




TR3818-BLE-ETSI

Equipment Under Test:	SONA TI351
Requirement(s):	ETSI EN 300 328
Test Date(s):	09/25/2024 – 11/11/2024
Prepared for:	Ezurio Attn: Brian Petted W66 N220 Commerce Ct. Cedarburg, WI 53012

Report Issued by: Dylan Rosenfeldt, EMC Engineer	
Signature: 	Date: 01/10/2025
Report Reviewed by: Adam Alger, Manager EMC Laboratory	
Signature: 	Date: 01/10/2025
Report Constructed by: Dylan Rosenfeldt, EMC Engineer	
Signature: 	Date: 01/10/2025

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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:



A2LA – American Association for Laboratory Accreditation

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

A2LA Certificate Number: 1255.01

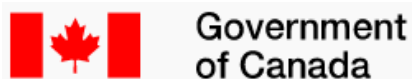
Scope of accreditation includes all test methods listed herein unless otherwise noted



Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers



Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

Company: Ezurio	Page 3 of 44	Name: SONA TI351
Report: TR3818-BLE-ETSI		Model: SONA TI351
Job: C-3818		Serial: 00013 00008

1 TEST REPORT SUMMARY

During **06/27/2024-10/01/2024** the Equipment Under Test (EUT), **SONA TI351**, as provided by **Ezurio** was tested to the following requirements:

ETSI EN 300 328 – BLE

Requirements	Description	Method	Specification	Compliant
4.3.2.2	RF Output Power	5.4.2.2.1.2	≤20 dBm	Yes
4.3.2.3	Power Spectral Density	5.4.3	10 dBm per MHz	Yes
4.3.2.7	Occupied Channel Bandwidth	5.4.7	2400-2483.5 MHz	Yes
4.3.2.8	Transmitter Unwanted Emissions in the Out-Of-Band Domain	5.4.8	2400 MHz - 2BW – 2483.5 MHz +2BW	Yes
4.3.2.9	Transmitter Unwanted Emissions in the Spurious Domain	5.4.9	30-12750 MHz	Yes
4.3.2.10	Receiver Spurious Emissions	5.4.10	30-12750 MHz	Yes
4.3.2.11	Receiver Blocking – Category 2	5.4.11	≤10% PER	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	1.5 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	SONA TI351
Model Number	SONA TI351
Serial Number	00013 00008
FCC ID	SQG-SONATI351
IC ID	3147A-SONATI351

2.2 Product Description

The TI351 is based upon TI CC3351 Wi-Fi 6 chipset. Feature-set includes 802.11 a/b/g/n/ac/ax Wi-Fi 6 and Bluetooth Low Energy v5.4.

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 - image-imx8mp-evk-rdvk 1.0.0.5

Ancillary Equipment

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

Development Kit, NXP 8MPLUS-BB

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

OUTPUT: USB Type C 45W, 5V/3A; 9V/3A; 15V/3 A; 20V/2.25 A

HP Elitebook 840G1

TeraTerm Version: 5.1

2.6 Antenna Information

Manufacturer	Model	Part Number	Dimension	Type	Peak Gain (dBi)	
					2400-2500 MHz	4900-5925 MHz
Ezurio	FlexPIFA 6E	EFB2471A3S-10MH4L	16mm X 36mm X 2.5mm	PIFA	2.2	3.9
Ezurio	Mini NanoBlade Flex 6E	EMF2471A3S-10MH4L	36mm X 12mm X 0.3mm	PCB Dipole	2.4	4.4
Ezurio	FlexPIFA	001-0021	38.5mm X 12.7mm X 2.5mm	PIFA	2.5	3.0
Joymax Electronics	N/A	TWX-100BRS3B	137mm X 13mm	Dipole	2.0	4.0
Ezurio	FlexPIFA	EFB2455A3S-15MH4L	2.5mm X 38.6mm X 12.7mm	PIFA	2.5	3.0
Ezurio	Mini NanoBlade Flex	EMF2449A1-10MH4L	36mm x 12mm x 0.1mm	PIFA	2.8	3.4
Ezurio	NanoBlade	ENB2449A1-10MH4L	50.8mm x 16.5mm	PCB Dipole	3.2	4.1

2.7 Test Channels

Channel	Frequency (MHz)	Data Rates
0	2402	125k, 500k, 1M and 2M
19	2440	
39	2480	

2.8 Power Table

Channel	Data Rate	Power Setting
0-39	125 kbps	8
0-39	500 kbps	8
0-39	1 Mbps	8
0-39	2 Mbps	8

3 REFERENCES

Publication	Edition	Date
ETSI EN 300 328	2.2.2	2019

4 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 \pm
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

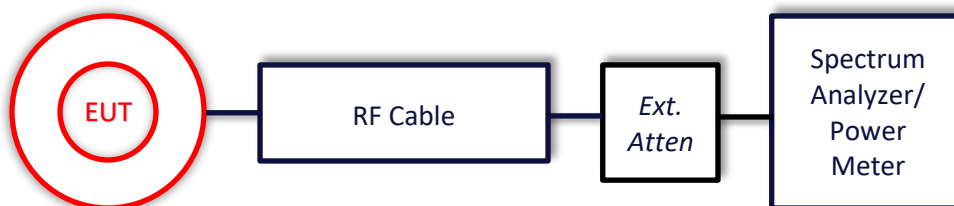
Parameter	ETSI U.C. \pm	U.C. \pm
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	<p>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.</p> <p>The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.</p>
Example Calculations	<p>Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm)</p> <p>Margin (dB) = Limit (dBm) – Corrected Reading (dBm)</p>

Block Diagram



5.1.1 RF Output Power

Operator	Dylan Rosenfeldt	QA	Mitchell Freund
Temperature	21.5°C	R.H. %	38.1%
Test Date	11/13/2024	Location	Temperature Chamber
Requirement	300 328 4.3.2.2	Method	5.4.2.2

Limits: The RF output power for non-FHSS equipment shall be equal to or less than 20 dBm.

Test Parameters

Frequency	2400-2483.5 MHz	Setup	Antenna Port
Operating Temperature	-40.0°C, +21.5°C, +85.0°C	Sample Speed	32 MS/s

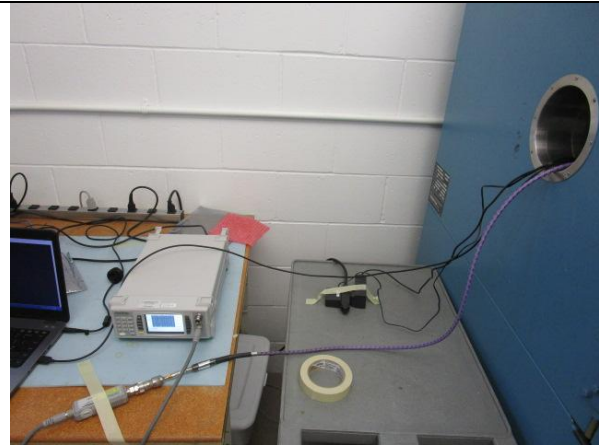
Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960090	Meter - RF Power	Anritsu	ML2495A	1335006	4/13/2024	4/13/2025	Active Calibration
EE 960091	Sensor - RF Power	Anritsu	MA2491A	1249277	4/13/2024	4/13/2025	Active Calibration
AA 960144	Cable	Gore	EKD01D010720	5800373	6/13/2024	6/13/2025	Active Verification

EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz BLE Tx
Frequency	2400-2483.5 MHz	Channel	See 2.7

Setup Photos



Company: Ezurio	Page 12 of 44	Name: SONA TI351
Report: TR3818-BLE-ETSI		Model: SONA TI351
Job: C-3818		Serial: 00013 00008

Output Power Measurements +21.5°C

Mode	Channel	Avg Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Power Setting
1M	0	3.0	3.2	6.2	20.0	17.0	8
	19	2.5	3.2	5.7	20.0	17.5	8
	39	1.7	3.2	4.9	20.0	18.3	8
2M	1	3.1	3.2	6.3	20.0	16.9	8
	19	2.7	3.2	5.9	20.0	17.3	8
	38	1.8	3.2	5.0	20.0	18.2	8
125k	0	2.8	3.2	6.0	20.0	17.2	8
	19	2.2	3.2	5.4	20.0	17.8	8
	39	1.5	3.2	4.7	20.0	18.5	8
500k	0	2.7	3.2	5.9	20.0	17.3	8
	19	2.2	3.2	5.4	20.0	17.8	8
	39	1.5	3.2	4.7	20.0	18.5	8

Output Power Measurements +85.0°C

Mode	Channel	Avg Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Power Setting
1M	0	-0.1	3.2	3.1	20.0	20.1	8
	19	-1.0	3.2	2.2	20.0	21.0	8
	39	-1.5	3.2	1.7	20.0	21.5	8
2M	1	-0.2	3.2	3.0	20.0	20.2	8
	19	-0.4	3.2	2.8	20.0	20.4	8
	38	-1.5	3.2	1.7	20.0	21.5	8
125k	0	-0.6	3.2	2.6	20.0	20.6	8
	19	-0.8	3.2	2.4	20.0	20.8	8
	39	-1.8	3.2	1.4	20.0	21.8	8
500k	0	-0.6	3.2	2.6	20.0	20.6	8
	19	-0.6	3.2	2.6	20.0	20.6	8
	39	-1.8	3.2	1.4	20.0	21.8	8

Output Power Measurements -40.0°C

Mode	Channel	Avg Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Power Setting
1M	0	5.4	3.2	8.6	20.0	14.6	8
	19	4.9	3.2	8.1	20.0	15.1	8
	39	4.1	3.2	7.3	20.0	15.9	8
2M	1	5.5	3.2	8.7	20.0	14.5	8
	19	5.0	3.2	8.2	20.0	15.0	8
	38	4.2	3.2	7.4	20.0	15.8	8
125k	0	5.3	3.2	8.5	20.0	14.7	8
	19	4.8	3.2	8.0	20.0	15.2	8
	39	4.0	3.2	7.2	20.0	16.0	8
500k	0	5.3	3.2	8.5	20.0	14.7	8
	19	4.8	3.2	8.0	20.0	15.2	8
	39	4.0	3.2	7.2	20.0	16.0	8

