Test Report TR3768-166-BTC-FHSS

Equipment Under Test:	Module, SONA NX 611 M.2 2230, 1 MHF
Requirement(s):	eCFR 47 Part 15.247 | RSS-247
Test Date(s):	01/22/2024-04/30/2024
Prepared for:	Ezurio Attn: Brian Petted W66 N220 Commerce Ct. Cedarburg, WI 53012

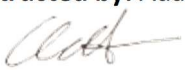
Report Issued by: Adam Hauke, EMC Engineer

Signature:  Date: 08/08/2024

Report Reviewed by: Adam Alger, Manager EMC Laboratory

Signature:  Date: 8/08/2024

Report Constructed by: Adam Hauke, EMC Engineer

Signature:  Date: 08/07/2024

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CONTENTS

Ezurio Test Services in Review

The Ezurio laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

Certificate #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted

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Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers

Government of Canada

Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

1 TEST REPORT SUMMARY

During **01/22/2024-04/30/2024** the Equipment Under Test (EUT), **Module, SONA NX611 M.2 2230, 1 MHF**, as provided by **Ezurio** was tested to the following requirements:

FCC 15.247 | RSS-247 – FHSS Bluetooth Classic

Requirements	Description	Method	Compliant
15.247(d) 15.209 RSS-247 Clause 5.5 RSS-GEN Clause 8.10	Spurious Radiated Emissions in Restricted Bands 30-40000 MHz	ANSI C63.10	Yes
2.1049 RSS-247 Clause 6.6	Occupied Bandwidth and 20dB DTS BW	ANSI C63.10	Yes
15.247(b)(1) RSS-247 Clause 5.4 (b)	RF Output Power	ANSI C63.10	Yes
15.247(d) RSS-247 Clause 5.5 RSS-GEN A1 Clause 8.9	Out-of-band Emissions	ANSI C63.10	Yes
15.247(a)(1) RSS-247 Clause 5.1	Channel Separation, Number of Hopping Frequencies, and Time of Occupancy	ANSI C63.10	Yes
2.1055(d) RSS-GEN 6.11	Frequency Stability	ANSI C63.10	Reported
15.207 RSS-GEN 8.8	AC Conducted Emissions	ANSI C63.10	Yes

Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

Measurement Type	Rule
Emissions – Amplitude	0.1 dB below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

2 CLIENT INFORMATION

Company Name	Ezurio
Contact Person	Brain Petted
Address	W66 N220 Commerce Ct. Cedarburg, WI 53012

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	Module, SONA NX611 M.2 2230, 1 MHF
Part Number	453-00166
Serial Number	00047
FCC ID	SQG-SONANX611M
IC ID	3147A-SONANX611M

2.2 Product Description

The NX611 is based upon NXP IW611 Wi-Fi 6 chipset. Feature-set includes 802.11 a/b/g/n/ac/ax Wi-Fi 6 and Dual-Mode Bluetooth v5.3 (BDR + EDR + BLE).

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 EUT Information

Power Supply – INPUT:100-240VAC 50/60 Hz 0.3A

OUTPUT: 5VDC 2A

Firmware - sduart_nw61x_v1.bin.se

Sduart_nw61x_v1_mfg.bin.se

2.6 Ancillary Equipment

Equipment used for EUT programming (not part of the EUT)

Development Kit, SU60-SOMC 6.0

P/N: 463-00138-K1 Rev 1

Power Supply: INPUT: 100-240 VAC 50/60Hz 0.7A

OUTPUT: 12VDC 2A

HP Elitebook 840G1

Labtool Version: 1.0.0.45.6

2.7 Antenna Information

Manufacturer	Model	Part Number	Dimension	Type	Peak Gain (dBi)	
					2400-2500 MHz	4900-5925 MHz
Laird Connectivity	FlexMIMO 6E	EFD2471A3S-10MH4L	39.5mm X 39.5mm X 4.7mm	PIFA	2.2	3.8
Laird Connectivity	FlexPIFA 6E	EFB2471A3S-10MH4L	16mm X 36mm X 2.5mm	PIFA	2.2	3.9
Laid Connectivity	Mini NanoBlade Flex 6E	EMF2471A3S-10MH4L	36mm X 12mm X 0.3mm	PCB Dipole	2.4	4.4
Joymax Electronics	N/A	TWX-100BRS3B	137mm X 13mm	Dipole	2.0	4.0
Laird Connectivity	FlexPIFA	EFB2455A3S-16MHF1	38.5mm X 12.7 mm X 2.5mm	PIFA	2.5	3.0

2.8 Test Channels

Channel	Frequency (MHz)	Data Rates
0	2402	DH5, 2DH5, and 3DH5
39	2441	
78	2480	

2.9 Power Table and Reduced Video Bandwidth for Average Measurements

Data Rate	Minimum Average VBW (Hz)	Power Setting
DH5	360	6
2DH5	360	6
3DH5	360	6

3 WORST CASE TEST RESULTS SUMMARY

Requirement	Channel and Data Rate	Frequency (MHz)	Measurement	Limit	Margin
2.1049 RSS-247 Clause 6.6 20 dB DTS Bandwidth	39 | DH5	-	956 kHz	at least 500 kHz	-
15.247 (b)(1) RSS-247 Clause 5.4 (b) Output Power	39 | DH5	-	7.0 dBm	30.0 dBm	23.0 dB
15.247 (d) RSS-247 Clause 5.5 Conducted	78 | DH5	2487.5	59.8 dBµV/m	74.0 dBµV/m	14.2 dB
15.247(d) RSS-247 Clause 5.5 RSS-GEN Clause 8.9 Radiated	19 | Basic Rate Single Channel	64.8	34.8 dBµV/m	40.0 dBµV/m	5.2 dB
15.207 RSS-GEN 8.8	37 | 1DH5	0.512	24.2 dBµV	46.0 dBµV	21.8 dB

4 REFERENCES

Publication	Edition	Date	AMD 1	AMD 2
FCC eCFR 47 Part 15	-	2023	-	-
ANSI C63.10	-	2020	-	-
RSS-247	3	2023	-	-
RSS-GEN	5	2018	2019	2021
KDB 558074 D01	-	2019	-	-

5 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References
CISPR 16-4-1
CISPR 16-4-2
CISPR 32
ANSI C63.23
A2LA P103
A2LA P103c
ETSI TR 100-028

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

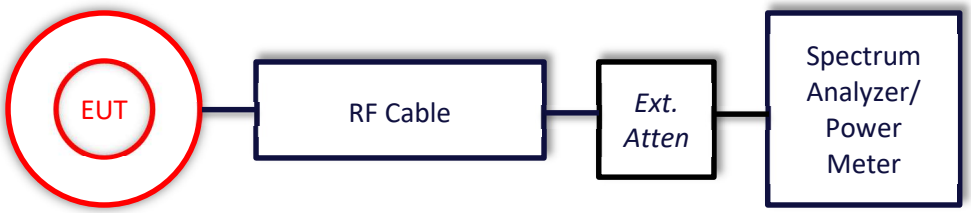
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

6 TEST DATA

6.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



6.1.1 20dB DTS and 99% Occupied Bandwidth

Operator	Dylan Rosenfeldt	**QA**	Adam Hauke
Temperature	22.3°C	**R.H. %**	30.30%
Test Date	03/15/2024	**Location**	Conducted RF Bench
Requirement	2.1049 RSS-247 Clause 6.6	**Method**	ANSI C63.10 6.9

Limits: 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.

