UNIFIED COMPLIANCE LABORATORY

427 West 12800 South
Draper, UT 84020

Test Report

Certification

FCC ID	SWX-WAVEML
Equipment Under Test	Wave-MLO5
Test Report Serial Number	TR9529_03
Date of Test(s)	13, 29 – 30 August; 3 – 5 September; 30 October 2024, 21 December 2024 – 3 January 2025.
Report Issue Date	03 January 2025

Test Specification	Applicant
47 CFR FCC Part 15, Subpart E	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.

NVLAP TESTING ilac-MRA

NVLAP LAB CODE 600241-0

Certification of Engineering Report

This report has been prepared by Unified Compliance Laboratory (UCL) to document compliance of the device described below with the requirement of Federal Communication Commissions (FCC) Part 15, Subpart E. This report may be reproduced in full. Partial reproduction of this report may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested with the specifications provided by the manufacturer.

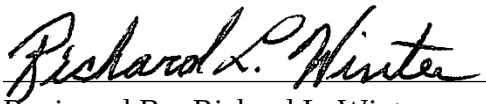
Applicant	Ubiquiti Inc.
Manufacturer	Ubiquiti Inc.
Brand Name	UBIQUITI
Model Number	Wave-MLO5
FCC ID	SWX-WAVEML

On this 3rd day of January 2025, I individually and for Unified Compliance Laboratory certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge and are made in good faith.

Although NVLAP has accredited the Unified Compliance Laboratory testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the U.S. federal government.

Unified Compliance Laboratory

Written By: Clay Allred



Reviewed By: Richard L. Winter

Revision History		
Revision	**Description**	**Date**
01	Original Report Release	21 November 2024
02	Updated with 30 dBi Antenna	3 January 2025
03	Corrected Highest Power In Section 5.4	8 January 2025

Table of Contents

1 Client Information

1.1 Applicant

Company	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.
Contact Name	Alex Macon
Title	Compliance

1.2 Manufacturer

Company	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.
Contact Name	Alex Macon
Title	Compliance

2 Equipment Under Test (EUT)

2.1 Identification of EUT

Brand Name	UBIQUITI
Model Number	Wave-MLO5
Serial Number	2F2513
Dimensions (cm)	24.9 x 8.2 x 4.8

2.2 Description of EUT

The Wave-MLO5 is a 5 GHz point-to-point customer premise equipment which features wave technology with a high throughput rate. The 5 GHz radio supports U-NII-1, U-NII-2 and U-NII-3 bands. The Wave-MLO5 has Bluetooth LE transceiver for system management. The Wave-MLO5 is an outdoor device and has an Ethernet port which is used for data transfer and is powered using a Model POE-54-30W-10G-WH 54-volt PoE power adapter.

The following is list of the antennas that the Wave-MLO5 can use.

Antenna Type	Model Number	Antenna Gain (dBi)
Omni	AMO-5G10	10 (Note 1)
	AMO-5G13	13
Dish	RD-5G30-LW	30
	RD-5G30	30 (Note 1)
	UISP Dish	30
	AF-5G30-S45	30
	AF-5G23-S45	23
Sector	AP-5AC-90-HD	22
	AM-5AC21-60	21
	AM-5AC22-45	22
	AM-V5G-Ti	21
	AM-M-V5G-Ti	17
	AM-5G16-120	16
	AM-5G17-90	17
	AM-5G19-120	19
	AM-5G20-90	20
Horn	UISP Horn	19.5
	Horn-5	19
Note 1: For reporting purposes the lowest and highest gain antennas are covered in this report		

The table below show the channels used within the different modulation bandwidths.

Band	WiFi Mode	Modulation Bandwidth	Modulation Type	Frequency (MHz)
UNII-1	a	20 MHz	OFDM	5180, 5200, 5210, 5240
	ax	20 MHz	HE	5180, 5200, 5210, 5240
	ax	40 MHz	HE	5190, 5230
	ax	80 MHz	HE	5210

This report covers the circuitry of the device subject to FCC Part 15, Subpart E. The circuitry of the device subject to FCC Part 15 Subpart B was found to be compliant and is covered under a separate Unified Compliance Laboratory test report.

2.3 EUT and Support Equipment

The EUT and support equipment used during the test are listed below.

Brand Name Model Number Serial Number	Description	Name of Interface Ports / Interface Cables
BN: UBIQUITI MN: Wave-MLO5 SN: 2F2513	Wireless Access Point	See Section 2.4
BN: UBIQUITI MN: POE-54-30W-10G-WH SN: N/A	PoE Injector Power Supply	Shielded or Un-shielded Cat 5e cable (Note 2)
BN: Dell MN: XPS 13 SN: N/A	Laptop Computer	Shielded or Un-shielded Cat 5e cable (Note 2)

Notes: (1) EUT
(2) Interface port connected to EUT (See Section 2.4)

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.4 Interface Ports on EUT

Name of Ports	No. of Ports Fitted to EUT	Cable Description/Length
AC (PoE Injector)	1	3 conductor power cord/80cm
LAN (PoE Injector)	1	Shielded or Un-shielded cat 5e cable/1 meter
Data	1	Shielded or Un-shielded cat 5e cable/1 meter

2.5 Operating Environment

Power Supply	120 Volts AC Mains to 54 Volts PoE
AC Mains Frequency	60 Hz
Temperature	21.1 – 23.5 °C
Humidity	22.7 – 28.8 %
Barometric Pressure	1017 mBar

2.6 Operating Modes

The Wave-MLO5 was tested using test software in order to enable a constant transmission. The measurements within this report are corrected to reference a 100% duty cycle. All emission modes of 802.11 a/ax were investigated. All measurements are reported with the worst-case mode (802.11ax) unless otherwise stated.

2.7 EUT Exercise Software

EUT firmware version 1.0 was used to operate the transmitter using a constant transmit mode.

2.8 Block Diagram of Test Configuration

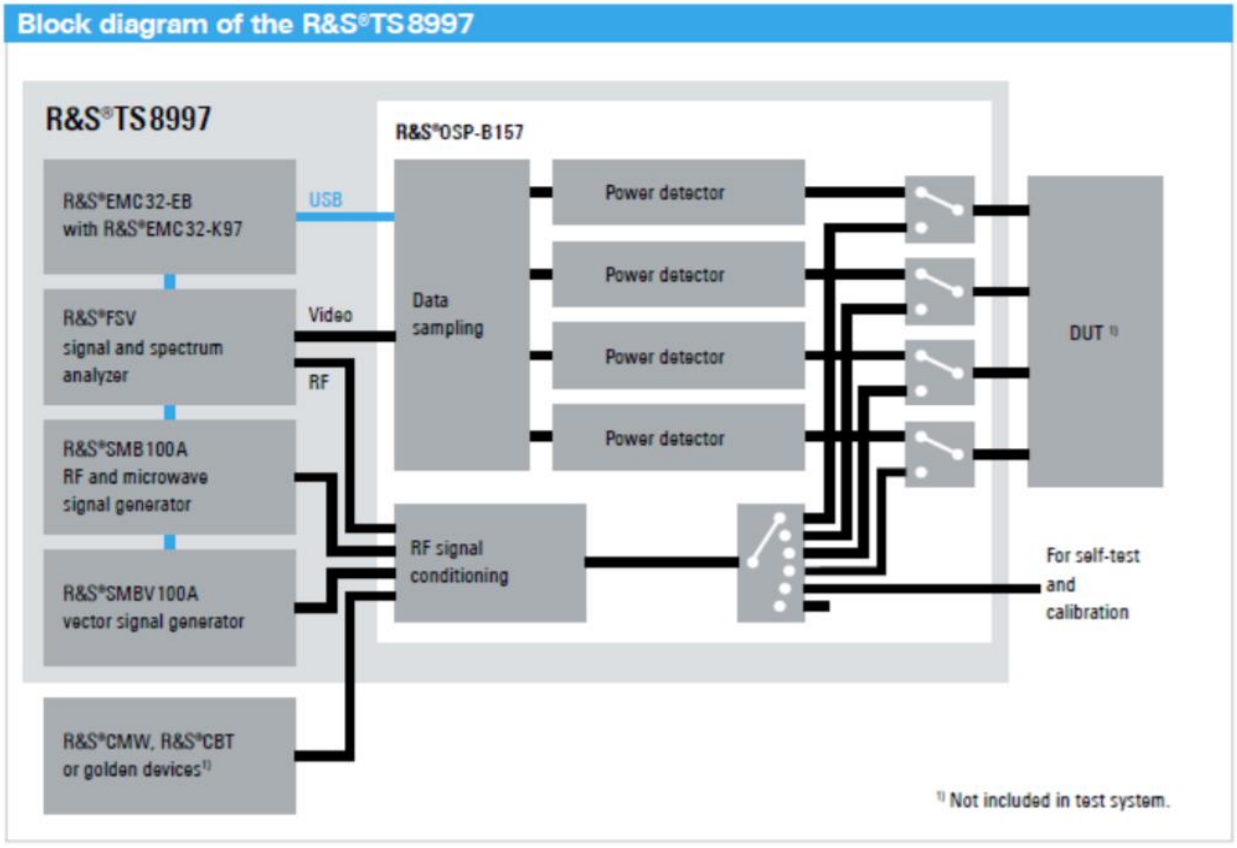


Diagram 1: Test Configuration Block Diagram

2.9 Modification Incorporated/Special Accessories on EUT

There were no modifications made to the EUT during testing to comply with the specification.

2.10 Deviation, Opinions Additional Information or Interpretations from Test Standard

There were no deviations, opinions, additional information or interpretations from the test specification.

3 Test Specification, Method and Procedures

3.1 Test Specification

Title	47 CFR FCC Part 15, Subpart E, Section 15.407 Limits and methods of measurement of radio interference characteristics of Unlicensed National Information Infrastructure Devices
Purpose of Test	The tests were performed to demonstrate initial compliance

3.2 Methods & Procedures

3.2.1 47 CFR FCC Part 15 Section 15.407

See test standard for details.

3.3 FCC Part 15, Subpart E

3.3.1 Summary of Tests

FCC Section	ISED Section	Environmental Phenomena	Frequency Range (MHZ)	Result
15.407(a)	N/A	Antenna requirements	Structural Requirement	Compliant
15.407(b)	RSS-Gen	Conducted Disturbance at Mains Port	0.15 to 30	Compliant
15.407(c)	RSS-247 §6.2.2, §6.2.3	Bandwidth Requirement	5180 to 5210	Compliant
15.407(e)	RSS-247 §6.2.2, §6.2.3	Peak Output Power	5180 to 5210	Compliant
15.407(f)	RSS-247 §6.2.2, §6.2.3	Antenna Conducted Spurious Emissions	0.009 to 40000	N/A
15.407(g)	RSS-247 §6.2.2, §6.2.3	Radiated Spurious Emissions	0.009 to 40000	Compliant
15.407(h)	RSS-247 §6.2.2, §6.2.3	Peak Power Spectral Density	5180 to 5210	Compliant
The testing was performed according to the procedures in ANSI C63.10-2013, KDB 789033 and 47 CFR Part 15. Where applicable, KDB 662911 was followed to sum required measurements.				

3.4 Results

In the configuration tested, the EUT complied with the requirements of the specification.

