

Partial Report on the Radio Testing of the: Apple Inc. Model: A1993

In accordance with FCC 47 CFR Part 15, Industry
Canada RSS 247 & Industry Canada RSS-GEN,
(Simultaneous Transmissions)

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

FCC ID: BCGA1993

IC: 579C-A1993



Product Service

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SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Matthew Russell	RF Team Leader	Authorised Signatory	08 October 2018

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service 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 15, Industry Canada RSS 247 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
Graeme Lawler	Test Engineer	Testing	08 October 2018

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: 2017 and Industry Canada RSS-247: Issue 2 (2017-02) and Industry Canada RSS-GEN: Issue 05 (2017-02) for the tests detailed in section 1.3.



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

TÜV SÜD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuv-sud.co.uk

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



Contents

1 Report Summary2

1.1 Report Modification Record.....2

1.2 Introduction.....2

1.3 Brief Summary of Results3

1.4 Product Information4

1.5 Deviations from the Standard.....4

1.6 EUT Modification Record4

1.7 Test Location.....4

2 Test Details5

2.1 Radiated Spurious Emissions (Simultaneous Transmission)5

3 Measurement Uncertainty16



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	26 September 2018
2	Second Issue - FCCID and ICID updated	08 October 2018

Table 1

1.2 Introduction

Applicant	Apple Inc.
Manufacturer	Apple Inc.
Model Number(s)	A1993
Serial Number(s)	C07WT00HK2V0
Hardware Version(s)	EVT
Software Version(s)	18B2034
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15: (2017) Industry Canada RSS-247: Issue 2 (2017-02) Industry Canada RSS-GEN: Issue 05 (2017-02)
Order Number	0540058293
Date	18-May-2018
Date of Receipt of EUT	20-June-2018
Start of Test	20-August-2018
Finish of Test	20-August-2018
Name of Engineer(s)	Graeme Lawler
Related Document(s)	ANSI C63.10 (2013)



Product Service

1.3 Brief Summary of Results

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

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC Part 15	RSS-247	RSS-GEN			
Configuration and Mode: CoTX - 2.4 GHz WLAN Main, 5 GHz WLAN Aux & Bluetooth BDR						
2.1	15.247 (d), 15.407 (b)	5.5, 6.2	8.9, 8.10	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	ANSI C63.10
Configuration and Mode: CoTX – 5 GHz WLAN Main, 2.4 GHz WLAN Aux & Bluetooth BDR						
2.1	15.247 (d) and 15.407 (b)	5.5 and 6.2	8.9 and 8.10	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	ANSI C63.10

Table 2



1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) was a desktop computer, with Bluetooth, Bluetooth Low Energy and 802.11 b/g/n/ac capabilities in the 2.4GHz and 5GHz 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
Serial Number: C07WT00HK2V0			
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: CoTX - 2.4 GHz WLAN Main, 5 GHz WLAN Aux & Bluetooth BDR		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS
Configuration and Mode: CoTX – 5 GHz WLAN Main, 2.4 GHz WLAN Aux & Bluetooth BDR		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom



2 Test Details

2.1 Radiated Spurious Emissions (Simultaneous Transmission)

2.1.1 Specification Reference

FCC 47 CFR Parts 15, Clause 15.247 (d) and 15.407 (b)
Industry Canada RSS 247, Clause 5.5 and 6.2
Industry Canada RSS GEN, Clause 8.9 and 8.10

2.1.2 Equipment Under Test and Modification State

A1993, S/N: C07WT00HK2V0 - Modification State 0

2.1.3 Date of Test

20-August-2018

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clauses 6.3, 6.5 and 6.6.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.2.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to the relevant limits outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

For frequencies > 18 GHz, the measurement distance was reduced to 1 meter and the limit line was increased by $20 \cdot \log(3/1) = 9.54$ dB.