Test Parameters

Frequency	2400-2483.5 MHz	**Setup**	Antenna Port
RBW	30 kHz	**VBW**	300 kHz
Detector(s)	Peak	**Settings**	Max Hold

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2023	6/12/2024	Active Verification
EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/27/2023	4/27/2024	Active Calibration

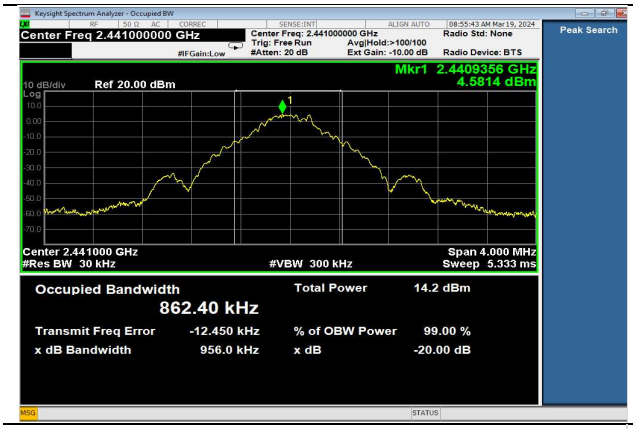
EUT Parameters

Input Power	120 VAC @ 60 Hz	**Mode**	BTC FHSS Tx
Frequency	2400-2483.5 MHz	**Channel**	See 2.9

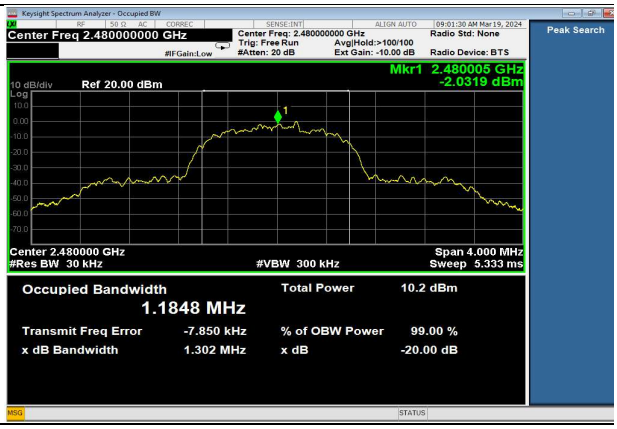
Table

Rate	Channel	20 dB BW (kHz)	99% BW (kHz)
DH5	0	957	858
	39	956	862
	78	957	858
2DH5	0	1333	1180
	39	1332	1180
	78	1338	1179
3DH5	0	1301	1181
	39	1302	1183
	78	1302	1185

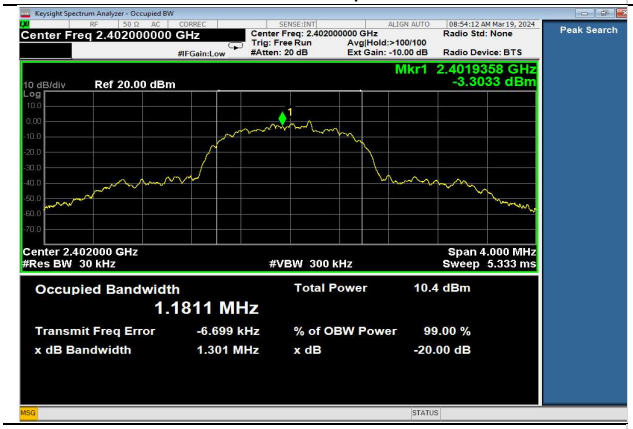
Plots



Channel 39 | DH5



Channel 78 | 2DH5



Channel 0 | 3DH5

6.1.2 RF Output Power

Operator	Dylan Rosenfeldt	**QA**	Adam Hauke
Temperature	21.8°C	**R.H. %**	32.20%
Test Date	03/12/2024	**Location**	Conducted RF Bench
Requirement	15.247 (b)(1) RSS-247 Clause 5.4 (b)	**Method**	ANSI C63.10 11.9.1

Limit: For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.

Test Parameters

Frequency	2400-2483.5 MHz	**Setup**	Antenna Port
RBW	3 MHz	**VBW**	50 MHz
Detector(s)	Peak	**Settings**	Max Hold Span: 10 MHz

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2023	6/12/2024	Active Verification
EE 960088	Analyzer - EMI Receiver	Agilent	N9038A	MY51210138	4/10/2023	4/10/2024	Active Calibration

EUT Parameters

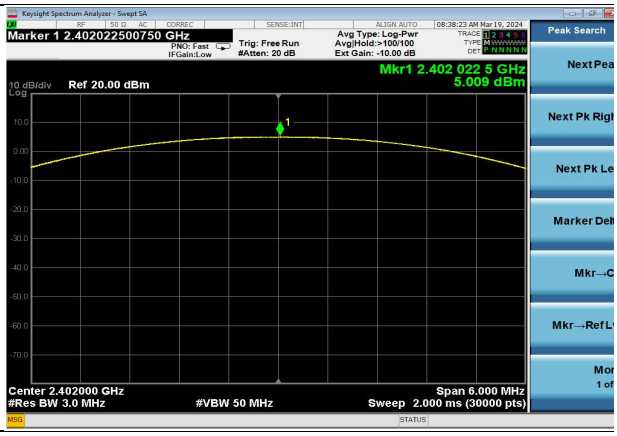
Input Power	120 VAC @ 60 Hz	**Mode**	BTC FHSS Tx
Frequency	2400-2483.5 MHz	**Channel**	See 2.9

Tables

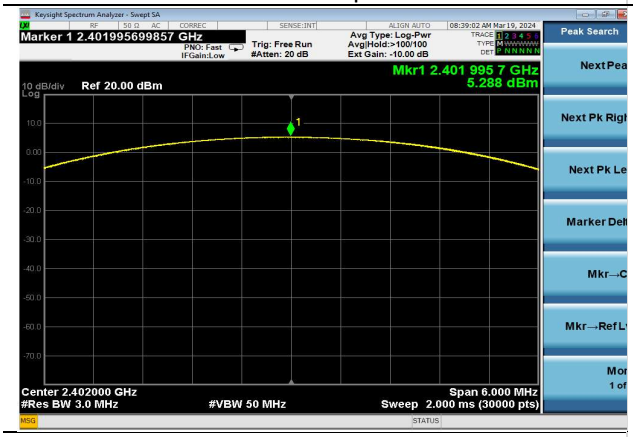
Rate	Channel	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)
DH5	0	6.7	30	23.3
	39	7.0	30	23.0
	78	7.0	30	23.0
2DH5	0	5.0	30	25.0
	39	4.9	30	25.1
	78	4.7	30	25.3
3DH5	0	5.3	30	24.7
	39	5.1	30	24.9
	78	4.9	30	25.1

Plots

Channel 39 | DH5



Channel 0 | 2DH5



Channel 0 | 3DH5

6.1.3 Out-of-band Emissions

Operator	Dylan Rosenfeldt	**QA**	Adam Alger
Temperature	22.3°C | 21.9°C	**R.H. %**	27.30% | 24.50%
Test Date	03/11/2024 | 03/29/2024	**Location**	Conducted RF Bench
Requirement	15.247(d) RSS-247 Clause 5.5	**Method**	ANSI C63.10 11.12.2.5.2

Limits: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement provided the transmitter demonstrates compliance with the peak conducted power limits.

Reference Level (Worst Case PSD)

DH5 – 6.8 dBm/100 kHz

6.8 dBm-20 dB = -13.2 dBm Limit

Test Parameters

Frequency	30-40000 MHz	**Setup**	Antenna Port
RBW	100 kHz	**VBW**	300 kHz
Detector(s)	Peak and Average (RMS)		
Notes	Declared antenna gain for band edge – 2.5 dBi		
Example Calculations	Correction Factor = 20 log (1/D), where D is the duty cycle		

Instrumentation

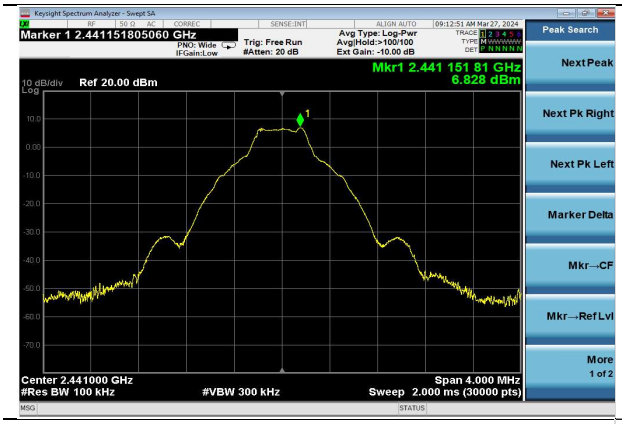
Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960172	Cable	A.H. Systems, Inc.	SAC-26G-1	387	06/13/2023	06/12/2024	Active Verification
EE 960085	Analyzer – Spectrum	Agilent	N9010A	MY53400296	04/11/2023	04/11/2024	Active Calibration
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/11/2023	4/11/2024	Active Calibration
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2023	6/12/2024	Active Verification

