FCC PART 15, SUBPART C
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Angie Hospitality, Inc.

6203 San Ignacio Avenue
San Jose, CA 95119

FCC ID: 2AQSG-73500011
IC: 24166-73500011

Report Type:	**Product Type:**
Class II Permissive Change	802.11Wi-Fi 2.4GHz Module

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Report Number:	R18072714-247
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R18072714-247	CIIPC Report	2018-11-04

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Angie Hospitality, Inc.*, and their product model*: 735-00011, FCC ID: 2AQSG-73500011, IC: 24166-73500011* or the "EUT" as referred to in this report. The product is an 802.11Wi-Fi 2.4GHz module.

1.2 Objective

This report is prepared on behalf of *Angie Hospitality, Inc.*, in accordance with Part 2, Subpart J, and Part 15, Subparts C of the Federal Communication Commission's rules and ISEDC RSS-247 Issue 2, February 2017.

The objective is to determine compliance with FCC Part 15.247 and ISEDC RSS-247 rules for Output Power, Antenna Requirements, and Radiated Spurious Emissions.

This project is a Permissive Change II submission for the purpose of an antenna change to a dipole loop antenna.

1.3 Related Submittal(s)/Grant(s)

N/A

1.4 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 15.247 Meas Guidance v05: Guidance For Compliance Measurements On Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules.

1.5 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 ° C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.6 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Innovation, Science and Economic development Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.7 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3279.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Innovation, Science and Economic development Canada - ISEDC):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Infocomm Media Development Authority - IMDA):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IMDA MRA Recognition Scheme: 2011, Annex 2

2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IMDA MRA Recognition Scheme: 2011, Annex 2

- For the Hong Kong Special Administrative Region:
  1 All Radio Equipment, per KHCA 10XX-series Specifications;
  2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  1 MIC Telecommunication Business Law (Terminal Equipment):
  - All Scope A1 - Terminal Equipment for the Purpose of Calls;
  - All Scope A2 - Other Terminal Equipment
  2 Radio Law (Radio Equipment):
  - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
  - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
  - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;

- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
    - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
    - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
    - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
    - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
    - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
    - ENERGY STAR Recognized Test Laboratory – US EPA
    - Telecommunications Certification Body (TCB) – US FCC;
    - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 15.247 Guidance v05.

2.2 EUT Exercise Software

The test firmware used was Putty provided by *Angie Hospitality, Inc*. The software is compliant with the standard requirements being tested against.

2.3 Equipment Modifications

No modifications to the EUT were made.

2.4 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.5 Support Equipment

Manufacturer	Description	Model
ASUS	Laptop	SonicMaster
Shenzhen ABP Technology Co., ltd.	Adapter	CGSW48-120-3730II

2.6 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Ethernet Cable	2 m	Laptop	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen Clause 6.8	Antenna Requirement	Compliant
FCC §2.1091, §15.247(i) ISED RSS-102	RF Exposure	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4 (d)	Output Power Measurements	Compliant
FCC §2.1053, §15.205, §15.209, §15.247 (d) ISEDC RSS-247 Clause 5.5 ISEDC RSS-Gen Clause 8.9 and 8.10	Radiated Spurious Emissions	Compliant

4 FCC §15.203 and ISEDC RSS-Gen Clause 6.8 - Antenna Requirements

4.1 Applicable Standards

According to FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to ISEDC RSS-Gen Clause 6.8: Transmitter Antenna

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

4.2 Antenna Description

The antennas used by the EUT are permanent attached antennas.

Frequency Range (MHz)	Antenna Usage	Maximum Antenna Gain (dBi)	Antenna Type
2400 - 2500	2.4 GHz Wi-Fi	2.80	Dipole Loop

5 FCC §2.1091, §15.247(i) and ISED RSS-102 – RF Exposure

5.1 Applicable Standards

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF field

According to ISED RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz[6] and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

5.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

5.3 FCC MPE Results

2.4GHz Wi-Fi

Maximum peak output power at antenna input terminal (dBm):	18.38
Maximum peak output power at antenna input terminal (mW):	68.87
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	2.80
Maximum Antenna Gain (numeric):	1.905
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0261
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0261 mW/cm^2. Limit is 1.0 mW/cm^2.

