

Report on the FCC and IC Testing of the: Apple Inc. Model: A2159

In accordance with FCC 47 CFR Part 15C and Industry Canada RSS-GEN

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



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FCC ID: BCGA2159

IC: 579C-A2159

COMMERCIAL-IN-CONFIDENCE

Document 75945152-14 | Issue: 02

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Andy Lawson	Senior EMC Engineer	Authorised Signatory	01 July 2019

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 Industry Canada RSS-210 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Mohammad Malik	Shift Technician	Testing	01 July 2019

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation
IC2932B-1 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, Industry Canada RSS-210 and Industry Canada RSS-GEN: 2016, Issue 09 (08-2016) and Issue 04 (11-2014).



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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	02 May 2019
2	Removed Set-Up Photos	01 July 2019

Table 1

1.2 Introduction

Applicant	Apple Inc.
Manufacturer	Apple Inc.
Model Number(s)	A2159
Serial Number(s)	C02Y3006L59G
Hardware Version(s)	REV 1.0
Software Version(s)	18F65
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN: 2016, Issue 09 (08-2016) and Issue 04 (11-2014)
Order Number	0540175066
Date	21-February-2019
Date of Receipt of EUT	18-February-2019
Start of Test	03-March-2019
Finish of Test	03-March-2019
Name of Engineer(s)	Mohammad Malik
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, Industry Canada RSS-210 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 15C	RSS-GEN			
Configuration and Mode: 2.4GHz WLAN - 802.11n (MIMO)					
2.1	15.207	8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10: 2013
Configuration and Mode: 5GHz WLAN - 802.11n (MIMO)					
2.1	15.207	8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10: 2013
Configuration and Mode: Bluetooth (ePA) - BR (DH5)					
2.1	15.207	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 (EUT) was a Laptop computer with Bluetooth, Bluetooth Low Energy and 802.11 a/b/g/n/ac capabilities in the 2.4 GHz and 5.0 GHz bands.

1.4.2 EUT Configuration and Rationale for Conducted Spurious Emissions

The EUT was powered and charging from 120V, 60Hz via its USB type C power adaptor.

The device's internal battery was discharged prior to testing.

The display setting on the device was set to maximum brightness, and the device was configured to ensure that the display remained active throughout testing.

A set of wired Ear Pods were connected to the EUT

Tests were performed with the device transmitting at maximum power in each of the operating bands supported by the device. Bluetooth Basic Rate (DH5), 2.4GHz WLAN (802.11n MIMO) and 5GHz WLAN (802.11n MIMO)

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
Serial Number: C02Y3006L59G			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3



1.7 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4GHz WLAN - 802.11n (MIMO)		
AC Power Line Conducted Emissions	Mohammad Malik	UKAS
Configuration and Mode: 5GHz WLAN - 802.11n 20 MHz (MIMO)		
AC Power Line Conducted Emissions	Mohammad Malik	UKAS
Configuration and Mode: Bluetooth (ePA) - BR (DH5)		
AC Power Line Conducted Emissions	Mohammad Malik	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
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
Industry Canada RSS-GEN, Clause 8.8

2.1.2 Equipment Under Test and Modification State

A2159, S/N: C02Y4006L59F - Modification State 0

2.1.3 Date of Test

03-March-2019

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.

The AMN was placed 0.8m from the boundary of the EUT and bonded to the reference ground plane.

2.1.5 Environmental Conditions

Ambient Temperature	19.3 °C
Relative Humidity	53.3 %



2.1.6 Test Results

2.4GHz WLAN - 802.11n (MIMO)

Applied supply voltage: 120 Vac

Applied supply frequency: 60 Hz

Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	CISPR AV Level (dBμV)	CISPR AV Limit (dBμV)	CISPR AV Margin (dB)
0.183	46.3	64.4	18.1	24.0	54.4	30.3
0.207	43.3	63.3	20.1	24.0	53.3	29.3
0.231	40.7	62.4	21.7	16.8	52.4	35.6
0.350	31.8	59.0	27.1	16.3	49.0	32.7
0.389	29.7	58.1	28.4	14.7	48.1	33.4
17.338	30.6	60.0	29.4	24.6	50.0	25.4