Input Power	120 VAC @ 60 Hz	**Mode**	BTC FHSS Tx
Frequency	2400-2483.5 MHz	**Channel**	See 2.8

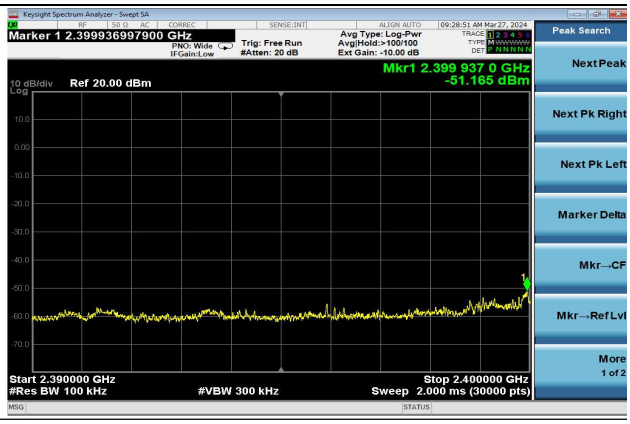
Measurements

Rate	Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Margin (dB)
DH5	0	2399.9	-51.2	-13.2	38.0
	78	2493.0	-49.3	-13.2	36.1
	Hopping	2390.6	-49.9	-13.2	36.7
	Hopping	2489.0	-50.1	-13.2	36.9
2DH5	0	2399.9	-52.3	-13.2	39.1
	78	2483.6	-57.4	-13.2	44.2
	Hopping	2399.6	-55.8	-13.2	42.6
	Hopping	2490.0	-58.1	-13.2	44.9
3DH5	0	2400.0	-50.2	-13.2	37.0
	78	2484.4	-55.3	-13.2	42.1
	Hopping	2399.9	-51.9	-13.2	38.7
	Hopping	2483.8	-56.8	-13.2	43.6

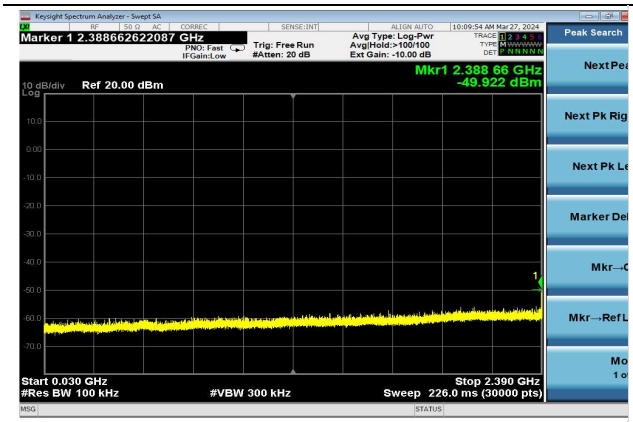
Worst Case Plots



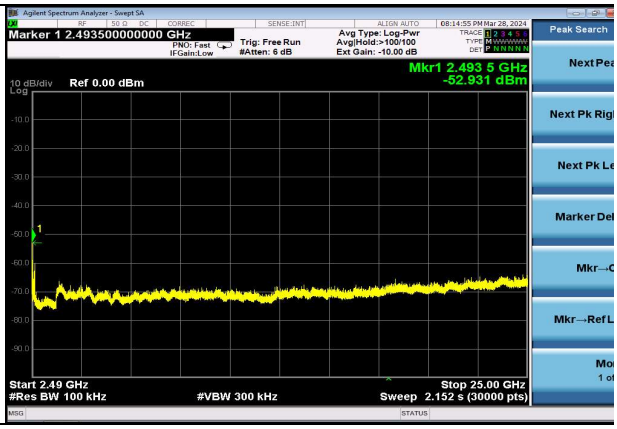
Channel 0 |DH5 | Reference



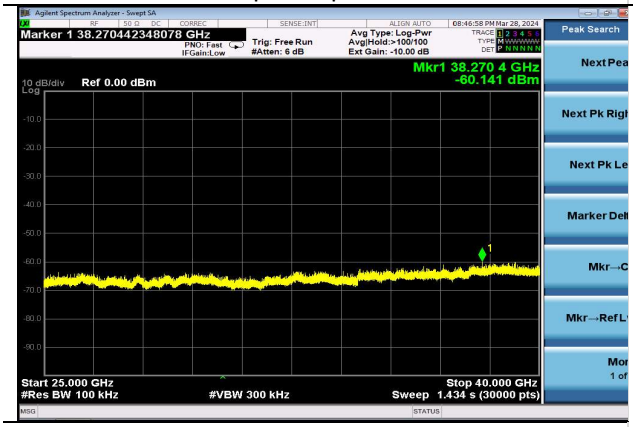
Channel 78 | DH5 | 2390-2400 MHz



Channel 0 | DH5 | 30-2390 MHz



Channel 78 | DH5 | 2490-25000 MHz



Channel 39 | 3DH5 | 25000-40000 MHz

6.1.4 Spurious Emissions in The Restricted Bands

Operator	Dylan Rosenfeldt	**QA**	Adam Alger
Temperature	22.3°C | 21.9°C	**R.H. %**	27.30% | 24.50%
Test Date	03/11/2024 | 03/29/2024	**Location**	Conducted RF Bench
Requirement	15.247(d) RSS-247 Clause 5.5	**Method**	ANSI C63.10 11.12.2.5.2

15.209 Limits:

Frequency (MHz)	Quasi-Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Peak Limit (dBµV/m)
30-88	40.0	-	-
88-216	43.5	-	-
216-960	46.0	-	-
960-1000	54.0	-	-
1000-40000	-	54.0	74.0

Test Parameters

Frequency	30-40000 MHz	**Setup**	Antenna Port
RBW	100 kHz	**VBW**	300 kHz
Detector(s)	Peak and Average (RMS)		
Notes	Declared antenna gain for band edge – 2.5 dBi		
Example Calculations	Correction Factor = 20 log (1/D), where D is the duty cycle EIRP = Measurement + Antenna Gain + Correction Factor E-Field = EIRP – 20log3 + 104.8		

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960172	Cable	A.H. Systems, Inc.	SAC-26G-1	387	06/13/2023	06/12/2024	Active Verification
EE 960085	Analyzer – Spectrum	Agilent	N9010A	MY53400296	04/11/2023	04/11/2024	Active Calibration
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/11/2023	4/11/2024	Active Calibration
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2023	6/12/2024	Active Verification

Input Power	120 VAC @ 60 Hz	**Mode**	BTC FHSS Tx
Frequency	2400-2483.5 MHz	**Channel**	See 2.8

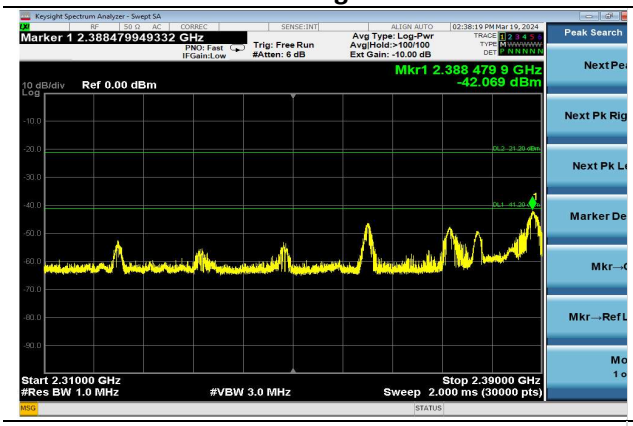
Measurements – Lower Band Edge

Rate	Channel	Measurement Type	Frequency (MHz)	Measurement (dBm)	EIRP (dBm)	E-Field (dBµV/m)	Limit (dBµV/m))	Margin (dB)
DH5	0	Peak	2388.5	-42.1	-39.6	55.7	74.0	18.3
		Average	2385.2	-62.7	-60.2	35.1	54.0	18.9
	Hopping	Peak	2388.1	-44.5	-42.0	53.3	74.0	20.7
		Average	2385.1	-62.9	-60.4	34.9	54.0	19.1
2DH5	0	Peak	2361.8	-55.8	-53.3	42.0	74.0	32.0
		Average	2362.5	-68.4	-65.9	29.4	54.0	24.6
	Hopping	Peak	2385.7	-56.3	-53.8	41.5	74.0	32.5
		Average	2383.4	-68.4	-65.9	29.4	54.0	24.6
3DH5	0	Peak	2361.8	-54.2	-51.7	43.6	74.0	30.4
		Average	2362.5	-68.3	-65.8	29.5	54.0	24.5
	Hopping	Peak	2377.9	-54.4	-51.9	43.4	74.0	30.6
		Average	2383.5	-68.5	-66.0	29.3	54.0	24.7