3.5 Test Location

Testing was performed at the Unified Compliance Laboratory 3-Meter and 10-Meter chambers located at 427 West 12800 South, Draper, UT 84020. Unified Compliance Laboratory is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Code 600241-0 which is effective until 30 June 2025. This site has also been registered with Innovations, Science and Economic Development (ISED) department as was accepted under Appendix B, Phase 1 procedures of the APEC Tel MRA for Canadian recognition. ISED No.: 25346, effective until 30 June 2025.

Unified Compliance Laboratory has been assigned Designation Number US5037 by the FCC and Conformity Assessment Number US0223 by ISED.

4 Test Equipment

4.1 Conducted Emissions at Mains Ports

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
EMI Receiver	AFJ	FFT3010	UCL-6754	1/23/2024	2/26/2025
LISN	AFJ	LS16C/10	UCL-2512	7/08/2024	7/08/2025
ISN	Teseq	ISN T800	UCL-2974	7/09/2024	7/09/2025
LISN	AFJ	LS16C\10	UCL-6749	1/29/2024	1/29/2025
AC Power Source	Laplace Instruments	AC1000A	UCL-2857	N/A	N/A
Test Software	AFJ	AFJ FFT3010	UCL-3107	N/A	N/A

Table 1: List of equipment used for Conducted Emissions Testing at Mains Port

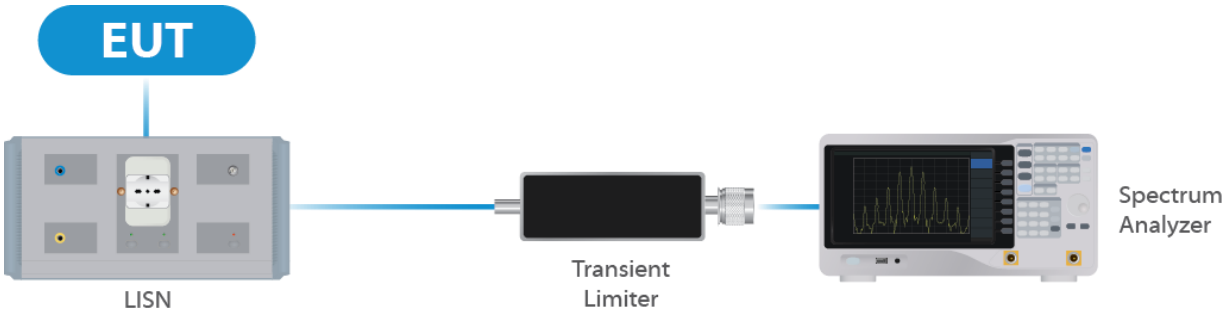


Figure 1: Conducted Emissions Test

4.2 Direct Connect at the Antenna Port Tests

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	R&S	FSV40	UCL-2861	11/27/2023	12/27/2024
Signal Generator	R&S	SMB100A	UCL-2864	N/A	N/A
Vector Signal Generator	R&S	SMBV100A	UCL-2873	N/A	N/A
Switch Extension	R&S	OSP-B157WX	UCL-2867	4/12/2024	4/19/2025
Switch Extension	R&S	OSP-150W	UCL-2870	4/12/2024	4/19/2025
Test Software	R&S	EMC32	UCL-9442	-	-

Table 2: List of equipment used for Direct Connect at the Antenna Port

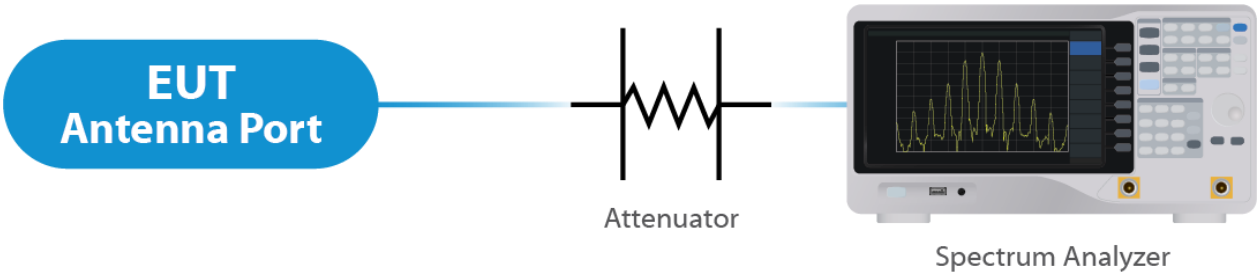


Figure 2: Direct Connect at the Antenna Port Test

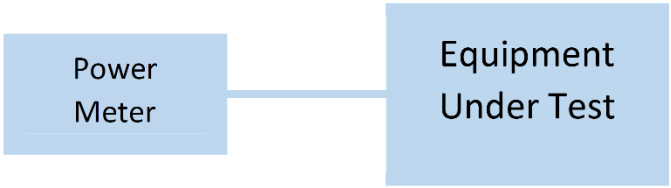


Figure 3: Output Power Measurement

4.3 Radiated Emissions

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
EMI Receiver	Keysight	N9038A	UCL-2778	1/25/2024	1/29/2025
Pre-Amplifier 9 kHz – 1 GHz	Sonoma Instruments	310N	UCL-2889	1/19/2024	1/19/2026
Broadband Antenna	Scwarzbeck	VULB 9163	UCL-3062	2/22/2023	2/22/2025
Broadband Antenna	Scwarzbeck	VULB 9163	UCL-3071	1/11/2023	1/11/2025
Double Ridge Horn Antenna	Scwarzbeck	BBHA 9120D	UCL-3065	3/10/2023	3/10/2025
Log Periodic	Scwarzbeck	STLP 9129	UCL-3068	1/27/2023	1/27/2025
15 - 40 GHz Horn Antenna	Scwarzbeck	BBHA 9170	UCL-2487	3/10/2023	3/10/2025
1 – 18 GHz Amplifier	Com-Power	PAM 118A	UCL-3833	1/19/2024	1/19/2026
Test Software	Nexio	BatEMC	UCL-5253 & UCL-5249	N/A	N/A

Table 3: List of equipment used for Radiated Emissions

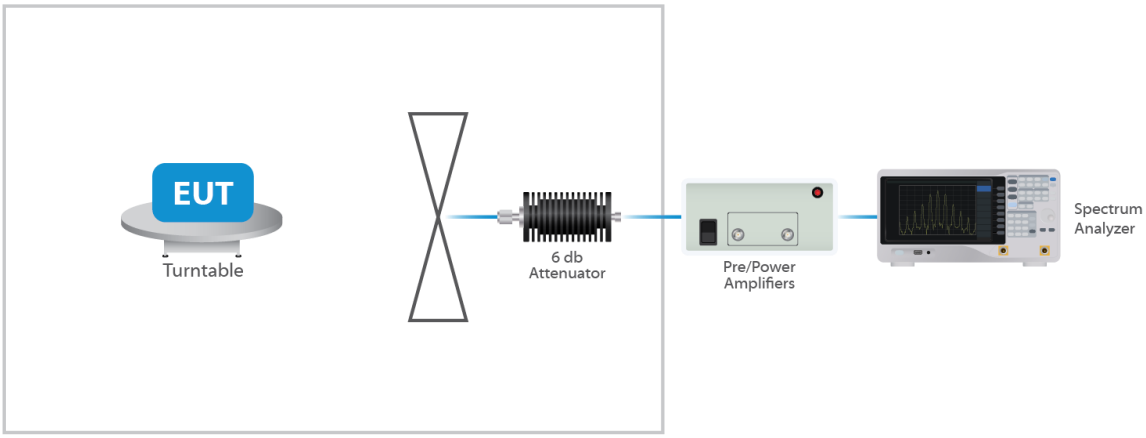


Figure 4: Radiated Emissions Test

4.4 Equipment Calibration

All applicable equipment is calibrated using either an independent calibration laboratory or Unified Compliance Laboratory personnel at intervals defined in ANSI C63.4:2014 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request.

4.5 Measurement Uncertainty

Test	Uncertainty (± dB)	Confidence (%)
Conducted Emissions	1.44	95
Radiated Emissions (9 kHz to 30 MHz)	2.50	95
Radiated Emissions (30 MHz to 1 GHz)	4.38	95
Radiated Emissions (1 GHz to 18 GHz)	4.37	95
Radiated Emissions (18 GHz to 40 GHz)	3.93	95
Direct Connect Tests	**K Factor**	**Value**
Emissions Bandwidth	2	2.0%
Output Power	2	1.0 dB
Peak Power Spectral Density	2	1.3 dB
Band Edge	2	0.8 dB
Transmitter Spurious Emissions	2	1.8 dB

5 Test Results

5.1 §15.203 Antenna Requirements

The EUT uses an Omni, Sector, Dish or horn antenna. Per the manufacturer, the Maximum gain of the antenna per chain is 30 dBi. This is an 802.11 device and utilizes CDD as described in KDB 662911 D01. The antenna is user replaceable. For CDD transmissions, directional gain is calculated as follows.

Array Gain = 10 log(NANT/NSS) dB
NANT = number of transmit antennas and
NSS = number of spatial streams. NSS = 1 considered worst case.

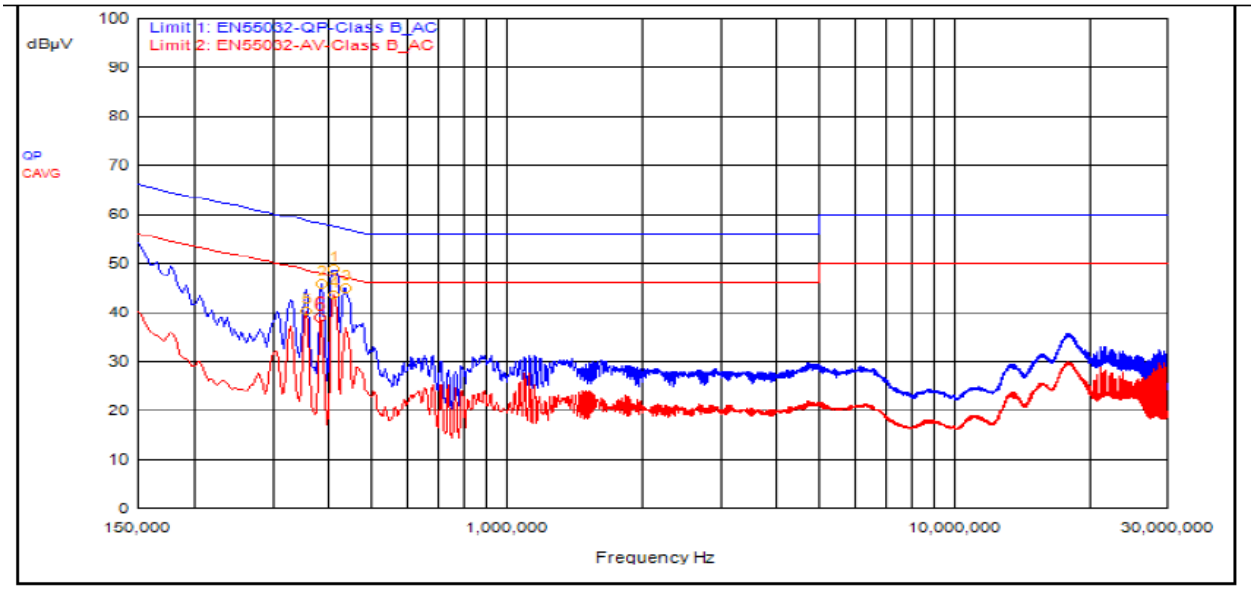
For power measurements on IEEE 802.11 devices, Array Gain = 0 dB for NANT ≤ 4;
For PSD measurements when Nss=1: Array Gain = 10 log(NANT/NSS) dB + Antenna Gain (dBi). Or 3.01 dB + 30 dBi = 33.01 dBi.

