Co-Location Test Report

TEST REPORT

For

hard & softWERK GmbH

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FCC ID: 2BBC6-BLUHUBMK3

Report Type:	Product Type:
Class II Permissive Change	Gateway

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Report Number:	R2602116-C2PC	
Report Date:	2026-04-17	
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ACCREDITED
CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2602116-C2PC	Class II Permissive Change	2026-04-17

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test report is prepared on behalf of *hard & softWERK GmbH,* and their product Gateway with model: blukii Hub MKIII, the "EUT" as referred to in this report. The EUT has 2.4GHz WiFi, BT, GNSS and LTE capabilities. It utilizes 2.4GHz Wifi and BT radios (FCC ID: 2BBC6-BLUHUBMK3) as well as LTE radio (FCC ID: XMR2023EG915QNA).

1.2 Mechanical Description of EUT (Host Enclosures)

Indoor:

Dimensions: approximately 10 cm (L) x 10 cm (W) x 4 cm (H)
Weight: approximately 1 kg
Serial Number: BACL assigned R2602116-1
The data gathered are from a production sample provided by the manufacturer.

Outdoor:

Dimensions: approximately 20 cm (L) x 15 cm (W) x 6 cm (H)
Weight: approximately 4 kg
Serial Number: BACL assigned R2602117-1
The data gathered are from a production sample provided by the manufacturer.

The two host enclosures are considered to be similar models with the main difference being the plastic enclosure differences.

1.3 Objective

This report is prepared on behalf of *hard & softWERK GmbH* in accordance with Part Part 15.247, Part 2 Subpart J, Part 15 Subpart E, and Part 15 Subpart C of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 15 for RF Exposure, Antenna Requirements, AC Line Conducted Emissions, and Radiated Spurious Emissions for enabling colocation of 2.4 GHz Wi-Fi radio with LTE radio and BT radio insides indoor and outdoor host gateway enclosures.

In order to determine compliance, the manufacturer or a contracted laboratory makes measurements and takes the necessary steps to ensure that the equipment complies with the appropriate technical standards.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product maybe which result in lowering the immunity should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing and/or I/O cable changes, etc.).

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2020, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0428.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2017 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report.

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA

Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2020.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

2.2 EUT Exercise Software

The exercising software used during testing was “EspRFTestTool_v4.7_Manual”, the software is compliant with the standard requirements being tested against.

Radio	Frequency (MHz)	Configuration	Power Setting
2.4GHz Wi-Fi	2437	802.11b	Default
BT	2402,2440,2480	DH1	Default
	2402,2440,2480	2DH1	Default
	2402,2440,2480	3DH1	Default
	2402,2440,2480	BLE	Default
LTE	1850-1910	Band 2	Default

2.3 Equipment Modification

No modifications were made to the EUT during testing.

2.4 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	Latitude E7440	-

2.5 Remote Support Equipment

Manufacturer	Description	Model	Serial Number
hard & softWERK GmbH	Debug Board	-	-

2.6 Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
Raspberry Pi	AC Adaptor	KSA-15E-051300HU	-
Volteq	DC Power Supply	HY6020EX	220401167

2.7 Interface Ports and Cabling

Manufacturer	Description	From	To
Sabrent	USBC2 Cable	Laptop	Debug Board
-	6-pin-UART Cable	EUT	Debug Board
Raspberry Pi	AC Power Cable	AC Outlet	EUT
-	DC Power Cables	DC Power Supply	EUT

3 Summary of Test Results

FCC Rules	Description of Test	Results
FCC §2.1091 FCC § 1.1307 (b)	RF Exposure	Compliant
FCC §15.203	Antenna Requirements	Compliant
FCC §15.207	AC Line Conducted Emissions	Compliant
FCC §2.1053, §15.35(b), §15.205, §15.209, §15.247(d)	Radiated Spurious Emissions	Compliant

BACL is responsible for all the information provided in this report, except when information is provided by the customer as identified in this report. Information provided by the customer, e.g., antenna gain, can affect the validity of results.

Note: AC Line Conducted Emissions was only required for the indoor unit. Outdoor unit is DC power supplied

4 FCC §15.203 – Antenna Requirements

4.1 Applicable Standards

According to FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

4.2 Antenna Description

External/Internal/ Integral	Model Number	Antenna Type	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Integral	ESP ANT B	PCB	2400-2500	3.42
Extenal	X9001091	Dipole	2400-2485	1.8

Note: Antenna information is provided by customer.
Note: ESP ANT B is permenantly attached.
Note: X9001091 is using unique coupling (U.FL from module to RP-SMA)

5 FCC §2.1091, §1.1307 (b) - RF Exposure

5.1 Applicable Standards

According to FCC §2.1091, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

According to FCC §1.1307(b)(1),

(i) With respect to the limits on human exposure to RF provided in § 1.1310 of this chapter, applicants to the Commission for the grant or modification of construction permits, licenses or renewals thereof, temporary authorities, equipment authorizations, or any other authorizations for radiofrequency sources must either:

(A) Determine that they qualify for an exemption pursuant to § 1.1307(b)(3);

(B) Prepare an evaluation of the human exposure to RF radiation pursuant to § 1.1310 and include in the application a statement confirming compliance with the limits in § 1.1310; or

(C) Prepare an Environmental Assessment if those RF sources would cause human exposure to levels of RF radiation in excess of the limits in § 1.1310.

(ii) Compliance with these limits for fixed RF source(s) may be accomplished by use of mitigation actions, as provided in § 1.1307(b)(4). Upon request by the Commission, the party seeking or holding such authorization must electronically submit technical information showing the basis for such compliance, either by exemption or evaluation. Notwithstanding the preceding requirements, in the event that RF sources cause human exposure to levels of RF radiation in excess of the limits in § 1.1310 of this chapter, such RF exposure exemptions and evaluations are not deemed sufficient to show that there is no significant effect on the quality of the human environment or that the RF sources are categorically excluded from environmental processing.

5.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Or

$$S = EIRP/4\pi R^2$$

Where: EIRP= Equivalent (or effective) Isotopically Radiated Power
R = distance to the center of radiation of the antenna

5.3 MPE Results

Radio	Tuned-up Power (dBm)	Max EIRP (dBm)	Worst-Case Exposure Level (mW/cm^2)	Limit (mW/cm^2)	Worst-Case Percentages	Sum of Percentages	Limit
Worst Case							
2.4GHz Wi-Fi	27	30.42	0.219	1.0	21.9%	42.74%	100%
BT	9	10.8	0.0024	1.0	0.24%		
LTE	25	26.49	0.089	0.4437	20.6%		

Note: 2.4GHz Wi-Fi Antenna gain is 3.42dBi
Note: BT Antenna gain is 1.8 dBi
Note: LTE Antenna gain is 1.49 dBi
Note: Evaluated Distance is 20 cm
Note: BT and 2.4 GHz Wi-Fi Power (dBm) are referenced from report with FCC ID: 2BBC6-BLUHUBMK3
Note: LTE Power (dBm) is referenced from from report with FCC ID: XMR2023EG915QNA
Note: LTE limit determined form the worst case margin per the original report.

6 FCC §15.207 – AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207: Conducted limits

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note1	56 to 46 Note2
0.5-5	56	46
5-30	60	50

Note1: Decreases with the logarithm of the frequency.
Note2: A linear average detector is required

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2020 measurement procedure. The specification used were FCC §15.207 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT was connected with LISN-1 and support laptop connected with LISN-2 which provided 120 V / 60 Hz AC power.

6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data were recorded in the peak, quasi-peak, and average detection mode. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Cable Loss (CL), the Attenuator Factor (Atten) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + CL + Atten$$

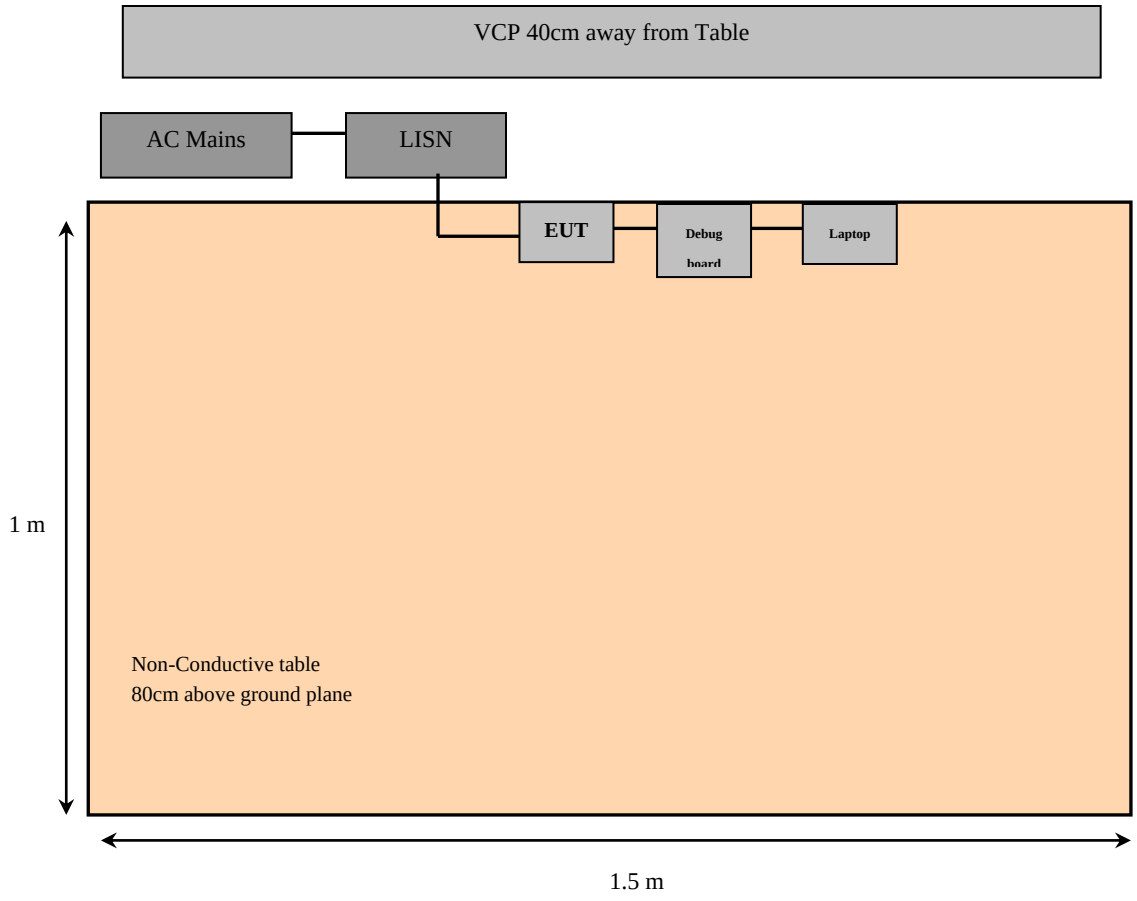
For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 dB)

The "Margin" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

$$Margin = Corrected\ Amplitude - Limit$$

6.5 Test Setup Block Diagram

Indoor Unit



6.6 Test Equipment List and Details

BACL No	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
1432	Keysight Technologies	MXE EMI Receiver, Multi-touch	N9038B	MY60180008	2026-01-22	1 year
1599	Pasternack	N-type RG58 Coax Cable, 5m	PE3441-500CM	W383627	2025-11-18	6 months
724	Solar Electronics Company	High Pass Filter	Type 7930-100	7930150202	2025-10-15	6 months
679	Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101963	2025-10-15	6 months
732	FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2025-09-02	1 year
733	FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160130	2026-03-09	1 year

