

FCC and ISED Test Report

Apple Inc
Model: A2901

In accordance with FCC 47 CFR Part 15C, ISED
RSS-247 and ISED RSS-GEN
(Bluetooth, 2.4 GHz WLAN, 5 GHz WLAN,
6 GHz WLAN, Thread & Narrowband)

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



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FCC ID: BCGA2901

IC: 579C-A2901

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Document 75958006-11 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Andrew Lawson	Chief Engineer, EMC	Authorised Signatory	28 April 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, 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
Report Generation	Lauren Walters	28 April 2023	

FCC Accreditation

90987 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: 2021, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.



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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	28-April-2023

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2901
Serial Number(s)	WXWRTFWXWV and G2XKW6X433
Hardware Version(s)	REV 1.0
Software Version(s)	22E217 and 22E62160k
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	19-April-2023
Finish of Test	24-April-2023
Name of Engineer(s)	James Cumming, Connor Lee and Callum Pennells
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
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz Bluetooth						
2.1	15.207	3.1	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	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	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	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	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	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 an Apple desktop computer with Bluetooth®, Bluetooth® Low Energy, Thread and IEEE 802.11 a/b/g/n/ac/ax Wi-Fi capabilities in the 2.4 GHz, 5 GHz and 6 GHz bands.

1.4.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Configuration and Mode: AC Powered - Transmitter Idle				
AC Power Port	2 m	Power	3 Core	No
Ethernet	3 m	Data	Cat 6	No
USB	2 m	Data	USB 3.0	No
Audio Output	2 m	Audio Output	3.5 mm Jack	No
Type-C	2 m	Data	USB Type - C	No
Type-C	2 m	Data	USB Type - C	No
HDMI	2 m	Data	HDMI	No

Table 3

1.4.3 Test Configuration

Configuration	Description
AC Powered	<p>The EUT was powered from a 120 V 60 Hz AC supply.</p> <p>A set of headphones was used to terminate the EUT's 3.5 mm audio jack port.</p> <p>A support keyboard and cable were used to terminate the USB-C port on the front.</p> <p>A supplied support mouse and cable were used to terminate the USB-C Port on the rear.</p> <p>A mouse was also used to terminate the USB 3.0 port on the rear.</p> <p>A switch box was used to terminate the ethernet port on the rear.</p> <p>A monitor was used to terminate the HDMI port.</p>

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.
2.4 GHz WLAN	The EUT was connected to a Wi-Fi access point.
5 GHz WLAN	The EUT was connected to a Wi-Fi access point.
6 GHz WLAN	The EUT was connected to a Wi-Fi access point.
Thread	The EUT was connected to a support slave device.
Narrowband	The EUT was connected to a support slave device.

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: A2901, Serial Number: WXWRTFWXWV			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2901, Serial Number: G2XKW6X433			
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	James Cumming	UKAS
Configuration and Mode: 2.4 GHz WLAN		
AC Power Line Conducted Emissions	James Cumming	UKAS
Configuration and Mode: 5 GHz WLAN		
AC Power Line Conducted Emissions	James Cumming	UKAS
Configuration and Mode: Thread		
AC Power Line Conducted Emissions	Connor Lee	UKAS
Configuration and Mode: NarrowBand		
AC Power Line Conducted Emissions	Callum Pennells	UKAS
Configuration and Mode: 6 GHz WLAN		
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

A2901, S/N: WXWRTFWXWV - Modification State 0
A2901, S/N: G2XKW6X433 - Modification State 0

2.1.3 Date of Test

19-April-2023 to 24-April-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 an Artificial Mains Network (AMN).

