

FCC and ISED Test Report

Apple Inc
Model: A2991

In accordance with FCC 47 CFR Part 15C, ISED
RSS-247 and ISED RSS-GEN

Prepared for: Apple Inc
One Apple Park Way
Cupertino, California
95014, USA

FCC ID: BCGA2991

IC: 579C-A2991

COMMERCIAL-IN-CONFIDENCE

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NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steven White	Senior Technical Specialist	Authorised Signatory	04 October 2023

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C and ISED RSS-247 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Jonas Ayipah	04 October 2023	
Testing	Connor Lee	04 October 2023	
Testing	James Cumming	04 October 2023	

FCC Accreditation

492497/UK2010 Octagon House, Fareham Test Laboratory

ISED Accreditation

12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN: 2021, Issue 2 (02-2017) and Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.



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ACCREDITATION

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	04-Oct-2023

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2991
Serial Number(s)	YY6D64HH6P Q32LXGQ6TQ
Hardware Version(s)	REV1.0
Software Version(s)	23A300 23A32391n
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2021 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Start of Test	28-July-2023
Finish of Test	04-August-2023
Name of Engineer(s)	Jonas Ayipah, Connor Lee and James Cumming
Related Document(s)	ANSI C63.10 (2020) ANSI C63.10 (2013)



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: 2.4 GHz Bluetooth				
2.1	15.207, 3.1 and 8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
Configuration and Mode: 2.4 GHz WLAN				
2.1	15.207, 3.1 and 8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
Configuration and Mode: 5 GHz WLAN				
2.1	15.207, 3.1 and 8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
Configuration and Mode: 6 GHz WLAN				
2.1	15.207, 3.1 and 8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
Configuration and Mode: Thread				
2.1	15.207, 3.1 and 8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
Configuration and Mode: Narrowband				
2.1	15.207, 3.1 and 8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)

Table 2

1.4 Product Information

1.4.1 Technical Description

The equipment under test (EUT) was a portable laptop computer.

1.4.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Configuration and Mode: AC Powered – All Modes				
AC Power Port	2 m	Power	AC to DC Power Adapter with USB-C Output	No
USB Port 1	2 m	Data	USB Type-C	No
USB Port 2	Unterminated	Data	USB Type-C	No
USB Port 3	Unterminated	Data	USB Type-C	No
HDMI Port	2 m	Data	HDMI	No
Audio Jack Port	0.5 m	Audio Output	3.5 mm Jack	No

Table 3

1.4.3 Test Configuration

Configuration	Description
AC Powered	The EUT was powered from a 115 V 60 Hz AC supply using an AC to DC adapter with a USB-C output. A set of headphones was used to terminate the EUT's 3.5 mm audio jack port. A USB-C to USB-A adapter and optical mouse were used to terminate the USB Port 1. An HDMI cable and monitor were used to terminate the EUT's HDMI port. USB Port 2 and USB Port 3 were unterminated.

Table 4



1.4.4 Modes of Operation

Mode	Description
2.4 GHz Bluetooth	The EUT was connected to a R&S CMW 500 test set. The EUT was configured to display video on the EUT screen whilst playing audio through the headphones. The display was set to maximum brightness and sleep mode was disabled.
2.4 GHz WLAN	The EUT was continuously pinging to the IP Address of a Wi-Fi router. The EUT was configured to display video on the EUT screen whilst playing audio through the headphones. The display was set to maximum brightness and sleep mode was disabled.
5 GHz WLAN	The EUT was continuously pinging to the IP Address of a Wi-Fi router. The EUT was configured to display video on the EUT screen whilst playing audio through the headphones. The display was set to maximum brightness and sleep mode was disabled.
6 GHz WLAN	The EUT was continuously pinging to the IP Address of a Wi-Fi router. The EUT was configured to display video on the EUT screen whilst playing audio through the headphones. The display was set to maximum brightness and sleep mode was disabled.
Thread	The EUT was placed in a link with another customer provided sample. The EUT was configured to display video on the EUT screen. As the EUT was in a diagnostic state for this mode of operation, audio output was unable to be exercised. The display was set to maximum brightness and sleep mode was disabled.
Narrowband	The EUT was placed in a link with another customer provided sample. The EUT was configured to display video on the EUT screen whilst playing audio through the headphones. The display was set to maximum brightness and sleep mode was disabled.