5.1.2 Power Spectral Density

Operator	Dylan Rosenfeldt	QA	Anthony Smith
Temperature	21.3°C	R.H. %	44.90%
Test Date	11/14/2024	Location	RF Conducted Bench
Requirement	ETSI 300 328 4.3.2.3	Method	ETSI 300 328 5.4.3

Limit: The maximum Power Spectral Density for non-FHSS equipment is 10 dBm per MHz EIRP

Test Parameters

Frequency	2400-2483.5 MHz	Setup	Antenna Port
RBW	10 kHz	VBW	30 kHz
Detector(s)	RMS	Settings	Max Hold
Note	PSD Measurement includes antenna gain in data post processing		

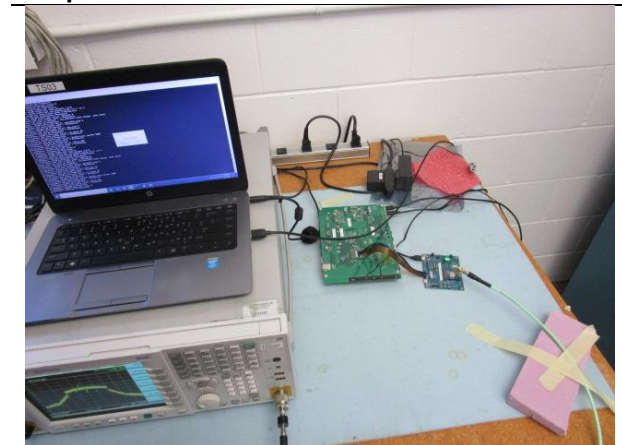
Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2024	6/12/2025	Active Verification
EE 960203	Analyzer - EMI Receiver	Keysight	N9038A	MY56400072	4/10/2024	4/10/2025	Active Calibration

EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz BLE Tx
Frequency	2400-2483.5 MHz	Channel	See 2.7

Setup Photos



Measurements

Mode	Channel	PSD (dBm) e.i.r.p	Limit (dBm) e.i.r.p	Margin (dB)	Power Setting
1M	0	6.1	10	3.9	8
	19	5.6	10	4.4	8
	39	4.8	10	5.2	8
2M	1	5.1	10	4.9	8
	19	4.7	10	5.3	8
	38	3.8	10	6.2	8
125k	0	5.9	10	4.1	8
	19	5.3	10	4.7	8
	39	4.6	10	5.4	8
500k	0	5.9	10	4.1	8
	19	5.3	10	4.7	8
	39	4.7	10	5.3	8

5.1.3 Occupied Channel Bandwidth

Operator	Mitchell Freund	QA	Dylan Rosenfeldt
Temperature	20.9°C	R.H. %	35.7%
Test Date	10/07/2024	Location	RF Conducted Bench
Requirement	ETSI 300 328 4.3.2.7	Method	5.4.7.2.1

Limits: The Occupied Channel Bandwidth shall be within the band 2400 MHz – 2483.5 MHz

In addition, for non-adaptive FHSS equipment with e.i.r.p. greater than 10 dBm, the Occupied Channel Bandwidth shall be equal to or less than 20 MHz.

Test Parameters

Frequency	2400-2483.5 MHz	Setup	Antenna Port
RBW	43 kHz	VBW	130 kHz
Detector(s)	Average (RMS)		

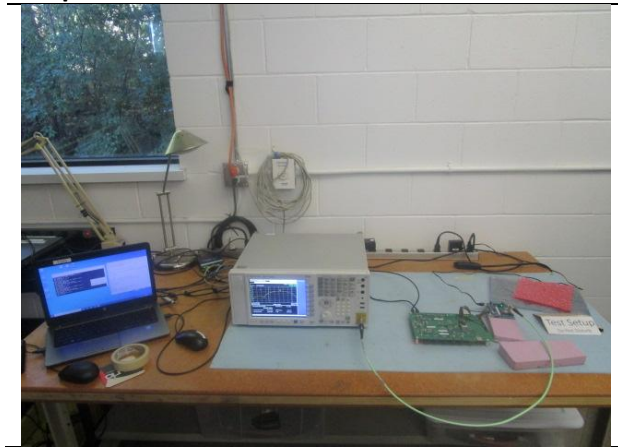
Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2024	6/12/2025	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/10/2024	4/10/2025	Active Calibration

EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz BLE Tx
Frequency	2400-2483.5 MHz	Channel	See 2.7

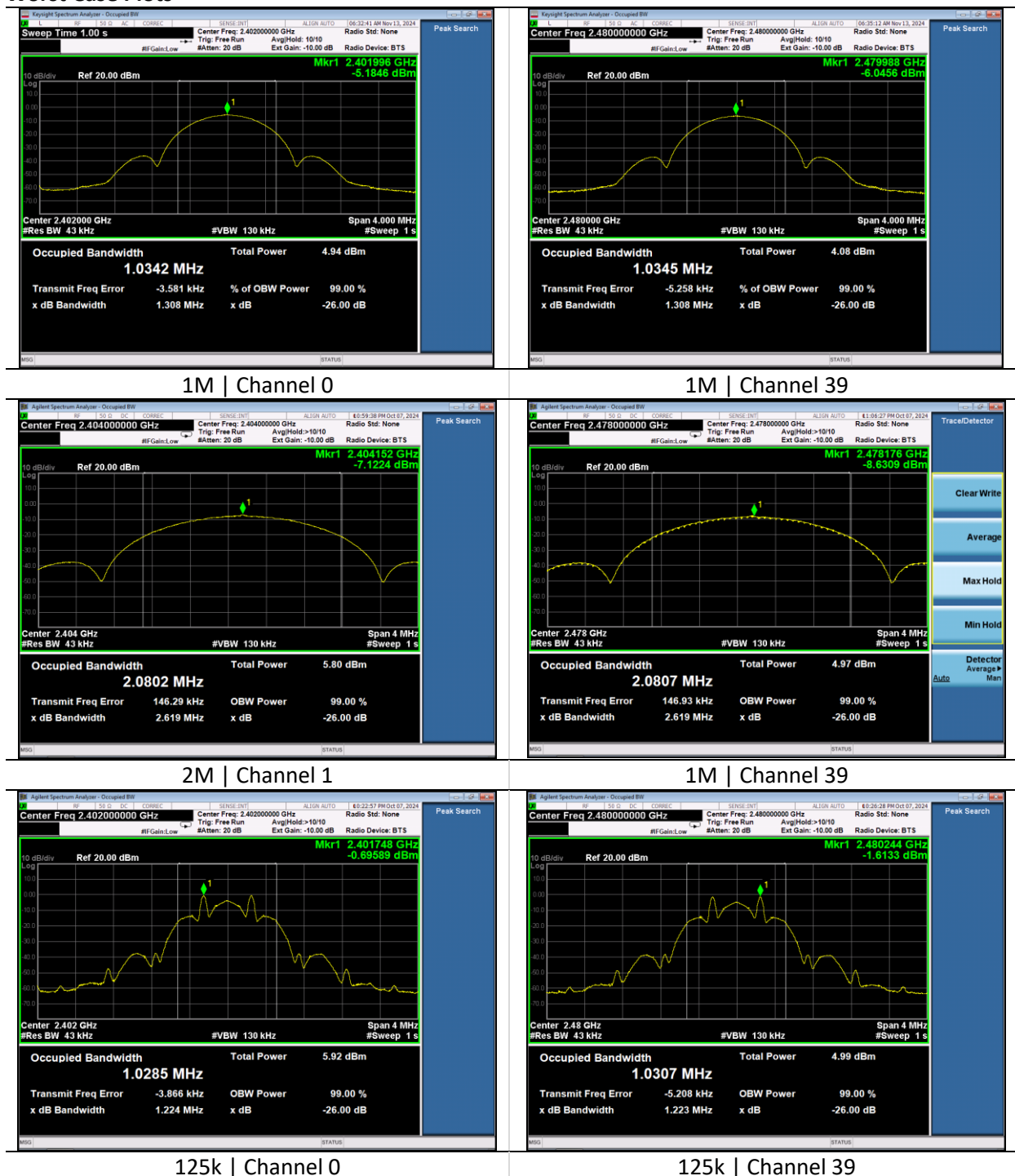
Setup Photos

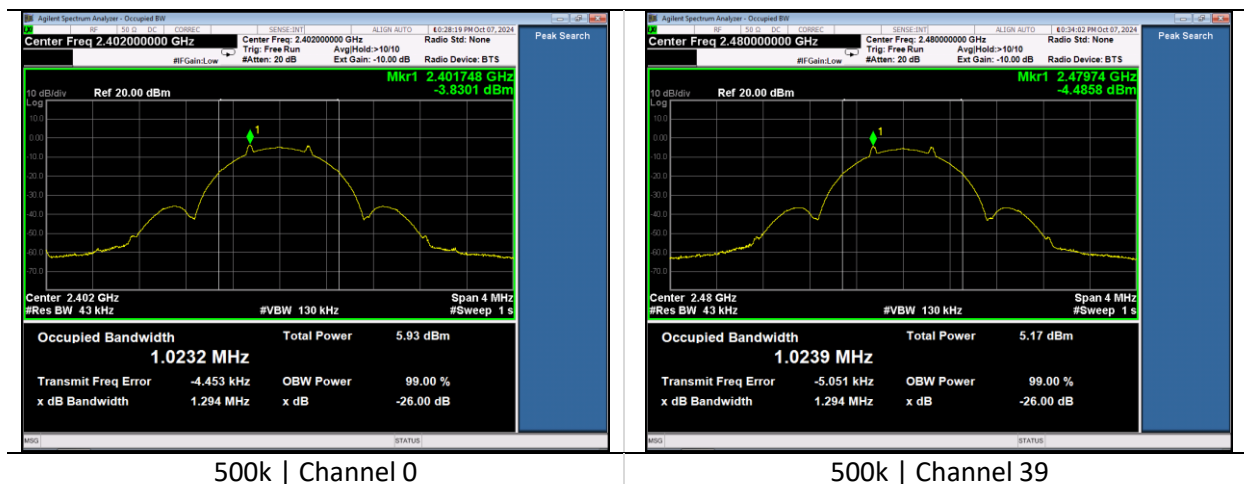


Measurements

Mode	Channel	OCBW (kHz)
1M	0	1034
	19	1034
	39	1035
2M	1	2080
	19	2081
	38	2081
125k	0	1028
	19	1030
	39	1030
500k	0	1023
	19	1023
	39	1024

Worst Case Plots





5.1.4 Transmitter unwanted emissions in the out-of-band domain

Operator	Mitchell Freund	QA	Dylan Rosenfeldt
Temperature	20.9°C	R.H. %	35.7%
Test Date	10/07/2024	Location	RF Conducted Bench
Requirement	ETSI 300 328 4.3.2.8	Method	ETSI 300 328 5.4.8.2

Limits:

Frequency (MHz)	Limit (dBm / MHz)
(2400 - BW) MHz – 2400 MHz	-10 e.i.r.p.
2483.5 MHz – (2483.5 + BW) MHz	-10 e.i.r.p.
(2400 - 2BW) MHz – (2400 - BW) MHz	-20 e.i.r.p.
(2483.5 + BW) MHz – (2483.5 + 2BW) MHz	-20 e.i.r.p.