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

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

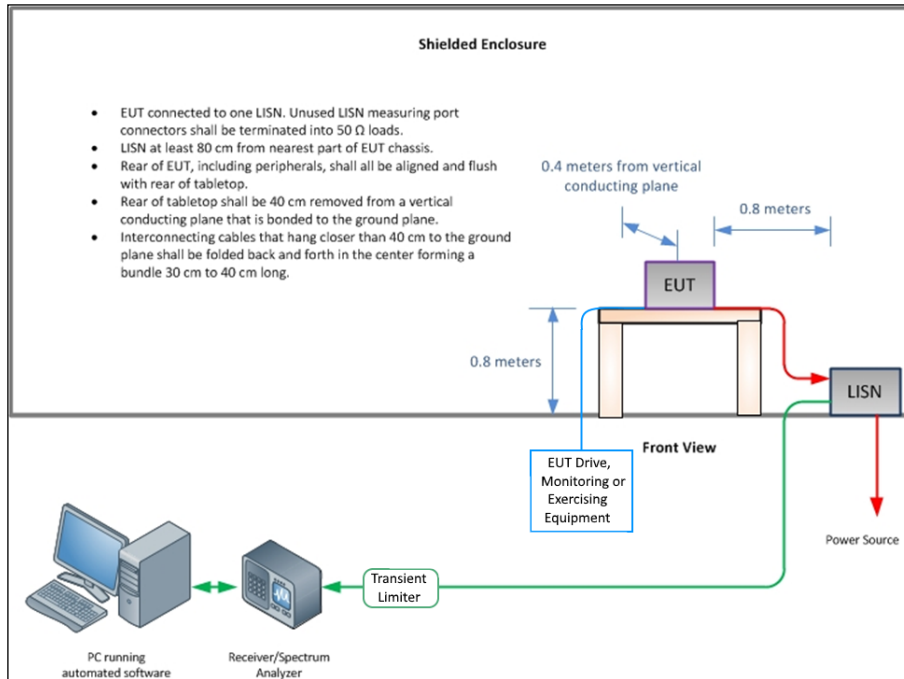


Figure 1 - Conducted Emissions

2.1.7 Environmental Conditions

Ambient Temperature 19.1 - 21.8 °C
 Relative Humidity 41.5 - 49.8 %



2.1.8 Test Results

2.4 GHz Bluetooth

Applied supply voltage: 120 V AC
 Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.173	44.38	64.80	-20.42	Q-Peak
0.173	34.51	54.80	-20.29	CISPR Avg
0.407	37.71	57.70	-19.99	Q-Peak
0.407	25.98	47.70	-21.72	CISPR Avg
0.457	41.36	56.70	-15.34	Q-Peak
0.457	31.10	46.70	-15.60	CISPR Avg

Table 8 - Live Line Emissions Results

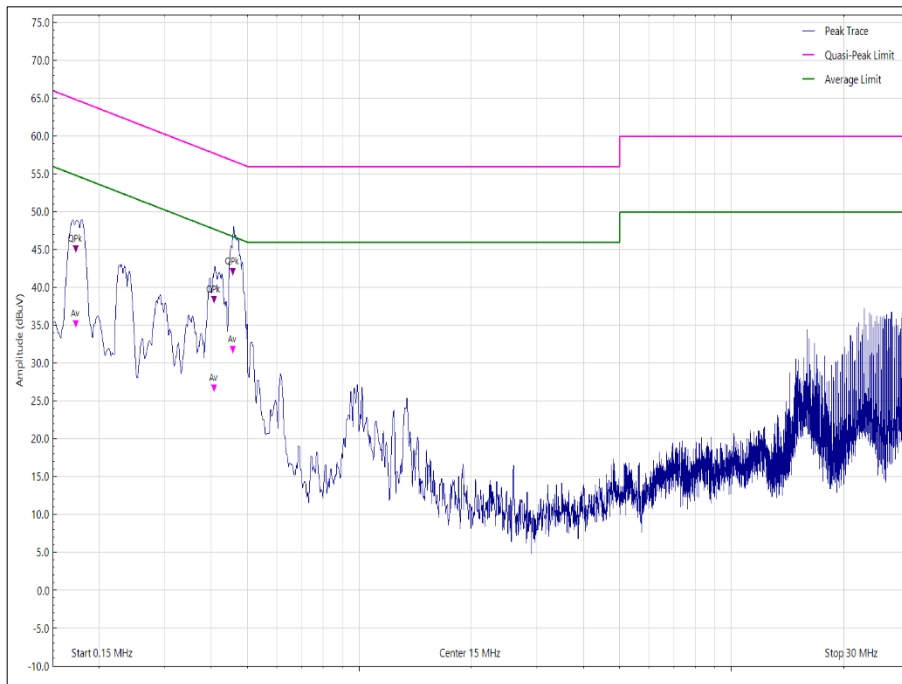


Figure 2 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.174	43.90	64.80	-20.90	Q-Peak
0.174	36.66	54.80	-18.14	CISPR Avg
0.411	38.25	57.60	-19.35	Q-Peak
0.411	26.68	47.60	-20.92	CISPR Avg
0.457	41.27	56.70	-15.43	Q-Peak
0.457	31.50	46.70	-15.20	CISPR Avg

