Test Report TR3768-166-BLE

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

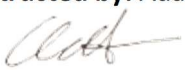
Report Issued by: Adam Hauke, EMC Engineer

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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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 – DTS Bluetooth Low Energy

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
15.247(a)(2) RSS-247 Clause 5.2 (a)	6dB and 99% Occupied Bandwidth	ANSI C63.10	Yes
15.247(b)(3) RSS-247 Clause 5.4 (d)	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(e) RSS-247 Clause 5.2 (b)	Power Spectral Density	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	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	Brian 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	3174A-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	125k, 500k, 1M and 2M
19	2440	
39	2480	

2.9 Power Table and Reduced Video Bandwidth for Average Measurements

Data Rate	Minimum Average VBW (Hz)	Power Setting
125 kbps	1000	6
500 kbps	330	6
1 Mbps	2700	6
2 Mbps	5100	6

3 WORST CASE TEST RESULTS SUMMARY

Requirement	Channel and Data Rate	Frequency (MHz)	Measurement	Limit	Margin
15.247 (a)(2) RSS-247 Clause 5.2(a)	39 | 500 kbps	-	648 kHz	at least 500 kHz	-
15.247 (b)(3) RSS-247 Clause 5.4 (d)	0 | 1 Mbps	-	7.1 dBm	30 dBm	22.9 dB
15.247 (e) RSS-247 Clause 5.2 (b)	19 | 125 kbps	-	7.0 dBm/100 kHz	8.0 dBm/3 kHz	1.0 dB
15.247 (d) RSS-247 Clause 5.5 Conducted	0 | 1 Mbps	2385.1	-58.6 dBm	-41.2 dBm	17.4 dB
	39 | 2 Mbps	2483.5	-51.7 dBm	-41.2 dBm	10.5 dB
15.247(d) RSS-247 Clause 5.5 RSS-GEN Clause 8.9 Radiated	19 | 1 Mbps	220.0	43.5 dBµV/m	46.0 dBµV/m	2.5 dB
15.207	17 | 1 Mbps	0.517	24.9 dBµV	46.0 dBµV	21.1 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

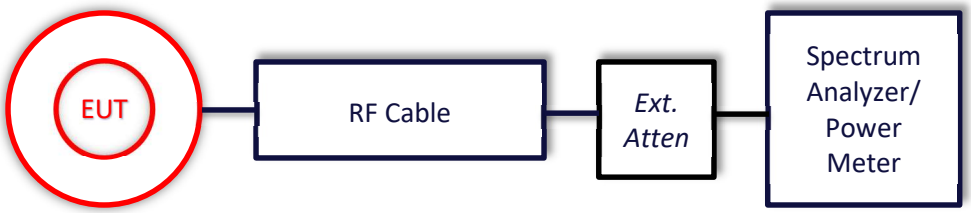
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
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 6dB 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	15.247 (a)(2) RSS-247 Clause 5.2 (a)	**Method**	ANSI C63.10 6.9

Limits: The minimum 6 dB bandwidth shall be at least 500 kHz

Test Parameters

Frequency	2400-2483.5 MHz	**Setup**	Antenna Port
RBW	99% OBW - 30 kHz 6dB DTS - 100 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

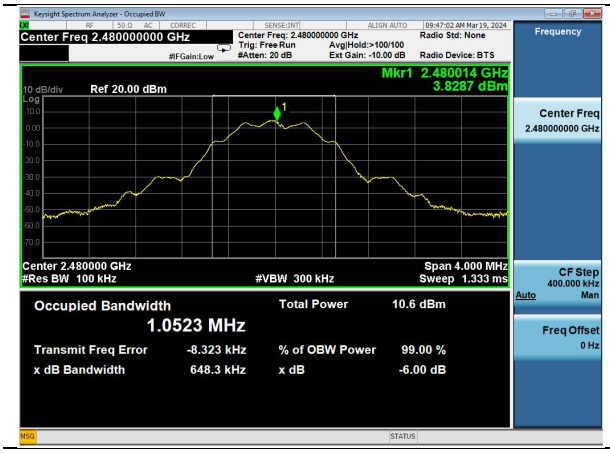
EUT Parameters

Input Power	120 VAC @ 60 Hz	**Mode**	BLE Tx
Frequency	2400-2483.5 MHz	**Channel**	See 2.10