Test Parameters

Frequency	30-12750 MHz	Setup	Antenna Port
RBW	1 MHz	VBW	3 MHz
Detector(s)	Peak – Trace Average (RMS) – Final	Span	0 Hz
Notes	Declared antenna gain 3.2 dBi		

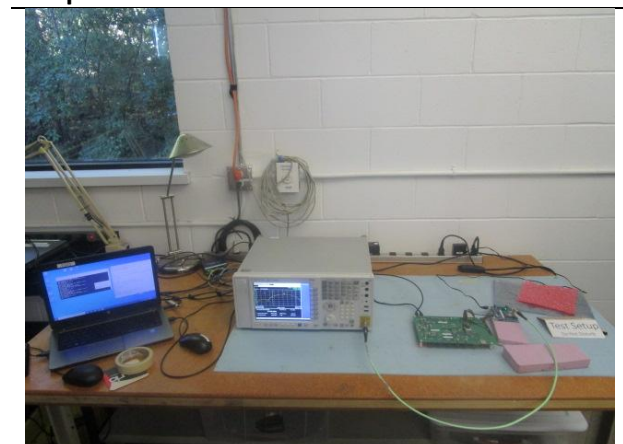
Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2024	6/12/2025	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/10/2024	4/10/2025	Active Calibration

EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz WLAN Tx
Frequency	2400-2483.5 MHz	Channel	See 2.7

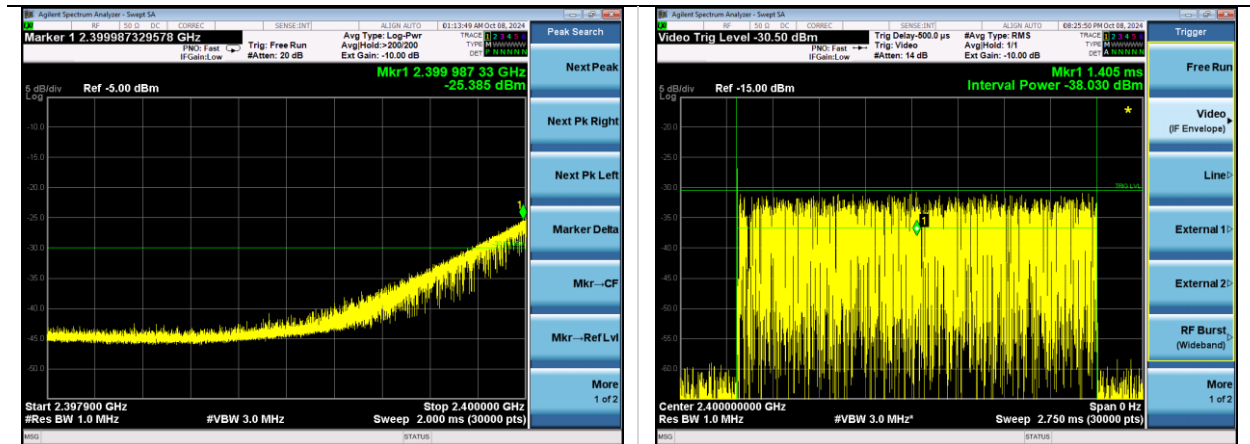
Setup Photos



Measurements

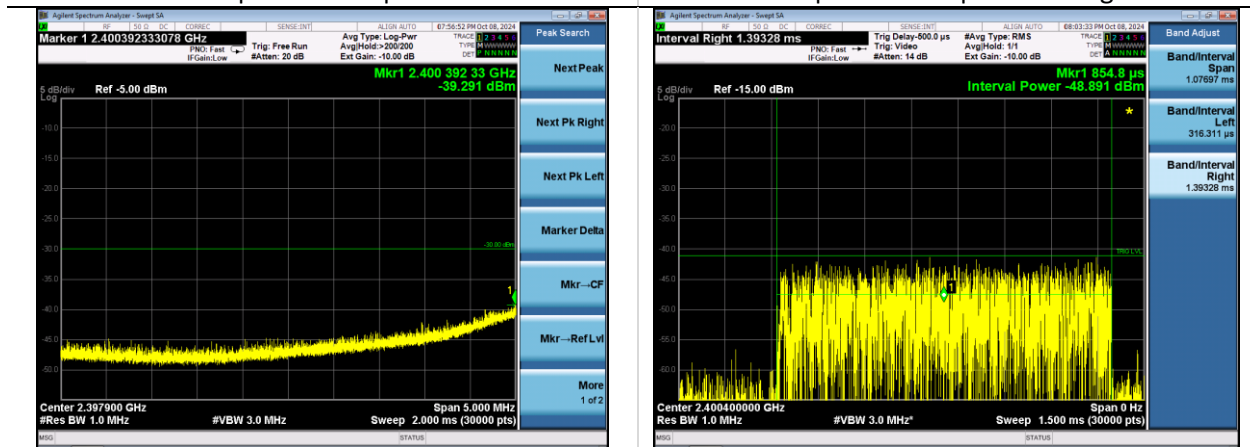
Mode	Channel	Frequency (MHz)	Measurement (dBm)	Antenna Gain	EIRP (dBm)	Limit (dBm)	Margin (dB)	Power Setting
1M	0	2400.0	-38.0	3.2	-34.8	-10.0	24.8	10
	39	2483.1	-54.3	3.2	-51.1	-10.0	41.1	10
2M	1	2400.4	-48.9	3.2	-45.7	-10.0	35.7	10
	38	2488.7	-60.1	3.2	-56.9	-10.0	46.9	10
125k	0	2400.0	-37.9	3.2	-34.7	-10.0	24.7	10
	39	2483.0	-53.2	3.2	-50.0	-10.0	40.0	10
500k	0	2400.0	-51.6	3.2	-48.4	-10.0	38.4	10
	39	2483.1	-57.6	3.2	-54.4	-10.0	44.4	10