Table 9 - Neutral Line Emissions Results



Figure 3 - Neutral Line - 150 kHz to 30 MHz



2.4 GHz WLAN

Applied supply voltage: 120 V AC
 Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
0.175	44.78	64.70	-19.92	Q-Peak
0.175	35.25	54.70	-19.45	CISPR Avg
0.408	38.26	57.70	-19.44	Q-Peak
0.408	27.77	47.70	-19.93	CISPR Avg
0.462	42.53	56.70	-14.17	Q-Peak
0.462	29.61	46.70	-17.09	CISPR Avg

Table 10 - Live Line Emissions Results

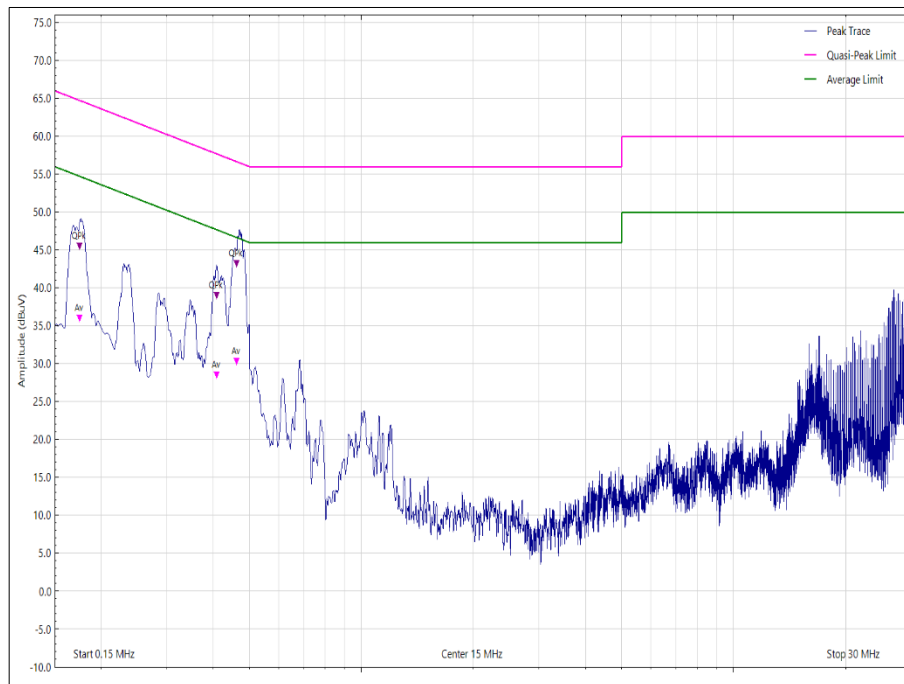


Figure 4 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
0.176	44.09	64.70	-20.61	Q-Peak
0.176	36.76	54.70	-17.94	CISPR Avg
0.420	37.79	57.40	-19.61	Q-Peak
0.420	27.78	47.40	-19.62 well below</td <td>CISPR Avg</td>	CISPR Avg
0.465	42.36	56.60	-14.24	Q-Peak
0.465	29.21	46.60	-17.39	CISPR Avg