Table 5

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Model: A2991, Serial Number: YY6D64HH6P			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2991, Serial Number: Q32LXGQ6TQ			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 6



1.7 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz Bluetooth		
AC Power Line Conducted Emissions	Jonas Ayipah	UKAS
Configuration and Mode: 2.4 GHz WLAN		
AC Power Line Conducted Emissions	Jonas Ayipah	UKAS
Configuration and Mode: 5 GHz WLAN		
AC Power Line Conducted Emissions	Jonas Ayipah	UKAS
Configuration and Mode: 6 GHz WLAN		
AC Power Line Conducted Emissions	Jonas Ayipah	UKAS
Configuration and Mode: Thread		
AC Power Line Conducted Emissions	Connor Lee	UKAS
Configuration and Mode: Narrowband		
AC Power Line Conducted Emissions	James Cumming	UKAS

Table 7

Office Address:

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire
PO15 5RL
United Kingdom



2 Test Details

2.1 AC Power Line Conducted Emissions

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.207
ISED RSS-247, Clause 3.1
ISED RSS-GEN, Clause 8.8

2.1.2 Equipment Under Test and Modification State

A2991, S/N: YY6D64HH6P - Modification State 0
A2991, S/N: Q32LXGQ6TQ - Modification State 0

2.1.3 Date of Test

28-July-2023 to 04-August-2023

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.2.

The EUT was placed on a non-conductive table 0.8m above a reference ground plane and 0.4m away from a vertical coupling plane

All power was connected to the EUT through a Line Impedance Stabilisation Network (LISN).

Conducted disturbance voltage measurements on mains lines were made at the output of the LISN

2.1.5 Example Calculation

Quasi-Peak level (dB μ V) = Receiver level (dB μ V) + Correction Factor (dB)
Margin (dB) = Quasi-Peak level (dB μ V) - Limit (dB μ V)

CISPR Average level (dB μ V) = Receiver level (dB μ V) + Correction Factor (dB)
Margin (dB) = CISPR Average level (dB μ V) - Limit (dB μ V)

2.1.6 Example Test Setup Diagram

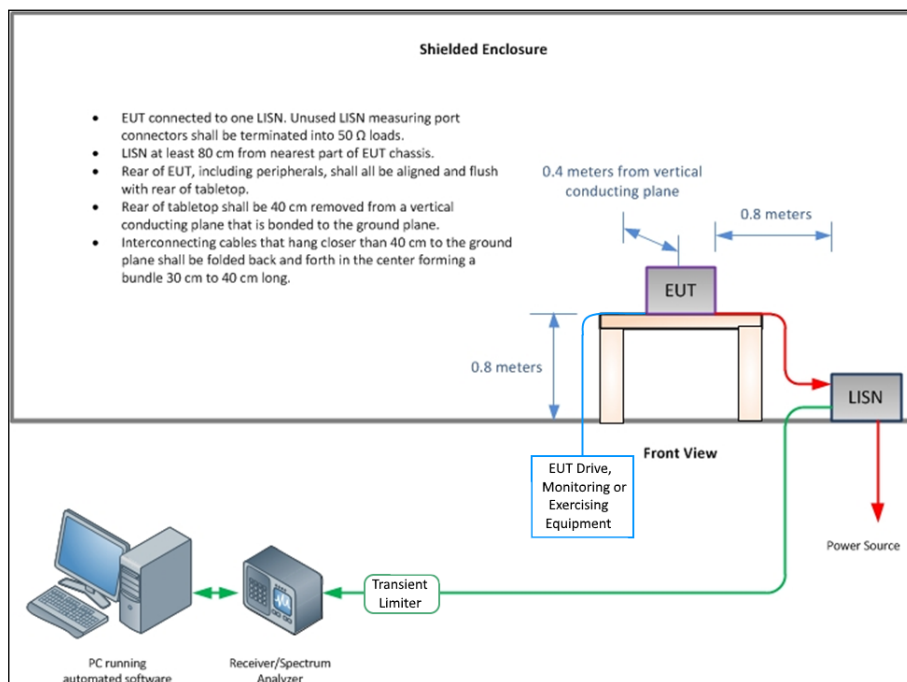


Figure 1 - Conducted Emissions

FCC 47 CFR Part 15, Limit Clause 15.207 and ISED RSS-GEN, Limit Clause 8.8

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	CISPR Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

Table 8

*Decreases with the logarithm of the frequency.

2.1.7 Environmental Conditions

Ambient Temperature	21.7 - 24.0 °C
Relative Humidity	54.5 – 69.7 %
Atmospheric Pressure	999.0 – 1001.0 %



2.1.8 Test Results

Results for Configuration and Mode: AC Powered – 2.4 GHz Bluetooth

Applied supply voltage: 115 V AC
Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
*				