Results

The EUT complied with the specification

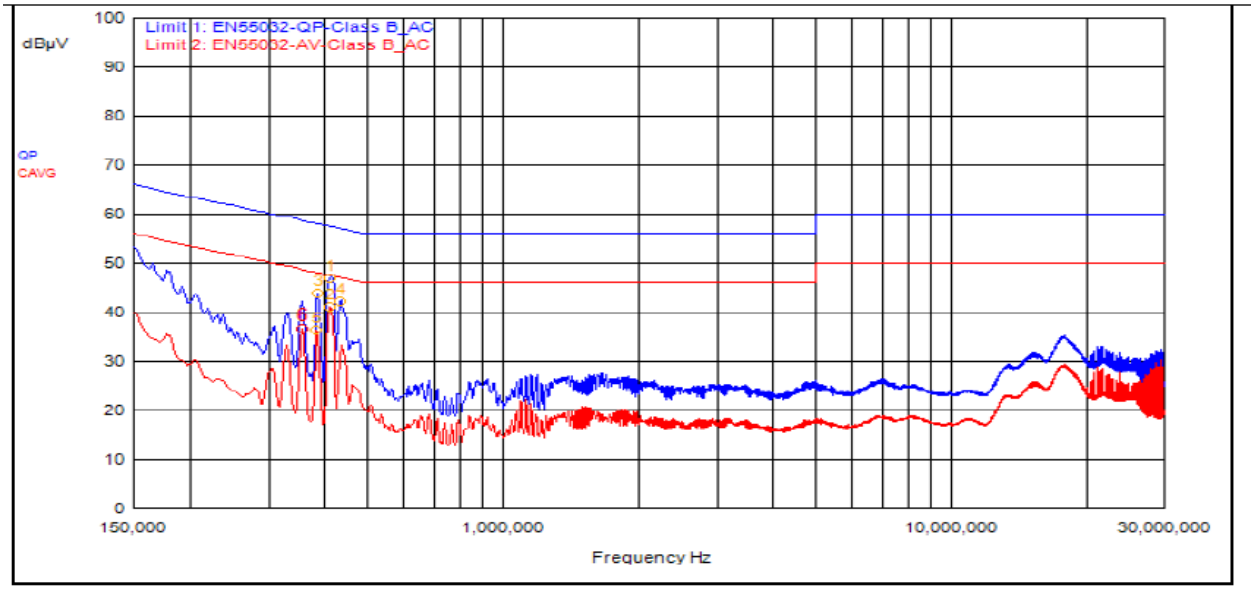
5.2 Conducted Emissions at Mains Ports Data

5.2.1 Line



ID	Frequency	Probe	Cable	Atten.	Detector	Meter Read	Meas Level	Limit 1	Limit 1 Dist.	Limit 2	Limit 2 Dist.	P/F
MU	MHz	dB	dB	dB	Type	dBµV	dBµV	dBµV	dB	dBµV	dB	P/F
1	411,000kHz	9.49			QPeak	39.26	48.75	57.63	-8.88			
3	435,000kHz	9.49			QPeak	35.61	45.10	57.16	-12.06			
2	387,000kHz	9.48			QPeak	36.48	45.96	58.13	-12.16			
4	411,000kHz	9.49			C_AVG	33.99	43.48			47.63	-4.15	
5	357,000kHz	9.48			C_AVG	30.67	40.15			48.80	-8.65	
6	384,000kHz	9.48			C_AVG	29.47	38.95			48.19	-9.24	

5.2.2 Neutral



ID	Frequency	Probe	Cable	Atten.	Detector	Meter Read	Meas Level	Limit 1	Limit 1 Dist.	Limit 2	Limit 2 Dist.	P/F
MU	MHz	dB	dB	dB	Type	dBµV	dBµV	dBµV	dB	dBµV	dB	P/F
1	411,000kHz	9.63			QPeak	37.40	47.03	57.63	-10.60			
3	387,000kHz	9.63			QPeak	34.35	43.98	58.13	-14.15			
4	432,000kHz	9.64			QPeak	32.63	42.27	57.21	-14.95			
2	411,000kHz	9.63			C_AVG	31.42	41.05			47.63	-6.58	
5	384,000kHz	9.63			C_AVG	26.89	36.52			48.19	-11.67	
6	357,000kHz	9.63			C_AVG	27.08	36.71			48.80	-12.09	

Result

The EUT complied with the specification limit.

5.3 §15.403(i) 26 dB Emissions Bandwidth

All chains were measured under the guidance of KDB 789033 Section II.C. and KDB 662911 D01. Please see associated annex for details on instrument settings.

5.3.1 Omni Antenna

Nominal BW (MHz)	Frequency (MHz)	99% Bandwidth (MHz)	Emissions 26 dB Bandwidth (MHz)
OFDM 20	5180	17.3	22.3
OFDM 20	5210	17.3	22.6
OFDM 20	5240	17.5	23.1
HE 20	5180	19.5	22.2
HE 20	5210	19.5	22.8
HE 20	5240	19.3	23.1
HE 40	5190	38.5	42.9
HE 40	5230	38.5	43.1
HE 80	5210	79.0	88.0
HE 160	5250	160.0	172.0

5.3.2 Dish Antenna

Nominal BW (MHz)	Frequency (MHz)	99% Bandwidth (MHz)	Emissions 26 dB Bandwidth (MHz)
OFDM 20	5180	16.79	21.53
OFDM 20	5210	16.77	21.42
OFDM 20	5240	16.77	21.47
HE 20	5180	19.17	21.39
HE 20	5210	19.16	21.48
HE 20	5240	19.17	21.34
HE 40	5190	38.22	41.5

Nominal BW (MHz)	Frequency (MHz)	99% Bandwidth (MHz)	Emissions 26 dB Bandwidth (MHz)
HE 40	5230	38.19	41.39
HE 80	5210	78.09	83.99
HE 160	5250	158.11	163.00

Result

All chains were tested and the highest bandwidth per chain is reported above.

The 26 dB bandwidths are reported for information purposes. Please see Annex for all bandwidth measurements.

5.4 §15.407(a)(2) Maximum Average Output Power

All chains were measured and summed under the guidance of KDB 789033 Section II. E.2. and KDB 662911 D01. Please see associated annex for details on instrument settings.

The maximum average RF conducted output power measured for this device using the Omni Antenna was 20.69 dBm or 117.22 mW. The limit is 30 dBm, or 1 Watt when using an antenna with 23 dBi (Fixed point to point) or 6 dBi (indoor/outdoor access point) or less gain. The Omni antenna has a gain of 10 dBi, therefor the adjusted conducted limit is 26 dBm.

The maximum average RF conducted output power measured for this device using the Dish Antenna, was 17.44 dBm or 55.46 mW. The limit is 30 dBm, or 1 Watt when using an antenna with 23 dBi (Fixed point to point) or 6 dBi (indoor/outdoor access point) or less gain. When using the Dish Antenna, it will only be used in the point-to-point application therefore the adjusted conducted limit is 23 dBm.

5.4.1 Omni Antenna

NSS2

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
OFDM 20	5180	Mcs0_Nss2	19	19.51	29.51	8.36
OFDM 20	5210	Mcs0_Nss2	20	20.38	30.38	9.56
OFDM 20	5240	Mcs0_Nss2	21	20.69	30.69	10.05
HE 20	5180	Mcs0_Nss2	19	19.75	29.75	8.45
HE 20	5210	Mcs0_Nss2	20	20.43	30.43	9.59
HE 20	5240	Mcs0_Nss2	22	20.67	30.67	10.00
HE 40	5190	Mcs0_Nss2	16	18.02	28.02	3.24
HE 40	5230	Mcs0_Nss2	20	20.46	30.46	6.84
HE 80	5210	Mcs0_Nss2	16	17.95	27.95	-0.24
HE 160	5250	Mcs0_Nss2	16	18.14	28.14	-2.39

NSS1

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
OFDM 20	5180	Mcs0_Nss1	19	19.51	29.51	8.36
OFDM 20	5210	Mcs0_Nss1	20	20.38	30.38	9.56
OFDM 20	5240	Mcs0_Nss1	20	19.69	29.69	9.05
HE 20	5180	Mcs0_Nss1	19	19.75	29.75	8.45
HE 20	5210	Mcs0_Nss1	20	20.43	30.43	9.59

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
HE 20	5240	Mcs0_Nss1	21	19.67	29.67	9.00
HE 40	5190	Mcs0_Nss1	16	18.02	28.02	3.24
HE 40	5230	Mcs0_Nss1	20	20.46	30.46	6.84
HE 80	5210	Mcs0_Nss1	16	17.95	27.95	-0.24
HE 160	5250	Mcs0_Nss1	16	18.14	28.14	-2.39

30 Degree Elevation

Antenna gain, 30 Degrees above elevation = ~0dB. See Plot 1

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP
OFDM 20	5180	Mcs0_Nss1	19	19.51	19.51
OFDM 20	5210	Mcs0_Nss1	20	20.38	20.38
OFDM 20	5240	Mcs0_Nss1	21	20.69	20.69
HE 20	5180	Mcs0_Nss1	19	19.75	19.75
HE 20	5210	Mcs0_Nss1	20	20.43	20.43
HE 20	5240	Mcs0_Nss1	22	20.67	20.67
HE 40	5190	Mcs0_Nss1	16	18.02	18.02
HE 40	5230	Mcs0_Nss1	20	20.46	20.46
HE 80	5210	Mcs0_Nss1	16	17.95	17.95
HE 160	5250	Mcs0_Nss1	16	18.14	18.14

