

TEST REPORT

Report Number. : R14896020-E2

Applicant : Sonos
301 Coromar Dr
Goleta, CA 93117 USA

Model : S45

Brand : Sonos

FCC ID : SBVRM045

IC : 5373A-RM045

EUT Description : Wireless Smart Speaker

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 3
ISED RSS-GEN ISSUE 5 + A1 + A2

Date Of Issue:

2024-05-15

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2024-05-02	Initial Issue	B. Kiewra
V2	2024-05-15	Corrected Plots on page 37	Noah Bennett

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Sonos
301 Coromar Dr
Goleta, CA 93117 USA

EUT DESCRIPTION: Wireless Smart Speaker

MODEL: S45

BRAND: Sonos

SERIAL NUMBER: 00E5828D66C8, 000E58E7E7FB2, 000E58A36F038

SAMPLE RECEIPT DATE: 2024-02-20

DATE TESTED: 2024-02-20 to 2024-05-15

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	
ISED RSS-247 Issue 3	Refer to Section 2
ISED RSS-GEN Issue 5 + A1 + A2	

UL LLC 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 LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released
For UL LLC By:

Prepared By:



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Consumer, Medical and IT Segment
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2. TEST RESULTS SUMMARY

This report contains info provided by the customer which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.

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

- 1) Antenna gain and type (see section 6.3)
- 2) Worst-case data rates (see section 6.5)

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	Compliant	None
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Number of Hopping Channels		
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Average Time of Occupancy		
15.247 (b)(1)	RSS-247 (5.4) (b)	Output Power		
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	Compliant	None
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions		
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions		

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC 47 CFR Part 2, FCC 47 CFR Part 15, ANSI C63.10-2020, 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 3.

4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, certification # 0751.06, 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: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	825374
☒	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A		27265	

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	UNCERTAINTY
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	1.22%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	1.94 dB
All emissions, radiated	6.01 dB
Conducted Emissions (0.150-30MHz) - LISN	3.40 dB
Temperature	0.57°C
Humidity	3.39%
DC Supply voltages	1.70%
Time	3.39%

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

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
 $36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
 $36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Wireless Smart Speaker that contains Radio0 and Radio1. Radio0 transmits BT, BLE, 2.4GHz WLAN, 5GHz WLAN, 6GHz WLAN. Radio1 transmits 5GHz and 6GHz WLAN. This report covers testing on Radio0 BT.

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	14.48	28.05
2402 - 2480	Enhanced DQPSK	14.36	27.29
2402 - 2480	Enhanced 8PSK	14.44	27.80

Note: GFSK, DQPSK, 8PSK average Power are all investigated, The GFSK & 8PSK Power are the worst case. Testing is based on these modes to showing compliance. For average power data please refer to section 9.7.

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:
The radio utilizes a Tri-band Dipole antenna, with a maximum gain of 3.1 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 78.1-45200-diag-lasso-rel-202312282317.

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 intended to operate in one orientation. Therefore all testing was performed with the EUT in this intended orientation of operation.

Worst-case packet sized as provided by the client were:

GFSK mode: DH5

8PSK mode: 3-DH5

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	T450s	NA	NA
Laptop	Lenovo	T470s	NA	NA
Ethernet Switch	Netgear	GS305v3	5U81385JA2EE6	NA
Switch PSU	Netgear	AD2015F20	332-10727-02	NA

I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Mains	1	Hardwired	Non-Shielded	>3m	Connects to AC Mains
2	Ethernet	1	Ethernet	Non-Shielded	>3m	Connects to ENET switch

TEST SETUP

The EUT is connected to a test laptop during the tests.

SETUP DIAGRAMS

Please refer to R14896020-EP1 for setup diagrams

7. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 4)

Equipment ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
0.009-30MHz					
135144	Active Loop Antenna	ETS-Lindgren	6502	2024-01-24	2025-01-24
30-1000 MHz					
90628	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2024-01-02	2026-01-02
1-18 GHz					
89509	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2023-05-23	2025-05-23
Gain-Loss Chains					
207638	Gain-loss string: 0.009-30MHz	Various	Various	2023-09-18	2024-09-18
207639	Gain-loss string: 25-1000MHz	Various	Various	2023-09-18	2024-09-18
207640	Gain-loss string: 1-18GHz	Various	Various	2023-05-17	2024-05-17
Receiver & Software					
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2023-04-10	2024-04-10
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
Additional Equipment used					
241204	Environmental Meter	Fisher Scientific	15-077-963	2023-09-05	2025-09-05

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 1)

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Wormsville Chamber 1)					
Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
18-40 GHz					
204704	Horn Antenna, 18-26.5GHz	Com-Power	AH-826	2023-07-20	2025-07-20
Gain-Loss Chains					
135999	Gain-loss string: 18-40GHz	Various	Various	2023-05-16	2024-05-16
Receiver & Software					
81018	Spectrum Analyzer	Agilent	E4446A	2023-08-01	2024-08-01
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
Additional Equipment used					
241205	Environmental Meter	Fisher Scientific	15-077-963	2023-09-05	2025-09-05

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
90410	Spectrum Analyzer	Keysight Technologies	N9030A	2023-06-14	2024-06-14
90416	Spectrum Analyzer	Keysight Technologies	N9030A	2023-06-09	2024-06-30
238710	Environmental Meter	Fisher Scientific	15-077-963	2023-06-27	2024-06-27
SOFTEMI	Antenna Port Software	UL	Version 2021.5.28	NA	NA
SOFTEMI	Antenna Port Software	UL	Version 2022.8.16	NA	NA
SOFTEMI	Antenna Port Software	UL	Version 2023.2.16	NA	NA
SOFTEMI	Antenna Port Software	UL	Version 2024.2.23	NA	NA
Power Software	Boonton Power Analyzer	Boonton	Version 3.0.13.0	NA	NA
245262	Conducted Switch Box	UL	CSB	2024-02-20	2025-02-20
211056	Real-Time Peak Power Sensor 50MHz to 8GHz	Boonton	RTP5000	2023-08-01	2024-08-01
211055	Real-Time Peak Power Sensor 50MHz to 8GHz	Boonton	RTP5000	2023-08-01	2024-08-01
211057	Real-Time Peak Power Sensor 50MHz to 8GHz	Boonton	RTP5000	2023-08-01	2024-08-01
211058	Real-Time Peak Power Sensor 50MHz to 8GHz	Boonton	RTP5000	2023-08-01	2024-08-01

Test Equipment Used - Wireless Conducted Attenuators, Cables, and Couplers

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
Attenuators					
226561	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2023-02-29	2024-02-29
226563	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2023-02-29	2024-02-29
226561	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2024-02-29	2025-02-29
226563	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2024-02-29	2025-02-29
Cables					
CBL030	SMA Male to SMA Male Cable Using PE-P141 Coax - 12"	Pasternack	Sucoflex 104PEA	2023-06-27	2024-06-27
CBL031	SMA Male to SMA Male Cable Using PE-P141 Coax - 12"	Pasternack	Sucoflex 104PEA	2023-06-27	2024-06-27

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2023-04-04	2024-04-04
179892	Environmental Meter	Fisher Scientific	15-077-963	2023-07-26	2024-06-31
80391	LISN, 50-ohm/50-uH, 250uH 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50/250-25-2-01	2023-07-31	2024-07-31
75141	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2023-08-01	2024-08-01
52859	Transient Limiter, 0.009-100MHz	Electro-Metrics	EM-7600	2023-04-04	2024-04-04
PS214	AC Power Source	Elgar	CW2501M	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
91432	LISN, 50-ohm/50-uH, 2-conductor, 25A (For support gear only.)	Solar Electronics	8012-50-R-24-BNC	NA	NA

8. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2020 Section 11.6

Occupied BW (20dB): ANSI C63.10-2020 Section 6.9.2

Occupied BW (99%): ANSI C63.10-2020 Section 6.9.3

Carrier Frequency Separation: ANSI C63.10-2020 Section 7.8.2

Number of Hopping Frequencies: ANSI C63.10-2020 Section 7.8.3

Time of Occupancy (Dwell Time): ANSI C63.10-2020 Section 7.8.4

Output Power: ANSI C63.10-2020 Section 7.8.5

Conducted Spurious Emissions: ANSI C63.10-2020 Section 7.8.7

Conducted Band-Edge: ANSI C63.10-2020 Section 7.8.7.2

Radiated Band-edge: ANSI C63.10-2020 Section 6.10.5

Radiated Spurious Emissions: ANSI C63.10-2020 Sections 6.3 to 6.6

AC Power Line Conducted Emissions: ANSI C63.10-2020, Section 6.2.

9. ANTENNA PORT TEST RESULTS

9.1. 20 dB AND 99% BANDWIDTH

LIMITS

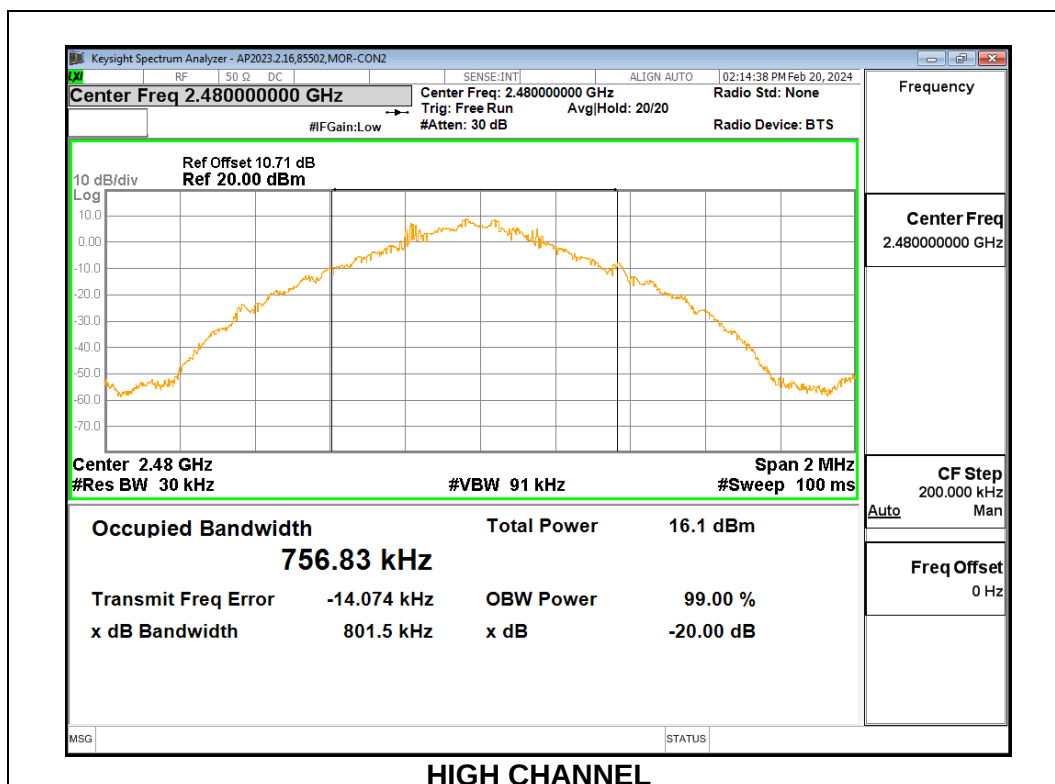
None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

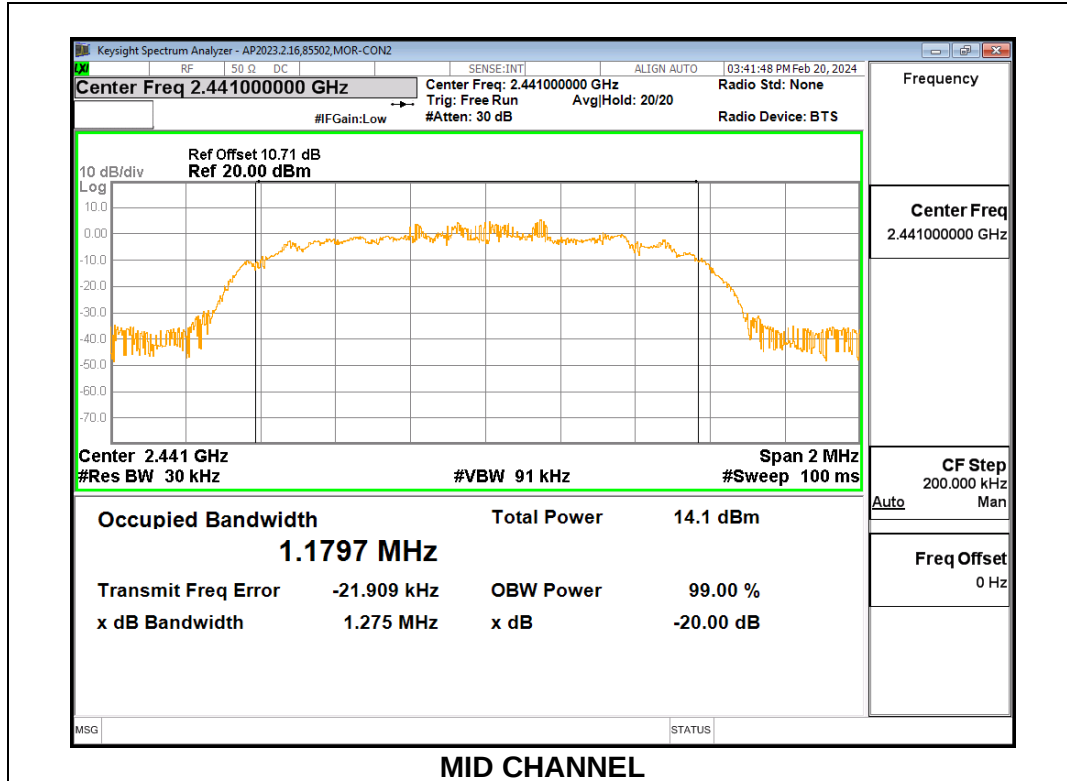
9.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	798.1	754.64
Mid	2441	796.4	758.98
High	2480	801.5	756.83



9.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.274	1.1758
Mid	2441	1.275	1.1797
High	2480	1.267	1.1751



9.2. ON TIME AND DUTY CYCLE

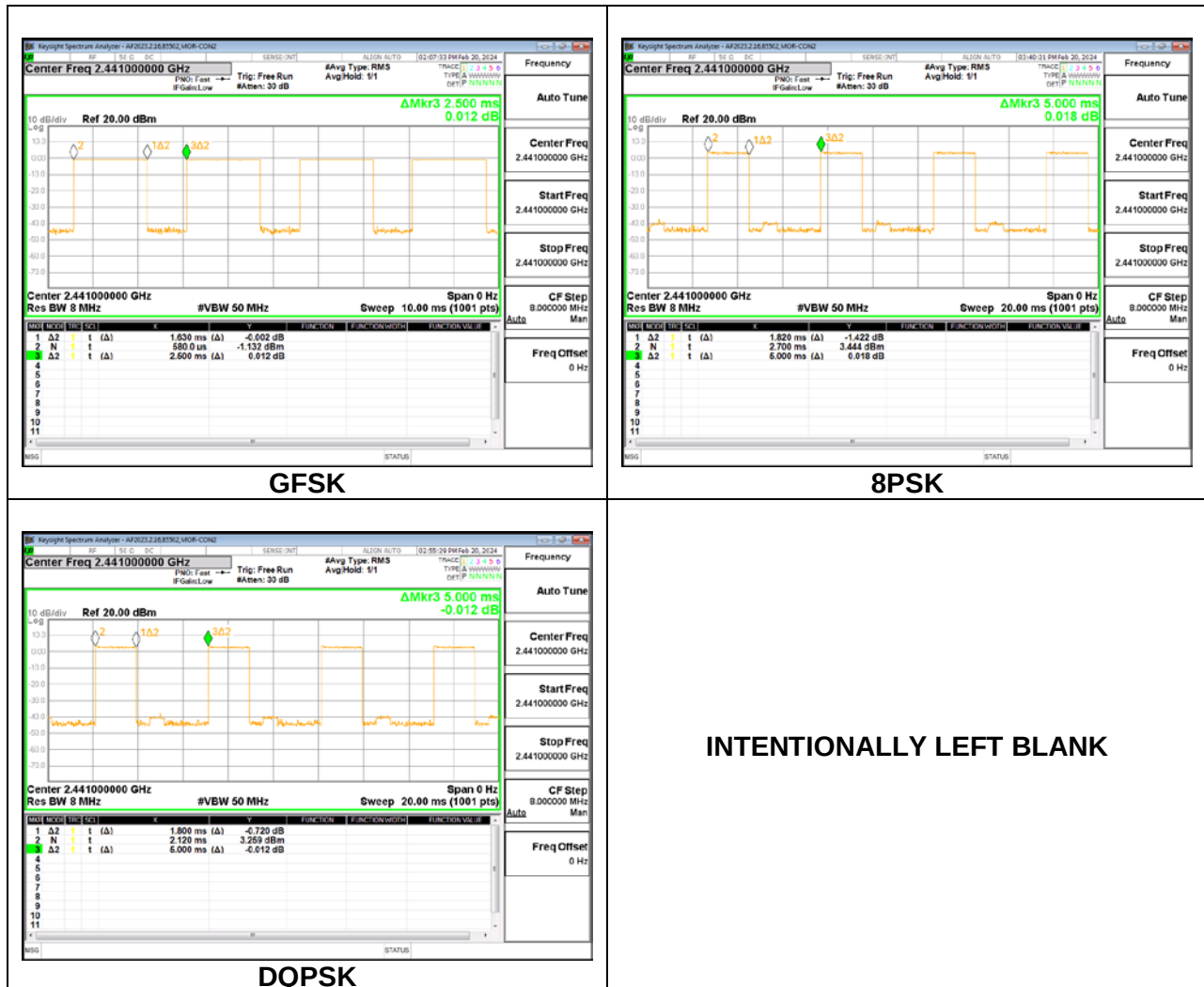
LIMITS

None; for reporting purposes only.

PROCEDURE

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

Mode	ON Time B (ms)	Period (ms)	Duty Cycle x (lineari)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
GFSK	1.630	2.500	0.652	65.20	1.86	0.613
8PSK	1.820	5.000	0.364	36.40	4.39	0.549
DQPSK	1.800	5.000	0.360	36.00	4.44	0.556



9.3. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)
RSS-247 (5.1) (b)

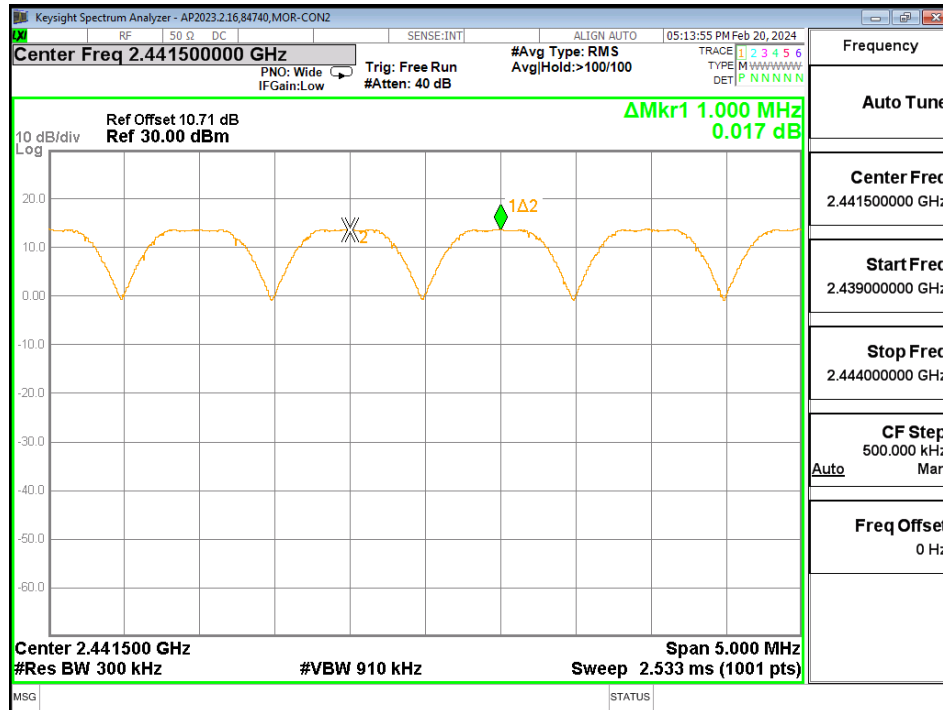
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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

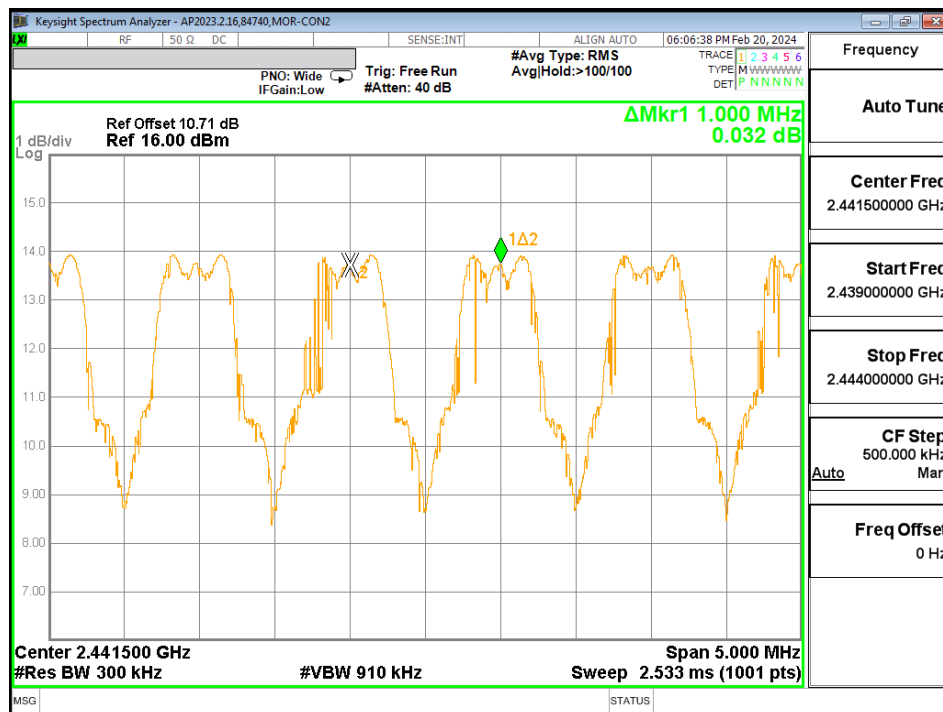
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to $VBW \geq RBW$. The sweep time is coupled.

