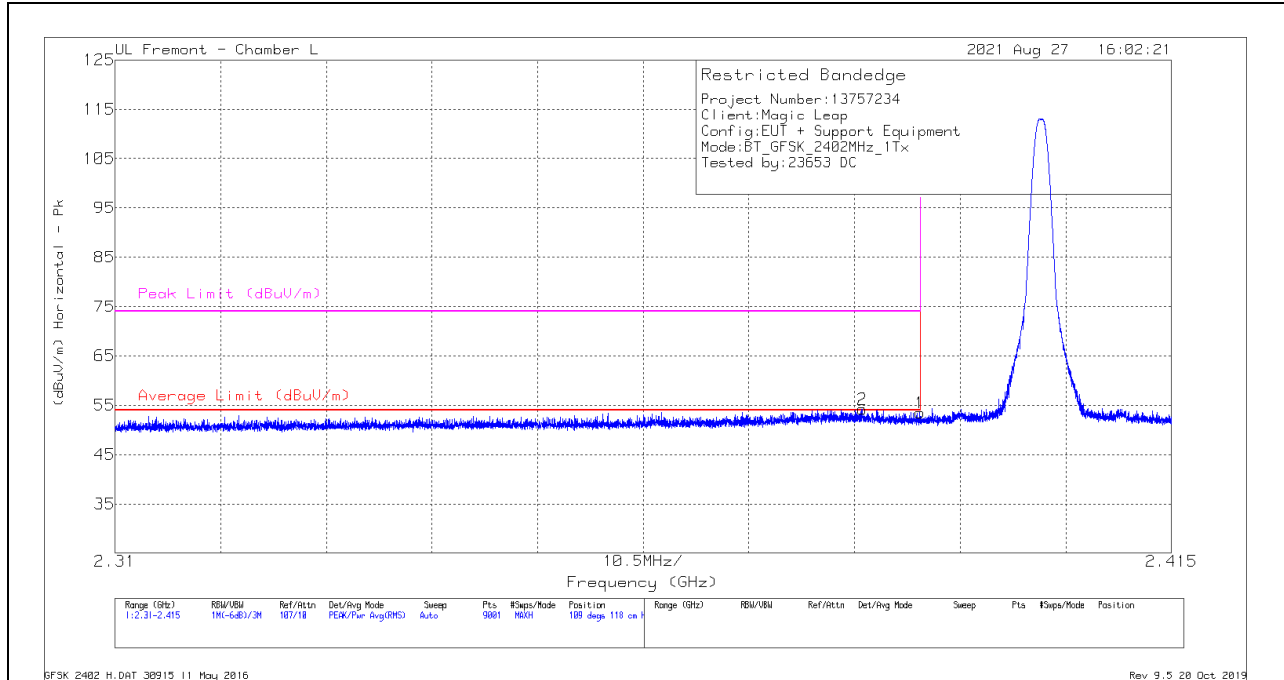
Note - For this test program, Peak detection was used. The DCCF was then subtracted from the peak value. The DCCF was calculated based on the worst case on-time when the device transmits DH5 packets and operates on 20 channels (5/1600 s per hop = 3.125 ms per channel). In this mode, the device will have a maximum of 2 hops on a channel in 100ms or $2 \times 3.125 \text{ ms} = 6.25 \text{ ms}$ on any channel. Therefore, $\text{DCCF} = 20 \log(6.25 / 100) = -24 \text{ dB}$.

10.1. TRANSMITTER ABOVE 1 GHz

10.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT

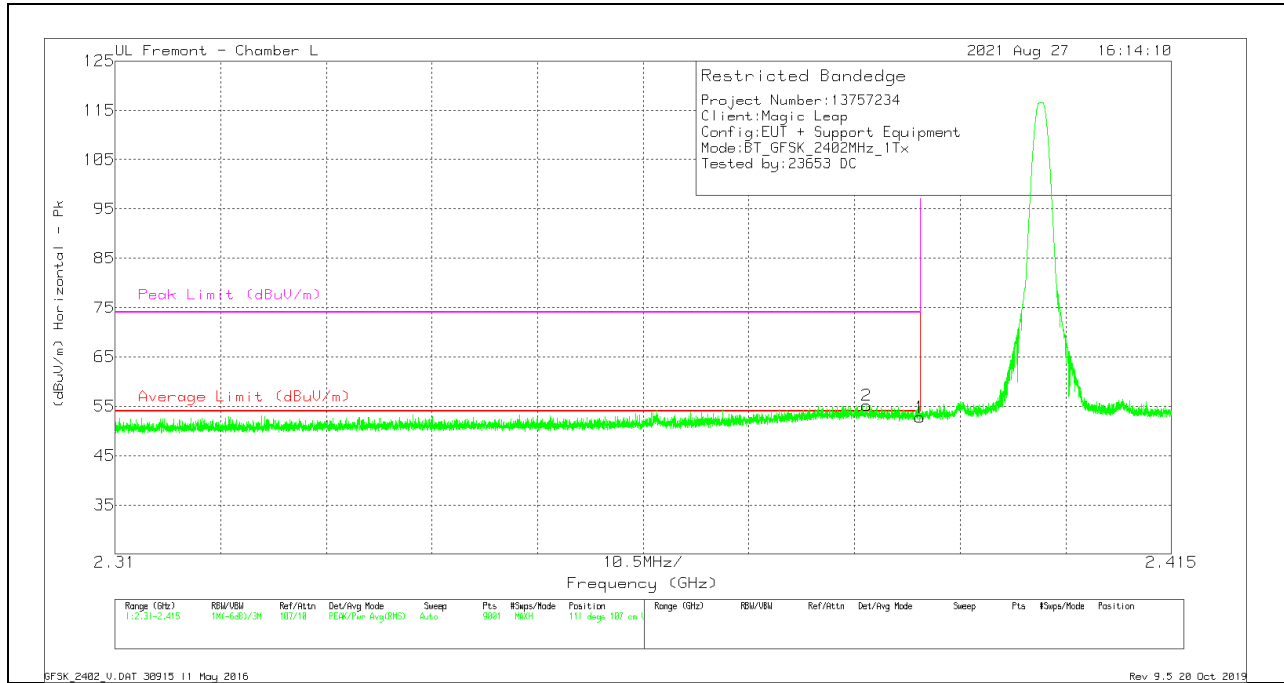


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Filt/Pa d (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	40.82	Pk	32	-19.3	0	53.52			74	-20.48	109	118	H
	* 2.38999	40.82	Pk	32	-19.3	-24	29.52	54	-24.48			109	118	H
2	* 2.38428	41.38	Pk	32.1	-19.3	0	54.18			74	-19.82	109	118	H
	* 2.38428	41.38	Pk	32.1	-19.3	-24	30.18	54	-23.82			109	118	H

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

Pk - Peak detector

VERTICAL RESULT

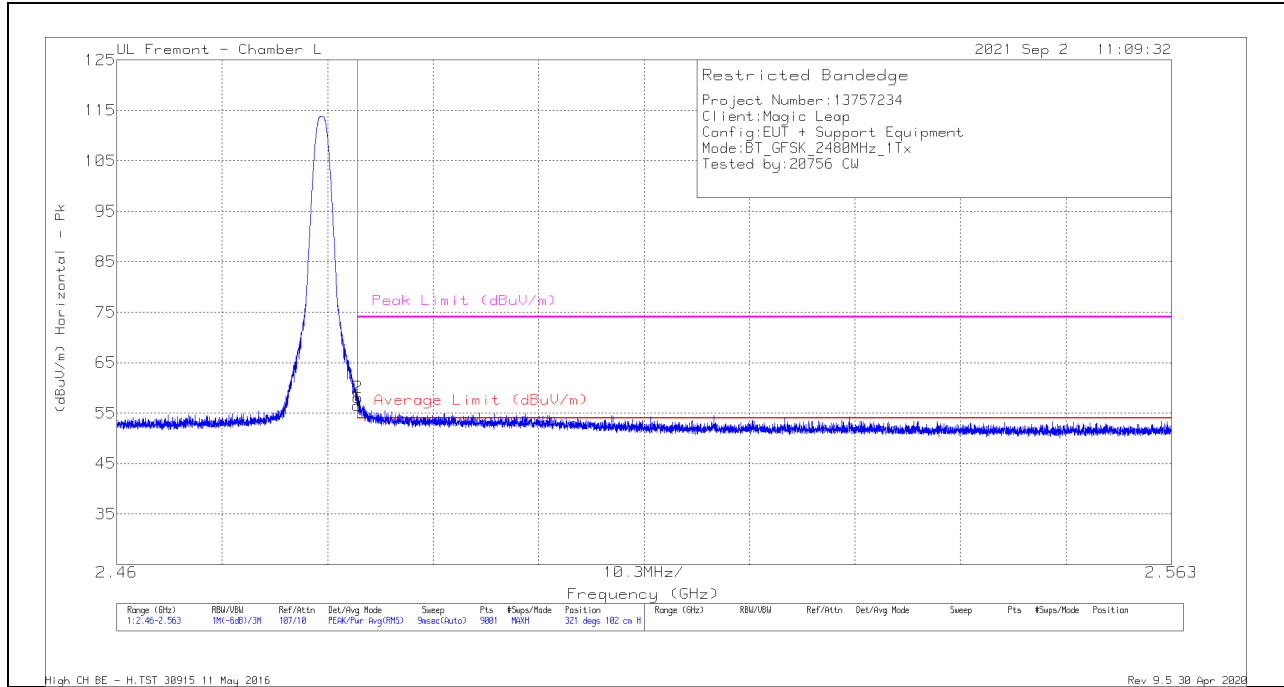


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Filtr/PA d (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	40.06	Pk	32	-19.3	0	52.76			74	-21.24	111	107	V
	* 2.38999	40.06	Pk	32	-19.3	-24	28.76	54	-25.24			111	107	V
2	* 2.38469	42.37	Pk	32.1	-19.3	0	55.17			74	-18.83	111	107	V
	* 2.38469	42.37	Pk	32.1	-19.3	-24	31.17	54	-22.83			111	107	V

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

BANDEDGE (HIGH CHANNEL)

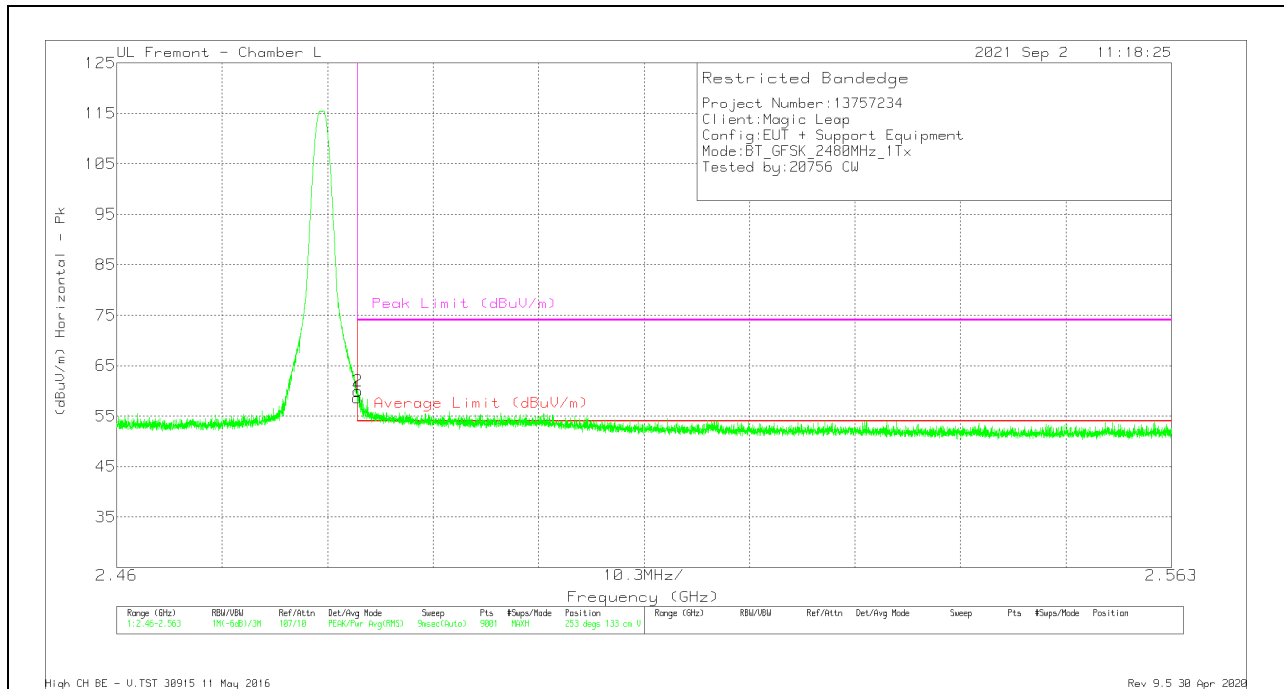
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fitr/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	* 2.48351	43.26	Pk	32.3	-19	0	56.56	54	-21.44	74	-17.44	321	102	H
	* 2.48351	43.26	Pk	32.3	-19	-24	32.56	54	-21.44	74	-17.44	321	102	H
2	* 2.48354	44.83	Pk	32.3	-19	0	58.13	54	-19.87	74	-15.87	321	102	H
	* 2.48354	44.83	Pk	32.3	-19	-24	34.13	54	-19.87	74	-15.87	321	102	H

