

FCC and ISED Test Report

Apple Inc
Model: A2681

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

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



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FCC ID: BCGA2681 IC: 579C-A2681

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Document 75954421-13 Issue 01

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NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Jensen Adams	Technical Solutions, Manager	Authorised Signatory	03 May 2022

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	Hollie Marshall	03 May 2022	

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: 2020, 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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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	03 May 2022

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2681
Serial Number(s)	LM461YY61Y
Hardware Version(s)	REV 1.0
Software Version(s)	21F27
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C:2020 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	0540246998
Date of Receipt of EUT	16-February-2022
Start of Test	16-March-2022
Finish of Test	16-March-2022
Name of Engineer(s)	James Cumming
Related Document(s)	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
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz WLAN						
2.1	15.207	3.1	8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2013)
Configuration and Mode: 2.4 GHz Bluetooth						
2.1	15.207	3.1	8.8	AC Power Line Conducted Emissions	Pass	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 (2013)

Table 2



1.4 Product Information

1.4.1 Technical Description

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

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: A2681, Serial Number: LM461YV61Y			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.7 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz WLAN		
AC Power Line Conducted Emissions	James Cumming	UKAS
Configuration and Mode: 2.4 GHz Bluetooth		
AC Power Line Conducted Emissions	James Cumming	UKAS
Configuration and Mode: 5 GHz WLAN		
AC Power Line Conducted Emissions	James Cumming	UKAS

Table 4

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

A2681, S/N: LM461YV61Y - Modification State 0

2.1.3 Date of Test

16-March-2022

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 Environmental Conditions

Ambient Temperature 18.8 °C
Relative Humidity 44.2 %

2.1.6 Specification Limits

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 5

*Decreases with the logarithm of the frequency



2.1.7 Test Results

2.4 GHz WLAN

Applied supply voltage: 120 V AC

Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.167	49.8	65.1	-15.3	Q-Peak
0.167	22.3	55.1	-32.8	CISPR Avg
0.206	48.0	63.4	-15.4	Q-Peak
0.206	26.7	53.4	-26.7	CISPR Avg
0.254	45.8	61.6	-15.8	Q-Peak
0.254	19.0	51.6	-32.6	CISPR Avg
0.305	17.4	50.1	-32.8	CISPR Avg
0.305	44.5	60.1	-15.6	Q-Peak
0.326	44.2	59.6	-15.4	Q-Peak
0.326	17.3	49.6	-32.3	CISPR Avg
0.377	19.0	48.3	-29.3	CISPR Avg
0.377	44.0	58.3	-14.3	Q-Peak
0.442	16.9	47.0	-30.1	CISPR Avg
0.442	43.6	57.0	-13.4	Q-Peak
0.488	15.6	46.2	-30.6	CISPR Avg
0.488	42.1	56.2	-14.1	Q-Peak
0.590	29.2	46.0	-16.8	CISPR Avg
0.590	37.8	56.0	-18.2	Q-Peak

