FCC and ISED Test Report

Apple Inc
Model: A2941

In accordance with FCC 47 CFR Part 15C and ISED RSS-247 and ISED RSS-GEN (2.4 GHz Bluetooth, 2.4 GHz Bluetooth Low Energy, 2.4 GHz WLAN and 5 GHz WLAN)

Add value.
Inspire trust.

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

TUV SUD Digitally signed by TUV SUD
Date: 2023.03.16 12:14:01 Z

FCC ID: BCGA2941 IC: 579C-A2941

COMMERCIAL-IN-CONFIDENCE

Document 75957632-13 Issue 01

SIGNATURE			
AJ Lawson.			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Andrew Lawson	EMC Chief Engineer	Authorised Signatory	16 March 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	James Cumming	16 March 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, 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.

TÜV SÜD
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Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuvsud.com/en

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

Contents

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	16 March 2023

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2941
Serial Number(s)	HH9525P706
Hardware Version(s)	REV1.0
Software Version(s)	22E229
Number of Samples Tested	1
Test Specification/Issue/Date	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)
Date of Receipt of EUT	26-January-2023
Start of Test	03-March-2023
Finish of Test	03-March-2023
Name of Engineer(s)	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 and 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)

Table 2

1.4 Product Information

1.4.1 Technical Description

The equipment under test (EUT) was an Apple laptop computer with Bluetooth®, Bluetooth® Low Energy and IEEE 802.11 a/b/g/n/ac/ax Wi-Fi capabilities in the 2.4 GHz and 5 GHz bands.

1.4.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Configuration and Mode: AC Powered – All Modes				
AC Power	2 m	Mains power to the EUT's AC/DC adapter.	AC/DC adapter with USB-C output to EUT.	No
USB	2 m	Data	USB Type - C	No
Audio Output	2 m	Audio Output	3.5 mm Jack	No

Table 3

1.4.3 Test Configuration

Configuration	Description
AC Powered	The EUT was powered from an AC to DC adapter using a USB-C output. The adapter was supplied from a 120 V 60 Hz AC supply. 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 was used to terminate the USB-C port.

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.
5 GHz WLAN	The EUT was continuously pinging to the IP Address of a Wi-Fi router.
2.4 GHz WLAN	The EUT was continuously pinging to the IP Address of a Wi-Fi router.

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: A2941 Serial Number: HH9525P706			
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: AC Powered - 2.4 GHz Bluetooth		
AC Power Line Conducted Emissions	James Cumming	UKAS
Configuration and Mode: AC Powered - 2.4 GHz WLAN		
AC Power Line Conducted Emissions	James Cumming	UKAS
Configuration and Mode: AC Powered - 5 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, ISED RSS-247 and ISED RSS-GEN, Clause 15.207, 3.1 and 8.8

2.1.2 Equipment Under Test and Modification State

A2941 S/N: HH9525P706 - Modification State 0

2.1.3 Date of Test

03-March-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 0.8 m 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 Environmental Conditions