5.4.2 Dish Antenna

NSS2

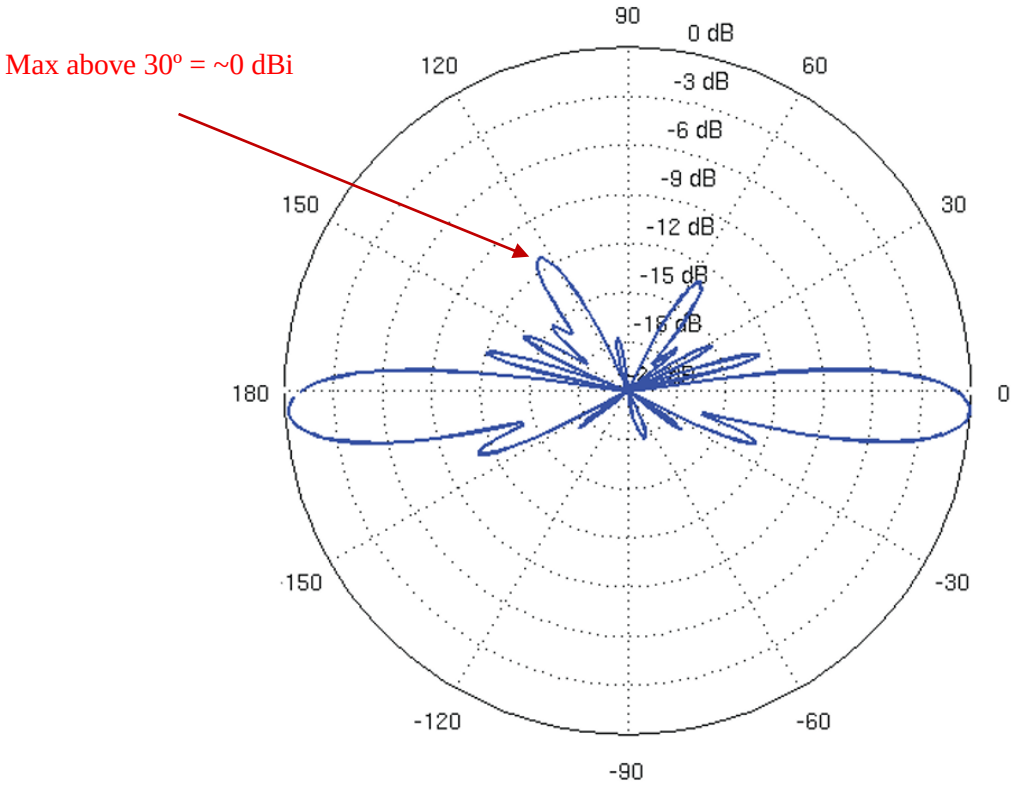
Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
OFDM 20	5180	Mcs0_Nss2	12	13.90	43.90	0.89
OFDM 20	5210	Mcs0_Nss2	14	15.86	45.86	2.85
OFDM 20	5240	Mcs0_Nss2	15	16.80	46.80	3.79
HE 20	5180	Mcs0_Nss2	11	13.61	43.61	0.60
HE 20	5210	Mcs0_Nss2	14	16.84	46.84	3.83
HE 20	5240	Mcs0_Nss2	15	17.44	47.44	4.43
HE 40	5190	Mcs0_Nss2	10	13.31	43.31	-2.72
HE 40	5230	Mcs0_Nss2	14	17.28	47.28	1.26
HE 80	5210	Mcs0_Nss2	10	13.25	43.25	-5.78
HE 160	5250	Mcs0_Nss2	8	10.89	40.89	-11.15

NSS1

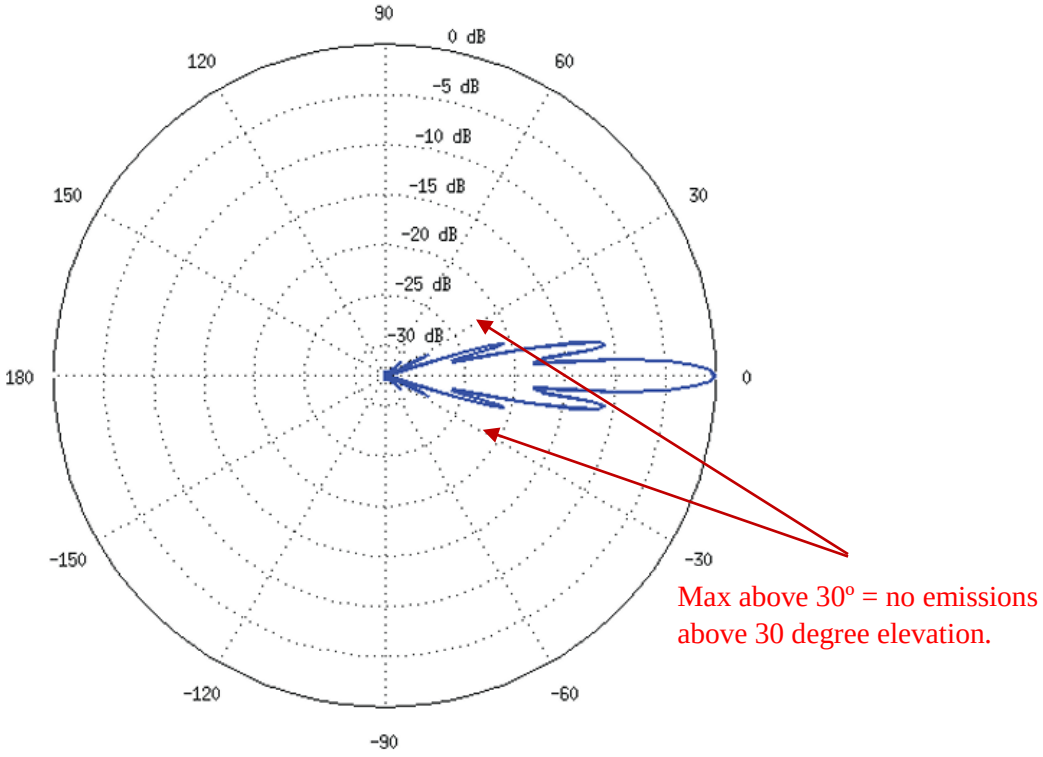
Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
OFDM 20	5180	Mcs0_Nss1	1	2.90	32.90	-10.11
OFDM 20	5210	Mcs0_Nss1	1	2.86	32.86	-10.15
OFDM 20	5240	Mcs0_Nss1	1	2.80	32.80	-10.21
HE 20	5180	Mcs0_Nss1	0	2.61	32.61	-10.40
HE 20	5210	Mcs0_Nss1	0	2.84	32.84	-10.17
HE 20	5240	Mcs0_Nss1	0	2.44	32.44	-10.57
HE 40	5190	Mcs0_Nss1	2	5.31	35.31	-10.72
HE 40	5230	Mcs0_Nss1	2	5.28	35.28	-10.74
HE 80	5210	Mcs0_Nss1	5	8.25	38.25	-10.78
HE 160	5250	Mcs0_Nss1	8	10.89	40.89	-11.15

Result

In the configuration tested, the maximum summed average RF output power was less than 1 watt; therefore, the EUT compiled with the requirements of the specification (see spectrum analyzer plots in attached Annex).



Plot 1: Elevation Plot Greater Then 30-Degrees from Horizon (10dB Omni)



Plot 2: Elevation Plot Greater Then 30-Degrees From Horizon (30 dBi Dish)

5.5 §15.407(b) Spurious Emissions

5.5.1 Conducted Spurious Emissions

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The graphs show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency and upper frequency. Shown below are plots with the EUT turned to the upper and lower channels with the antenna gain of 30 dBi accounted for. These demonstrate compliance with the provisions of this section at the band edges.

The emissions must be remain below -27 dBm EIRP.

Result

Conducted spurious emissions were below -27 dBm; therefore, the EUT complies with the specification.

5.5.2 Radiated Spurious Emissions in the Restricted Bands of § 15.205

The EUT uses various power settings based on the channel in use. In order to reduce test time, the radiated spurious emissions at the lowest, middle, and highest channel were measured at the maximum power of TP25, as this setting was found to be worst case for spurious emissions. Power was subsequently reduced during in-band and band edge testing. The band edge at the restricted band ending at 5180 MHz was measured using radiated measurement or conducted at the antenna port methods. All emissions modes were tested, and the worst-case measurement are shown below. For frequencies above 1 GHz, a measurement of 3 meters was used. For frequencies below 1 GHz, a measurement distance of 10 meters was used.

Correction Factor = Antenna Factor (dBi) + Cable Loss (dB) - Pre-Amplifier Gain (dB), and is added to the Receiver reading.

Result

All emissions in the restricted bands of § 15.205 met the limits specified in § 15.209; therefore, the EUT complies with the specification. All emissions me the limits specified in § 15.407(b). Representative band edge plots are included in this report. See Annex for Conducted Band edge plots.

5.5.3 Omni Antenna

QuasiPeak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin	Azimuth (°)	Height	Pol.	Correction (dB)
31.30 MHz	39.85	40.0	-0.15	119	1	Vertical	-4.36
42.05 MHz	28.35	40.0	-11.65	295	1.97	Vertical	-11.55
282.57 MHz	31.96	47.0	-15.04	44	1.8	Horizontal	-9.99

Table 4: Radiated Emissions 30 – 1000 MHz

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.36 GHz	54.63	74.0	-19.37	158	1.638	Vertical	9.19
11.49 GHz	55.17	74.0	-18.83	217	1.638	Vertical	10.68
9.19 GHz	54.40	74.0	-19.60	271	1.643	Horizontal	4.64
10.36 GHz	57.83	74.0	-16.17	209	1.638	Horizontal	9.19

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.36 GHz	42.53	54.0	-11.47	158	1.638	Vertical	9.19
11.49 GHz	42.19	54.0	-11.81	217	1.638	Vertical	10.68
9.19 GHz	47.58	54.0	-6.42	271	1.643	Horizontal	4.64
10.36 GHz	50.27	54.0	-3.73	209	1.638	Horizontal	9.19

Table 5: Radiated Emissions 1 – 17 GHz Lowest Frequency

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
9.19 GHz	50.57	74.0	-23.43	171	1.643	Vertical	4.64
10.42 GHz	54.81	74.0	-19.19	172	1.638	Vertical	9.29
10.98 GHz	55.13	74.0	-18.87	1	1.638	Vertical	11.05
14.04 GHz	57.24	74.0	-16.76	151	2.142	Vertical	13.23
15.62 GHz	68.18	74.0	-5.82	174	2.142	Vertical	10.69
9.19 GHz	51.49	74.0	-22.51	138	2.65	Horizontal	4.64
10.42 GHz	57.27	74.0	16.73	199	2.645	Horizontal	9.29
13.70 GHz	56.56	74.0	17.44	90	2.645	Horizontal	12.39
15.63 GHz	63.64	74.0	10.36	204	2.645	Horizontal	10.64

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
9.19 GHz	38.48	54.0	-15.52	171	1.643	Vertical	4.64
10.42 GHz	42.98	54.0	-11.02	172	1.638	Vertical	9.29
10.98 GHz	41.53	54.0	-12.47	1	1.638	Vertical	11.05
14.04 GHz	44.23	54.0	-9.97	151	2.142	Vertical	13.23
15.62 GHz	53.54	54.0	-0.46	174	2.142	Vertical	10.69
9.19 GHz	41.15	54.0	-12.85	138	2.65	Horizontal	4.64
10.42 GHz	45.96	54.0	-8.04	199	2.645	Horizontal	9.29
13.70 GHz	43.08	54.0	-10.92	90	2.645	Horizontal	12.39
15.63 GHz	50.64	54.0	-3.36	204	2.645	Horizontal	10.64

Table 6: Radiated Emissions 1 – 17 GHz Middle Frequency

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
15.71 GHz	64.85	74.0	-9.15	201	1.638	Vertical	10.37
10.47 GHz	57.36	74.0	-16.64	158	1.638	Horizontal	9.42
15.72 GHz	65.35	74.0	-8.65	206	1.638	Horizontal	10.37

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
15.71 GHz	51.32	54.0	-2.68	201	1.638	Vertical	10.37
10.47 GHz	49.21	54.0	-4.79	158	1.638	Horizontal	9.42
15.72 GHz	50.59	54.0	-3.41	206	1.638	Horizontal	10.37

Table 7: Radiated Emissions 1 – 17 GHz Highest Frequency

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
20.96 GHz	67.31	74.0	-6.69	345	Vertical	-0.38
30.94 GHz	57.47	74.0	-16.53	1	Vertical	1.64
20.94 GHz	65.84	74.0	-8.16	359	Horizontal	-0.31
34.91 GHz	57.12	74.0	-16.88	290	Horizontal	6.25
39.26 GHz	56.19	74.0	-17.81	208	Horizontal	4.30