9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

9.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)
RSS-247 (5.1) (d)

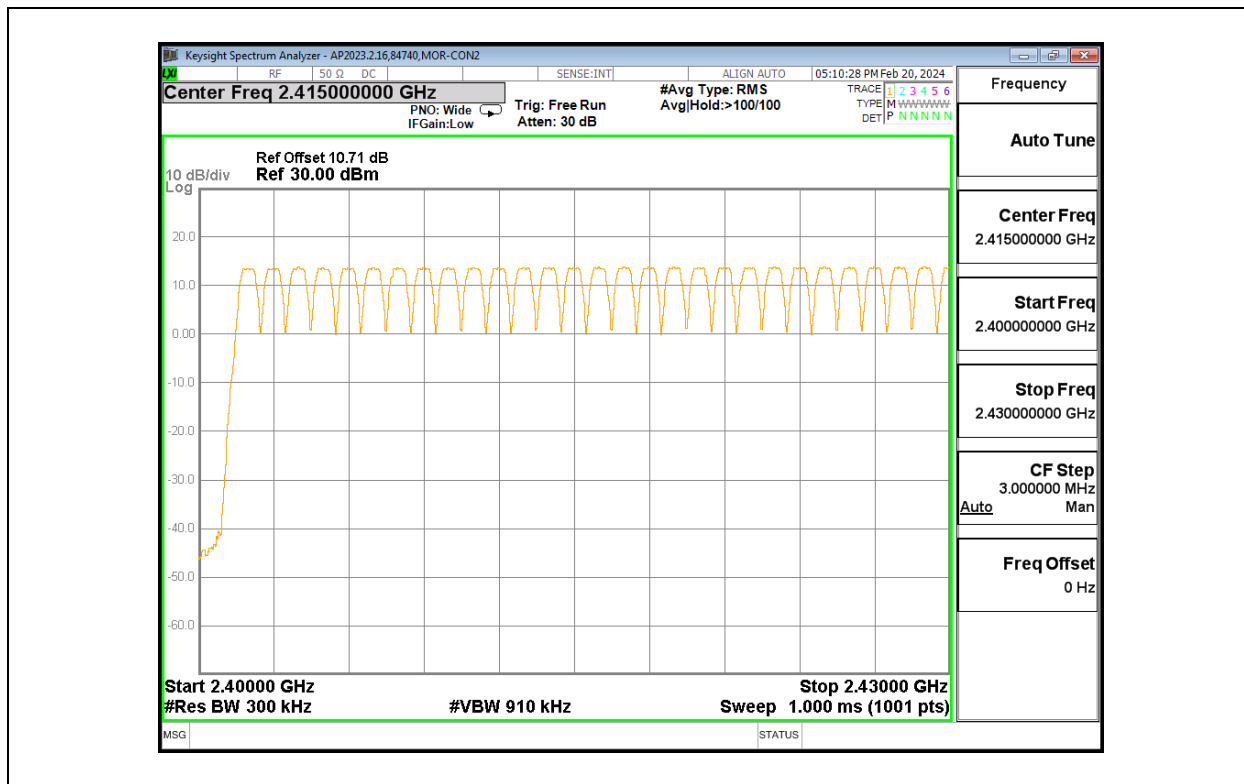
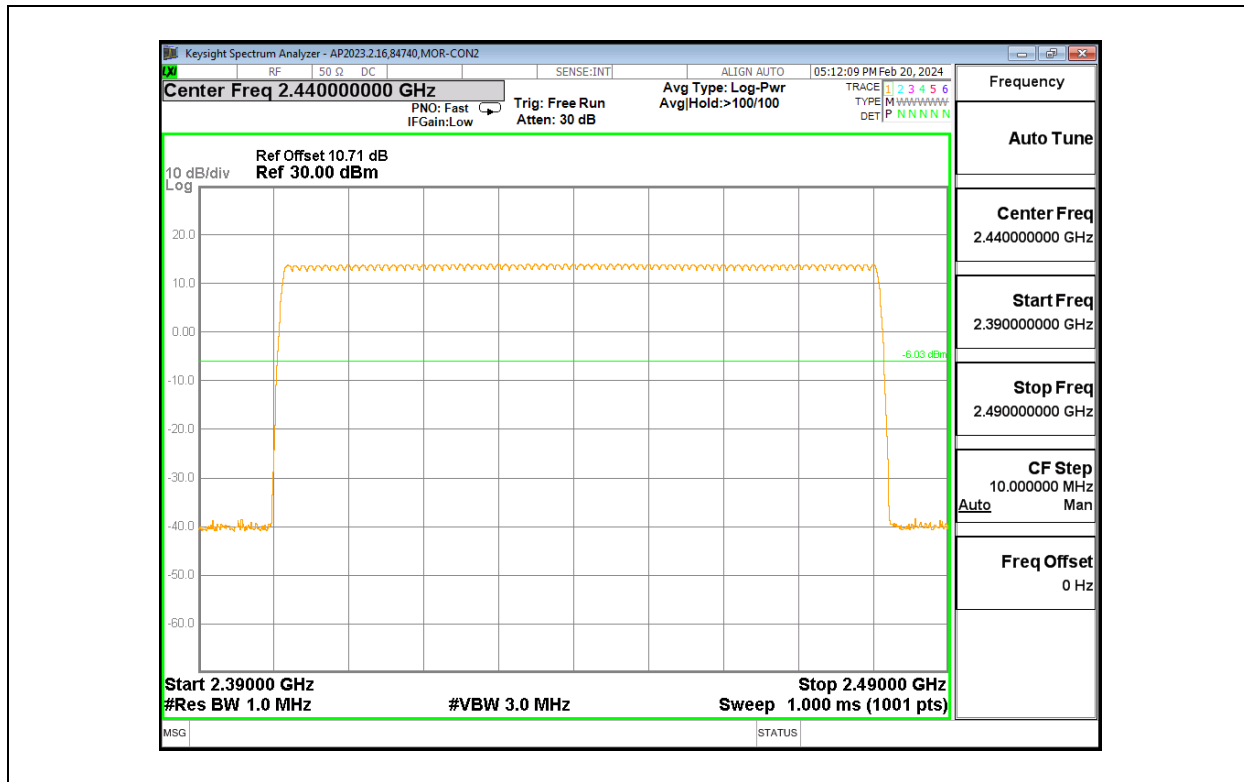
Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

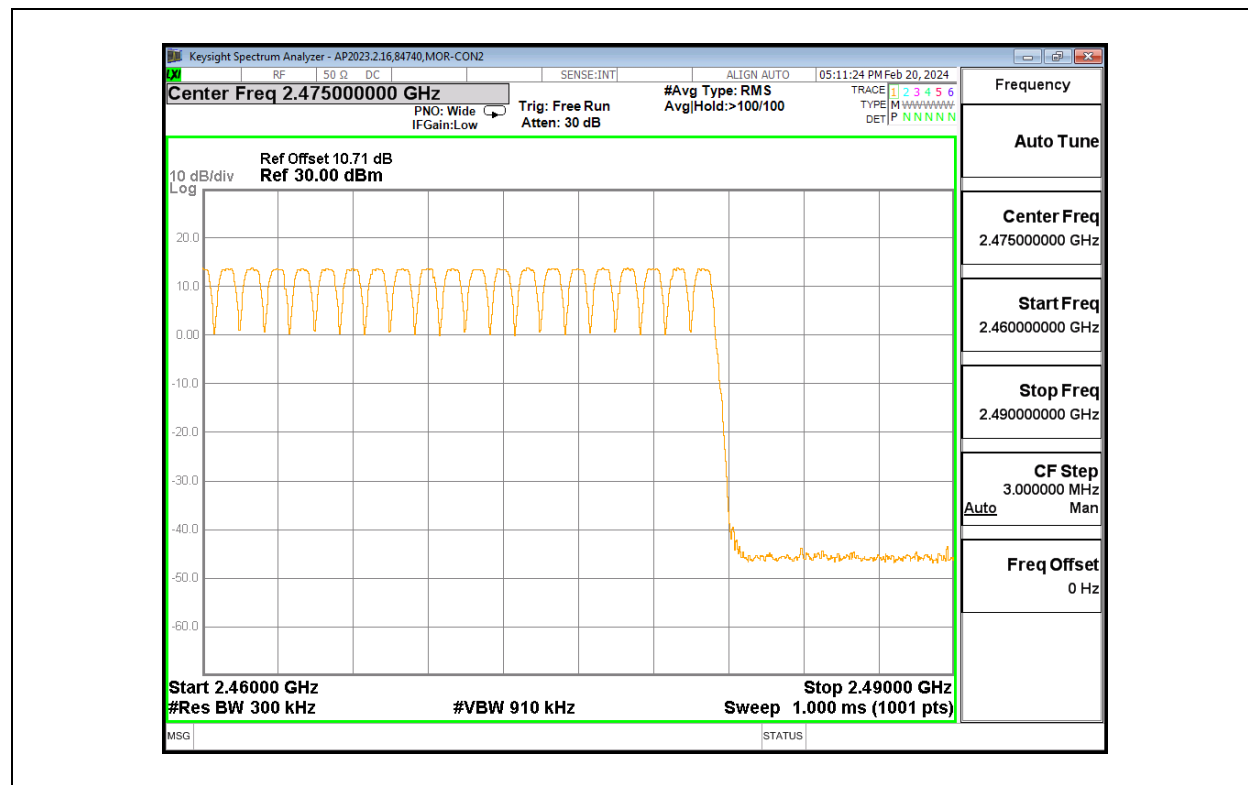
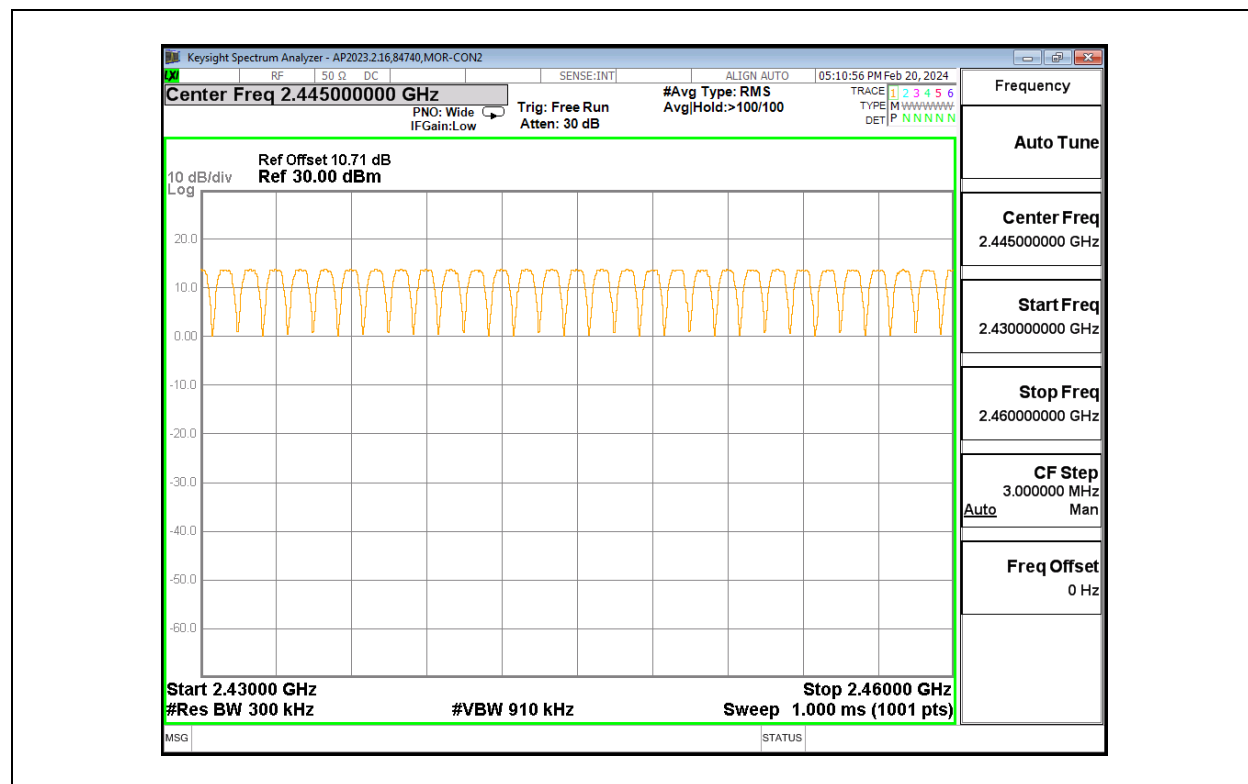
TEST PROCEDURE

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.

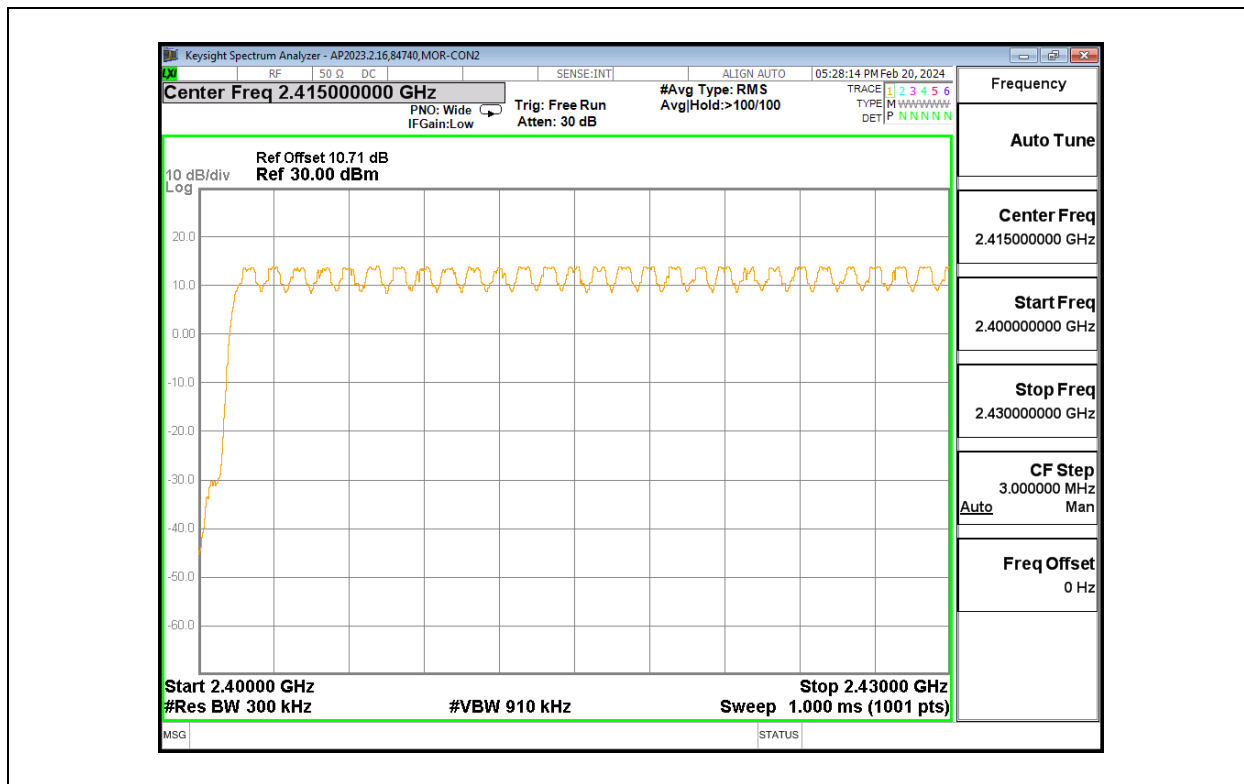
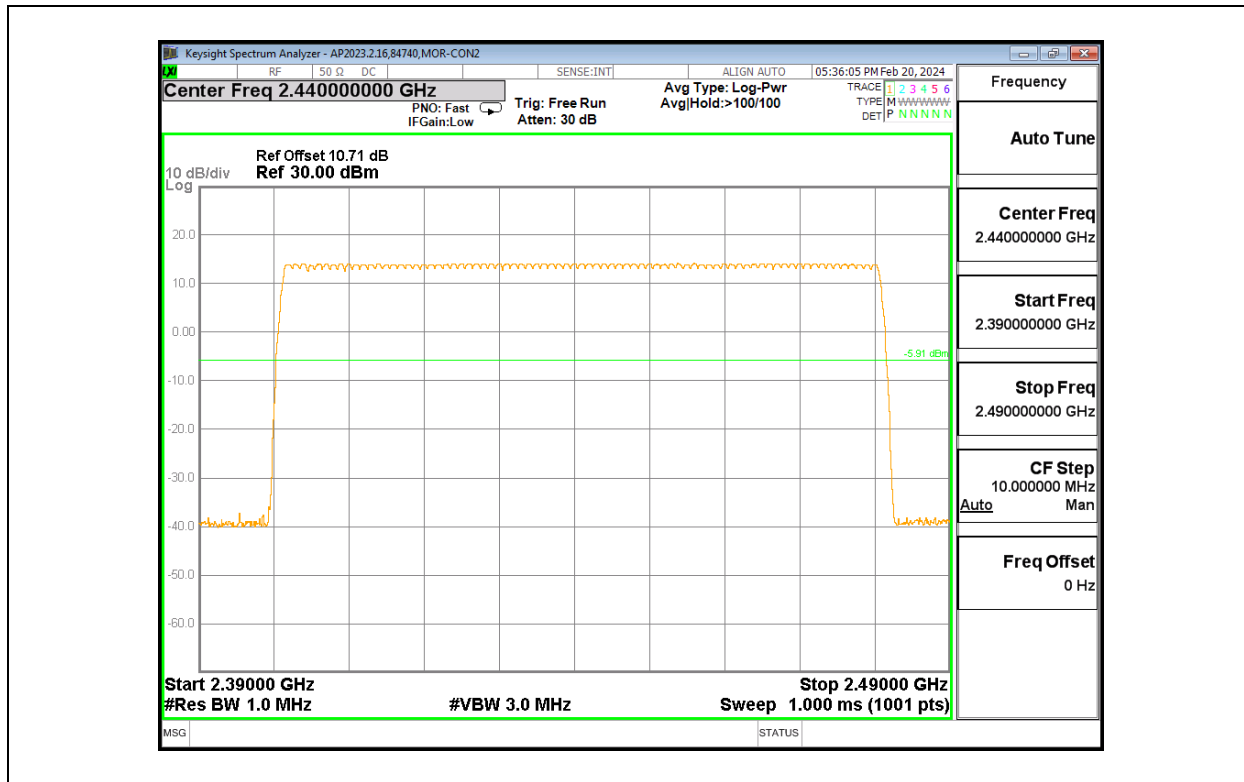
Normal Mode: 79 Channels Observed

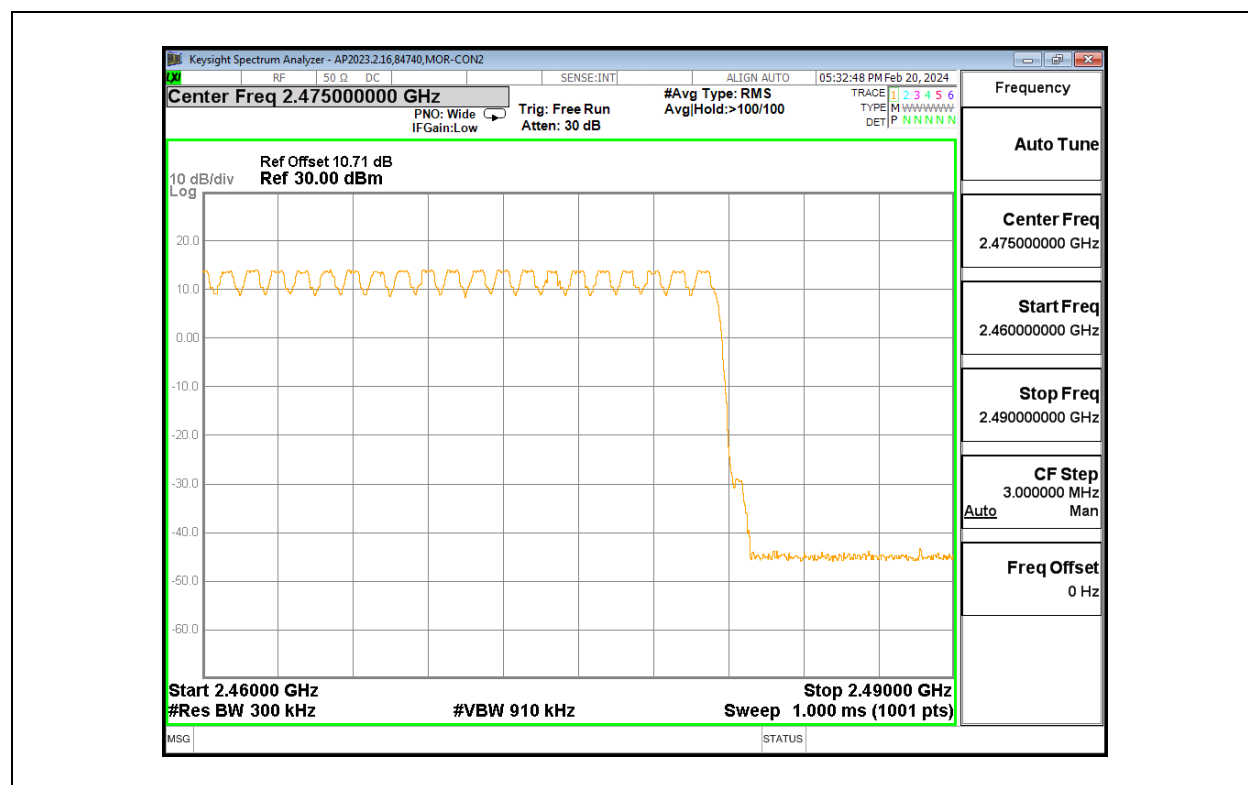
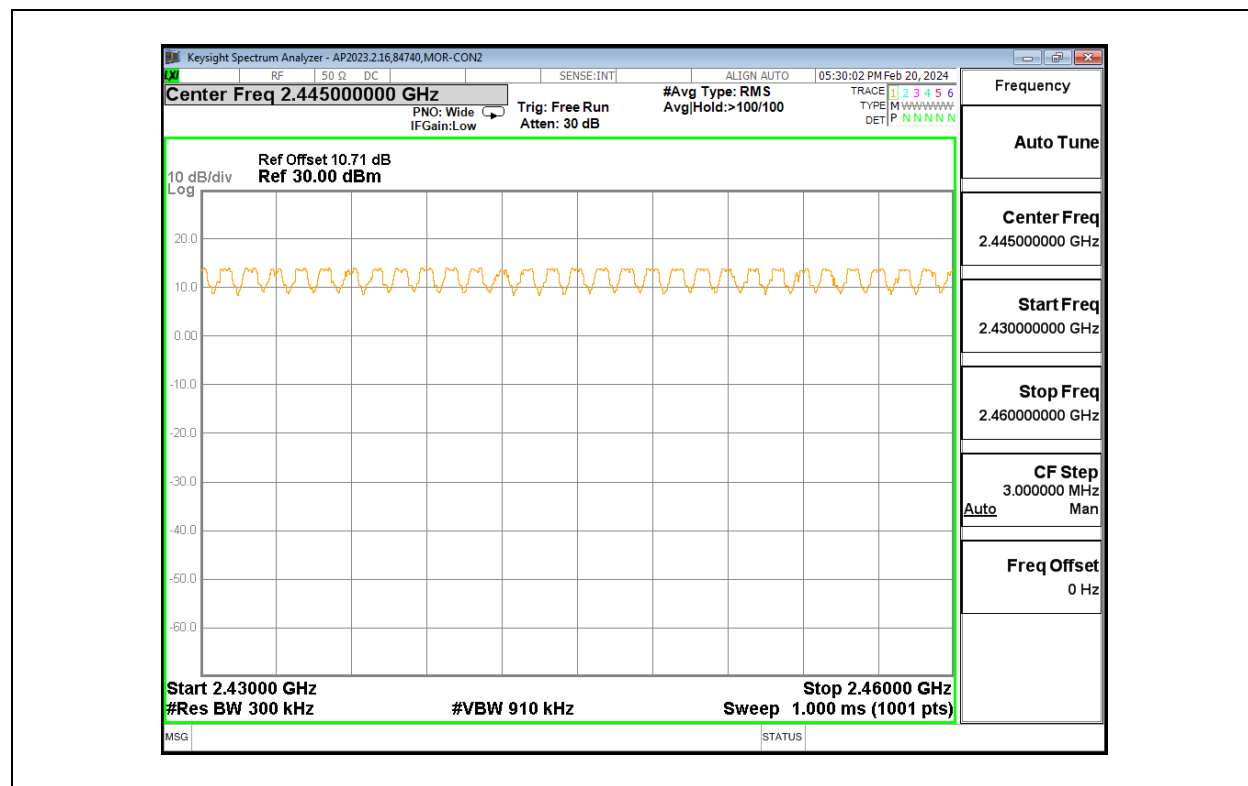
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION





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

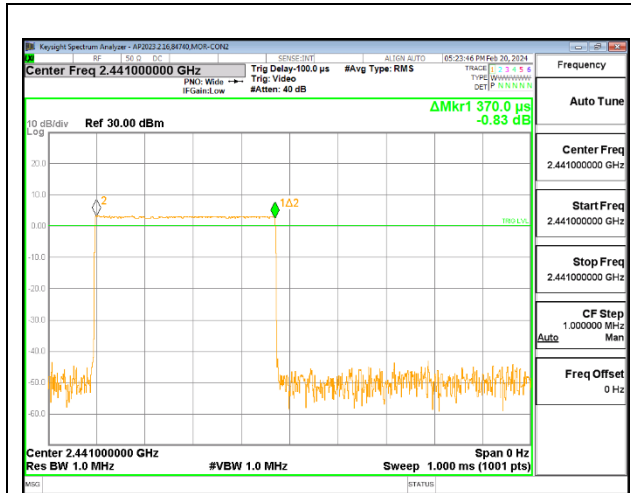
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

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

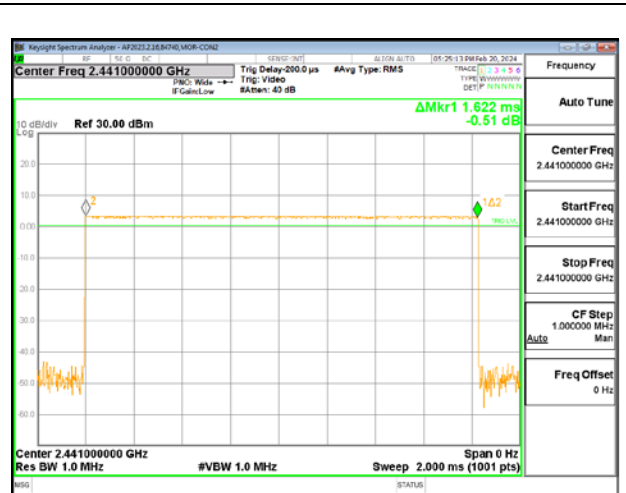
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

9.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

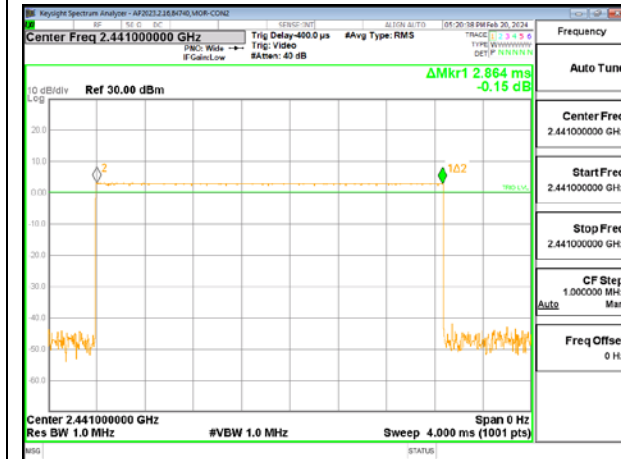
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.37	15	0.0555	0.4	-0.3445
DH3	1.622	17	0.2757	0.4	-0.1243
DH5	2.864	9	0.2578	0.4	-0.1422
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.37	3.75	0.01388	0.4	-0.3861
DH3	1.622	4.25	0.06894	0.4	-0.3311
DH5	2.864	2.25	0.06444	0.4	-0.3356



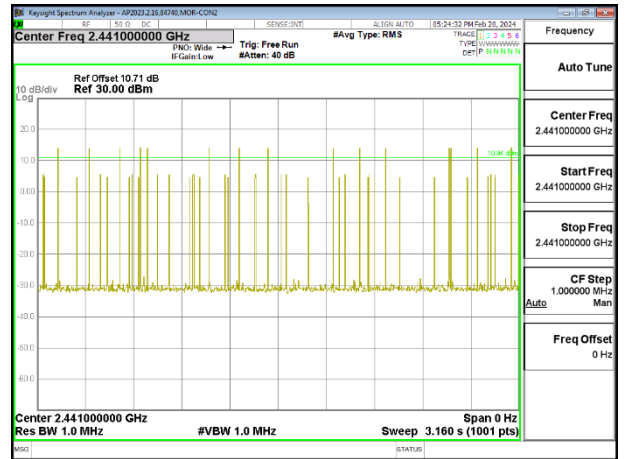
PULSE WIDTH - DH1



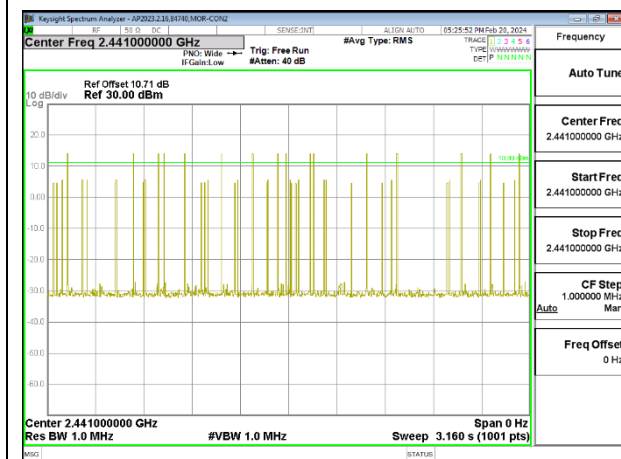
PULSE WIDTH - DH3



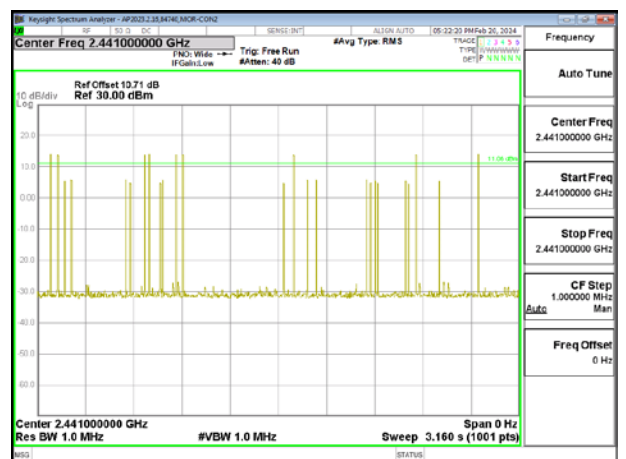
PULSE WIDTH - DH5



NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD - DH1



NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD - DH3

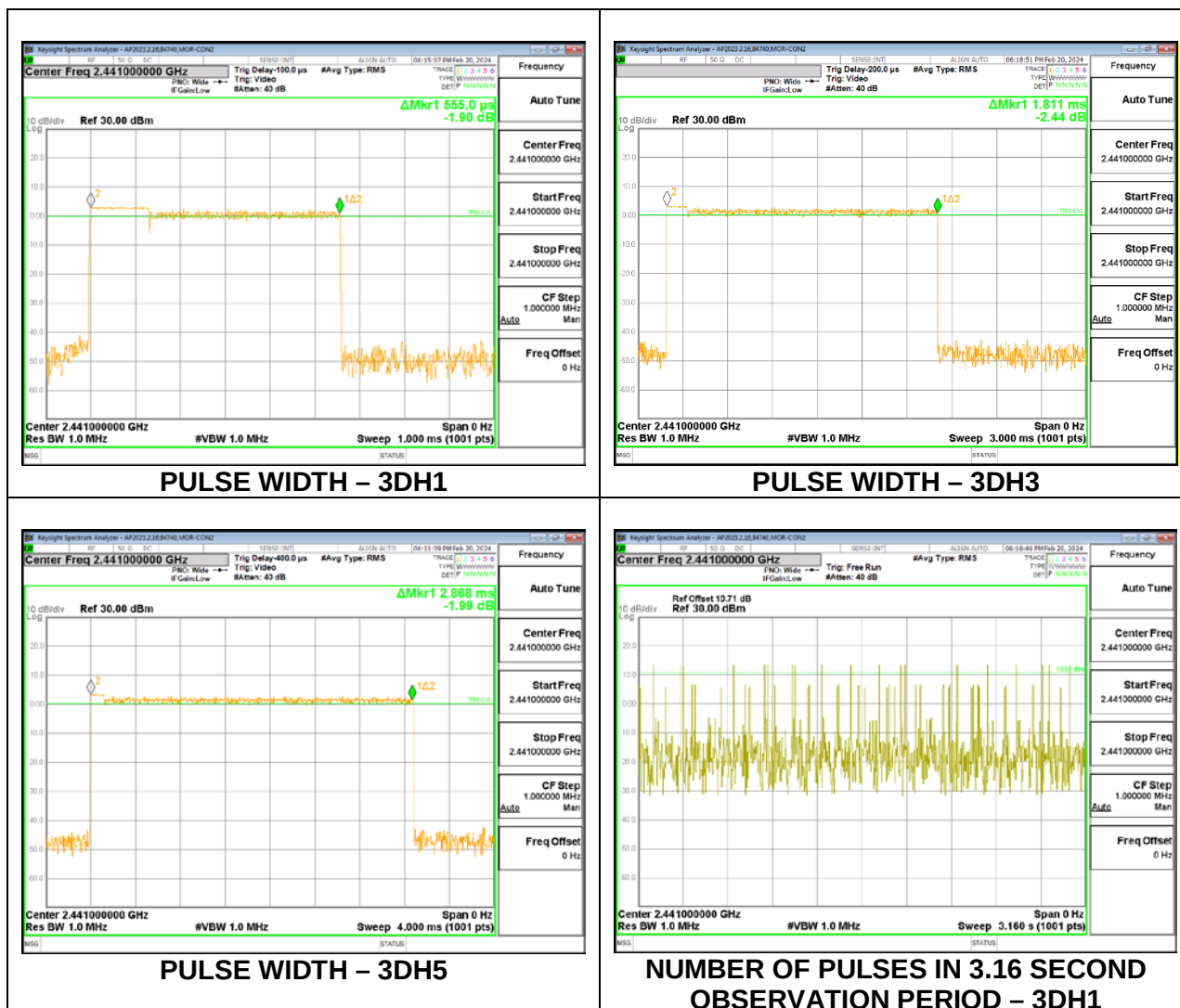


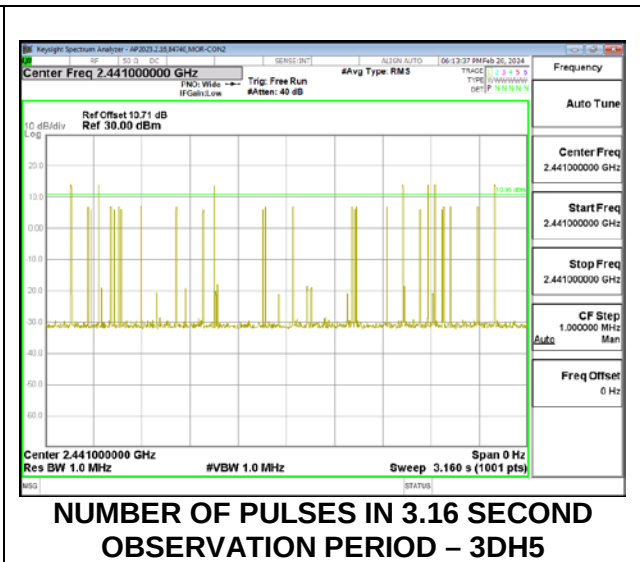
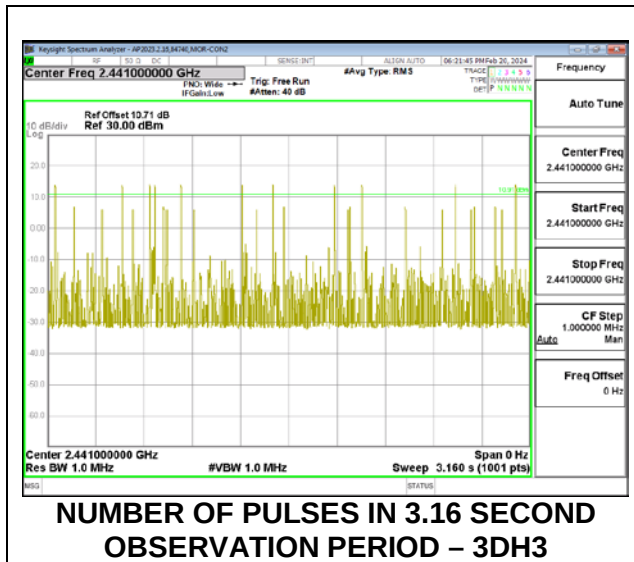
NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD - DH5

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	0.555	19	0.10545	0.4	-0.2946
3DH3	1.811	11	0.19921	0.4	-0.2008
3DH5	2.868	7	0.20076	0.4	-0.1992

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.





9.6. 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

Measurements perform using a wideband gated RF power meter.

The cable assembly insertion loss of 10.41 dB (including 9.71 dB pad and 0.70 dB cable) was entered as an offset in the power meter.

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

9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	85502
Date:	2024-02-20

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	14.26	30	-15.74
Middle	2441	14.33	30	-15.67
High	2480	14.48	30	-15.52

9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	85502
Date:	2024-02-20

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	14.31	30	-15.69
Middle	2441	14.36	30	-15.64
High	2480	14.35	30	-15.65

9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	85502
Date:	2024-02-20

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	14.18	21	-6.82
Middle	2441	14.44	21	-6.56
High	2480	14.41	21	-6.59

9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

The cable assembly insertion loss of 10.41 dB (including 9.71 dB pad and 0.70 dB cable) was entered as an offset in the power meter.

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

9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	85502
Date	2024-02-20

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	13.78
Middle	2441	13.81
High	2480	13.98

9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	85502
Date	2024-02-20

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.43
Middle	2441	11.46
High	2480	11.45

9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	85502
Date	2024-02-20

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.19
Middle	2441	11.46
High	2480	11.46

9.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)
RSS-247 5.5

Limit = -20 dBc

TEST PROCEDURE

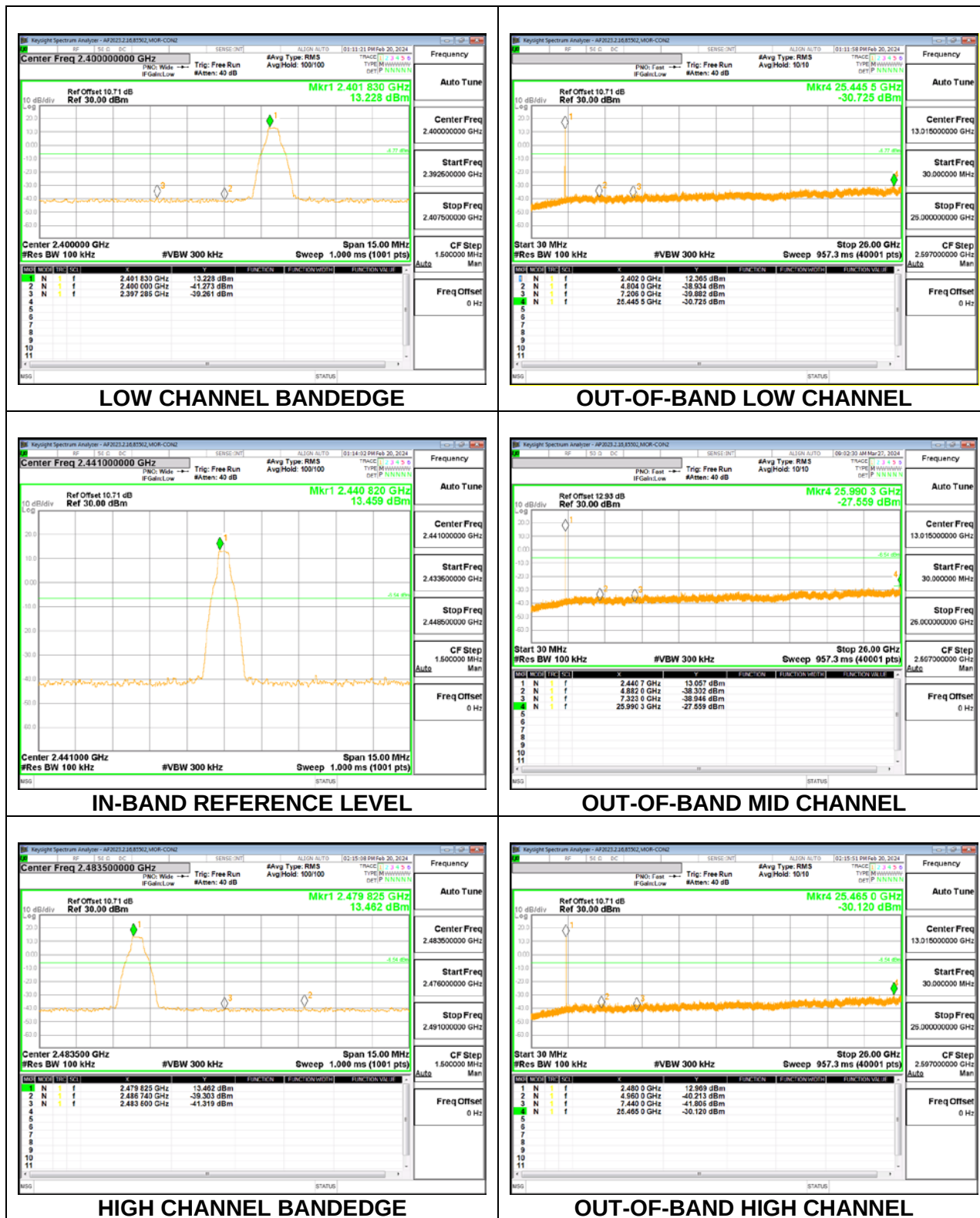
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

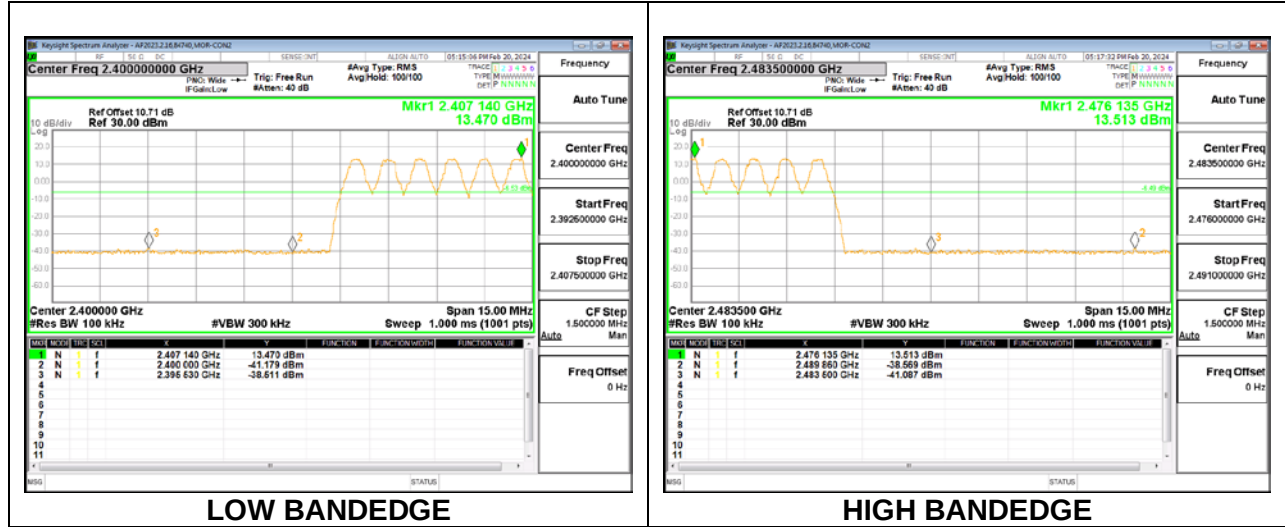
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping and hopping modes.