Measurements – Upper Band Edge

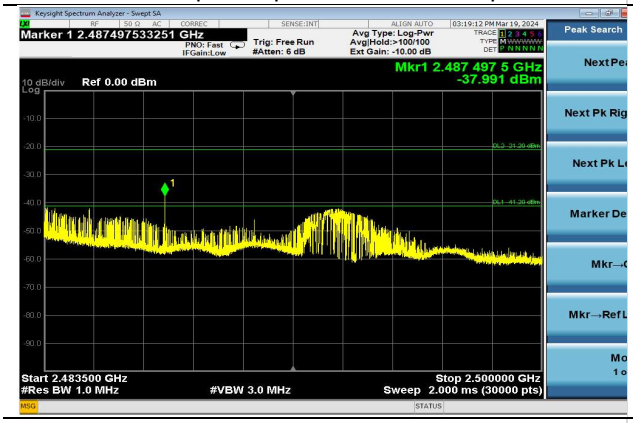
Rate	Channel	Measurement Type	Frequency (MHz)	Measurement (dBm)	EIRP (dBm)	E-Field (dBµV/m)	Limit (dBµV/m))	Margin (dB)
DH5	78	Peak	2487.5	-38.0	-35.5	59.8	74.0	14.2
		Average	2483.5	-61.2	-58.7	36.6	54.0	17.4
	Hopping	Peak	2492.0	-42.0	-39.5	55.8	74.0	18.2
		Average	2483.7	-62.6	-60.1	35.2	54.0	18.8
2DH5	78	Peak	2483.5	-41.1	-38.6	56.7	74.0	17.3
		Average	2483.5	-63.8	-61.3	34.0	54.0	20.0
	Hopping	Peak	2484.1	-44.0	-41.5	53.8	74.0	20.2
		Average	2483.5	-64.4	-61.9	33.4	54.0	20.6
3DH5	78	Peak	2483.5	-41.6	-39.1	56.2	74.0	17.8
		Average	2483.5	-63.4	-60.9	34.4	54.0	19.6
	Hopping	Peak	2483.5	-44.5	-42.0	53.3	74.0	20.7
		Average	2483.5	-63.7	-61.2	34.1	54.0	19.9

Worst Case Plots – Band Edge

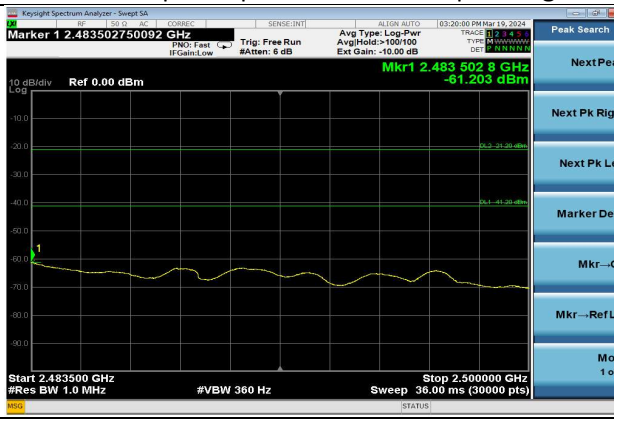


Channel 0 | DH5 | 2310-2390 MHz | Peak

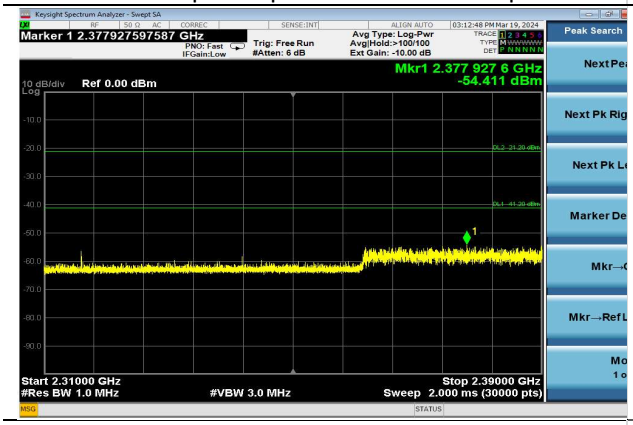
Channel 0 | DH5 | 2310-2390 MHz | Average