Table 6 - Live Line Emissions Results

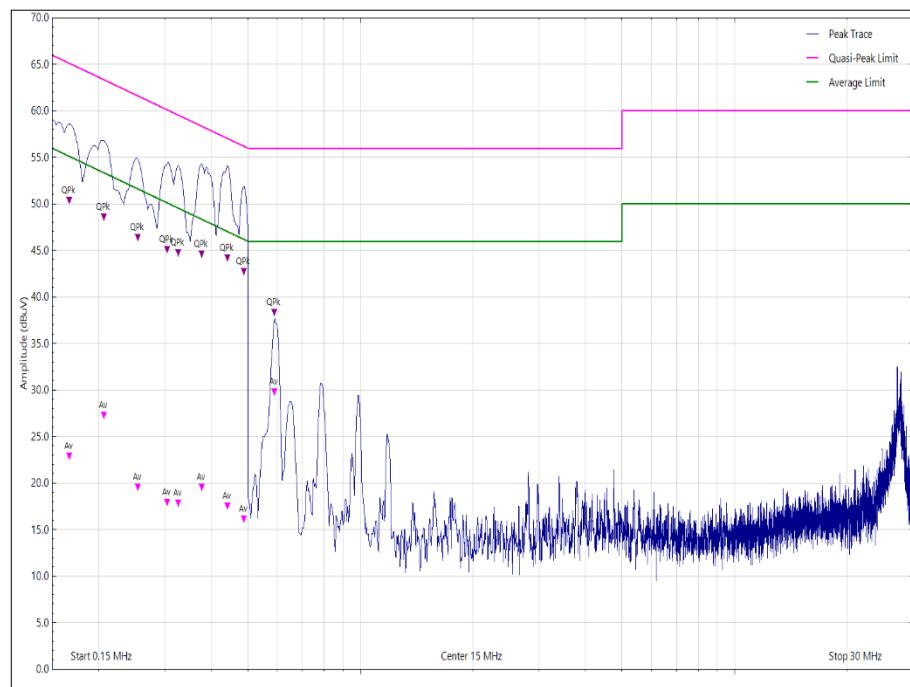


Figure 1 - Live Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.161	49.9	65.4	-15.5	Q-Peak
0.161	22.4	55.4	-33.0	CISPR Avg
0.194	47.9	63.9	-16.0	Q-Peak
0.194	28.6	53.9	-25.3	CISPR Avg
0.215	47.4	63.0	-15.6	Q-Peak
0.215	23.7	53.0	-29.3	CISPR Avg
0.259	19.3	51.5	-32.2	CISPR Avg
0.259	45.7	61.5	-15.8	Q-Peak
0.325	17.6	49.6	-32.0	CISPR Avg
0.325	44.2	59.6	-15.4	Q-Peak
0.362	43.9	58.7	-14.8	Q-Peak
0.362	19.4	48.7	-29.3	CISPR Avg
0.411	44.0	57.6	-13.6	Q-Peak
0.411	21.8	47.6	-25.8	CISPR Avg
0.494	41.7	56.1	-14.4	Q-Peak
0.494	16.7	46.1	-29.4	CISPR Avg
0.579	24.1	46.0	-21.9	CISPR Avg
0.579	37.5	56.0	-18.5	Q-Peak
0.620	34.2	56.0	-21.8	Q-Peak
0.620	18.0	46.0	-28.1	CISPR Avg

