

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

PREPARED FOR KEYCAFE
BY QAI LABORATORIES



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American Association for Laboratory Accreditation Certificate Number: 3657.02

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Applicable Test Standards:

47 CFR Part 15, Subpart C – 15.209, 15.225

RSS-210 Issue 9 – Annex A2.6

RSS-Gen Issue 4

EN 300 330 V2.1.1, EN 62479:2010

Equipment Tested:

SmartBox

Model Number:

KCESAF01

FCC ID:

2AELP-RFID01

IC Certification Number:

24333- RFID01

Manufacturer:

Keycafe Inc.

REVISION HISTORY

Date	Report Number	Rev #	Details	Author's Initials
October 05, 2018	E10741-1802_Keycafe- KCESAF01	1.2	P.8 – Aux. Equipt added, P.29-Transmitter 2 was XPYSARAU201/8595A-SARAU201	RS
September 28, 2018	E10741-1802_Keycafe- KCESAF01	1.1	P.5 Part 8 added. P.29 Separation dist. of 20cm added.	RS
September 24, 2018	E10741-1802_Keycafe- KCESAF01	1.0	Final Test Report	RS
September 19, 2018	E10741-1802_Keycafe- KCESAF01	0.0	Draft Test Report	RA

All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.

REPORT AUTHORIZATION

The data documented in this report is for the test equipment provided by Keycafe Inc.. Tests were conducted on the sample equipment as requested by Keycafe Inc. for the purpose of demonstrating compliance with 47 CFR Part 15: Subpart C – 15.209, 15.225, RSS-210 Issue 9 – Annex A2.6, and RSS-Gen Issue 4 as agreed upon by Keycafe Inc. as per Quote 18SH05142.

Keycafe Inc. is responsible for the tested product configuration, continued product compliance, and for the appropriate auditing of subsequent products as required. This report may comprise partial list of tests that are required for FCC or IC. Declaration of Conformity and can only be produced by the manufacturer.

This is to certify that the following report is true and correct to the best of our knowledge.






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QAI FACILITIES

Founded in 1994 by a group of experienced certification and testing experts, QAI is an independent third-party testing, inspection and certification organization which serves the building industry, government and individuals with cost effective solutions through our in-house capabilities / services, and an established world-wide network of qualified affiliates. To help get your product to market, trust the provider that many leading global manufacturers do: QAI.

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QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
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Headquarters & EMC Laboratory in Burnaby, BC

TABLE OF CONTENTS

REVISION HISTORY	2
REPORT AUTHORIZATION	2
QAI FACILITIES.....	3
QAI EMC ACCREDITATION.....	3
Section I: EXECUTIVE SUMMARY	5
1.1 Purpose	5
1.2 Scope.....	5
1.3 Summary of Results	5
Section II: GENERAL INFORMATION.....	6
2.1 Product Description	6
2.2 Environmental Conditions.....	6
2.3 Measurement Uncertainty.....	6
2.4 Worst Test Case	7
2.5 Sample Calculations of Emissions Data.....	7
2.6 Test Equipment List.....	8
Section III: REQUIREMENTS FOR THE US MARKET (FCC) & THE CANADIAN MARKET (IC) & EUROPEAN MARKET(CE) -	
Exigences pour le Marché Canadien	9
3.1 Radiated Emissions – Intentional.....	9
3.2 AC Power Line Conducted Emissions	10
3.3 Radiated Spurious Emissions-Transmit Mode	19
3.4 Radiated Emissions – Unintentional	22
3.5 99% Occupied Bandwidth.....	24
3.6 20dB Occupied Bandwidth.....	26
3.7 Frequency Stability	28
3.8 RF Exposure Evaluation.....	29
Appendix A: TEST SETUP PICTURES.....	30
Appendix B: ABBREVIATIONS.....	32

Section I: EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of “SmartBox” as per Sections 1.2 & 1.3.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 18SH05142:

- **47 CFR Part 15** – Radio Frequency Devices, Subpart C – Intentional Radiator
 - o 15.209: Radiated emission limits; general requirements
 - o 15.225: Operation within the band 13.110-14.010 MHz
- **RSS-210 Issue 9** – License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
 - o Annex B.6: Band 13.110-14010 MHz
- **RSS-Gen Issue 4** – General Requirements and Information for the Certification of Radio Apparatus

1.3 Summary of Results

The following tests demonstrate the testimony to “FCC and ISED” Mark Electromagnetic compatibility testing for “SmartBox” manufactured by Keycafe Inc..

	Test	Standard	Description	Result
Part 1	Radiated Emissions – Intentional	FCC Part 15.225, RSS 210 Issue 8 A2.6	84 dB μ V/m at 30 m within the band 13.553-13.567 MHz	Complies
Part 2	AC Power Line Conducted Emissions	47 CFR Part 15, Subpart B Section 15.107 RSS-Gen Issue 4	Class B Limite	Complies
Part 3	Radiated Spurious Emissions	FCC Part 15.225, FCC Part 15.205, RSS 210 Issue 8 A2.6 & RSS-Gen Issue 4	Radiated Emissions test was performed from 9 kHz-6GHz	Complies
Part 4	Radiated Emissions – Unintentional	FCC CFR47, Part 15, Subpart B, ICES-003 Issue 5	Radiated Emissions test was performed from 30MHz-6GHz	Complies
Part 5	99% Occupied Bandwidth	RSS-Gen Issue 4	The Occupied Bandwidth should be within the band 13.553-13.567 MHz	Complies
Part 6	20 dB Occupied Bandwidth	FCC Part 15.215, FCC Part 15.225	The Occupied Bandwidth should be within the band 13.553-13.567 MHz	Complies
Part 7	Frequency Stability	FCC Part 15.225, RSS 210 Issue 8 A2.6	$\pm 0.01\%$ (± 100 ppm)	Complies
Part 8	RF Exposure Evaluation	FCC KDB 447498 D01: v06	MPR ratio = 0.616 <1	Complies

Section II: GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as complete system.