Table 5 - Live Line Emissions Results

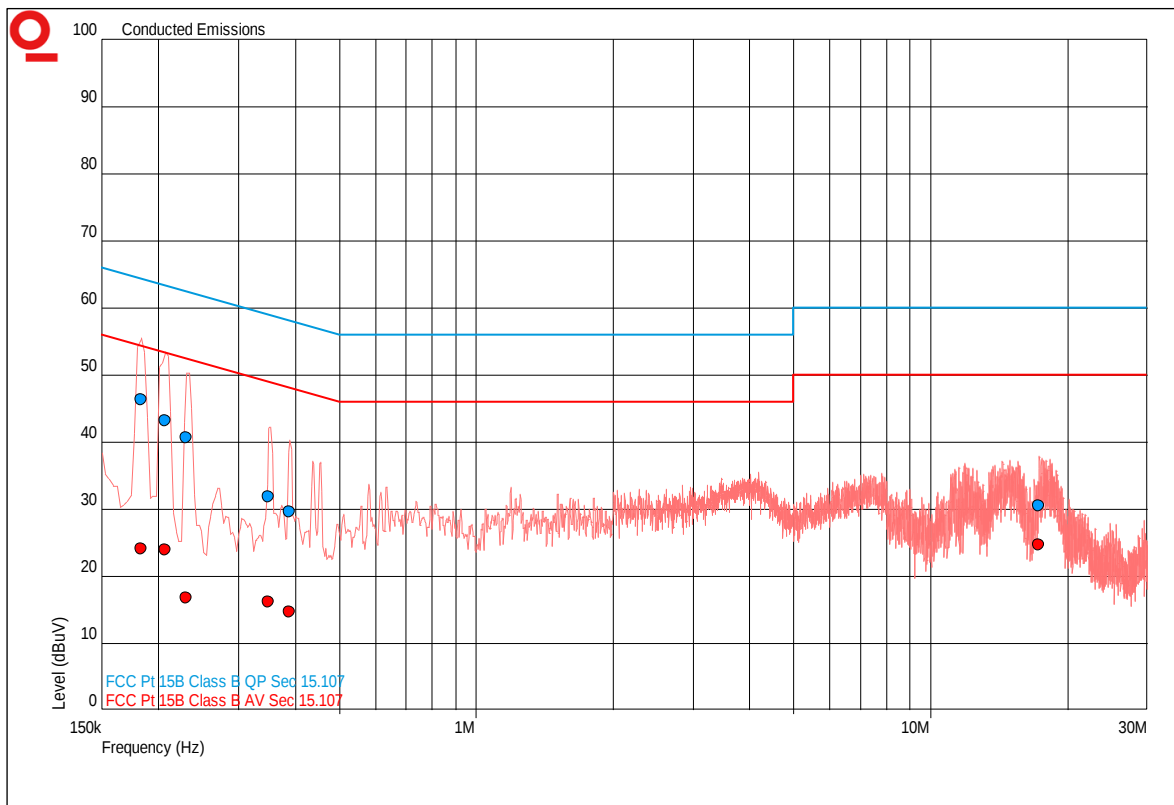


Figure 1 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	CISPR AV Level (dBμV)	CISPR AV Limit (dBμV)	CISPR AV Margin (dB)
0.201	43.9	63.6	19.7	24.2	53.6	29.3
0.243	39.6	62.0	22.4	19.7	52.0	32.3
0.299	35.0	60.3	25.2	16.5	50.3	33.8
0.365	30.9	58.6	27.7	15.8	48.6	32.9
11.827	31.3	60.0	28.7	22.8	50.0	27.2
14.779	32.2	60.0	27.8	23.6	50.0	26.4