Table 11 - Neutral Line Emissions Results

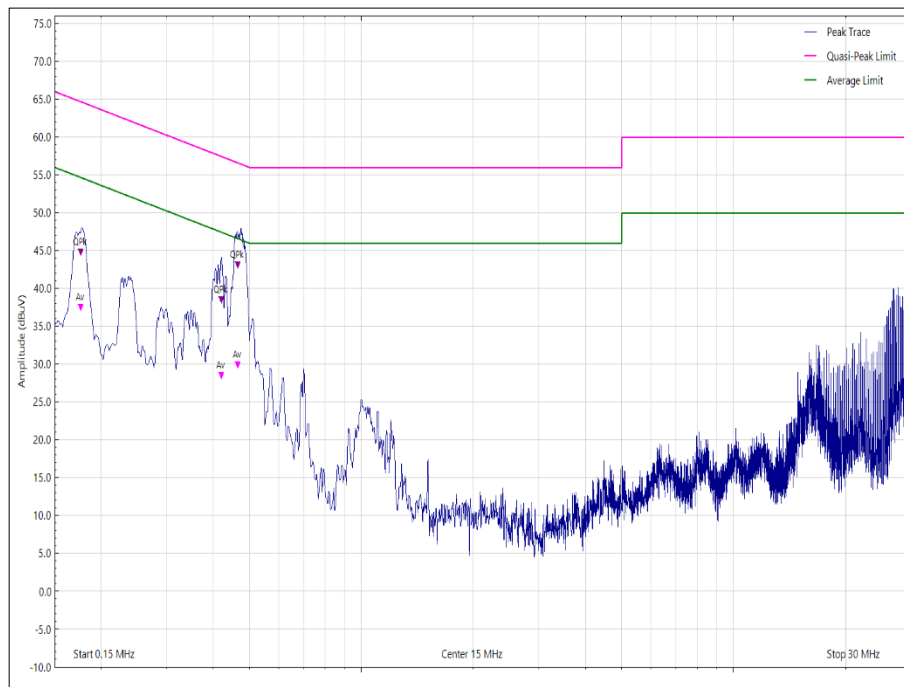


Figure 5 - Neutral Line - 150 kHz to 30 MHz



5 GHz WLAN

Applied supply voltage: 120 V AC
 Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
0.176	44.73	64.70	-19.97	Q-Peak
0.176	35.20	54.70	-19.50	CISPR Avg
0.410	38.42	57.70	-19.28	Q-Peak
0.410	27.86	47.70	-19.84	CISPR Avg
0.461	42.76	56.70	-13.94	Q-Peak
0.461	30.83	46.70	-15.87	CISPR Avg