2.1.5 Environmental Conditions

Ambient Temperature 20.4 - 20.8 °C
Relative Humidity 60.8 - 61.0 %

2.1.6 Test Results

CoTX - 2.4 GHz WLAN Main, 5 GHz WLAN Aux & Bluetooth BDR

The EUT was configured for simultaneous transmission in the following mode of operation:

Technology	Frequency Band (MHz)	Channel Frequency (MHz)
Main: 802.11b	2400 MHz to 2483.5 MHz	2441
Aux: 802.11n - 20 MHz Bandwidth	U-NII 2c	5500
Bluetooth (BDR)	2400 MHz to 2483.5 MHz	2402

Table 5 - Modes of Operation



Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
*						

Table 6 - 30 MHz to 1 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

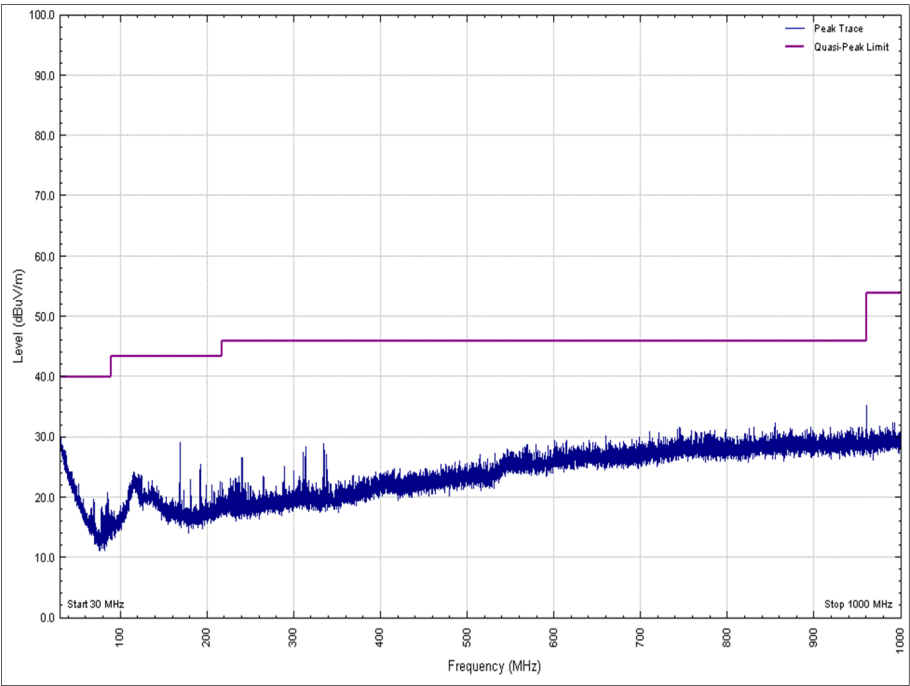


Figure 1 - 30 MHz to 1 GHz - Horizontal

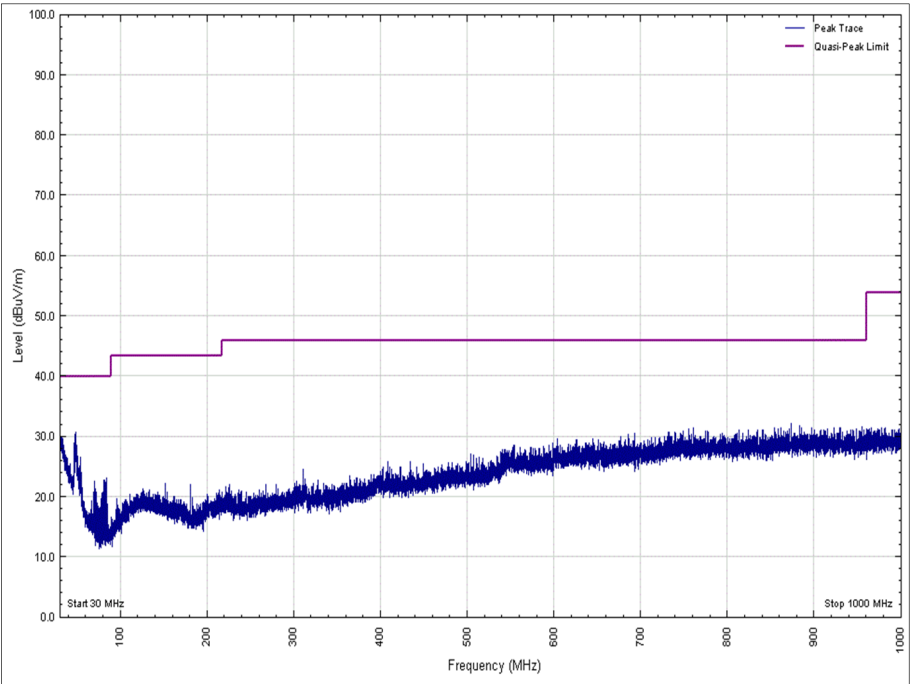


Figure 2 - 30 MHz to 1 GHz - Vertical



Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 7 - 1 GHz to 40 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