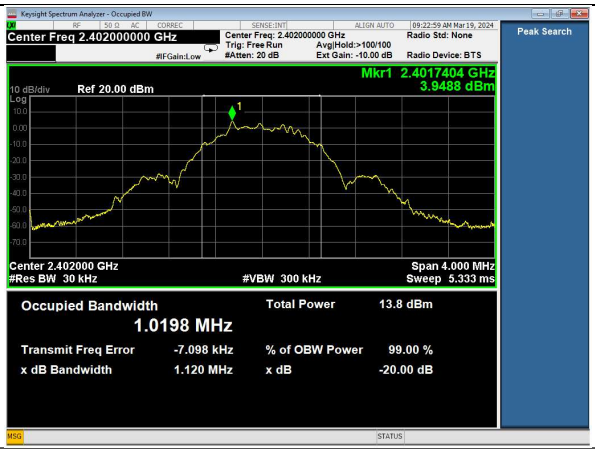
Table

Rate	Channel	6 dB BW (kHz)	99% BW (kHz)
1 Mbps	0	704	1036
	19	700	1036
	39	700	1036
2 Mbps	0	1166	2056
	19	1168	2058
	39	1167	2058
500 kbps	0	649	1056
	19	650	1057
	39	648	1059
125 kbps	0	670	1020
	19	670	1021
	39	670	1021

Plots



Channel 39 | 500k | 6 dB DTS BW



Channel 0 | 125k | 99% OBW

6.1.2 RF Output Power

Operator	Dylan Rosenfeldt	**QA**	Adam Hauke
Temperature	21.9°C-22.1°C	**R.H. %**	31.50%-33.30%
Test Date	03/12/2024 | 03/15/2024	**Location**	Conducted RF Bench
Requirement	15.247 (b)(3) RSS-247 Clause 5.4 (d)	**Method**	ANSI C63.10 11.9.1

Limit: The maximum peak conducted output power of the intentional radiator shall not exceed 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**	BLE Tx
Frequency	2400-2483.5 MHz	**Channel**	See 2.10

Tables

Rate	Channel	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)
1 Mbps	0	6.6	30.0	23.4
	19	7.1	30.0	22.9
	39	7.1	30.0	22.9
2 Mbps	0	6.6	30.0	23.4
	19	7.1	30.0	22.9
	39	7.1	30.0	22.9
500 kbps	0	6.7	30.0	23.3
	19	7.0	30.0	23.0
	39	7.0	30.0	23.0
125 kbps	0	6.7	30.0	23.3
	19	7.0	30.0	23.0
	39	7.0	30.0	23.0

Plots

Channel 19 | 1 Mbps

Channel 19 | 2 Mbps

6.1.3 Power Spectral Density

Operator	Dylan Rosenfeldt	**QA**	Adam Hauke
Temperature	21.8°C	**R.H. %**	33.70%
Test Date	03/13/2024	**Location**	Conducted RF Bench
Requirement	15.247 (e) RSS-247 Clause 5.2 (b)	**Method**	ANSI C63.10 11.10.2

Limits: Power spectral density shall not be greater than 8 dBm in any 3 kHz band.

Test Parameters

Frequency	2400-2483.5 MHz	**Detector(s)**	Peak
RBW	100 kHz	**VBW**	300 kHz
Notes	The same method of determining the conducted output power shall be used to determine the power spectral density		

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**	BLE Tx
Frequency	2400-2483.5 MHz	**Channel**	See 2.10

Table

Rate	Channel	Peak PSD (dBm/100 kHz)	Limit (dBm/3 kHz)	Margin (dB)
1 Mbps	0	6.1	8.0	1.9
	19	6.4	8.0	1.6
	39	6.4	8.0	1.6
2 Mbps	0	6.2	8.0	1.8
	19	6.5	8.0	1.5
	39	6.5	8.0	1.5
500 kbps	0	4.5	8.0	3.5
	19	4.8	8.0	3.2
	39	4.8	8.0	3.2
125 kbps	0	6.6	8.0	1.4
	19	7.0	8.0	1.0
	39	6.9	8.0	1.1

Plots

Channel 19 | 125 kbps

Channel 39 | 125 kbps

6.1.4 Out-of-band Emissions

Operator	Dylan Rosenfeldt	**QA**	Adam Alger
Temperature	21.3°C | 22.0°C	**R.H. %**	23.00% | 24.60%
Test Date	03/18/2024 | 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)