Table 12 - Live Line Emissions Results

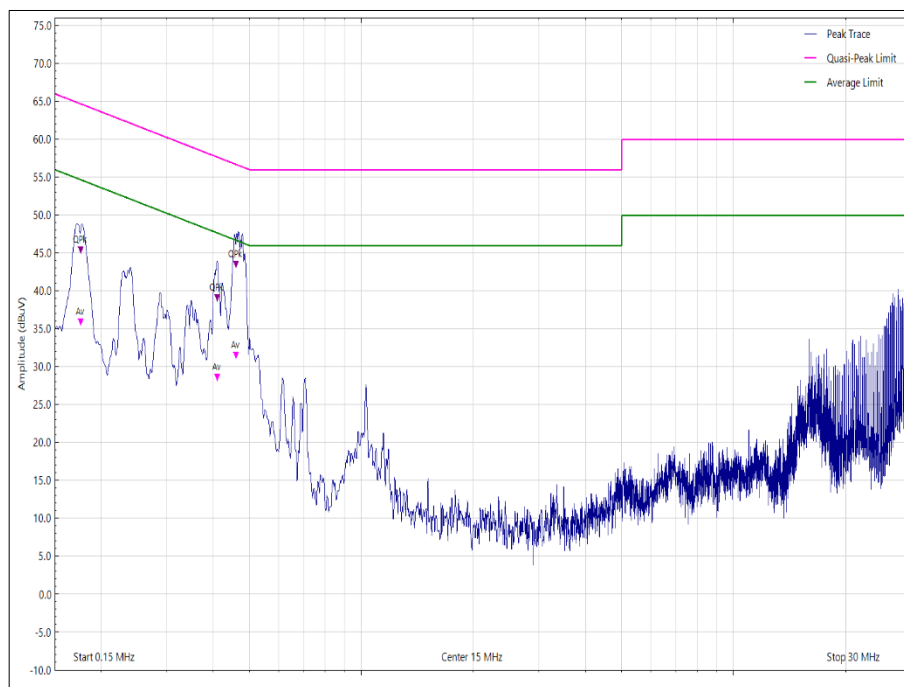


Figure 6 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
0.176	44.14	64.70	-20.56	Q-Peak
0.176	36.96	54.70	-17.74	CISPR Avg
0.413	38.11	57.60	-19.49	Q-Peak
0.413	27.90	47.60	-19.70	CISPR Avg
0.464	42.31	56.60	-14.29	Q-Peak
0.464	28.95	46.60	-17.65	CISPR Avg

Table 13 - Neutral Line Emissions Results

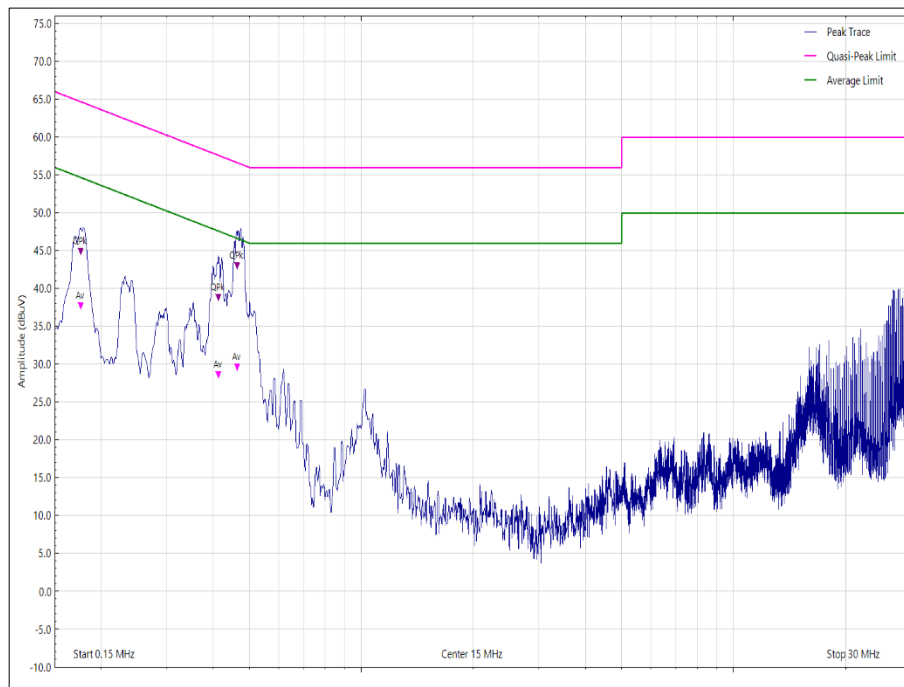


Figure 7 - Neutral Line - 150 kHz to 30 MHz



Thread

Applied supply voltage: 120 V AC
 Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
0.167	43.89	65.10	-21.21	Q-Peak
0.167	34.89	55.10	-20.21	CISPR Avg
0.387	37.04	58.10	-21.06	Q-Peak
0.387	27.04	48.10	-21.06	CISPR Avg
0.441	40.69	57.00	-16.31	Q-Peak
0.441	29.02	47.00	-17.98	CISPR Avg
2.953	28.71	56.00	-27.29	Q-Peak
2.953	17.89	46.00	-28.11	CISPR Avg
3.204	34.20	56.00	-21.80	Q-Peak
3.204	26.49	46.00	-19.51	CISPR Avg
3.610	36.96	56.00	-19.04	Q-Peak
3.610	34.70	46.00	-11.30	CISPR Avg

Table 14 - Live Line Emissions Results



Figure 8 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.167	43.58	65.10	-21.52	Q-Peak
0.167	40.15	55.10	-14.95	CISPR Avg
0.392	26.20	48.00	-21.80	CISPR Avg
0.392	36.11	58.00	-21.89	Q-Peak
0.443	30.60	47.00	-16.40	CISPR Avg
0.443	40.53	57.00	-16.47	Q-Peak
3.008	31.65	46.00	-14.35	CISPR Avg
3.008	33.71	56.00	-22.29	Q-Peak
3.205	25.18	46.00	-20.82	CISPR Avg
3.205	32.83	56.00	-23.17	Q-Peak
3.607	24.34	46.00	-21.66	CISPR Avg
3.607	30.09	56.00	-25.91	Q-Peak