9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

SPURIOUS EMISSIONS, NON-HOPPING

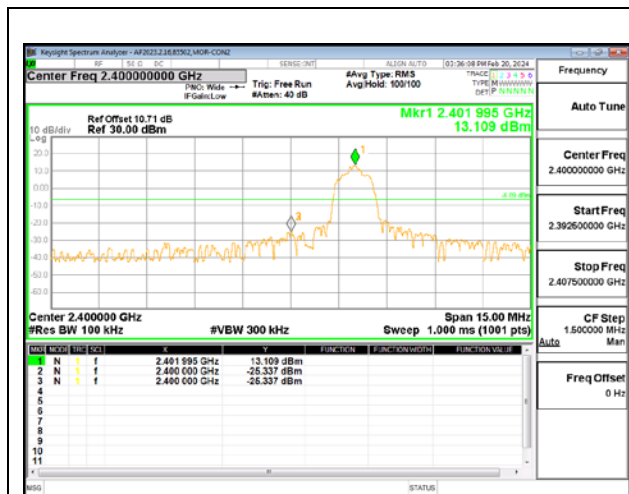


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

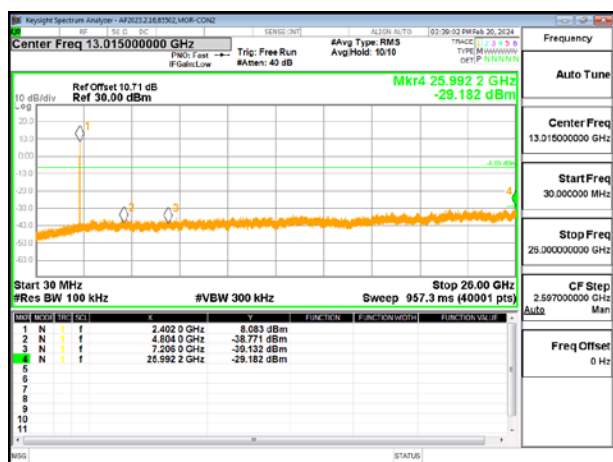


9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

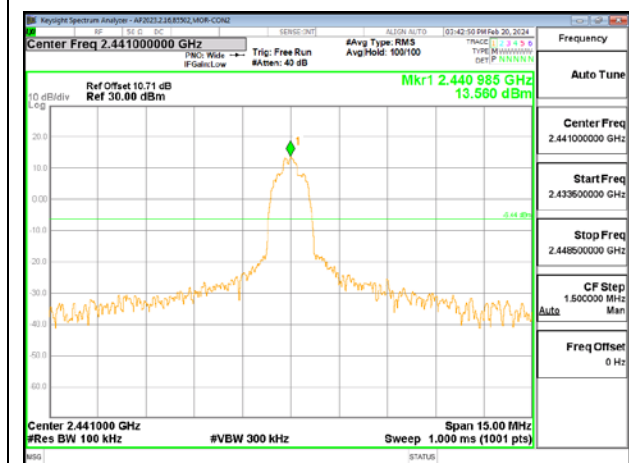
SPURIOUS EMISSIONS, NON-HOPPING



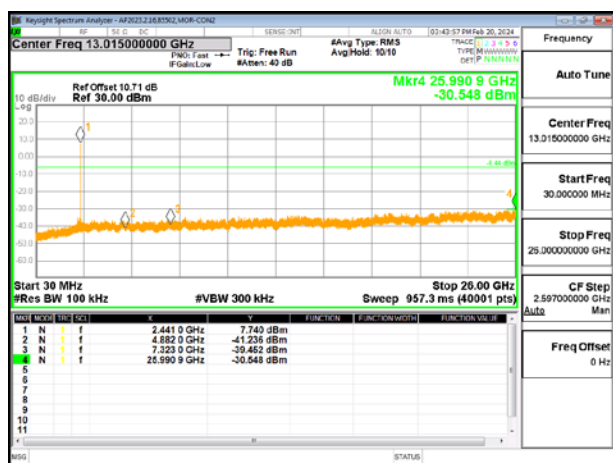
LOW CHANNEL BANDEDGE



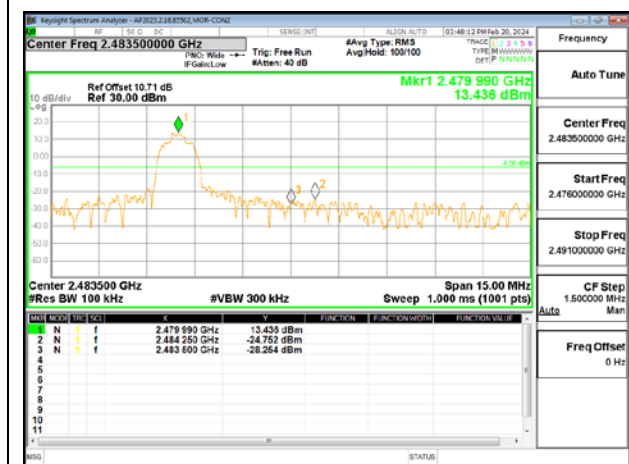
OUT-OF-BAND LOW CHANNEL



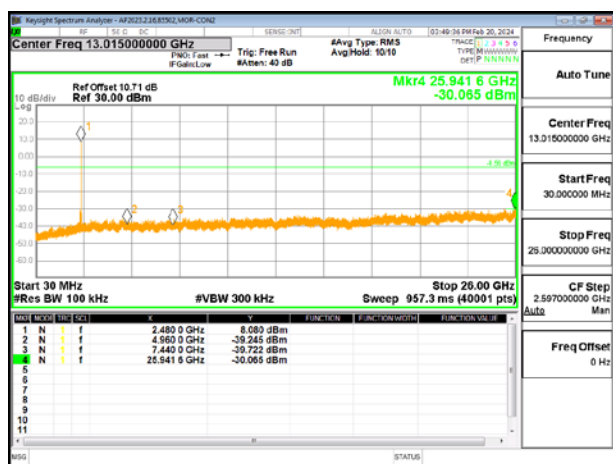
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

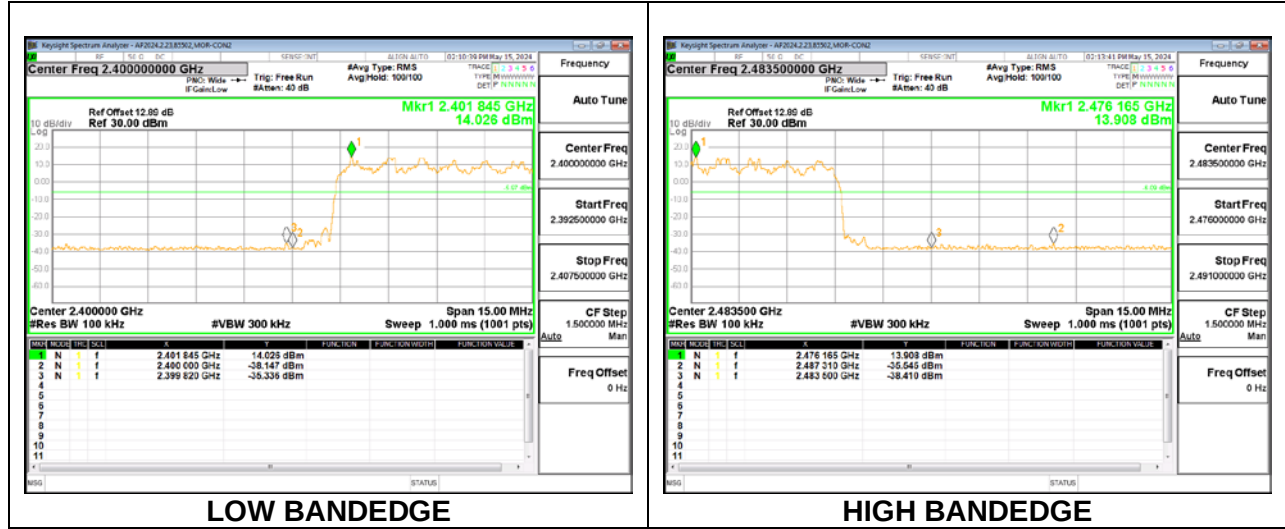


HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



10. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

IC RSS-GEN Clause 8.9 and 8.10

Frequency Range (kHz)	Field Strength Limit (uA/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	6.37/F(kHz) @ 300 m	-
0.490-1.705	63.7/F(kHz) @ 30 m	-
1.705 - 30	0.08 @ 30m	-
Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. Peak detection is used unless otherwise noted as quasi-peak or average (9-90kHz and 110-490kHz).

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3MHz 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.

3D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

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

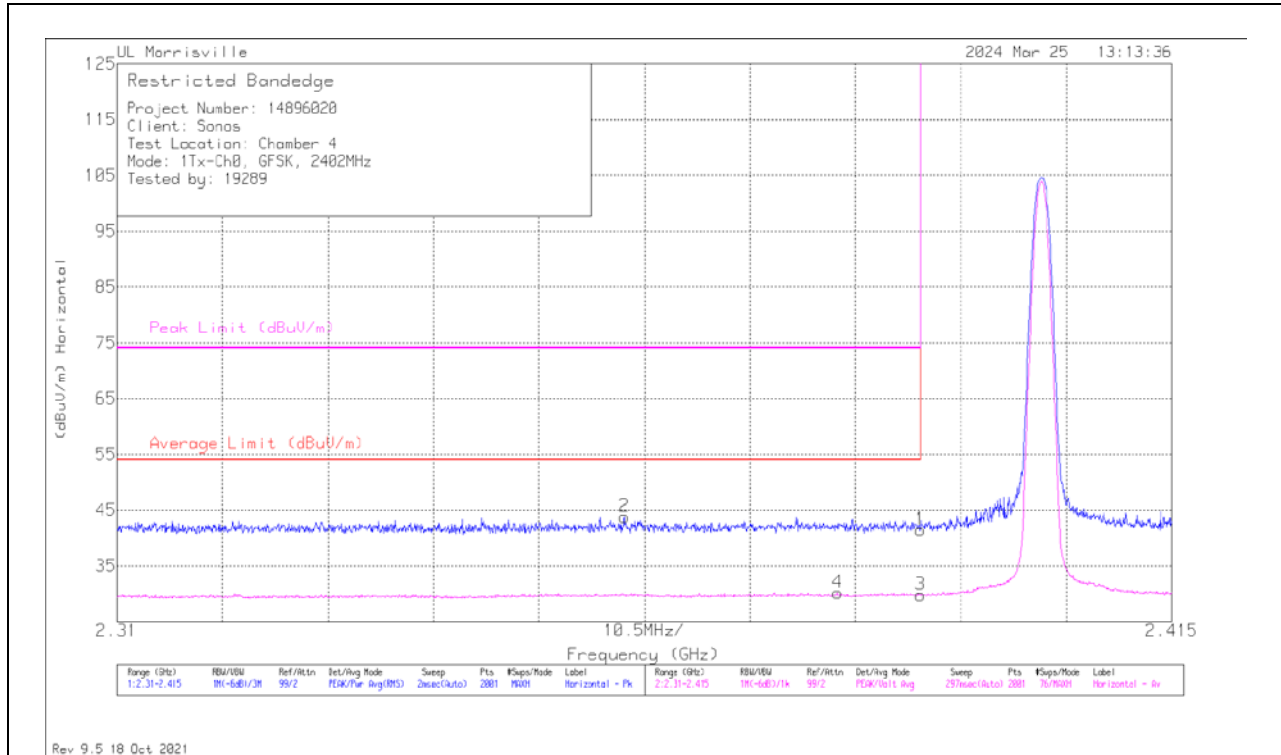
OFS and chamber correlation testing had been performed and chamber measured test result is the worst-case test result.

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	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.38996	22.66	Pk	32	-13.2	41.46	-	-	74	-32.54	106	100	H
2	* ** 2.36051	24.88	Pk	31.9	-13	43.78	-	-	74	-30.22	106	100	H
3	* ** 2.38996	11	V1TV	32	-13.2	29.8	54	-24.2	-	-	106	100	H
4	* ** 2.38177	11.5	V1TV	32	-13.3	30.2	54	-23.8	-	-	106	100	H

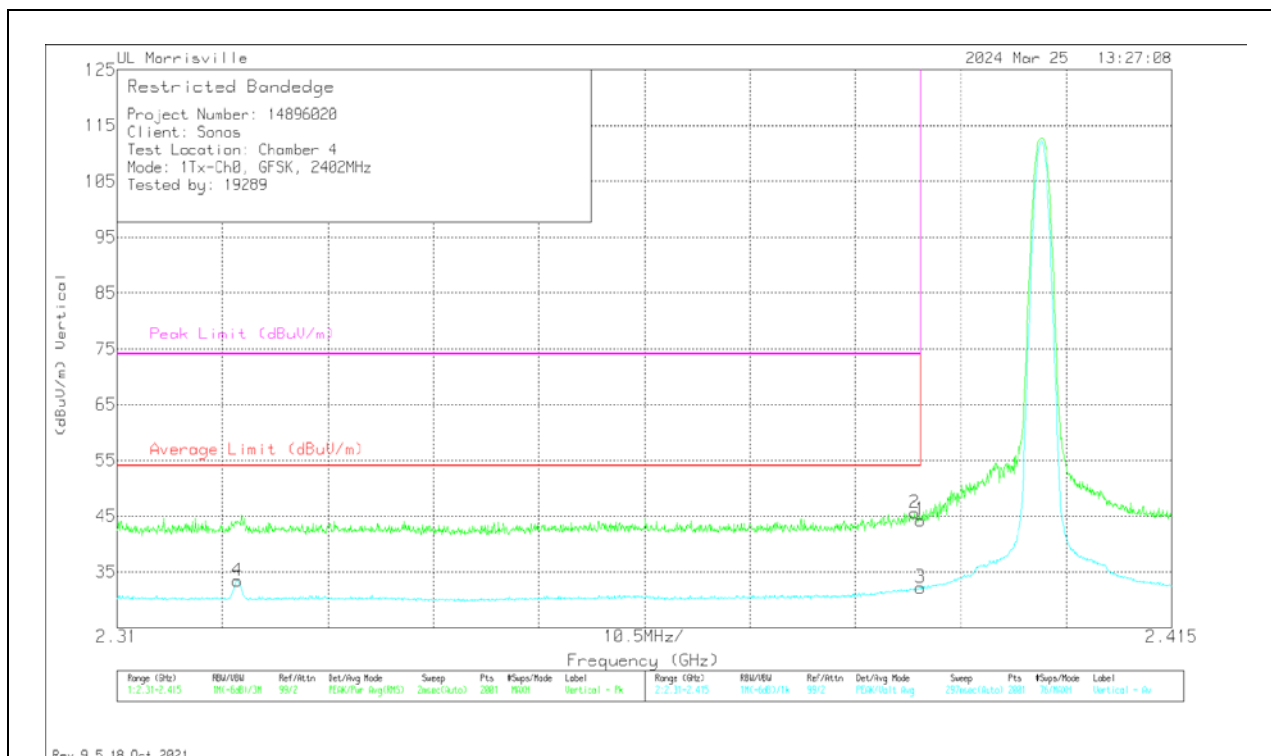
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

V1TV - Linear Voltage Average where: Ton is packet duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	25.47	Pk	32	-13.2	44.27	-	-	74	-29.73	52	119	V
2	*** 2.38943	26.76	Pk	32	-13.2	45.56	-	-	74	-28.44	52	119	V
3	*** 2.38996	13.31	V1TV	32	-13.2	32.11	54	-21.89	-	-	52	119	V
4	*** 2.32197	14.75	V1TV	32	-13.3	33.45	54	-20.55	-	-	52	119	V

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

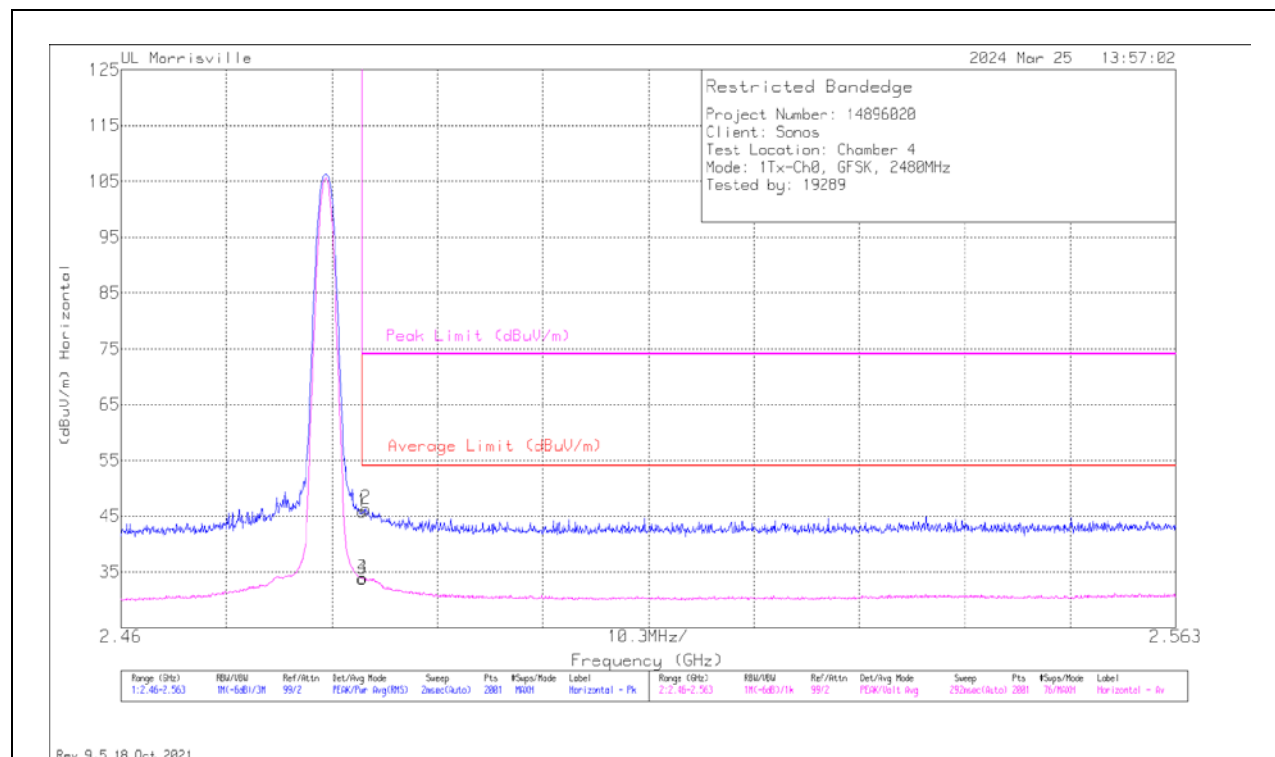
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

V1TV - Linear Voltage Average where: Ton is packet duration

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.48354	26.39	Pk	32.3	-12.9	45.79	-	-	74	-28.21	98	108	H
2	* ** 2.4839	26.98	Pk	32.3	-12.9	46.38	-	-	74	-27.62	98	108	H
3	* ** 2.48354	14.44	V1TV	32.3	-12.9	33.84	54	-20.16	-	-	98	108	H
4	* ** 2.48364	14.49	V1TV	32.3	-12.9	33.89	54	-20.11	-	-	98	108	H

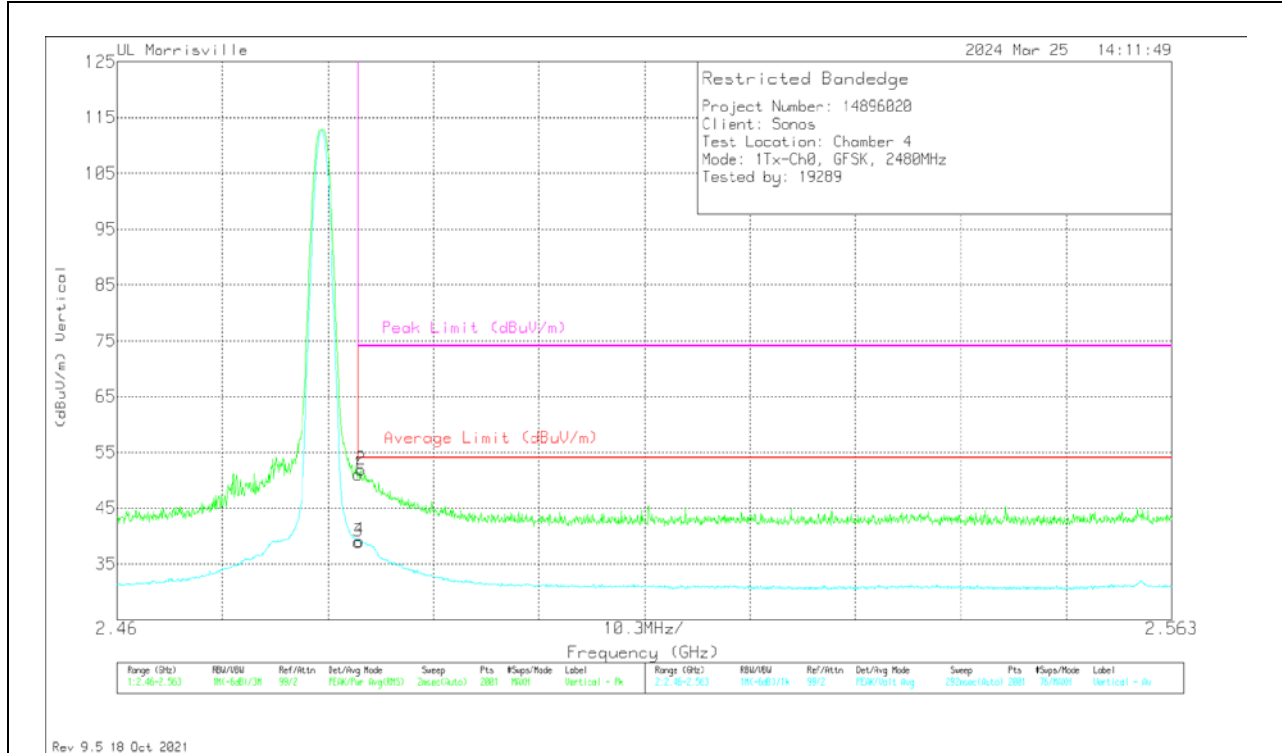
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