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
20.96 GHz	53.33	54.0	-0.67	345	Vertical	-0.38
30.94 GHz	50.70	54.0	-3.30	1	Vertical	1.64
20.94 GHz	50.19	54.0	-3.81	359	Horizontal	-0.31
34.91 GHz	43.81	54.0	-10.19	290	Horizontal	6.25
39.26 GHz	42.94	54.0	-11.06	208	Horizontal	4.30

Table 8: Radiated Emissions 17 – 40 GHz Highest Frequency (worse case)

5.5.4 Dish Antenna

QuasiPeak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin	Azimuth (°)	Height	Pol.	Correction (dB)
31.30 MHz	39.85	40.0	-0.15	119	1	Vertical	-4.36

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin	Azimuth (°)	Height	Pol.	Correction (dB)
42.05 MHz	28.35	40.0	-11.65	295	1.97	Vertical	-11.55
282.57 MHz	31.96	47.0	-15.04	44	1.8	Horizontal	-9.99

Table 9: Radiated Emissions 30 – 1000 MHz

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.36 GHz	55.07	74.0	-18.93	164	1.638	Vertical	9.19
15.54 GHz	66.14	74.0	-7.86	357	2.146	Vertical	11.40
11.49 GHz	60.05	74.0	-13.95	267	3.802	Horizontal	10.67
14.59 GHz	58.44	74.0	-15.56	136	1.5	Horizontal	14.04
15.54 GHz	64.61	74.0	-9.39	61	3.802	Horizontal	11.42

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.36 GHz	41.87	54.0	-12.13	164	1.638	Vertical	9.19
15.54 GHz	53.27	54.0	-0.73	357	2.146	Vertical	11.40
11.49 GHz	53.87	54.0	-0.13	267	3.802	Horizontal	10.67
14.59 GHz	45.18	54.0	-8.82	136	1.5	Horizontal	14.04
15.54 GHz	51.12	54.0	-2.88	61	3.802	Horizontal	11.42

Table 10: Radiated Emissions 1 – 17 GHz Lowest Frequency

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.42 GHz	56.64	74.0	-17.36	168	1.643	Vertical	9.29
15.63 GHz	61.68	74.0	-12.32	352	2.146	Vertical	10.63
10.43 GHz	53.82	74.0	-20.18	83	3.802	Horizontal	9.29
15.63 GHz	55.33	74.0	-18.67	63	2.324	Horizontal	10.65

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.42 GHz	43.36	54.0	-10.64	168	1.643	Vertical	9.29
15.63 GHz	47.36	54.0	-6.64	352	2.146	Vertical	10.63
10.43 GHz	40.76	54.0	-13.24	83	3.802	Horizontal	9.29
15.63 GHz	42.17	54.0	-11.83	63	2.324	Horizontal	10.65

Table 11: Radiated Emissions 1 – 17 GHz Middle Frequency

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.48 GHz	53.55	74.0	-20.45	125	3.802	Vertical	9.41
15.72 GHz	61.27	74.0	-12.73	23	3.311	Vertical	10.38
10.48 GHz	53.90	74.0	-20.10	305	1.638	Horizontal	9.40
15.74 GHz	57.20	74.0	-16.80	36	2.645	Horizontal	10.39

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.48 GHz	40.28	54.0	-13.72	125	3.802	Vertical	9.41
15.72 GHz	47.33	54.0	-6.67	23	3.311	Vertical	10.38
10.48 GHz	40.35	54.0	-13.65	305	1.638	Horizontal	9.40
15.74 GHz	42.68	54.0	-11.32	36	2.645	Horizontal	10.39

Table 12: Radiated Emissions 1 – 17 GHz Highest Frequency

Peak

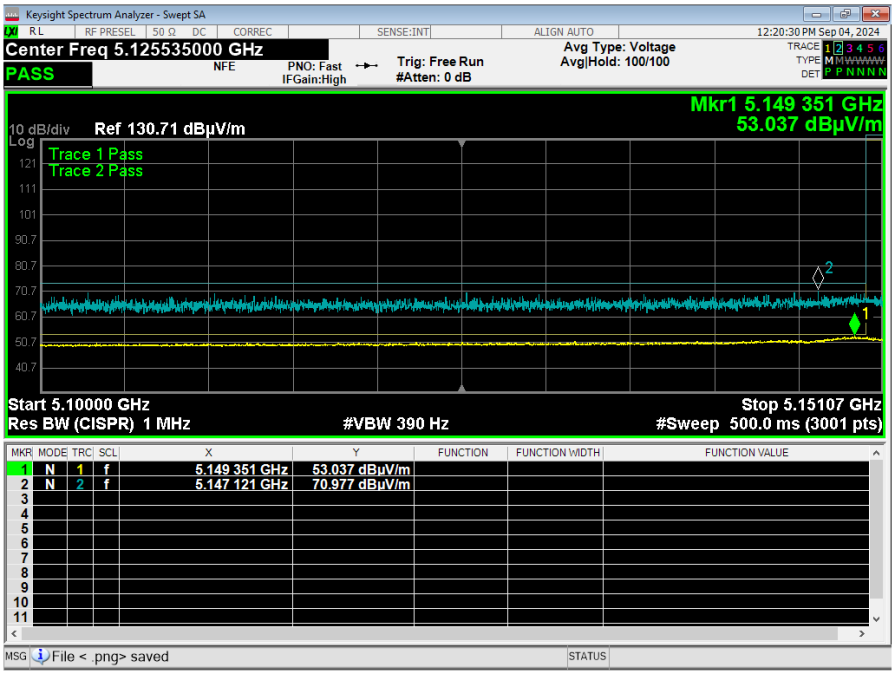
Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
20.71 GHz	57.21	74.0	-16.79	337	Vertical	-0.27
20.72 GHz	57.55	74.0	-16.45	337	Vertical	-0.07
20.75 GHz	56.03	74.0	-17.97	337	Vertical	0.18
30.94 GHz	56.32	74.0	-17.68	8	Vertical	1.64
20.71 GHz	61.85	74.0	-12.15	43	Horizontal	-0.22
20.73 GHz	60.88	74.0	-13.12	49	Horizontal	-0.02
20.75 GHz	62.68	74.0	-11.32	49	Horizontal	0.25
35.06 GHz	56.91	74.0	-17.09	1	Horizontal	6.08

Avg

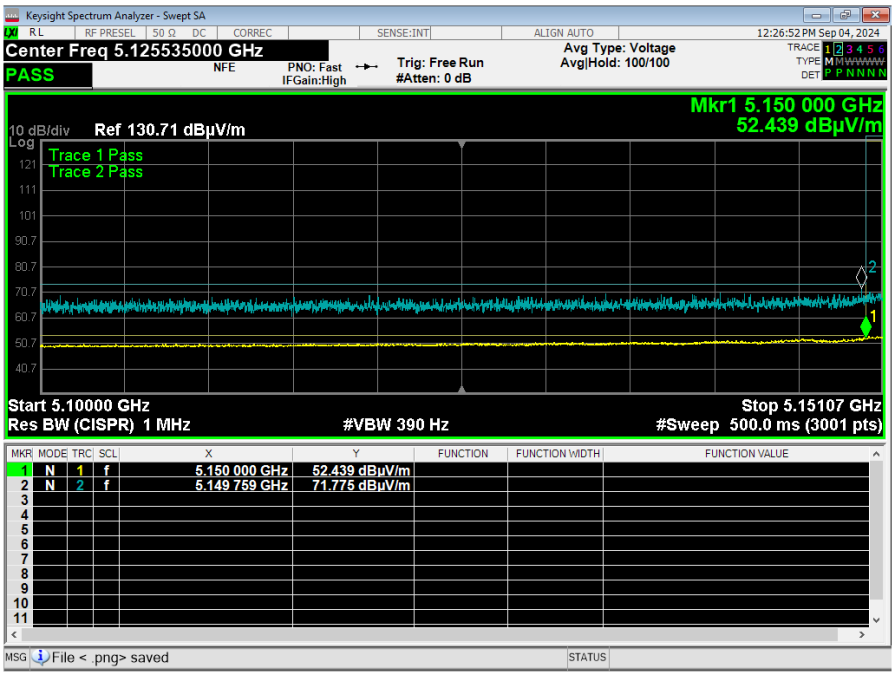
Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
20.71 GHz	43.46	54.0	-10.54	337	Vertical	-0.27
20.72 GHz	43.77	54.0	-10.23	337	Vertical	-0.07
20.75 GHz	40.17	54.0	-13.83	337	Vertical	0.18
30.94 GHz	47.99	54.0	-6.01	8	Vertical	1.64
20.71 GHz	47.88	54.0	-6.12	43	Horizontal	-0.22
20.73 GHz	46.54	54.0	-7.46	49	Horizontal	-0.02
20.75 GHz	43.35	54.0	-10.65	49	Horizontal	0.25
35.06 GHz	43.77	54.0	-10.23	1	Horizontal	6.08

Table 13: Radiated Emissions 17 – 40 GHz Lowest Frequency (worse case)