Conclusion

The device is compliant with the requirement MPE limit for uncontrolled exposure. All transceiver modules must be installed with a separation distance of no less than **20** cm from all persons.

5.4 RF exposure evaluation exemption for IC

2.4GHz Wi-Fi: 18.38 + 2.80 dBi = 21.18 dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.703 W = 34.32 dBm

Conclusion

Therefore the RF exposure is not required. All transceiver modules must be installed with a separation distance of no less than **20** cm from all persons.

6 FCC §15.247(b) (3) and ISEDC RSS-247 §5.4 (d) - Output Power Measurement

6.1 Applicable Standards

According to ECFR §15.247(b) (3) and ISEDC RSS-247 §5.4 (d) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

6.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 15.247 Meas Guidance v05: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules.

6.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
ETS-LINDGREN	Power Sensor	7002-006	160097	2016-12-05	2 years
-	RF cable	-	-	Each time[1]	N/A
-	20dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

6.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Chin Ming Lui on 2018-10-08 in RF site.

6.5 Test Results

Output Power

Channel	Frequency (MHz)	Average Output Power (dBm)	Limit (dBm)
802.11b mode			
1	2412	17.54	30
6	2437	18.38	30
11	2462	18.01	30
802.11g mode			
1	2412	15.05	30
6	2437	15.93	30
11	2462	15.45	30
802.11n-HT20 mode			
1	2412	14.07	30
6	2437	15.31	30
11	2462	14.88	30
802.11n-HT40 mode			
3	2422	11.16	30
6	2437	13.57	30
9	2452	13.33	30

7 FCC §15.209, §15.247(d) and ISEDC RSS-247 Clause 5.5, RSS-Gen Clause 8.9, 8.10 - Spurious Radiated Emissions

7.1 Applicable Standards

As per FCC §15.35(b): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) and RSS-Gen 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 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3332 – 3339 3345.8 – 3358 3600 – 4400	4.5 – 5.15 5.35 – 5.46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/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	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz.

However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §15.247 (d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

As per ISEDC RSS-Gen 8.9,

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 – General field strength limits at frequencies above 30 MHz

Frequency (MHz)	Field strength (µV/m at 3 m)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Table 6 – General field strength limits at frequencies below 30 MHz

Frequency	Magnetic field strength (H-Field) (µA/m)	Measurement distance (m)
9 - 490 kHz [1]	6.37/F (F in kHz)	300
490 - 1705 kHz	63.7/F (F in kHz)	30
1.705 - 30 MHz	0.08	30

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

As per ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C and ISEDC RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

7.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

7.4 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + AF + CL + Atten - Ga$$

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2018-07-05	2 years
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2018-02-26	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2018-04-02	1 year
IW	AOBOR Hi frequency Co AX Cable	KPS-1501N-3960-KPS	-	2018-01-11	1 year
-	SMA-Type Cable	-	C00011	Each time[1]	N/A
HP	Amplifier, Pre	8449B	3147A00400	2018-02-02	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2017-03-27	2 years
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

7.6 Test Environmental Conditions

Temperature:	20-22 ºC
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Chin Ming Lui on 2018-09-24 and 2018-10-09 in 5m chamber 3.

7.7 Summary of Test Results

According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C and ISEDC RSS-247 standard's radiated emissions limits, and had the worst margin of:

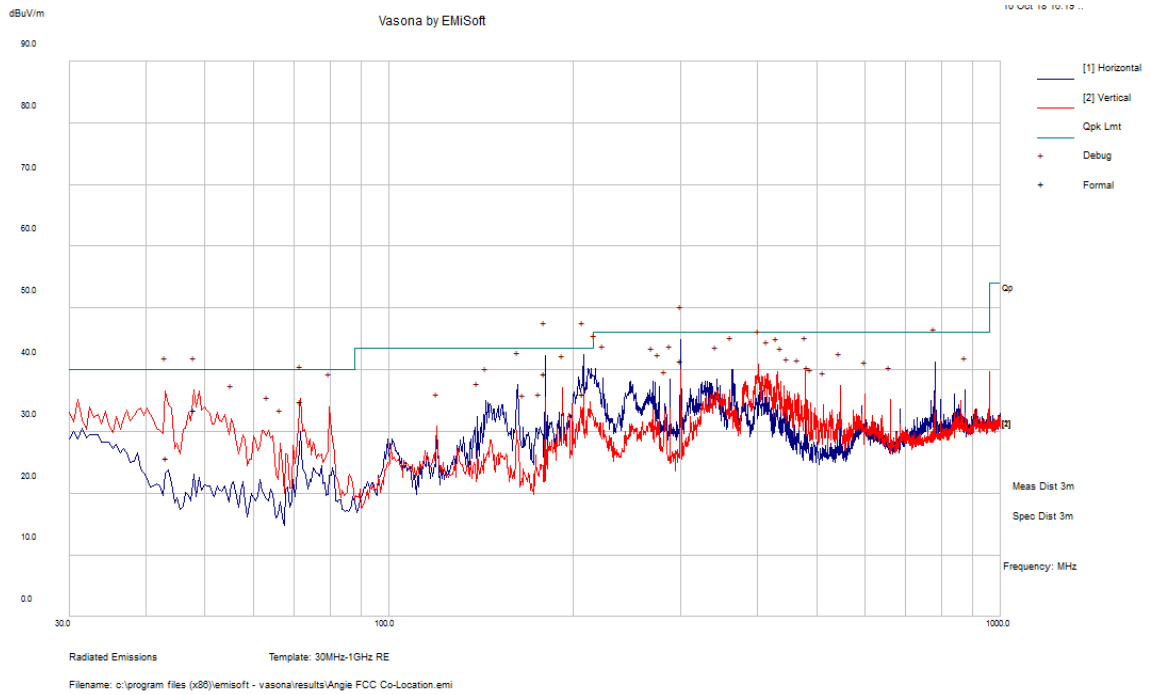
2.4 GHz Wi-Fi

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, channel**
-0.40	2390	Horizontal	n40 mode, low channel

Please refer to the following table and plots for specific test result details

7.8 Radiated Emissions Test Results

1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters



2.4 GHz Wi-Fi

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
300.0003	41.53	131	H	85	46	-4.47	QP
207.8225	36.06	150	H	295	43.5	-7.44	QP
179.9968	39.37	133	H	269	43.5	-4.13	QP
47.97625	33.57	100	V	134	40	-6.43	QP
43.29975	25.7	153	V	307	40	-14.3	QP
71.62975	34.82	128	V	192	40	-5.18	QP

Note: Performed worst-case scenario: Co-Location with five radios enabled, with each transmitting at worst case channel:

- *2.4 GHz TopLink Dipole Loop*
- *2.4 GHz TopLink PiFa*
- *5 GHz UNEX*
- *Bluetooth*
- *Zigbee*