Channel 0 – 125 kbps – 7.0 dBm/100 kHz

7.0 dBm-20 dB = -13.0 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

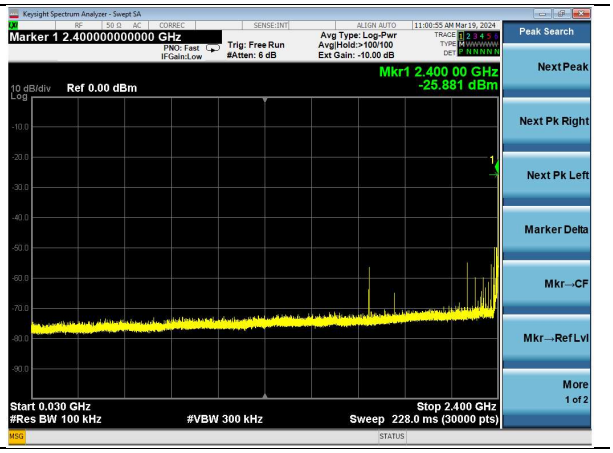
Input Power	120 VAC @ 60 Hz	**Mode**	2.4 GHz WLAN Tx
Frequency	2400-2483.5 MHz	**Channel**	See 2.8

Measurements

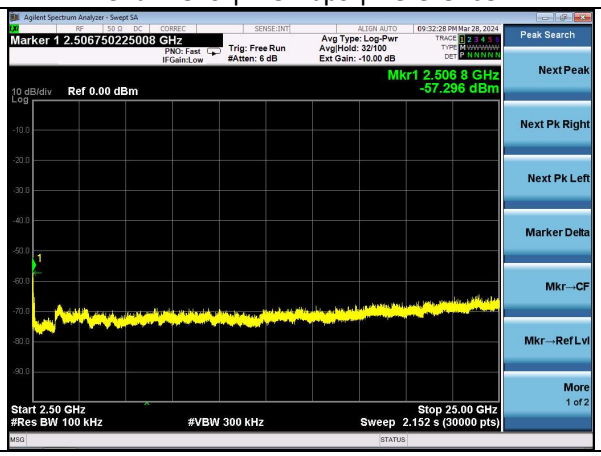
Rate	Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Margin (dB)
1 Mbps	0	2388.6	-50.0	-13.0	37.0
2 Mbps	0	2400.0	-25.9	-13.0	12.9
	39	2506.3	-56.5	-13.0	43.5
500 kbps	0	2388.7	-51.2	-13.0	38.2
125 kbps	0	2388.5	-50.2	-13.0	37.2

Worst Case Plots

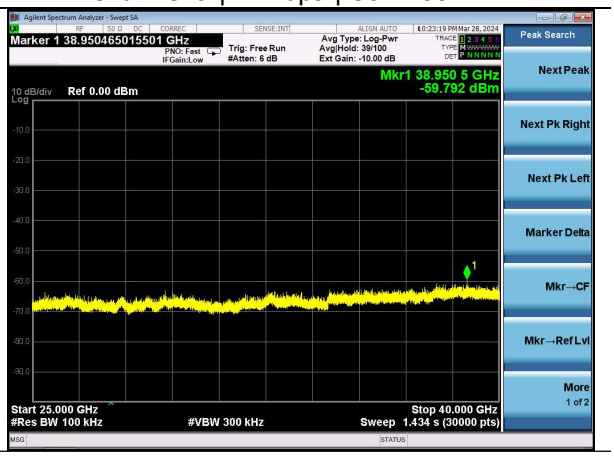
Channel 0 |125 kbps | Reference



Channel 0 | 2 Mbps | 30-2400 MHz



Channel 39| 2 Mbps | 2500-25000 MHz



Channel 39| 2 Mbps | 25000-40000 MHz

6.1.5 Spurious Emissions in Restricted Bands

Operator	Dylan Rosenfeldt	**QA**	Adam Alger
Temperature	21.7°C | 20.9°C	**R.H. %**	34.40% | 24.90%
Test Date	03/08/2024 | 03/11/2024	**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	1 MHz	**VBW**	3 MHz
Detector(s)	Peak	**Method**	Terminated
Notes	Declared antenna gain– 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