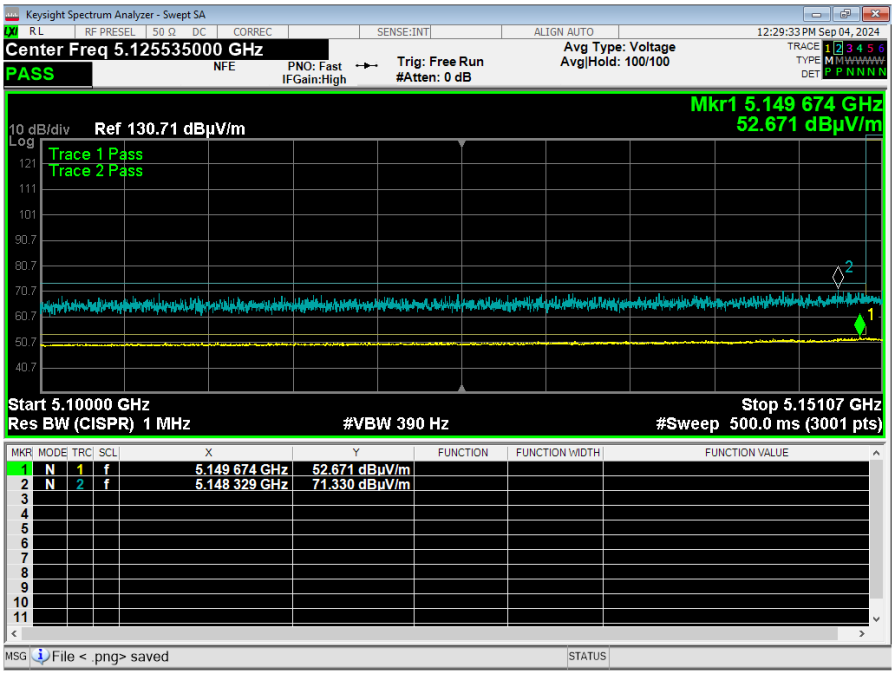
Omni Antenna



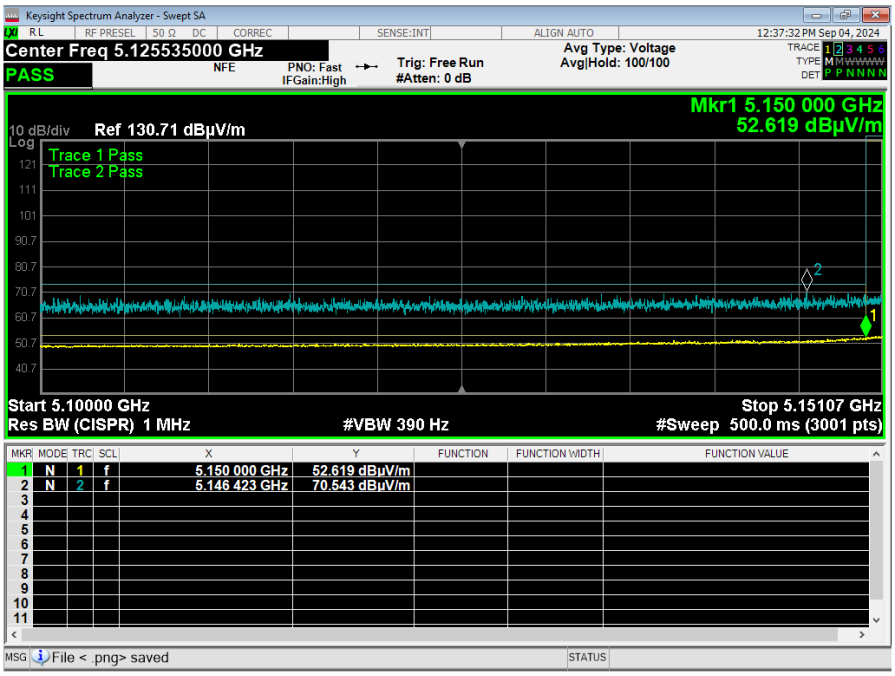
Plot 1: Band Edge OFDM 20 5180MHz



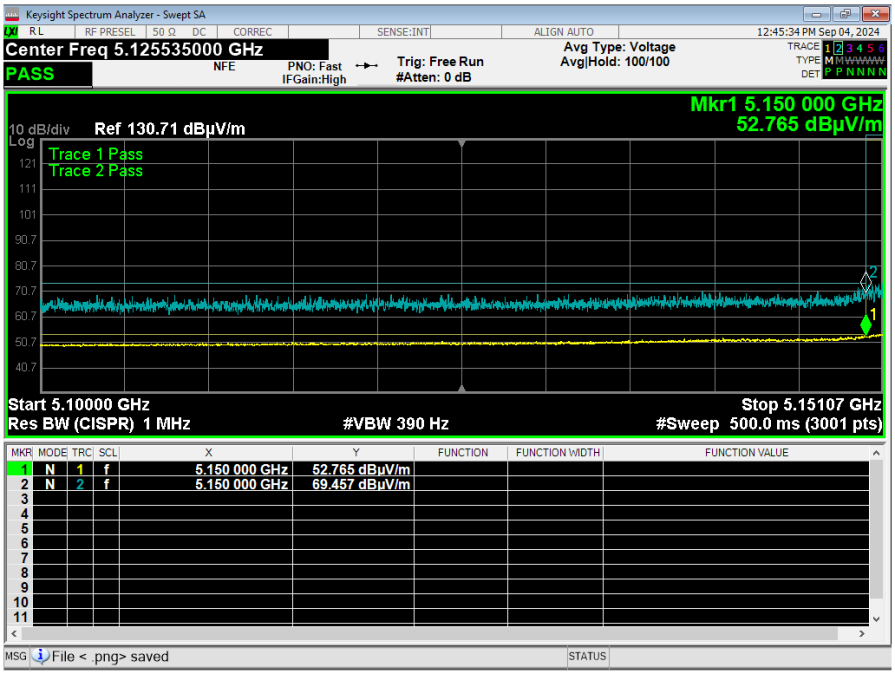
Plot 2: Band Edge OFDM 20 5210MHz



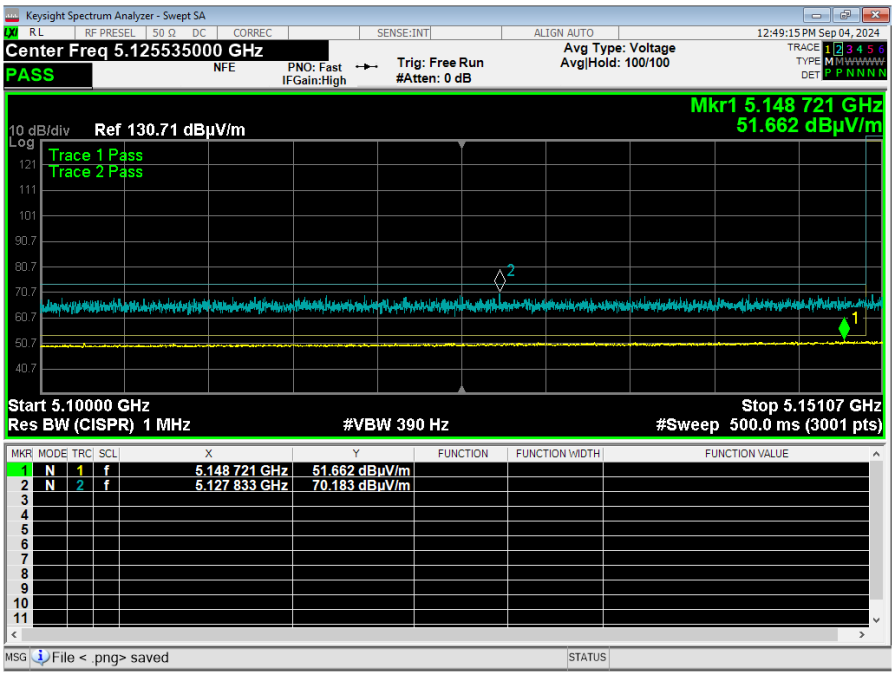
Plot 3: Band Edge OFDM 20 5240MHz



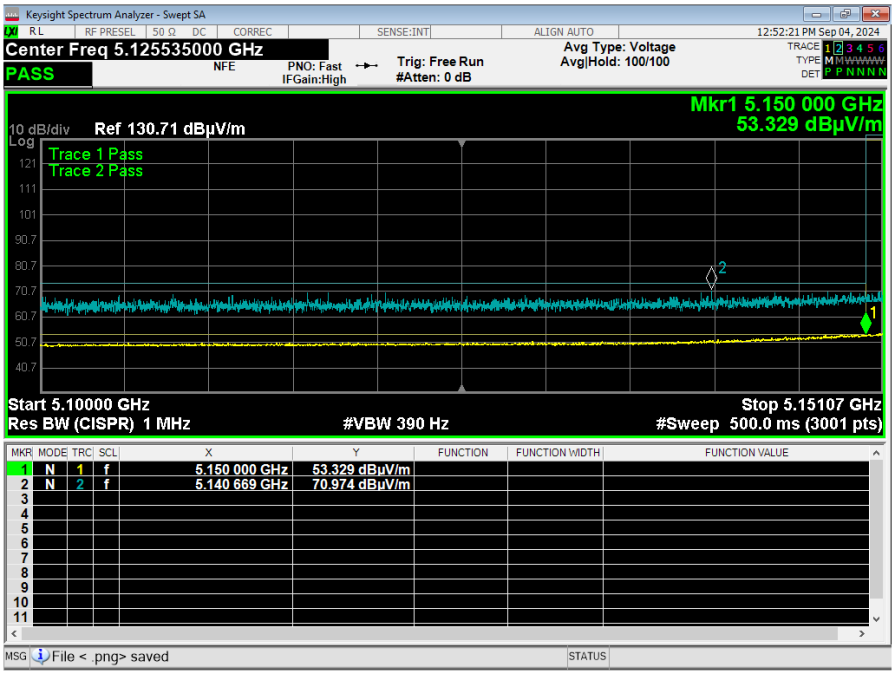
Plot 4: Band Edge HE 20 5180MHz



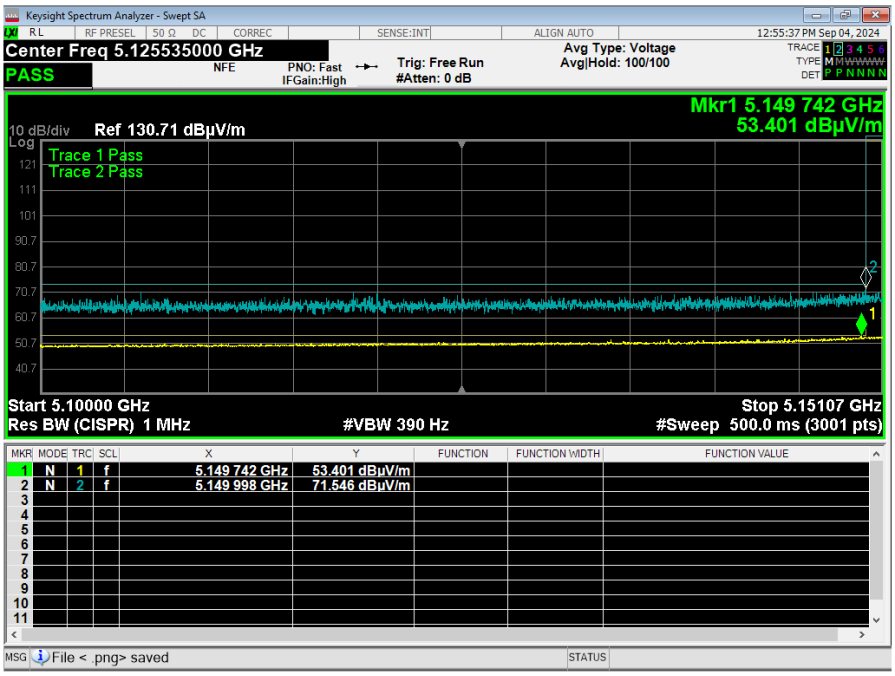
Plot 5: Band Edge HE 20 5210MHz



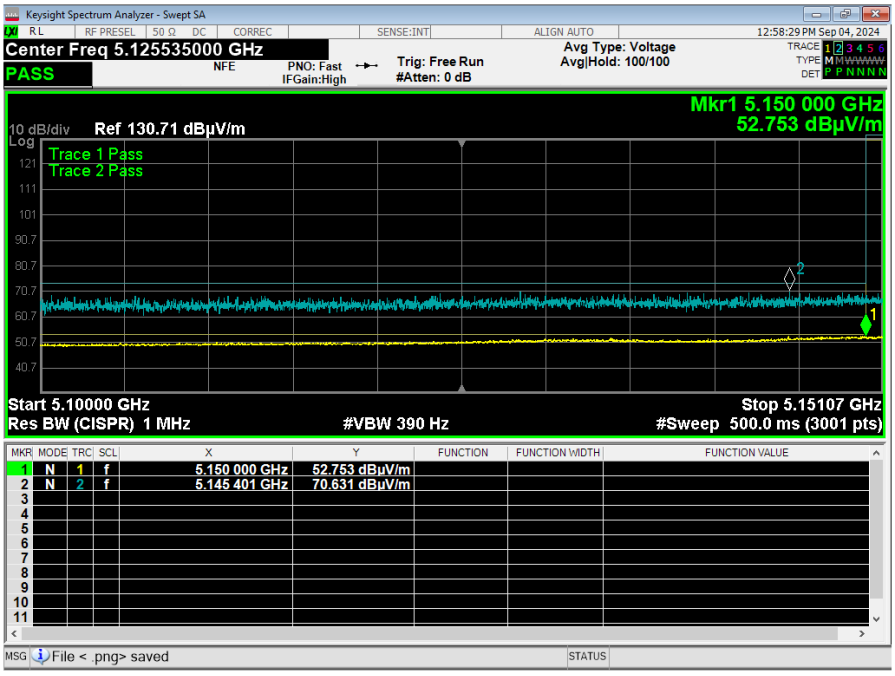
Plot 6: Band Edge HE 20 5240MHz



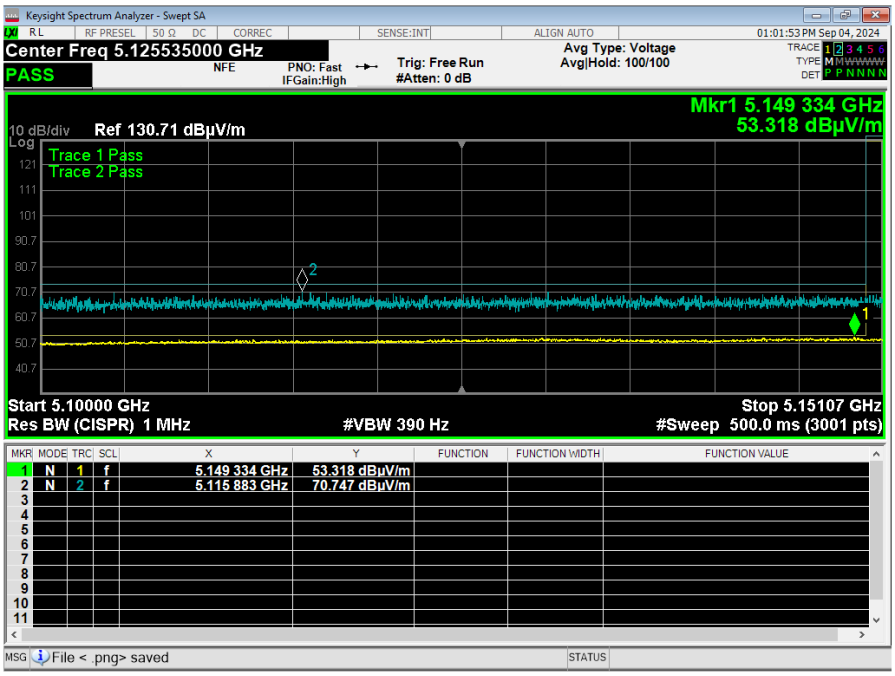
Plot 7: Band Edge HE 40 5190MHz



Plot 8: Band Edge HE 40 5230MHz

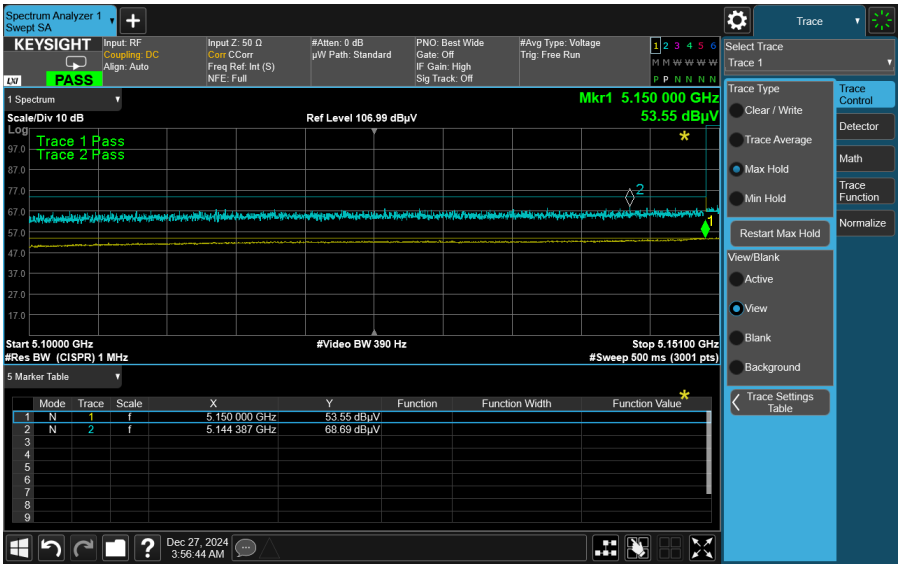


Plot 9: Band Edge HE 80 5210MHz

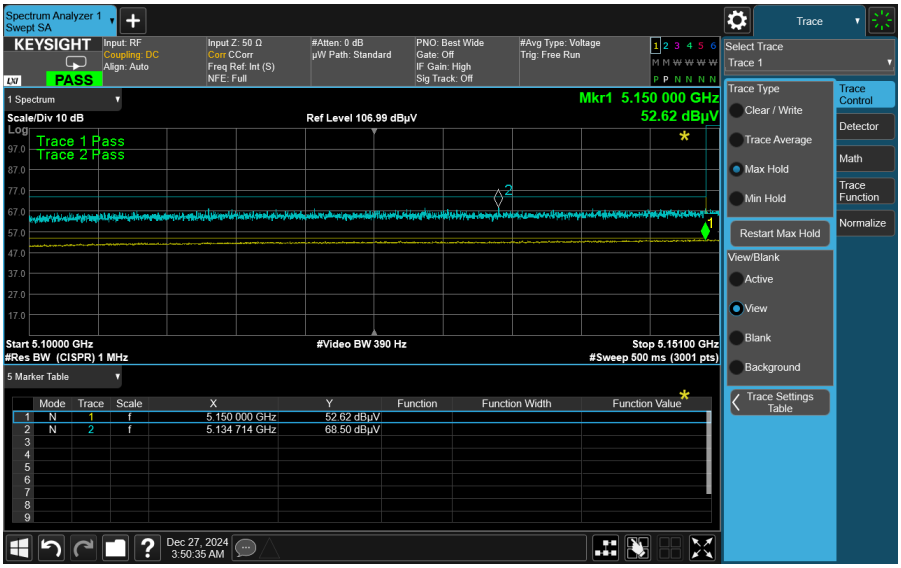


Plot 10: Band Edge HE 160 5250MHz

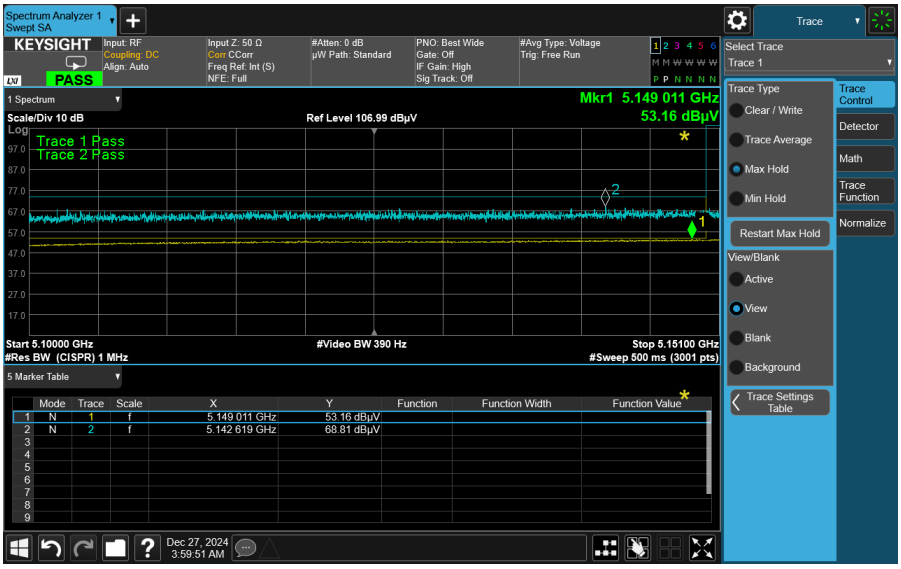
Dish Antenna



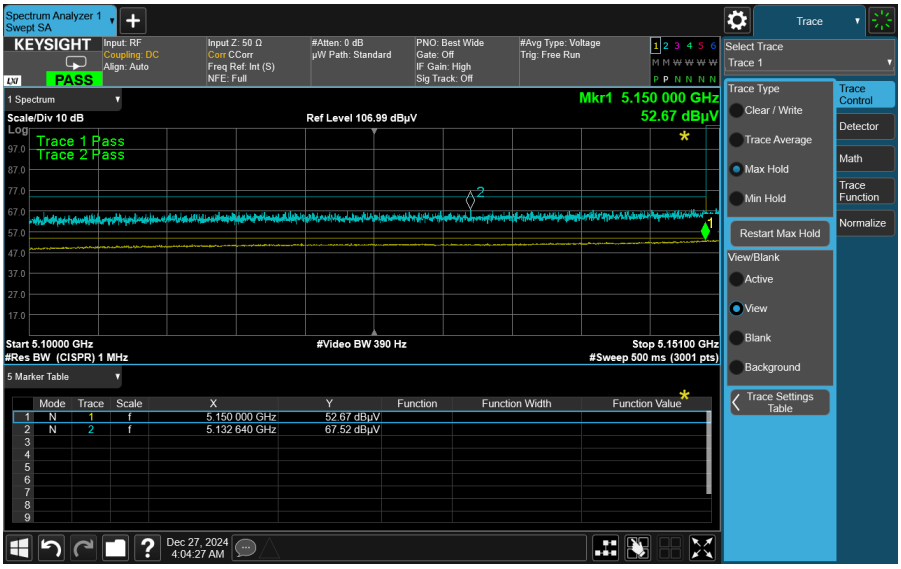
Plot 11: Band Edge OFDM 20 5180MHz



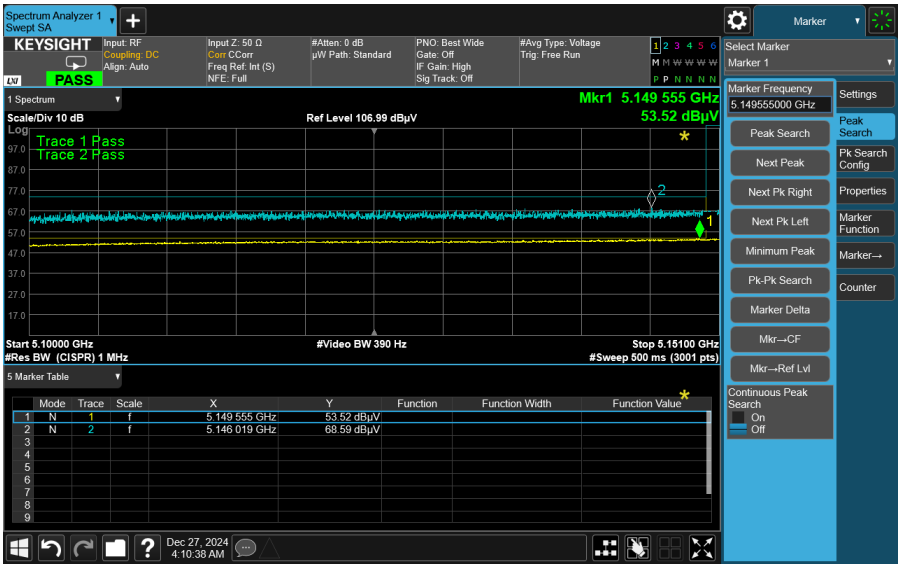
Plot 12: Band Edge OFDM 20 5210MHz



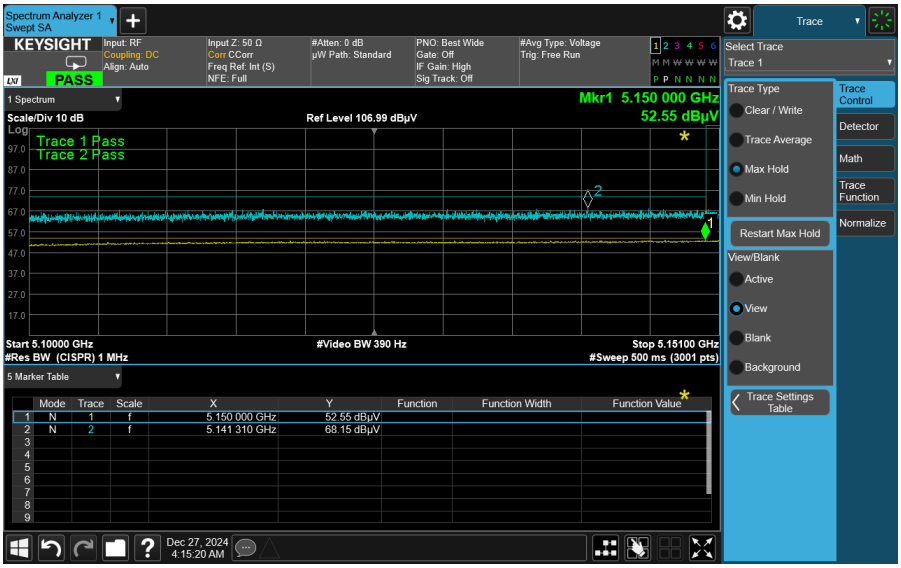
Plot 13: Band Edge OFDM 20 5240MHz



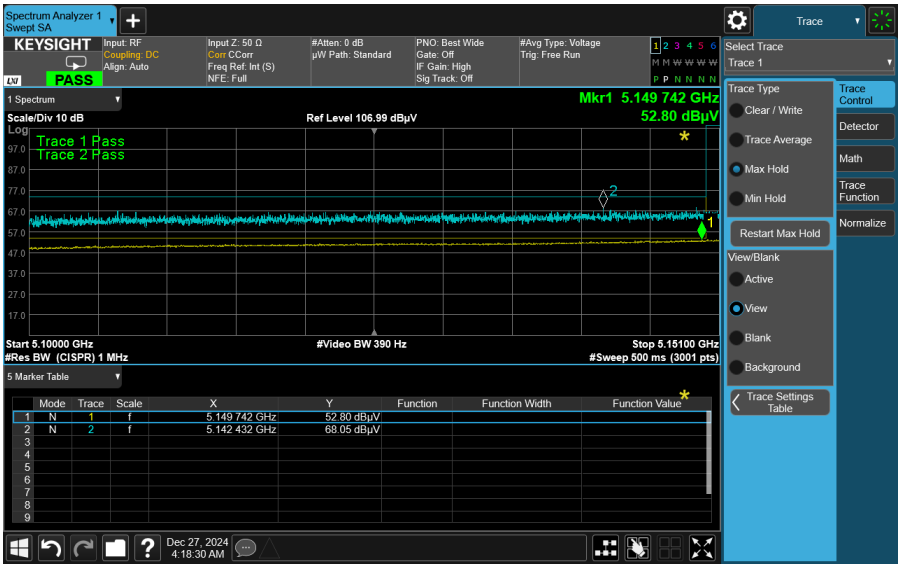
Plot 14: Band Edge HE 20 5180MHz



Plot 15: Band Edge HE 20 5210MHz

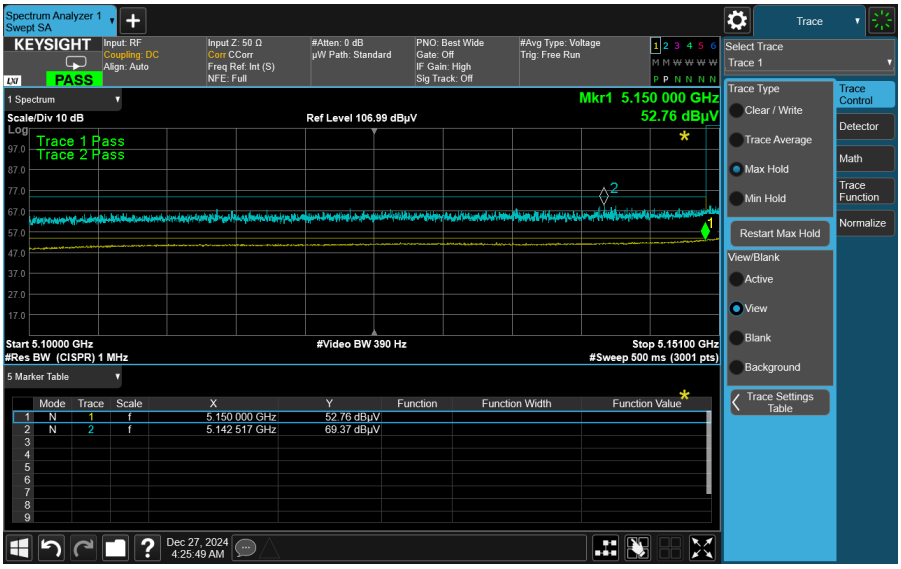


Plot 16: Band Edge HE 20 5240MHz

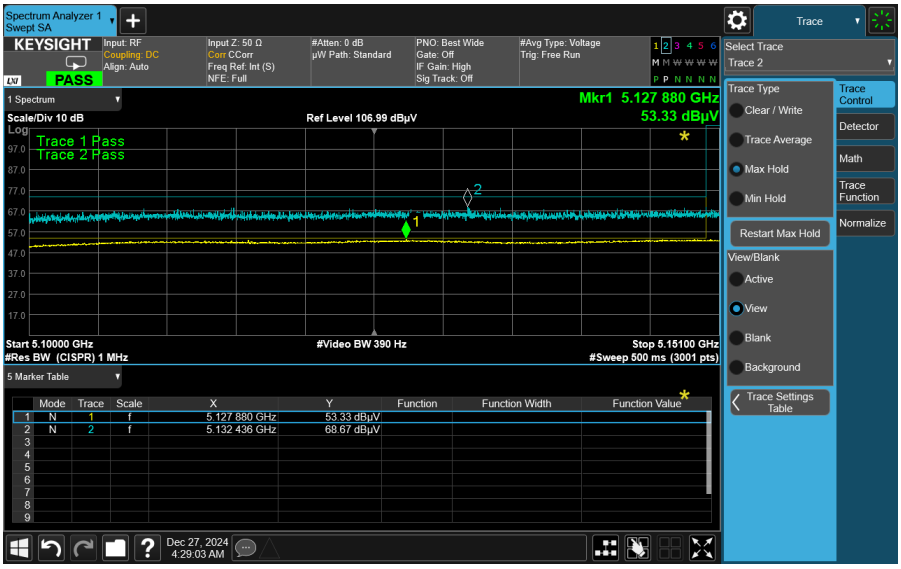


Plot 17: Band Edge HE 40 5190MHz

Plot 18: Band Edge HE 40 5230MHz



Plot 19: Band Edge HE 80 5210MHz