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

6.7 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	49 %
ATM Pressure:	101.4 kPa

The testing was performed by Libass Thiaw from 2026-03-18 on Ground Plane

6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C conducted emissions limits, with the margin reading of:

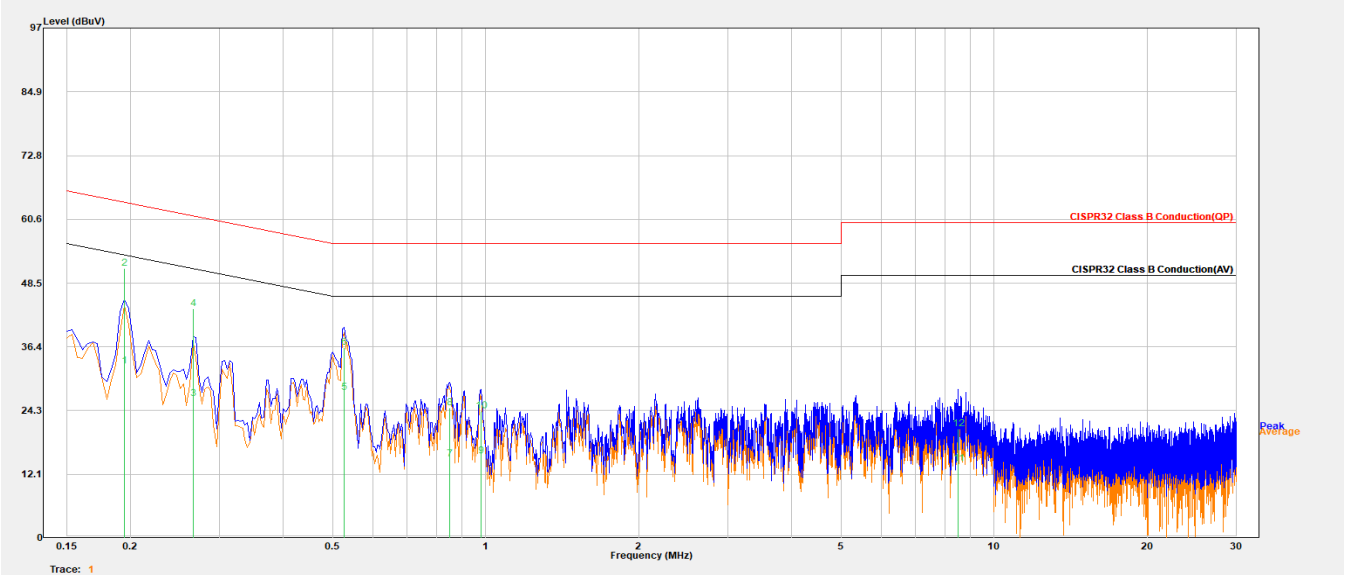
Worst Case – AC Line: 120V, 60Hz			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Hot/Neutral)**	**Range (MHz)**
-12.59	0.195	Live	0.15 to 30

Please refer to the tables and plots in the next section for detailed test results.

6.9 Conducted Emissions Test Plots and Data

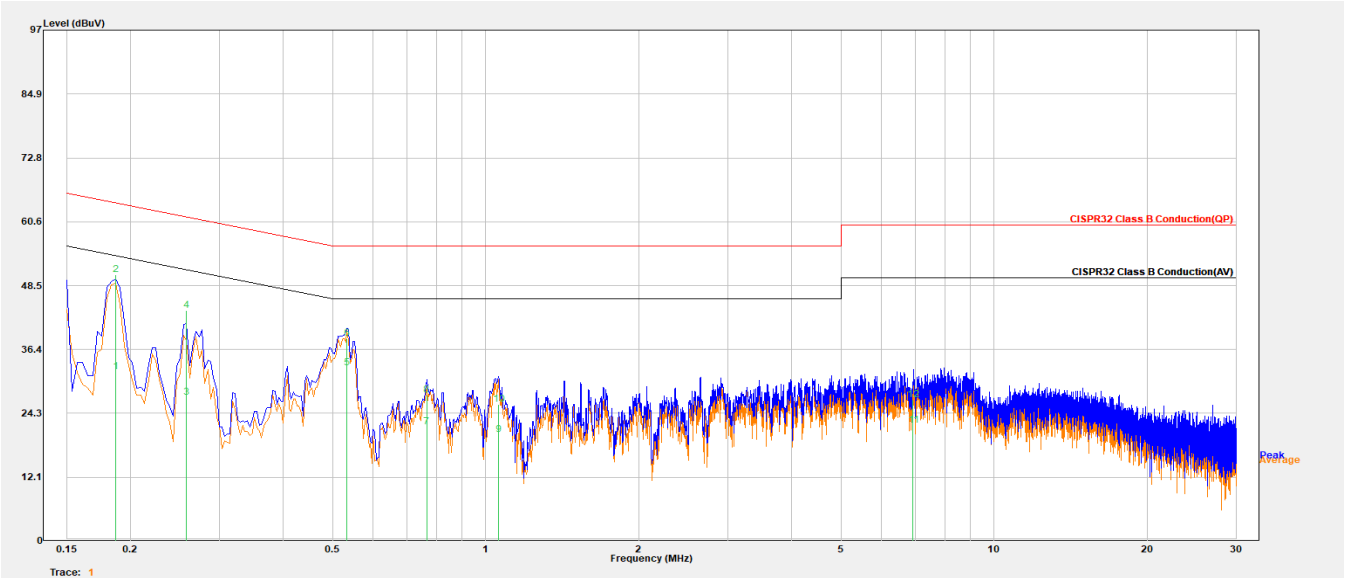
2.4GHz Wifi + LTE + BT Indoor

AC Line: 120V, 60Hz – Live Conductor



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.195	20.05	12.74	32.79	53.83	-21.04	Average
0.195	38.49	12.74	51.24	63.83	-12.59	QP
0.266	14.78	11.74	26.52	51.25	-24.73	Average
0.266	31.90	11.74	43.64	61.25	-17.61	QP
0.527	16.94	10.75	27.69	46.00	-18.31	Average
0.527	25.50	10.75	36.25	56.00	-19.75	QP
0.852	4.53	10.46	14.99	46.00	-31.01	Average
0.852	14.37	10.46	24.83	56.00	-31.17	QP
0.978	5.16	10.39	15.56	46.00	-30.44	Average
0.978	13.72	10.39	24.11	56.00	-31.89	QP
8.513	3.89	10.27	14.16	50.00	-35.84	Average
8.513	10.49	10.27	20.76	60.00	-39.24	QP
0.195	20.05	12.74	32.79	53.83	-21.04	Average
0.195	38.49	12.74	51.24	63.83	-12.59	QP
0.266	14.78	11.74	26.52	51.25	-24.73	Average
0.266	31.90	11.74	43.64	61.25	-17.61	QP

AC Line: 120V, 60Hz – Neutral Conductor



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.187	19.32	12.85	32.17	54.15	-21.98	Average
0.187	37.65	12.85	50.50	64.15	-13.66	QP
0.258	15.38	11.83	27.21	51.49	-24.27	Average
0.258	32.00	11.83	43.84	61.49	-17.65	QP
0.534	22.17	10.74	32.91	46.00	-13.09	Average
0.534	27.69	10.74	38.42	56.00	-17.58	QP
0.766	11.11	10.50	21.62	46.00	-24.38	Average
0.766	17.15	10.50	27.65	56.00	-28.35	QP
1.061	9.90	10.36	20.27	46.00	-25.73	Average
1.061	15.56	10.36	25.92	56.00	-30.08	QP
6.938	11.76	10.23	21.99	50.00	-28.01	Average
6.938	16.59	10.23	26.83	60.00	-33.17	QP

Note: during pretesting, it was verified that AC adaptor produced worst case results rather than POE thus AC adaptor results included.

7 FCC §15.35(b), §15.205, §15.209, §15.247(d)–Radiated Spurious Emissions

7.1 Applicable Standard

As per FCC §15.35(b): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.209: The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

Note 1: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §15.247 (d),

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2020. The specification used was the FCC §15.247.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

7.3 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter or 1.5 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

9 kHz-150 kHz

RBW = 200Hz /VBW = 1kHz

150 kHz-30 MHz

RBW = 9kHz /VBW = 30kHz

30 MHz- 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 1kHz / Sweep = Auto

7.4 Corrected Amplitude and Margin Calculation

For emissions below 1 GHz,

The Corrected Amplitude (CA) is calculated by adding the Correction Factor to the S.A. Reading. The basic equation is as follows:

CA = S.A. Reading + Correction Factor

For example, a corrected amplitude of 40.3 dBuV/m = S.A. Reading (32.5 dBuV) + Correction Factor (7.8 dB/m)

The Correction Factor is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) together. This calculation is done in the measurement software, and reported in the test result section. The basic equation is as follows:

Correction Factor = AF + CL + Atten – Ga

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude – Limit

For emission above 1 GHz,

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

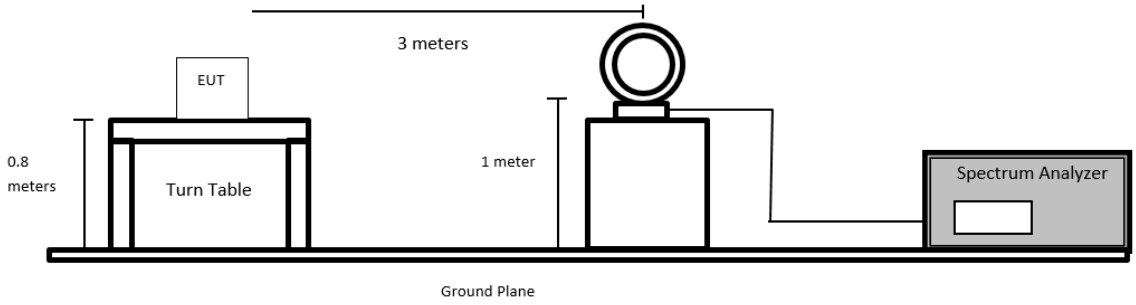
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