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

VERTICAL RESULT

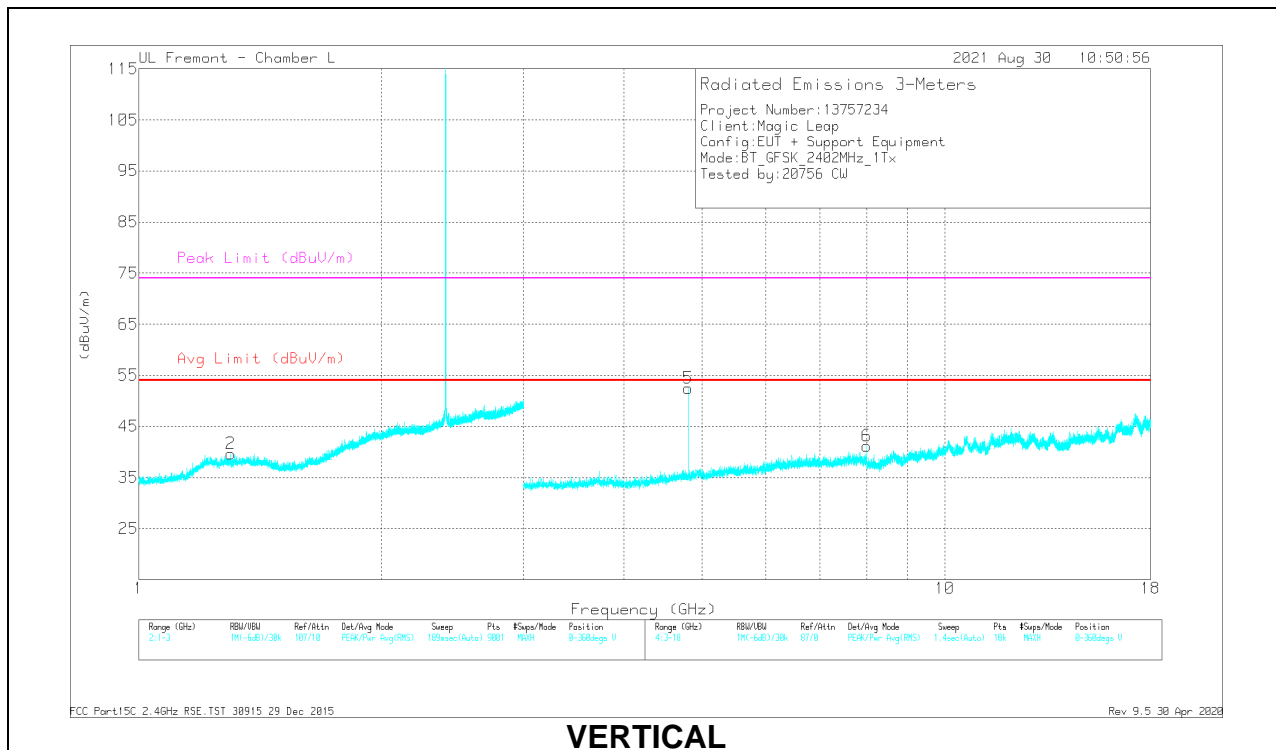
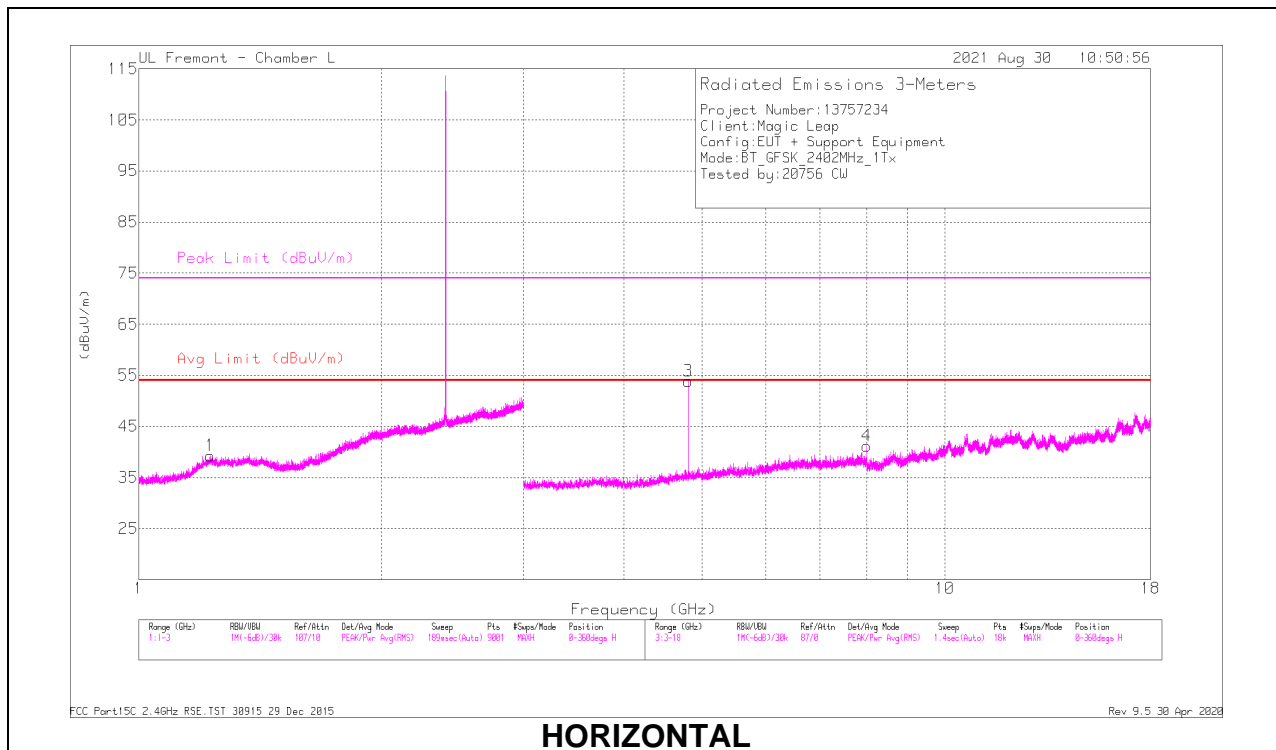


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbi/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	45.32	Pk	32.3	-19	0	58.62	54	-19.38	74	-15.38	253	133	V
	* 2.48351	45.32	Pk	32.3	-19	-24	34.62	54	-19.38	74	-15.38	253	133	V
2	* 2.48354	46.71	Pk	32.3	-19	0	60.01	54	-17.99	74	-13.99	253	133	V
	* 2.48354	46.71	Pk	32.3	-19	-24	36.01	54	-17.99	74	-13.99	253	133	V