Plot 20: Band Edge HE 160 5250MHz

5.6 §15.407(a) Maximum Power Spectral Density

All chains were measured and summed under the guidance of KDB 789033 Section II. F. and KDB 662911 D01. Please see associated annex for details on instrument settings.

The maximum average power spectral density conducted from the intentional radiator of the antenna shall not be greater than 17 dBm in any 1 MHz band during any time interval of continuous transmission.

As per KDB 662911, when the EUT is using spatial-multiplexing in HT to HE modes, there is not additional array gain to accommodate. When the EUT uses Nss=1 data rates, the Omni antenna gain is 10 dBi + Array gain of 3.01 dB which is a total of 13.01 dBi.

As per KDB 662911, when the EUT is using spatial-multiplexing in HT to HE modes, there is not additional array gain to accommodate. When the EUT uses Nss=1 data rates, the Dish antenna gain is 30 dBi + Array gain of 3.01 dB which is a total of 34.01 dBi.

Results of this testing are summarized.

5.6.1 Omni Antenna

NSS2

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
OFDM 20	5180	Mcs0_Nss2	19	8.36
OFDM 20	5210	Mcs0_Nss2	20	9.56
OFDM 20	5240	Mcs0_Nss2	21	10.05
HE 20	5180	Mcs0_Nss2	19	8.45
HE 20	5210	Mcs0_Nss2	20	9.59
HE 20	5240	Mcs0_Nss2	22	10.00
HE 40	5190	Mcs0_Nss2	16	3.24
HE 40	5230	Mcs0_Nss2	20	6.84
HE 80	5210	Mcs0_Nss2	16	-0.24
HE 160	5250	Mcs0_Nss2	16	-2.39

NSS1