EUT Parameters

Input Power	120 VAC @ 60 Hz	**Mode**	BLE Tx
Frequency	2402 MHz | 2440 MHz	**Channel**	0 | 19

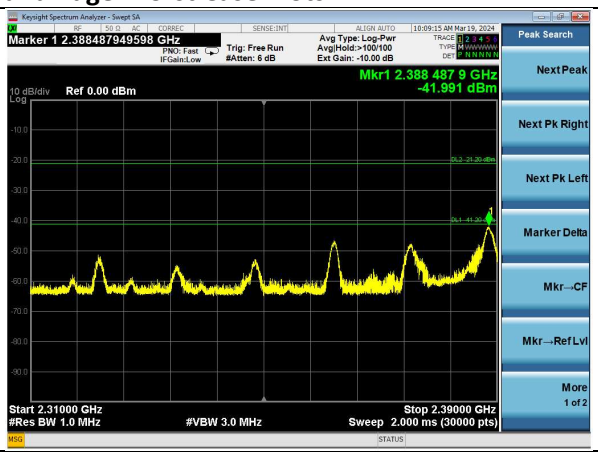
Measurements – Lower Band Edge

Rate	Channel	Measurement Type	Frequency (MHz)	Measurement (dBm)	EIRP (dBm)	E-Field (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1 Mbps	0	Peak	2388.5	-42.0	-39.5	55.8	74.0	18.2
	0	Average	2385.1	-61.1	-58.6	36.7	54.0	17.3
2 Mbps	0	Peak	2388.2	-42.1	-39.6	55.7	74.0	18.3
	0	Average	2385.2	-62.3	-59.8	35.5	54.0	18.5
500 kbps	0	Peak	2388.9	-42.4	-39.9	55.4	74.0	18.6
	0	Average	2385.3	-62.6	-60.1	35.2	54.0	18.8
125 kbps	0	Peak	2388.4	-42.2	-39.7	55.6	74.0	18.4
	0	Average	2385.0	-61.3	-58.8	36.5	54.0	17.5

Measurements – Upper Band Edge

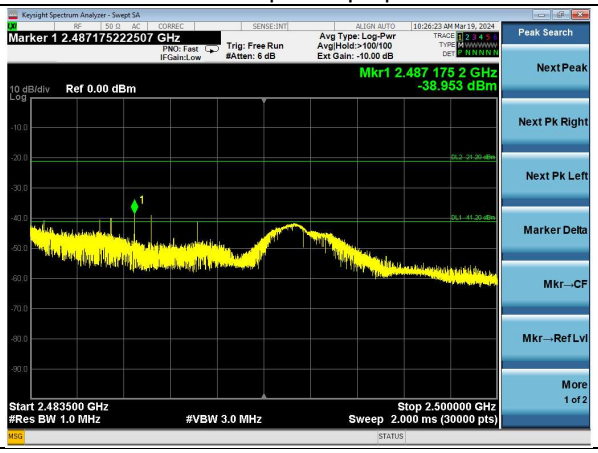
Rate	Channel	Measurement Type	Frequency (MHz)	Measurement (dBm)	EIRP (dBm)	E-Field (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1 Mbps	39	Peak	2487.8	-38.7	-36.2	59.1	74.0	14.9
	39	Average	2483.5	-60.8	-58.3	37.0	54.0	17.0
2 Mbps	39	Peak	2487.2	-39.0	-36.5	58.8	74.0	15.2
	39	Average	2483.5	-54.2	-51.7	43.6	54.0	10.4
500 kbps	39	Peak	2487.7	-38.2	-35.7	59.6	74.0	14.4
	39	Average	2483.5	-61.3	-58.8	36.5	54.0	17.5
125 kbps	39	Peak	2489.5	-40.5	-38.0	57.3	74.0	16.7
	39	Average	2483.5	-61.4	-58.9	36.4	54.0	17.6