Ambient Temperature	19.6 - 19.7 °C
Relative Humidity	29.9 - 30.1 %

2.1.6 Example Calculation

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

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

2.1.7 Example Test Setup Diagram

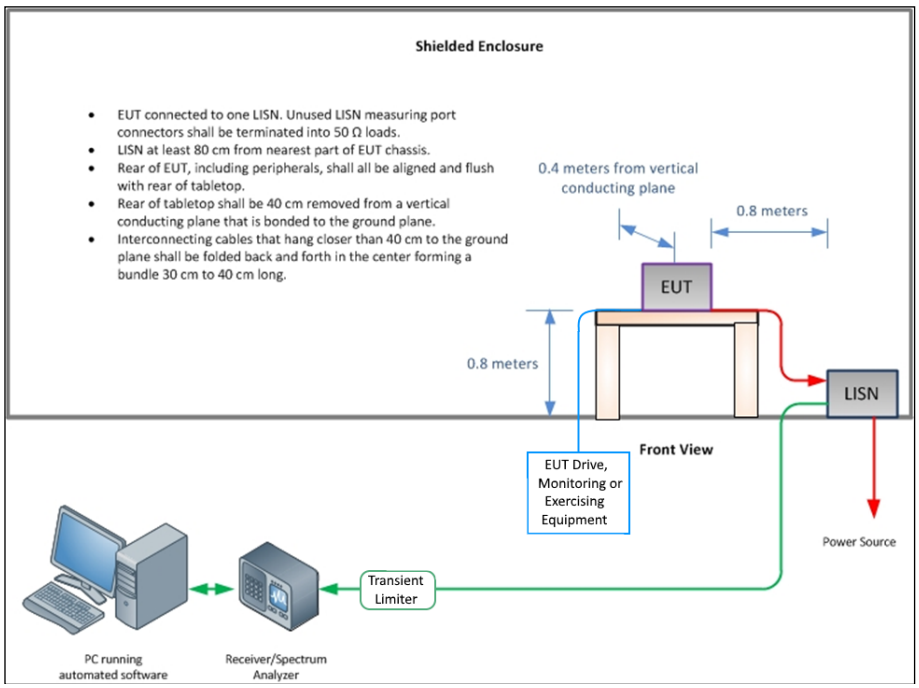

Figure 1 - Conducted Emissions

2.1.8 Test Results

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

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

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.151	42.94	65.90	-22.96	Q-Peak
0.151	16.95	55.90	-38.95	CISPR Avg
0.157	42.38	65.60	-23.22	Q-Peak
0.157	16.24	55.60	-39.36	CISPR Avg
0.177	39.54	64.60	-25.06	Q-Peak
0.177	14.65	54.60	-39.95	CISPR Avg

Table 8 - 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.

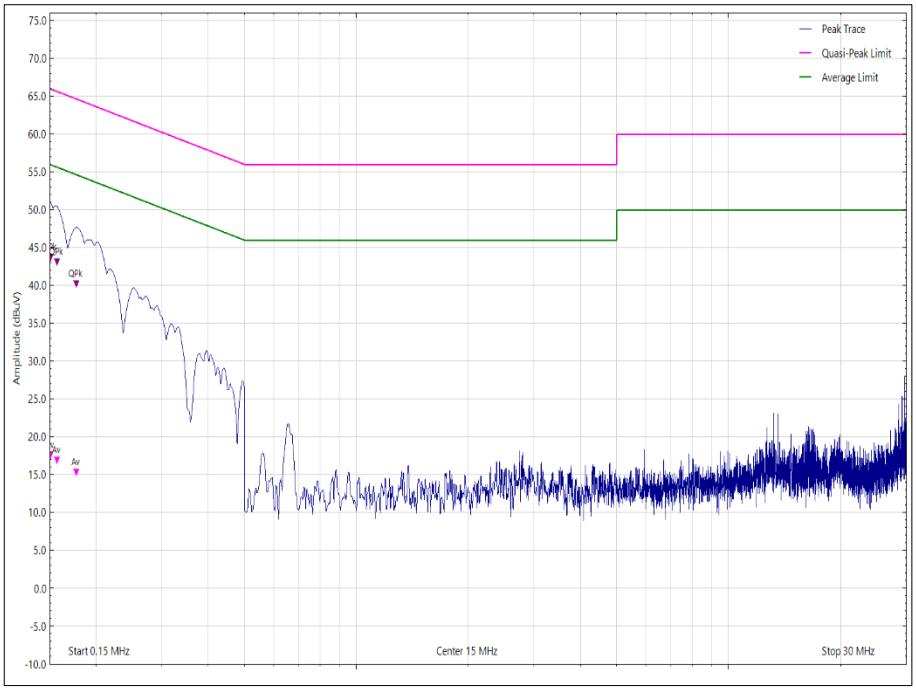

Figure 2 - Live Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.151	43.21	65.90	-22.69	Q-Peak
0.151	17.11	55.90	-38.79	CISPR Avg
0.171	40.32	64.90	-24.58	Q-Peak
0.171	15.11	54.90	-39.79	CISPR Avg
0.182	38.89	64.40	-25.51	Q-Peak
0.182	14.63	54.40	-39.77	CISPR Avg
0.199	36.81	63.70	-26.89	Q-Peak
0.199	14.75	53.70	-38.95	CISPR Avg

Table 9 - 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.