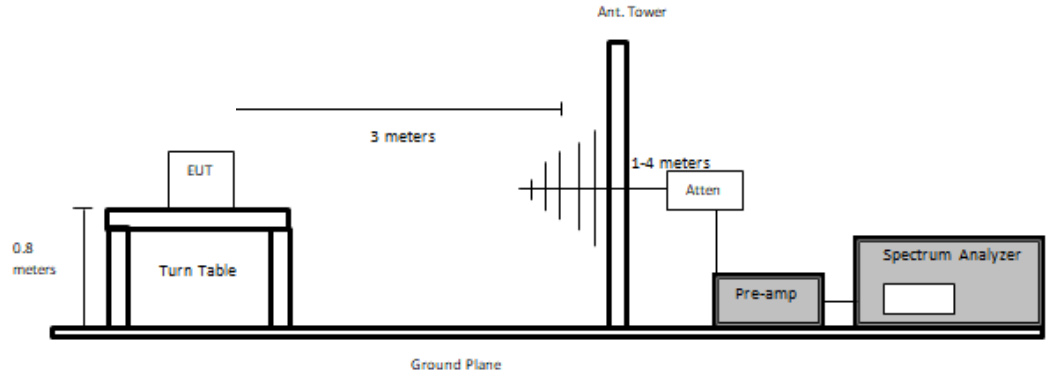
Margin = Corrected Amplitude – Limit

7.5 Test Setup Block Diagram

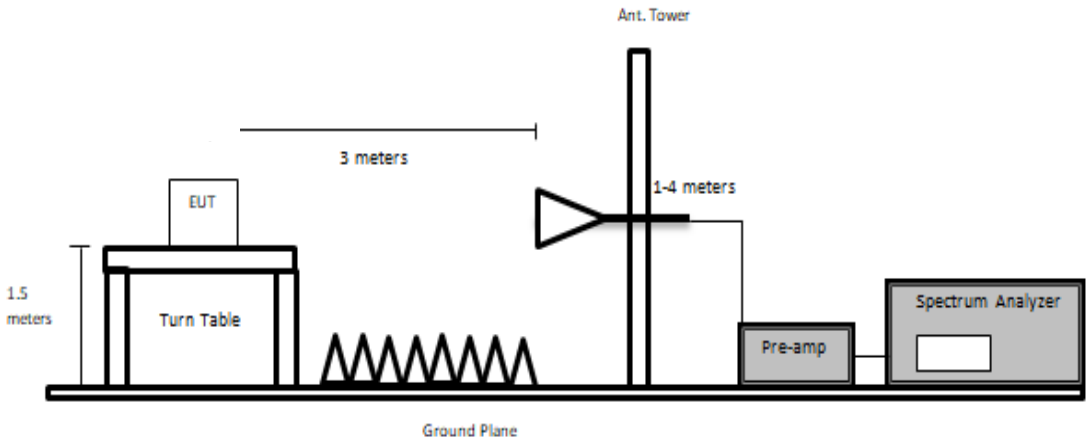
9 kHz to 30 MHz Test Setup



30 MHz to 1 GHz Test Setup



Above 1 GHz Test Setup



7.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
327	Sunol Sciences	System Controller	SC110V	122303-1	N/R	N/R
1075	Sunol Sciences	Boresight Tower	TLT3	050119-7	N/R	N/R
1388	Sunol Sciences	Flush Mount Turntable	FM	112005-2	N/R	N/R
1432	Keysight Technologies	MXE EMI Receiver, Multi-touch	N9038B	MY60180008	2026-01-22	1 year
316	Sonoma Instruments	Preamplifier 10 kHz - 2.5 GHz	317	260406	2025-11-12	6 months
321	Sunol Sciences	Biconilog Antenna 30MHz-1GHz	JB3	A020106-2; 1504	2025-12-16	2 years
1245	Pasternack	6dB Attenuator	PE7390-6	01182018A	2025-12-16	2 years
1246	Hewlet Packard	RF Limiter 9KHz-1GHz	11867A	01734	2025-09-09	1 year
1210	Pasternack	N-type Coax Cable, 50ft RG213	PE3496-0600	2103161	2025-11-12	6 months
1248	Pasternack	RG214 COAX Cable 9 kHz - 1 GHz	PE3062	NA	2025-10-03	1 year
1192	ETS Lindgren	Horn Antenna 1-18GHz	3117	00218973	2024-10-23	2 years
1295	CarlisleIT	10m Coaxial Cable	UFB142A-1-3937-200200	64639890912-001	2026-04-14	6 months
1449	BACL	Preamplifier 100MHz-18GHz	BACL1313-A100M18G	4052472	2026-02-17	6 months
90	Wisewave	Horn Antenna 18-26.5GHz	ARH-4223-02	10555-01	2025-05-06	2 years
393	Com-Power	Loop Antenna, Active	AL-130	17043	2025-05-06	2 years
1451	BACL	Preamplifier 18-40GHz	BACL-1313-A1840	4052432	2026-02-17	6 months
1545	Megaphase	K-type coax cable	TM40-K1K3-12	20869601 001	2026-02-17	6 months
1546	Megaphase	SMA coax cable	TM26-S1S3-12	20869602 001	2026-02-27	6 months
672	Micro-Tronics	2.4 - 2.6GHz Notch Filter	BRM50701	160	2026-03-05	1 year
1334	Micro-Tronics	Notch Filter 2.4GHz	BRM50702	G361	2025-12-17	1 year
387	Micro-Tronics	Notch Filter	BRC50703	6	2026-03-05	1 year

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

7.7 Test Environmental Conditions

Temperature:	23.1 ºC
Relative Humidity:	56.8 %
ATM Pressure:	101.3 kPa

The radiated testing testing was performed by Libass Thiaw and Rachana Khanduri on 2026-03-13, 2026-03-18 and 2026-04-17 in 5m chamber 3.

7.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.209 and Part 15.247 standards' radiated emissions limits, and had the worst margin of:

Worst Case – Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Configuration**
-1.44	45.11188	Vertical	2.4 GHz WiFi + BT + LTE

Please refer to the tables and plots in the next section for detailed test results.

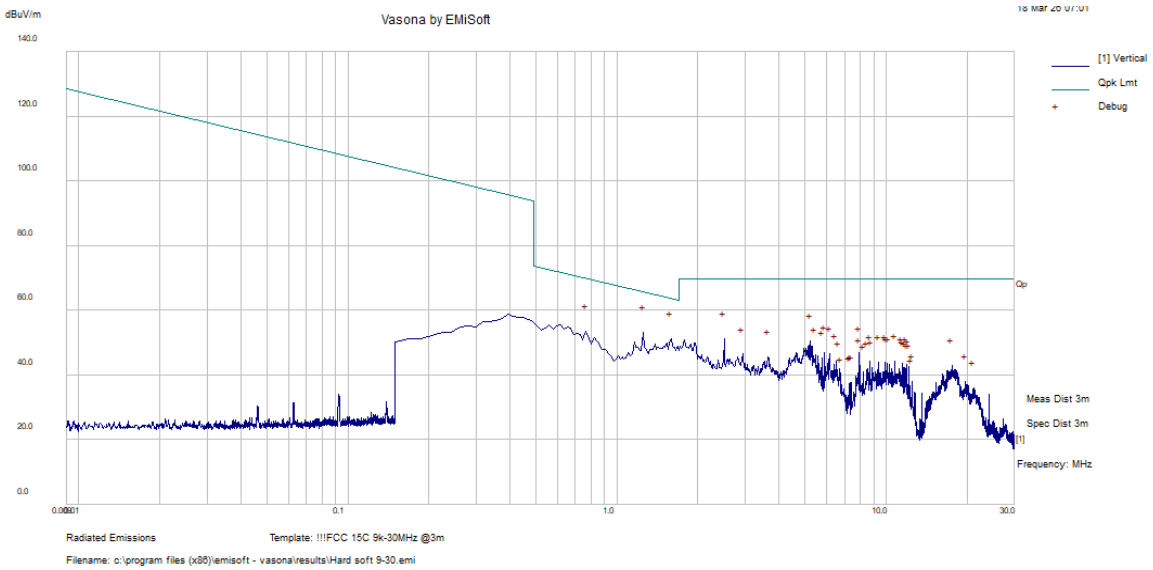
7.9 Radiated Emissions Test Result Data

Note:
1. For 9kHz-30MHz, devices were tested in parallel, perendicular, and ground-parallel. The worst orientation was parallel and the data was recorded in report.
2. Pre-scan was performed in order to determine worst-case orientation of device with respect to measurement antenna in the X/Y/Z axis. Plots/data shown represent measurements made in worst-case orientation.

1) 9 kHz – 30 MHz, Measured at 3 meters

2.4GHz Wifi + LTE + BT Indoor

Parallel

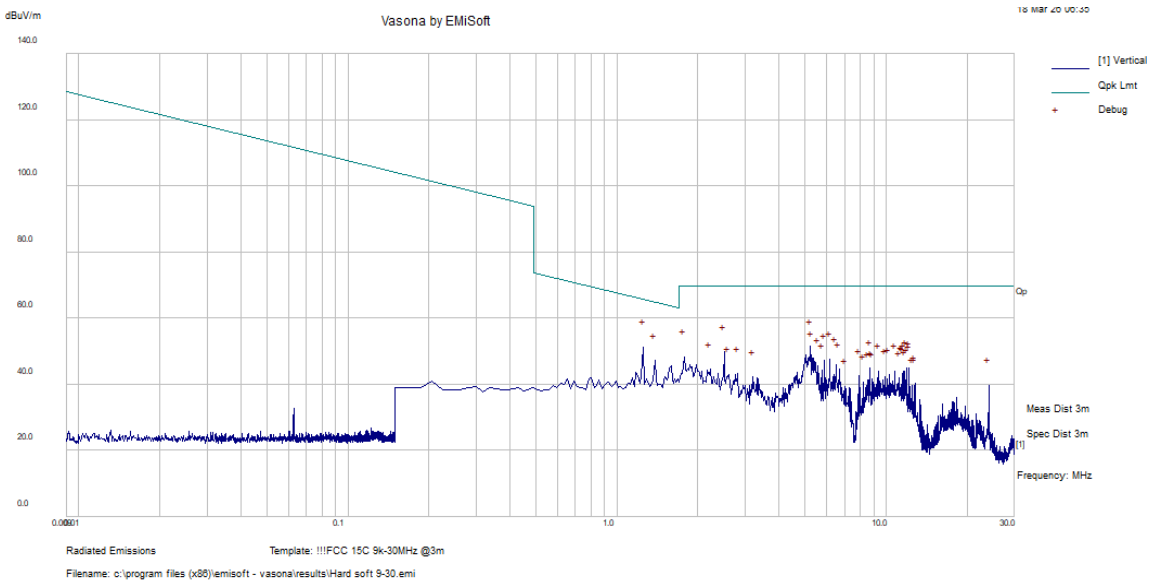


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Detector	Limit (dBµV/m)	Margin (dB)
1.586531	41.01	10.26	51.27	Peak	63.6	-12.33
1.250719	42.97	10.15	53.12	Peak	65.66	-12.54
0.765656	43.52	10.1	53.62	Peak	69.92	-16.3
2.500688	40.83	10.41	51.24	Peak	69.54	-18.3
5.243156	40.16	10.38	50.54	Peak	69.54	-19
5.914781	36.29	10.56	46.85	Peak	69.54	-22.69

Note: The Peak measurement is used to show compliance, which is evaluated against the Quasi-Peak Limit.