Equipment Under Test (EUT) Information

EUT	SmartBox
Description	Modular Intentional Radiator, Short Range Device, operating at 13.56 MHz Powered by a 12Vdc AC/DC DCPCS for EMC testing
FRN	0024531949
FCC ID	2AELP-RFID01
IC Certification Number	24333- RFID01
Manufacturer	Keycafe Inc.
Model No.	KCESAF01
Serial No.	20000

Auxiliary Equipment Information

Equipment	Manufacturer	Product Description	Model No.
Auxiliary 1	XP Power	AC/DC Adapter	VER36US120-JA

2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	22-28°C
Relative Humidity	39.7 - 54.4%

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1,5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1°C
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohdes & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Quasi-Peak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turtable position (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Quasi Peak reading shown in the table above is already corrected by the software using correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

$$\text{Corr.(dB)} = \text{Antenna factor} + \text{Cable loss}$$

Or

$$\text{Corr.(dB)} = \text{Antenna factor} + \text{Cable Loss} - \text{Amp gain (if pre-amplifier was used)}$$

The final Quasi peak reading shown in the data is calculated by the software using following equation:

$$\text{Corrected Quasi Peak(dB μ V/m)} = \text{Raw Quasi Peak Reading} + \text{Antenna factor} + \text{Cable loss}$$

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150	44.3	1000.000	9.000	0.6	21.7	66.0

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150	27.2	1000.000	9.000	0.6	28.8	56.0

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

$$\text{Corr.(dB)} = \text{Antenna factor} + \text{Cable loss}$$

The final Quasi peak or Average reading shown in the data is calculated by the software using following equation:

$$\text{Corr. Quasi Peak/Average Reading (dB μ V)} = \text{Raw Quasi Peak/Average Reading} + \text{Antenna factor} + \text{Cable loss}$$

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

$$\text{Margin(dB)} = \text{Limit} - \text{Quasi-Peak or Average reading}$$

2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.3.

Emissions Test Equipment

Manufacturer	Model	Description	Serial No.	Calibration Due Date
Sunol Sciences	SM46C	Turntable	051204-2	N/A
Sunol Sciences	TWR95	Mast	TREML0001	N/A
Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A120106	2020-Sep-24
EMCO	6502	Loop Antenna, 10kHz-30MHz	2178	8/21/2019
Sunol Sciences	DRH-118	Horn Antenna 1GHz-18GHz	A050905	2019-Mar-10
ETS Lindgren	2165	Turntable	00043677	N/A
ETS Lindgren	2125	Mast	00077487	N/A
Rohde & Schwarz	ESU40	EMI Receiver	100011	2018-Nov-20
Fischer	FCC-LISN-50-25-2-08	LISN (150kHz-30MHz)	2041	2018-Nov-19
ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A
AH Systems	PAM118	Amplifier 10KHz-18GHz	189	Conditional Use
Weinschel Engineering	44	6db attenuator	665	N/A
Insulated Wire Inc.	SPS-1753-1140-SPS	Yellow cable, 3m	102395	N/A
Insulated Wire Inc.	SPS-1753-2400-SPS	Yellow cable, 6m	091096	N/A

Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	6.20.0	Emissions Pre-scan Test Software

Section III: REQUIREMENTS FOR THE US MARKET (FCC) & THE CANADIAN MARKET (IC) & EUROPEAN MARKET(CE) - Exigences pour le Marché Canadien

3.1 Radiated Emissions – Intentional

Date Performed:

August 1, 2018

Test Standard:

FCC Part 15.225, RSS 210 Issue 8 A2.6

Requirement:

The field strength of any emission shall not exceed the following limits:
15.848 millivolts/m (84 dB μ V/m) at 30 m, within the band 13.553-13.567 MHz

Measurement Data and Plot:

Table 1: Data of Radiated Emissions for Fundamental Frequency

Freq.	Raw PK @ 3m	Ant. Factor	Atten.	Corr. PK @ 3m	Angle	Ant. Orientation	Ant. Ht.	Limit @ 30m	Limit @ 3m	Margin
							MHz	dBuV	dB/m	dB
13.560	37.8	10.8	1.25	49.85	122	Parallel	150	84	104	54.15
13.560	39.5	10.8	1.25	51.55	156	Perpendicular	150	84	104	52.45
13.560	41.6	10.8	1.25	53.65	156	Parallel to GND	150	84	104	50.35

Performance: Complies with Standard

3.2 AC Power Line Conducted Emissions

Date Performed:

June 25, 2018

Test Standard:

- 47 CFR Part 15, Subpart B Section 15.107
- RSS-Gen Issue 4

Test Method:

- ANSI C63.10 2013

Minimum Requirement:

47 CFR Part 15, Subpart B (Section § 15.107) – The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table:

Frequency (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15 – 0.50	79	66
0.50 – 30.0	73	60

Note 1: The lower limit shall apply at the transition frequencies.

Method of Measurement:

The Line Impedance Stabilizing Network (LISN) was used to make conducted emissions measurements. The equipment was operated and tested at 120Vac/60Hz while in “Continuous Mode” of operation. Measurements were made by using an EMI test receiver with 9 kHz bandwidth, CISPR Quasi-Peak and Average detector capabilities. Test receiver requirements, including the bandwidths used, for the test receiver are those specified in CISPR 16-1-1.

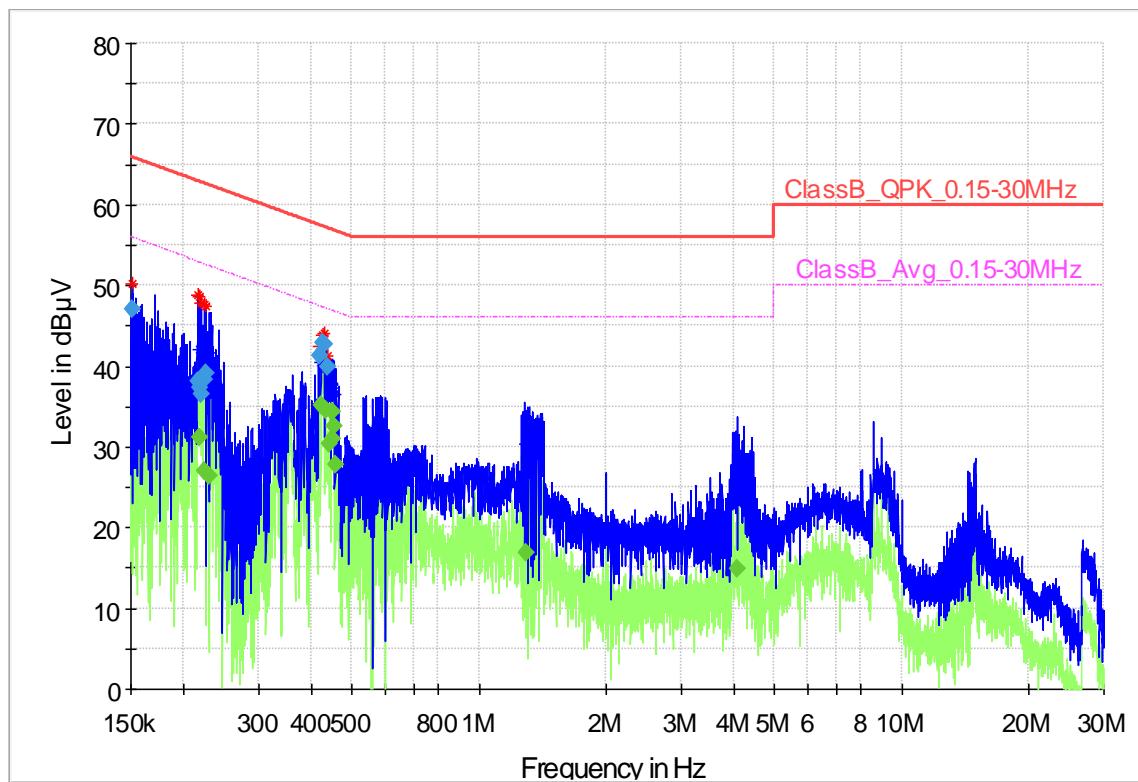
Modifications:

No modification was required to comply for this test.

Performance:

Complies with the applicable standard.

Measurement Data and Plot:



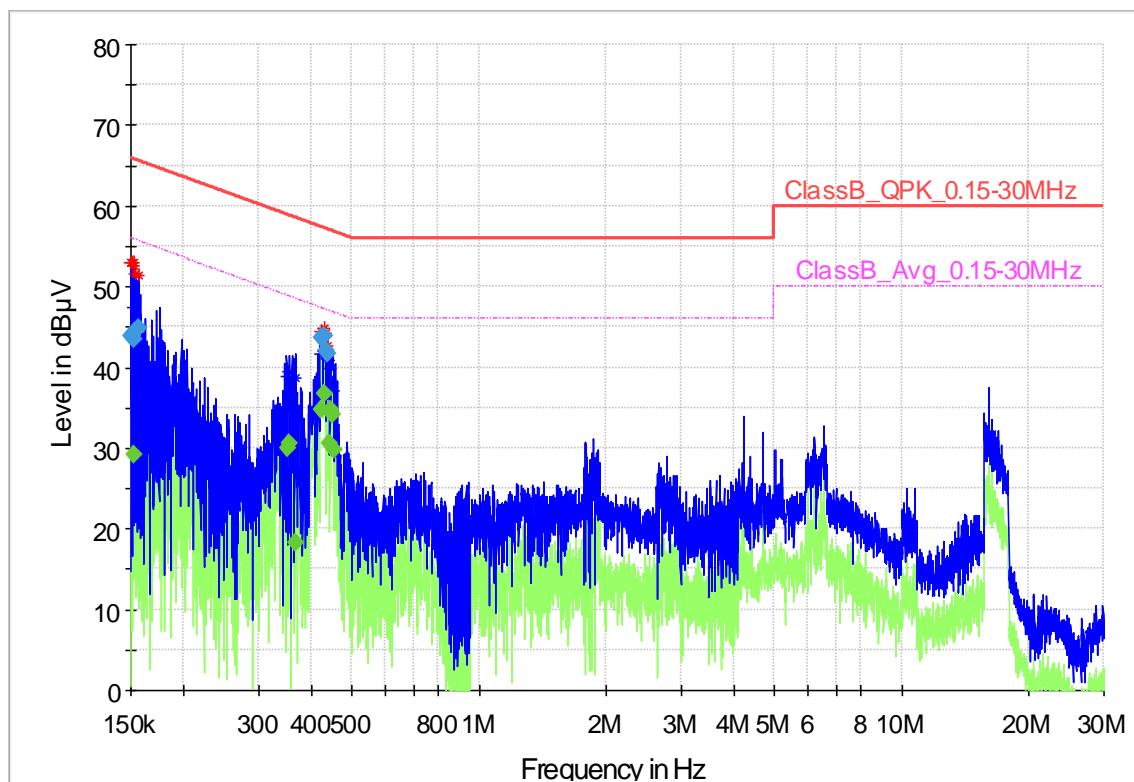
Plot 1: Main Power Line Conducted Emissions 150 kHz to 30 MHz at 120Vac/60Hz – Line 1

Table 2: Quasi-peak data Main Power Line Conducted Emissions at 120Vac/60Hz – Line 1

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.151810	47.05	1000.000	9.000	GND	10.9	18.86	65.90
0.216038	38.17	1000.000	9.000	GND	10.8	24.80	62.97
0.217555	37.23	1000.000	9.000	GND	10.8	25.68	62.91
0.220620	36.62	1000.000	9.000	GND	10.8	26.18	62.80
0.223729	38.34	1000.000	9.000	GND	10.8	24.34	62.68
0.226655	39.02	1000.000	9.000	GND	10.8	23.55	62.57
0.419524	41.26	1000.000	9.000	GND	10.7	16.20	57.46
0.426287	42.93	1000.000	9.000	GND	10.7	14.39	57.33
0.432294	42.72	1000.000	9.000	GND	10.7	14.49	57.21
0.439702	39.98	1000.000	9.000	GND	10.7	17.09	57.07

Table 3: Average data Main Power Line Conducted Emissions at 120Vac/60Hz – Line 1

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.217555	31.26	1000.000	9.000	GND	10.8	21.65	52.91
0.224625	26.95	1000.000	9.000	GND	10.8	25.70	52.65
0.229849	26.50	1000.000	9.000	GND	10.7	25.96	52.46
0.423738	35.23	1000.000	9.000	GND	10.7	12.14	47.38
0.433159	34.56	1000.000	9.000	GND	10.7	12.63	47.19
0.442789	30.36	1000.000	9.000	GND	10.7	16.64	47.01
0.448132	34.37	1000.000	9.000	GND	10.7	12.54	46.91
0.451278	30.99	1000.000	9.000	GND	10.7	15.87	46.85
0.453086	32.53	1000.000	9.000	GND	10.7	14.28	46.82
0.457638	27.84	1000.000	9.000	GND	10.7	18.90	46.74
1.290209	16.81	1000.000	9.000	GND	10.7	29.19	46.00
4.091000	14.87	1000.000	9.000	GND	10.8	31.13	46.00