Table 7 - Neutral Line Emissions Results

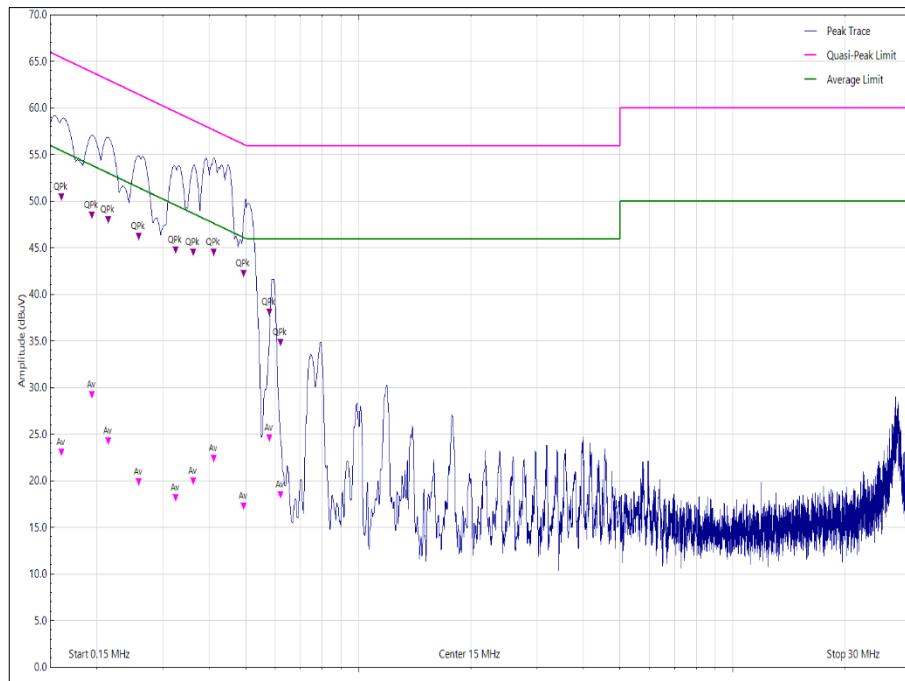


Figure 2 - Neutral Line - 150 kHz to 30 MHz

2.4 GHz Bluetooth

Applied supply voltage: 120 V AC

Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.166	50.8	65.2	-14.4	Q-Peak
0.166	22.8	55.2	-32.5	CISPR Avg
0.224	47.9	62.7	-14.8	Q-Peak
0.224	20.3	52.7	-32.5	CISPR Avg
0.290	18.2	50.5	-32.3	CISPR Avg
0.290	45.7	60.5	-14.8	Q-Peak
0.353	18.3	48.9	-30.6	CISPR Avg
0.353	45.1	58.9	-13.8	Q-Peak
0.388	44.9	58.1	-13.2	Q-Peak
0.388	24.3	48.1	-23.8	CISPR Avg
0.479	43.8	56.4	-12.6	Q-Peak
0.479	17.3	46.4	-29.1	CISPR Avg
0.595	29.8	46.0	-16.2	CISPR Avg
0.595	38.9	56.0	-17.1	Q-Peak

Table 8 - Live Line Emissions Results

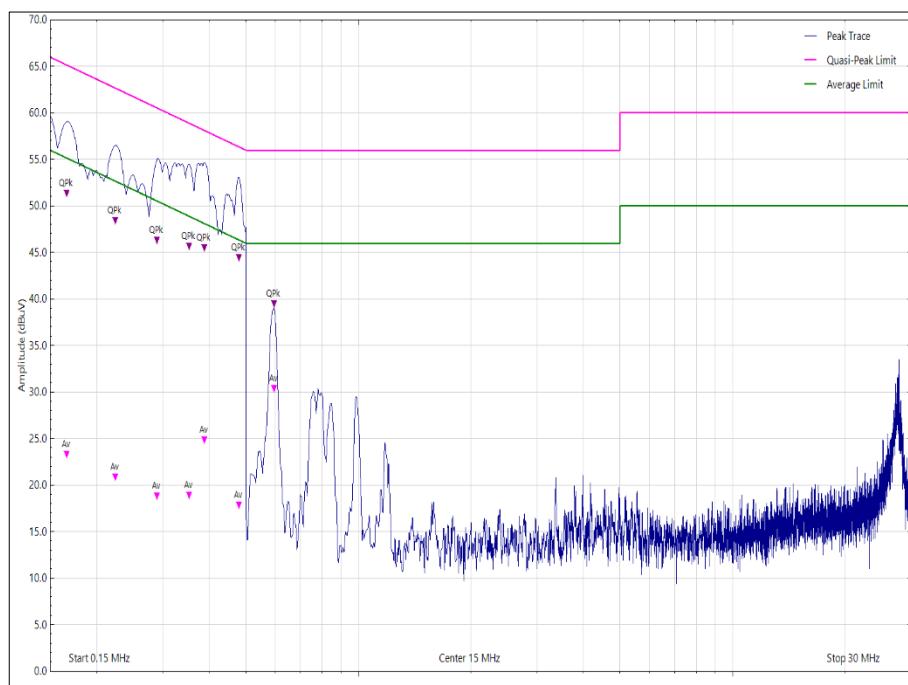


Figure 3 - Live Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.161	23.2	55.4	-32.2	CISPR Avg
0.161	50.9	65.4	-14.5	Q-Peak
0.191	28.3	54.0	-25.7	CISPR Avg
0.191	49.6	64.0	-14.4	Q-Peak
0.217	23.0	52.9	-29.9	CISPR Avg
0.217	48.3	62.9	-14.6	Q-Peak
0.272	46.3	61.1	-14.8	Q-Peak
0.272	18.9	51.1	-32.2	CISPR Avg
0.324	45.3	59.6	-14.3	Q-Peak
0.324	18.1	49.6	-31.5	CISPR Avg
0.351	45.2	58.9	-13.7	Q-Peak
0.351	18.4	48.9	-30.5	CISPR Avg
0.418	18.6	47.5	-28.9	CISPR Avg
0.418	45.2	57.5	-12.3	Q-Peak
0.462	17.6	46.7	-29.1	CISPR Avg
0.462	44.5	56.7	-12.2	Q-Peak
0.536	41.1	56.0	-14.9	Q-Peak
0.536	18.5	46.0	-27.5	CISPR Avg