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS

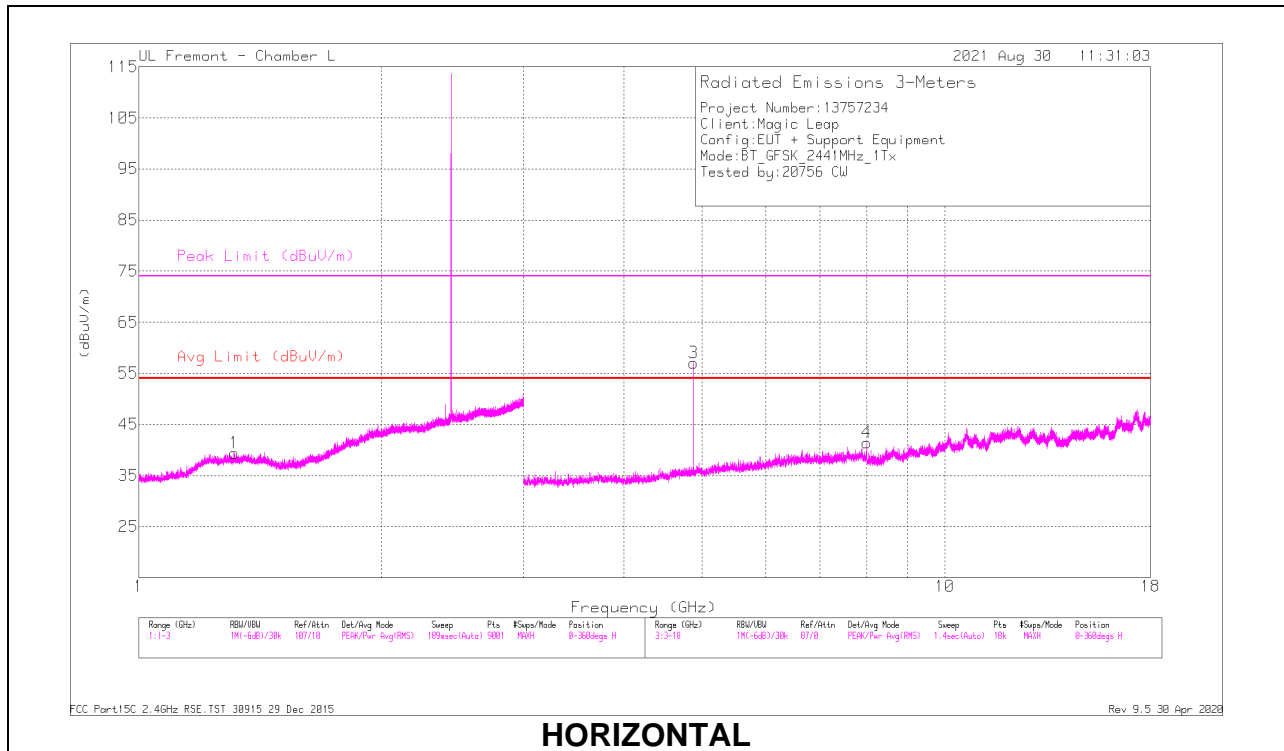


RADIATED EMISSIONS

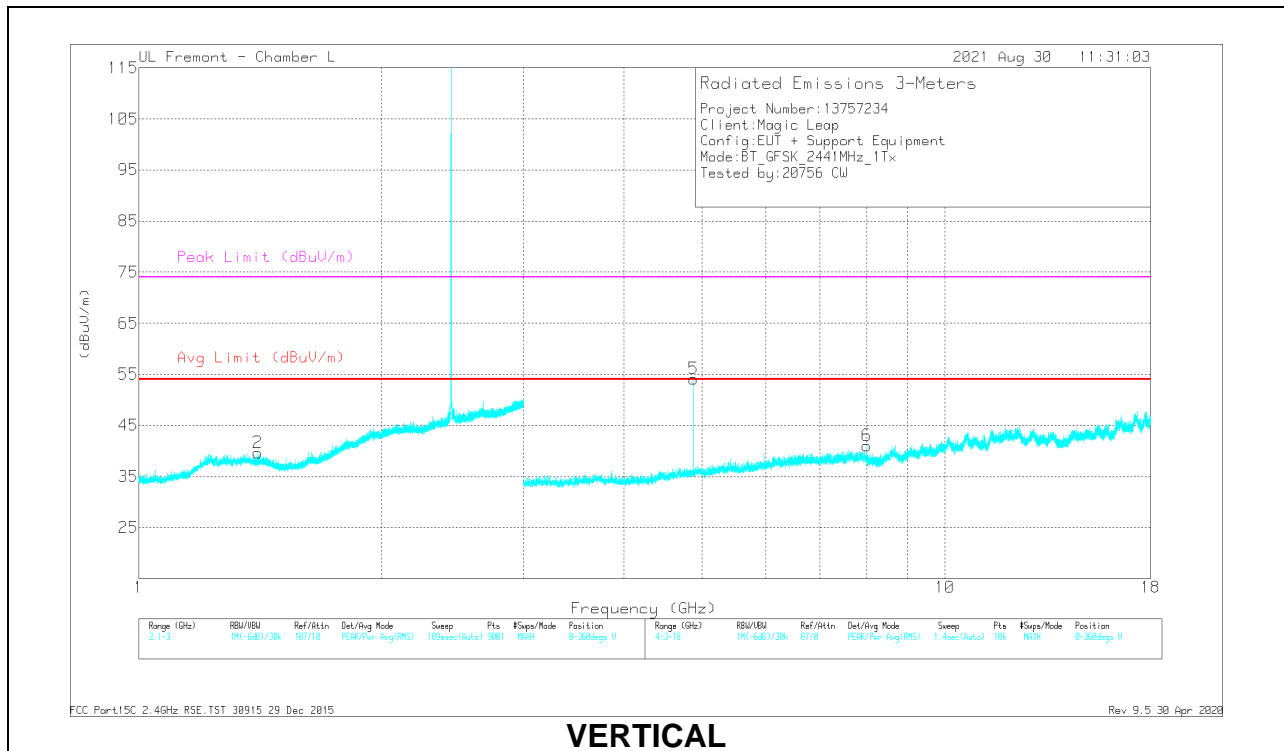
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Prod (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.22658	32.39	PKFH	30.2	-15.9	0	46.69	-	-	74	-27.31	360	111	H
	* 1.22658	32.39	PKFH	30.2	-15.9	-24	22.69	54	-31.31	-	-	360	111	H
2	* 1.30045	33.71	PKFH	29.7	-15.7	0	47.71	-	-	74	-26.29	237	267	V
	* 1.30045	33.71	PKFH	29.7	-15.7	-24	23.71	54	-30.29	-	-	237	267	V
3	* 4.80374	47.53	PKFH	34.1	-24.5	0	57.13	-	-	74	-16.87	108	190	H
	* 4.80374	47.53	PKFH	34.1	-24.5	-24	33.13	54	-20.87	-	-	108	190	H
4	8.00008	33.51	PKFH	35.8	-19.2	0	50.11	-	-	-	-	85	188	H
5	* 4.80403	46.94	PKFH	34.1	-24.5	0	56.54	-	-	74	-17.46	180	189	V
	* 4.80403	46.94	PKFH	34.1	-24.5	-24	32.54	54	-21.46	-	-	180	189	V
6	7.99939	29.2	PKFH	35.8	-19.2	0	45.8	-	-	-	-	285	115	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

MID CHANNEL RESULTS



HORIZONTAL



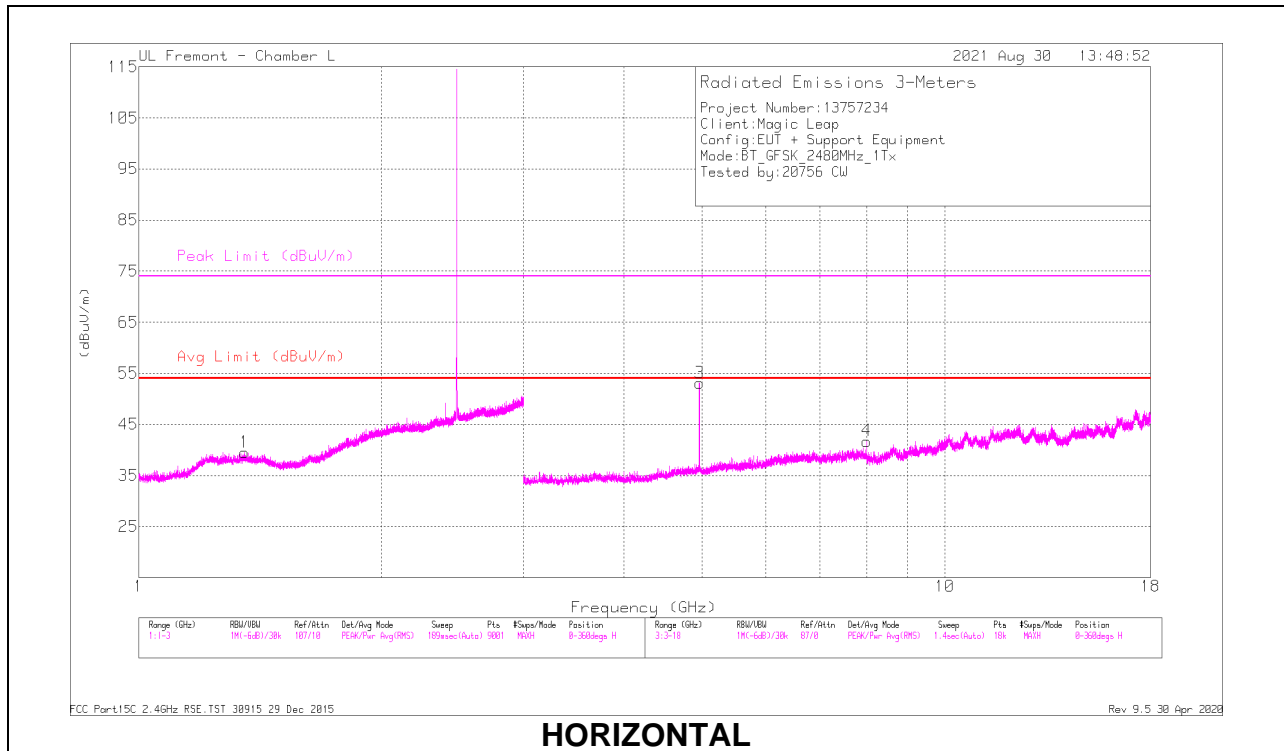
VERTICAL

RADIATED EMISSIONS

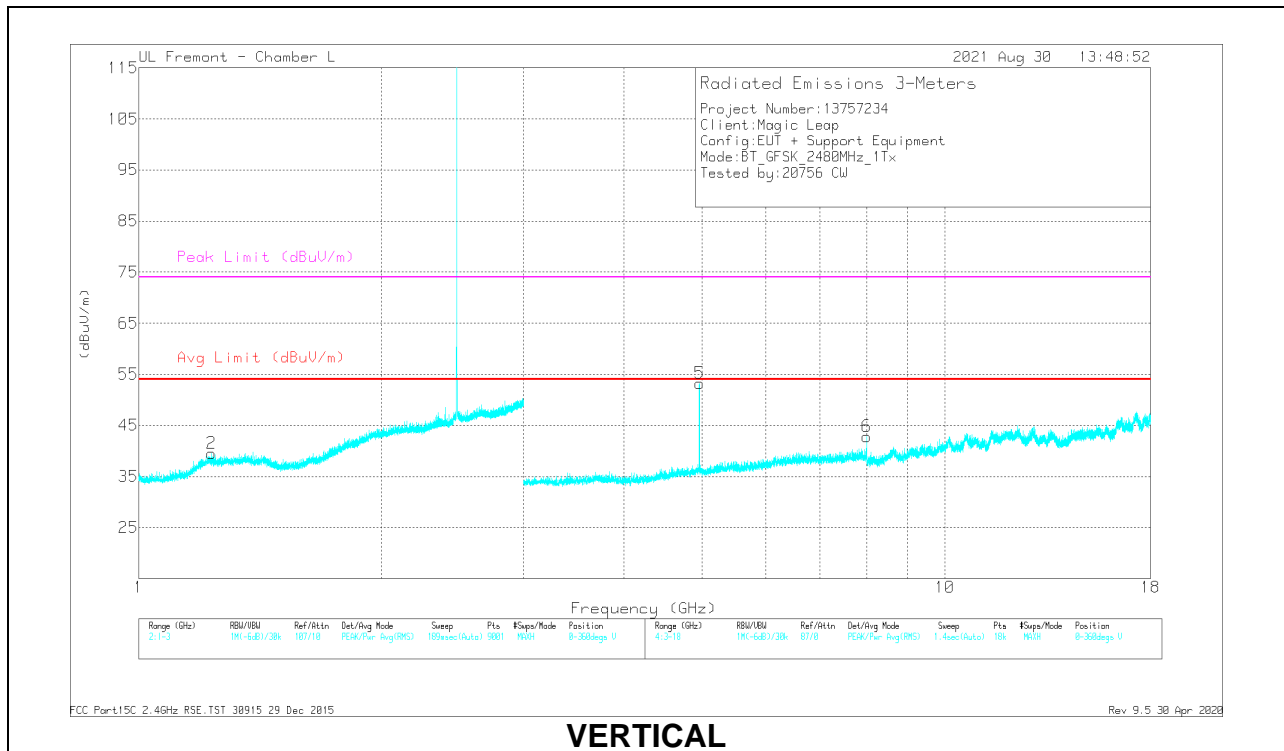
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.31203	33.32	PKFH	29.6	-15.7	0	47.22	-	-	74	-26.78	354	162	H
	* 1.31203	33.32	PKFH	29.6	-15.7	-24	23.22	54	-30.78	-	-	354	162	H
2	* 1.40481	33.79	PKFH	29.2	-15.5	0	47.49	-	-	74	-26.51	101	198	V
	* 1.40481	33.79	PKFH	29.2	-15.5	-24	23.49	54	-30.51	-	-	101	198	V
3	* 4.88228	49.48	PKFH	34.2	-24.3	0	59.38	-	-	74	-14.62	75	224	H
	* 4.88228	49.48	PKFH	34.2	-24.3	-24	35.38	54	-18.62	-	-	75	224	H
4	8.00004	32.46	PKFH	35.8	-19.2	0	49.06	-	-	-	-	81	199	H
5	* 4.88233	49.37	PKFH	34.2	-24.3	0	59.27	-	-	74	-14.73	196	213	V
	* 4.88233	49.37	PKFH	34.2	-24.3	-24	35.27	54	-18.73	-	-	196	213	V
6	8.00015	33.44	PKFH	35.8	-19.2	0	50.04	-	-	-	-	44	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