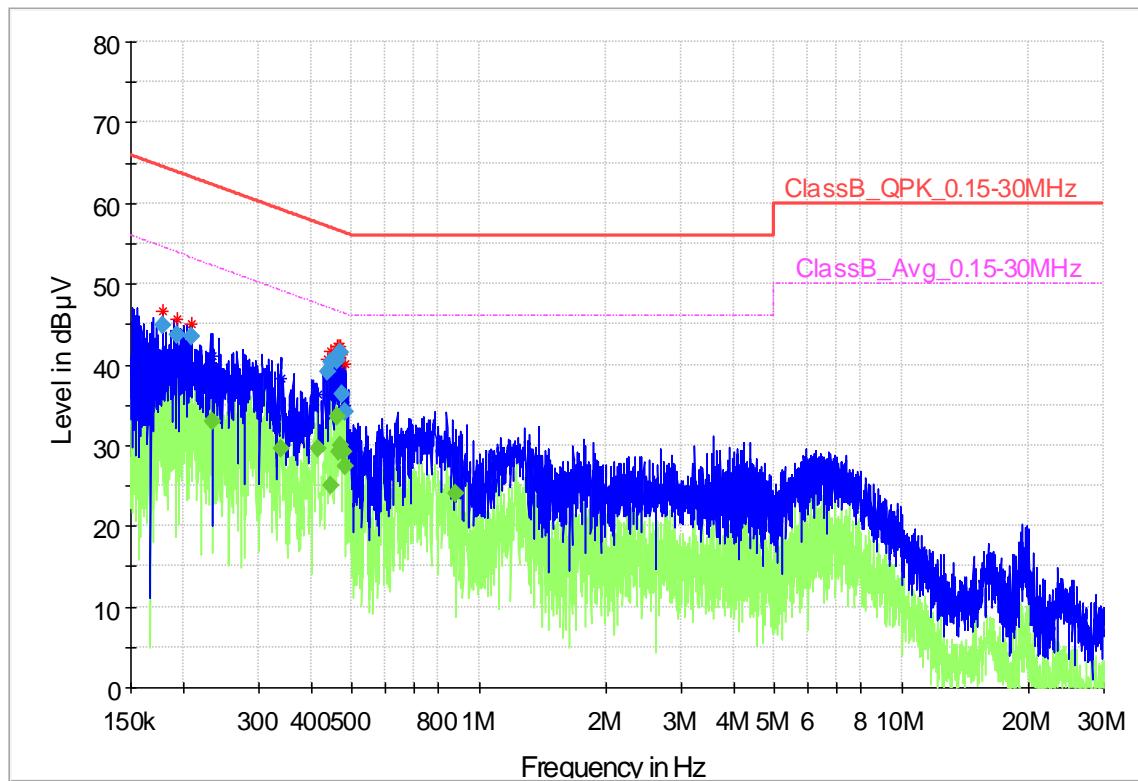
Plot 2: Main Power Line Conducted Emissions 150 kHz to 30 MHz at 120Vac/60Hz – Line 2

Table 4: Quasi-peak data Main Power Line Conducted Emissions at 120Vac/60Hz – Line 2

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150450	43.90	1000.000	9.000	GND	10.9	22.07	65.98
0.151053	43.86	1000.000	9.000	GND	10.9	22.08	65.94
0.152114	43.54	1000.000	9.000	GND	10.9	22.35	65.88
0.152571	44.19	1000.000	9.000	GND	10.9	21.67	65.86
0.154103	44.40	1000.000	9.000	GND	10.9	21.38	65.78
0.156901	44.94	1000.000	9.000	GND	10.9	20.68	65.63
0.424586	43.67	1000.000	9.000	GND	10.7	13.69	57.36
0.430139	43.86	1000.000	9.000	GND	10.7	13.39	57.25
0.436200	42.15	1000.000	9.000	GND	10.7	14.98	57.13
0.439263	41.73	1000.000	9.000	GND	10.7	15.35	57.08

Table 5: Average data Main Power Line Conducted Emissions at 120Vac/60Hz – Line 2

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.152114	29.18	1000.000	9.000	GND	10.9	26.70	55.88
0.351149	30.07	1000.000	9.000	GND	10.7	18.86	48.94
0.355741	30.48	1000.000	9.000	GND	10.7	18.35	48.83
0.368038	18.25	1000.000	9.000	GND	10.7	30.29	48.55
0.422048	34.83	1000.000	9.000	GND	10.7	12.58	47.41
0.430139	36.75	1000.000	9.000	GND	10.7	10.50	47.25
0.440142	30.59	1000.000	9.000	GND	10.7	16.47	47.06
0.446790	34.71	1000.000	9.000	GND	10.7	12.23	46.94
0.451278	34.09	1000.000	9.000	GND	10.7	12.76	46.85
0.455356	29.82	1000.000	9.000	GND	10.7	16.96	46.78



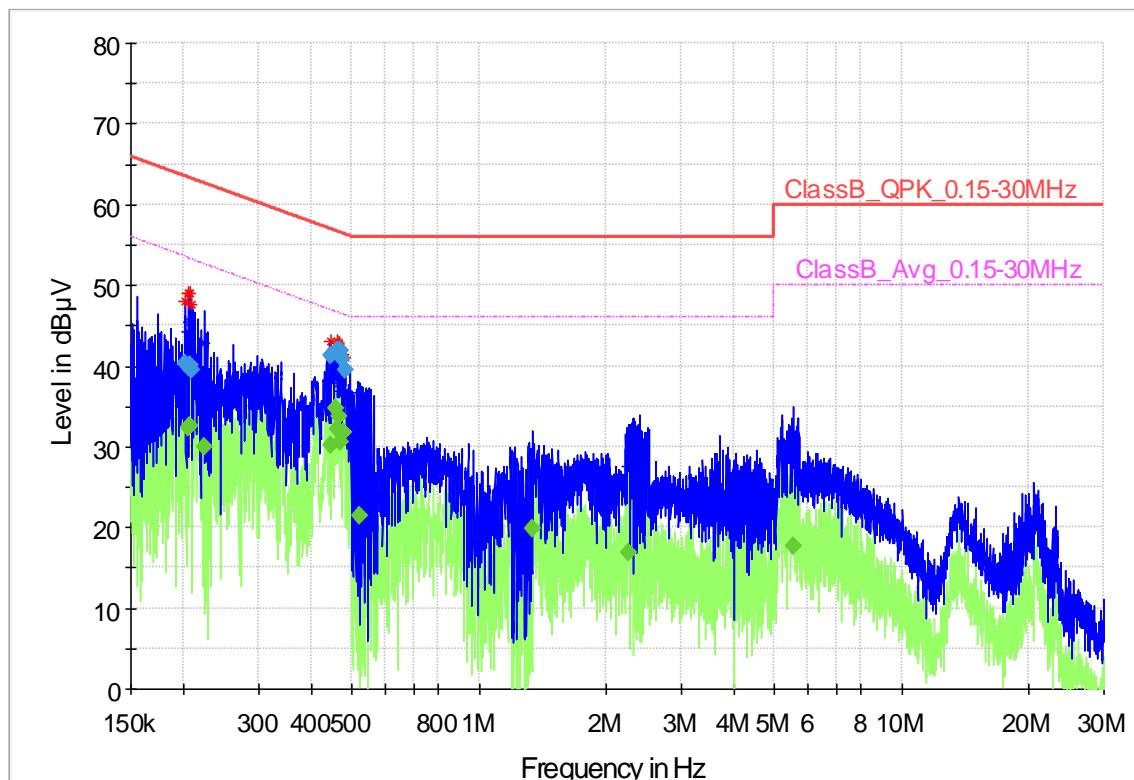
Plot 3: Main Power Line Conducted Emissions 150 kHz to 30 MHz at 230Vac/50Hz – Line 1