V1TV - Linear Voltage Average where: Ton is packet duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	31.65	Pk	32.3	-12.9	51.05	-	-	74	-22.95	48	112	V
2	*** 2.48384	32.47	Pk	32.3	-12.9	51.87	-	-	74	-22.13	48	112	V
3	*** 2.48354	19.62	V1TV	32.3	-12.9	39.02	54	-14.98	-	-	48	112	V
4	*** 2.48369	19.78	V1TV	32.3	-12.9	39.18	54	-14.82	-	-	48	112	V

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

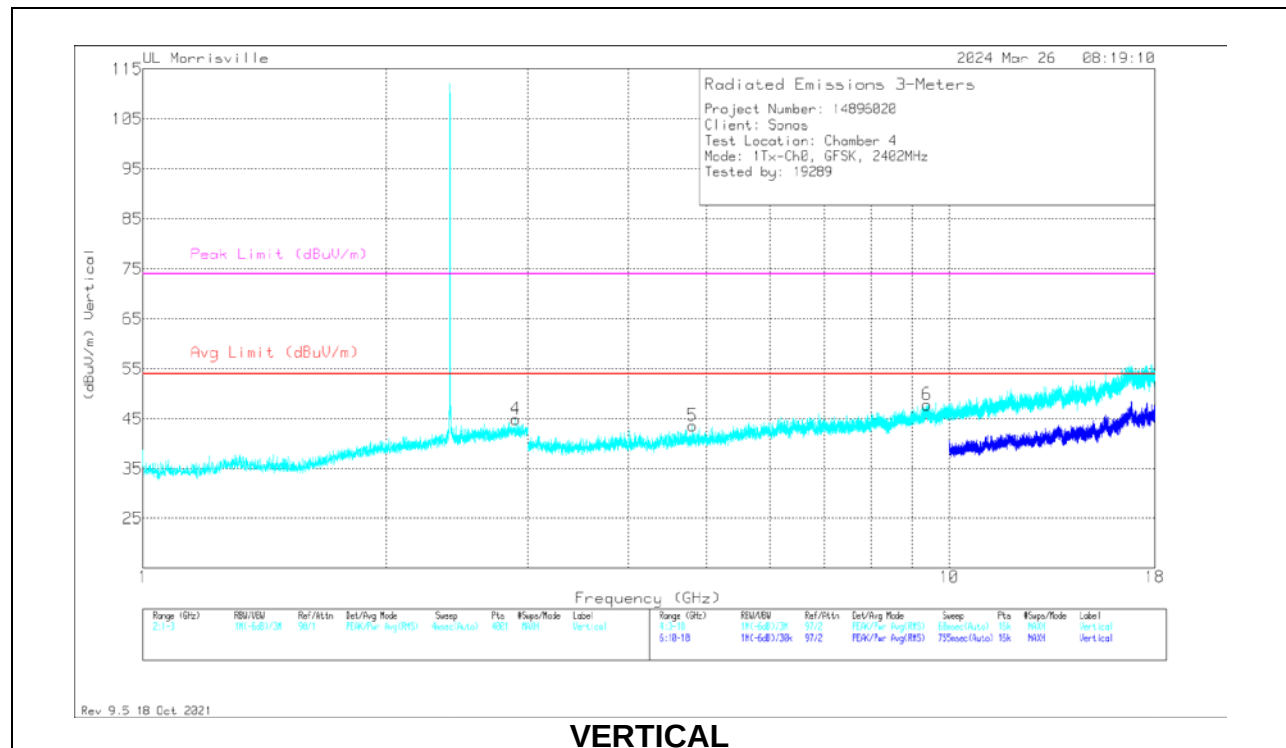
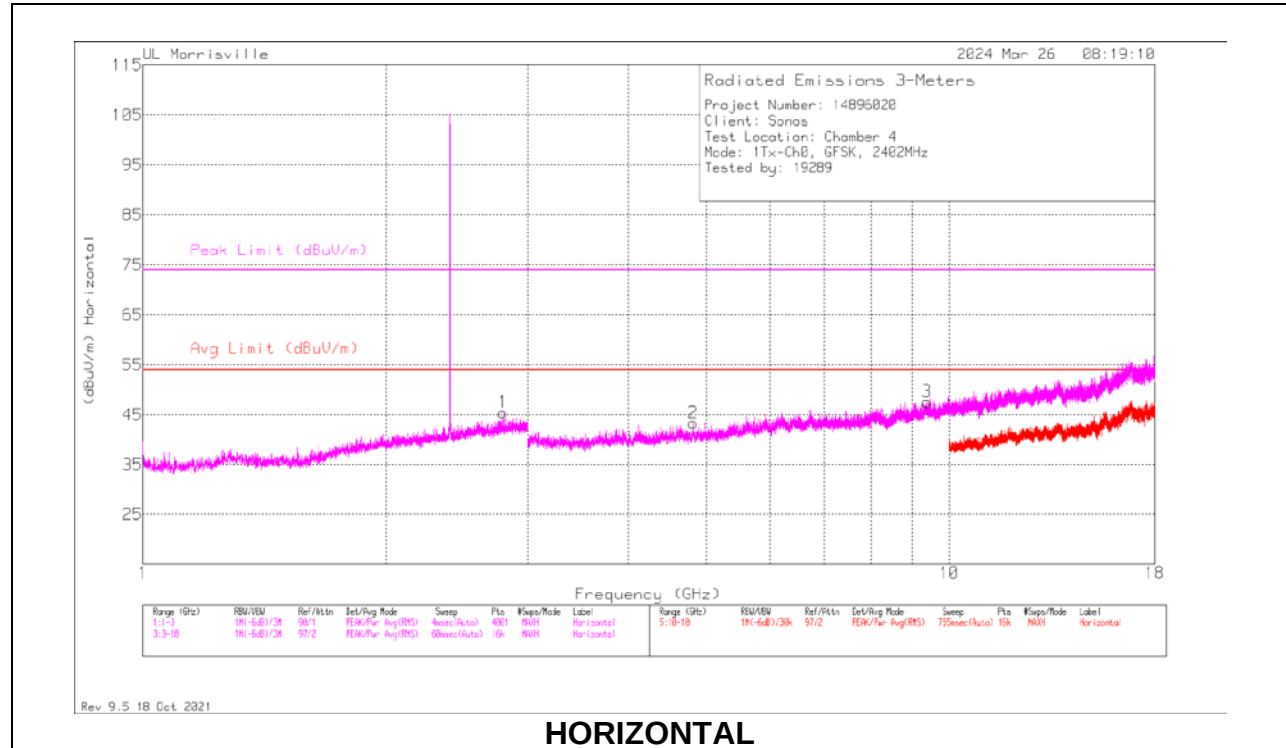
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

V1TV - Linear Voltage Average where: Ton is packet duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

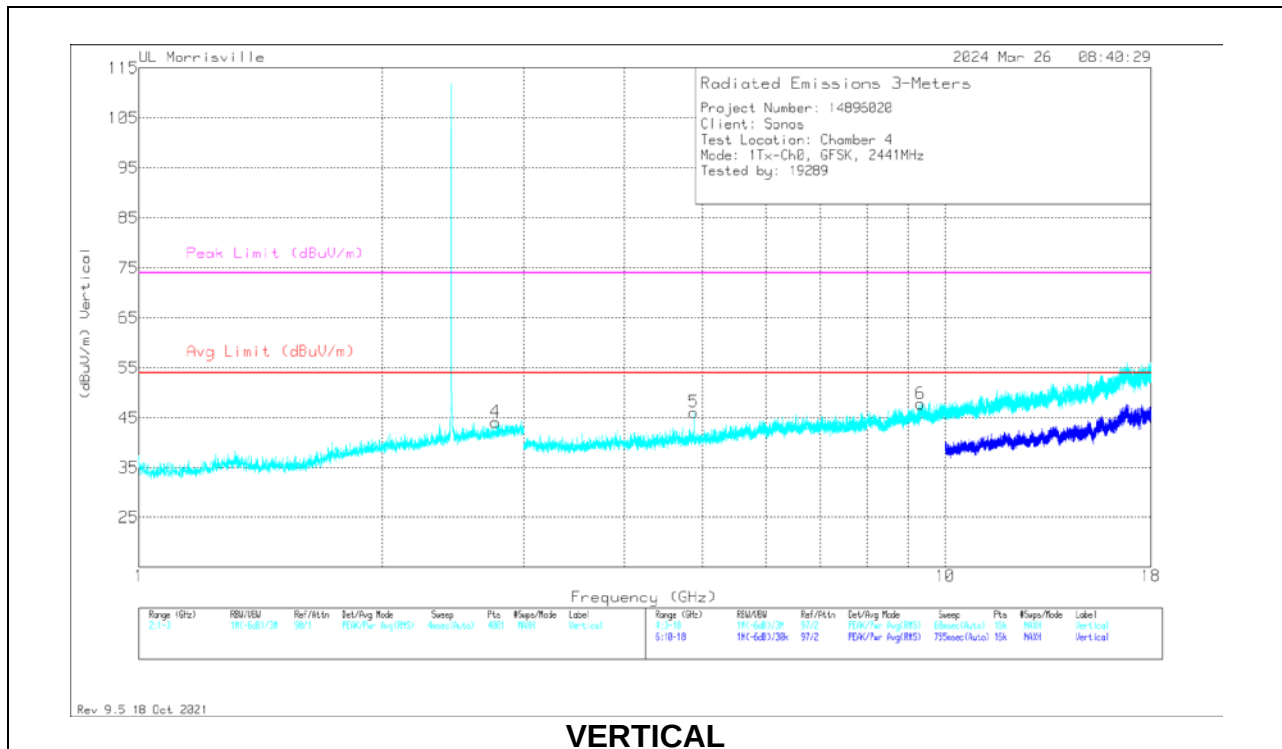
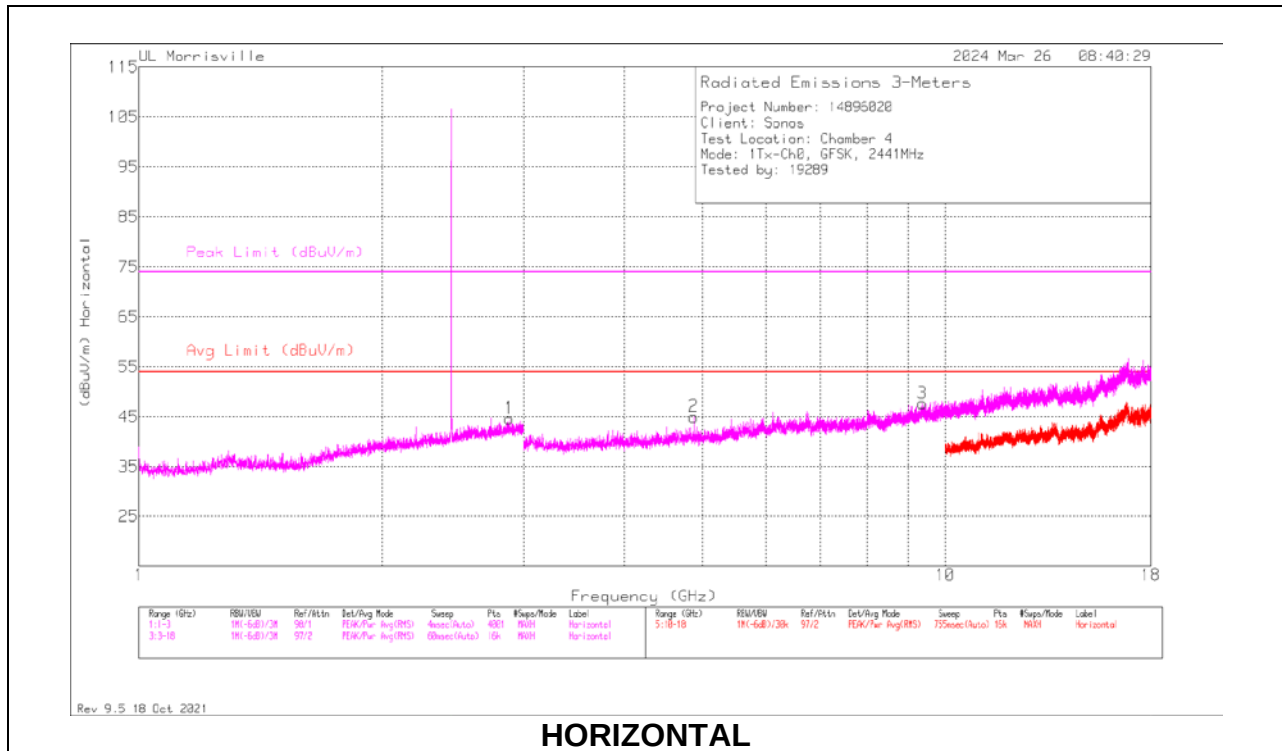
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.795	25.13	Pk	32.6	-12.3	45.43	54	-8.57	74	-28.57	0-360	100	H
4	* ** 2.898	24.45	Pk	32.5	-12	44.95	54	-9.05	74	-29.05	0-360	200	V
2	* ** 4.81031	40.96	Pk	34.1	-31.7	43.36	54	-10.64	74	-30.64	0-360	100	H
3	* ** 9.38813	36.38	Pk	36.6	-25.4	47.58	54	-6.42	74	-26.42	0-360	100	H
5	* ** 4.80375	41.21	Pk	34.1	-31.7	43.61	54	-10.39	74	-30.39	0-360	200	V
6	* ** 9.38156	36.14	Pk	36.6	-24.9	47.84	54	-6.16	74	-26.16	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

MID CHANNEL RESULTS



RADIATED EMISSIONS

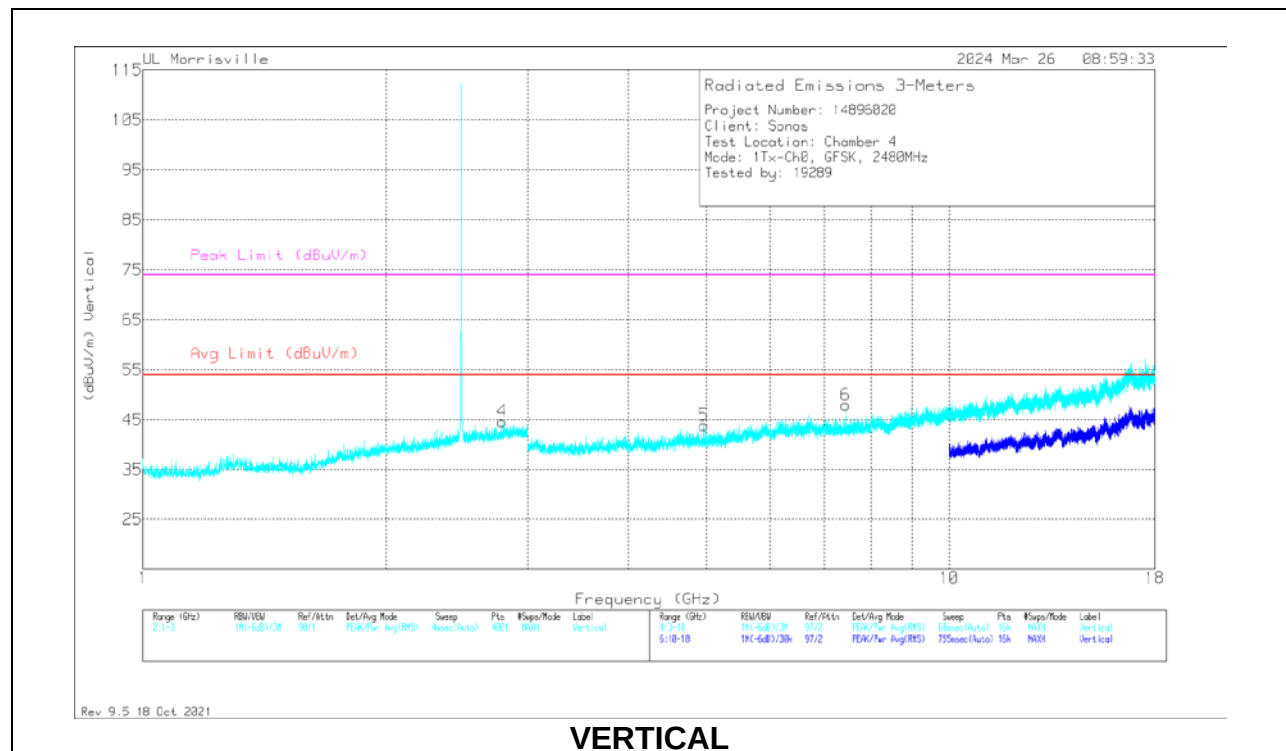
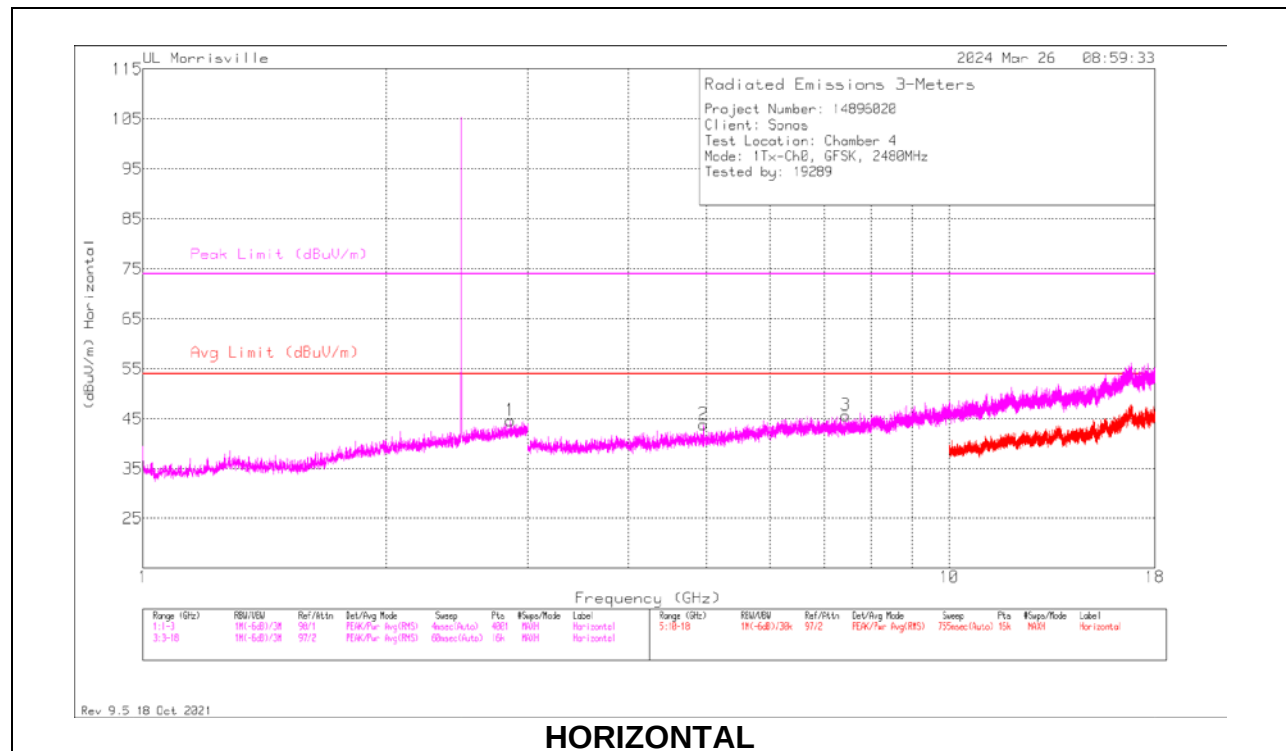
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.881	24.39	Pk	32.4	-12.1	44.69	54	-9.31	74	-29.31	0-360	100	H
4	** 2.7675	24.12	Pk	32.5	-12.5	44.12	54	-9.88	74	-29.88	0-360	200	V
2	*** 4.88156	42.39	Pk	34	-31.4	44.99	54	-9.01	74	-29.01	0-360	100	H
3	*** 9.36375	35.89	Pk	36.5	-24.7	47.69	54	-6.31	74	-26.31	0-360	100	H
5	*** 4.88156	43.44	Pk	34	-31.4	46.04	54	-7.96	74	-27.96	0-360	200	V
6	*** 9.32813	36.31	Pk	36.5	-25	47.81	54	-6.19	74	-26.19	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.853	24.6	Pk	32.4	-12.3	44.7	54	-9.3	74	-29.3	0-360	100	H
4	* ** 2.7915	24.48	Pk	32.6	-12.4	44.68	54	-9.32	74	-29.32	0-360	200	V
2	* ** 4.95938	41.36	Pk	33.9	-31.4	43.86	54	-10.14	74	-30.14	0-360	100	H
3	* ** 7.44	37.95	Pk	35.7	-28	45.65	54	-8.35	74	-28.35	0-360	100	H
5	* ** 4.96031	41.33	Pk	33.9	-31.4	43.83	54	-10.17	74	-30.17	0-360	200	V
6	* ** 7.44	40.26	Pk	35.7	-28	47.96	54	-6.04	74	-26.04	0-360	200	V