2) 1–25 GHz Measured at 3 meters

802.11b mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz b mode Power Setting = 14											
2412	70.68	15	170	H	28.94	5.76	0	105.38	-	-	PK
2412	64.99	15	170	H	28.94	5.76	0	99.69	-	-	AV
2412	65.63	36	197	V	28.93	5.76	0	100.32	-	-	PK
2412	59.92	36	197	V	28.93	5.76	0	94.61	-	-	AV
2390	54.63	15	170	H	28.94	6.489	36.174	53.89	74.00	-20.11	PK
2390	45.11	15	170	H	28.94	6.489	36.174	44.37	54.00	-9.63	AV
2390	51.16	36	197	V	28.93	6.489	36.174	50.41	74.00	-23.59	PK
2390	41.20	36	197	V	28.93	6.489	36.174	40.45	54.00	-13.55	AV
4824	46.81	78	170	H	32.54	9.36	35.747	52.97	74.00	-21.03	PK
4824	37.95	78	170	H	32.54	9.36	35.747	44.11	54.00	-9.89	AV
4824	47.59	0	100	V	32.56	9.36	35.747	53.76	74.00	-20.24	PK
4824	35.63	0	100	V	32.56	9.36	35.747	41.80	54.00	-12.20	AV
Middle Channel 2437 MHz b mode Power Setting = 17											
2437	71.79	244	170	H	29.15	5.76	0.00	106.70	-	-	PK
2437	65.72	244	170	H	29.15	5.76	0.00	100.63	-	-	AV
2437	63.36	39	100	V	29.19	5.76	0.00	98.31	-	-	PK
2437	57.57	39	100	V	29.19	5.76	0.00	92.52	-	-	AV
4874	46.13	51	100	H	32.79	9.46	35.70	52.67	74.00	-21.33	PK
4874	38.75	51	100	H	32.79	9.46	35.70	45.29	54.00	-8.71	AV
4874	46.00	330	300	V	32.53	9.46	35.70	52.28	74.00	-21.72	PK
4874	35.46	330	300	V	32.53	9.46	35.70	41.74	54.00	-12.26	AV
High Channel 2462 MHz b mode Power Setting = 18											
2462	70.32	241	238	H	29.15	5.87	0.00	105.34	-	-	PK
2462	64.56	241	238	H	29.15	5.87	0.00	99.58	-	-	AV
2462	66.29	321	190	V	29.19	5.87	0.00	101.35	-	-	PK
2462	60.13	321	190	V	29.19	5.87	0.00	95.19	-	-	AV
2483.5	52.38	241	238	H	29.25	6.654	36.13	52.16	74.00	-21.85	PK
2483.5	43.32	241	238	H	29.25	6.654	36.13	43.10	54.00	-10.91	AV
2483.5	50.46	321	190	V	29.18	6.654	36.13	50.16	74.00	-23.84	PK
2483.5	40.25	321	190	V	29.18	6.654	36.13	39.95	54.00	-14.05	AV
4924	47.24	63	100	H	32.81	9.46	35.70	53.80	74.00	-20.20	PK
4924	38.34	63	100	H	32.81	9.46	35.70	44.90	54.00	-9.10	AV
4924	45.49	0	100	V	32.70	9.46	35.70	51.94	74.00	-22.06	PK
4924	34.27	0	100	V	32.70	9.46	35.70	40.72	54.00	-13.28	AV

802.11g mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz g mode Power Setting = 17											
2412	68.41	224	115	H	28.94	5.76	0	103.11	-	-	PK
2412	60.65	224	115	H	28.94	5.76	0	95.35	-	-	AV
2412	64.73	326	273	V	28.93	5.76	0	99.42	-	-	PK
2412	57.11	326	273	V	28.93	5.76	0	91.80	-	-	AV
2390	66.08	224	115	H	28.94	6.489	36.174	65.34	74.00	-8.66	PK
2390	53.42	224	115	H	28.94	6.489	36.174	52.68	54.00	-1.32	AV
2390	61.14	326	273	V	28.93	6.489	36.174	60.39	74.00	-13.61	PK
2390	48.70	326	273	V	28.93	6.489	36.174	47.95	54.00	-6.05	AV
4824	47.58	0	100	H	32.54	9.36	35.747	53.74	74.00	-20.26	PK
4824	37.25	0	100	H	32.54	9.36	35.747	43.41	54.00	-10.59	AV
4824	47.34	0	100	V	32.56	9.36	35.747	53.51	74.00	-20.49	PK
4824	37.52	0	100	V	32.56	9.36	35.747	43.69	54.00	-10.31	AV
Middle Channel 2437 MHz g mode Power Setting = 19											
2437	71.75	270	245	H	29.15	5.76	0.00	106.66	-	-	PK
2437	63.99	270	245	H	29.15	5.76	0.00	98.90	-	-	AV
2437	64.17	48	151	V	29.19	5.76	0.00	99.12	-	-	PK
2437	56.68	48	151	V	29.19	5.76	0.00	91.63	-	-	AV
4874	46.58	0	100	H	32.79	9.46	35.70	53.12	74.00	-20.88	PK
4874	37.33	0	100	H	32.79	9.46	35.70	43.87	54.00	-10.13	AV
4874	46.98	0	100	V	32.53	9.46	35.70	53.26	74.00	-20.74	PK
4874	37.21	0	100	V	32.53	9.46	35.70	43.49	54.00	-10.51	AV
High Channel 2462 MHz g mode Power Setting = 19											
2462	71.63	241	238	H	29.15	5.87	0.00	106.65	-	-	PK
2462	63.94	241	238	H	29.15	5.87	0.00	98.96	-	-	AV
2462	64.26	315	190	V	29.19	5.87	0.00	99.32	-	-	PK
2462	56.50	315	190	V	29.19	5.87	0.00	91.56	-	-	AV
2483.5	64.92	239	255	H	29.25	6.654	36.13	64.70	74.00	-9.31	PK
2483.5	52.89	239	255	H	29.25	6.654	36.13	52.67	54.00	-1.34	AV
2483.5	57.34	315	190	V	29.18	6.654	36.13	57.04	74.00	-16.96	PK
2483.5	45.36	315	190	V	29.18	6.654	36.13	45.06	54.00	-8.94	AV
4924	46.82	0	100	H	32.81	9.46	35.70	53.38	74.00	-20.62	PK
4924	36.99	0	100	H	32.81	9.46	35.70	43.55	54.00	-10.45	AV
4924	47.12	0	100	V	32.70	9.46	35.70	53.57	74.00	-20.43	PK
4924	37.11	0	100	V	32.70	9.46	35.70	43.56	54.00	-10.44	AV