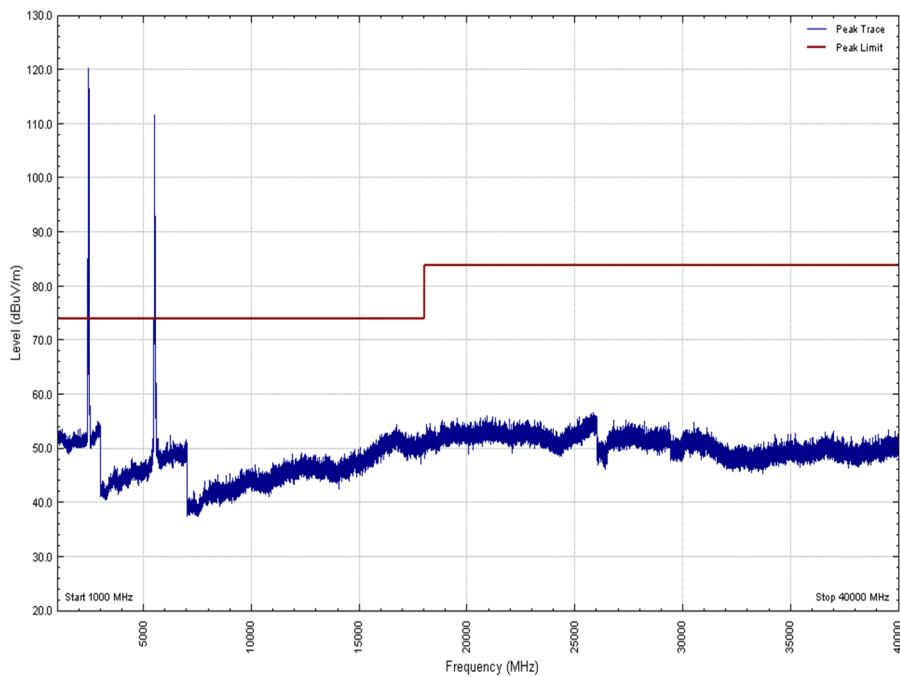


Figure 3 - 1 GHz to 40 GHz – Horizontal (Peak)

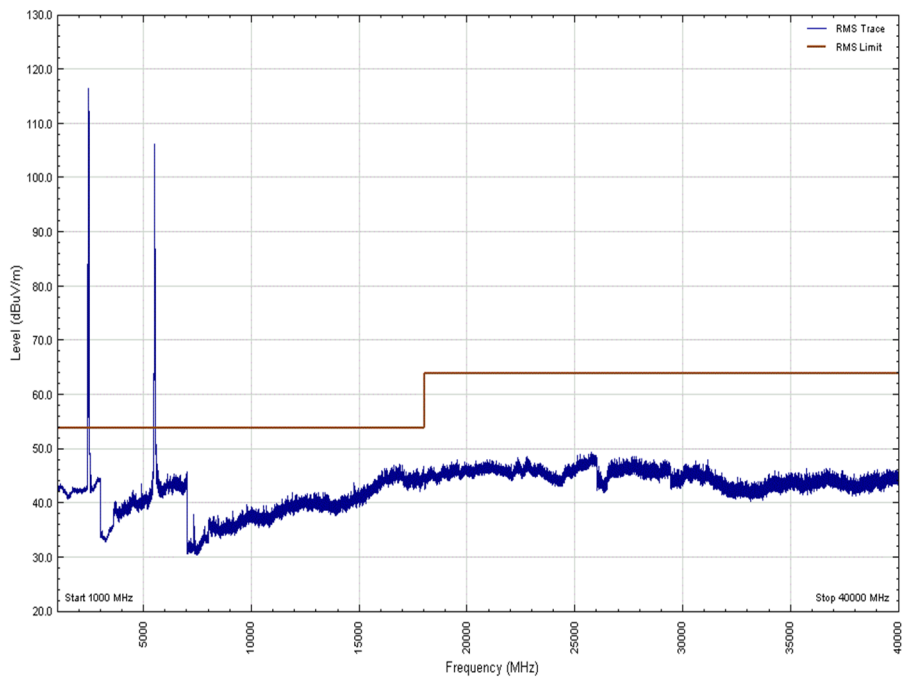


Figure 4 - 1 GHz to 40 GHz – Horizontal (Average)