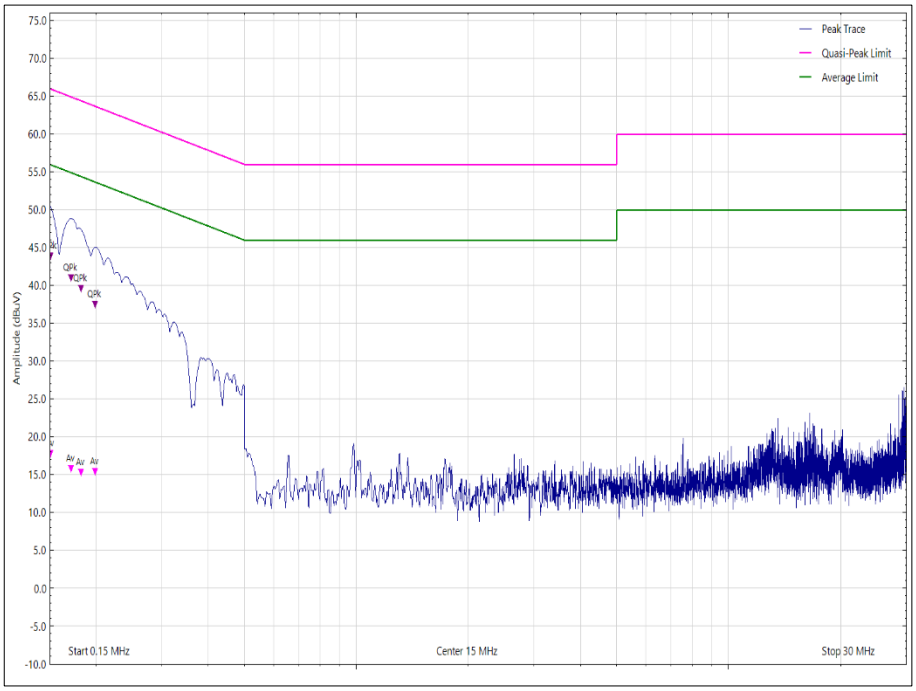

Figure 3 - Neutral Line - 150 kHz to 30 MHz

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

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	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 10

*Decreases with the logarithm of the frequency.

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

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

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.151	43.62	66.00	-22.38	Q-Peak
0.151	17.38	56.00	-38.62	CISPR Avg
0.158	42.54	65.60	-23.06	Q-Peak
0.158	16.50	55.60	-39.10	CISPR Avg
0.162	41.98	65.40	-23.42	Q-Peak
0.162	16.05	55.40	-39.35	CISPR Avg
0.165	41.54	65.20	-23.66	Q-Peak
0.165	15.86	55.20	-39.34	CISPR Avg
0.179	39.65	64.50	-24.85	Q-Peak
0.179	14.87	54.50	-39.63	CISPR Avg
0.189	15.59	54.10	-38.51	CISPR Avg
0.189	38.39	64.10	-25.71	Q-Peak

Table 11 - Live Line Emissions Results

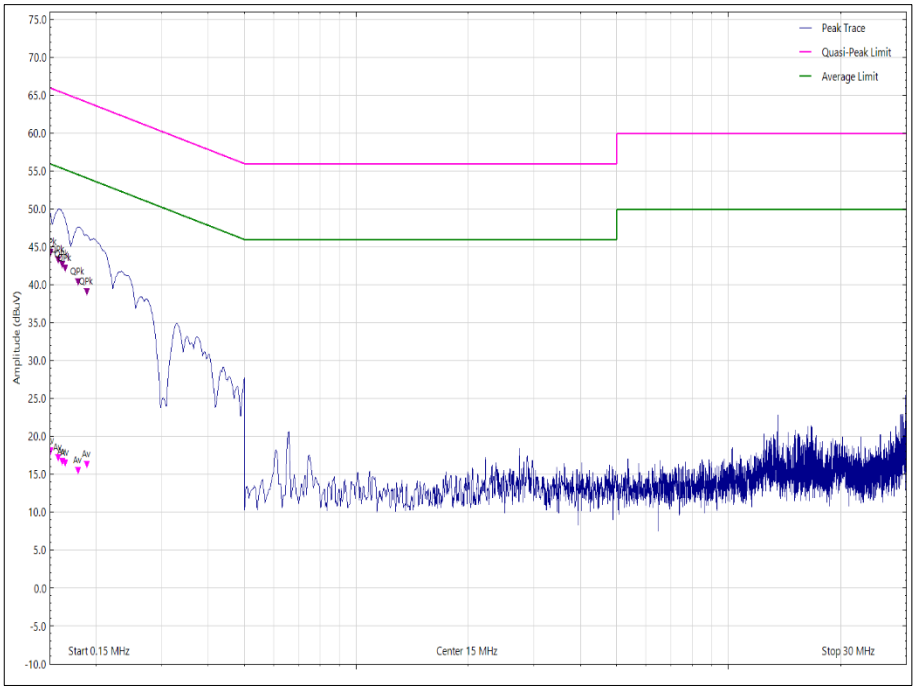

Figure 4 - Live Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.155	43.11	65.70	-22.59	Q-Peak
0.155	16.77	55.70	-38.93	CISPR Avg
0.163	16.04	55.30	-39.26	CISPR Avg
0.163	41.89	65.30	-23.41	Q-Peak
0.188	15.21	54.10	-38.89	CISPR Avg
0.188	38.67	64.10	-25.43	Q-Peak