Table 9 - Neutral Line Emissions Results

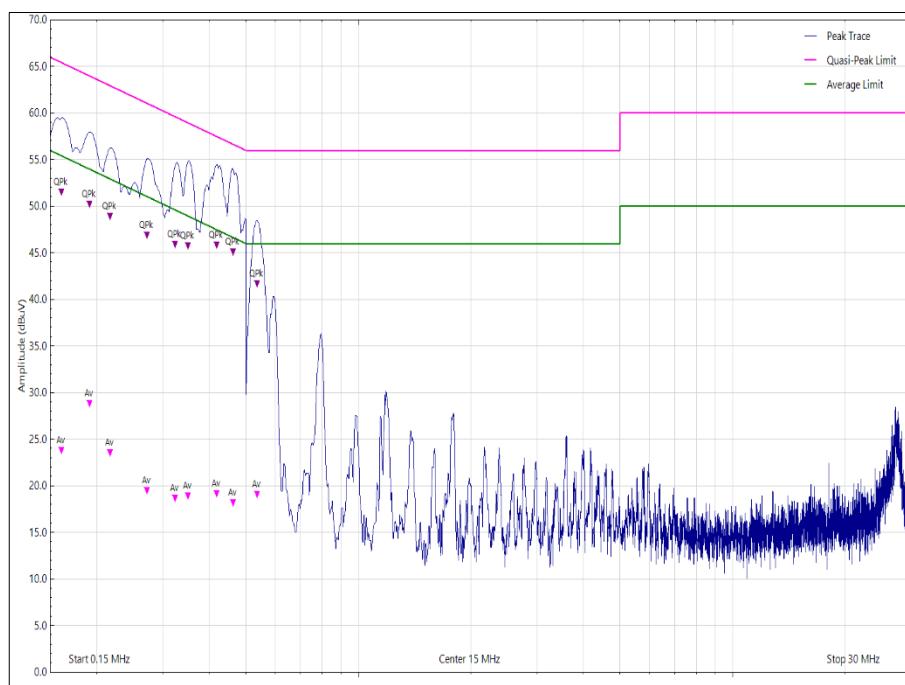


Figure 4 - Neutral Line - 150 kHz to 30 MHz

5 GHz WLAN

Applied supply voltage: 120 V AC

Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.171	50.6	64.9	-14.3	Q-Peak
0.171	22.2	54.9	-32.7	CISPR Avg
0.232	47.7	62.4	-14.7	Q-Peak
0.232	21.0	52.4	-31.4	CISPR Avg
0.325	18.0	49.6	-31.7	CISPR Avg
0.325	45.5	59.6	-14.1	Q-Peak
0.353	45.3	58.9	-13.6	Q-Peak
0.353	18.3	48.9	-30.6	CISPR Avg
0.385	23.2	48.2	-25.0	CISPR Avg
0.385	45.2	58.2	-13.0	Q-Peak
0.462	17.4	46.7	-29.3	CISPR Avg
0.462	44.5	56.7	-12.2	Q-Peak
0.567	39.5	56.0	-16.5	Q-Peak
0.567	19.4	46.0	-26.6	CISPR Avg