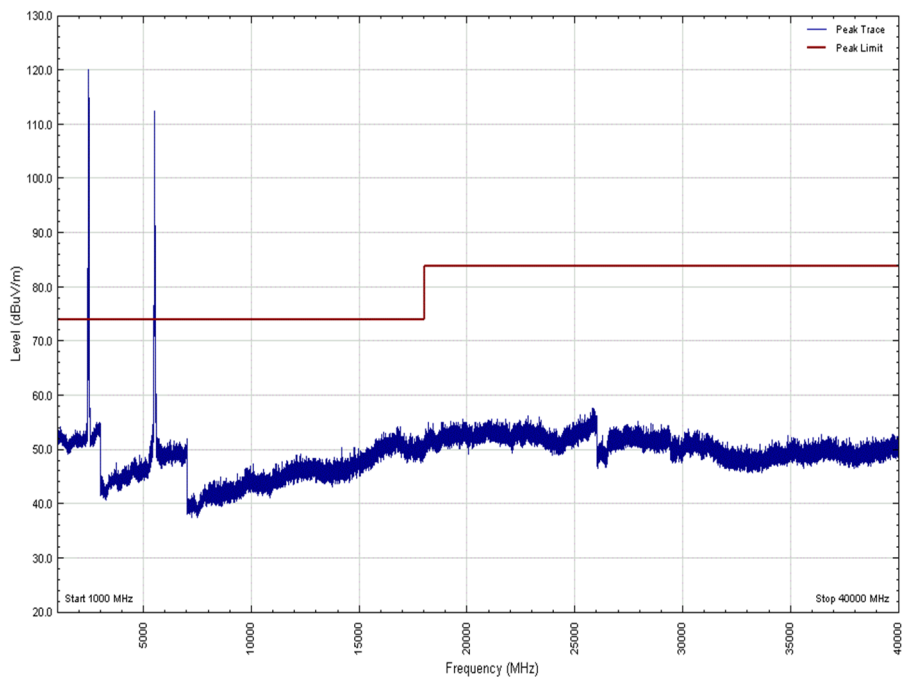


Figure 5 - 1 GHz to 40 GHz – Vertical (Peak)

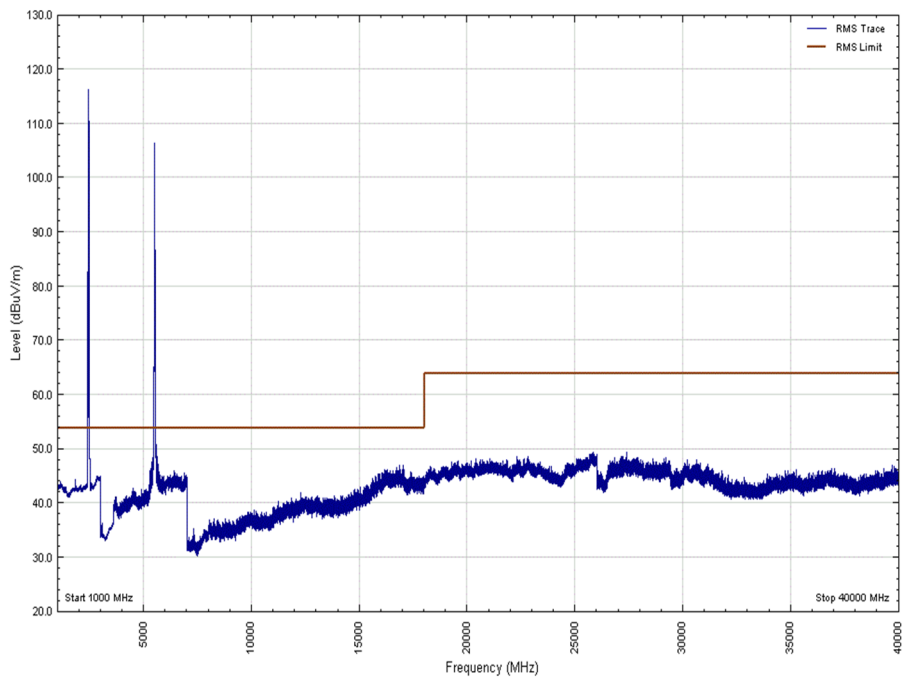


Figure 6 - 1 GHz to 40 GHz – Vertical (Average)