Table 6: Quasi-peak data Main Power Line Conducted Emissions at 230Vac/50Hz – Line 1

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.178136	44.79	1000.000	9.000	GND	10.8	19.78	64.57
0.193351	43.71	1000.000	9.000	GND	10.8	20.18	63.89
0.209028	43.54	1000.000	9.000	GND	10.8	19.70	63.24
0.436637	39.17	1000.000	9.000	GND	10.7	17.96	57.13
0.444119	40.22	1000.000	9.000	GND	10.7	16.77	56.98
0.462235	40.59	1000.000	9.000	GND	10.7	16.06	56.65
0.466878	41.22	1000.000	9.000	GND	10.7	15.34	56.57
0.468748	41.47	1000.000	9.000	GND	10.7	15.06	56.54
0.475829	36.28	1000.000	9.000	GND	10.7	20.13	56.41
0.481089	34.20	1000.000	9.000	GND	10.7	22.12	56.32

Table 7: Average data Main Power Line Conducted Emissions at 230Vac/50Hz – Line 1

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.234959	32.94	1000.000	9.000	GND	10.7	19.33	52.27
0.339416	29.55	1000.000	9.000	GND	10.7	19.67	49.22
0.414522	29.56	1000.000	9.000	GND	10.7	18.00	47.56
0.444119	25.10	1000.000	9.000	GND	10.7	21.88	46.98
0.459930	33.50	1000.000	9.000	GND	10.7	13.19	46.69
0.466878	29.18	1000.000	9.000	GND	10.7	17.39	46.57
0.470156	29.96	1000.000	9.000	GND	10.7	16.55	46.51
0.473930	29.38	1000.000	9.000	GND	10.7	17.06	46.45
0.476781	29.15	1000.000	9.000	GND	10.7	17.24	46.40
0.483983	27.40	1000.000	9.000	GND	10.7	18.87	46.27
0.880729	24.10	1000.000	9.000	GND	10.7	21.90	46.00



Plot 4: Main Power Line Conducted Emissions 150 kHz to 30 MHz at 230Vac/50Hz – Line 2

Table 8: Quasi-peak data Main Power Line Conducted Emissions at 230Vac/50Hz – Line 2

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.201439	40.28	1000.000	9.000	GND	10.8	23.27	63.55
0.204687	39.89	1000.000	9.000	GND	10.8	23.53	63.42
0.206330	40.12	1000.000	9.000	GND	10.8	23.24	63.35
0.209656	39.42	1000.000	9.000	GND	10.8	23.80	63.22
0.444119	41.37	1000.000	9.000	GND	10.7	15.61	56.98
0.462697	41.93	1000.000	9.000	GND	10.7	14.72	56.64
0.466411	41.96	1000.000	9.000	GND	10.7	14.62	56.58
0.468748	41.92	1000.000	9.000	GND	10.7	14.62	56.54
0.475829	40.85	1000.000	9.000	GND	10.7	15.56	56.41
0.481570	39.56	1000.000	9.000	GND	10.7	16.75	56.31

Table 9: Average data Main Power Line Conducted Emissions at 230Vac/50Hz – Line 2

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.204687	32.31	1000.000	9.000	GND	10.8	21.10	53.42
0.206330	32.64	1000.000	9.000	GND	10.8	20.71	53.35
0.223505	29.96	1000.000	9.000	GND	10.8	22.72	52.69
0.444119	30.10	1000.000	9.000	GND	10.7	16.89	46.98
0.457180	34.75	1000.000	9.000	GND	10.7	11.99	46.74
0.459930	32.12	1000.000	9.000	GND	10.7	14.58	46.69
0.465480	33.70	1000.000	9.000	GND	10.7	12.89	46.59
0.470156	30.56	1000.000	9.000	GND	10.7	15.95	46.51
0.479649	31.73	1000.000	9.000	GND	10.7	14.62	46.35
0.522702	21.38	1000.000	9.000	GND	10.7	24.62	46.00
1.337479	19.90	1000.000	9.000	GND	10.7	26.10	46.00
2.248108	16.94	1000.000	9.000	GND	10.7	29.06	46.00
5.521445	17.75	1000.000	9.000	GND	10.9	32.25	50.00

3.3 Radiated Spurious Emissions-Transmit Mode

Date Performed:

August 01, 2018

Test Standard:

- FCC Part 15.225, FCC Part 15.205
- RSS 210 Issue 8 A2.6 & RSS-Gen Issue 4

Minimum Requirement:

The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the limits shown in the table below.

Frequency (MHz)	Field strength (microvolts/meter)		Measurement distance (meters)
0.009–0.490	2400/F(kHz)		300
0.490–1.705	24000/F(kHz)		30
1.705–30.0	30	29.5 dBuV/m	30
30–88	100	40.0 dBuV/m	3
88–216	150	43.5 dBuV/m	3
216–960	200	46.0 dBuV/m	3
Above 960	500	54.0 dBuV/m	3

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

FCC PART 15.205-RESTRICTED BANDS OF OPERATION

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
1.0495-0.505*	16.69475- 16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425- 16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475- 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209.

RESTRICTED FREQUENCY BANDS (RSS-GEN)

MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

Note: Certain frequency bands listed in Table 3 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200- and 300- series RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

Unwanted emissions falling into restricted bands of shall comply with the limits specified in the table above.