Band Edge Worst Case Plots



Channel 0 | 1 Mbps | Peak

Channel 0 | 1 Mbps | Average



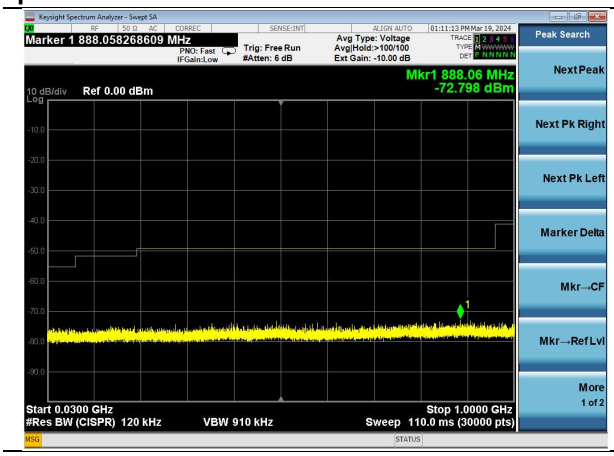
Channel 39 | 2 Mbps | Peak

Channel 39 | 2 Mbps | Average

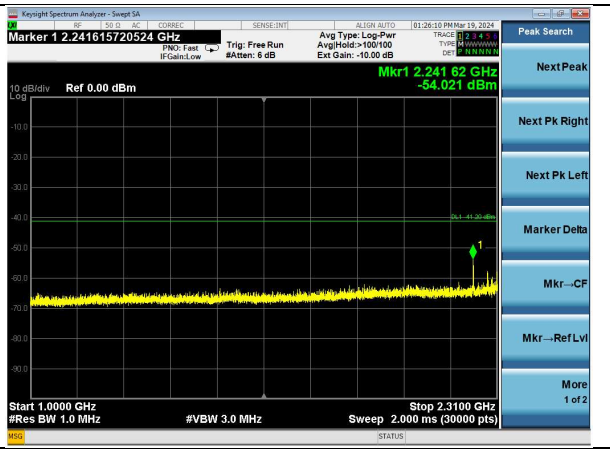
Spurious Table

Rate	Channel	Measurement Type	Frequency (MHz)	Measurement (dBm)	EIRP (dBm)	E-Field (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1 Mbps	0	Peak	2242.0	-53.7	-51.2	44.1	74.0	29.9
	0	Average	2281.6	-69.3	-66.8	28.5	54.0	25.5
2 Mbps	0	Peak	2241.7	-52.9	-50.4	44.9	74.0	29.1
	0	Average	2281.3	-68.6	-66.1	29.2	54.0	24.8
500 kbps	0	Peak	2241.7	-53.9	-51.4	43.9	74.0	30.1
	0	Average	2281.6	-71.5	-69.0	26.3	54.0	27.7
125 kbps	19	Peak	2241.7	-54.1	-51.6	43.7	74.0	30.3
	19	Average	2294.2	-71.2	-68.7	26.6	54.0	27.4