Table 6 - Neutral Line Emissions Results

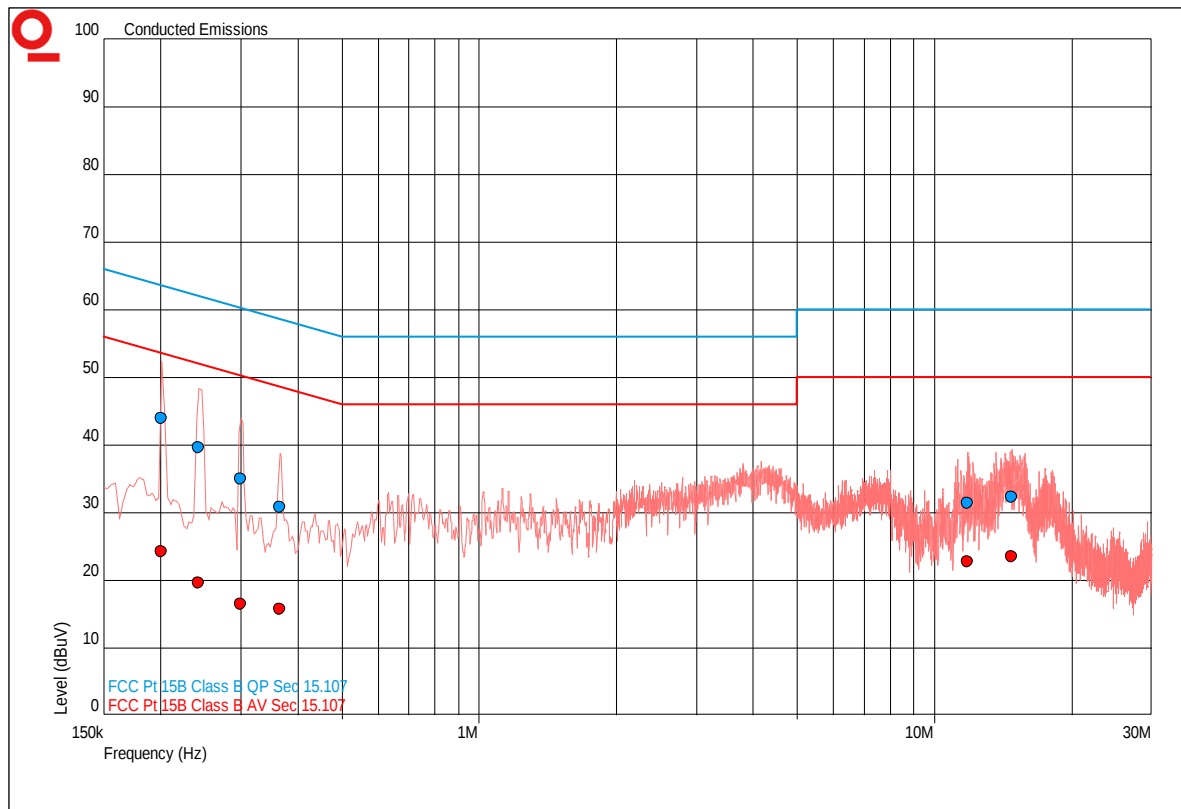


Figure 2 - Neutral Line - 150 kHz to 30 MHz



FCC 47 CFR Part 15, Limit Clause 15.207 and Industry Canada 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 7

*Decreases with the logarithm of the frequency.



5GHz WLAN - 802.11n 20 MHz (MIMO)

Applied supply voltage: 120 Vac

Applied supply frequency: 60 Hz

Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	CISPR AV Level (dBμV)	CISPR AV Limit (dBμV)	CISPR AV Margin (dB)
0.152	50.5	65.9	15.4	27.2	55.9	28.7
0.177	46.8	64.6	17.8	25.1	54.6	29.6
0.189	45.1	64.1	19.0	21.3	54.1	32.8
0.207	42.9	63.3	20.4	23.9	53.3	29.4
0.293	35.3	60.4	25.1	16.3	50.4	34.1
0.308	34.3	60.0	25.7	18.4	50.0	31.7