Plots



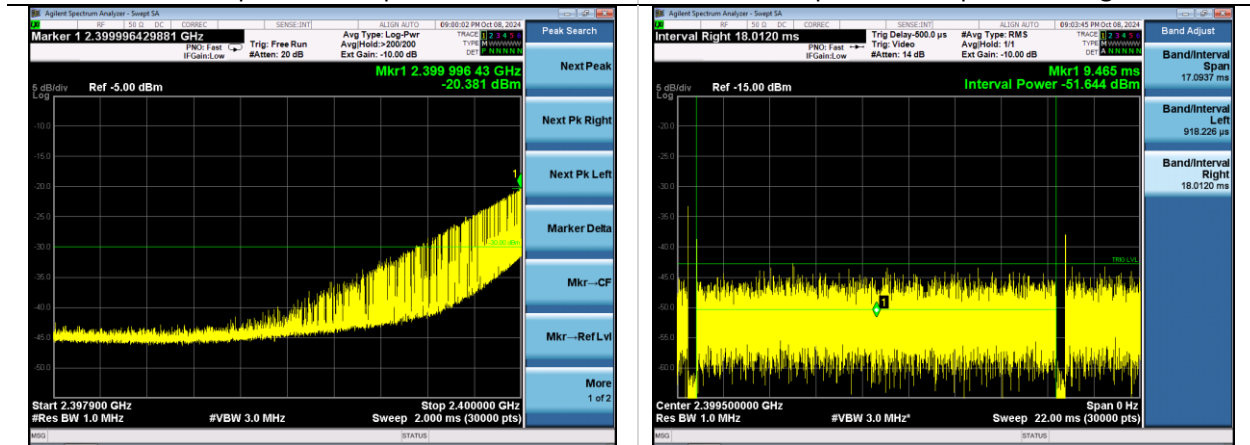
1M | Channel 0 | Peak

1M | Channel 0 | TDP Average



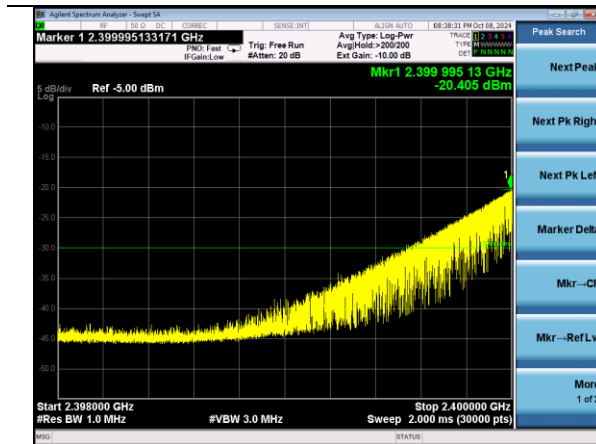
2M | Channel 1 | Peak

2M | Channel 1 | TDP Average

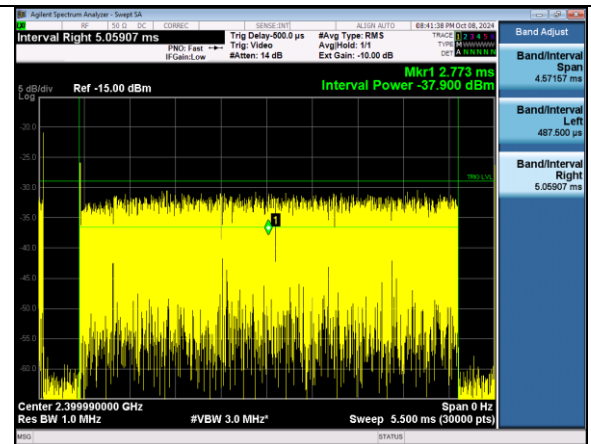


125k | Channel 0 | Peak

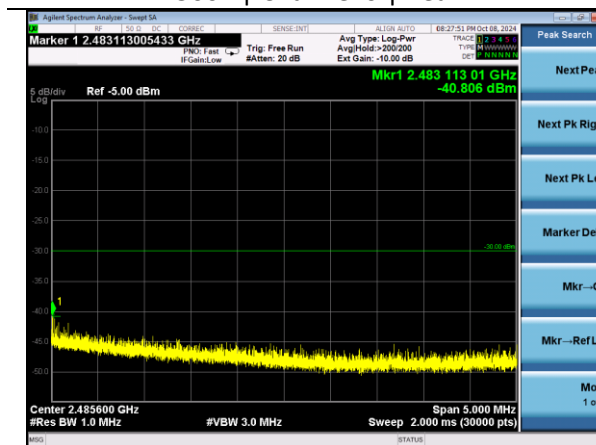
125k | Channel 0 | TDP Average



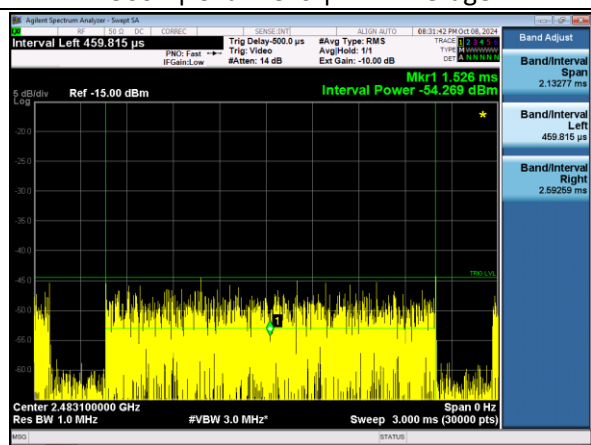
500k | Channel 0 | Peak



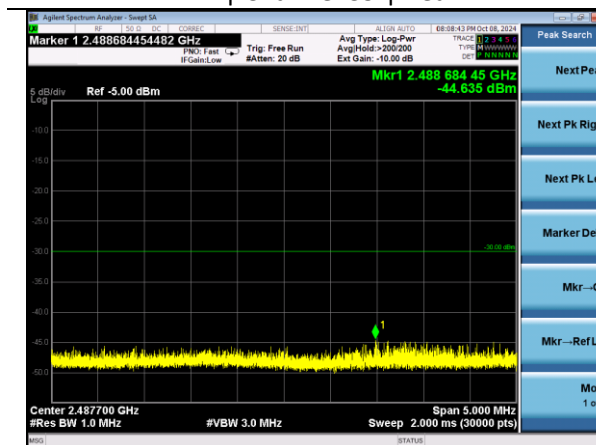
500k | Channel 0 | TDP Average



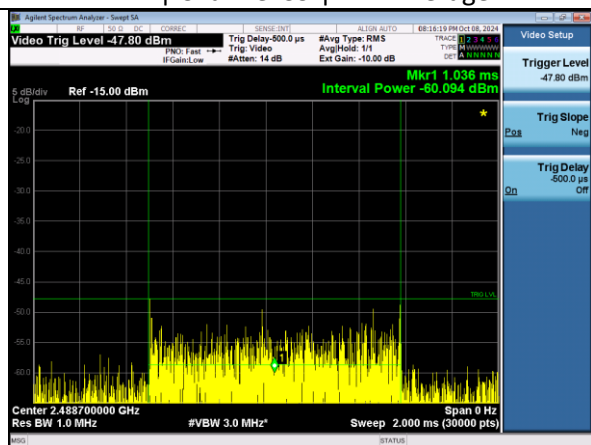
1M | Channel 39 | Peak



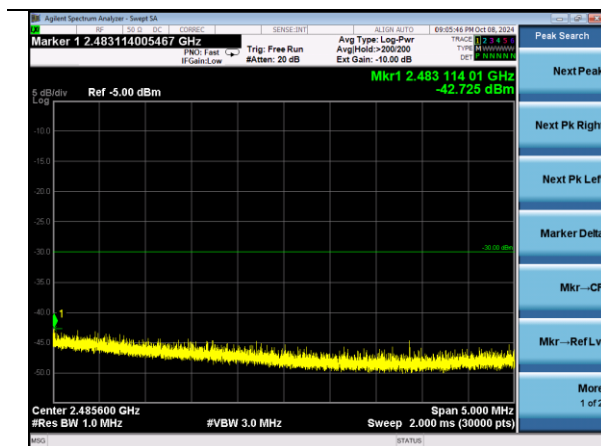
1M | Channel 39 | TDP Average



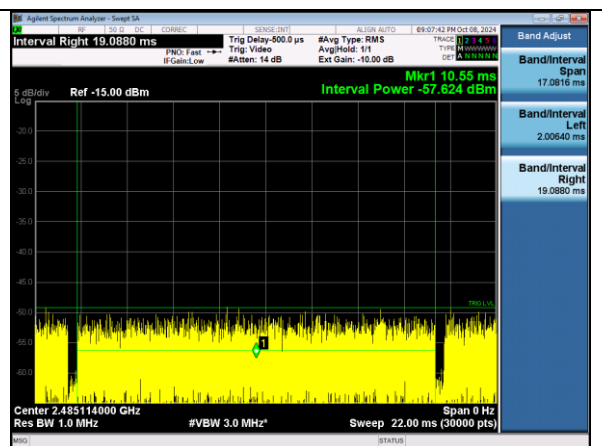
2M | Channel 38 | Peak



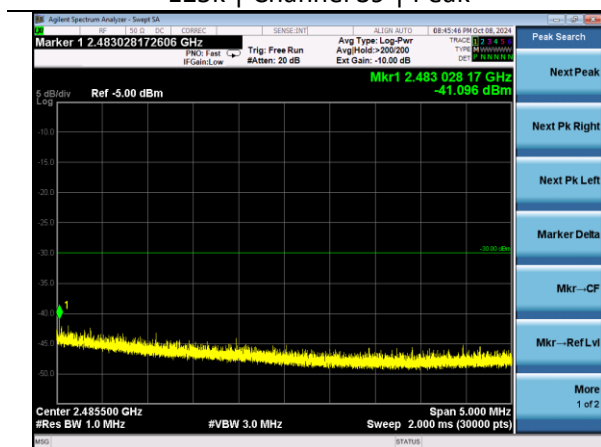
2M | Channel 38 | TDP Average



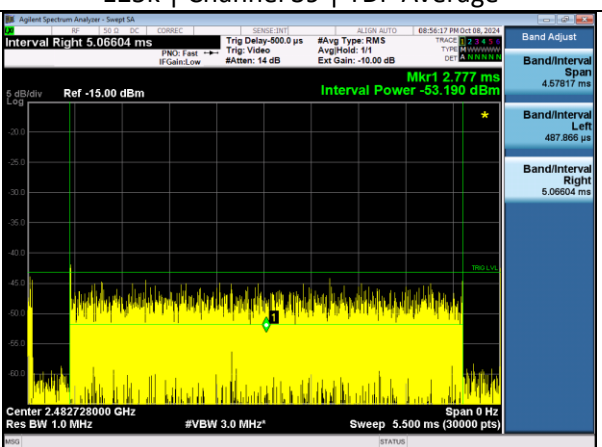
125k | Channel 39 | Peak



125k | Channel 39 | TDP Average



500k | Channel 39 | Peak



500k | Channel 39 | TDP Average

5.1.5 Transmitter unwanted emissions in the spurious domain

Operator	Mitchell Freund	QA	Dylan Rosenfeldt
Temperature	20.9°C – 21.0°C	R.H. %	34.40%
Test Date	10/9/2024 – 10/10/2024	Location	RF conducted bench
Requirement	ETSI 300 328 4.3.2.9	Method	ETSI 300 328 5.4.9

Limits:

Frequency (MHz)	Maximum Power	Bandwidth
30-47	-36 dBm	100 kHz
47-74	-54 dBm	100 kHz
74-87.5	-36 dBm	100 kHz
87.5-118	-54 dBm	100 kHz
118-174	-36 dBm	100 kHz
174-230	-54 dBm	100 kHz
230-470	-36 dBm	100 kHz
470-694	-54 dBm	100 kHz
694-1000	-36 dBm	100 kHz
1000-12750	-30 dBm	1 MHz

Test Parameters

Frequency	30-12750 MHz	Setup	Antenna Port
RBW	100kHz (<1GHz), 1 MHz (>1GHz)	VBW	300kHz (<1GHz), 3 MHz (>1GHz)
Detector(s)	Peak – Trace Average (RMS) – Final	Span	0 Hz
Notes	Declared antenna gain 3.2 dBi		

Instrumentation

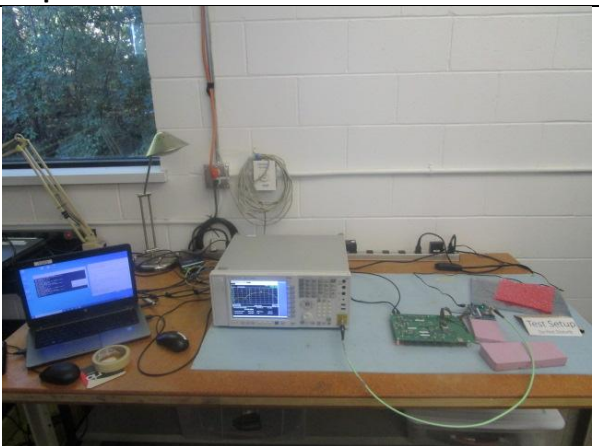
Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2024	6/12/2025	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/10/2024	4/10/2025	Active Calibration
EE 960088	Analyzer - EMI Receiver	Agilent	N9038A	MY51210138	4/11/2024	4/11/2025	Active Calibration
AA 960172	Cable	A.H. Systems, Inc.	SAC-26G-1	387	6/13/2024	6/12/2025	Active Verification