Channel 78 | DH5 | 2483.5-2500 MHz | Peak

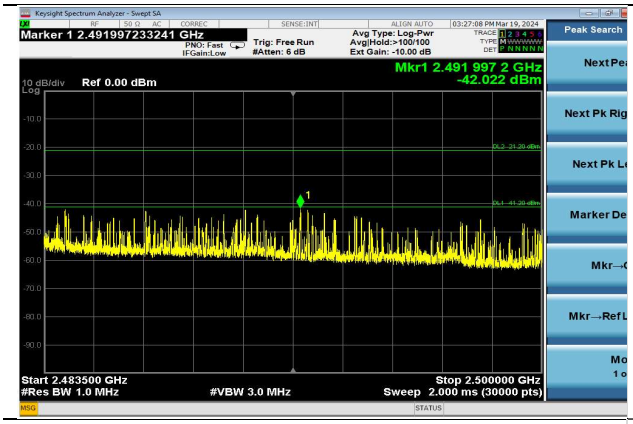


Channel 78 | DH5 | 2483.5-2500 MHz | Average

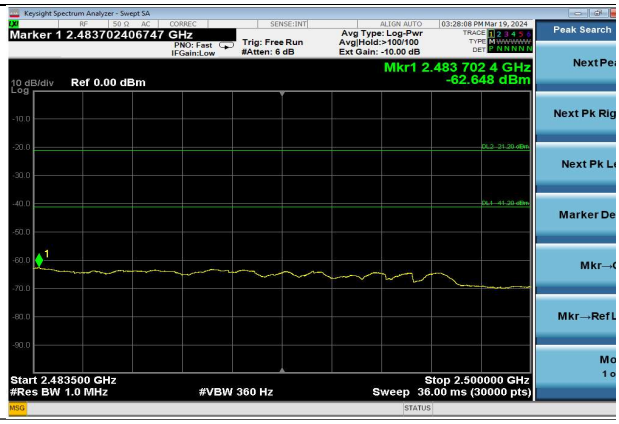


Hopping | 3DH5 | 2310-2390 MHz | Peak

Hopping | 3DH5 | 2310-2390 MHz | Average



Hopping | DH5 | 2483.5-2500 MHz | Peak

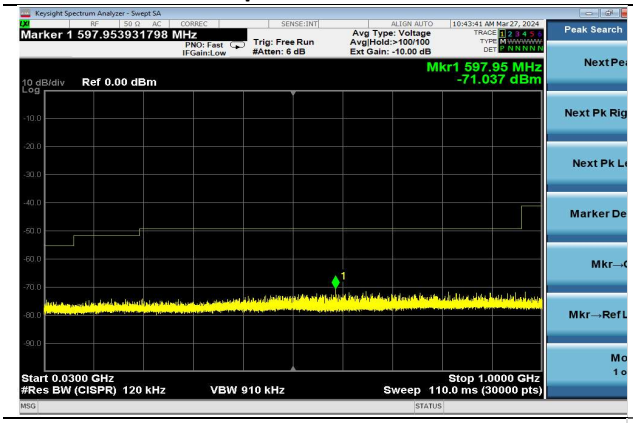


Hopping | DH5 | 2483.5-2500 MHz | Average

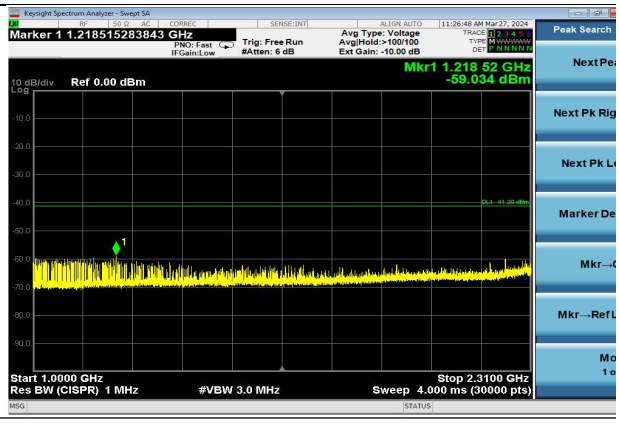
Measurements - Spurious

Rate	Channel	Measurement Type	Frequency (MHz)	Measurement (dBm)	EIRP (dBm)	E-Field (dBµV/m)	Limit (dBµV/m))	Margin (dB)
DH5	0	Peak	1217.7	-59.6	-57.1	38.2	74.0	35.8
		Average	1224.6	-77.7	-75.2	20.1	54.0	33.9
	39	Peak	2281.1	-53.5	-51.0	44.3	74.0	29.7
		Average	2281.2	-69.3	-66.8	28.5	54.0	25.5
2DH5	78	Peak	2801.0	-50.5	-48.0	47.3	74.0	26.7
		Average	2799.8	-75.2	-72.7	22.6	54.0	31.4
3DH5	0	Peak	2725.0	-51.8	-49.3	46.0	74.0	28.0
		Average	2721.8	-75.2	-72.7	22.6	54.0	31.4
	78	Peak	3DH5	2802.1	-50.7	-48.2	47.1	74.0
		Average	3DH5	2800.0	-75.2	-72.7	22.6	54.0

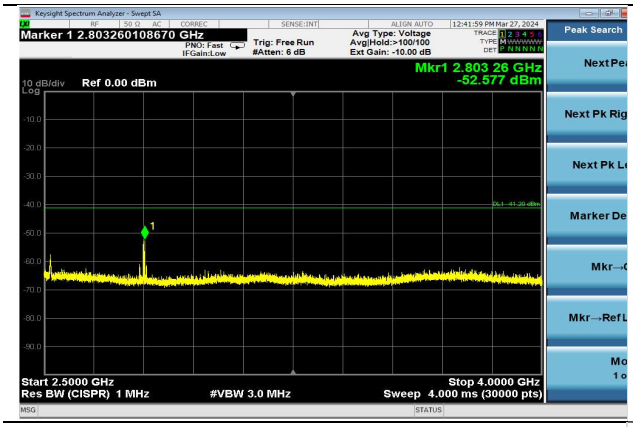
Worst Case Plots - Spurious



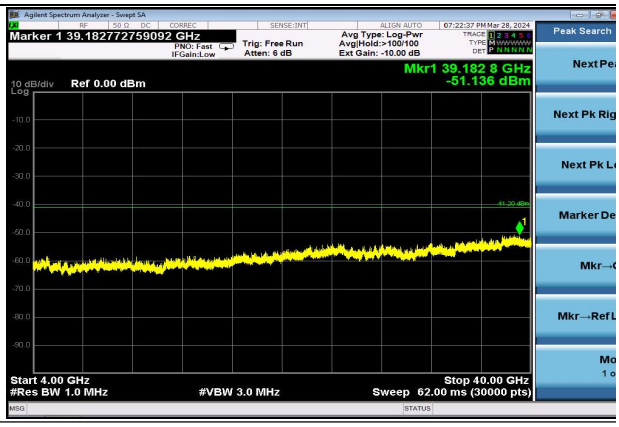
Channel 0 | DH5 | 30-1000 MHz



Channel 0 | 2DH5 | 1000-2310 MHz



Channel 78 | 3DH5 | 2500-4000 MHz



Channel 0 | DH5 | 4000-40000 MHz

6.1.5 Frequency Stability | Channel Separation | Number of Hopping Frequencies | Time of Occupancy

Operator	Dylan Rosenfeldt	**QA**	Anthony Smith
Temperature	21.6°C | 22.0°C	**R.H. %**	30.00% | 29.10%
Test Date	04/24/2024-04/25/2024	**Location**	Conducted RF Bench
Requirement	15.247(a)(1) 2.1055 (d) RSS-247 Clause 5.1 RSS-GEN Clause 6.11	**Method**	ANSI C63.10

Test Parameters

Frequency	2402-2480 MHz	**Voltage**	4.3 VDC, 5 VDC, and 5.8 VDC
Detector(s)	Peak	**Settings**	Max Hold

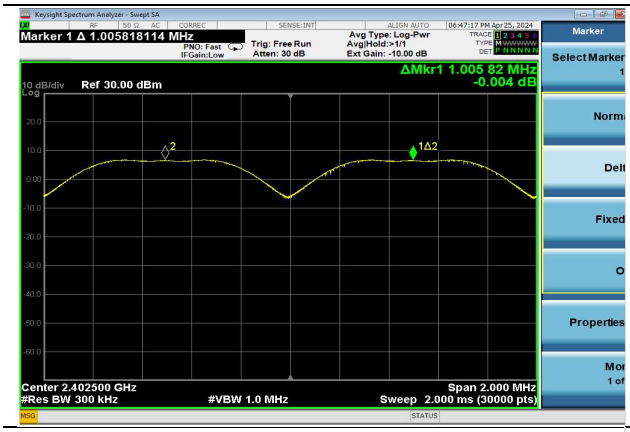
Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	387	06/13/2023	06/12/2024	Active Verification
EE 960088	Analyzer - EMI Receiver	Agilent	N9038A	MY51210138	4/10/2023	4/10/2024	Active Calibration

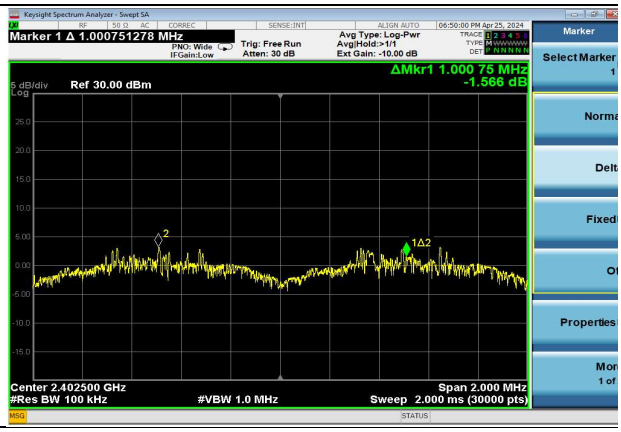
Frequency Stability Table

Channel	Voltage (VDC)	Center Frequency (Hz)
0	5	2401999913
	4.3	2401999390
	5.8	2402000063
39	5	2440999125
	4.3	2440998913
	5.8	2440999248
78	5	2480000066
	4.3	2480000109
	5.8	2480000138