2.4GHz Wifi + LTE + BT Outdoor

Parallel

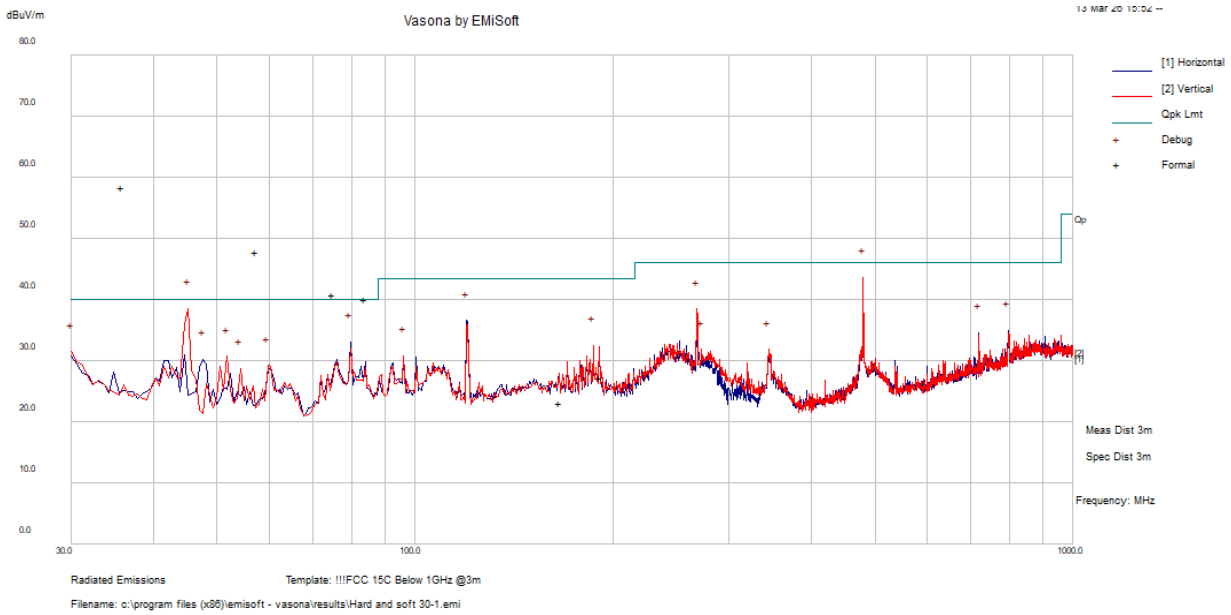


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Detector	Limit (dBµV/m)	Margin (dB)
1.250719	41.08	10.15	51.23	Peak	65.66	-14.43
1.381313	36.9	10.19	47.09	Peak	64.8	-17.71
5.243156	40.97	10.38	51.35	Peak	69.54	-18.19
2.500688	39.33	10.41	49.74	Peak	69.54	-19.8
1.773094	37.91	10.3	48.21	Peak	69.54	-21.33
5.299125	37.36	10.39	47.75	Peak	69.54	-21.79

Note: The Peak measurement is used to show compliance, which is evaluated against the Quasi-Peak Limit.

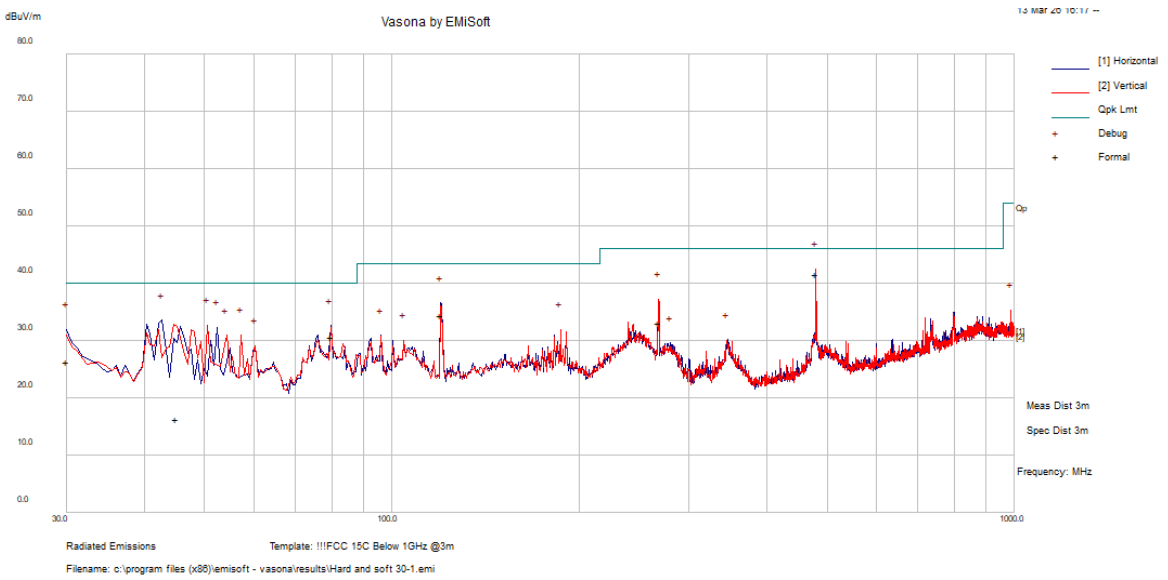
30 MHz – 1 GHz, Measured at 3 meters

2.4GHz Wifi + BT + LTE Indoor



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Limit (dBµV/ m)	Margin (dB)	Detector
45.11188	59.51	-20.95	38.56	V	40	-1.44	QP
479.9947	51.87	-10.32	41.55	V	46	-4.45	QP
119.975	50.78	-16.35	34.43	H	43.5	-9.07	QP
79.89531	53.89	-23.24	30.65	H	40	-9.35	QP
268.2769	49.36	-16.21	33.15	V	46	-12.85	QP
30	36.38	-10.01	26.37	V	40	-13.63	QP

2.4GHz Wifi + BT + LTE Outdoor



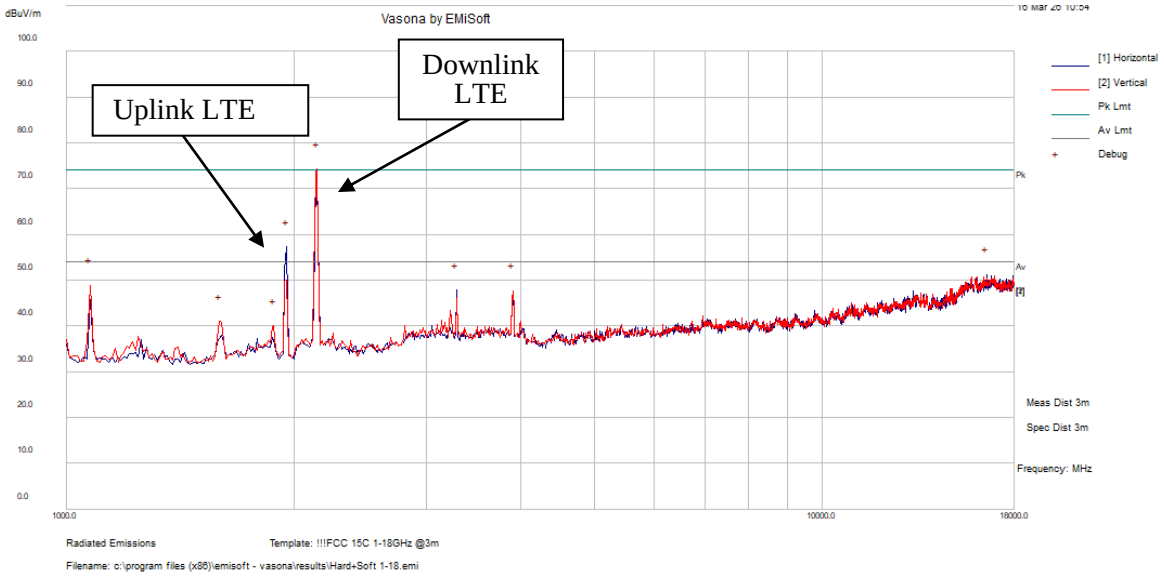
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Limit (dBµV/m)	Margin (dB)	Detector
480.0022	52.41	-10.32	42.09	V	46	-3.91	QP
42.98	44.45	-19.54	24.91	H	40	-15.09	QP
119.9734	50.62	-16.35	34.27	H	43.5	-9.23	QP
50.38	55.92	-23.25	32.67	V	40	-7.33	QP
79.88031	54.66	-23.25	31.41	H	40	-8.59	QP
52.57594	55.84	-23.53	32.31	H	40	-7.69	QP

FCC Limits for 1 GHz to 26.5 GHz			
Applicability	**(dBm)**	**(uV/m at 3meters)**	**(dBuV/m at 3meters)**
Restricted Band Average Limit	-	500	54[2]
Restricted Band Peak Limit[1]	-	-	74

Note 1: Restricted Band Peak Limit is defined to be 20dB higher than Average Limit.
Note 2: Above 1GHz limit calculation:
dBuV/m = 20*log(V/m) + 120 = 20*log((500 [uV/m]/1000000)) + 120 = 54 [dBuV/m]

2) 1 GHz – 18 GHz, Measured at 3 meters

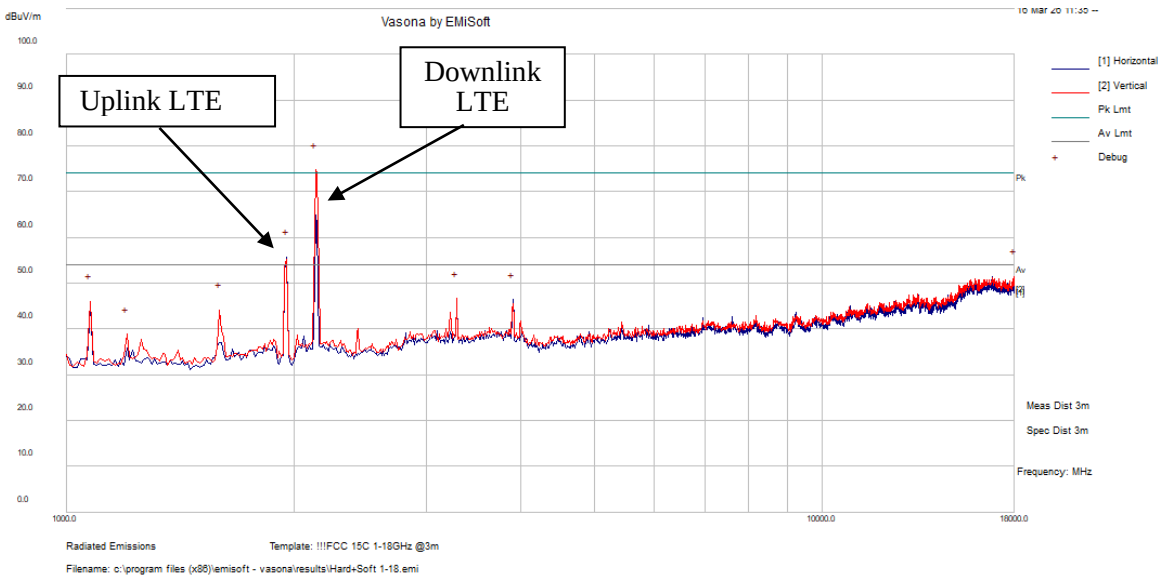
2.4GHz Wifi + BT + LTE Indoor



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Limit (dBµV/m)	Margin (dB)	Detector
16523.13	32.79	18.45	51.24	H	54	-2.76	Peak
1074.375	58.46	-9.56	48.9	V	54	-5.1	Peak
3284.375	49.42	-1.59	47.84	H	54	-6.17	Peak
3900.625	48.53	-0.79	47.74	V	54	-6.26	Peak
1595	49.03	-8.09	40.94	V	54	-13.06	Peak
1881.875	44.81	-4.75	40.06	V	54	-13.94	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.
Note: Downlink emissions shown were verified to be coming from support callbox signal necessary to inititate communication with the EUT.