Table 9 - Live Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

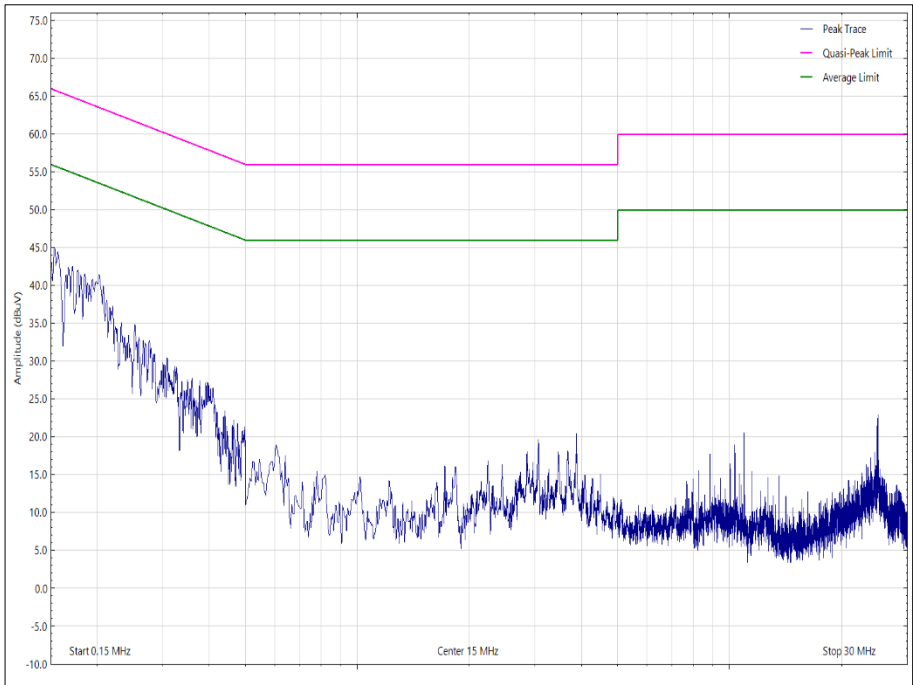


Figure 2 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
*				

Table 10 - Neutral Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

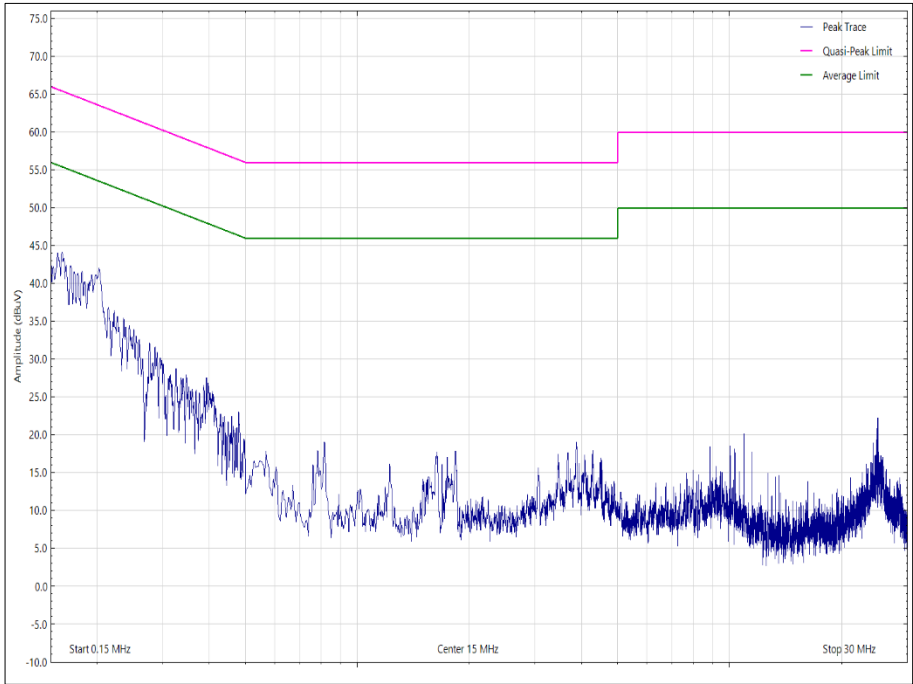


Figure 3 - Neutral Line - 150 kHz to 30 MHz



Results for Configuration and Mode: AC Powered – 2.4 GHz WLAN

Applied supply voltage: 115 V AC
Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
*				