Table 15 - Neutral Line Emissions Results

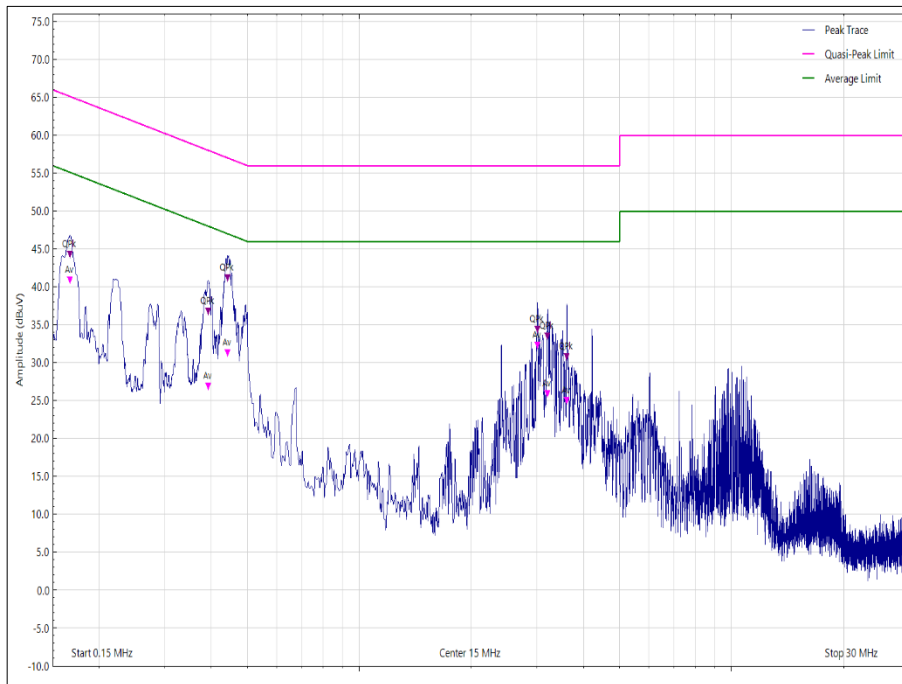


Figure 9 - Neutral Line - 150 kHz to 30 MHz



NarrowBand

Applied supply voltage: 120 V AC
 Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
0.180	43.57	64.50	-20.93	Q-Peak	0	100	Horizontal
0.180	32.92	54.50	-21.58	CISPR Avg	0	100	Horizontal
0.292	33.67	60.50	-26.83	Q-Peak	0	100	Horizontal
0.292	23.82	50.50	-26.68	CISPR Avg	0	100	Horizontal
0.451	39.04	56.80	-17.76	Q-Peak	0	100	Horizontal
0.451	28.33	46.80	-18.47	CISPR Avg	0	100	Horizontal
0.472	27.58	46.50	-18.92	CISPR Avg	0	100	Horizontal
0.472	41.80	56.50	-14.70	Q-Peak	0	100	Horizontal
27.895	30.71	50.00	-19.29	CISPR Avg	0	100	Horizontal
27.895	37.85	60.00	-22.15	Q-Peak	0	100	Horizontal