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

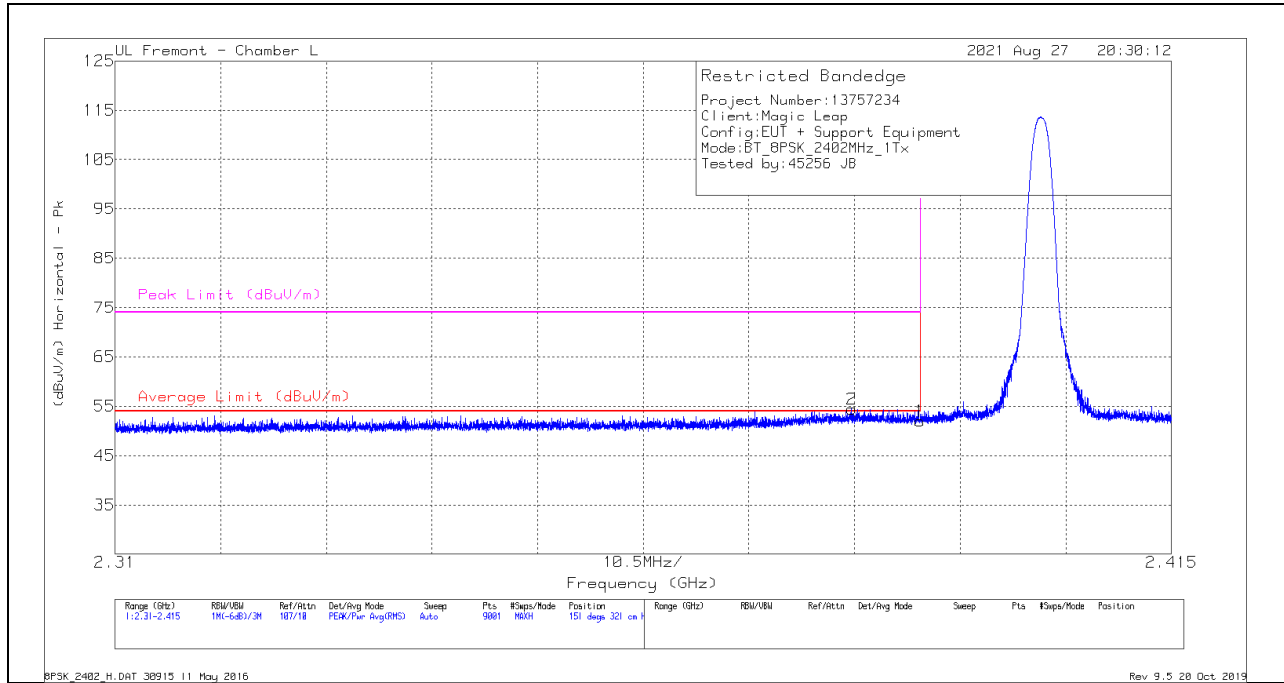
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.35136	33.32	PKFH	29.8	-15.7		47.42	-	-	74	-26.58	114	194	H
	* 1.35136	33.32	PKFH	29.8	-15.7	-24	23.42	54	-30.58	-	-	114	194	H
2	* 1.23157	32.26	PKFH	30	-15.8		46.46	-	-	74	-27.54	90	251	V
	* 1.23157	32.26	PKFH	30	-15.8	-24	22.46	54	-31.54	-	-	90	251	V
3	* 4.96027	46.12	PKFH	34.2	-23.2		57.12	-	-	74	-16.88	63	101	H
	* 4.96027	46.12	PKFH	34.2	-23.2	-24	33.12	54	-20.88	-	-	63	101	H
4	7.99932	31.62	PKFH	35.8	-19.2		48.22	-	-	-	-	197	111	H
5	* 4.96027	46.09	PKFH	34.2	-23.2		57.09	-	-	74	-16.91	55	283	V
	* 4.96027	46.09	PKFH	34.2	-23.2	-24	33.09	54	-20.91	-	-	55	283	V
6	8.0004	32.31	PKFH	35.8	-19.2		48.91	-	-	-	-	151	110	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

10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT

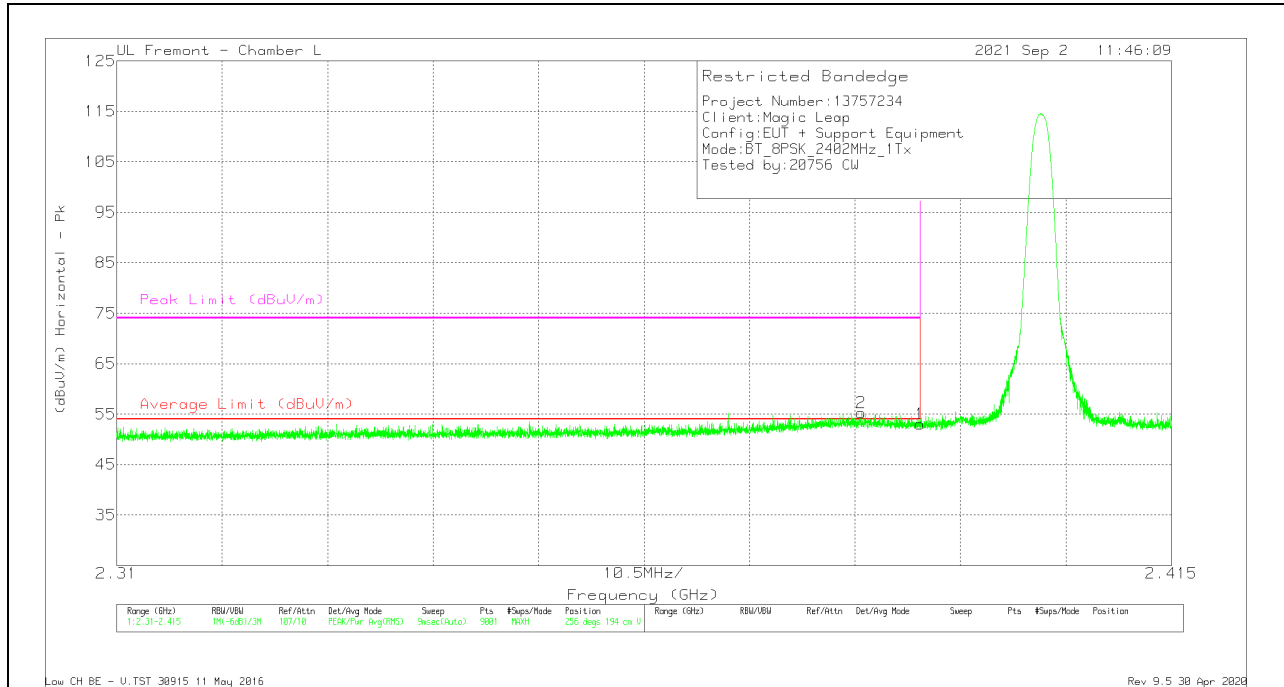


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Filtr/Pa d (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	39.28	Pk	32	-19.3	0	51.98			74	-22.02	151	321	H
	* 2.38999	39.28	Pk	32	-19.3	-24	27.98	54	-26.02			151	321	H
2	* 2.38321	41.74	Pk	32.1	-19.4	0	54.44			74	-19.56	151	321	H
	* 2.38321	41.74	Pk	32.1	-19.4	-24	30.44	54	-23.56			151	321	H

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

Pk - Peak detector

VERTICAL RESULT

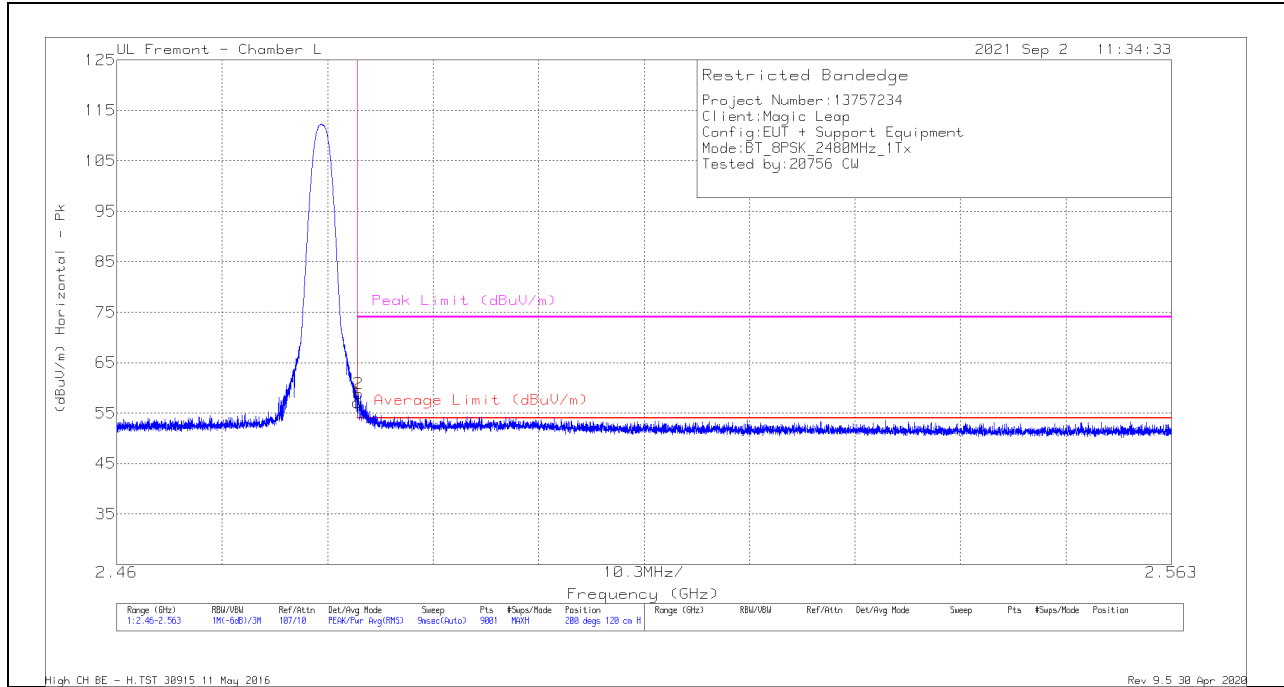


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	40.35	Pk	32	-19.3	0	53.05	54	-24.95	74	-20.95	256	194	V
	* 2.38999	40.35	Pk	32	-19.3	-24	29.05	54	-24.95	74	-18.75	256	194	V
2	* 2.38411	42.45	Pk	32.1	-19.3	0	55.25	54	-22.75	74	-18.75	256	194	V
	* 2.38411	42.45	Pk	32.1	-19.3	-24	31.25	54	-22.75	74	-18.75	256	194	V

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

BANDEDGE (HIGH CHANNEL)

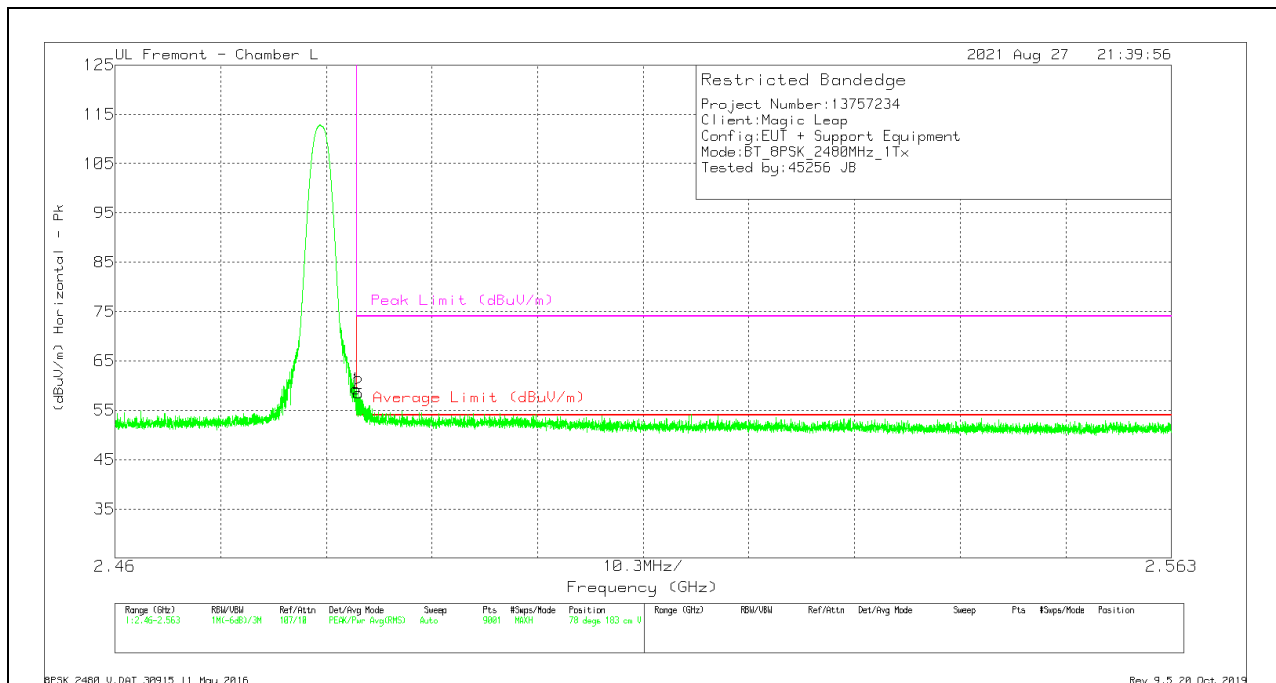
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/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	* 2.48351	43.84	Pk	32.3	-19	0	57.14	54	-20.86	74	-16.86	200	120	H
	* 2.48351	43.84	Pk	32.3	-19	-24	33.14	54	-20.86	74	-15.15	200	120	H
2	* 2.48361	45.55	Pk	32.3	-19	0	58.85	54	-19.15	74	-15.15	200	120	H
	* 2.48361	45.55	Pk	32.3	-19	-24	34.85	54	-19.15	74	-15.15	200	120	H