Company: Ezurio	Page 27 of 44	Name: SONA TI351
Report: TR3818-BLE-ETSI		Model: SONA TI351
Job: C-3818		Serial: 00013 00008

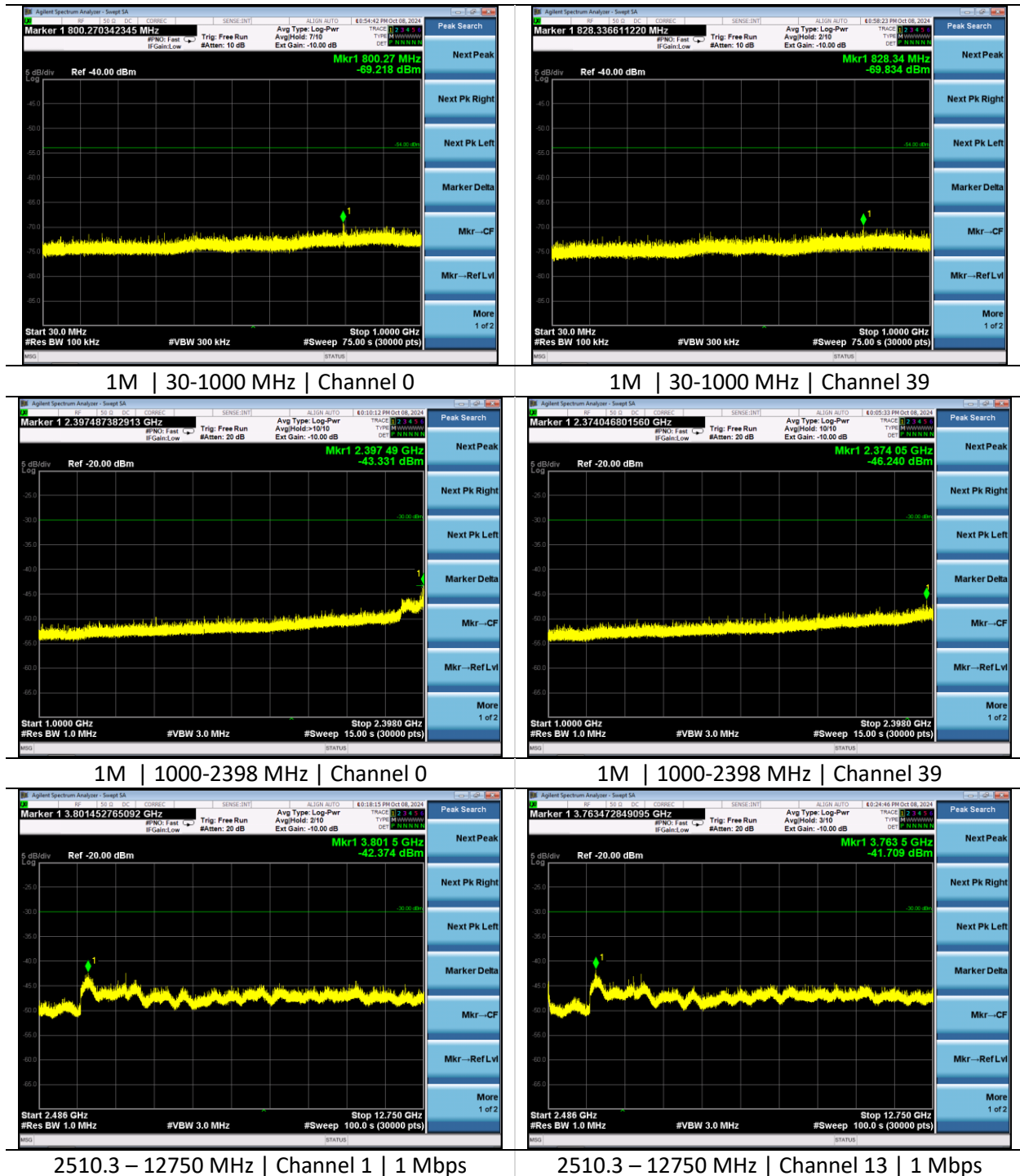
EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz BLE Tx
Frequency	2400-2483.5 MHz	Channel	See 2.7

Setup Photos



Plots



1M | 30-1000 MHz | Channel 0

1M | 30-1000 MHz | Channel 39

1M | 1000-2398 MHz | Channel 0

1M | 1000-2398 MHz | Channel 39

2510.3 – 12750 MHz | Channel 1 | 1 Mbps

2510.3 – 12750 MHz | Channel 13 | 1 Mbps

5.1.6 Receiver spurious emissions

Operator	Mitchell Freund	QA	Dylan Rosenfeldt
Temperature	20.9°C – 21.0°C	R.H. %	34.40%
Test Date	10/9/2024 – 10/10/2024	Location	RF conducted bench
Requirement	ETSI 300 328 4.3.2.9	Method	ETSI 300 328 5.4.9

Limits:

Frequency (MHz)	Maximum Power	Bandwidth
30-47	-36 dBm	100 kHz
47-74	-54 dBm	100 kHz
74-87.5	-36 dBm	100 kHz
87.5-118	-54 dBm	100 kHz
118-174	-36 dBm	100 kHz
174-230	-54 dBm	100 kHz
230-470	-36 dBm	100 kHz
470-694	-54 dBm	100 kHz
694-1000	-36 dBm	100 kHz
1000-12750	-30 dBm	1 MHz

Test Parameters

Frequency	30-12750 MHz	Setup	Antenna Port
RBW	100kHz (<1GHz), 1 MHz (>1GHz)	VBW	300kHz (<1GHz), 3 MHz (>1GHz)
Detector(s)	Peak – Trace Average (RMS) – Final	Span	0 Hz
Notes	Declared antenna gain 3.2 dBi		

Instrumentation

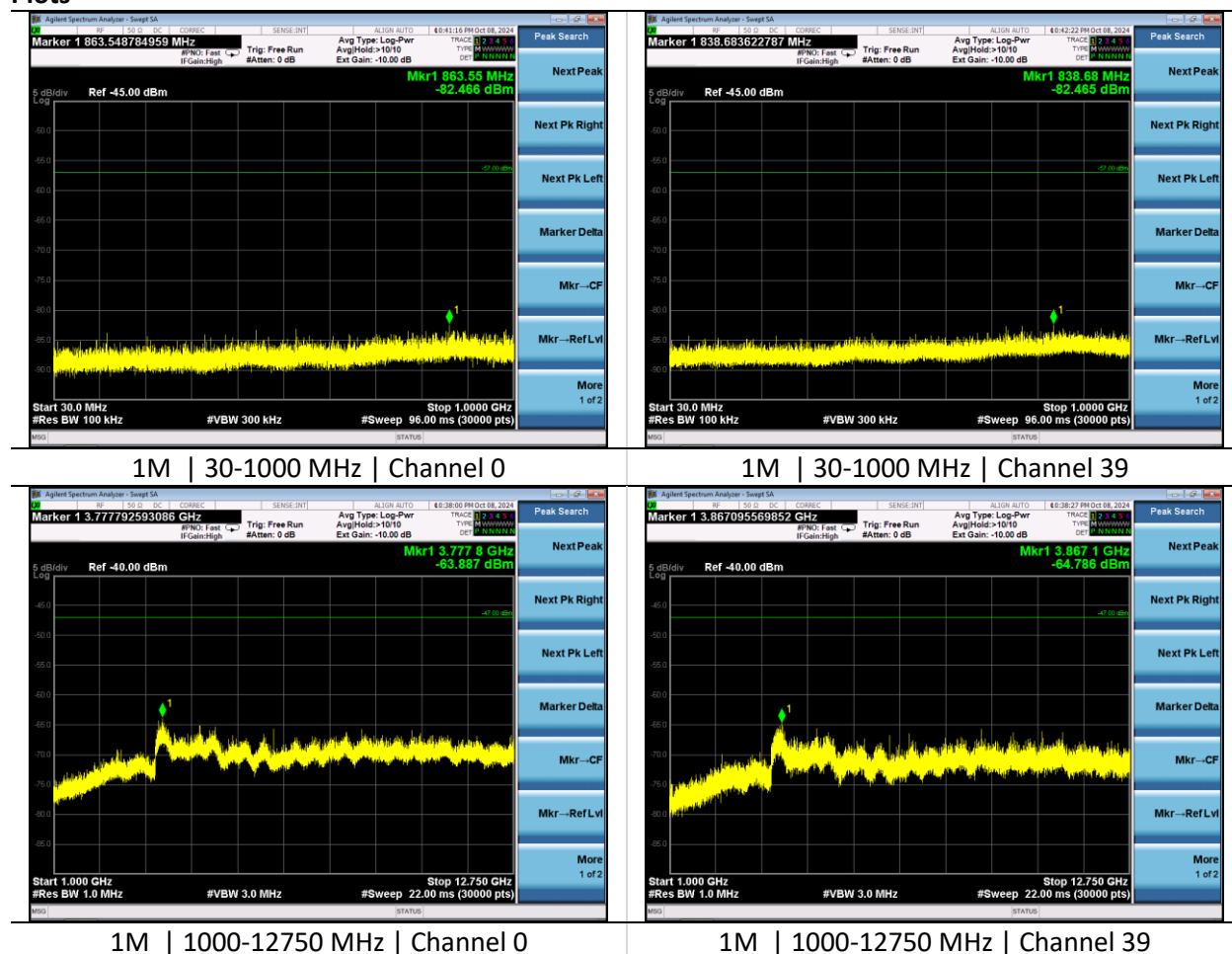
Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2024	6/12/2025	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/10/2024	4/10/2025	Active Calibration
EE 960088	Analyzer - EMI Receiver	Agilent	N9038A	MY51210138	4/11/2024	4/11/2025	Active Calibration
AA 960172	Cable	A.H. Systems, Inc.	SAC-26G-1	387	6/13/2024	6/12/2025	Active Verification