Table 16 - Live Line Emissions Results

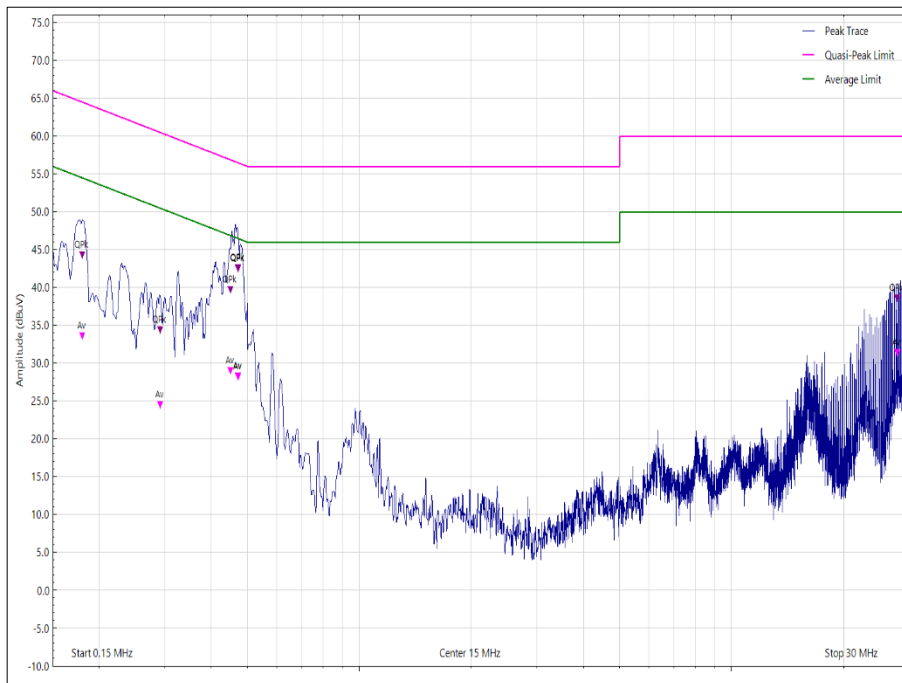


Figure 10 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
0.180	33.85	54.50	-20.65	CISPR Avg	0	100	Horizontal
0.180	43.03	64.50	-21.47	Q-Peak	0	100	Horizontal
0.419	26.69	47.50	-20.81	CISPR Avg	0	100	Horizontal
0.419	37.62	57.50	-19.88	Q-Peak	0	100	Horizontal
0.463	27.33	46.60	-19.27	CISPR Avg	0	100	Horizontal
0.463	42.31	56.60	-14.29	Q-Peak	0	100	Horizontal
0.475	41.34	56.40	-15.06	Q-Peak	0	100	Horizontal
0.475	28.17	46.40	-18.23	CISPR Avg	0	100	Horizontal
27.620	31.41	50.00	-18.59	CISPR Avg	0	100	Horizontal
27.620	37.75	60.00	-22.25	Q-Peak	0	100	Horizontal

Table 17 - Neutral Line Emissions Results



Figure 11 - Neutral Line - 150 kHz to 30 MHz



6 GHz WLAN

Applied supply voltage: 120 V AC
 Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector
0.174	44.79	64.70	-19.91	Q-Peak
0.174	35.11	54.70	-19.59	CISPR Avg
0.419	37.89	57.50	-19.61	Q-Peak
0.419	28.31	47.50	-19.19	CISPR Avg
0.462	42.53	56.70	-14.17	Q-Peak
0.462	29.26	46.70	-17.44	CISPR Avg