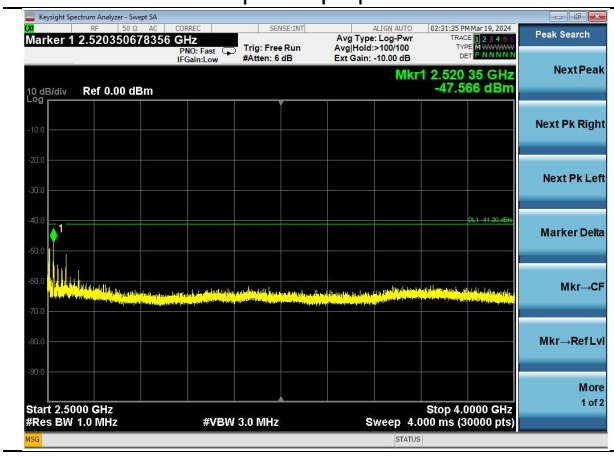
Spurious Worst Case Plots



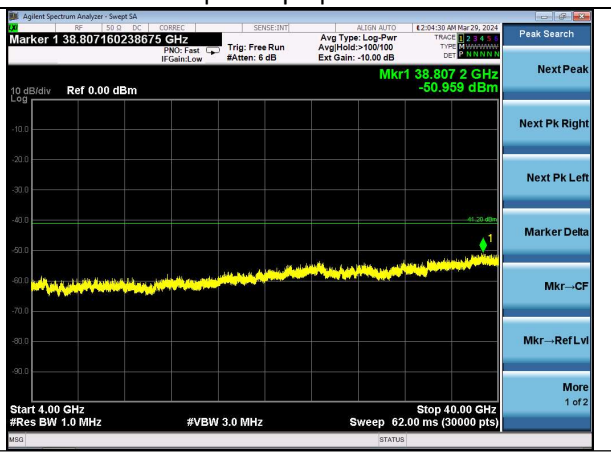
Channel 19 | 2 Mbps | 30-1000 MHz



Channel 0 | 2 Mbps | 1000-2310 MHz



Channel 39 | 2 Mbps | 2500-4000 MHz



Channel 0 | 1 Mbps | 4000-40000 MHz

6.1.6 Frequency Stability

Operator	Dylan Rosenfeldt	**QA**	Anthony Smith
Temperature	21.6°C	**R.H. %**	30.00%
Test Date	04/25/2024	**Location**	Conducted RF Bench
Requirement	15.407(g) RSS-GEN Clause 6.11	**Method**	ANSI C63.10 6.8

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

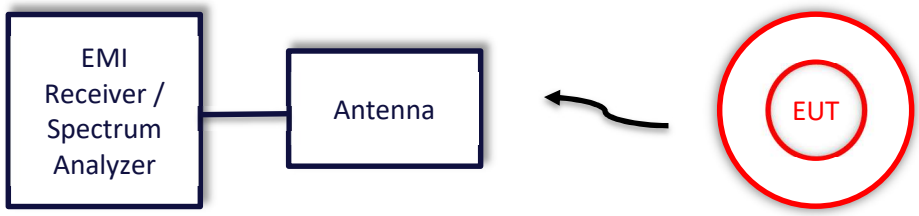
Table

Channel	Voltage (VDC)	Center Frequency (Hz)
0	5	2402000075
	4.3	2402000071
	5.8	2401999986
19	5	2439999767
	4.3	2440000130
	5.8	2439999893
39	5	2479999784
	4.3	2479999972
	5.8	2479999711

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**	BLE 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 – 1 Mbps

Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)
44.0	V	102	254	32.1	40.0	7.9
64.8	H	281	158	34.8	40.0	5.2
77.0	V	101	138	26.3	40.0	13.7
84.0	H	228	164	29.1	40.0	10.9
131.7	H	230	201	27.7	43.5	15.8
132.3	V	100	49	34.2	43.5	9.3
220.0	H	107	95	43.5	46.0	2.5
351.7	H	292	223	31.3	46.0	14.7
620.7	H	160	229	29.3	46.0	16.7

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

1000-40000 MHz

Band Edge

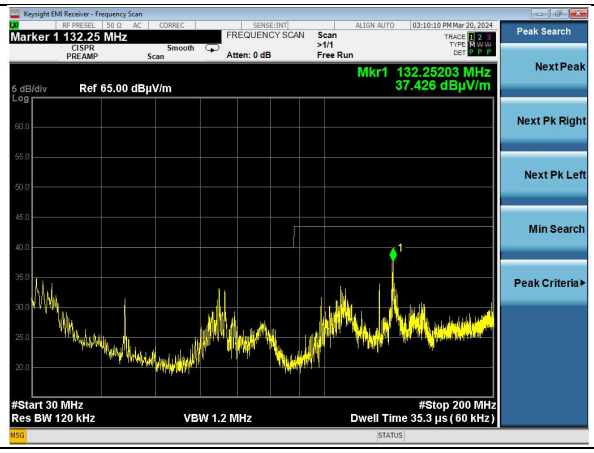
Channel	EUT Orientation	Data Rate	Measurement Type	Frequency (MHz)	Antenna Polarity	Measurement (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0	X Plane	125 kbps	Peak	2351.5	H	47.0	74.0	21.2
			Average	2380.1	H	35.5	54.0	18.5
		500 kbps	Peak	2389.9	H	46.4	74.0	21.8
			Average	2387.7	H	34.9	54.0	19.1
		1 Mbps	Peak	2378.0	H	47.0	74.0	21.2
			Average	2388.7	H	36.1	54.0	17.9
		2 Mbps	Peak	2378.9	H	46.4	74.0	21.8
			Average	2372.8	H	36.9	54.0	17.1
39	Z Plane	125 kbps	Peak	2498.1	H	47.3	74.0	20.9
			Average	2485.3	H	35.5	54.0	18.5
		500 kbps	Peak	2498.5	H	47.6	74.0	20.6
			Average	2483.9	H	35.0	54.0	19.0