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
OFDM 20	5180	Mcs0_Nss1	19	8.36
OFDM 20	5210	Mcs0_Nss1	20	9.56
OFDM 20	5240	Mcs0_Nss1	20	9.05
HE 20	5180	Mcs0_Nss1	19	8.45
HE 20	5210	Mcs0_Nss1	20	9.59

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
HE 20	5240	Mcs0_Nss1	21	9.00
HE 40	5190	Mcs0_Nss1	16	3.24
HE 40	5230	Mcs0_Nss1	20	6.84
HE 80	5210	Mcs0_Nss1	16	-0.24
HE 160	5250	Mcs0_Nss1	16	-2.39

5.6.2 Dish Antenna

NSS2

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
OFDM 20	5180	Mcs0_Nss2	12	0.89
OFDM 20	5210	Mcs0_Nss2	14	2.85
OFDM 20	5240	Mcs0_Nss2	15	3.79
HE 20	5180	Mcs0_Nss2	11	0.60
HE 20	5210	Mcs0_Nss2	14	3.83
HE 20	5240	Mcs0_Nss2	15	4.43
HE 40	5190	Mcs0_Nss2	10	-2.72
HE 40	5230	Mcs0_Nss2	14	1.26
HE 80	5210	Mcs0_Nss2	10	-5.78
HE 160	5250	Mcs0_Nss2	8	-11.15

NSS1

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
OFDM 20	5180	Mcs0_Nss1	1	-10.11
OFDM 20	5210	Mcs0_Nss1	1	-10.15
OFDM 20	5240	Mcs0_Nss1	1	-10.21
HE 20	5180	Mcs0_Nss1	0	-10.40
HE 20	5210	Mcs0_Nss1	0	-10.17
HE 20	5240	Mcs0_Nss1	0	-10.57
HE 40	5190	Mcs0_Nss1	2	-10.72
HE 40	5230	Mcs0_Nss1	2	-10.74
HE 80	5210	Mcs0_Nss1	5	-10.78
HE 160	5250	Mcs0_Nss1	8	-11.15

Result

The maximum summed average power spectral density was less than the limit of 17 dBm (Nss=1 for Omni antenna is 9.99 dBm and Nss1 =1 for Dish antenna is -10.01 dBm); therefore, the EUT complies with the specification.

-- End of Test Report --