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

VERTICAL RESULT

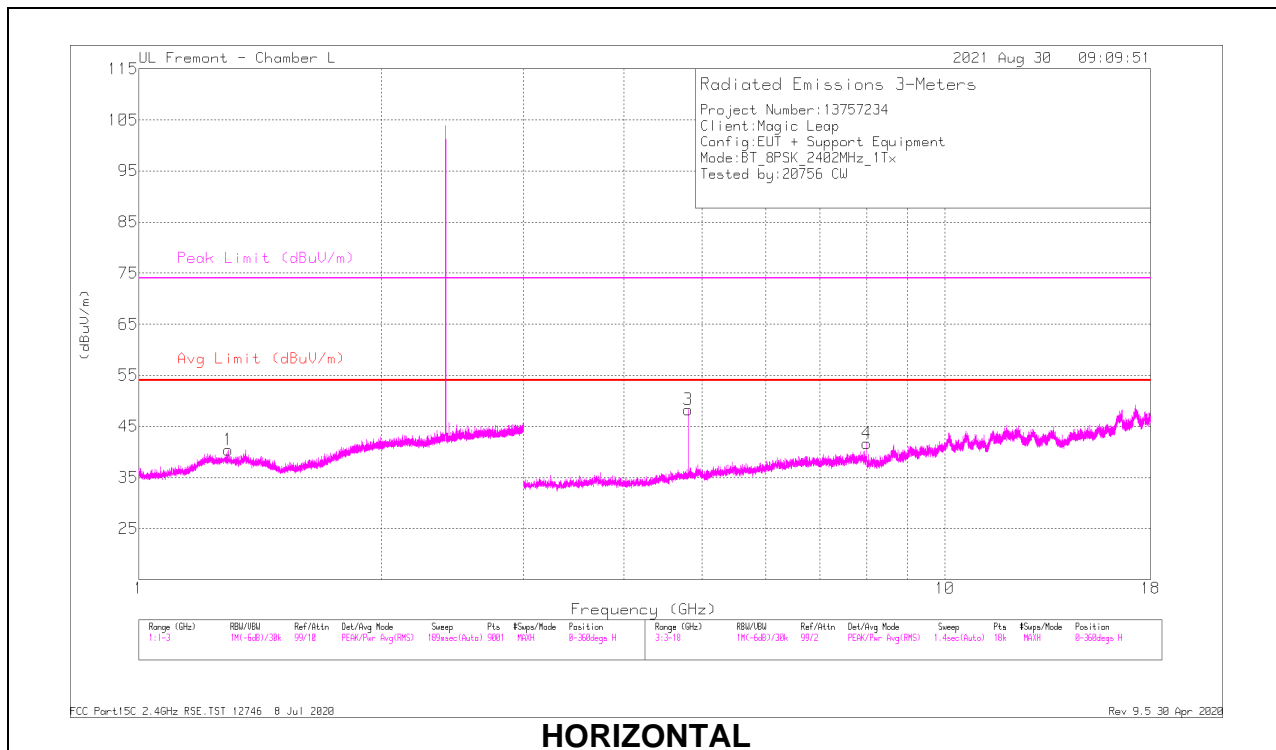


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Filtr/Pa d (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	46.02	Pk	32.3	-19	0	59.32	54	-18.68	74	-14.68	78	183	V
	* 2.48351	46.02	Pk	32.3	-19	-24	35.32	54	-18.68	74	-15.51	78	183	V
2	* 2.48371	45.19	Pk	32.3	-19	0	58.49	54	-19.51	74	-15.51	78	183	V
	* 2.48371	45.19	Pk	32.3	-19	-24	34.49	54	-19.51	74	-15.51	78	183	V

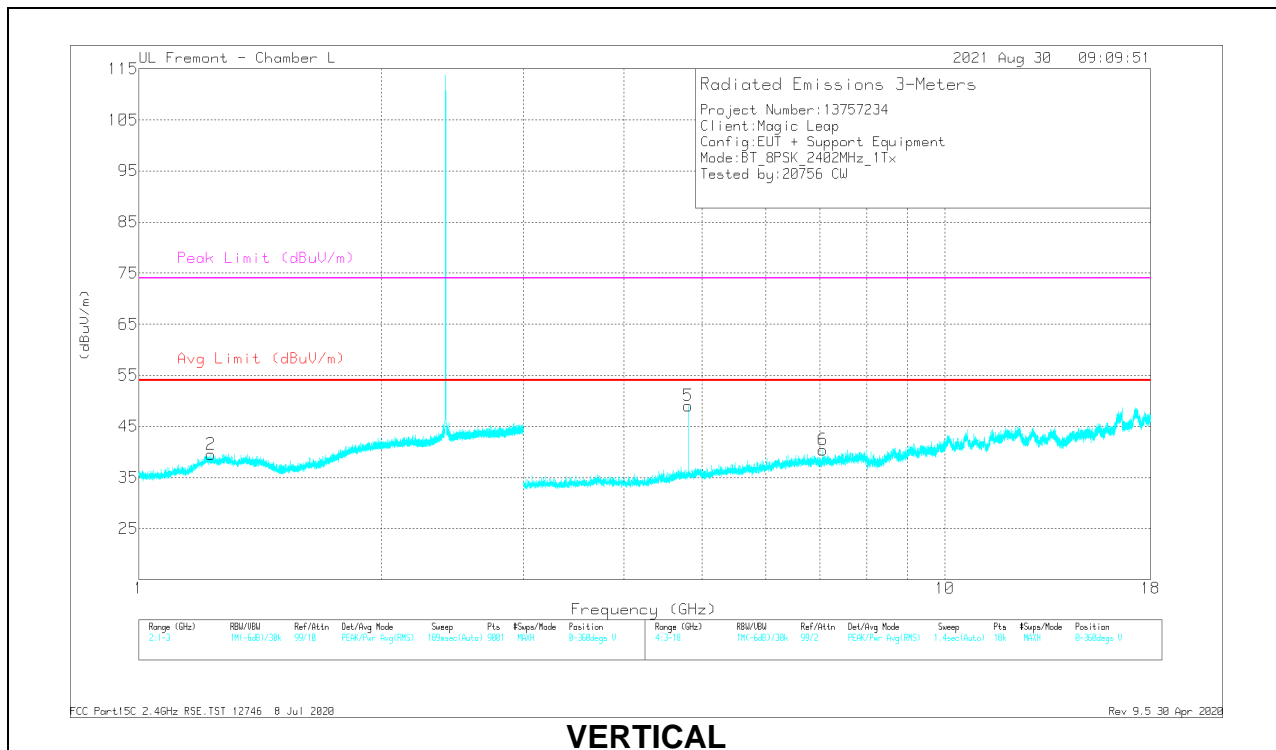
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