Test Setup:

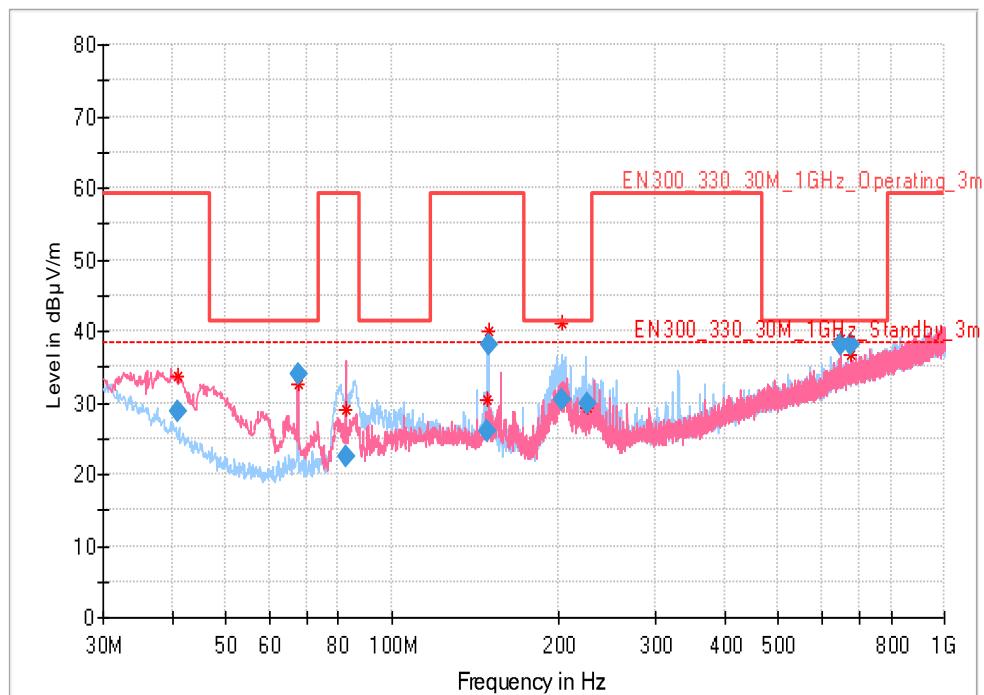
The EUT was placed on a turntable, which is 0.8m above ground plane. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable and moving the receiving antenna from 1m to 4m high to maximize the emissions signal strength. The equipment was setup in a 3m Semi-Anechoic Chamber for preliminary measurements and finals were completed in 3m and 10m Open Air Test Site at 3m.

During pre-compliance test, worst-case orientation was determined by rotating the EUT on three axes and final radiated emissions tests were performed in that orientation.

Performance:

Complies with Standard.

Measurement Data and Plot:



Plot 5: Radiated Emissions FCC/ISED 30MHz - 1GHz at 3m, Operating Mode – Reference Only

Note:

1. Radiated Emissions test was performed from 9 kHz-6GHz
2. Except the emissions reported below, all emissions were more than 20dB lower than the limit.

Table 1: Data of Radiated Emissions, 30MHz - 1GHz at 3m

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)
40.961250	28.85	1000.000	120.000	107.0	V	82.0	21.7
67.514850	34.00	1000.000	120.000	154.0	V	215.0	16.2
82.491950	22.40	1000.000	120.000	125.0	V	134.0	16.2
148.834500	25.92	1000.000	120.000	195.0	H	185.0	20.7
150.021300	38.07	1000.000	120.000	150.0	H	187.0	20.6
203.620300	30.45	1000.000	120.000	110.0	H	134.0	20.4
225.634500	29.82	1000.000	120.000	143.0	H	180.0	19.5
650.873850	38.02	1000.000	120.000	166.0	V	340.0	30.0
677.993650	38.10	1000.000	120.000	149.0	V	344.0	30.4

3.4 Radiated Emissions – Unintentional

Date Performed:

August 01, 2018

Test Standard:

- FCC CFR47, Part 15, Subpart B
- ICES-003 Issue 5

Minimum Requirement:

Class B Limit:

Frequency (MHz)	Class B Radiated Limit (dB μ V/m) at 3m
	Quasi-peak (dB μ V/m)
30 – 88	40
88 – 216	43.5
216 – 960	46
960 – 1000	54

Test Setup:

The EUT was placed on a turntable, which is 0.8m above ground plane. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable and moving the receiving antenna from 1m to 4m high to maximize the emissions signal strength. The equipment was setup in a 3m Semi-Anechoic Chamber for preliminary measurements and finals were completed in 3m and 10m Open Air Test Site at 3m. Measurements were also performed from 9 kHz to 30 MHz with an active loop antenna, but no emissions were found in that range.

During pre-compliance test, worst-case orientation was determined by rotating the EUT on three axes and final radiated emissions tests were performed in that orientation.

Modifications:

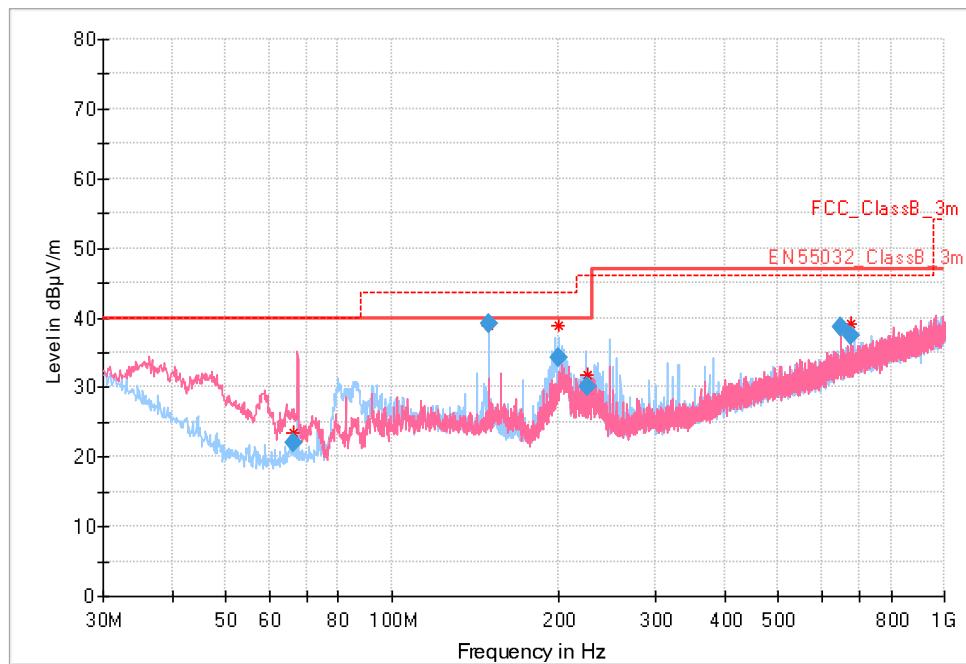
No modification was required to comply for this test.