802.11n20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz n20 mode Power Setting = 15											
2412	67.63	224	131	H	28.94	5.76	0	102.33	-	-	PK
2412	60.22	224	131	H	28.94	5.76	0	94.92	-	-	AV
2412	64.50	326	273	V	28.93	5.76	0	99.19	-	-	PK
2412	56.89	326	273	V	28.93	5.76	0	91.58	-	-	AV
2390	67.72	224	131	H	28.94	6.489	36.174	66.98	74.00	-7.02	PK
2390	54.23	224	131	H	28.94	6.489	36.174	53.49	54.00	-0.51	AV
2390	62.59	326	273	V	28.93	6.489	36.174	61.84	74.00	-12.16	PK
2390	49.80	326	273	V	28.93	6.489	36.174	49.05	54.00	-4.95	AV
4824	47.46	0	100	H	32.54	9.36	35.747	53.62	74.00	-20.38	PK
4824	37.92	0	100	H	32.54	9.36	35.747	44.08	54.00	-9.92	AV
4824	47.12	0	100	V	32.56	9.36	35.747	53.29	74.00	-20.71	PK
4824	38.03	0	100	V	32.56	9.36	35.747	44.20	54.00	-9.80	AV
Middle Channel 2437 MHz n20 mode Power Setting = 18											
2437	71.53	269	243	H	29.15	5.76	0.00	106.44	-	-	PK
2437	64.15	269	243	H	29.15	5.76	0.00	99.06	-	-	AV
2437	64.01	34	141	V	29.19	5.76	0.00	98.96	-	-	PK
2437	56.48	34	141	V	29.19	5.76	0.00	91.43	-	-	AV
4874	46.64	0	100	H	32.79	9.46	35.70	53.18	74.00	-20.82	PK
4874	36.95	0	100	H	32.79	9.46	35.70	43.49	54.00	-10.51	AV
4874	46.27	0	100	V	32.53	9.46	35.70	52.55	74.00	-21.45	PK
4874	37.13	0	100	V	32.53	9.46	35.70	43.41	54.00	-10.59	AV
High Channel 2462 MHz n20 mode Power Setting = 18											
2462	69.13	244	238	H	29.15	5.87	0.00	104.15	-	-	PK
2462	61.52	244	238	H	29.15	5.87	0.00	96.54	-	-	AV
2462	64.40	321	192	V	29.19	5.87	0.00	99.46	-	-	PK
2462	56.82	321	192	V	29.19	5.87	0.00	91.88	-	-	AV
2483.5	67.71	244	238	H	29.25	6.654	36.13	67.49	74.00	-6.52	PK
2483.5	53.08	244	238	H	29.25	6.654	36.13	52.86	54.00	-1.15	AV
2483.5	62.62	321	192	V	29.18	6.654	36.13	62.32	74.00	-11.68	PK
2483.5	47.74	321	192	V	29.18	6.654	36.13	47.44	54.00	-6.56	AV
4924	46.53	0	100	H	32.81	9.46	35.70	53.09	74.00	-20.91	PK
4924	36.77	0	100	H	32.81	9.46	35.70	43.33	54.00	-10.67	AV
4924	46.66	0	100	V	32.70	9.46	35.70	53.11	74.00	-20.89	PK
4924	36.32	0	100	V	32.70	9.46	35.70	42.77	54.00	-11.23	AV