Table 8 - Live Line Emissions Results

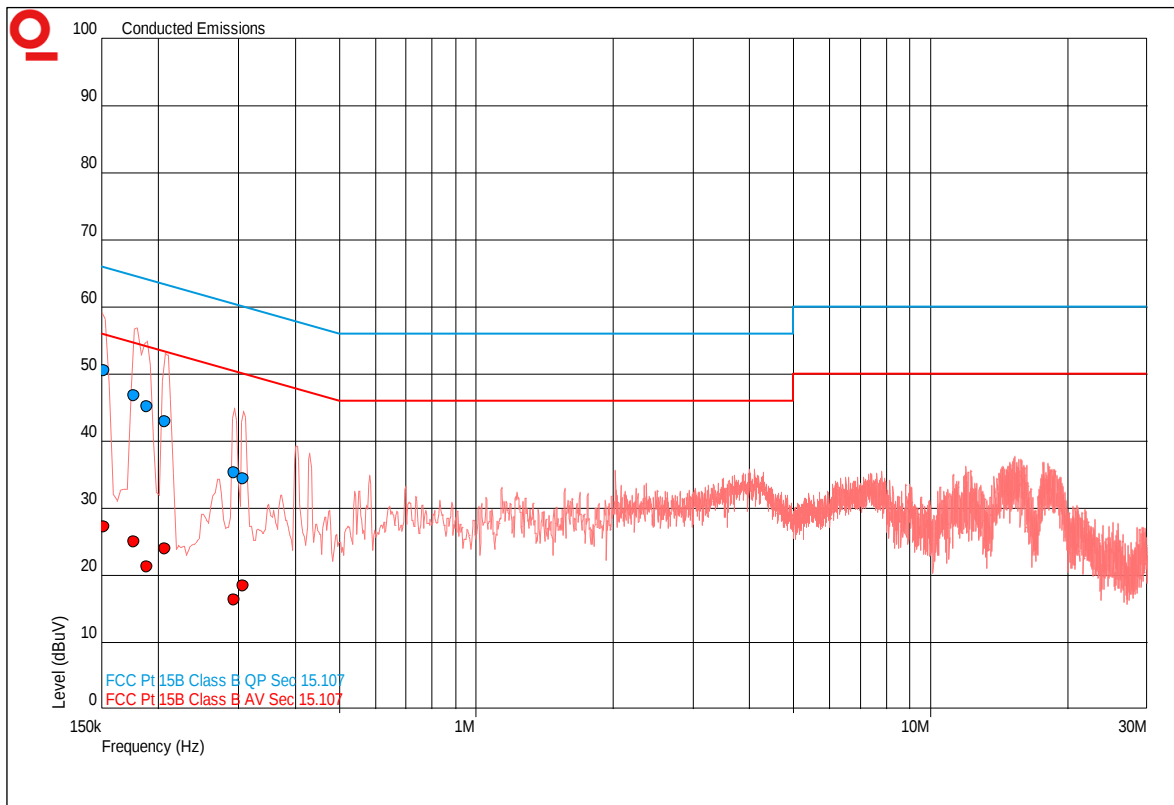


Figure 3 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	CISPR AV Level (dBμV)	CISPR AV Limit (dBμV)	CISPR AV Margin (dB)
0.165	48.3	65.2	17.0	25.5	55.2	29.7
0.260	38.0	61.4	23.4	19.0	51.4	32.4
0.278	36.4	60.9	24.5	18.4	50.9	32.5
0.374	30.4	58.4	28.1	15.9	48.4	32.5
0.410	28.5	57.7	29.2	14.2	47.7	33.5
14.794	29.2	60.0	30.8	22.9	50.0	27.1