Table 11 - Live Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

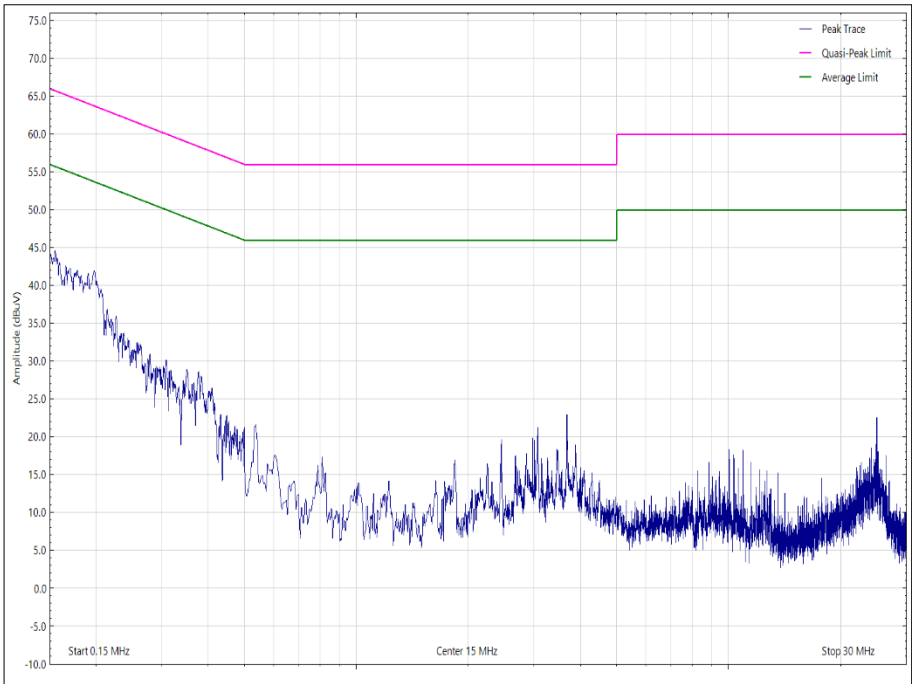


Figure 4 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
*				

Table 12 - Neutral Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

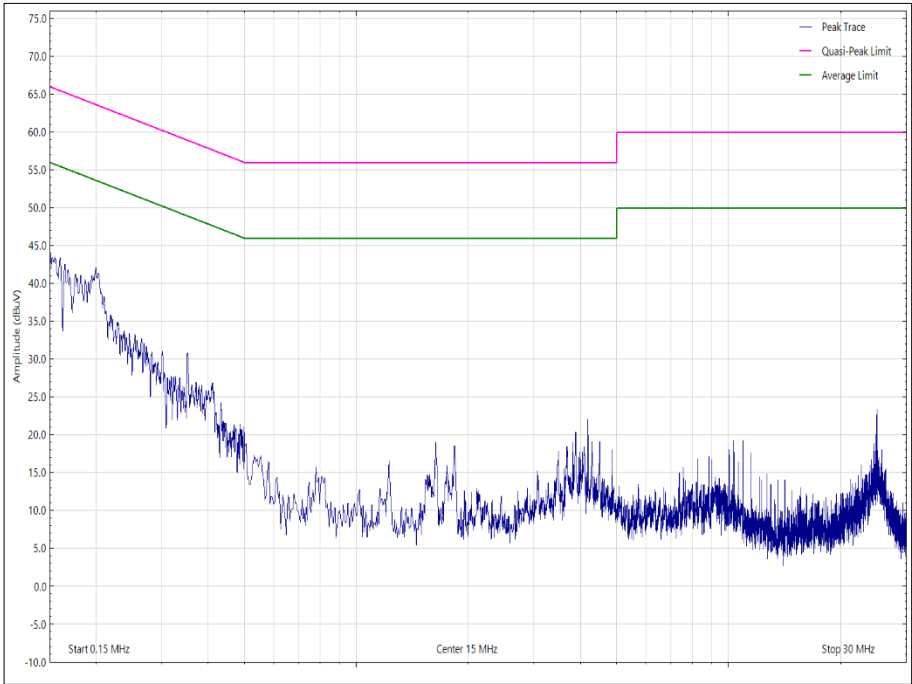


Figure 5 - Neutral Line - 150 kHz to 30 MHz

Results for Configuration and Mode: AC Powered – 5 GHz WLAN

Applied supply voltage: 115 V AC

Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
*				

Table 13 - Live Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