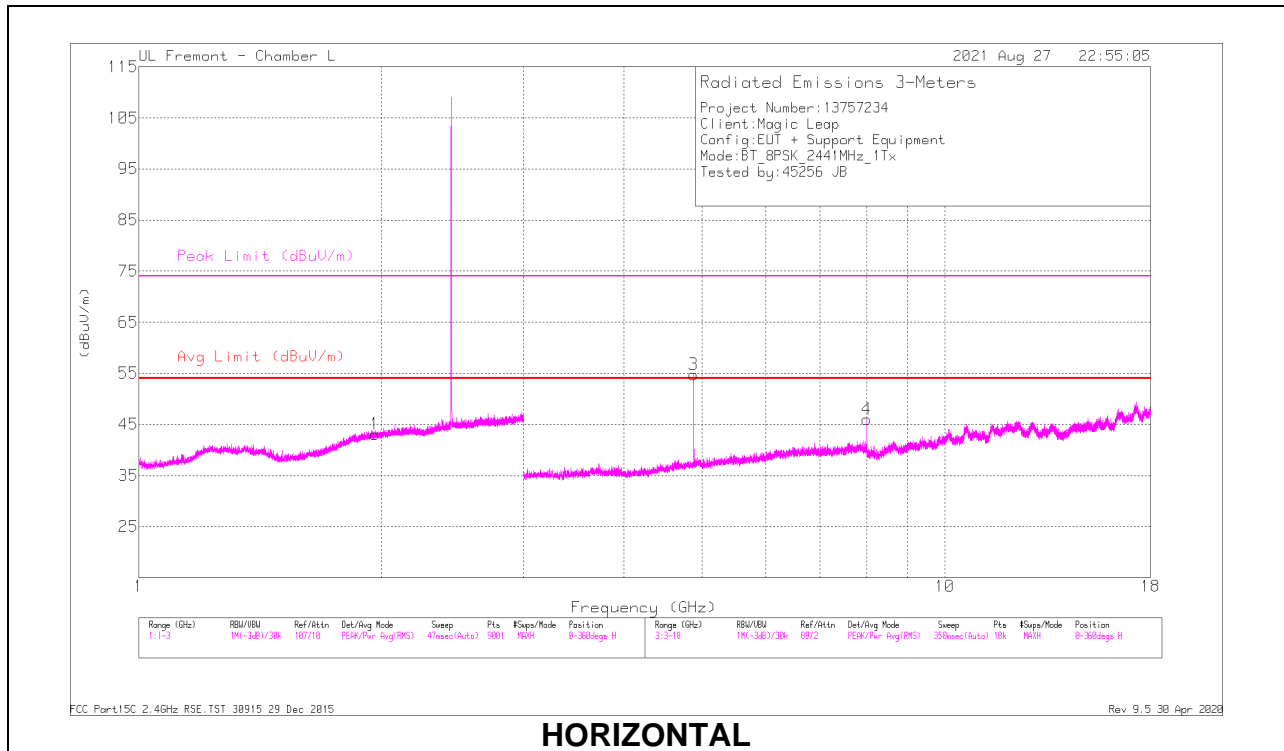
VERTICAL

RADIATED EMISSIONS

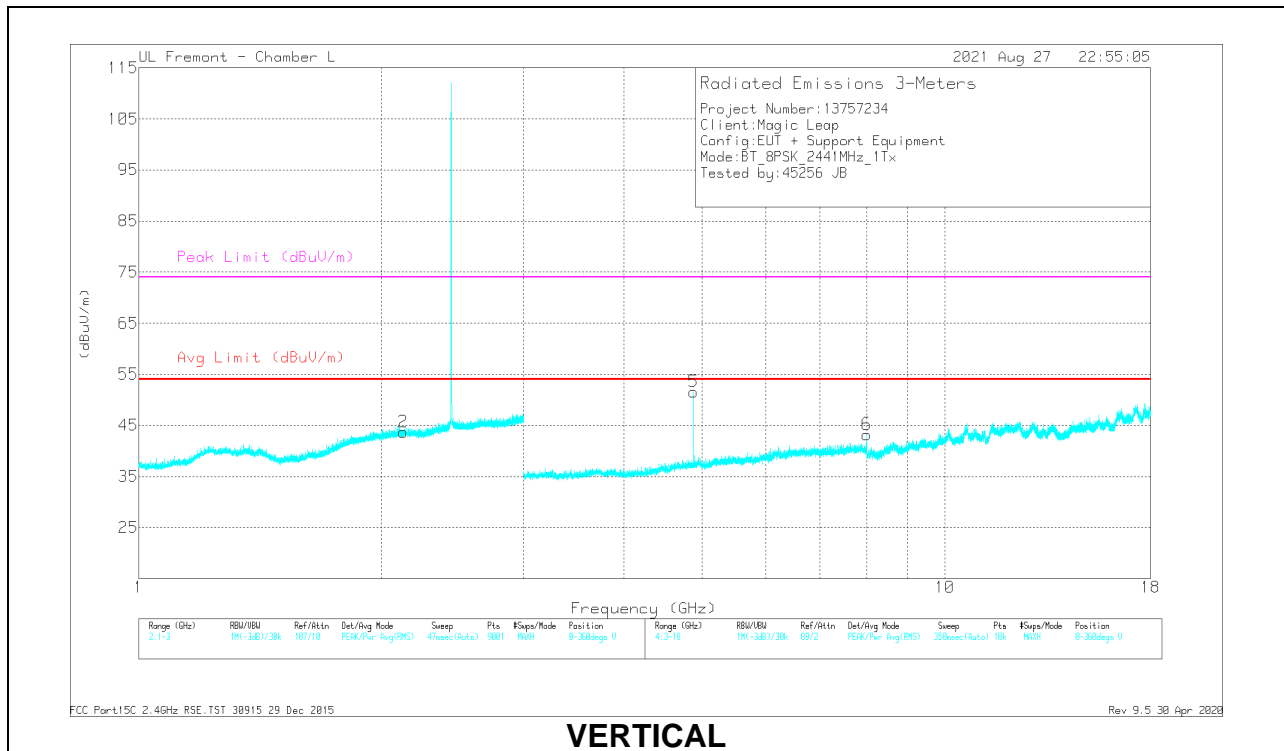
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.2897	40.08	PKFH	29.8	-22.8	-	47.08	-	-	74	-26.92	167	314	H
	* 1.2897	40.08	PKFH	29.8	-22.8	-24	23.08	54	-30.92	-	-	167	314	H
2	* 1.22654	40.68	PKFH	30.2	-23.1	-	47.78	-	-	74	-26.22	16	212	V
	* 1.22654	40.68	PKFH	30.2	-23.1	-24	23.78	54	-30.22	-	-	16	212	V
3	* 4.80414	44.33	PKFH	34.1	-24.5	-	53.93	-	-	74	-20.07	110	202	H
	* 4.80414	44.33	PKFH	34.1	-24.5	-24	29.93	54	-24.07	-	-	110	202	H
4	7.99815	28.43	PKFH	35.8	-19.2	-	45.03	-	-	-	-	355	287	H
5	* 4.80424	44.05	PKFH	34.1	-24.5	-	53.65	-	-	74	-20.35	175	208	V
	* 4.80424	44.05	PKFH	34.1	-24.5	-24	29.65	54	-24.35	-	-	175	208	V
6	7.05934	31.36	PKFH	35.6	-20.5	-	46.46	-	-	-	-	132	380	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

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

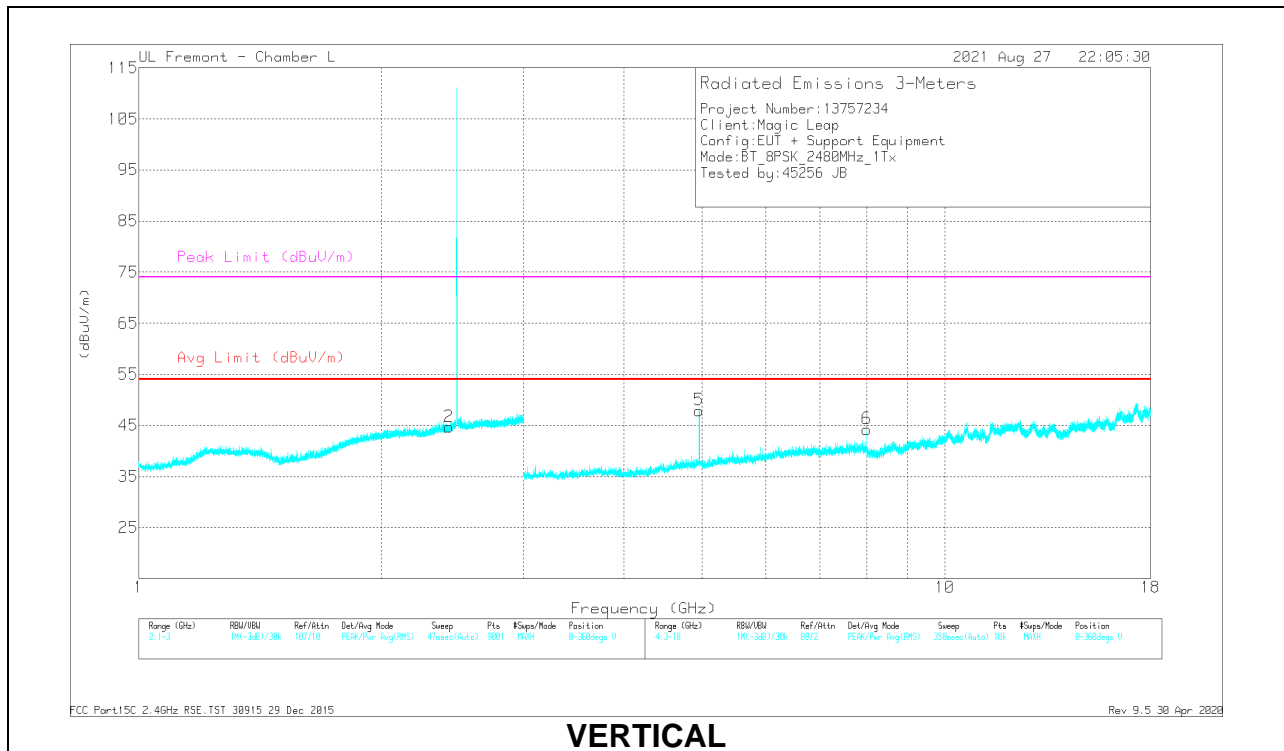
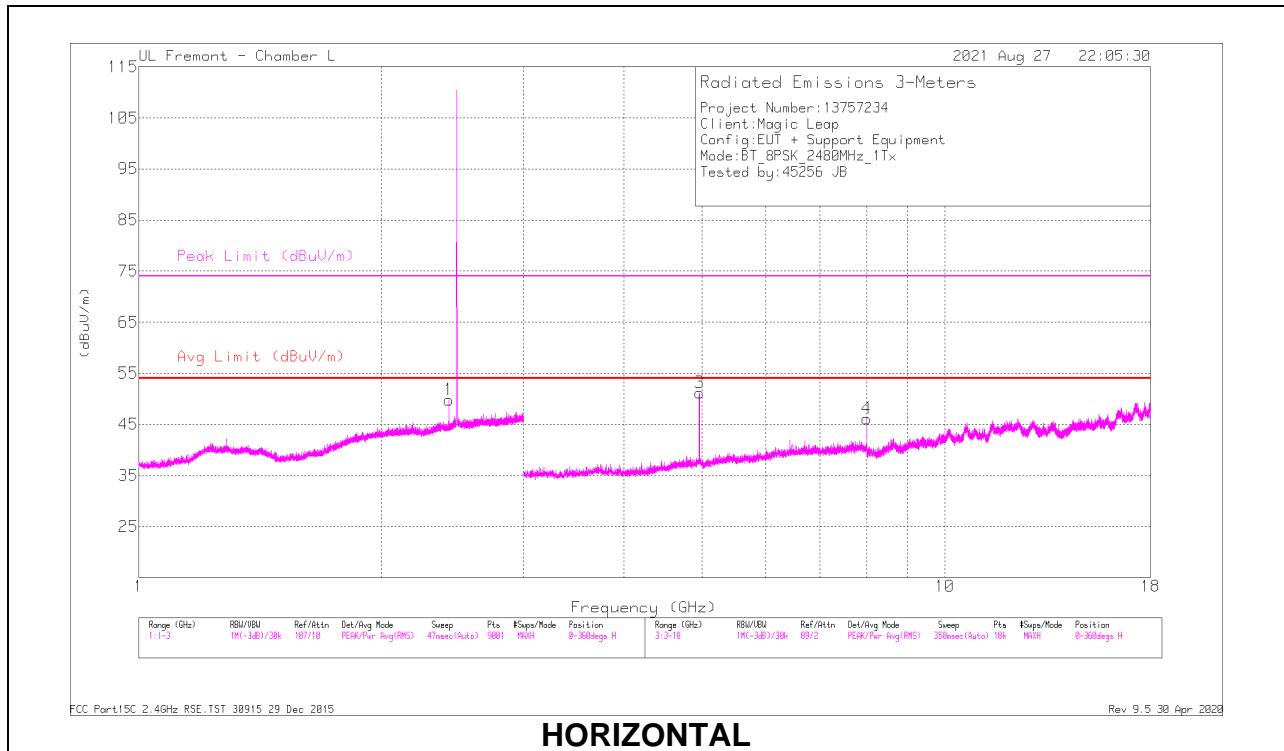
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/P ad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.96422	32.31	PKFH	31.4	-20.6	-	43.11	-	-	-	-	0-360	200	H
2	2.12955	32.1	PKFH	31.6	-20	-	43.7	-	-	-	-	0-360	200	V
3	* 4.88195	49.64	PKFH	34.2	-24.3	-	59.54	-	-	74	-14.46	170	196	H
	* 4.8818	49.64	PKFH	34.2	-24.3	-24	35.54	54	-18.46	-	-	170	196	H
4	7.99991	34.76	PKFH	35.8	-19.2	-	51.36	-	-	-	-	147	190	H
5	* 4.88165	47.15	PKFH	34.2	-24.3	-	57.05	-	-	74	-16.95	197	199	V
	* 4.88182	47.15	PKFH	34.2	-24.3	-24	35.05	54	-18.95	-	-	197	199	V
6	8.00035	32.64	PKFH	35.8	-19.2	-	49.24	-	-	-	-	126	206	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