Performance:

Complies with the applicable standard.

Measurement Data and Plot:

Plot 7: Radiated Emissions 10kHz-30MHz 3m (SAC)



Plot 8: Radiated Emissions FCC/ISED 30MHz - 1GHz at 3m

Table 2: Data of Radiated Emissions, 30MHz - 1GHz at 3m

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)
66.493050	22.06	1000.000	120.000	123.0	V	12.0	16.1
149.991850	38.16	1000.000	120.000	146.0	H	180.0	20.6
199.894100	34.29	1000.000	120.000	104.0	H	171.0	20.6
225.629400	30.21	1000.000	120.000	97.0	H	213.0	19.5
650.874750	38.66	1000.000	120.000	156.0	V	343.0	30.0
677.986100	37.44	1000.000	120.000	157.0	H	93.0	30.4

3.5 99% Occupied Bandwidth

Date Performed:

August 01, 2018

Test Standard:

- RSS-Gen Issue 4

Test Method:

- ANSI C63.10 2013

Test Setup:

RSS-Gen Issue 4: Section 6.6 – A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

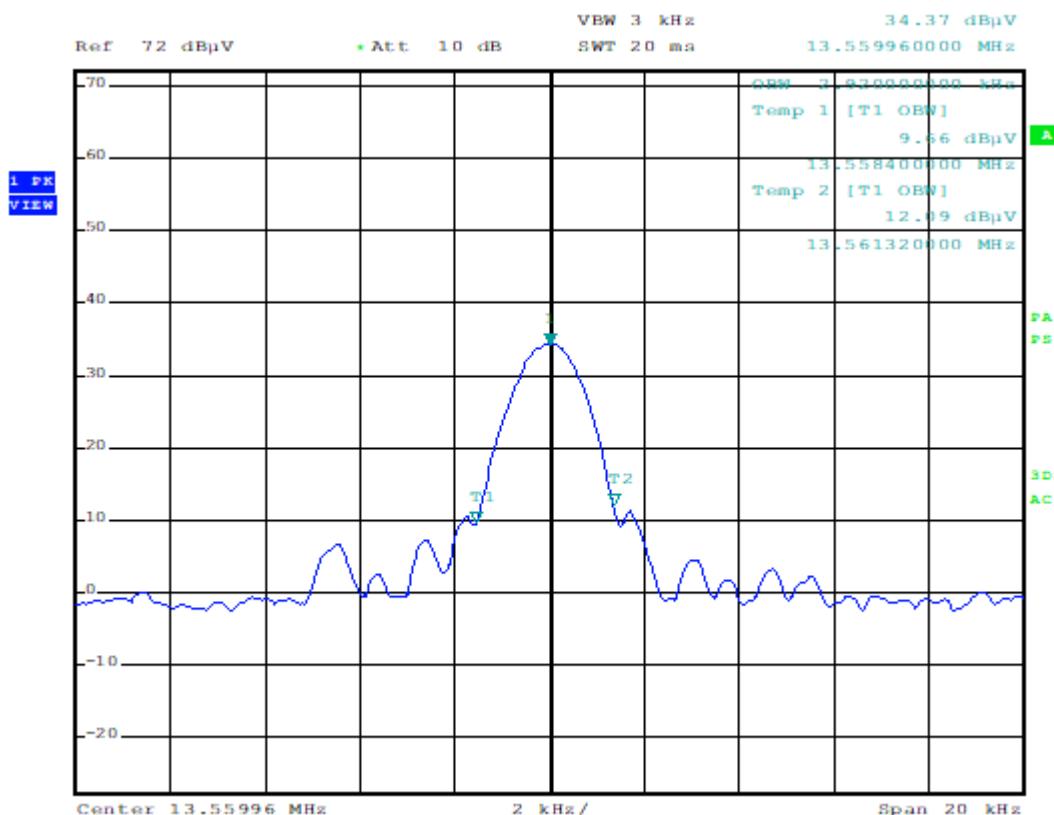
The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

Performance:

Complies with the applicable standard.

Measurement Data and Plot:

99% Occupied Bandwidth of the EUT is 2.92 kHz and within the band 13.553-13.567 MHz



Plot 6: 99% Occupied Bandwidth Data Plot

3.6 20dB Occupied Bandwidth

Date Performed:

August 01, 2018

Test Standard:

- FCC Part 15.215, FCC Part 15.225

Test Method:

- ANSI C63.10 2013

Test Setup:

The antenna port of EUT was directly connected to a spectrum analyzer.

Modifications:

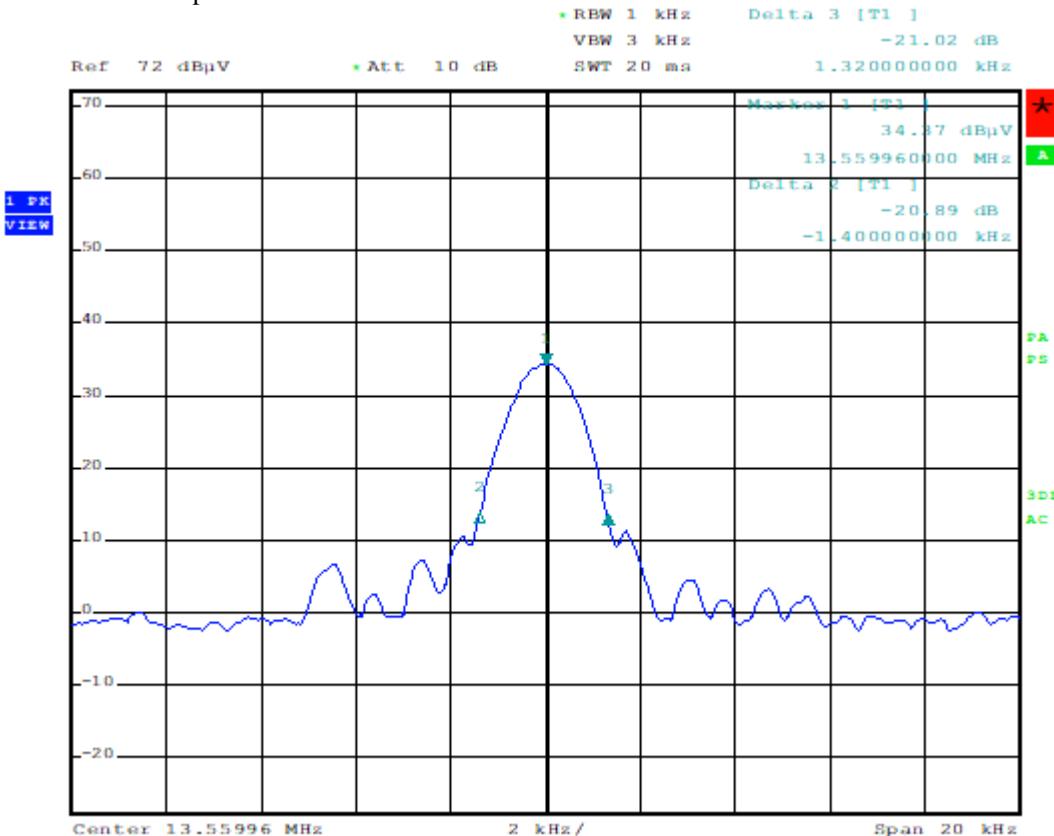
No modification was required to comply for this test.