FCC 47 CFR Parts Limit Clause15.247(d), 15.407(b), 15.205, Industry Canada RSS 247 Limit Clause 5.5, 6.2 and Industry Canada RSS-GEN Limit Clause 8.10

The least stringent limit from the applicable rule parts was used to determine compliance for Radiated Emissions testing of multiple transmission sources.

Rule Part	Limit
Part 15.247 (d) / RSS 247, clause 5.5	-20 dBc
Part 15.407 (b) / RSS 247, clause 6.2.3.2	-27 dBm (EIRP) / 68 dBμV/m at 3m.
Part 15.205 / RSS GEN clause 8.10	Peak: 74 dBμV/m at 3m, Average 54 dBμV/m at 3m

Table 8 - Limit Table

CoTX – 5 GHz WLAN Main, 2.4 GHz WLAN Aux & Bluetooth BDR

The EUT was configured for simultaneous transmission in the following mode of operation:

Technology	Frequency Band (MHz)	Channel Frequency (MHz)
Main: 802.11n - 20 MHz Bandwidth	U-NII 2c	5500
Aux: 802.11b	2400 MHz to 2483.5 MHz	2441
Bluetooth	2400 MHz to 2483.5 MHz	2480

Table 9 - Modes of Operation

Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
*						

Table 10 - 30 MHz to 1 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

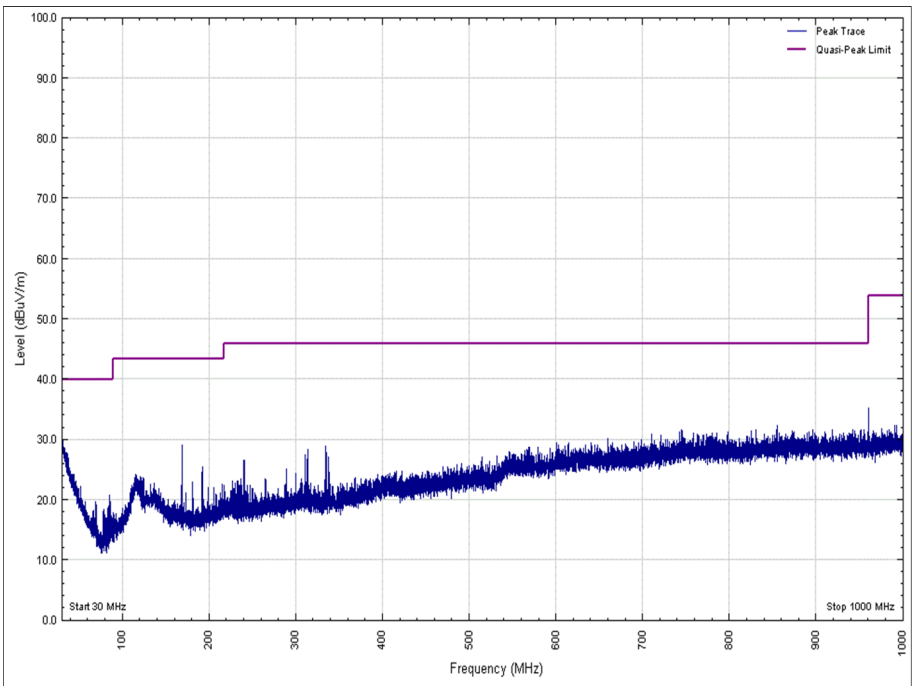


Figure 7 - 30 MHz to 1 GHz - Horizontal

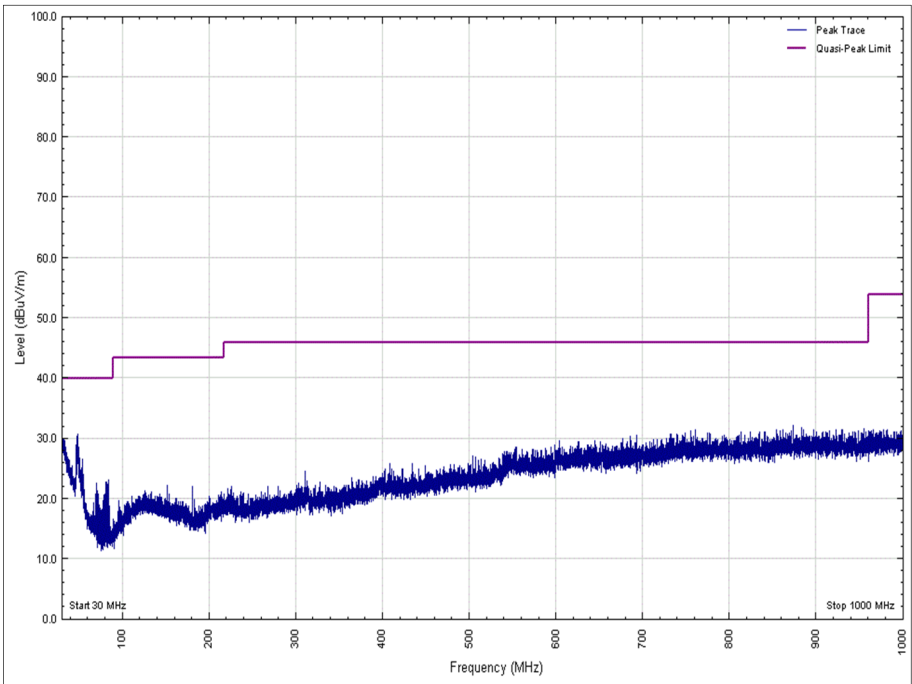


Figure 8 - 30 MHz to 1 GHz - Vertical



Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 11 - 1 GHz to 40 GHz Emissions Results

*No emissions were detected within 10 dB of the limit.

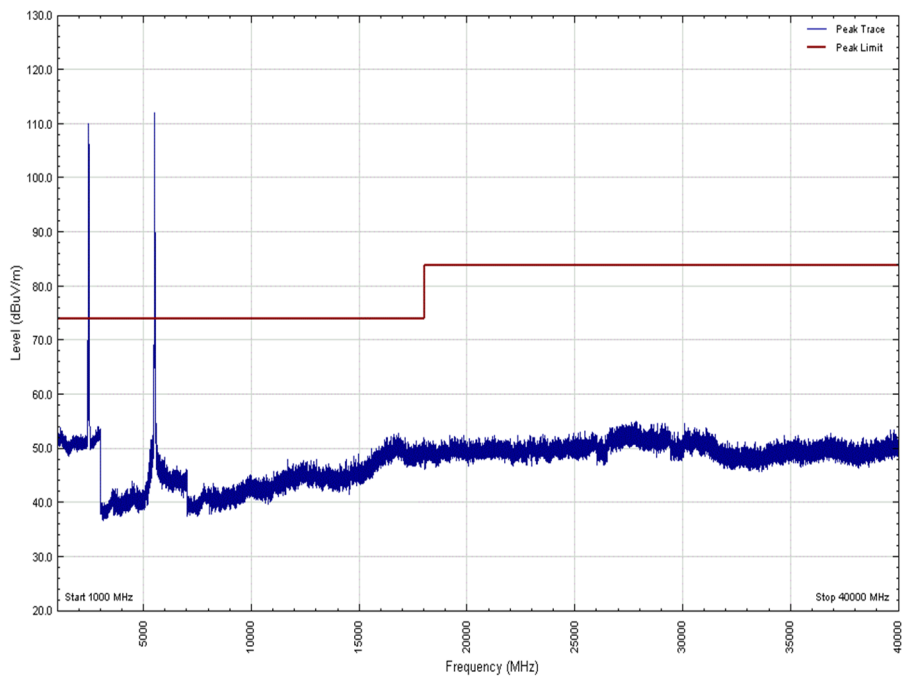


Figure 9 - 1 GHz to 40 GHz – Horizontal (Peak)