Table 10 - Live Line Emissions Results

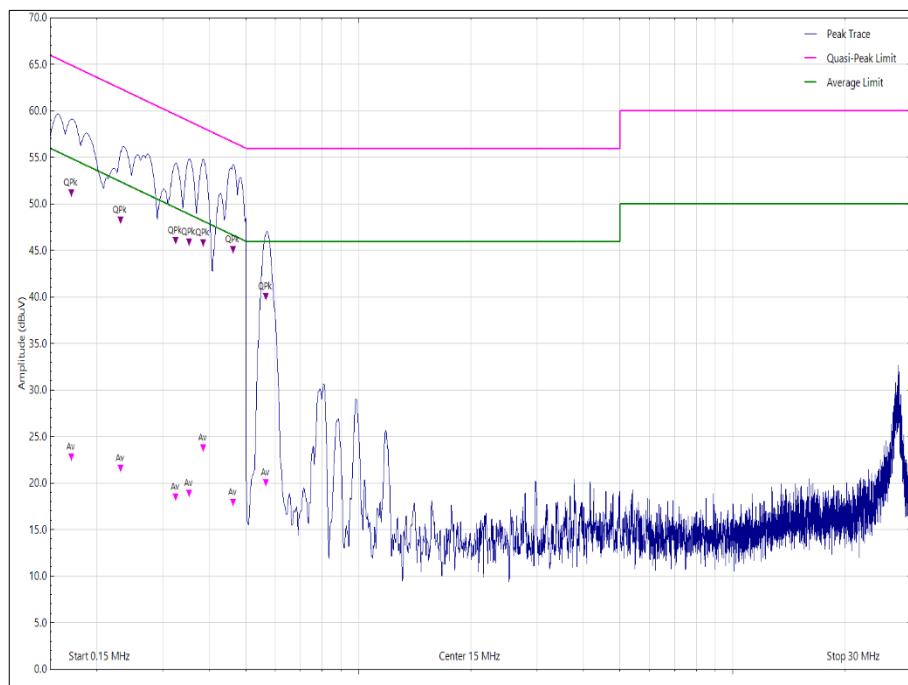


Figure 5 - Live Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.160	23.2	55.5	-32.3	CISPR Avg
0.160	51.4	65.5	-14.1	Q-Peak
0.194	28.8	53.9	-25.1	CISPR Avg
0.194	49.7	63.9	-14.2	Q-Peak
0.285	19.0	50.7	-31.7	CISPR Avg
0.285	46.1	60.7	-14.7	Q-Peak
0.339	18.6	49.2	-30.7	CISPR Avg
0.339	45.3	59.2	-13.9	Q-Peak
0.374	45.2	58.4	-13.2	Q-Peak
0.374	19.2	48.4	-29.2	CISPR Avg
0.415	45.2	57.5	-12.3	Q-Peak
0.415	20.0	47.5	-27.5	CISPR Avg
0.451	44.7	56.9	-12.2	Q-Peak
0.451	17.6	46.9	-29.3	CISPR Avg
0.601	38.8	56.0	-17.2	Q-Peak
0.601	30.1	46.0	-15.9	CISPR Avg

Table 11 - Neutral Line Emissions Results

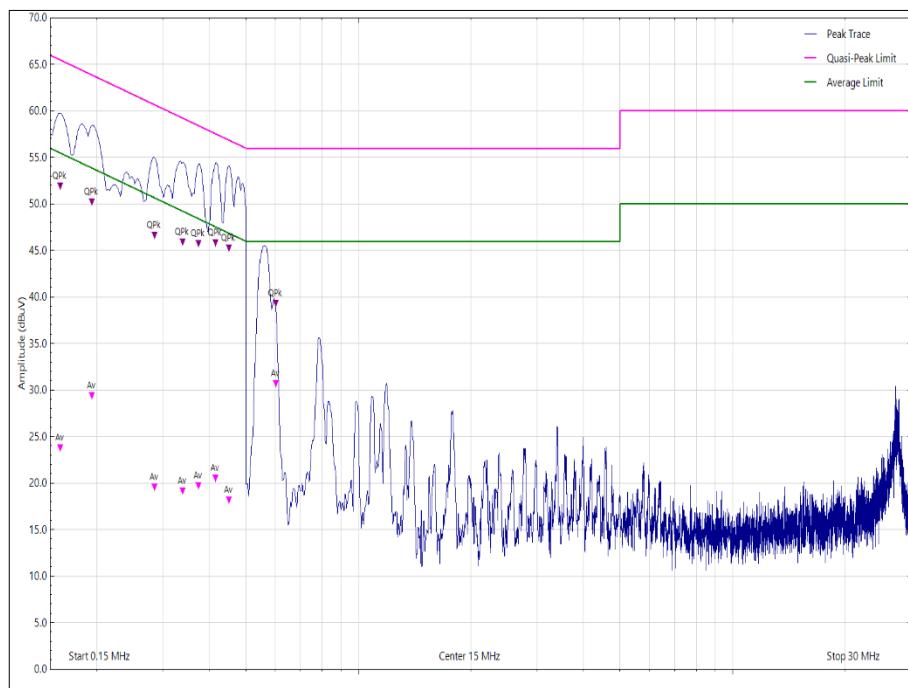


Figure 6 - Neutral Line - 150 kHz to 30 MHz



2.1.8 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	-	14-May-2022
EMI Test Receiver	Rohde & Schwarz	ESW44	5382	12	10-May-2022
Transient Limiter	Hewlett Packard	11947A	2378	12	13-Oct-2022
Cable (N-Type, 10 Hz-18 GHz)	Teledyne	PR90-088-5MTR	5206	12	31-Aug-2022
Termination (50ohm)	Meca	405-1	3517	12	16-Dec-2022
LISN	Rohde & Schwarz	ESH3-Z5	1390	12	31-Jan-2023

Table 12

3 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 13

Measurement Uncertainty Decision Rule – Accuracy Method

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2007, Clause 4.4.3 and 4.5.1. (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.