Performance:

Complies with the applicable standard.

Measurement Data and Plot:

20dB Occupied Bandwidth of the EUT is 2.72 kHz and within the band 13.553-13.567 MHz.



3.7 Frequency Stability

DATE:

August 8, 2018

TEST STANDARD:

FCC Part 15.225, RSS 210 Issue 8 A2.6

MINIMUM STANDARD:

Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

MEASUREMENT METHOD:

Measurements were made using a Spectrum Analyzer with 10kHz RBW Average detector while directly connected to the EUT through the antenna port.

OBSERVATIONS:

The EUT performed as expected.

Temperature (°C)	Frequency (MHz)	Delta (kHz)	ppm
-20	13.5591	-0.9	-0.07
-10	13.5598	-0.2	-0.01
0	13.5602	0.2	0.01
10	13.5597	-0.3	-0.02
23	13.5600	0	0.00
30	13.5601	0.1	0.01
40	13.5602	0.2	0.01
50	13.5607	0.7	0.05

PERFORMANCE:

Complies with Standard.

3.8 RF Exposure Evaluation

Date Performed:

September 20, 2018

Test Standard:

FCC KDB 447498 D01 Clause 7.2

Host Product:

Equipment Tested:	SmartBox
Model Number:	KCESAF01
FCC ID:	2AELP-RFID01
IC Certification Number:	24333- RFID01

Transmitters contained in the host product:

Transmitters	Description	Model Number	FCC ID	IC ID
1	RF ID Operation within the band 13.110-14.010 MHz	KCESAF01	2AELP-RFID01	24333- FID01
2	GSM/UMTS Module	SARA-U201	XPY1CGM5NNN	8595A-1CGM5NNN

RF Exposure Evaluation:

The calculation below is used to consider situations in which simultaneous exposure to fields of different frequencies occur at test separation distance of 20cm. The calculation is performed by the sum of each relative exposure for each equipment according to the following criteria.

$$\sum_1^N \frac{S_{eqn}}{S_{Limn}} = \frac{S_{eq1}}{S_{Lim1}} + \frac{S_{eq2}}{S_{Lim2}} + \dots + \frac{S_{eqN}}{S_{LimN}} \leq 1$$

Where:

S_{eq} is the power density of the electromagnetic field at a given distance by a specific transmitter and a defined frequency.

S_{lim} is the MPE limit for the frequency being evaluated.

Transmitter	Maximum	sum of the MPE ratios	Compliance
	Seq / Slin (mW/cm ²)		
GSM/UMTS Module	0.616	0.616	Compliant
RF ID	0.000		

Result:

This unit meets the SARS exclusion as defined in FCC KDB 447498 D01.

Appendix A: TEST SETUP PICTURES



Figure 1: Radiated Emissions (30 MHz – 1 GHz) Test Setup



Figure 2: Radiated Emissions (below 30 MHz) Test Setup

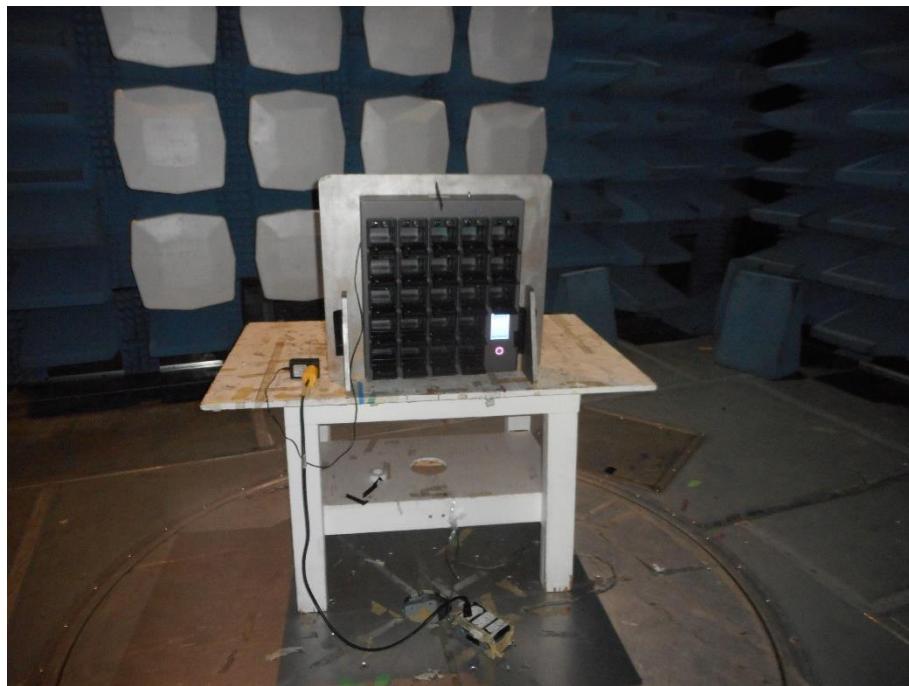


Figure 3: Radiated Emissions Test Setup



Figure 4: Conducted Emissions Test Setup

Appendix B: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
DC	Direct Current
E.I.R.P.	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EUT	Equipment Under Test
FCC	Federal Communications Commission
IC	Industry Canada
ICES	Interference-Causing Equipment Standard
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
RSS	Radio Standards Specifications
SAC	Semi-Anechoic Chamber

END OF REPORT