2.4GHz Wifi + BT + LTE Outdoor

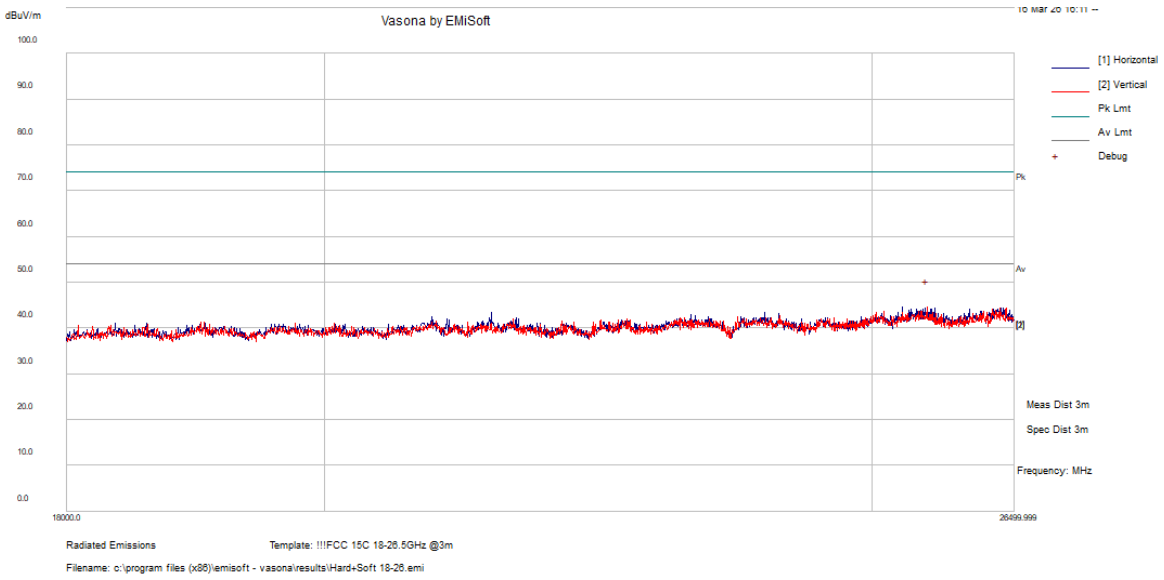


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Limit (dBµV/m)	Margin (dB)	Detector
17989.38	33.69	17.8	51.49	V	54	-2.51	Peak
3284.375	48.18	-1.59	46.59	H	54	-7.41	Peak
3900.625	47.19	-0.79	46.4	V	54	-7.6	Peak
1074.375	55.6	-9.56	46.04	V	54	-7.96	Peak
1595	52.19	-8.09	44.1	H	54	-9.9	Peak
1201.875	47.54	-8.7	38.84	V	54	-15.16	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.
Note: Downlink emissions shown were verified to be coming from support callbox signal necessary to inititate communication with the EUT.

3) 18 GHz – 26.5 GHz, Measured at 3 meters

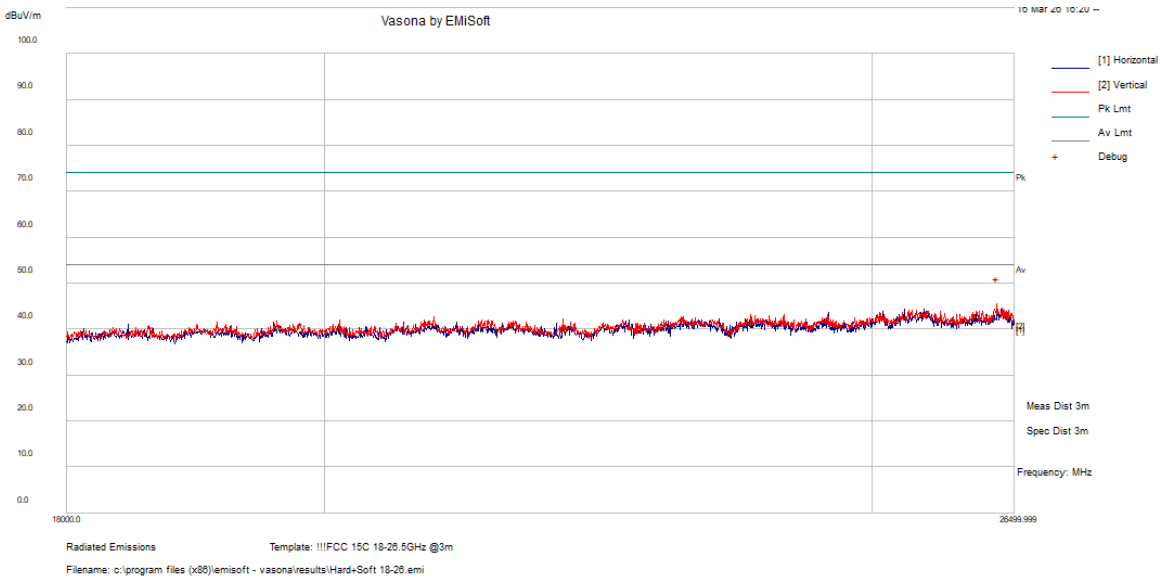
2.4GHz Wifi + BT + LTE Indoor



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Limit (dBµV/m)	Margin (dB)	Detector
25570.31	38.41	6.21	44.62	V	54	-9.38	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.

2.4GHz Wifi + BT + LTE Outdoor



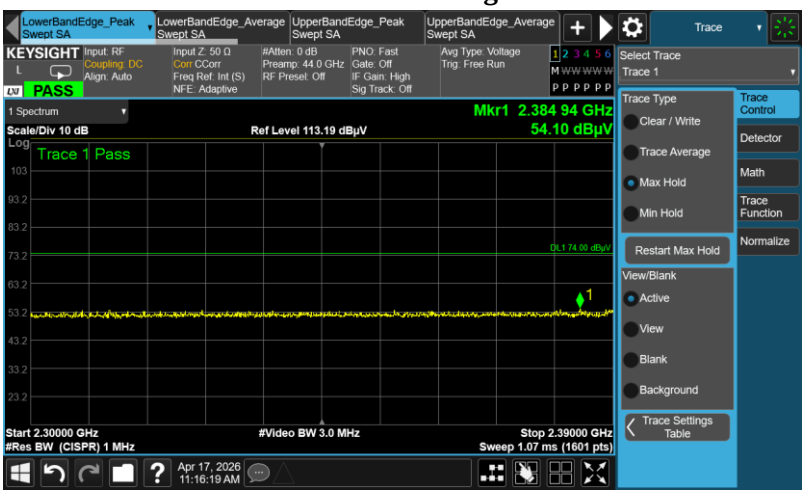
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Limit (dBµV/m)	Margin (dB)	Detector
26314.06	39.19	6.25	45.44	V	54	-8.56	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.

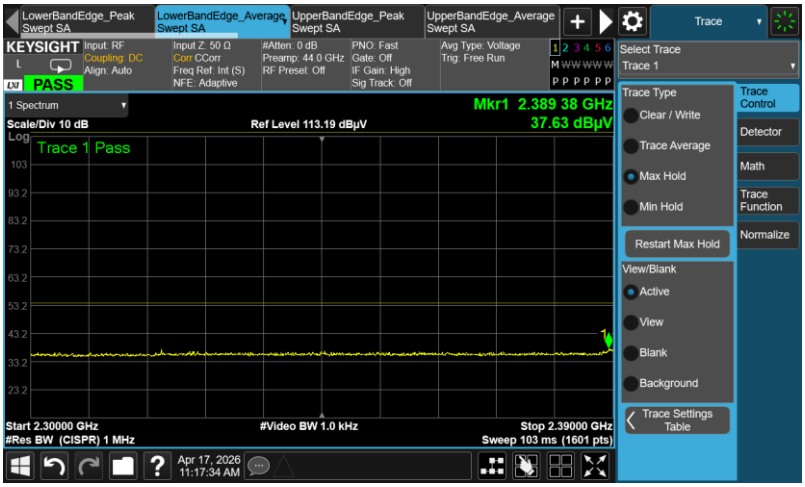
Band Edges

Note: pretesting was determined to determine the worst position overall. In doing so, it was determined that Horizontal polarization produced worst-case emissions. As such, the below plots show worst-case measruements performed in the horizontal polarization of the measurement antenna.