	1 Mbps	Peak	2493.1	H	47.0	74.0	21.2
		Average	2496.3	H	36.2	54.0	17.8
	2 Mbps	Peak	2493.7	H	46.6	74.0	21.6
		Average	2486.2	H	37.0	54.0	17.0

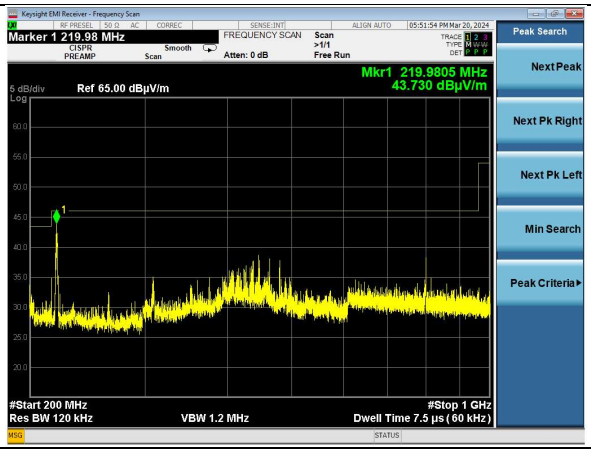
Spurious

No Emissions Present

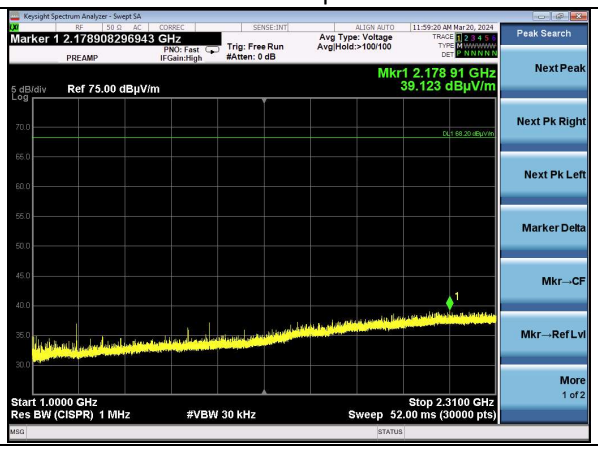
Worst Case Plots



Channel 19 | 1 Mbps
30-200 MHz | Vertical

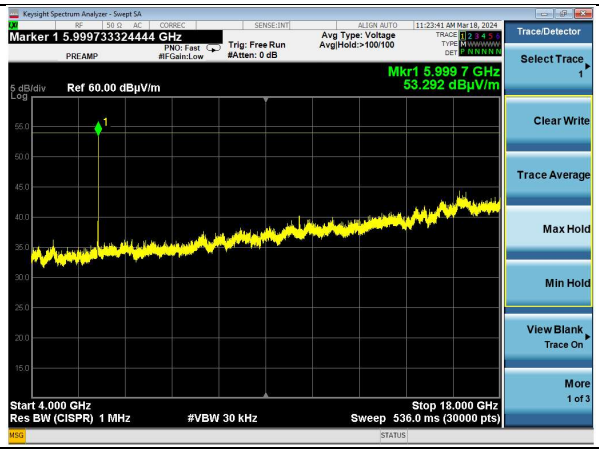


Channel 0 | 1 Mbps
200-1000 MHz | Vertical

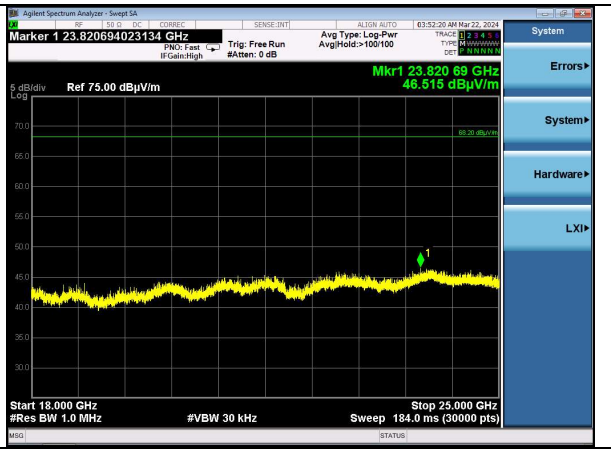


Channel 0 | 125 kbps
1000-2310 MHz | Horizontal

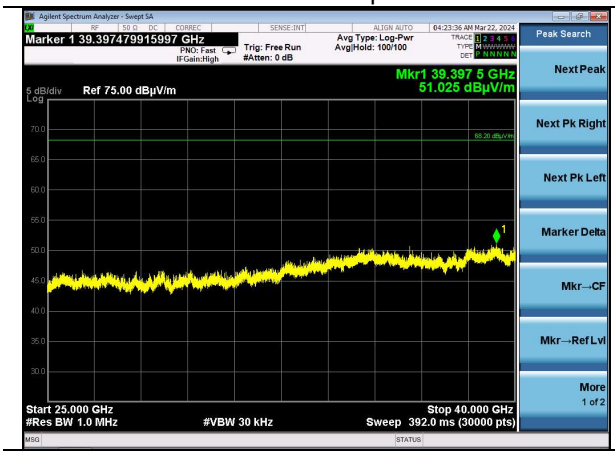
Channel 0 | 125 kbps
2500-4000 MHz | Vertical



Channel 0 | 1 Mbps
4000-18000 MHz | Vertical



Channel 19 | 1 Mbps
18000-25000 MHz | Vertical