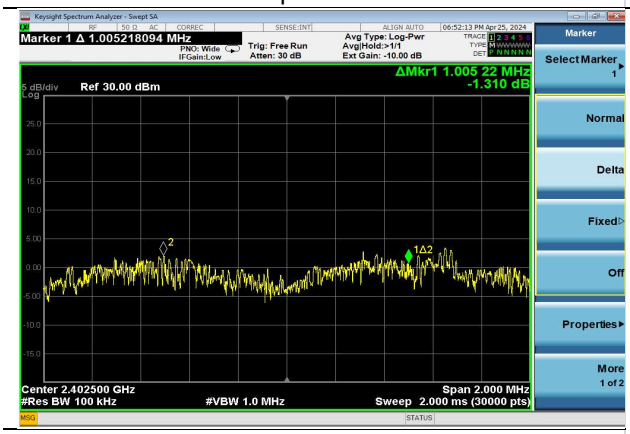
Carrier Frequency Separation



1DH5 | 1.006 MHz



2DH5 | 1.001 MHz



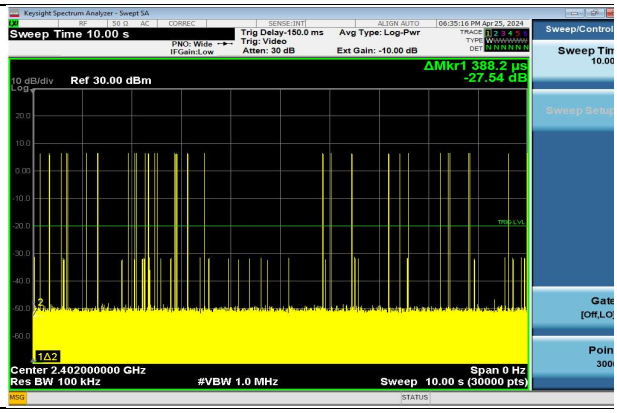
3DH5 | 1.005 MHz

Dwell Time

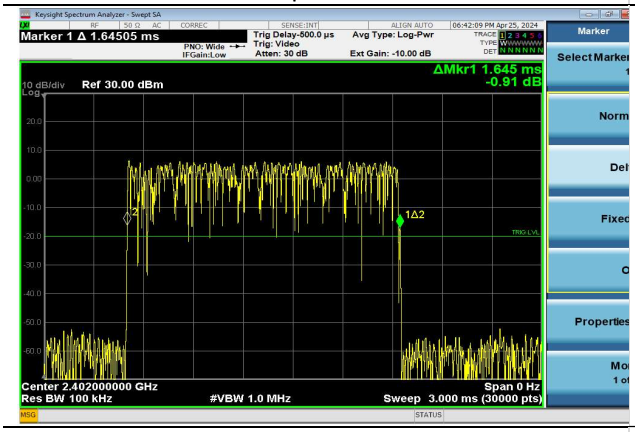
Rate	Length of Transmission on Time (ms)	Number of Transmissions in 31.6s (79 Hopping *0.4)	Result (s)	Limit (s)	Margin (s)
1DH5	2.892	126.4	0.366	0.400	0.034
1DH3	1.645	180.1	0.296	0.400	0.104
1DH1	0.388	350	0.136	0.400	0.264

Plots

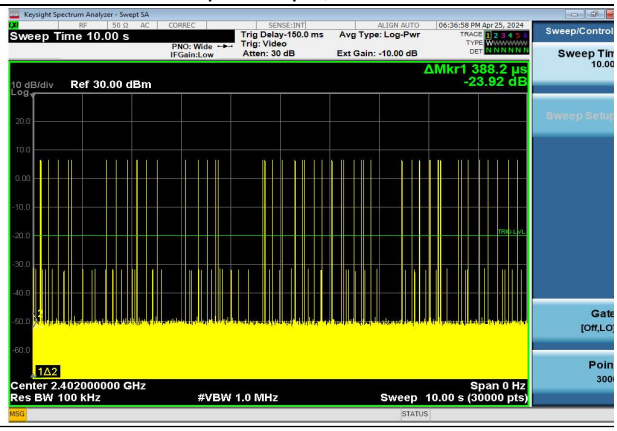
1DH5 | 2.892 ms



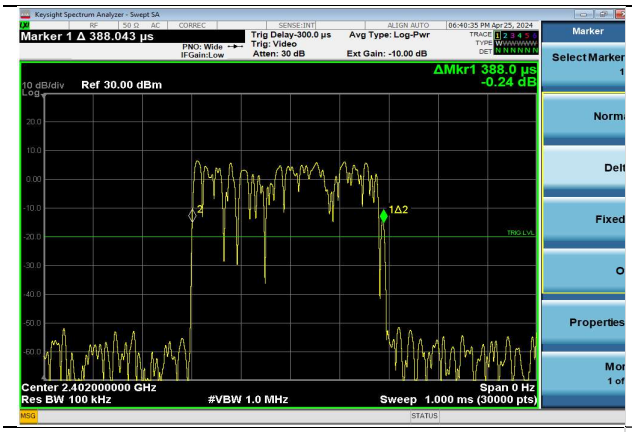
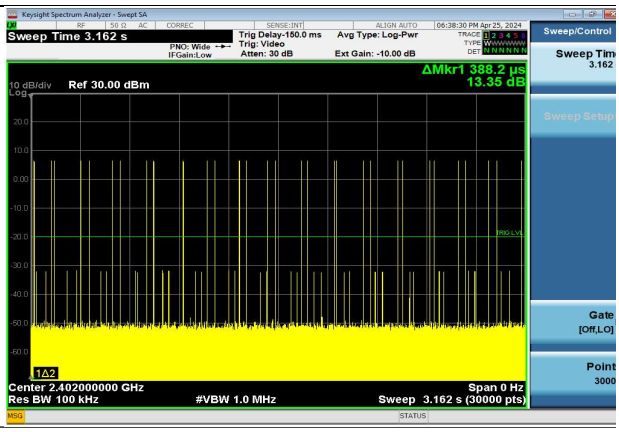
1DH5 | 40 hops / 10 seconds



1DH3 | 1.645 ms



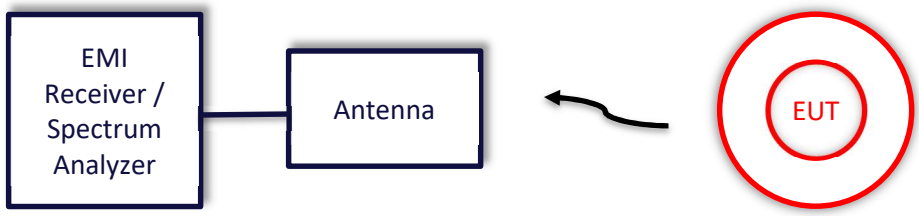
1DH3 | 57 hops / 10 seconds

	
1DH1 | 388 µs	1DH1 | 35 hops / 3.16 seconds

6.2 Radiated Emissions

Description of Measurement	The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values. The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.
Example Calculations	Measurement (dBµV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBµV/m) Margin (dB) = Limit (dBµV/m) - Corrected Reading (dBµV/m) Example at 4000 MHz: Reading = 40 dBµV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBµV/m Average Limit = 20 log (500) = 54 dBµV/m Margin = 54 dBµV/m - 50.8 dBµV/m = 3.2 dB

Block Diagram



6.2.1 Spurious Radiated Emissions in the Restricted Bands

Operator	Mitchell Freund | Nicole Sedmak Jon Dilley | Zachary Brown	**QA**	Anthony Smith | Adam Alger Adam Hauke | Dylan Rosenfeldt
Temperature	23.4°C-24.0°C	**R.H. %**	19.90%-32.40%
Test Date	03/14/2024-03/21/2024	**Location**	Chamber 3 | Chamber 5
Requirement	15.247 (d) | 15.209 RSS-247 Clause 5.5 RSS-GEN Clause 8.9	**Method**	ANSI C63.10

15.209 Limits:

Frequency (MHz)	Quasi-Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Peak Limit (dBµV/m)
30-88	40.0	-	-
88-216	43.5	-	-
216-960	46.0	-	-
960-1000	54.0	-	-
1000-40000	-	54.0	74.0

Test Parameters

Frequency	30-40000 MHz	**Distance**	3 m
Detector(s)	Peak Trace Peak and Average Final	**Table height**	150 cm
RBW	<1000 MHz – 120 kHz >1000 – 1 MHz	**VBW**	<1000 – 1.2 MHz >1000 – See 2.9

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960007	Antenna - Double Ridge Horn	EMCO	3115	9311-4138	8/10/2023	8/10/2024	Active Calibration
AA 960081	Antenna - Double Ridge Horn	EMCO	3115	6907	1/11/2024	1/11/2025	Active Calibration
AA 960154	Filter - High Pass 2.4 GHz	KWM	HPF-L-14186	7272-02	4/11/2023	4/11/2024	Active Calibration
AA 960163	Antenna - Log Periodic	A.H. Systems, Inc.	SAS-512-2	500	8/10/2023	8/10/2024	Active Calibration
AA 960217	Antenna - Biconical	A.H. Systems, Inc.	SAS-540	852	7/17/2023	7/17/2024	Active Calibration
AA 960221	Cable	A.H. Systems, Inc.	SAC-26G-6	524	6/13/2023	6/13/2024	Active Verification
EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/27/2023	4/27/2024	Active Calibration

EE 960203	Analyzer - EMI Receiver	Keysight	N9038A	MY56400072	4/11/2023	4/11/2024	Active Calibration
LSC-300	Cable	Chamber 3 Emissions	-	-	1/5/2024	1/5/2025	Active Verification
LSC-500	Cable	Chamber 5 Emissions	-	-	1/8/2024	1/8/2025	Active Verification

EUT Parameters

Input Power	120 VAC @ 60 Hz	**Mode**	BTC FHSS Tx
EUT	X, Y, Z Plane Orientations Antenna ports terminated with 50 Ω SMA terminators	**AE**	HP Elitebook 840G1 Ezurio – SOM60 Development Kit
Notes	6000 MHz Emission from auxiliary equipment. Not a function of the EUT.		