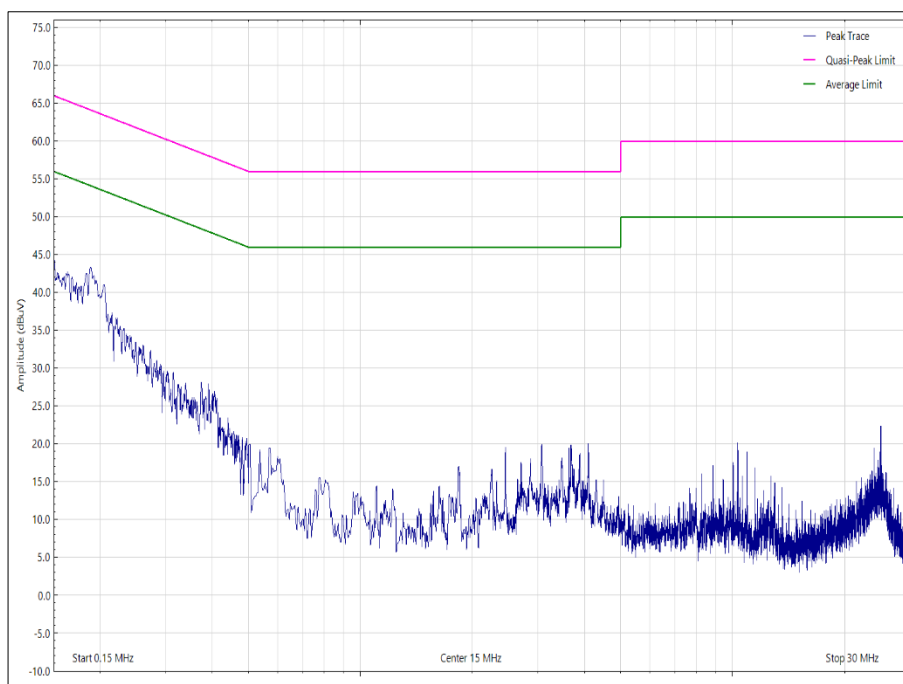


Figure 6 - Live Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
*				

Table 14 - Neutral Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

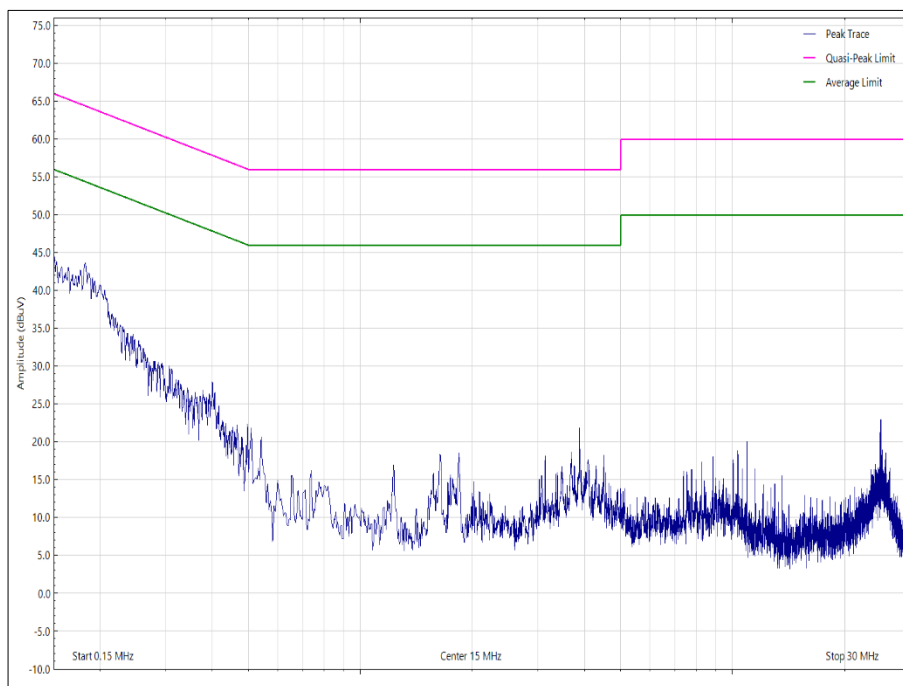


Figure 7 - Neutral Line - 150 kHz to 30 MHz

Results for Configuration and Mode: AC Powered – 6 GHz WLAN

Applied supply voltage: 115 V AC

Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
*				

Table 15 - Live Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

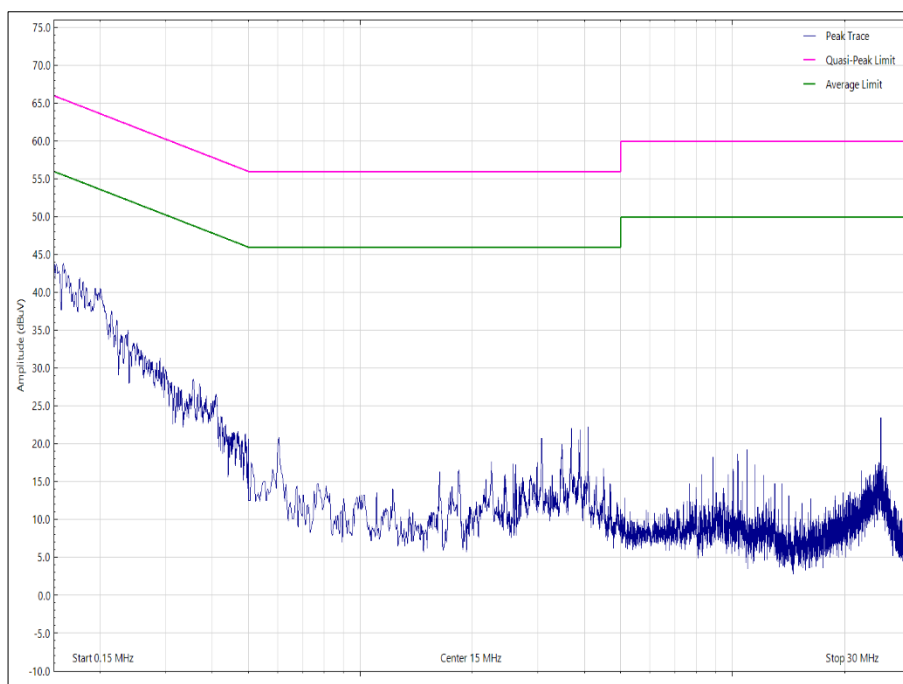


Figure 8 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