Table 18 - Live Line Emissions Results

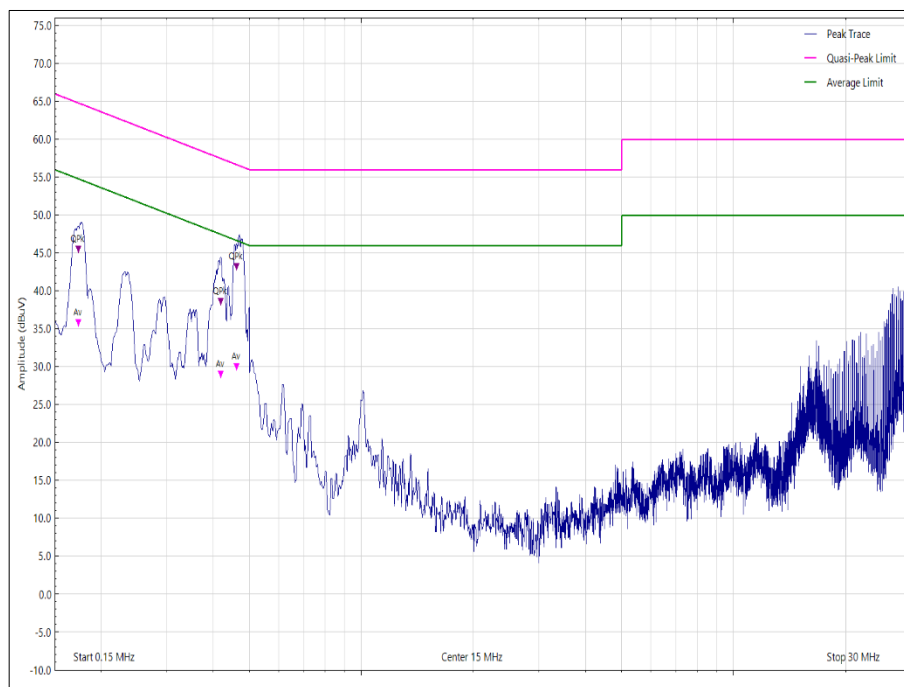


Figure 12 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.174	43.84	64.80	-20.96	Q-Peak
0.174	36.82	54.80	-17.98	CISPR Avg
0.415	38.18	57.60	-19.42	Q-Peak
0.415	27.80	47.60	-19.80	CISPR Avg
0.471	42.39	56.50	-14.11	Q-Peak
0.471	29.15	46.50	-17.35	CISPR Avg

Table 19 - Neutral Line Emissions Results

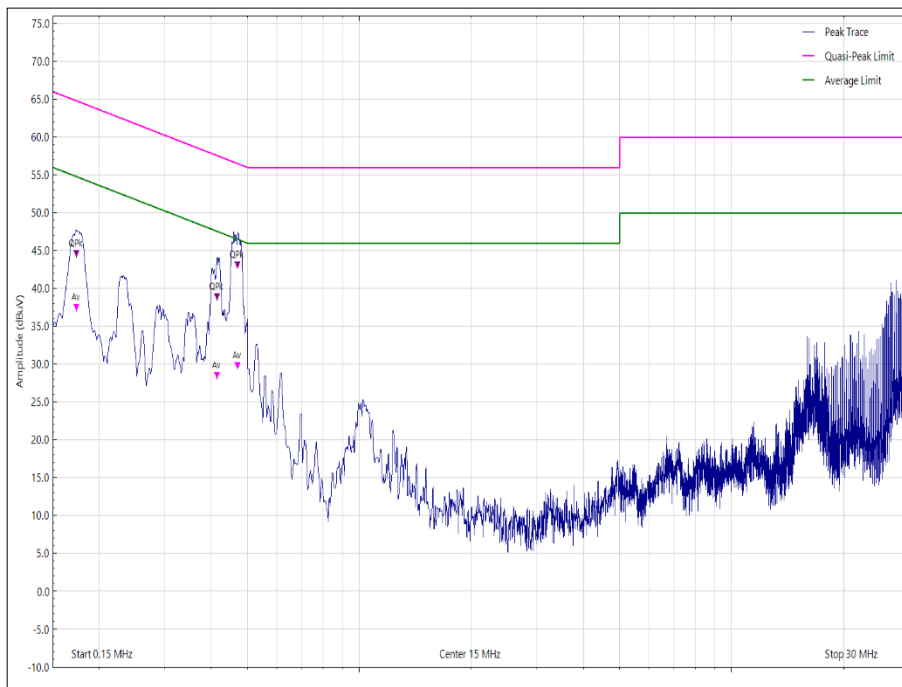


Figure 13 - Neutral Line - 150 kHz to 30 MHz

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 20

*Decreases with the logarithm of the frequency.



2.1.9 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 1 and EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Screened Room (1)	Rainford	Rainford	1541	12	01-Jul-2023
Emissions Software	TUV SUD	EmX V3.1.11	5125	-	Software
EMC Test Receiver	Rohde & Schwarz	ESW44	5808	12	14-Mar-2024
Transient Limiter	Hewlett Packard	11947A	1032	12	21-Dec-2023
Cable (N(m)-N(m), 8 m)	Teledyne	PR90-088-8MTR	5451	6	23-Aug-2023
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	5476	12	06-Oct-2023

Table 22



4 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.