Table 9 - Neutral Line Emissions Results

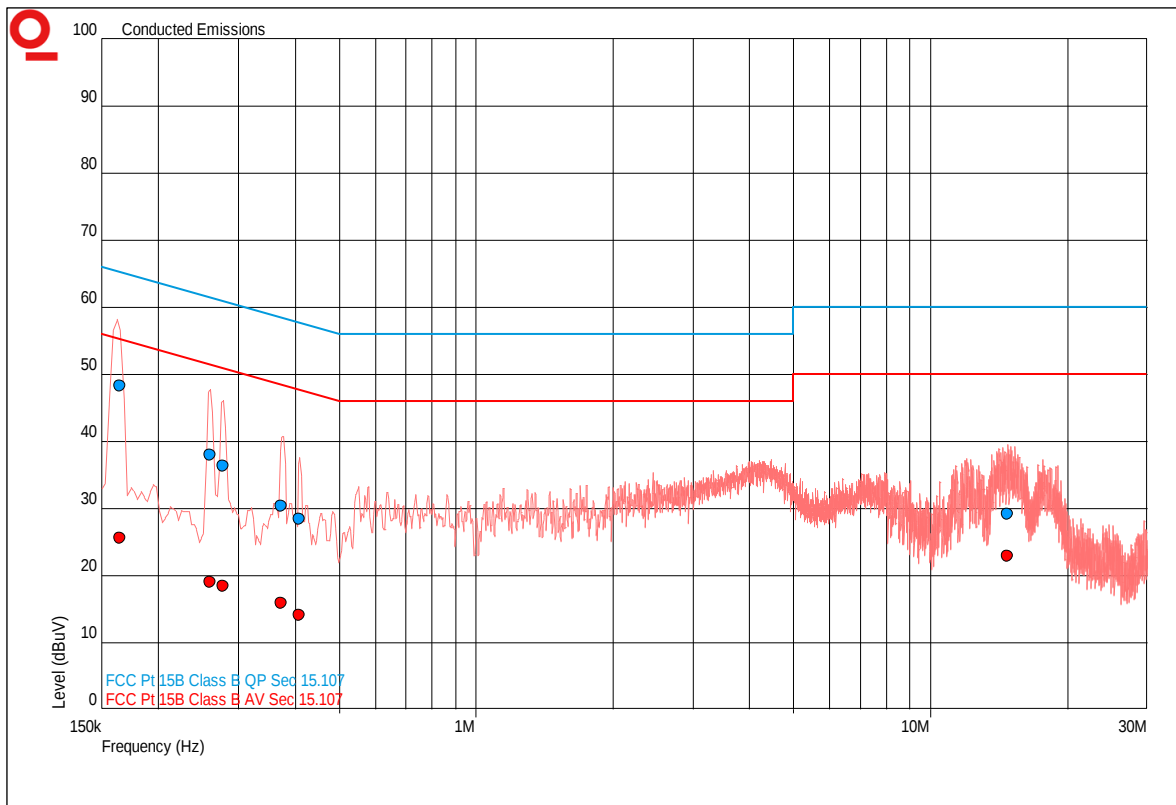


Figure 4 - Neutral Line - 150 kHz to 30 MHz



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

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	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.



Bluetooth (ePA) - BR (DH5)

Applied supply voltage: 120 Vac

Applied supply frequency: 60 Hz

Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	CISPR AV Level (dBμV)	CISPR AV Limit (dBμV)	CISPR AV Margin (dB)
0.153	49.8	65.8	16.0	27.3	55.8	28.5
0.180	46.0	64.5	18.4	24.5	54.5	29.9
0.222	41.2	62.8	21.6	21.4	52.8	31.3
0.290	35.3	60.5	25.2	16.8	50.5	33.7
0.404	28.5	57.8	29.3	14.4	47.8	33.3
11.991	30.9	60.0	29.1	22.5	50.0	27.5