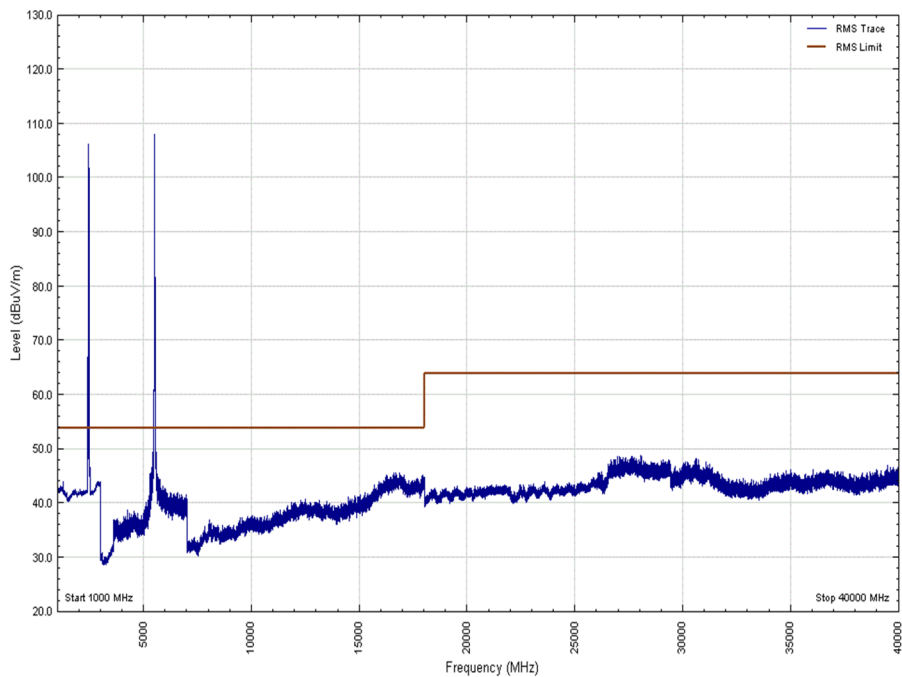


Figure 10 - 1 GHz to 40 GHz – Horizontal (Average)

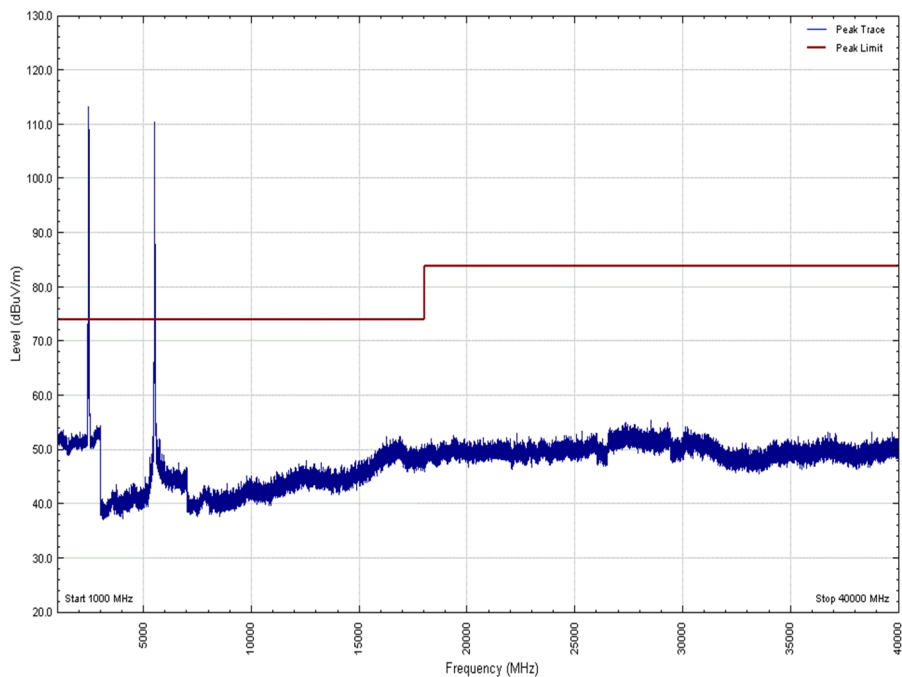


Figure 11 - 1 GHz to 40 GHz – Vertical (Peak)