Table 12 - 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.

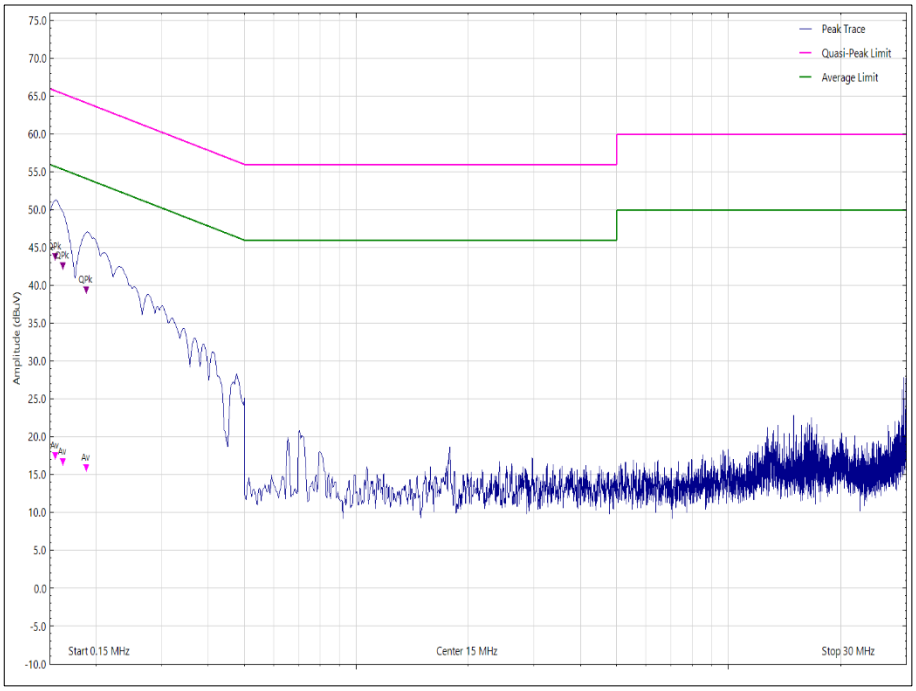

Figure 5 - Neutral Line - 150 kHz to 30 MHz

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

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	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 13

*Decreases with the logarithm of the frequency.

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

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

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.152	43.31	65.90	-22.59	Q-Peak
0.152	17.07	55.90	-38.83	CISPR Avg
0.158	42.50	65.60	-23.10	Q-Peak
0.158	16.29	55.60	-39.31	CISPR Avg
0.164	41.57	65.20	-23.63	Q-Peak
0.164	15.88	55.20	-39.32	CISPR Avg
0.173	40.37	64.80	-24.43	Q-Peak
0.173	15.18	54.80	-39.62	CISPR Avg

Table 14 - 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.