Table 11 - Live Line Emissions Results

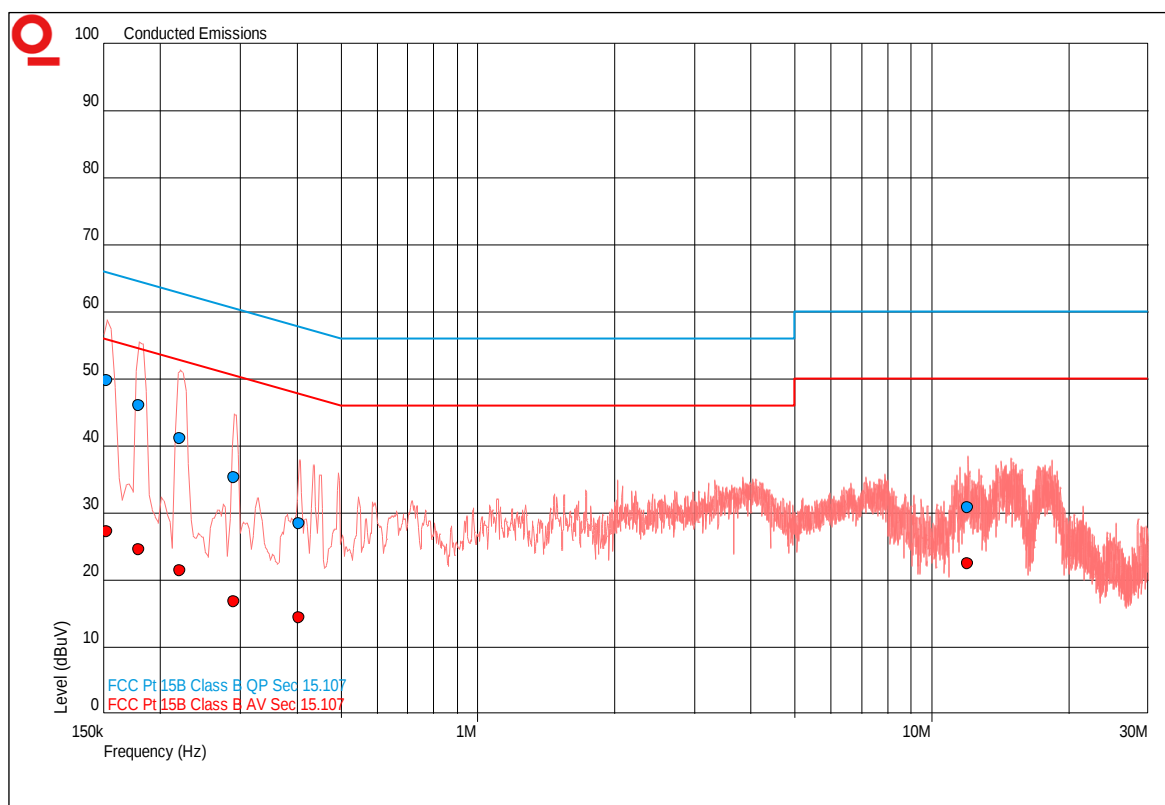


Figure 5 - Live Line - 150 kHz to 30 MHz



Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	CISPR AV Level (dBμV)	CISPR AV Limit (dBμV)	CISPR AV Margin (dB)
0.156	48.8	65.7	16.8	28.3	55.7	27.4
0.186	44.6	64.2	19.6	22.8	54.2	31.4
0.198	43.2	63.7	20.5	23.1	53.7	30.6
0.308	33.5	60.0	26.5	18.6	50.0	31.4
0.356	30.3	58.8	28.6	15.2	48.8	33.6
11.633	31.8	60.0	28.2	21.0	50.0	29.0

Table 12 - Neutral Line Emissions Results

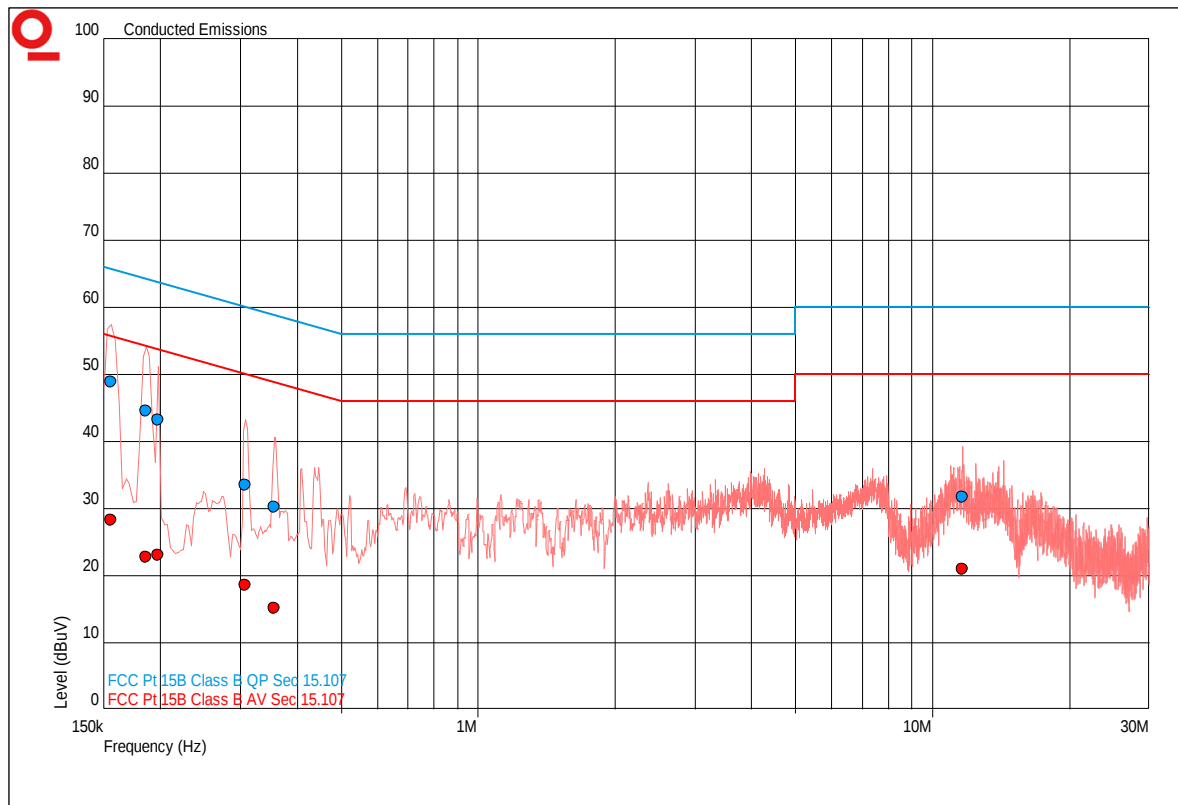


Figure 6 - Neutral Line - 150 kHz to 30 MHz



FCC 47 CFR Part 15, Limit Clause 15.207 and Industry Canada 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.



2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Compliance 5 Emissions	Teseq	V5.26.51	3275	-	Software
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Transient Limiter	Hewlett Packard	11947A	15	12	26-Jul-2019
LISN	Rohde & Schwarz	ESH3-Z5	1390	12	20-Nov-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019

Table 14



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 15

Worst case error for both Time and Frequency measurement 12 parts in 106.
All measurement uncertainties have been calculated in accordance with CISPR guidelines.