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

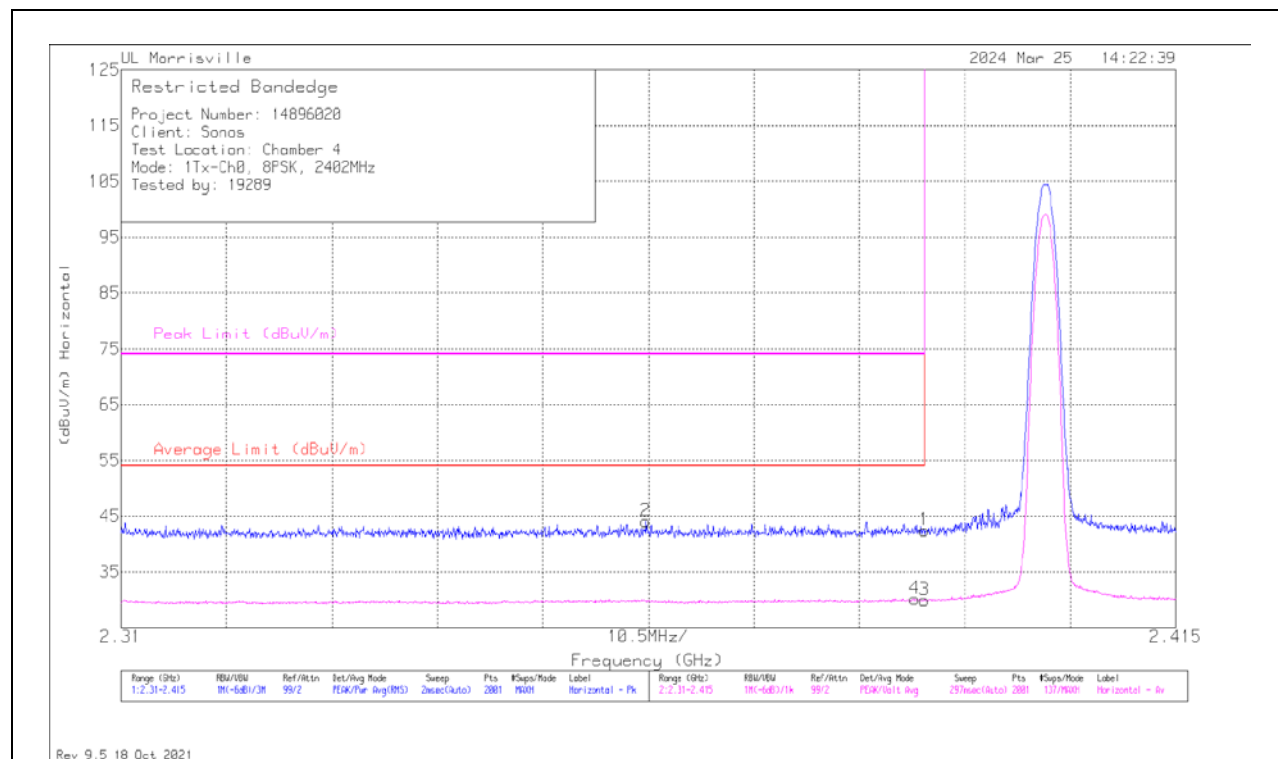
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	23.72	Pk	32	-13.2	42.52	-	-	74	-31.48	112	113	H
2	*** 2.36224	25.23	Pk	31.9	-13	44.13	-	-	74	-29.87	112	113	H
3	*** 2.38996	11.12	V1TV	32	-13.2	29.92	54	-24.08	-	-	112	113	H
4	*** 2.38907	11.43	V1TV	32	-13.2	30.23	54	-23.77	-	-	112	113	H

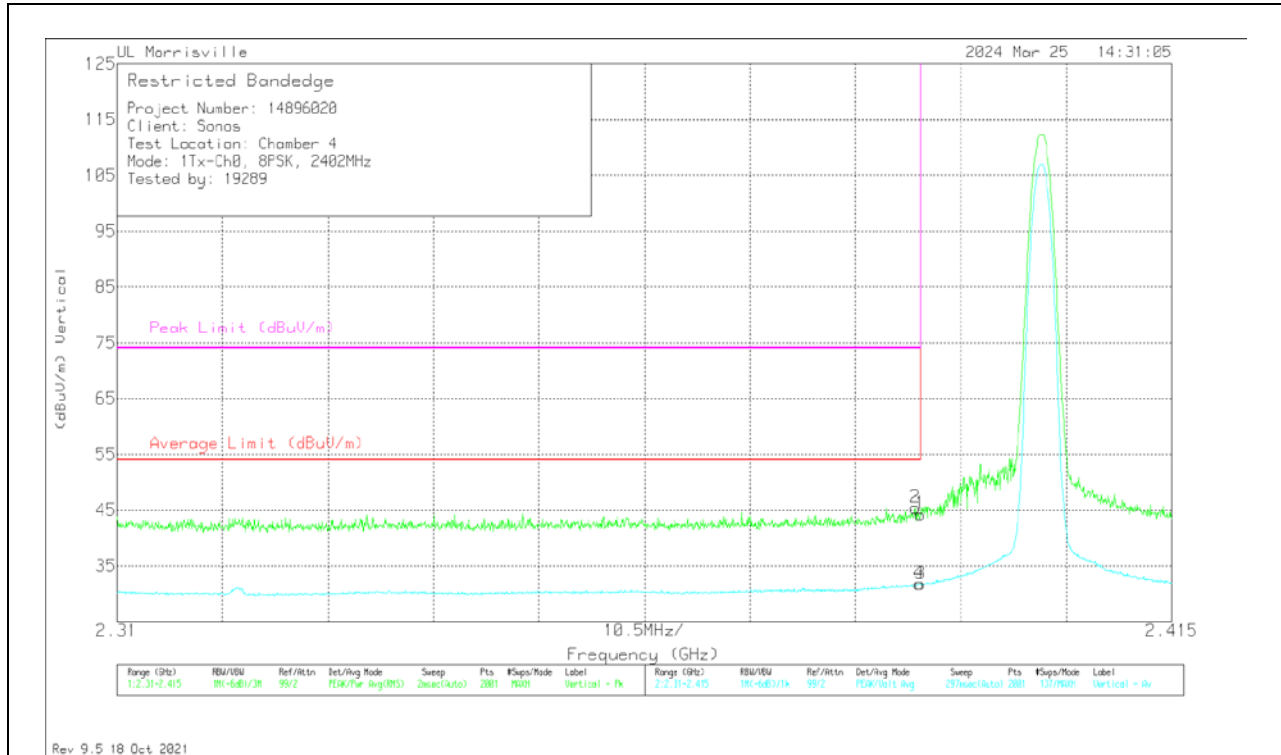
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

V1TV - Linear Voltage Average where: Ton is packet duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBUV/m)	Average Limit (dBUV/m)	Margin (dB)	Peak Limit (dBUV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	25.47	Pk	32	-13.2	44.27	-	-	74	-29.73	19	117	V
2	*** 2.38949	26.62	Pk	32	-13.2	45.42	-	-	74	-28.58	19	117	V
3	*** 2.38996	13.02	V1TV	32	-13.2	31.82	54	-22.18	-	-	19	117	V
4	*** 2.38985	12.98	V1TV	32	-13.2	31.78	54	-22.22	-	-	19	117	V

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

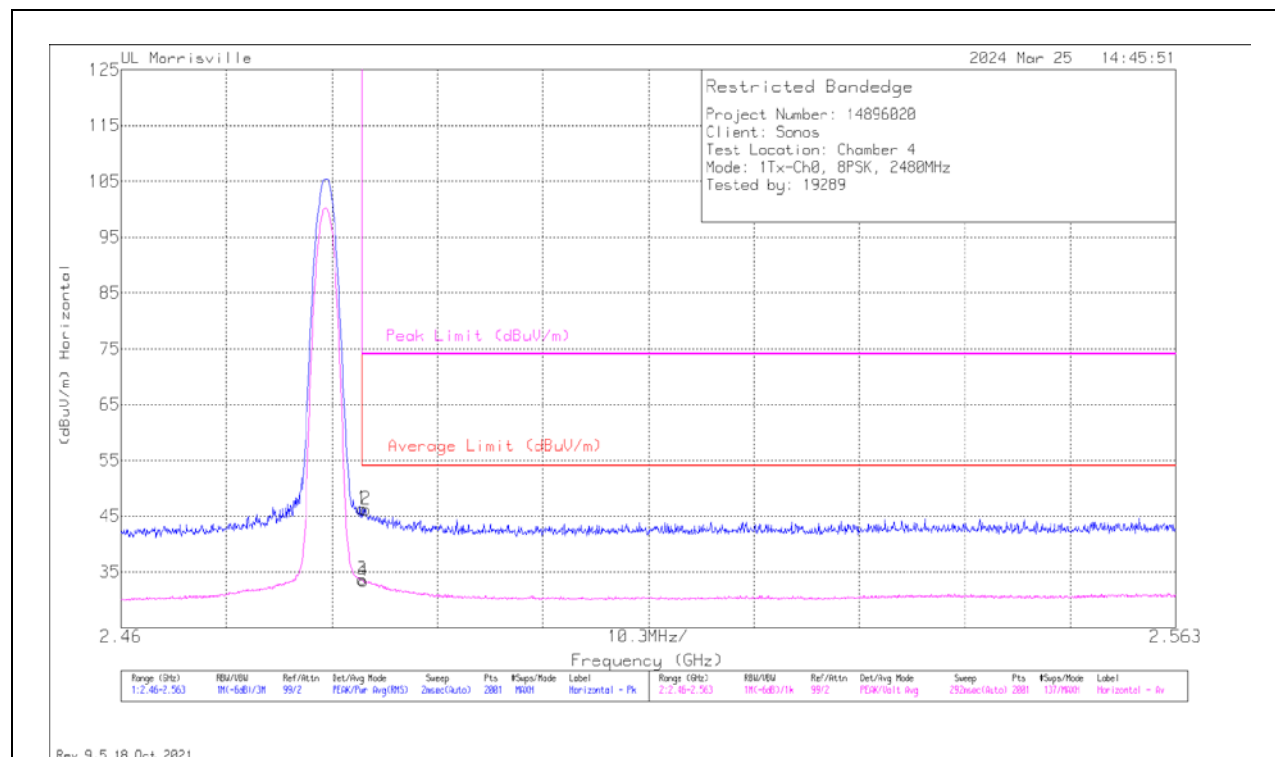
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

V1TV - Linear Voltage Average where: Ton is packet duration

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	26.89	Pk	32.3	-12.9	46.29	-	-	74	-27.71	98	113	H
2	*** 2.4839	26.81	Pk	32.3	-12.9	46.21	-	-	74	-27.79	98	113	H
3	*** 2.48354	14.26	V1TV	32.3	-12.9	33.66	54	-20.34	-	-	98	113	H
4	*** 2.48369	14.01	V1TV	32.3	-12.9	33.41	54	-20.59	-	-	98	113	H

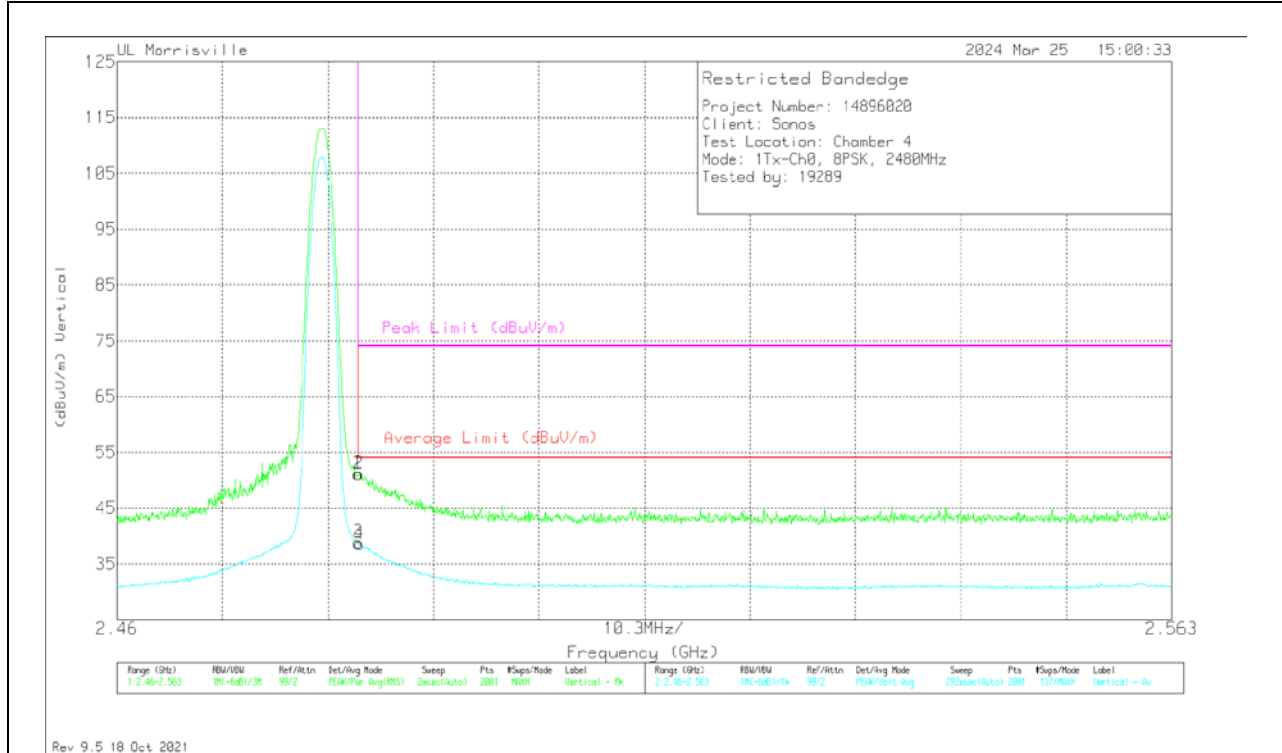
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

V1TV - Linear Voltage Average where: Ton is packet duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	31.79	Pk	32.3	-12.9	51.19	-	-	74	-22.81	116	198	V
2	*** 2.48364	31.77	Pk	32.3	-12.9	51.17	-	-	74	-22.83	116	198	V
3	*** 2.48354	19.42	V1TV	32.3	-12.9	38.82	54	-15.18	-	-	116	198	V
4	*** 2.48369	19.27	V1TV	32.3	-12.9	38.67	54	-15.33	-	-	116	198	V

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

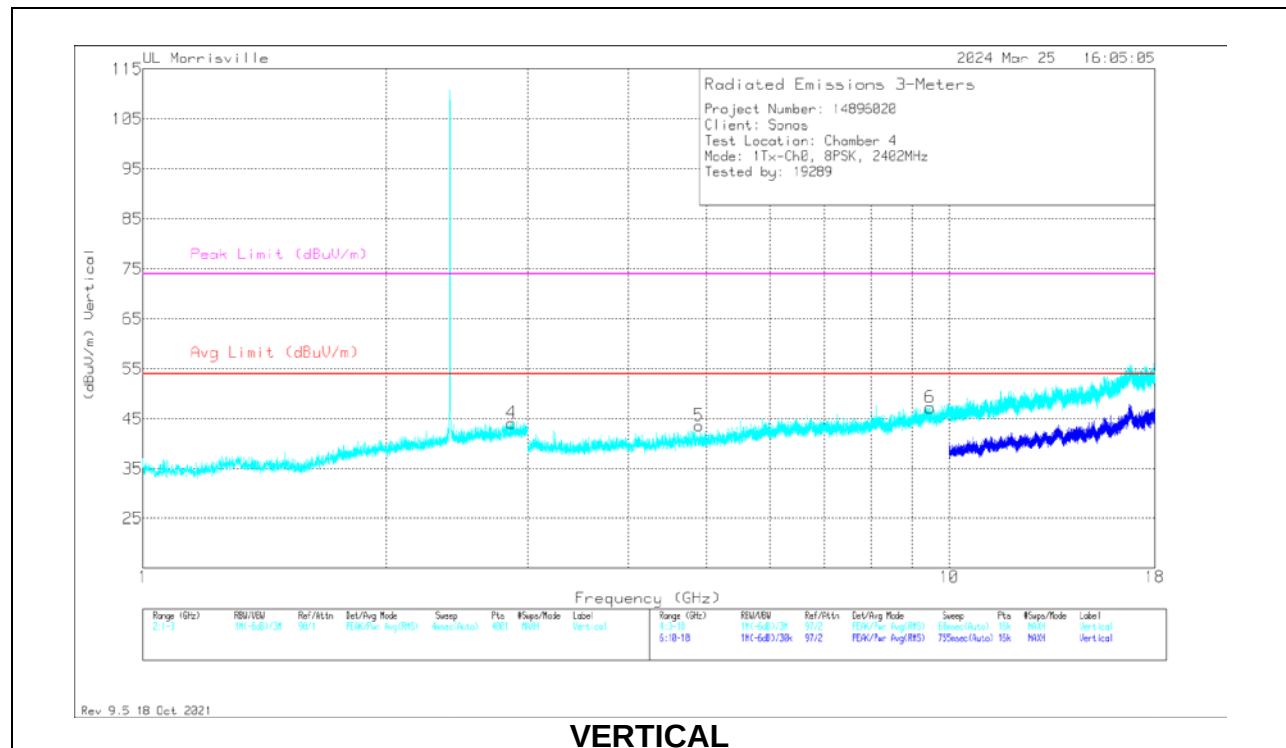
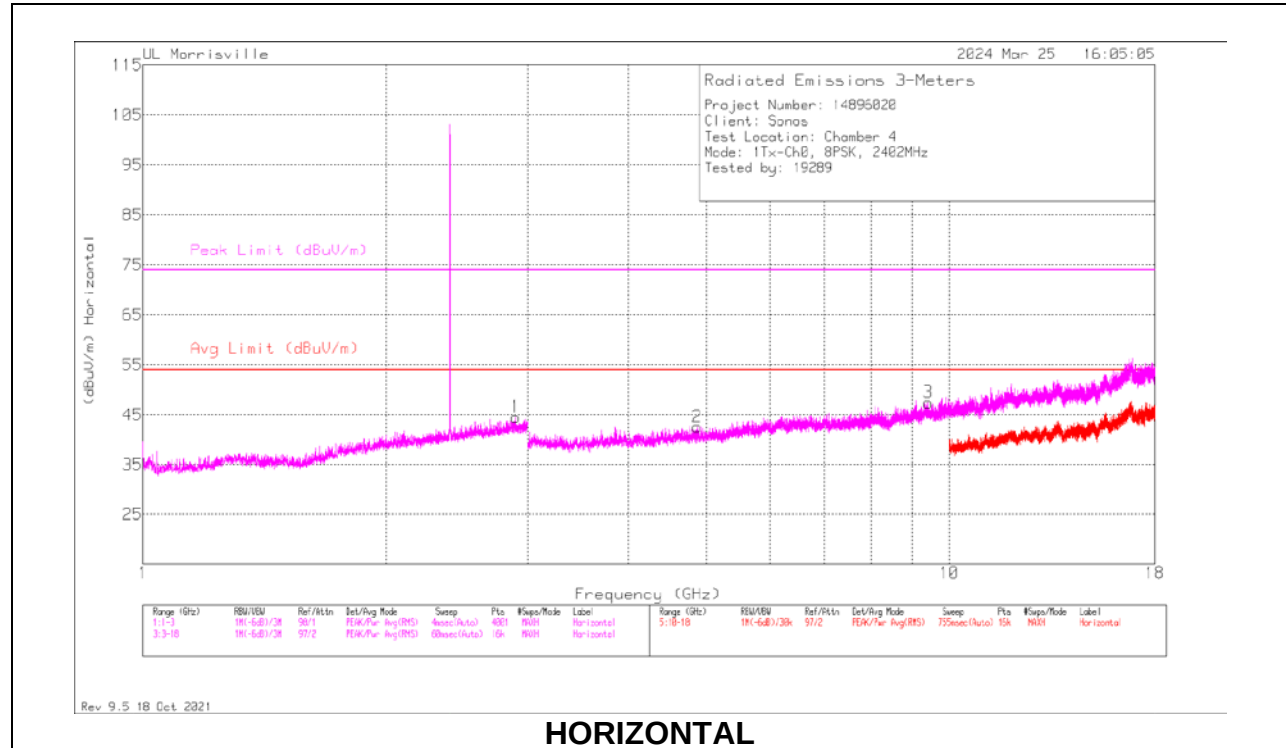
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

V1TV - Linear Voltage Average where: Ton is packet duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