802.11n40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2422 MHz n40 mode Power Setting = 10											
2422	63.19	227	100	H	28.94	5.76	0	97.89	-	-	PK
2422	51.68	227	100	H	28.94	5.76	0	86.38	-	-	AV
2422	59.52	313	192	V	28.93	5.76	0	94.21	-	-	PK
2422	52.06	313	192	V	28.93	5.76	0	86.75	-	-	AV
2390	63.16	227	100	H	28.94	6.489	36.174	62.42	74.00	-11.58	PK
2390	54.34	227	100	H	28.94	6.489	36.174	53.60	54.00	-0.40	AV
2390	59.83	313	192	V	28.93	6.489	36.174	59.08	74.00	-14.92	PK
2390	51.13	313	192	V	28.93	6.489	36.174	50.38	54.00	-3.62	AV
4844	47.24	0	100	H	32.79	9.36	35.747	53.64	74.00	-20.36	PK
4844	38.10	0	100	H	32.79	9.36	35.747	44.50	54.00	-9.50	AV
4844	47.25	0	100	V	32.53	9.36	35.747	53.39	74.00	-20.61	PK
4844	38.14	0	100	V	32.53	9.36	35.747	44.28	54.00	-9.72	AV
Middle Channel 2437 MHz n40 mode Power Setting = 14											
2437	67.53	269	241	H	29.15	5.76	0.00	102.44	-	-	PK
2437	60.25	269	241	H	29.15	5.76	0.00	95.16	-	-	AV
2437	60.58	45	153	V	29.19	5.76	0.00	95.53	-	-	PK
2437	52.49	45	153	V	29.19	5.76	0.00	87.44	-	-	AV
4874	47.35	0	100	H	32.79	9.46	35.70	53.89	74.00	-20.11	PK
4874	37.85	0	100	H	32.79	9.46	35.70	44.39	54.00	-9.61	AV
4874	47.39	0	100	V	32.53	9.46	35.70	53.67	74.00	-20.33	PK
4874	37.97	0	100	V	32.53	9.46	35.70	44.25	54.00	-9.75	AV
High Channel 2452 MHz n40 mode Power Setting = 14											
2452	62.44	224	257	H	29.15	5.87	0.00	97.46	-	-	PK
2452	55.23	224	257	H	29.15	5.87	0.00	90.25	-	-	AV
2452	60.43	234	136	V	29.19	5.87	0.00	95.49	-	-	PK
2452	52.90	234	136	V	29.19	5.87	0.00	87.96	-	-	AV
2483.5	63.25	224	257	H	29.25	6.654	36.13	63.03	74.00	-10.98	PK
2483.5	53.35	224	257	H	29.25	6.654	36.13	53.13	54.00	-0.88	AV
2483.5	62.10	337	187	V	29.18	6.654	36.13	61.80	74.00	-12.20	PK
2483.5	51.98	337	187	V	29.18	6.654	36.13	51.68	54.00	-2.32	AV
4904	46.44	0	100	H	32.81	9.46	35.70	53.00	74.00	-21.00	PK
4904	37.72	0	100	H	32.81	9.46	35.70	44.28	54.00	-9.72	AV
4904	46.77	0	100	V	32.70	9.46	35.70	53.22	74.00	-20.78	PK
4904	37.56	0	100	V	32.70	9.46	35.70	44.01	54.00	-9.99	AV

8 Appendix A – EUT Test Setup Photographs

Please refer to the attachment

9 Appendix B – EUT External Photographs

10 Appendix C – EUT Internal Photographs

11 Appedix D (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA *R222 - Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system *(refer to joint ISO-ILAC-IAF Communiqué dated April 2017)*.

Presented this 2nd day of October 2018.

President and CEO
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2020

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

--- END OF REPORT ---