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

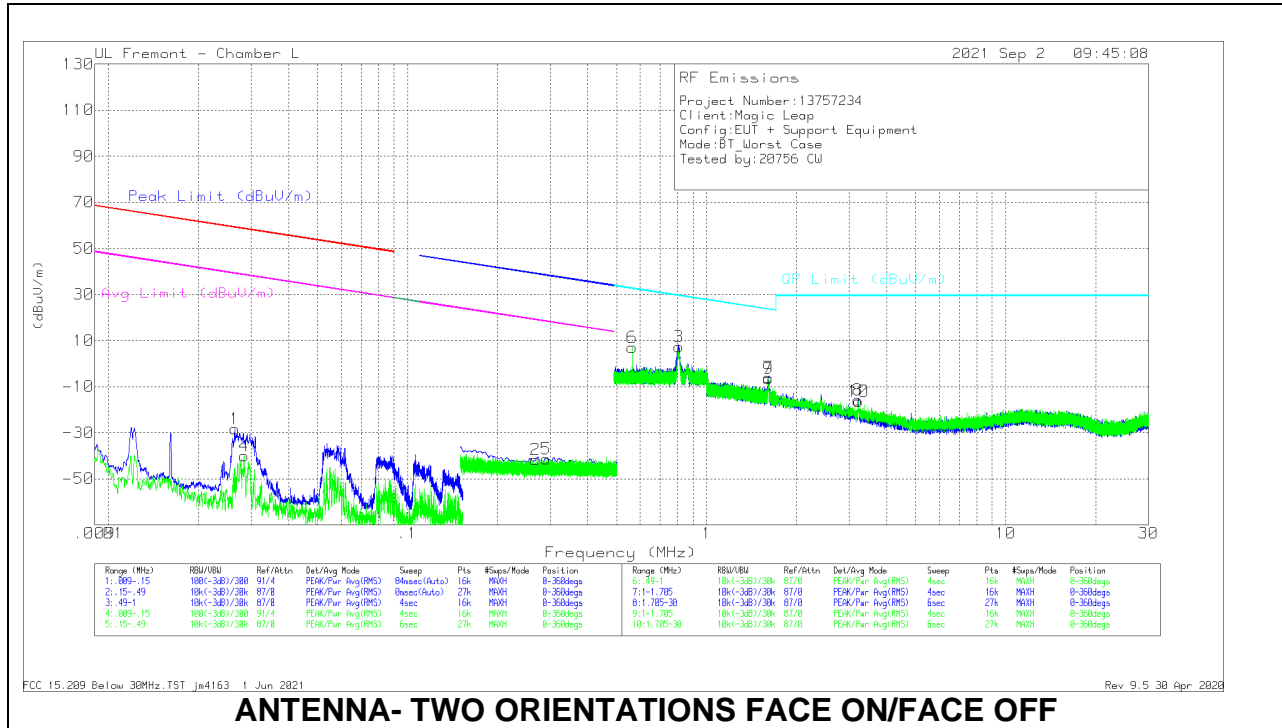
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Prod (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.42546	39.64	PKFH	31.9	-19.2	-	52.34	-	-	-	-	228	146	H
2	2.42489	31.96	PKFH	31.9	-19.2	-	44.66	-	-	-	-	0-360	200	V
3	* 4.95993	45.85	PKFH	34.2	-23.2	-	56.85	-	-	74	-17.15	164	196	H
	* 4.95993	45.85	PKFH	34.2	-23.2	-24	32.85	54	-21.15	-	-	164	196	H
4	* 4.95968	43.6	PKFH	34.2	-23.2	-	54.6	-	-	74	-19.4	66	105	V
	* 4.95968	43.6	PKFH	34.2	-23.2	-24	32.6	54	-21.4	-	-	66	105	V
5	8.0001	32.29	PKFH	35.8	-19.2	-	48.89	-	-	-	-	123	188	V
6	8.00018	22.76	PKFH	35.8	-19.2	-	39.36	-	-	-	-	123	188	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

10.2. WORST CASE BELOW 30MHz

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

Below 30MHz Data

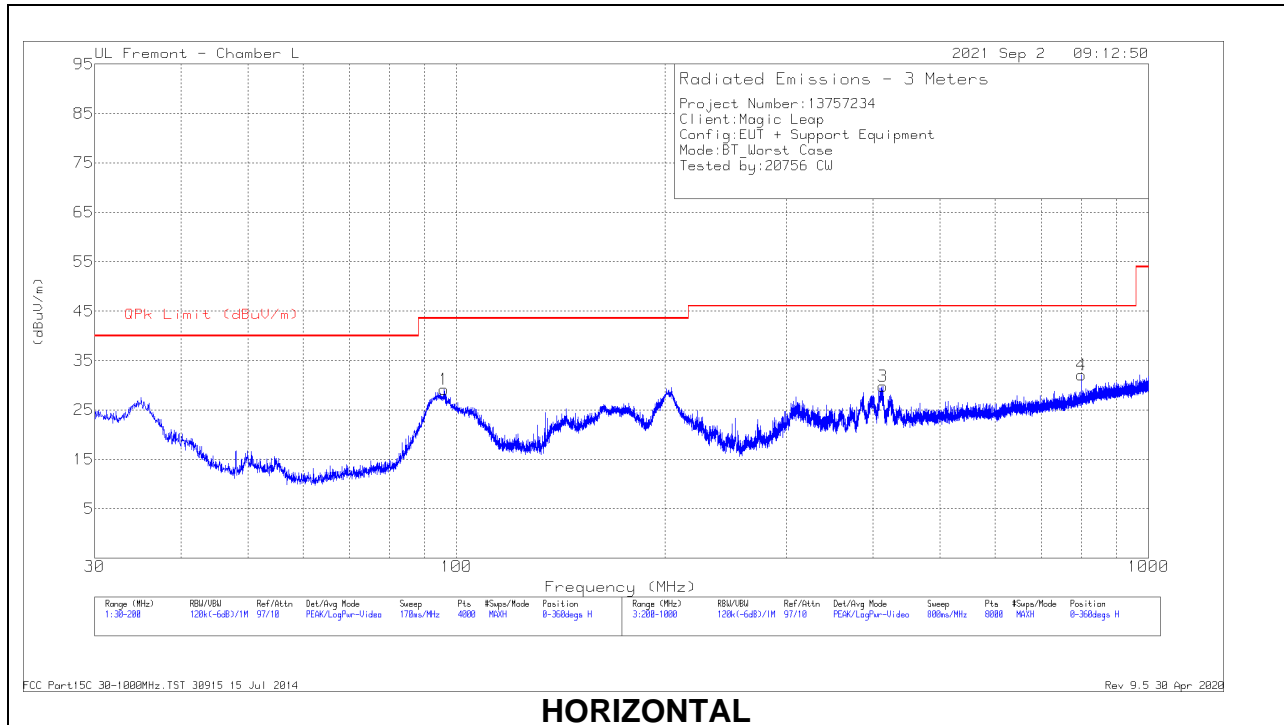
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (E AC7)	Amp/Cb1 (dB)	Dist Corr 30m (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.02646	24.91	Pk	58.3	-31.4	-80	-28.19	59.13	-87.32	39.13	-67.32	0-360
2	.26808	14.14	Pk	56.2	-32	-80	-41.66	39.05	-80.71	19.05	-60.71	0-360
4	.02842	13.27	Pk	58.1	-31.5	-80	-40.13	58.51	-98.64	38.51	-78.64	0-360
5	.2903	14.33	Pk	56.2	-32	-80	-41.47	38.36	-79.83	18.36	-59.83	0-360

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (E AC7)	Amp/Cb1 (dB)	Dist Corr 30m (dB)	Corrected Reading (dBuV/m)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	.80709	23.16	Pk	56.2	-31.9	-40	7.46	29.48	-22.02	0-360
6	.56379	22.73	Pk	56.2	-31.9	-40	7.03	32.59	-25.56	0-360
7	1.60821	22.44	Pk	43.5	-31.9	-40	-5.96	23.51	-29.47	0-360
8	3.20993	17.61	Pk	38.3	-31.8	-40	-15.89	29.5	-45.39	0-360
9	1.6054	21.72	Pk	43.6	-31.9	-40	-6.58	23.52	-30.1	0-360
10	3.21831	17.06	Pk	38.3	-31.8	-40	-16.44	29.5	-45.94	0-360

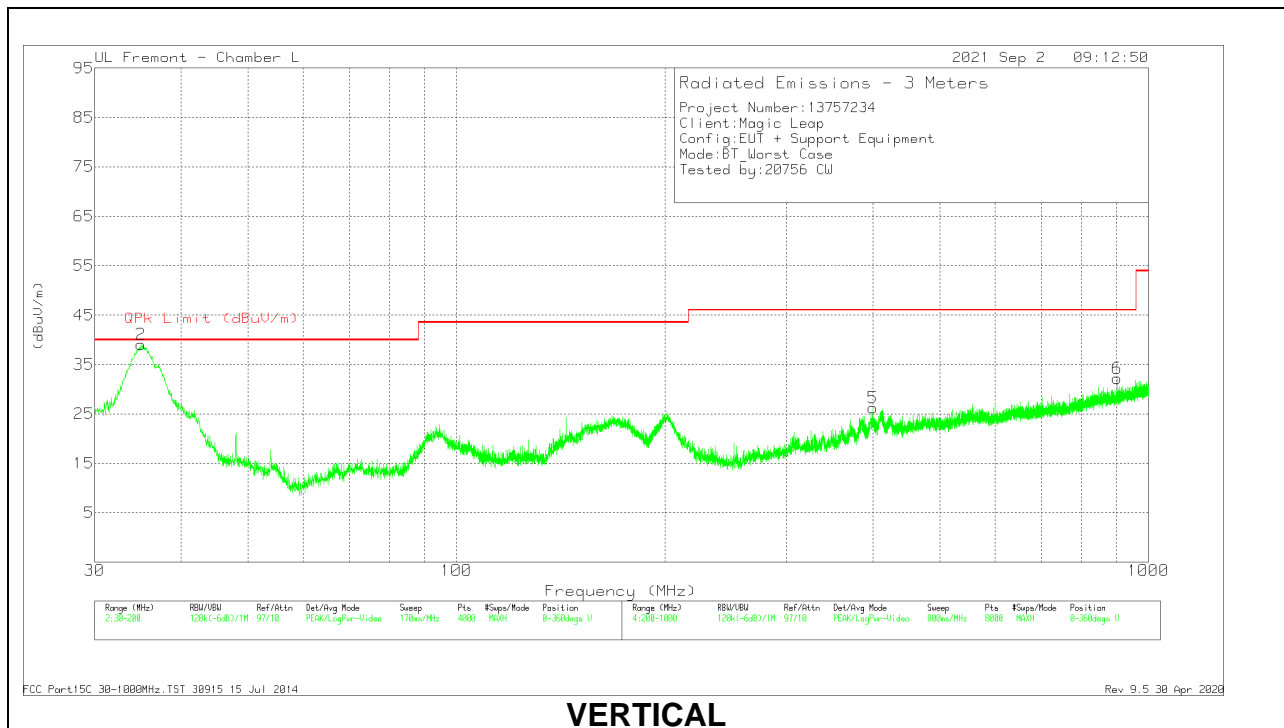
Pk - Peak detector

10.3. WORST CASE BELOW 1 GHz

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



HORIZONTAL



VERTICAL

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	96.0196	44.96	Pk	15	-30.8	29.16	43.52	-14.36	0-360	299	H
2	35.1558	45.04	Qp	23	-31.3	36.74	40	-3.26	160	101	V
3	412.9277	36.84	Pk	21.9	-29	29.74	46.02	-16.28	0-360	299	H
4	800.078	33.19	Pk	27	-28.1	32.09	46.02	-13.93	0-360	299	H
5	* 400.026	33.84	Pk	21.4	-29	26.24	46.02	-19.78	0-360	299	V
6	900.5911	31.45	Pk	27.9	-27.2	32.15	46.02	-13.87	0-360	99	V