*				

Table 16 - Neutral Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

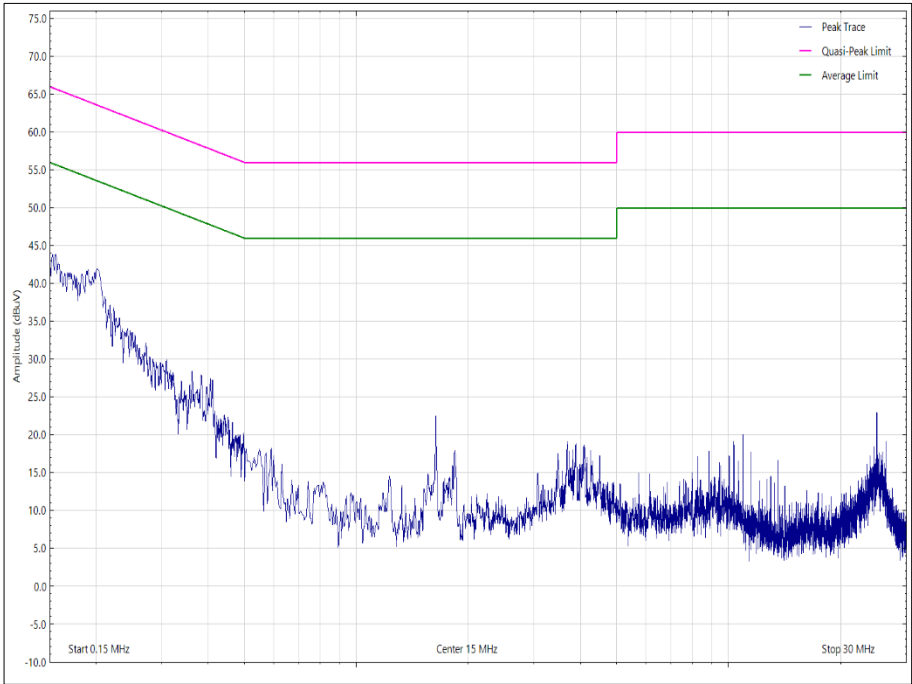


Figure 9 - Neutral Line - 150 kHz to 30 MHz

Results for Configuration and Mode: AC Powered – Thread

Applied supply voltage: 115 V AC

Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.151	39.51	65.90	-26.39	Q-Peak
0.151	14.10	55.90	-41.80	CISPR Avg
0.164	41.34	65.30	-23.96	Q-Peak
0.164	19.09	55.30	-36.21	CISPR Avg
0.172	38.74	64.90	-26.16	Q-Peak
0.172	18.81	54.90	-36.09	CISPR Avg
0.179	38.39	64.50	-26.11	Q-Peak
0.179	22.77	54.50	-31.73	CISPR Avg