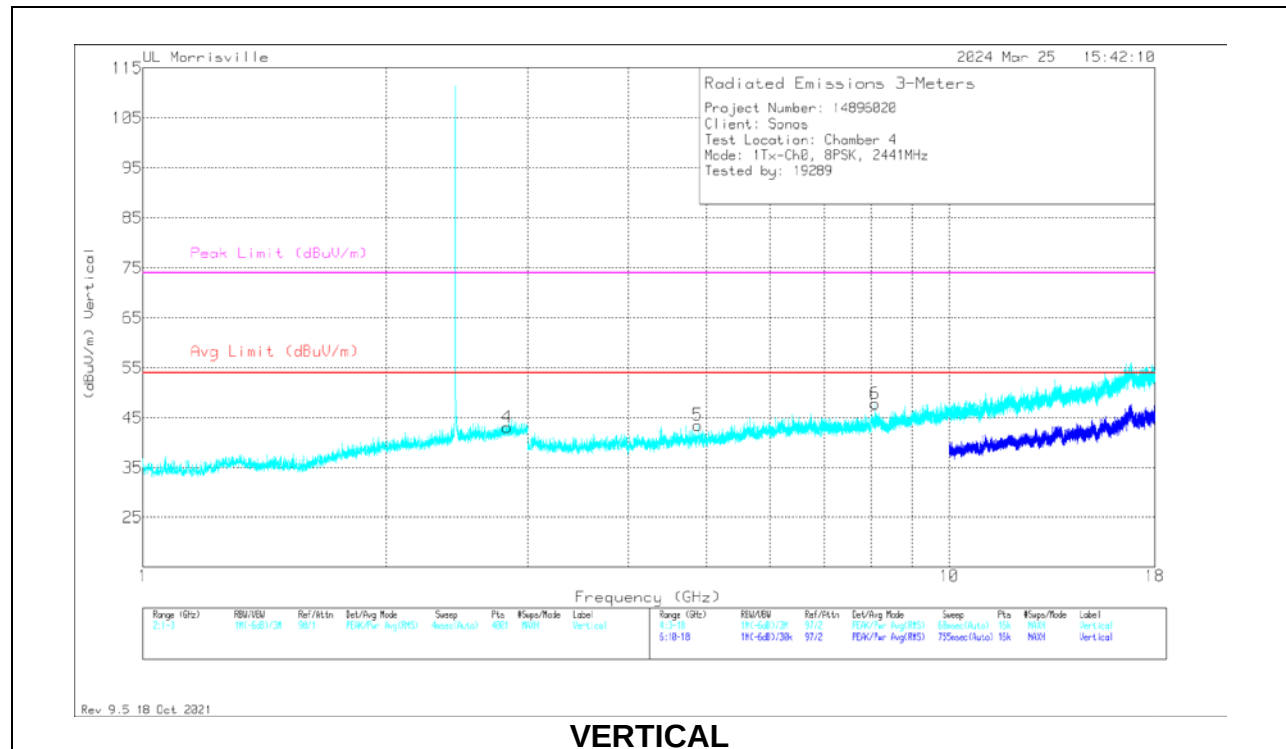
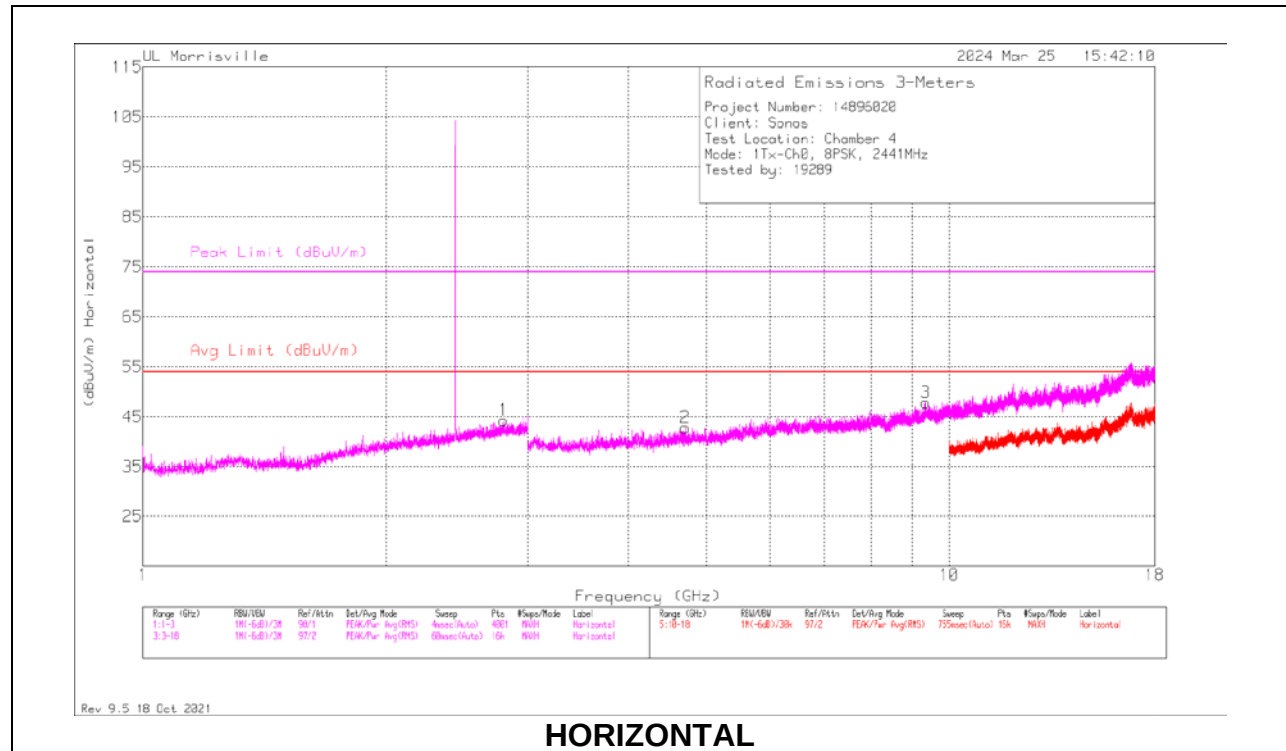
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.899	24.04	Pk	32.5	-12	44.54	54	-9.46	74	-29.46	0-360	100	H
4	* ** 2.867	23.94	Pk	32.4	-12.2	44.14	54	-9.86	74	-29.86	0-360	200	V
2	* ** 4.8675	39.89	Pk	34.1	-31.4	42.59	54	-11.41	74	-31.41	0-360	100	H
3	* ** 9.42188	36.55	Pk	36.6	-25.7	47.45	54	-6.55	74	-26.55	0-360	100	H
5	* ** 4.89469	40.9	Pk	34	-31.3	43.6	54	-10.4	74	-30.4	0-360	200	V
6	* ** 9.47531	36.24	Pk	36.7	-25.7	47.24	54	-6.76	74	-26.76	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

MID CHANNEL RESULTS



RADIATED EMISSIONS

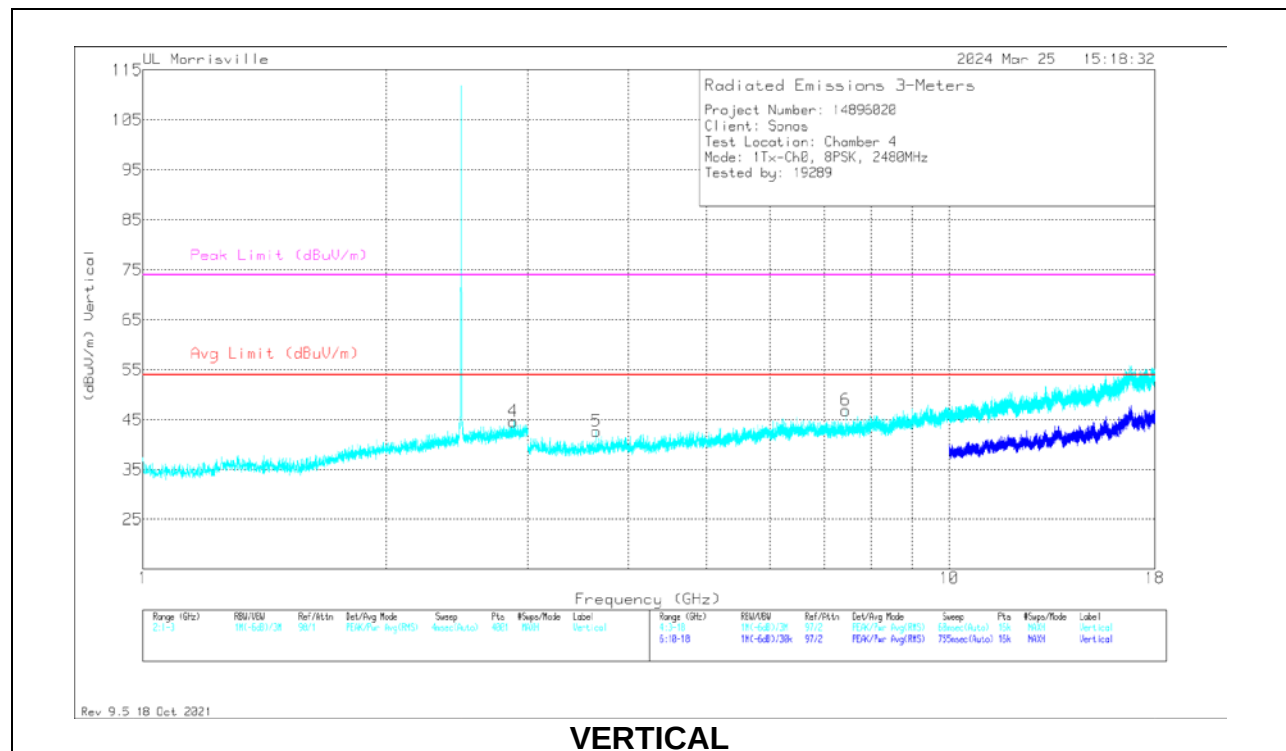
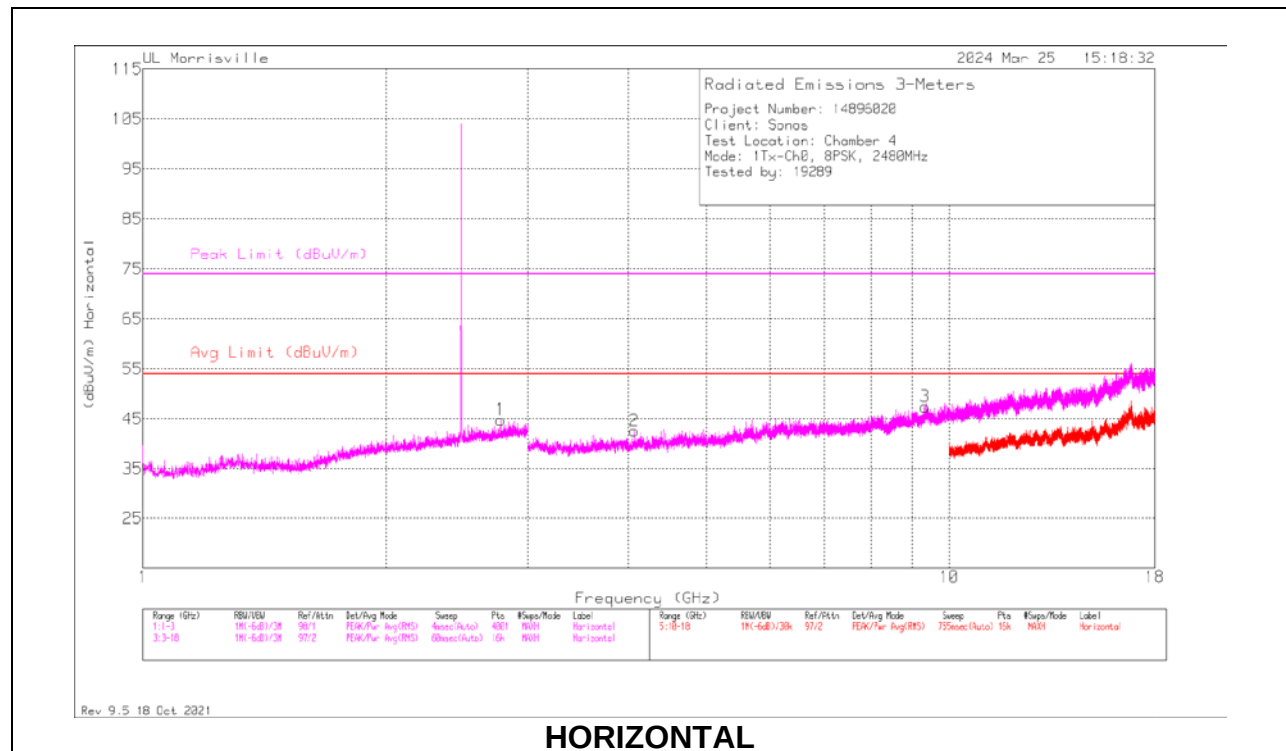
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.8025	24.01	Pk	32.6	-12.3	44.31	54	-9.69	74	-29.69	0-360	100	H
4	*** 2.8285	23.01	Pk	32.4	-12.3	43.11	54	-10.89	74	-30.89	0-360	200	V
2	*** 4.70625	40.15	Pk	34.1	-31.4	42.85	54	-11.15	74	-31.15	0-360	100	H
3	*** 9.35906	35.95	Pk	36.5	-24.7	47.75	54	-6.25	74	-26.25	0-360	100	H
5	*** 4.88156	40.89	Pk	34	-31.4	43.49	54	-10.51	74	-30.51	0-360	200	V
6	*** 8.0925	39.4	Pk	35.8	-27.4	47.8	54	-6.2	74	-26.2	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.776	24.63	Pk	32.6	-12.4	44.83	54	-9.17	74	-29.17	0-360	100	H
4	* ** 2.88	24.39	Pk	32.4	-12.1	44.69	54	-9.31	74	-29.31	0-360	200	V
2	* ** 4.065	41.63	Pk	33.3	-32.3	42.63	54	-11.37	74	-31.37	0-360	100	H
3	*** 9.33281	35.59	Pk	36.5	-24.7	47.39	54	-6.61	74	-26.61	0-360	100	H
5	*** 3.64875	43.27	Pk	33	-33.6	42.67	54	-11.33	74	-31.33	0-360	200	V
6	* ** 7.44	39.2	Pk	35.7	-28	46.9	54	-7.1	74	-27.1	0-360	200	V

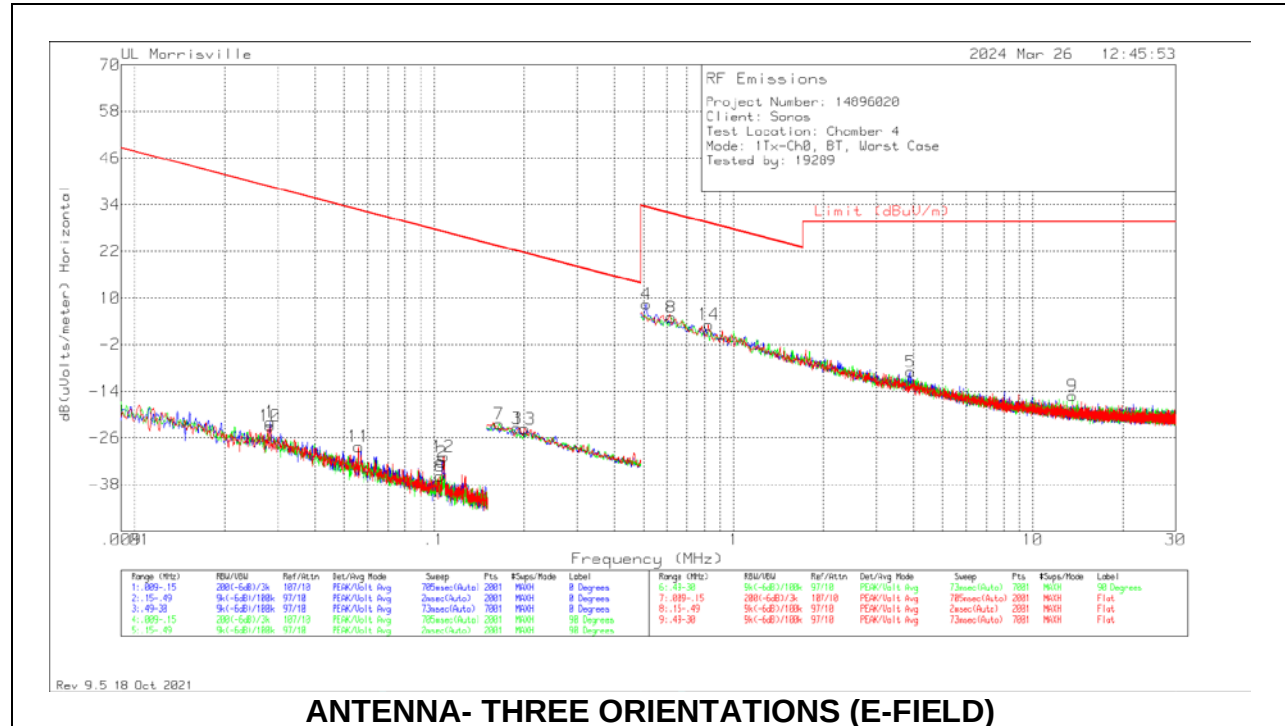
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

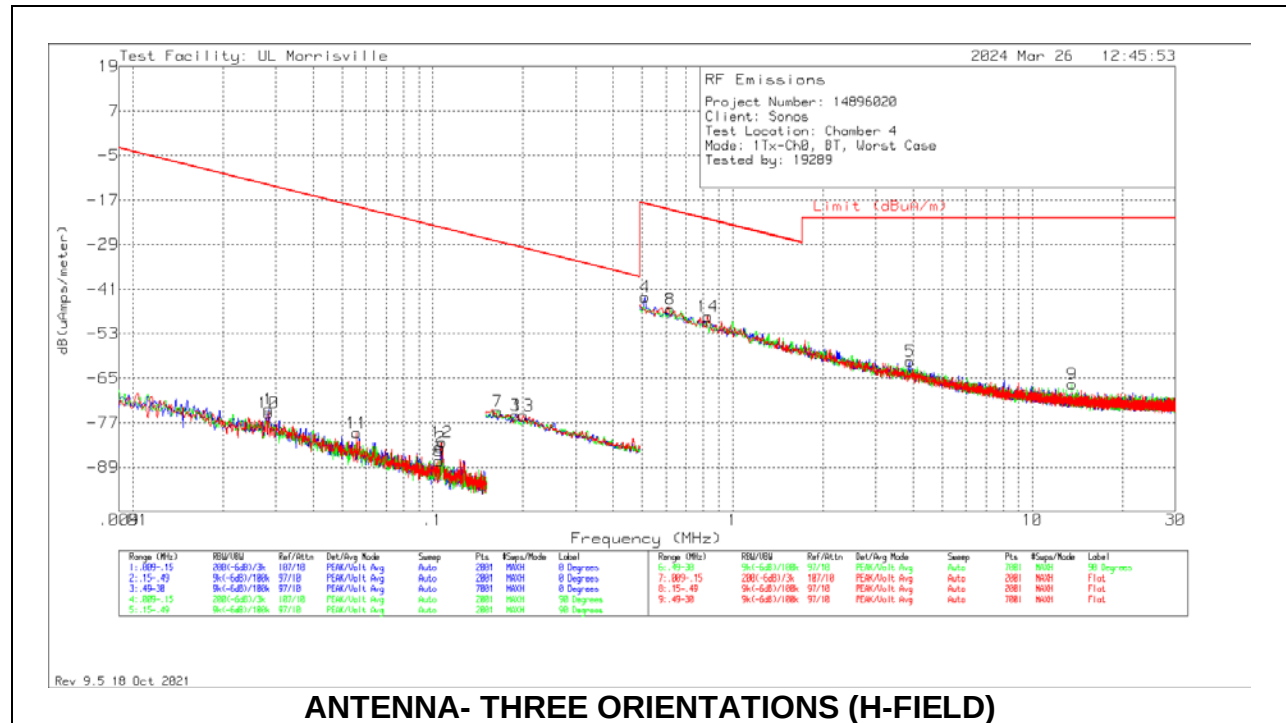
10.2. WORST CASE SPURIOUS BELOW 30MHZ

Note: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dBuV/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP/AV Limit (dBuV/m)	PK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
1	.02838	44.55	Pk	13.6	0	-80	-21.85	38.54	58.54	-60.39	0-360	0 degs
10	.02838	43.53	Pk	13.6	0	-80	-22.87	38.54	58.54	-61.41	0-360	Flat
11	.05579	40.11	Pk	11.6	0	-80	-28.29	32.67	52.67	-60.96	0-360	Flat
6	.10478	33.1	Pk	11.1	0	-80	-35.8	27.2	-	-63	0-360	90 degs
2	.1062	36.69	Pk	11.1	0	-80	-32.21	27.08	-	-59.29	0-360	0 degs
12	.10741	38.16	Pk	11.1	0	-80	-30.74	26.98	-	-57.72	0-360	Flat
7	.16462	46.51	Pk	11.1	0	-80	-22.39	23.27	43.27	-45.66	0-360	90 degs
3	.18902	45.39	Pk	11.1	0	-80	-23.51	22.07	42.07	-45.58	0-360	0 degs
13	.20058	45.27	Pk	11.1	0	-80	-23.63	21.56	41.56	-45.19	0-360	Flat
4	.51108	37.17	Pk	11.1	.1	-40	8.37	33.43	-	-25.06	0-360	0 degs
8	.6207	33.78	Pk	11.2	.1	-40	5.08	31.75	-	-26.67	0-360	90 degs
14	.82728	31.96	Pk	11.1	.1	-40	3.16	29.25	-	-26.09	0-360	Flat
5	3.90918	19.32	Pk	11.5	.2	-40	-8.98	29.54	-	-38.52	0-360	0 degs
9	13.56382	13.79	Pk	10.7	.4	-40	-15.11	29.54	-	-44.65	0-360	90 degs