Radiated Spurious – 30-1000 MHz – Channel 19 – Basic Rate - Single

Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)
44.0	Vertical	102	254	32.1	40.0	7.9
64.8	Horizontal	281	158	34.8	40.0	5.2
77.0	Vertical	101	138	26.3	40.0	13.7
84.0	Horizontal	228	164	29.1	40.0	10.9
131.7	Horizontal	230	201	27.7	43.5	15.8
132.3	Vertical	100	49	34.2	43.5	9.3

*The spurious signals detected do not depend on either the operating channel or the modulation mode

1000-40000 MHz

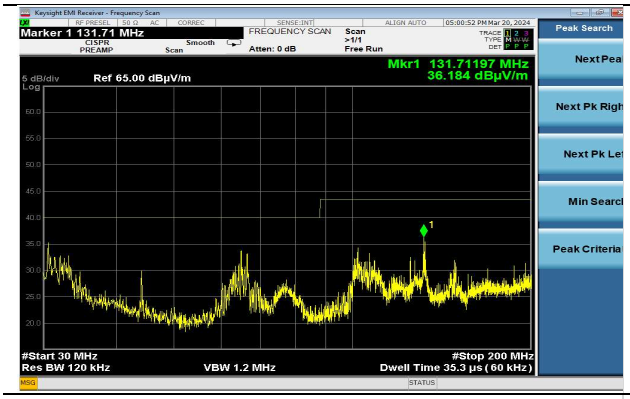
Band Edge

Channel	EUT Orientation	Data Rate	Measurement Type	Frequency (MHz)	Antenna Polarity	Measurement (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0	Z Plane	BR (Single)	Peak	2345.2	Horizontal	47.1	68.2	21.1
			Average	2387.9	Horizontal	34.9	54.0	19.1
		BR (Hopping)	Peak	2349.9	Horizontal	46.8	68.2	21.4
			Average	2378.6	Horizontal	34.9	54.0	19.1
		EDR2 (Single)	Peak	2388.5	Horizontal	47.3	68.2	20.9
			Average	2386.0	Horizontal	34.9	54.0	19.1
		EDR2 (Hopping)	Peak	2341.3	Horizontal	46.9	68.2	21.3
			Average	2388.3	Horizontal	35.0	54.0	19.0
		EDR# (Single)	Peak	2370.8	Horizontal	46.8	68.2	21.4
			Average	2389.7	Horizontal	34.9	54.0	19.1
		EDR (Hopping)	Peak	2334.9	Horizontal	46.4	68.2	21.8
			Average	2384.4	Horizontal	34.8	54.0	19.2
39	Z Plane	BR (Single)	Peak	2489.4	Horizontal	47.6	68.2	20.6
			Average	2491.9	Horizontal	35.0	54.0	19.0
		BR (Hopping)	Peak	2493.1	Horizontal	47.6	68.2	20.6
			Average	2485.1	Horizontal	35.0	54.0	19.0
		EDR2 (Single)	Peak	2497.0	Horizontal	47.2	68.2	21.0
			Average	2493.6	Horizontal	35.0	54.0	19.0
		EDR2 (Hopping)	Peak	2495.9	Horizontal	47.0	68.2	21.2
			Average	2495.2	Horizontal	35.0	54.0	19.0
		EDR# (Single)	Peak	2486.0	Horizontal	47.0	68.2	21.2
			Average	2497.9	Horizontal	35.0	54.0	19.0
		EDR (Hopping)	Peak	2496.5	Horizontal	46.8	68.2	21.4
			Average	2498.6	Horizontal	35.0	54.0	19.1

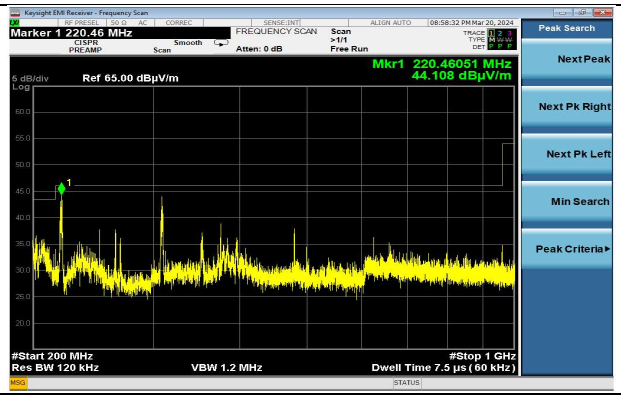
Spurious

No Emissions Present

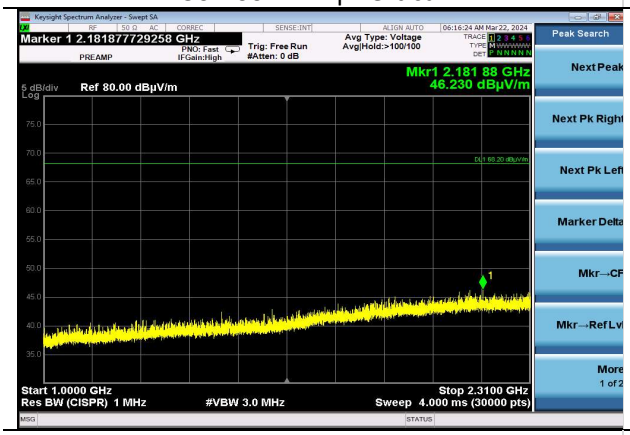
Worst Case Plots



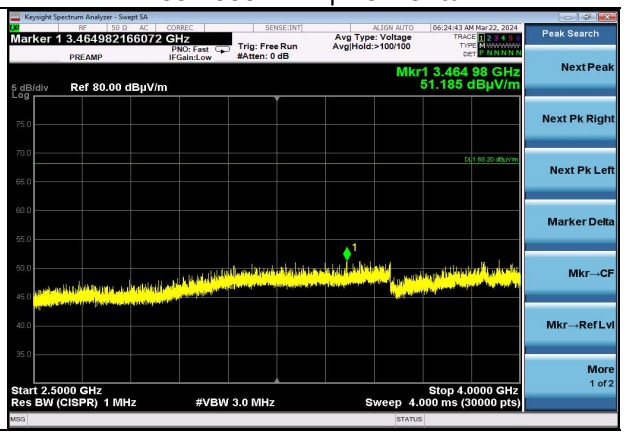
Channel 39 | Basic Rate | Single
30-200 MHz | Vertical



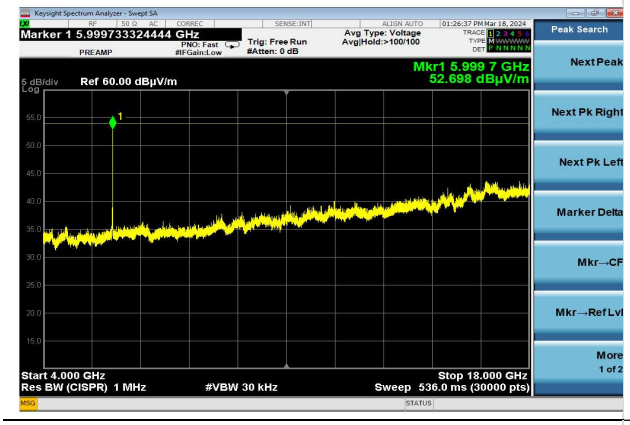
Channel 39 | Basic Rate | Single
200-1000 MHz | Horizontal