Table 17 - Live Line Emissions Results

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

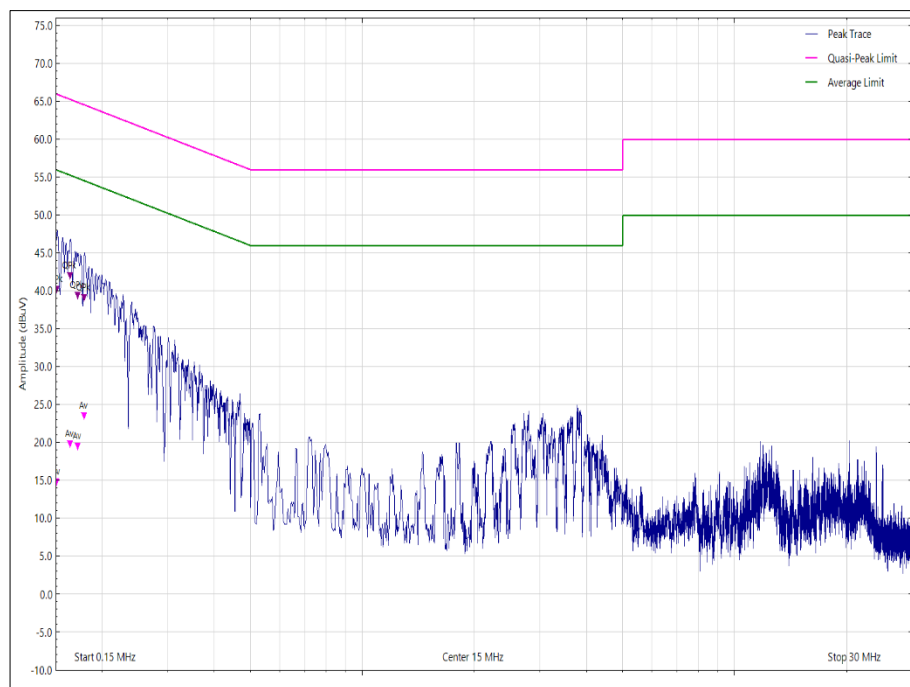


Figure 10 - Live Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
0.156	42.49	65.70	-23.21	Q-Peak
0.156	16.42	55.70	-39.28	CISPR Avg
0.171	41.37	64.90	-23.53	Q-Peak
0.171	16.16	54.90	-38.74	CISPR Avg
0.182	40.04	64.40	-24.36	Q-Peak
0.182	15.96	54.40	-38.44	CISPR Avg
0.193	38.72	63.90	-25.18	Q-Peak
0.193	18.72	53.90	-35.18	CISPR Avg