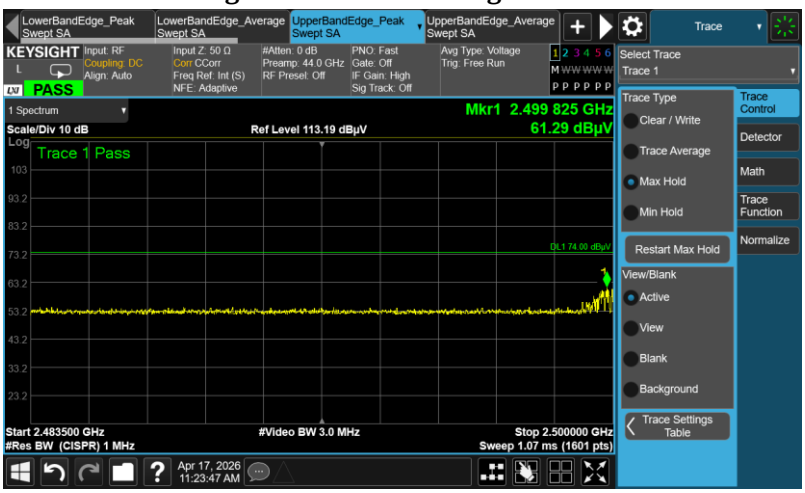
BLE Low Channel Band Edge Peak Indoor



BLE Low Channel Band Edge Average Indoor

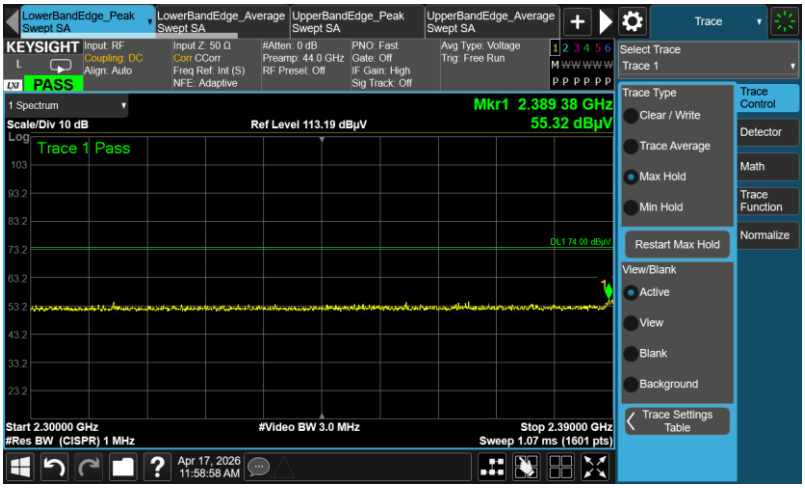


BLE High Channel Band Edge Peak Indoor

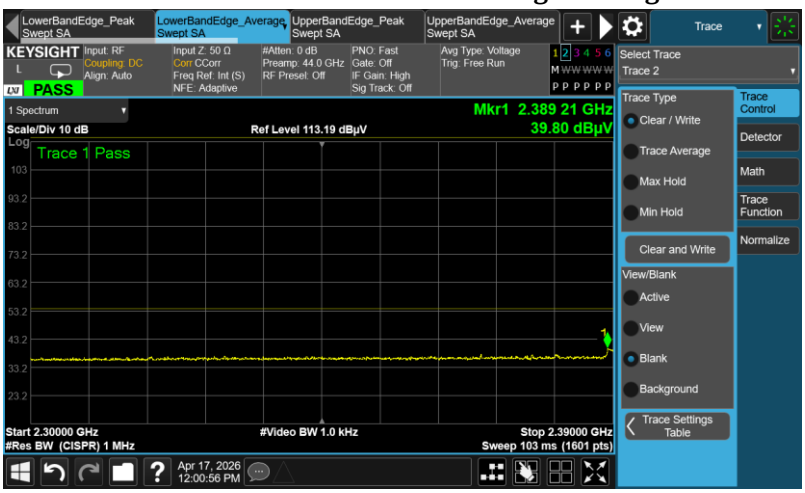


BLE High Channel Band Edge Average Indoor

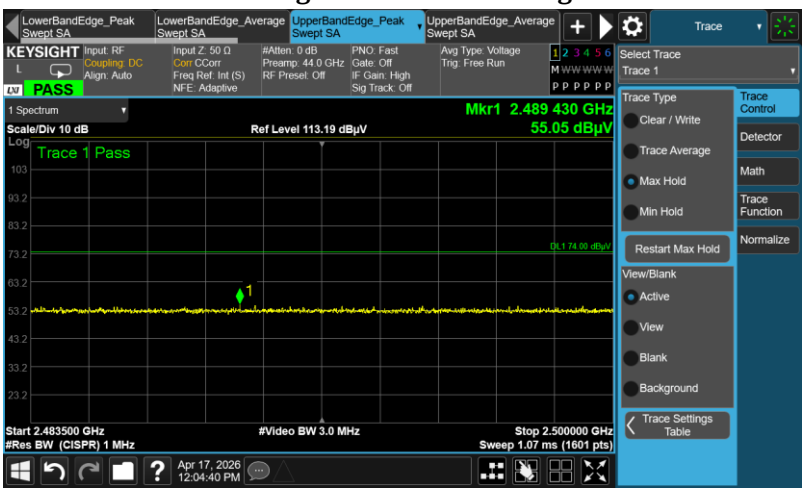
BT Classic DH1 Low Channel Band Edge Peak Indoor



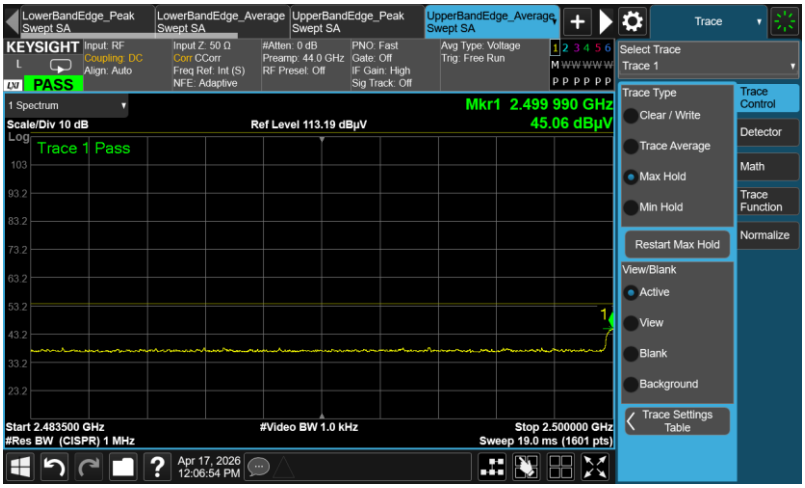
BT Classic DH1 Low Channel Band Edge Average Indoor



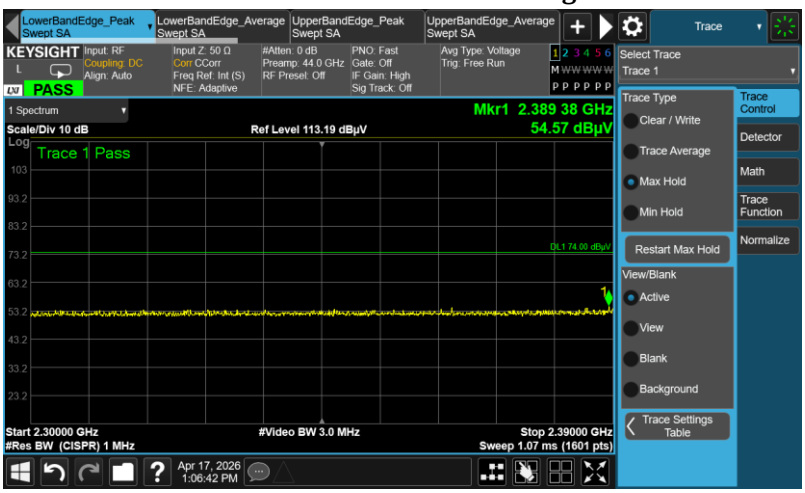
BT Classic DH1 High Channel Band Edge Peak Indoor



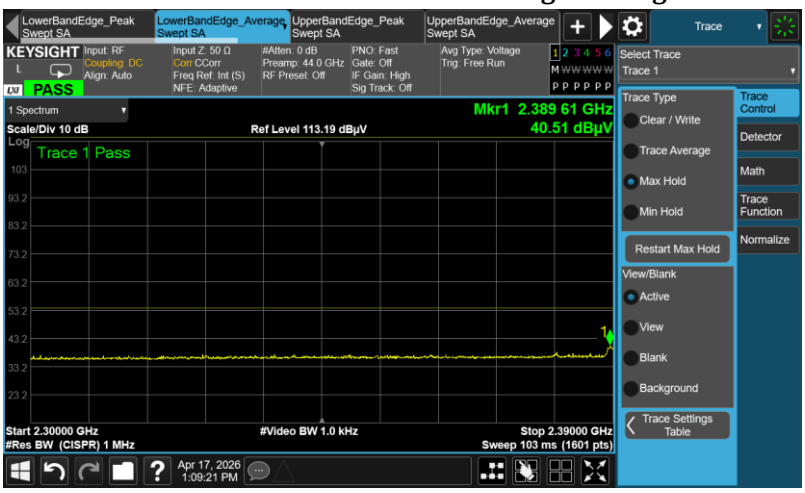
BT Classic DH1 High Channel Band Edge Average Indoor



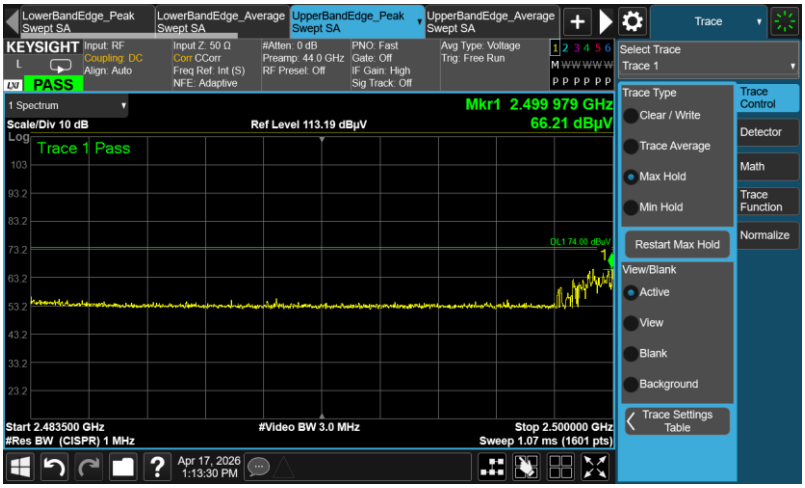
BT Classic 2DH1 Low Channel Band Edge Peak Indoor



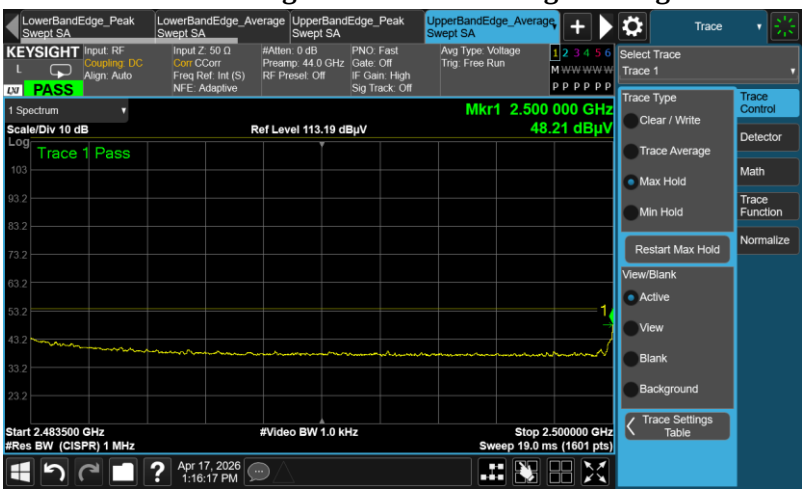
BT Classic 2DH1 Low Channel Band Edge Average Indoor



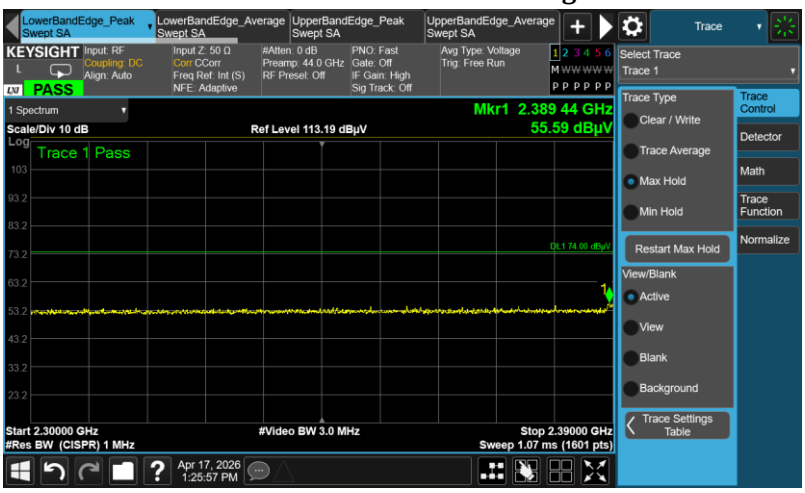
BT Classic 2DH1 High Channel Band Edge Peak Indoor