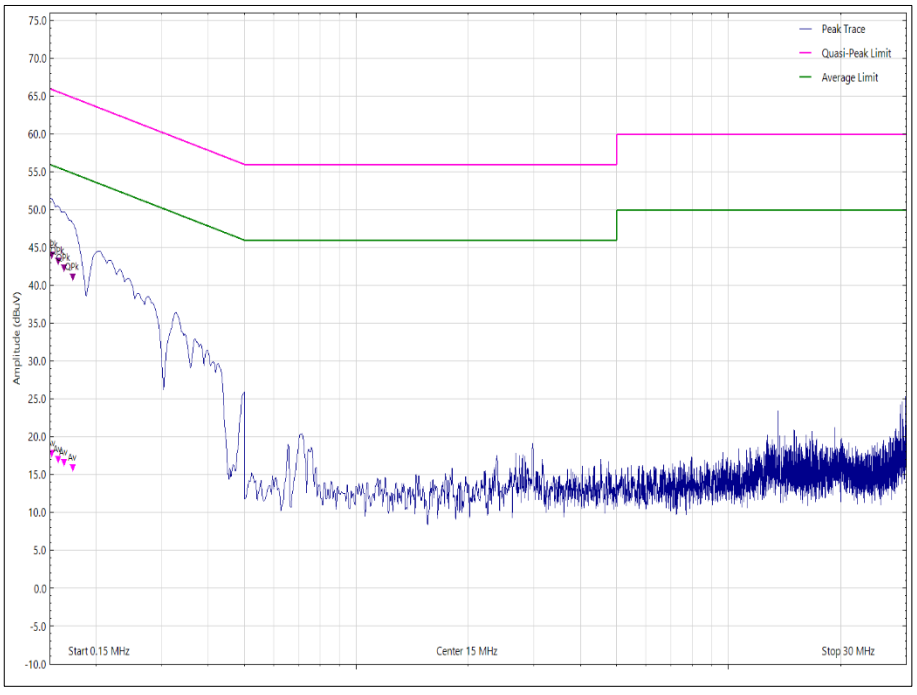

Figure 6 - Live Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.150	43.62	66.00	-22.38	Q-Peak
0.150	17.50	56.00	-38.50	CISPR Avg
0.157	42.71	65.60	-22.89	Q-Peak
0.157	16.50	55.60	-39.10	CISPR Avg
0.173	40.27	64.80	-24.53	Q-Peak
0.173	15.24	54.80	-39.56	CISPR Avg
0.185	38.85	64.30	-25.45	Q-Peak
0.185	14.93	54.30	-39.37	CISPR Avg

Table 15 - 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.

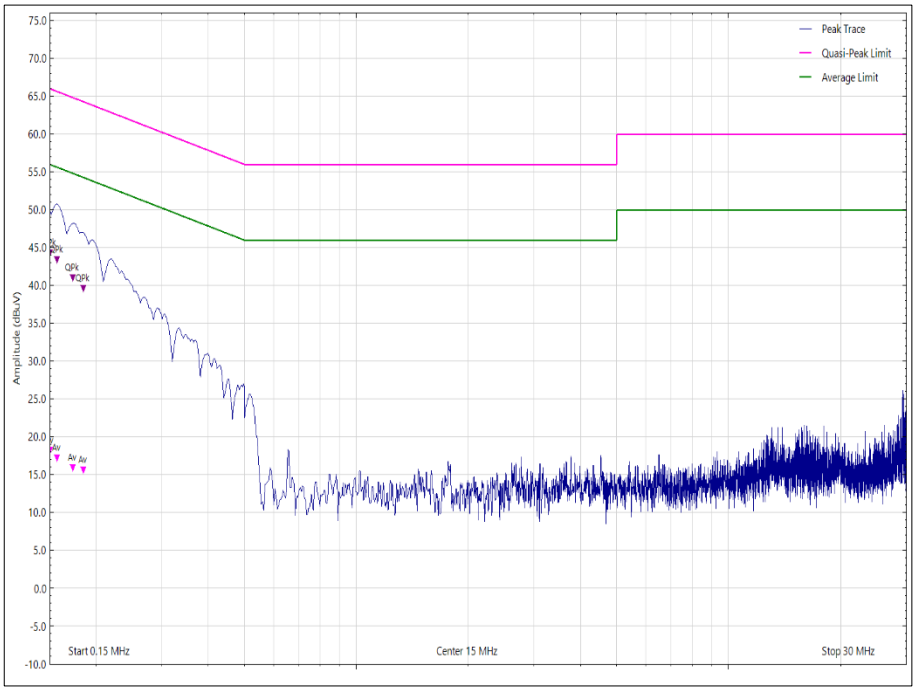

Figure 7 - Neutral Line - 150 kHz to 30 MHz

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

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	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 16

*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.

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 V3.1.10	5125	-	Software
Test Receiver	Rohde & Schwarz	ESW44	5802	12	12-Jul-2023
Transient Limiter	Hewlett Packard	11947A	2378	12	25-Oct-2023
Cable (N-Type to N-Type, 5 m)	Teledyne	PR90-088-5MTR	5206	12	04-Aug-2023
LISN (CISPR 16, Single Phase)	Rohde & Schwarz	ESH3-Z5	1390	12	02-Feb-2024

Table 17

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	5474	12	25-Mar-2023

Table 18

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 19

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.