Table 18 - Neutral Line Emissions Results

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

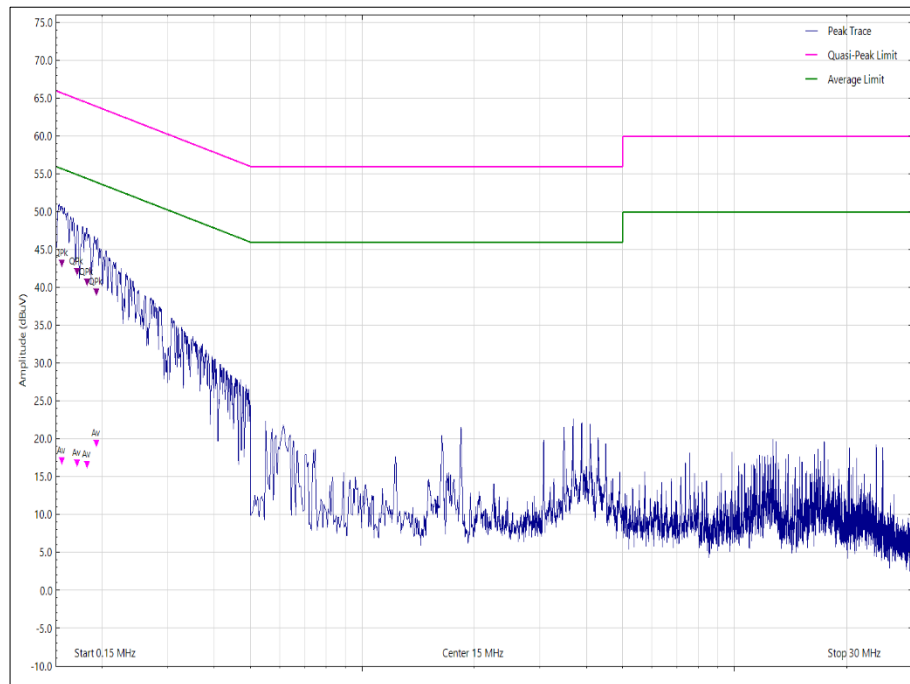


Figure 11 - Neutral Line - 150 kHz to 30 MHz

Results for Configuration and Mode: AC Powered – Narrowband

Applied supply voltage: 115 V AC

Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
*				

Table 19 - Live Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

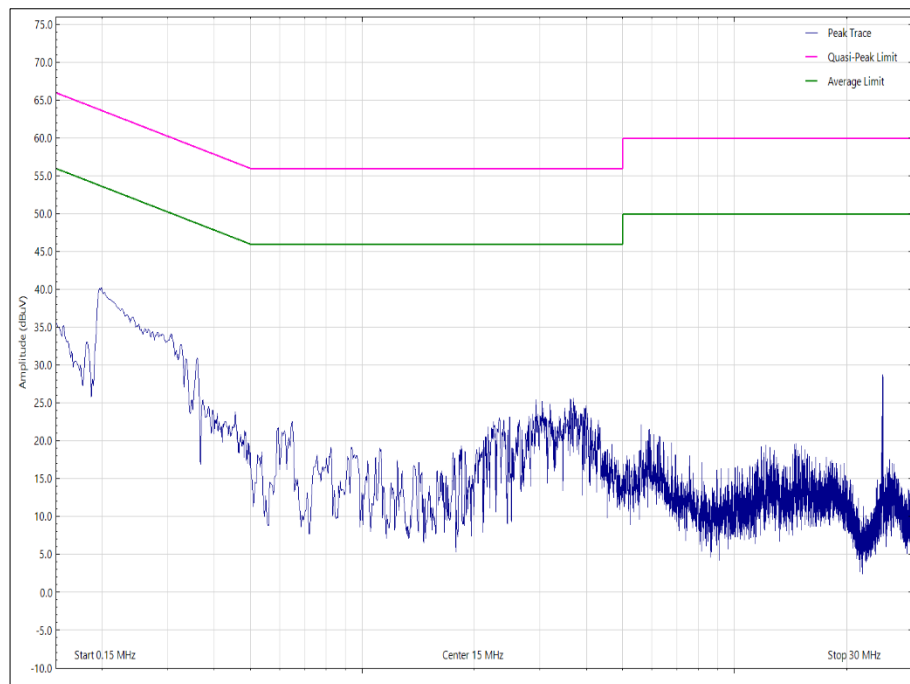


Figure 12 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
*				

Table 20 - Neutral Line Emissions Results

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

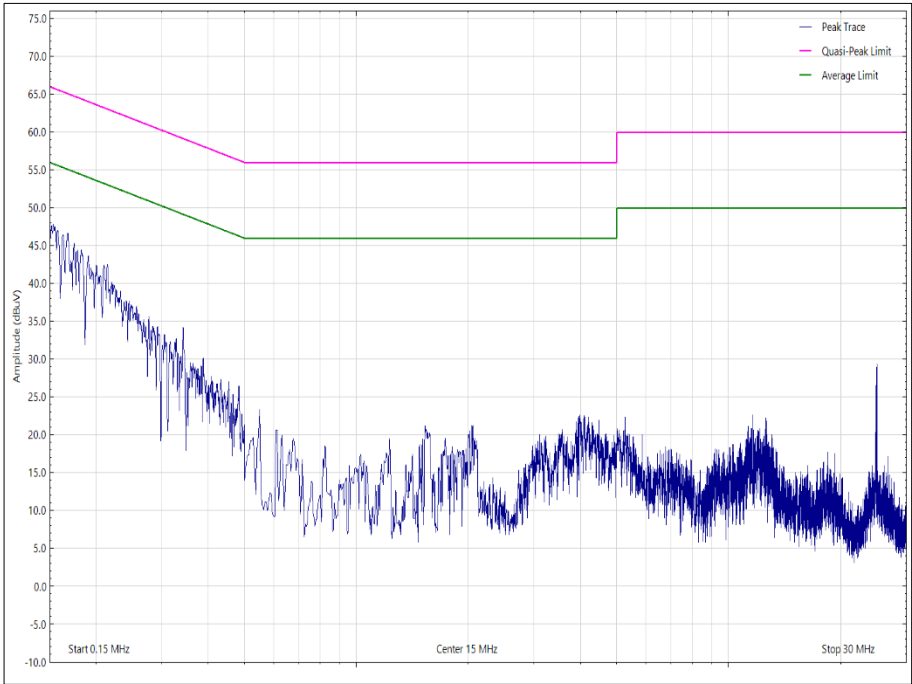


Figure 13 - Neutral Line - 150 kHz to 30 MHz



2.1.9 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Emissions Software	TUV SUD	EmX V3.1.12	5125	-	Software
Test Receiver	Rohde & Schwarz	ESU40	3506	12	30-Mar-2024
Transient Limiter	Hewlett Packard	11947A	2377	12	02-Mar-2024
Termination (50ohm)	JFW	50T-054	3952	12	22-Mar-2024
Cable (SMA to N-Type, 2 m)	Junkosha	MWX241/B	5817	6	04-Aug-2023
Cable (N-Type to N-Type, 8 m)	Junkosha	MWX221-08000NMSNMS/B	6321	12	04-Feb-2024
LISN (CISPR 16, Single Phase)	Chase	MN 2050	336	12	03-Jul-2024
LISN (CISPR 16, Single Phase)	Rohde & Schwarz	ESH3-Z5	1390	12	02-Feb-2024

Table 21



3 Test Equipment Information

3.1 General Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5478	12	21-Apr-2024

Table 22



4 Incident Reports

No incidents reports were raised.



5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
AC Power Line Conducted Emissions	150 kHz to 30 MHz, LISN, ± 3.7 dB

Table 23

Measurement Uncertainty Decision Rule – Accuracy Method

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.