Company: Ezurio	Page 30 of 44	Name: SONA TI351
Report: TR3818-BLE-ETSI		Model: SONA TI351
Job: C-3818		Serial: 00013 00008

EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz BLE Rx
Frequency	2400-2483.5 MHz	Channel	See 2.7

Plots



5.1.7 Receiver Blocking

Operator	Anthony Smith	QA	Dylan Rosenfeldt
Temperature	21.3°C	R.H. %	36.3%
Test Date	11/12/2024	Location	RF conducted bench
Requirement	ETSI 300 328 4.3.2.11	Method	ETSI 300 328 5.4.11

Limits:

Table 15: Receiver Blocking parameters receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log ₁₀ (OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
<p>NOTE 1: OCBW is in Hz.</p> <p>NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{min} + 26$ dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.</p> <p>NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.</p>			

Test Parameters

Receiver Category	1	Performance Criteria	10% PER
Wanted signal mean Power from Companion	-65.8 dBm	Actual Signal Power from Companion Device	-69.0 dBm
Blocking Signal Frequencies	2380, 2504, 2300, 2584 MHz		

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960086	Generator - Signal	Rohde & Schwarz	SMB100A	1406.600K03	4/13/2024	4/13/2025	Active Calibration
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/10/2024	4/10/2025	Active Calibration
AA 960180	Attenuator - Step Variable 1 dB	RF Lambda	RKT2G6A10	16100801	12/12/2023	12/12/2024	Active Verification
AA 960182	RF Splitter/Combiner	Mini-Circuits	ZFSC-2-10G+	F707701704	12/12/2023	12/12/2024	Active Verification
AA 960184	Attenuator - Step Variable 10 dB	RF Lambda	RKT2G6A60	17031005	12/12/2023	12/12/2024	Active Verification

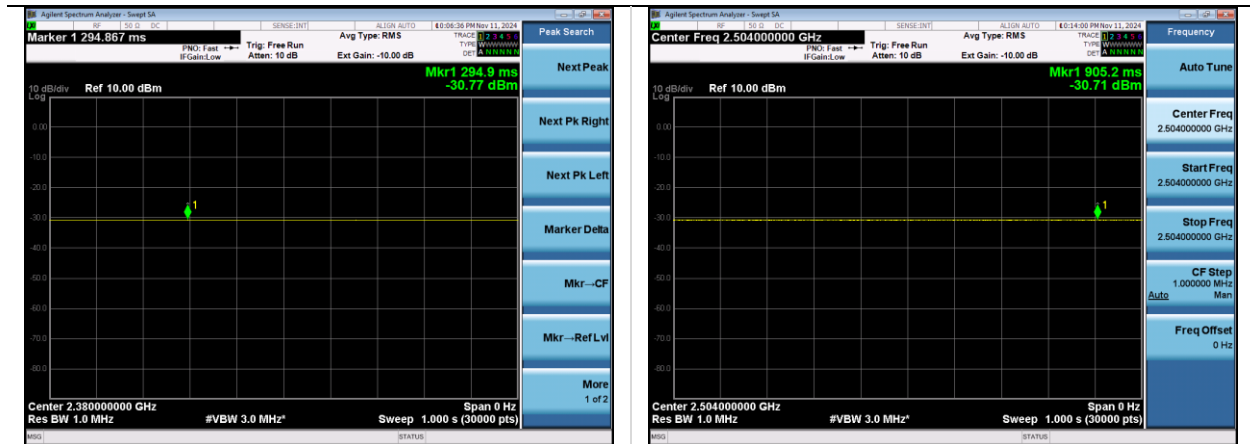
EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz BLE Rx
Frequency	2400-2483.5 MHz	Channel	See 2.7

Measurements

Channel	Rate	2380 MHz	2504 MHz	2300 MHz	2584 MHz	Packets Sent
PER %						
0	1M	0.0%	-	0.0%	-	2000
39	1M	-	0.2%	-	0.0%	2000
Packets Received						
0	1M	2000	-	2000	-	2000
39	1M	-	1996	-	2000	2000

Plots



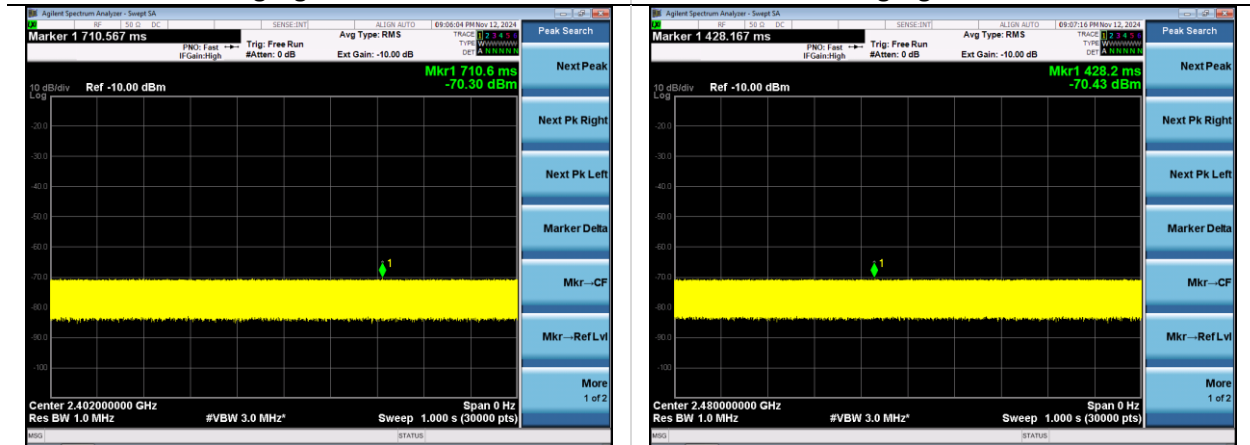
Blocking Signal 2380 MHz

Blocking Signal 2504 MHz



Blocking Signal 2300 MHz

Blocking Signal 2330 MHz



Companion Level low channel

Companion Level high channel

5.2 Radiated Emissions

Description of Measurement	<p>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.</p> <p>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.</p> <p>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.</p>
Example Calculations	<p>Measurement (dBμV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBμV/m)</p> <p>Margin (dB) = Limit (dBμV/m) - Corrected Reading (dBμV/m)</p> <p>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</p>

Block Diagram



5.2.1 Transmitter unwanted emissions in the spurious domain

Operator	Mitchell Freund Jon Dilley	QA	Jon Dilley Mitchell Freund
Temperature	22.3°C-23.0°C	R.H. %	36.5%-47.4%
Test Date	09/25/2024, 10/14/2024, 11/04/2024	Location	Chamber 3
Requirement	ETSI 300 328 4.3.2.9	Method	ETSI 300 328 5.4.9

Limits:

Frequency (MHz)	Maximum Power	Bandwidth
30-47	-36 dBm	100 kHz
47-74	-54 dBm	100 kHz
74-87.5	-36 dBm	100 kHz
87.5-118	-54 dBm	100 kHz
118-174	-36 dBm	100 kHz
174-230	-54 dBm	100 kHz
230-470	-36 dBm	100 kHz
470-694	-54 dBm	100 kHz
694-1000	-36 dBm	100 kHz
1000-12750	-30 dBm	1 MHz

Test Parameters

Frequency	30-12750 MHz	Distance	3 m
Detector(s)	Peak Trace Peak and Average Final	Table height	150 cm
RBW	<1000 MHz – 100 kHz >1000 MHz – 1 MHz	VBW	<1000 – 300 kHz >1000 MHz – 3MHz

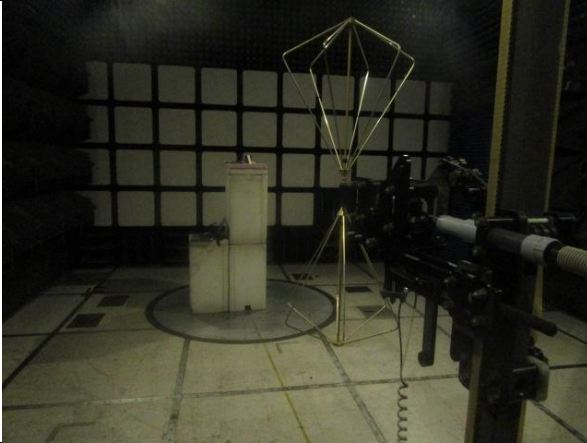
Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960203	Analyzer - EMI Receiver	Keysight	N9038A	MY56400072	4/11/2024	4/11/2025	Active Calibration
LSC-300	Cable	Chamber 3 Emissions	-	-	1/5/2024	1/5/2025	Active Verification
AA 960218	Antenna - Biconical	A.H. Systems, Inc.	SAS-540	853	7/17/2024	7/17/2025	Active Calibration
AA 960215	Antenna - LPDA	A.H. Systems, Inc.	SAS-512-2	706	7/18/2024	7/18/2025	Active Calibration
AA 960158	Antenna - Double Ridge Horn	ETS Lindgren	3117	109300	2/7/2024	2/7/2025	Active Calibration
AA 960154	Filter - High Pass 2.4 GHz	KWM	HPF-L-14186	7272-02	4/10/2024	4/10/2025	Active Calibration
AA 960211	Antenna - Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	977711030	2/7/2024	2/7/2025	Active Calibration
LSC-546	Cable	A.H. Systems, Inc.	SAC-26G-6	546	7/17/2024	7/18/2025	Active Verification

EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz BLE Tx
EUT	X, Y, Z Plane Orientations	AE	HP Elitebook 840G1 Development Kit, NXP 8MPLUS-BB
Notes	<1000 MHz Emissions from auxiliary equipment. Not a function of the EUT. Emission at 4GHz is not a function of the transmitter. No Emissions from the transmitter fall within 6dB of the limit.		