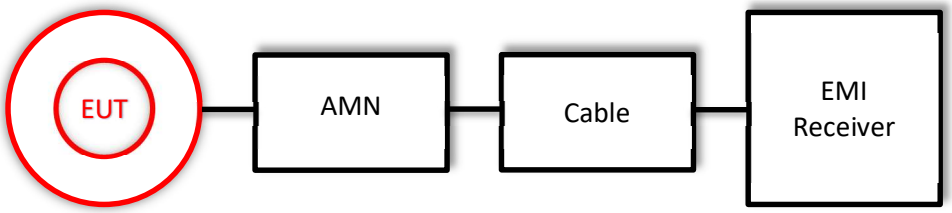


Channel 19 | 1 Mbps
25000-40000 MHz | Vertical

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	**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

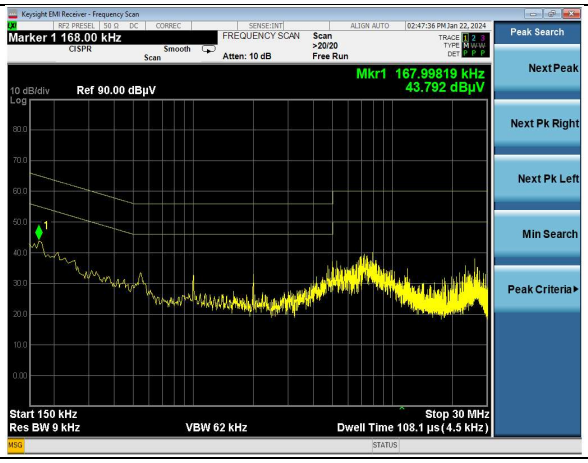
EUT Parameters

Input Power	120 VAC @ 60 Hz	**Mode**	BLE Tx Channel 17 1 Mbps

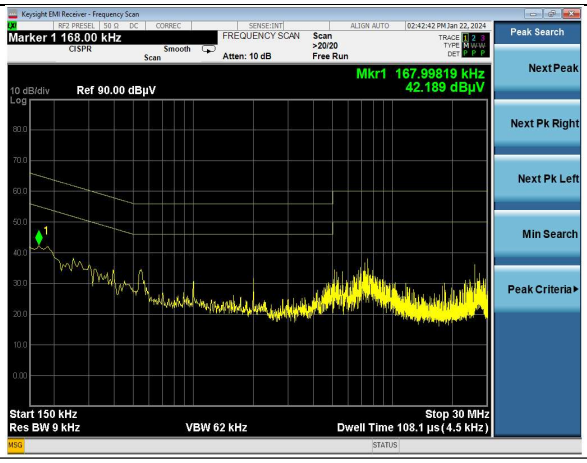
Measurements

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	0.159	38.3	65.5	27.2	29.2	55.5	26.3
1	0.517	30.7	56.0	25.3	24.9	46.0	21.1
1	11.870	35.6	60.0	24.4	24.9	50.0	25.1
2	0.155	39.0	65.8	26.8	29.7	55.8	26.1
2	0.530	29.2	56.0	26.8	22.2	46.0	23.9
2	11.780	28.4	60.0	31.6	14.3	50.0	35.7

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