BT Classic 2DH1 High Channel Band Edge Average Indoor

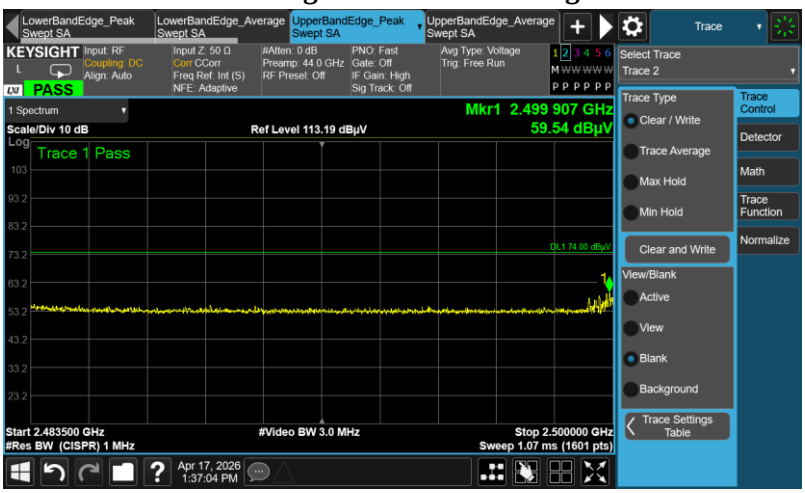


BT Classic 3DH1 Low Channel Band Edge Peak Indoor

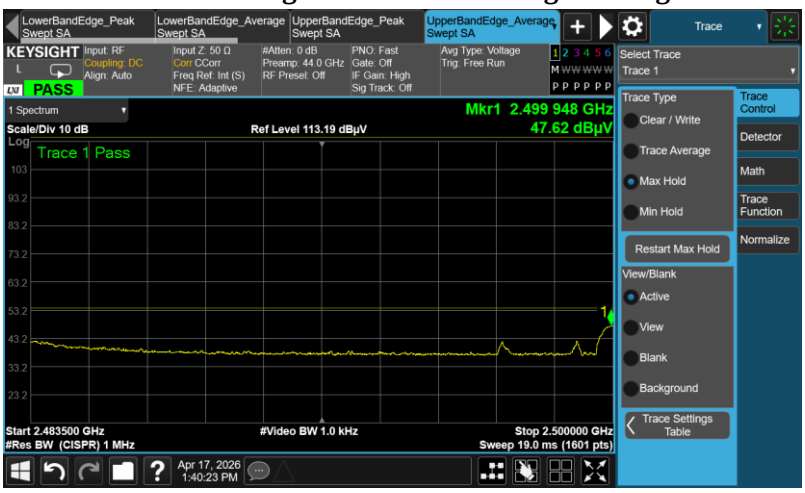


BT Classic 3DH1 Low Channel Band Edge Average Indoor

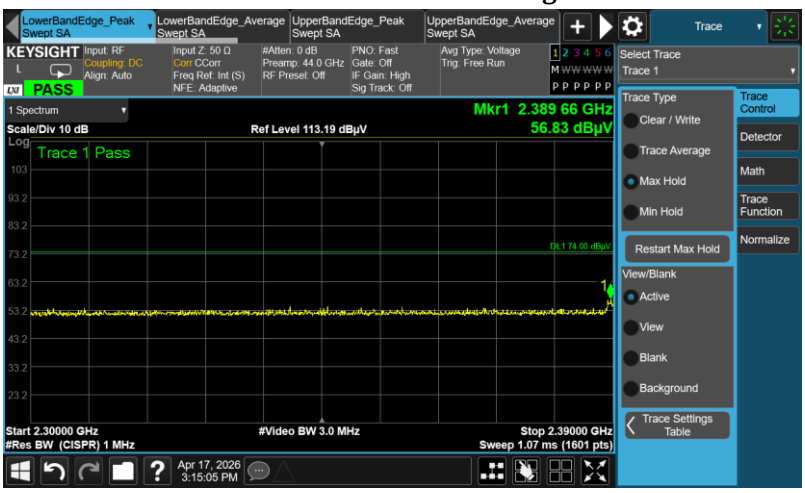
BT Classic 3DH1 High Channel Band Edge Peak Indoor



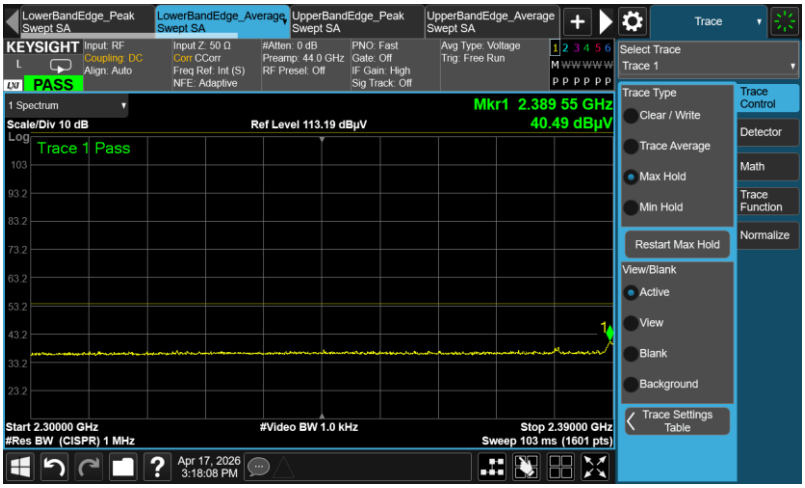
BT Classic 3DH1 High Channel Band Edge Average Indoor



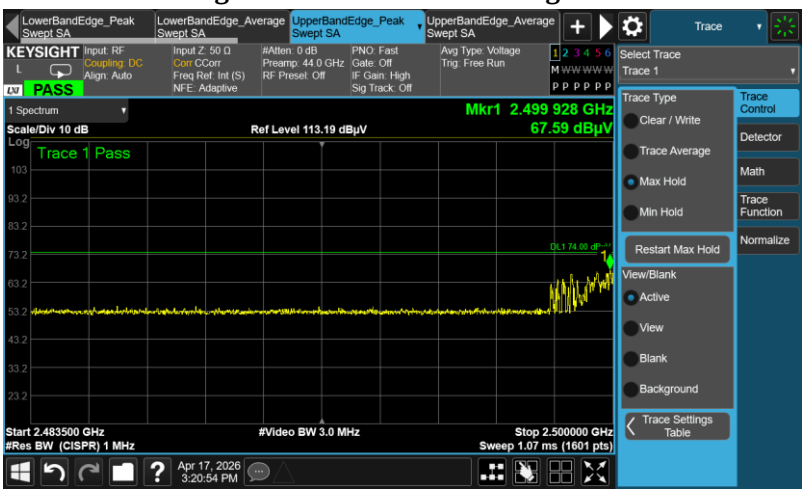
BLE Low Channel Peak Band Edge Outdoor



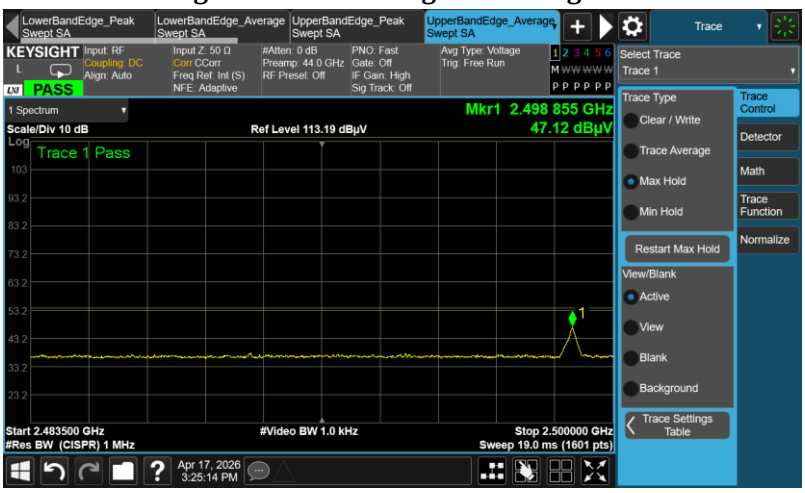
BLE Low Channel Average Band Edge Outdoor



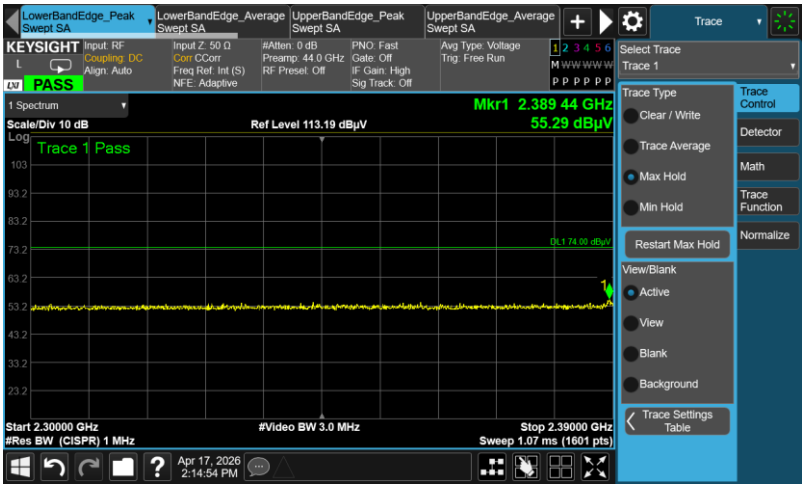
BLE High Channel Peak Band Edge Outdoor



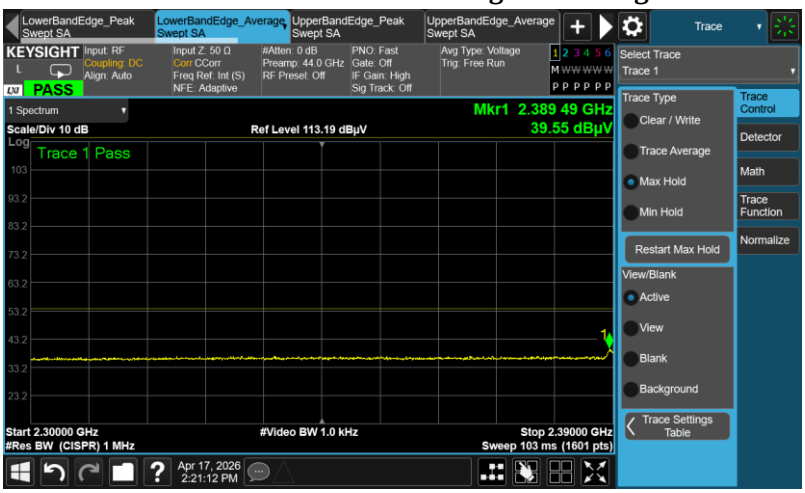
BLE High Channel Average Band Edge Outdoor



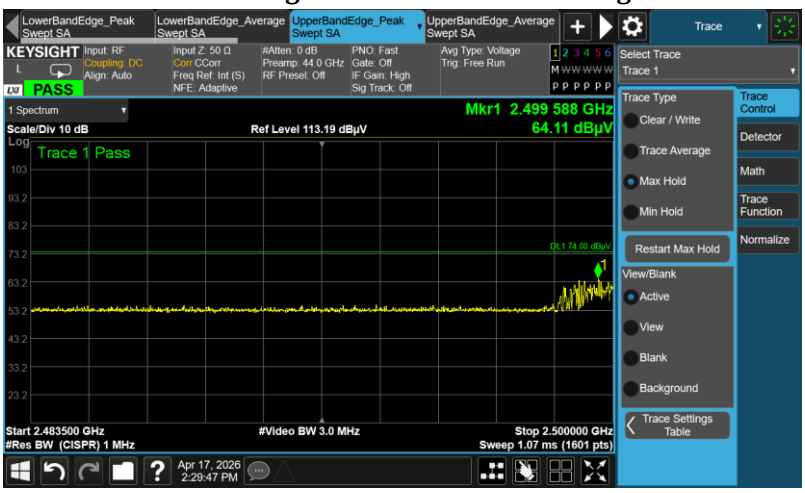
BT Classic DH1 Low Channel Peak Band Edge Outdoor