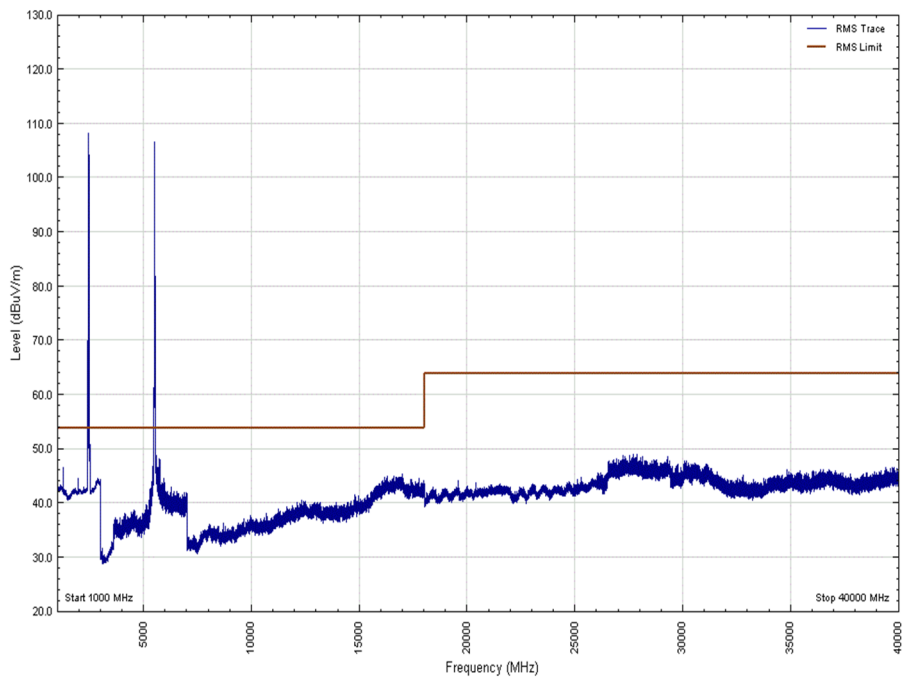


Figure 12 - 1 GHz to 40 GHz – Vertical (Average)

FCC 47 CFR Parts Limit Clause15.247(d), 15.407(b), 15.205, Industry Canada RSS 247 Limit Clause 5.5, 6.2 and Industry Canada RSS-GEN Limit Clause 8.10

The least stringent limit from the applicable rule parts was used to determine compliance for Radiated Emissions testing of multiple transmission sources.

Rule Part	Limit
Part 15.247 (d) / RSS 247, clause 5.5	-20 dBc
Part 15.407 (b) / RSS 247, clause 6.2.3.2	-27 dBm (EIRP) / 68 dBµV/m at 3m.
Part 15.205 / RSS GEN clause 8.10	Peak: 74 dBµV/m at 3m, Average 54 dBµV/m at 3m

Table 12 - Limit Table



2.1.7 Test Location and Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
10dB/1W SMA Attenuator dc -18GHz	Sealectro	60-674-1010-89	3	12	31-Aug-2018
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	2-May-2020
Antenna (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Filter (High Pass)	Lorch	SHP7-7000-SR	566	12	10-May-2019
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-2019
18GHz - 40GHz Pre-Amplifier	Phase One	PS04-0087	1534	12	2-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	8-Aug-2019
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	-	O/P Mon
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	19-Sep-2018
1501A 4.0M Km Km Cable	Rhophase	KPS-1501A-4000-KPS	4301	12	19-Feb-2019
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	18-Oct-2018
Cable (Rx, Nm-Nm, 7m)	Scott Cables	SLU18-NMNM-07.00M	4498	-	O/P Mon
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	31-Aug-2018
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	1-Mar-2019
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
9m N type RF cable	Rosenberger	2303-0 9.0m PNm PNm	4827	6	4-Jan-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
4dB Attenuator	Pasternack	PE7047-4	4935	12	28-Nov-2018
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
Cable (26.5GHz)	Rosenberger	LU7-133-5000	5019	-	O/P Mon
Cable (40GHz)	Rosenberger	LU1-001-2000	5020	-	O/P Mon

Table 13

TU - Traceability Unscheduled

O/P Mon - Output Monitored using calibrated equipment.



3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 14