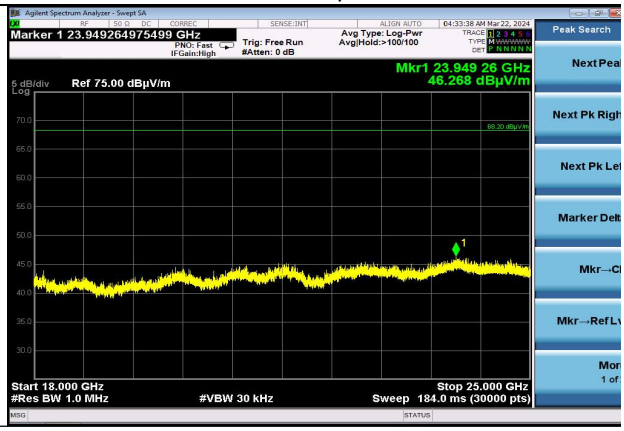
Channel 0 | Basic Rate | Single
1000-2310 MHz | Horizontal



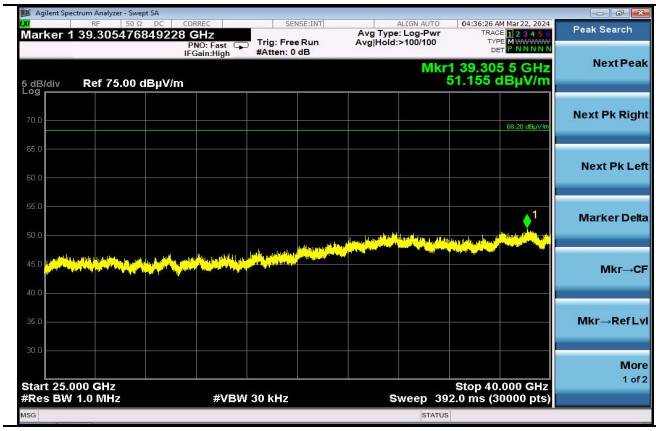
Channel 78 | Basic Rate | Single
2500-4000 MHz | Horizontal



Channel 39 | Basic Rate | Single
4000-18000 MHz | Vertical



Channel 39 | Basic Rate | Single
18000-25000 MHz | Horizontal

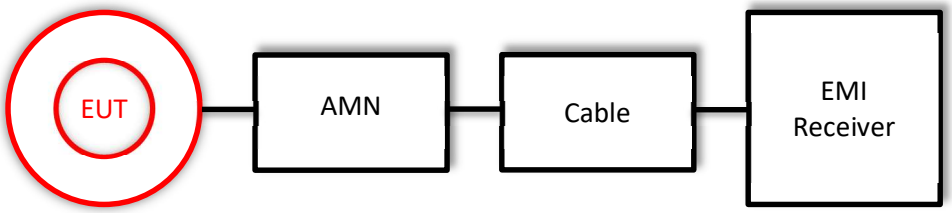


Channel 39 | Basic Rate | Single
25000-40000 MHz | Horizontal

6.3 AC Mains Conducted Emissions

Description of Measurement	A line impedance stabilization network (LISN) or artificial mains network (AMN) allows the emissions of the power supply conductors to be measured while isolating the EUT from the supply mains. The AMN, cable, and other necessary measurement system correction factors are loaded onto the EMI receiver when the measurements are performed. The data is gathered and reported as the corrected values. Maximum emissions are determined with a peak max hold trace then measurements at a selection of the highest points are made with quasi-peak and average detectors. Results are recorded and compared to limit for each line. (e.g. line and neutral)
Example Calculations	Measurement (dBµV) + Cable factor (dB) + Other (dB) = Corrected Reading (dBµV) Margin (dB) = Limit (dBµV) - Corrected Reading (dBµV)

Block Diagram



6.3.1 AC Mains Conducted Emissions

Operator	Jon Dilley	**QA**	Adam Hauke
Temperature	20.8°C	**R.H. %**	19.60%
Test Date	1/22/2024	**Location**	AC Conducted Bench
Requirement	15.207 RSS-GEN Clause 8.8	**Method**	ANSI C63.10

Limits:

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)
0.15-0.5	66.0-56.0*	56.0-46.0*
0.5-5	56.0	46.0
5-30	60.0	50.0

*Decreases with the logarithm of the frequency.

Test Parameters

Frequency	0.15-30 MHz	**Distance**	40 cm from wall 80 cm from LISN
Detector(s)	Peak Trace Quasi-Peak, Average Final	**Table height**	80 cm
RBW	9 kHz	**VBW**	62 kHz
Notes	Channel has no effect on emission		

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960088	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/27/2023	4/27/2024	Active Calibration
EE 960089	LISN	COM-POWER	LI-215A	191943	4/10/2023	4/10/2024	Active Calibration
EE 960162	LISN	COM-POWER	LI-215A	191969	4/10/2023	4/10/2024	Active Calibration
LSC-212	Cable	Micro-Coax	UFB311A-0-1440-70U70U	64639 224071-001	1/8/2024	1/8/2025	Active Verification

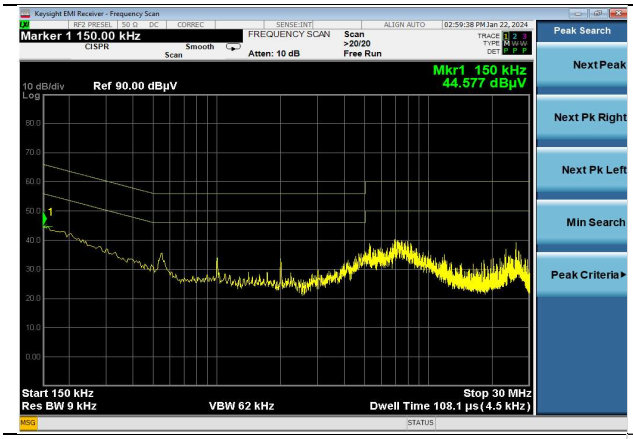
EUT Parameters

Input Power	120 VAC @ 60 Hz	**Mode**	BTC Tx Channel 37 1DH5

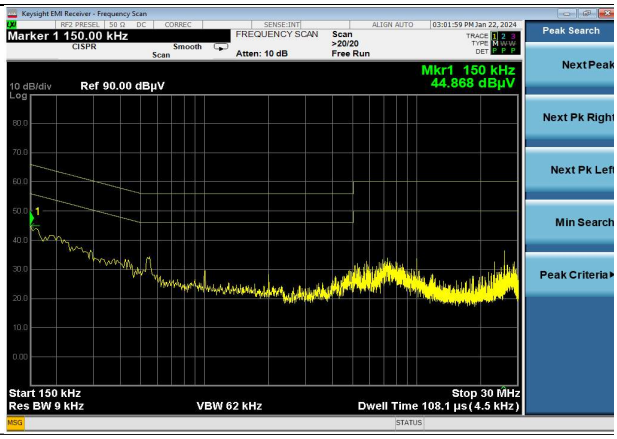
Measurements

Line	Frequency (MHz)	Quasi Peak Reading (dBµV)	Quasi-Peak Limit (dBµV)	Quasi Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
1	0.155	39.3	65.8	26.5	29.6	55.8	26.2
1	0.512	30.2	56.0	25.8	24.2	46.0	21.8
1	11.760	36.0	60.0	24.0	25.1	50.0	24.9
2	0.150	39.7	66.0	26.3	30.2	56.0	25.8
2	0.517	30.8	56.0	25.2	23.6	46.0	22.4
2	11.860	30.2	60.0	29.8	18.1	50.0	31.9

Plots



Line 1



Line 2

7 REVISION HISTORY

Version	Date	Notes	Person
0.0	08/05/2024	Initial Draft	Adam Hauke
1.0	08/08/2024	Final Draft	Adam Hauke

END OF REPORT