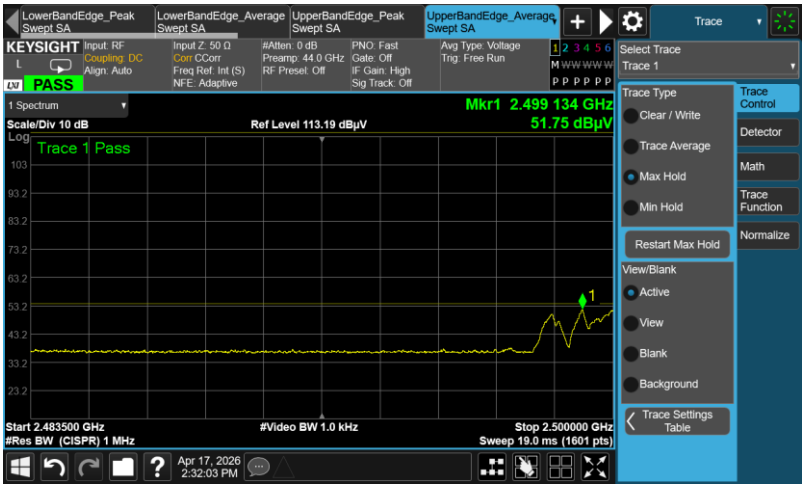
BT Classic DH1 Low Channel Average Band Edge Outdoor



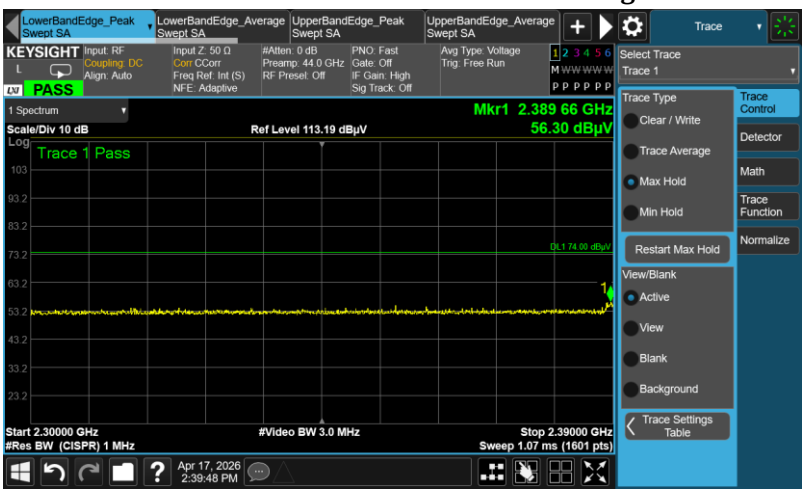
BT Classic DH1 High Channel Peak Band Edge Outdoor



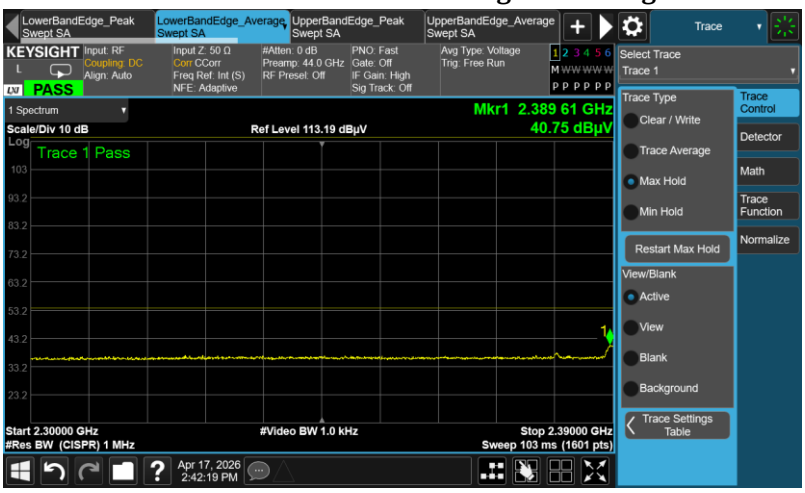
BT Classic DH1 High Channel Average Band Edge Outdoor



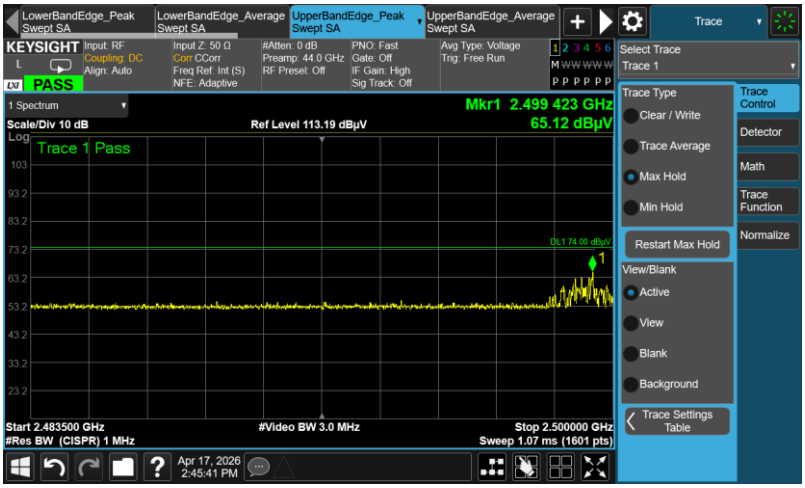
BT Classic 2DH1 Low Channel Peak Band Edge Outdoor



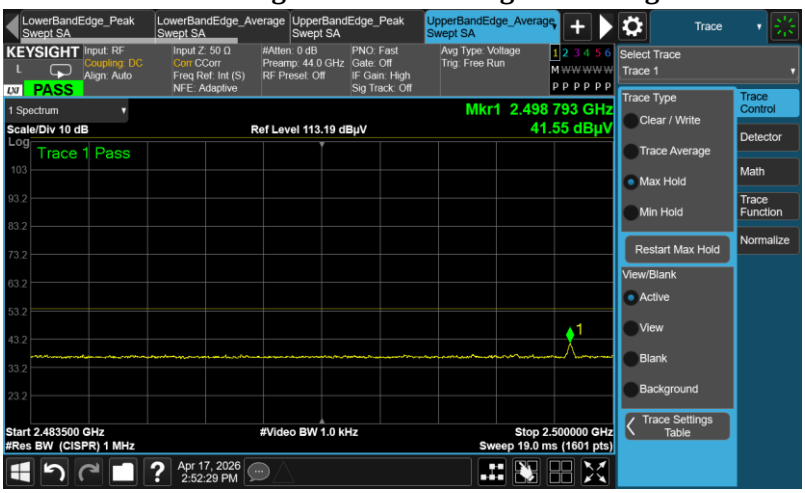
BT Classic 2DH1 Low Channel Average Band Edge Outdoor



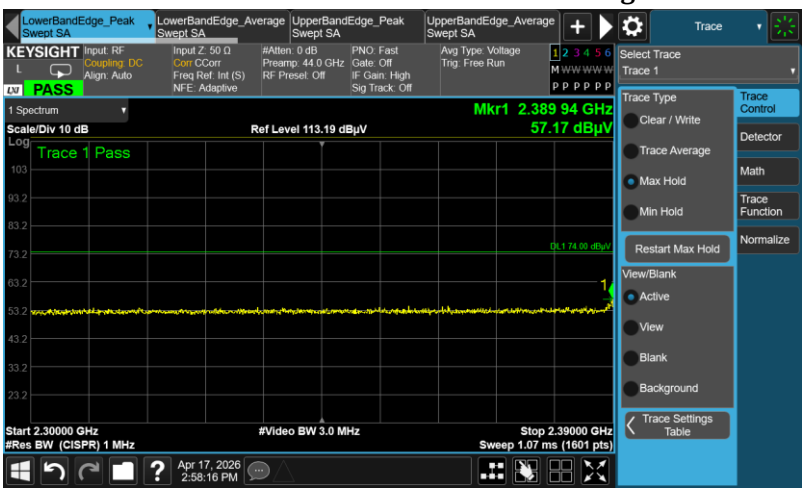
BT Classic 2DH1 High Channel Peak Band Edge Outdoor



BT Classic 2DH1 High Channel Average Band Edge Outdoor

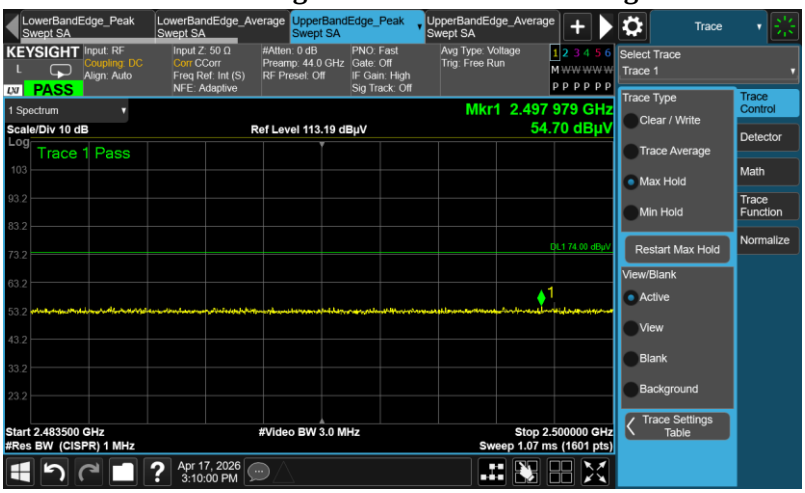


BT Classic 3DH1 Low Channel Peak Band Edge Outdoor

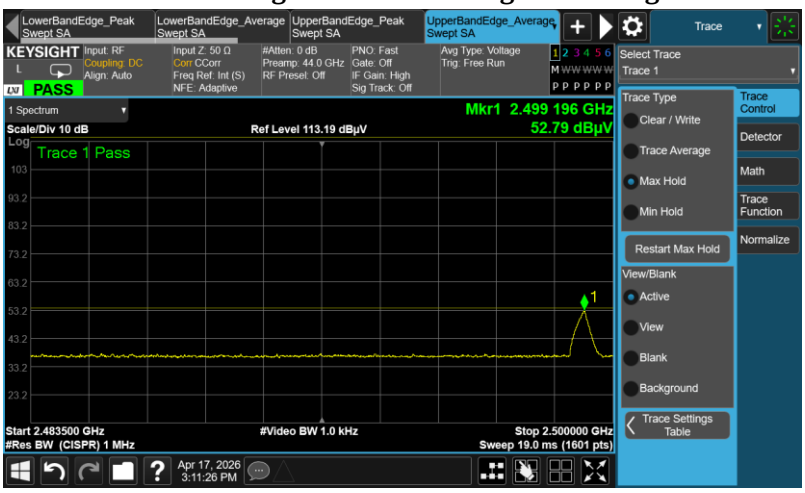


BT Classic 3DH1 Low Channel Average Band Edge Outdoor

BT Classic 3DH1 High Channel Peak Band Edge Outdoor



BT Classic 3DH1 High Channel Average Band Edge Outdoor



8 Appendix A (Normative) – EUT Test Setup Photographs

Please refer to attachement

9 Appendix B (Normative) – EUT External Photographs

Please refer to attachement

10 Appendix C (Normative) – EUT Internal Photographs

Please refer to attachement

11 Appendix D (Normative) – A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA R222 - Specific Requirements EPA ENERGY STAR Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 13th day of September 2024.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2026

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope.

https://www.a2la.org/scopepdf/3297-02.pdf

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