Setup Photos



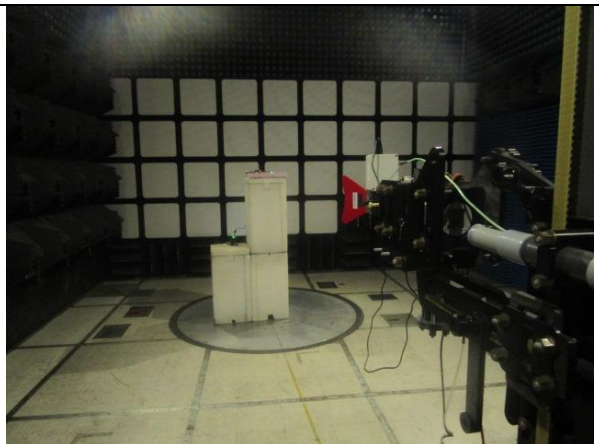
30-200 MHz



200-1000 MHz

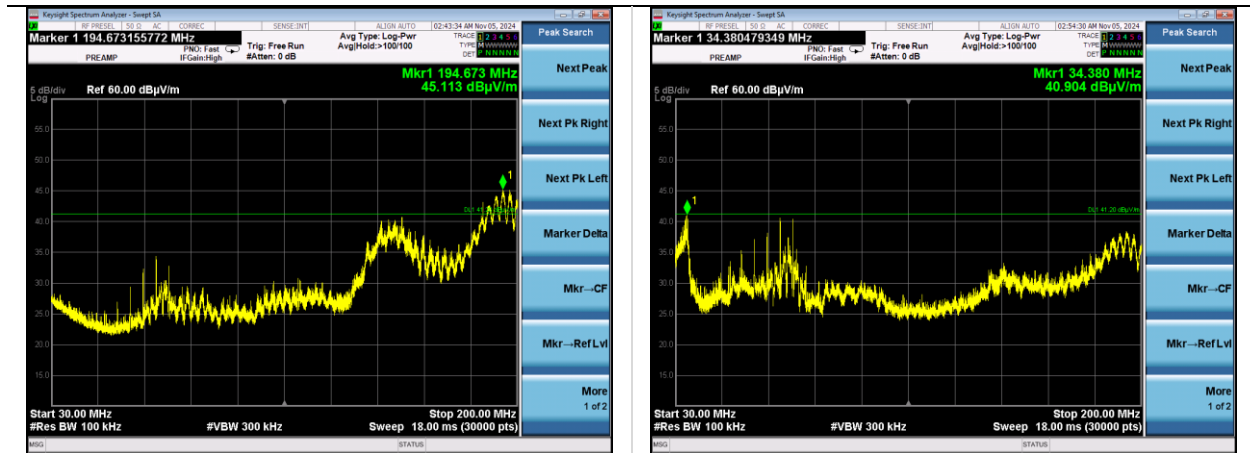


1000-4000 MHz



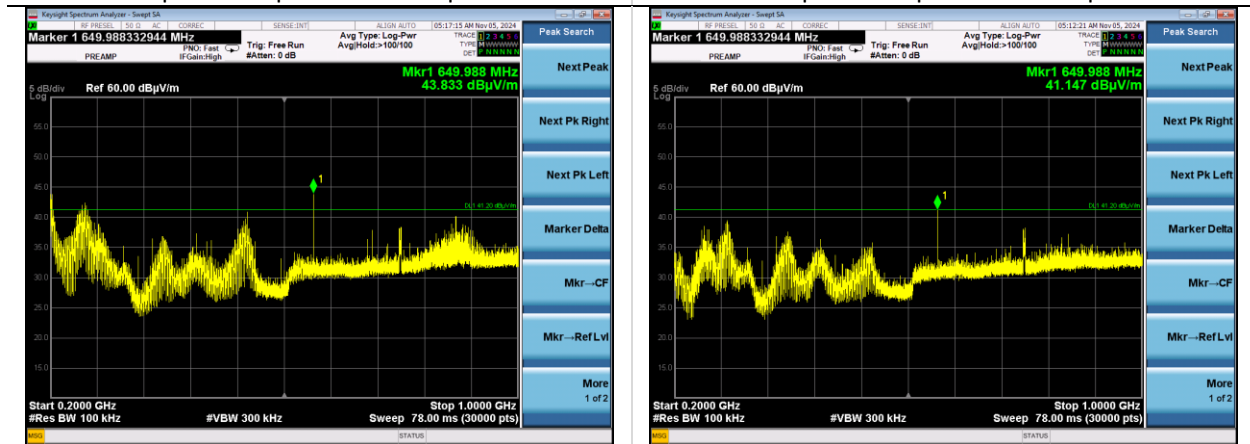
4000-12750 MHz

Plots



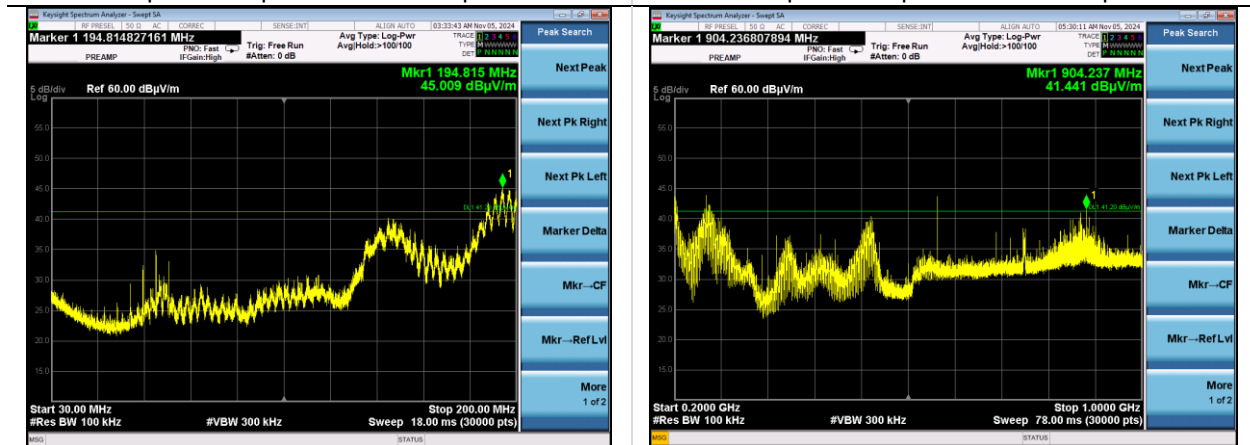
Baseline | EUT off | 30-200 MHz | Horizontal

Baseline | EUT off | 30-200 MHz | Vertical



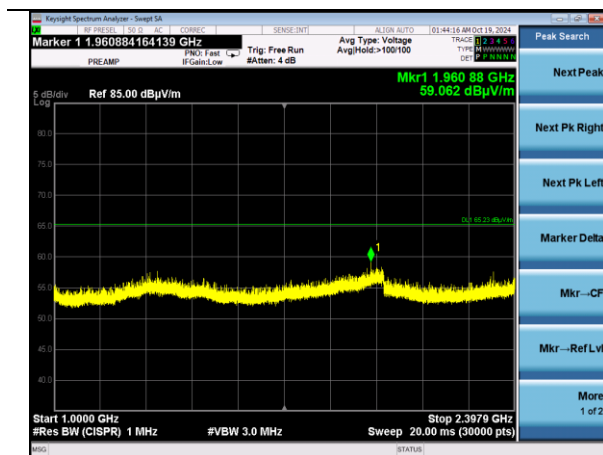
Baseline | EUT off | 200-1000 MHz | Horizontal

Baseline | EUT off | 200-1000 MHz | Vertical

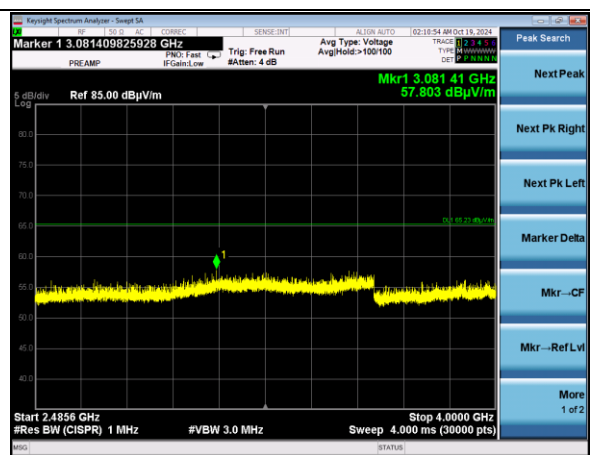


1M | Channel 0 | 30-200 MHz | Horizontal

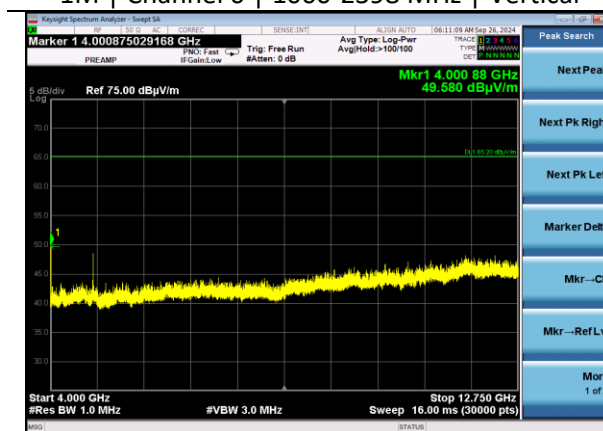
1M | Channel 0 | 200-1000 MHz | Horizontal



1M | Channel 0 | 1000-2398 MHz | Vertical



1M | Channel 0 | 2485-4000 MHz | Horizontal



1M | Channel 0 | 4000-12750 MHz | Horizontal

5.2.2 Receiver spurious emissions

Operator	Jon Dille	QA	Dylan Rosenfeldt
Temperature	19.9°C	R.H. %	33.9%
Test Date	10/28/2024	Location	Chamber 3
Requirement	ETSI 300 328 4.3.2.10	Method	ETSI 300 328 5.4.10