Pk - Peak detector

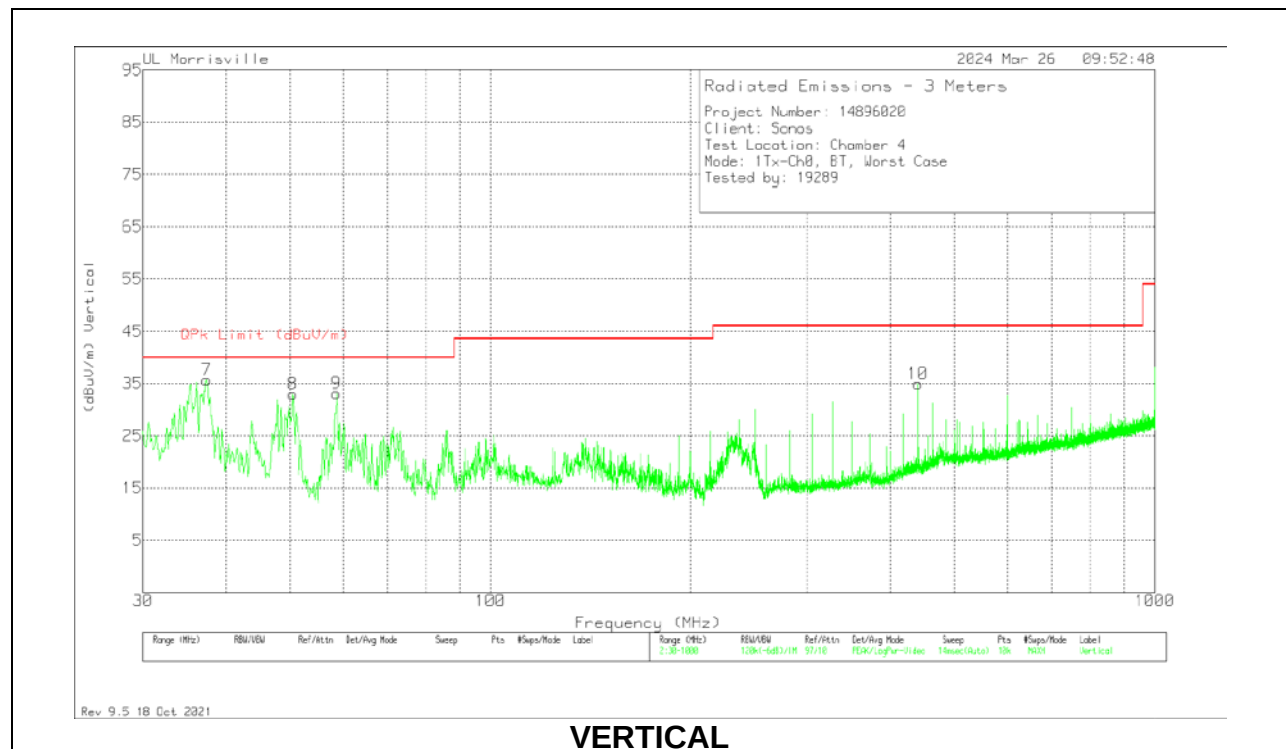
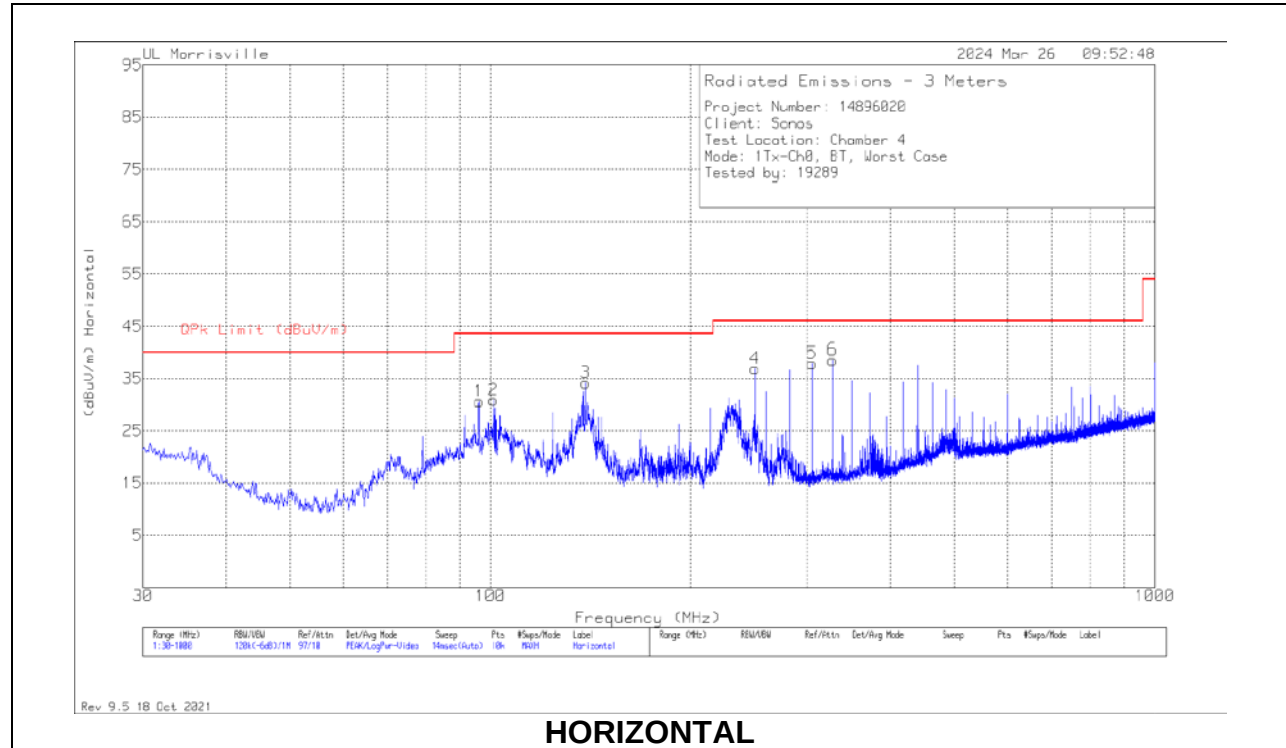


ANTENNA- THREE ORIENTATIONS (H-FIELD)

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dBuV/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uAmps/meter)	QP/AV Limit (dBuA/m)	PK Limit (dBuA/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
1	.02838	44.55	Pk	-37.9	0	-80	-73.35	-12.96	7.04	-60.39	0-360	0 degs
10	.02838	43.53	Pk	-37.9	0	-80	-74.37	-12.96	7.04	-61.41	0-360	Flat
11	.05579	40.11	Pk	-39.9	0	-80	-79.79	-18.83	1.17	-60.96	0-360	Flat
6	.10478	33.1	Pk	-40.4	0	-80	-87.3	-24.3	-	-63	0-360	90 degs
2	.1062	36.69	Pk	-40.4	0	-80	-83.71	-24.42	-	-59.29	0-360	0 degs
12	.10741	38.16	Pk	-40.4	0	-80	-82.24	-24.52	-	-57.72	0-360	Flat
7	.16462	46.51	Pk	-40.4	0	-80	-73.89	-28.23	-8.23	-45.66	0-360	90 degs
3	.18902	45.39	Pk	-40.4	0	-80	-75.01	-29.43	-9.43	-45.58	0-360	0 degs
13	.20058	45.27	Pk	-40.4	0	-80	-75.13	-29.94	-9.94	-45.19	0-360	Flat
4	.51108	37.17	Pk	-40.4	.1	-40	-43.13	-18.07	-	-25.06	0-360	0 degs
8	.6207	33.78	Pk	-40.3	.1	-40	-46.42	-19.75	-	-26.67	0-360	90 degs
14	.82728	31.96	Pk	-40.4	.1	-40	-48.34	-22.25	-	-26.09	0-360	Flat
5	3.90918	19.32	Pk	-40	.2	-40	-60.48	-21.96	-	-38.52	0-360	0 degs
9	13.56382	13.79	Pk	-40.8	.4	-40	-66.61	-21.96	-	-44.65	0-360	90 degs

Pk - Peak detector

10.3. WORST CASE SPURIOUS BELOW 1 GHZ

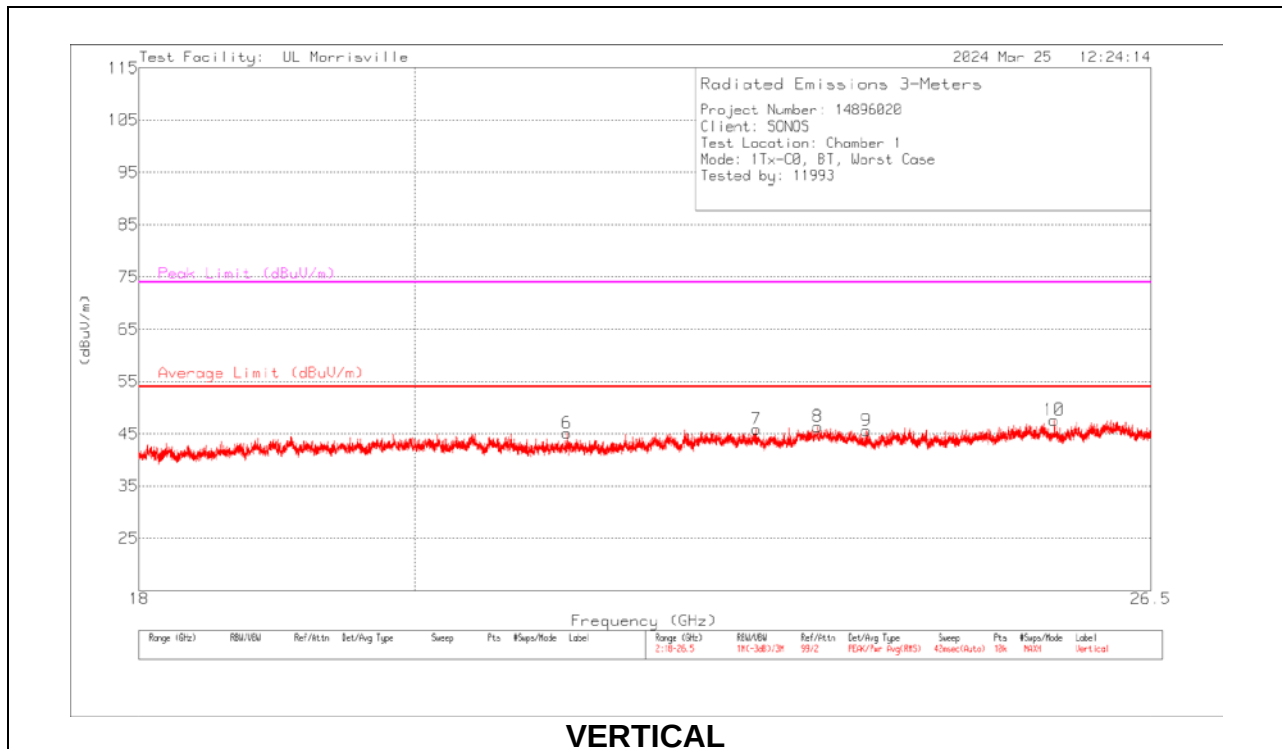
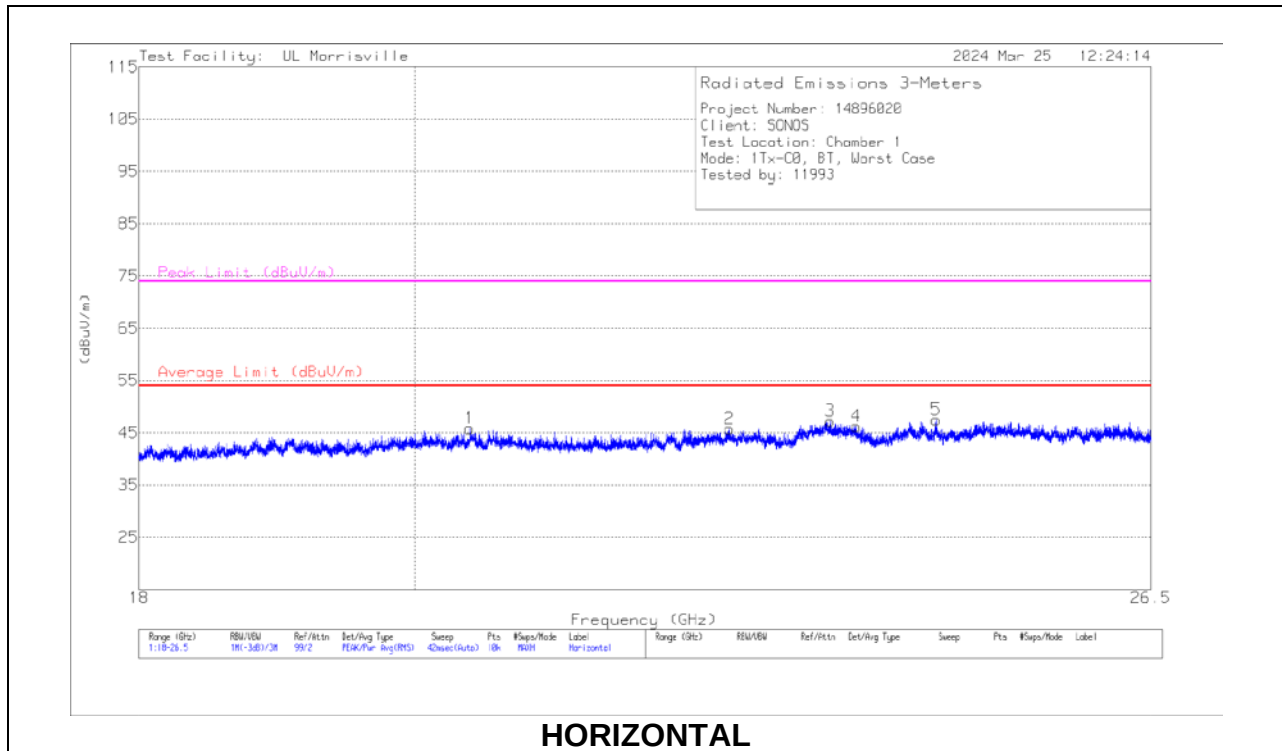


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	90628 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7	37.378	43.99	Qp	21.9	-32.1	33.79	40	-6.21	262	111	V
8	50.37	50.78	Pk	14.1	-31.9	32.98	40	-7.02	0-360	100	V
9	58.712	51.2	Pk	13.7	-31.8	33.1	40	-6.9	0-360	100	V
1	96.057	46.64	Pk	15.4	-31.5	30.54	43.52	-12.98	0-360	200	H
2	101.101	45.52	Pk	16.8	-31.5	30.82	43.52	-12.7	0-360	200	H
3	139.028	46.04	Pk	19.3	-31.2	34.14	43.52	-9.38	0-360	100	H
4	249.996	49.92	Pk	17.5	-30.5	36.92	46.02	-9.1	0-360	100	H
5	304.801	48.57	Pk	19.7	-30.3	37.97	46.02	-8.05	0-360	100	H
6	327.402	48.7	Pk	20.1	-30.2	38.6	46.02	-7.42	0-360	100	H
10	440.31	42.05	Pk	22.7	-29.8	34.95	46.02	-11.07	0-360	100	V

Pk - Peak detector

QP - Quasi Peak detector

10.4. WORST CASE SPURIOUS 18-26 GHZ



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	204704 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 20.42396	50.02	Pk	33.6	-37.8	45.82	54	-8.18	74	-28.18	0-360	150	H
2	* ** 22.55809	49.21	Pk	34.3	-37.8	45.71	54	-8.29	74	-28.29	0-360	200	H
4	* ** 23.67573	49.09	Pk	34.5	-37.3	46.29	54	-7.71	74	-27.71	0-360	101	H
6	* ** 21.20163	49.85	Pk	33.6	-38.3	45.15	54	-8.85	74	-28.85	0-360	250	V
7	* ** 22.79012	49.33	Pk	34.1	-37.5	45.93	54	-8.07	74	-28.07	0-360	200	V
9	* ** 23.76752	48.53	Pk	34.4	-37.3	45.63	54	-8.37	74	-28.37	0-360	200	V
8	23.33237	49.35	Pk	34.5	-37.5	46.35	-	-	-	-	0-360	250	V
3	23.44286	50.26	Pk	34.6	-37.6	47.26	-	-	-	-	0-360	101	H
5	24.41261	50	Pk	34.4	-36.9	47.5	-	-	-	-	0-360	150	H
10	25.5396	48.75	Pk	35.3	-36.4	47.65	-	-	-	-	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

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

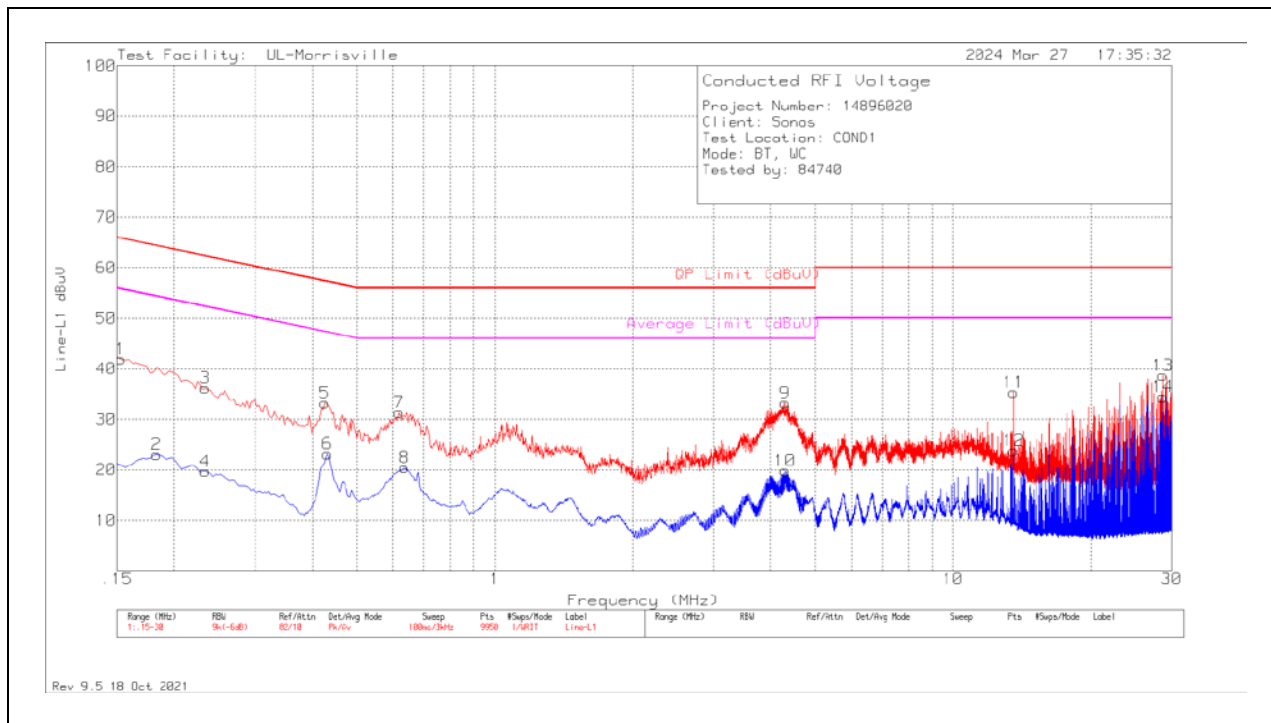
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

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 lines.

11.1. AC POWER LINE

LINE 1 RESULTS



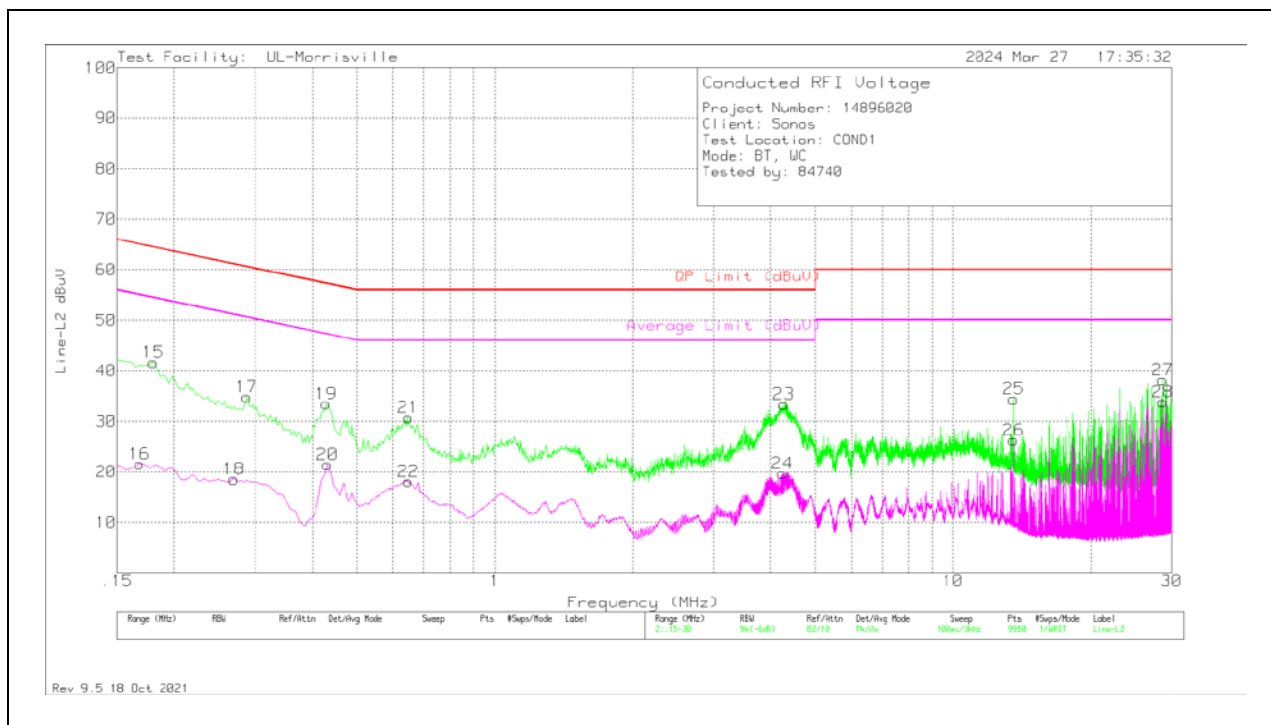
Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VDF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
1	.153	31.79	Pk	.3	9.8	41.89	65.84	-23.95	-	-
2	.183	12.97	Av	.3	9.8	23.07	-	-	54.35	-31.28
3	.234	26.25	Pk	.2	9.8	36.25	62.31	-26.06	-	-
4	.234	9.69	Av	.2	9.8	19.69	-	-	52.31	-32.62
5	.426	23.35	Pk	.1	9.8	33.25	57.33	-24.08	-	-
6	.432	13.28	Av	.1	9.8	23.18	-	-	47.21	-24.03
7	.618	21.51	Pk	.1	9.8	31.41	56	-24.59	-	-
8	.636	10.52	Av	.1	9.8	20.42	-	-	46	-25.58
9	4.302	23.21	Pk	.1	9.9	33.21	56	-22.79	-	-
10	4.302	9.79	Av	.1	9.9	19.79	-	-	46	-26.21
11	13.56	25.13	Pk	.2	10	35.33	60	-24.67	-	-
12	13.56	13.63	Av	.2	10	23.83	-	-	50	-26.17
13	28.686	28.15	Pk	.3	10.2	38.65	60	-21.35	-	-
14	28.686	23.92	Av	.3	10.2	34.42	-	-	50	-15.58

Pk - Peak detector

Av - Average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VDF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
15	.18	31.63	Pk	.3	9.8	41.73	64.49	-22.76	-	-
16	.168	11.44	Av	.3	9.8	21.54	-	-	55.06	-33.52
17	.288	24.87	Pk	.2	9.8	34.87	60.58	-25.71	-	-
18	.27	8.53	Av	.2	9.8	18.53	-	-	51.12	-32.59
19	.429	23.55	Pk	.1	9.8	33.45	57.27	-23.82	-	-
20	.432	11.58	Av	.1	9.8	21.48	-	-	47.21	-25.73
21	.648	20.8	Pk	.1	9.8	30.7	56	-25.3	-	-
22	.648	8.15	Av	.1	9.8	18.05	-	-	46	-27.95
23	4.275	23.42	Pk	.1	9.9	33.42	56	-22.58	-	-
24	4.251	9.68	Av	.1	9.9	19.68	-	-	46	-26.32
25	13.56	24.22	Pk	.2	10	34.42	60	-25.58	-	-
26	13.56	16.1	Av	.2	10	26.3	-	-	50	-23.7
27	28.686	27.65	Pk	.3	10.2	38.15	60	-21.85	-	-
28	28.686	23.39	Av	.3	10.2	33.89	-	-	50	-16.11

Pk - Peak detector
Av - Average detection

12. SETUP PHOTOS

Please refer to R14896020-EP1 for setup photos

END OF TEST REPORT