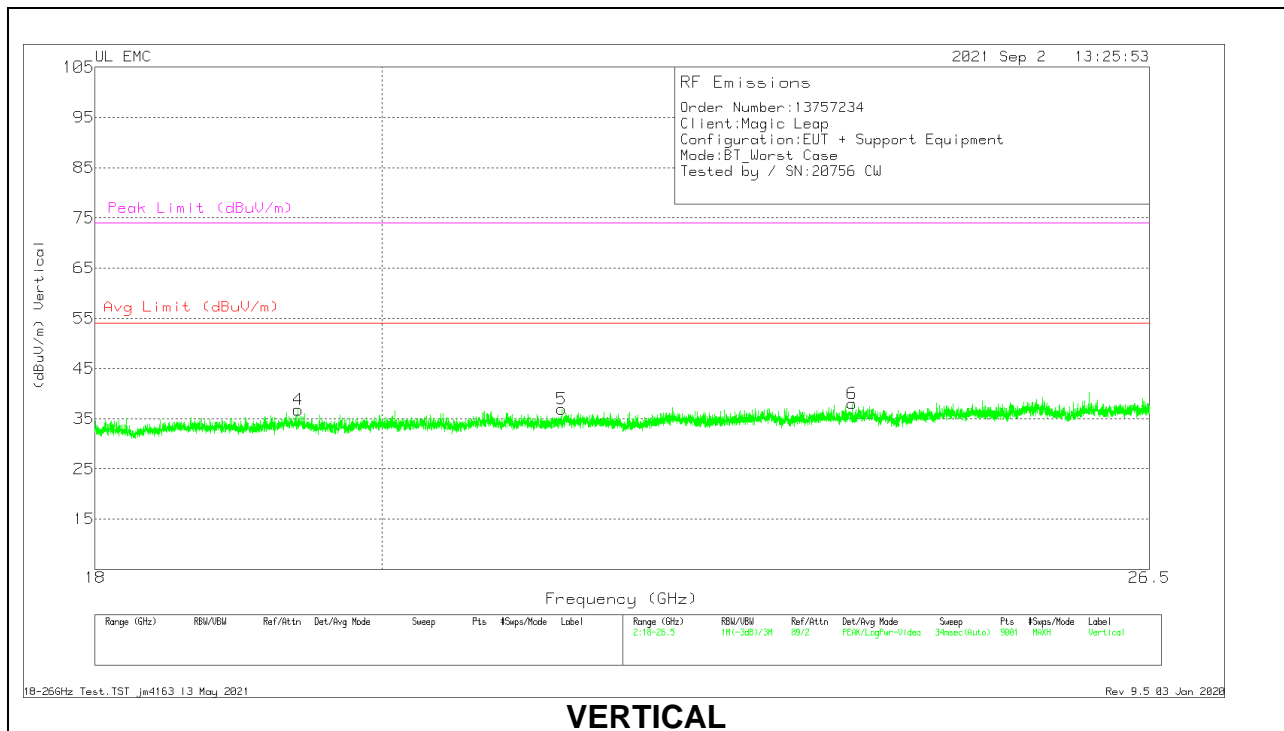
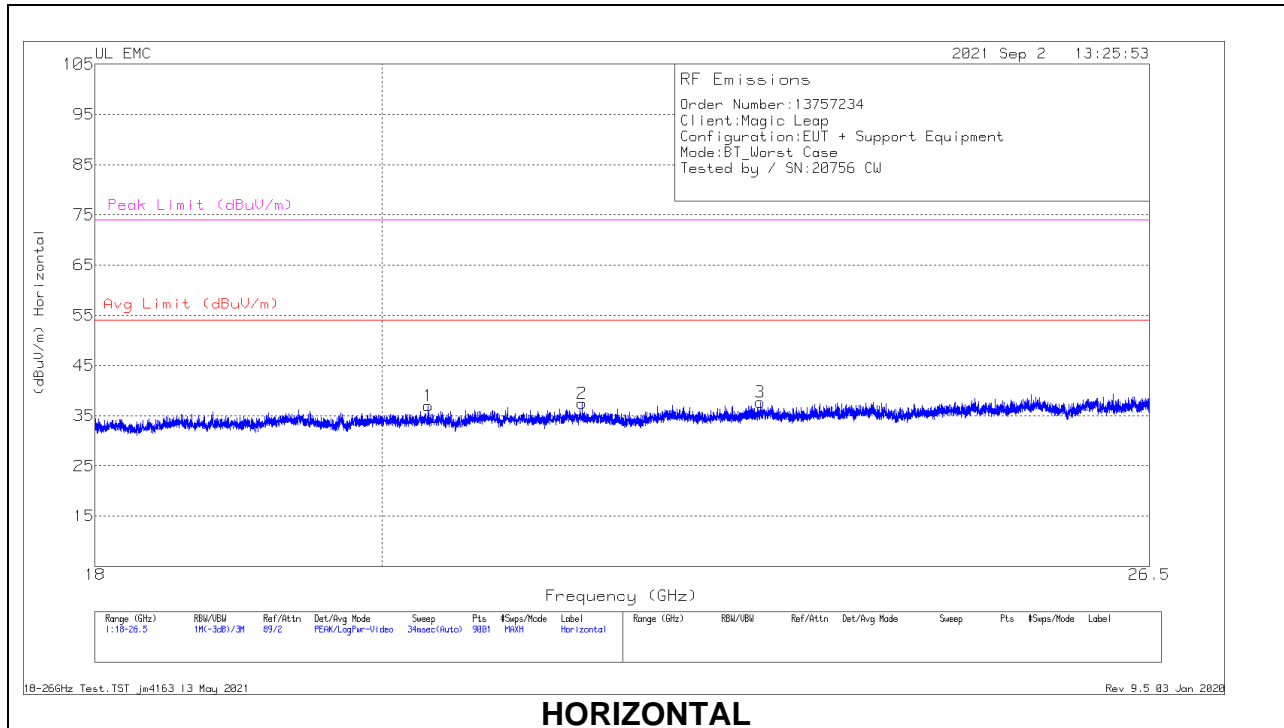
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Qp - Quasi-Peak detector

PK-U - U-NII: Maximum Peak

10.4. WORST CASE 18-26 GHz

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



18 – 26GHz Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T447 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	20.33939	70.06	Pk	33.4	-57	-9.5	36.96	54	-17.04	74	-37.04
2	21.51994	70.37	Pk	33.7	-57.1	-9.5	37.47	54	-16.53	74	-36.53
3	22.97344	70.58	Pk	34.2	-57.6	-9.5	37.68	54	-16.32	74	-36.32
4	19.39117	70.09	Pk	33.1	-56.9	-9.5	36.79	54	-17.21	74	-37.21
5	21.35939	70.2	Pk	33.6	-57.4	-9.5	36.9	54	-17.1	74	-37.1
6	23.76205	70.03	Pk	34.5	-57	-9.5	38.03	54	-15.97	74	-35.97

Pk - Peak detector

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

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

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

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

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

RESULTS

AC Power Line Norm

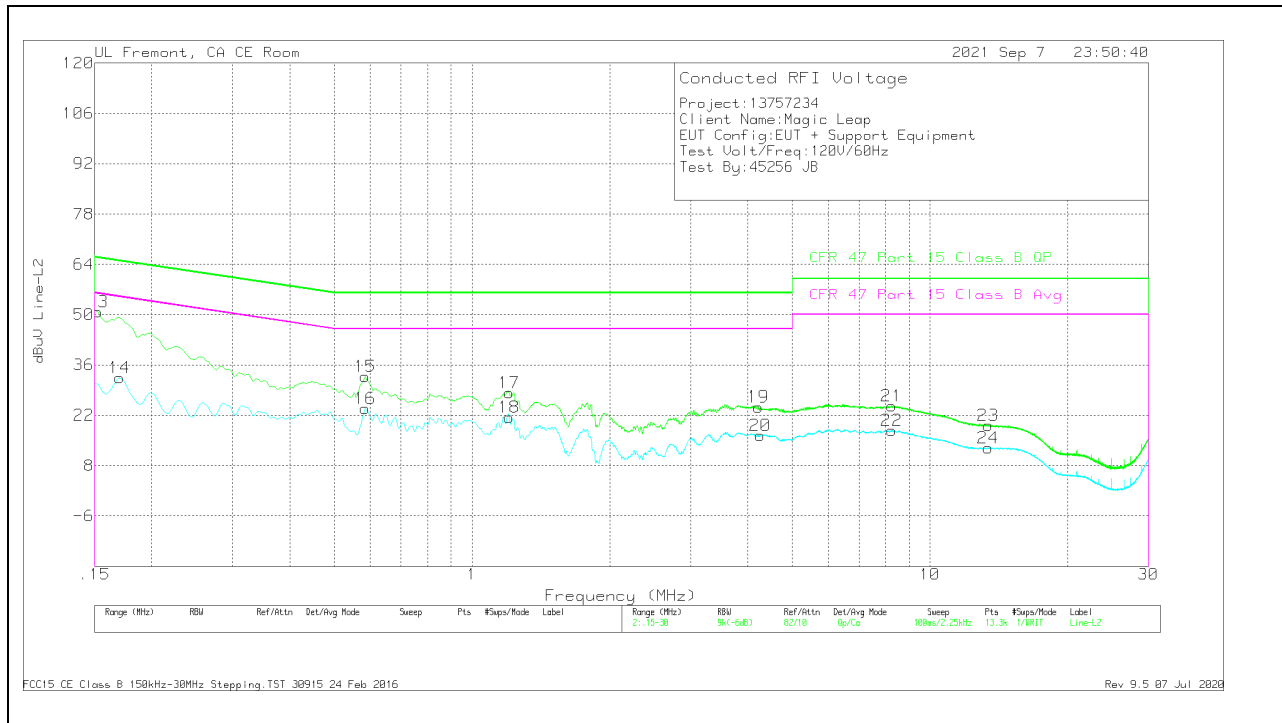
LINE 1 RESULTS



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	.17025	20.59	Ca	0	0	9.4	29.99	-	-	54.95	-24.96	
4	.58425	21.96	Ca	0	0	9.3	31.26	-	-	46	-14.74	
6	1.23	12.6	Ca	0	.1	9.3	22	-	-	46	-24	
8	4.2855	3.56	Ca	0	.1	9.3	12.96	-	-	46	-33.04	
10	8.16	-1.18	Ca	0	.2	9.3	8.32	-	-	50	-41.68	
12	13.56	-3.31	Ca	.1	.2	9.3	6.29	-	-	50	-43.71	
1	.15225	40.75	Qp	.1	0	9.4	50.25	65.88	-15.63	-	-	
3	.582	28.83	Qp	0	0	9.3	38.13	56	-17.87	-	-	
5	1.23225	19.24	Qp	0	.1	9.3	28.64	56	-27.36	-	-	
7	4.281	13.77	Qp	0	.1	9.3	23.17	56	-32.83	-	-	
9	8.13413	5.65	Qp	0	.2	9.3	15.15	60	-44.85	-	-	
11	13.56	5.27	Qp	.1	.2	9.3	14.87	60	-45.13	-	-	

Qp - Quasi-Peak detector
 Ca - CISPR average detection
 Markers 11 and 12 are an external NFC signal unrelated to the EUT.

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)M argin (dB)
14	.17025	22.98	Ca	0	0	9.4	32.38	-	-	54.95	-22.57
16	.58425	14.53	Ca	0	0	9.3	23.83	-	-	46	-22.17
18	1.20525	12.06	Ca	0	.1	9.3	21.46	-	-	46	-24.54
20	4.26075	7	Ca	0	.1	9.3	16.4	-	-	46	-29.6
22	8.26238	8.32	Ca	0	.2	9.3	17.82	-	-	50	-32.18
24	13.407	3.25	Ca	.1	.2	9.3	12.85	-	-	50	-37.15
13	.15225	41.3	Qp	0	0	9.4	50.7	65.88	-15.18	-	-
15	.58425	23.46	Qp	0	0	9.3	32.76	56	-23.24	-	-
17	1.20525	18.9	Qp	0	.1	9.3	28.3	56	-27.7	-	-
19	4.22475	14.94	Qp	0	.1	9.3	24.34	56	-31.66	-	-
21	8.26125	15.18	Qp	0	.2	9.3	24.68	60	-35.32	-	-
23	13.38225	9.65	Qp	.1	.2	9.3	19.25	60	-40.75	-	-

Qp - Quasi-Peak detector
 Ca - CISPR average detection

12. SETUP PHOTOS

Please refer to UL Verification Services Report number 13757234-EP2V1.

END OF TEST REPORT