Limits:

Frequency (MHz)	Maximum Power	Bandwidth
30-1000	-57 dBm	100 kHz
1000-12750	-47 dBm	1 MHz

Test Parameters

Frequency	30-12750 MHz	Distance	3 m
Detector(s)	Peak Trace Peak and Average Final	Table height	150 cm
RBW	<1000 MHz – 100 kHz >1000 MHz – 1 MHz	VBW	<1000 – 300 kHz >1000 MHz – 3 MHz

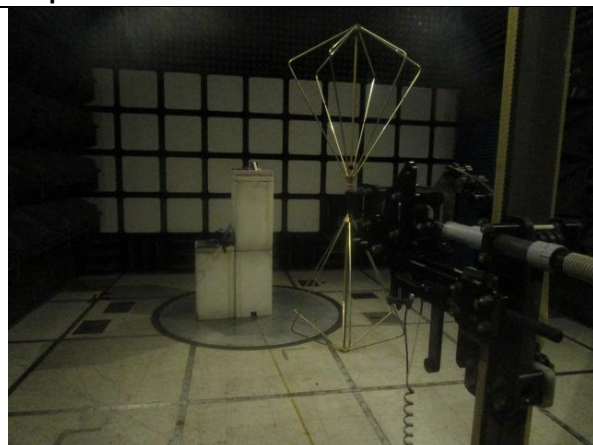
Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960203	Analyzer - EMI Receiver	Keysight	N9038A	MY56400072	4/11/2024	4/11/2025	Active Calibration
LSC-300	Cable	Chamber 3 Emissions	-	-	1/5/2024	1/5/2025	Active Verification
AA 960218	Antenna - Biconical	A.H. Systems, Inc.	SAS-540	853	7/17/2024	7/17/2025	Active Calibration
AA 960215	Antenna - LPDA	A.H. Systems, Inc.	SAS-512-2	706	7/18/2024	7/18/2025	Active Calibration
AA 960158	Antenna - Double Ridge Horn	ETS Lindgren	3117	109300	2/7/2024	2/7/2025	Active Calibration
AA 960150	Antenna - Biconical	ETS Lindgren	3110B	0003-3346	8/16/2024	8/16/2025	Active Calibration
AA 960211	Antenna - Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	977711030	2/7/2024	2/7/2025	Active Calibration
LSC-546	Cable	A.H. Systems, Inc.	SAC-26G-6	546	7/17/2024	7/18/2025	Active Verification
AA 960162	Cable	MegaPhase	EM2-S1S1-120	51503501 001	6/13/2024	6/13/2025	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/10/2024	4/10/2025	Active Calibration

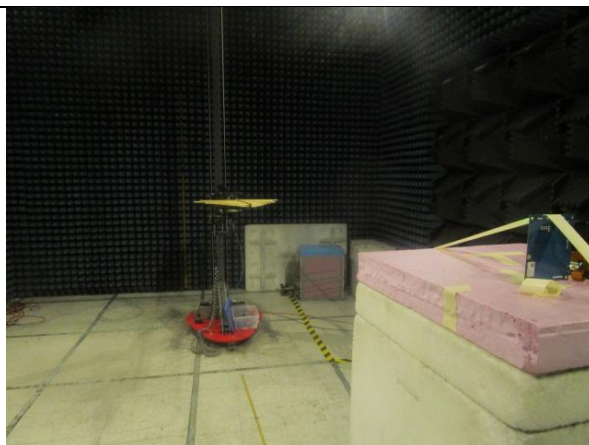
EUT Parameters

Input Power	120 VAC @ 60 Hz	Mode	2.4 GHz WLAN Rx
EUT	X, Y, Z Plane Orientations	AE	HP Elitebook 840G1 Development Kit, NXP 8MPLUS-BB
Notes	<1000 MHz Emissions from auxiliary equipment. Not a function of the EUT. Emission at 4GHz and 6GHz is not a function of the transmitter. No Emissions from the receiver fall within 6dB of the limit.		

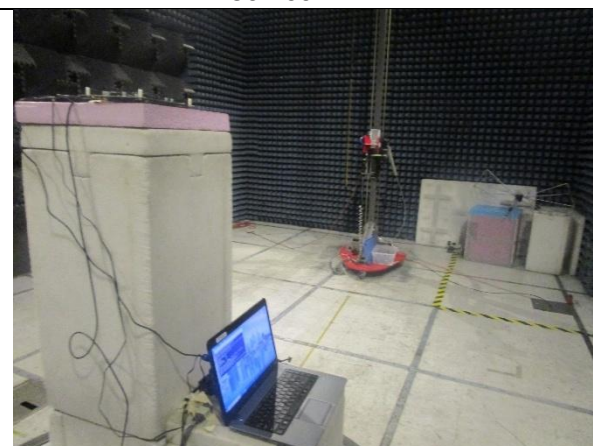
Setup Photos



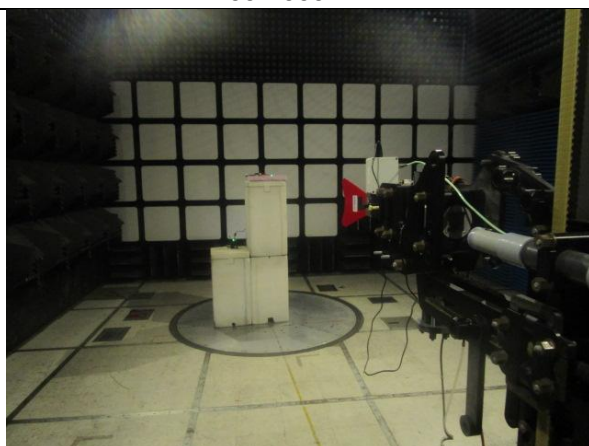
30-200 MHz



200-1000 MHz

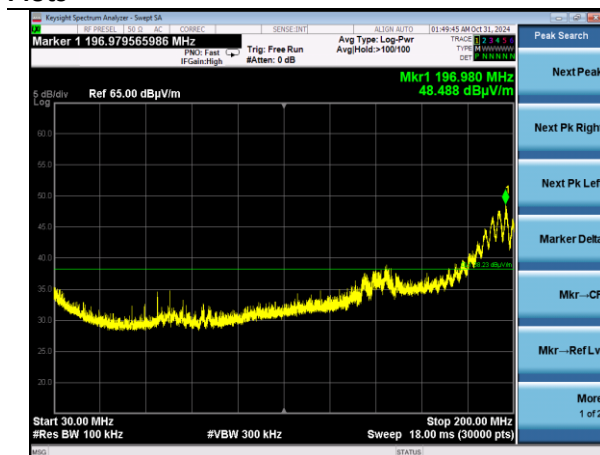


1000-4000 MHz

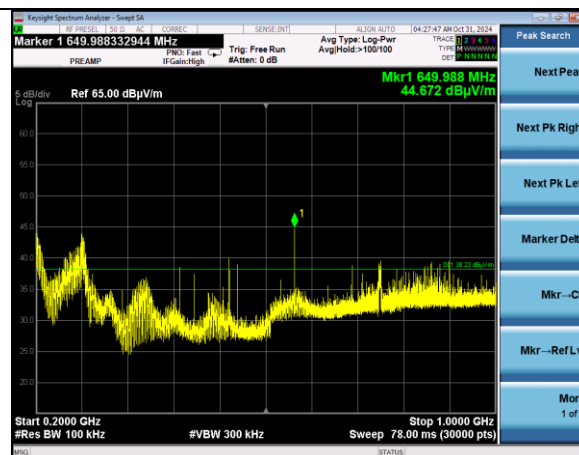


4000-12750 MHz

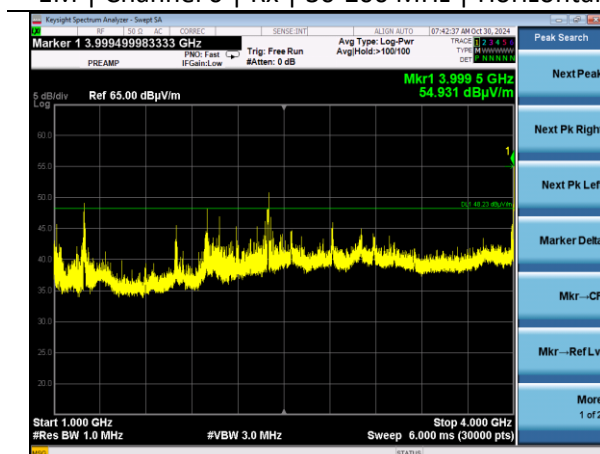
Plots



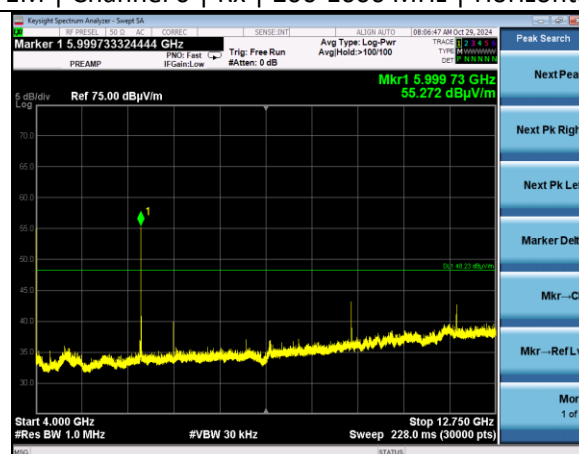
1M | Channel 0 | Rx | 30-200 MHz | Horizontal



1M | Channel 0 | Rx | 200-1000 MHz | Horizontal



1M | Channel 0 | Rx | 1000-4000 MHz | Vertical



802.11b | Channel 39 | Rx
4000-12750 MHz | Vertical

Observed Emissions are not a product of the Radio

6 REVISION HISTORY

Version	Date	Notes	Person
0	12/02/2024	Initial Draft	Dylan Rosenfeldt
1	01/07/2025	Fixed comments	Dylan Rosenfeldt
2	01/10/2025	Final Draft	Dylan Rosenfeldt

END OF REPORT