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

TEST REPORT

For

Trimble Inc.

935 Stewart Drive,
Sunnyvale, CA 94085, USA

FCC ID: JUP-WL18DBMOD
IC: 1756A-WL18DBMOD

Report Type:	**Product Type:**
CIIPC Report	Wi-Fi/BT Module

Prepared By:	Xiao Lin Test Engineer
Report Number:	R1707201-CIIPC DTS
Report Date:	2017-10-10
Reviewed By:	Frank Wang RF Engineer

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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1707201-CIIPC DTS	Original Report	2017-09-28
1	R1707201-CIIPC DTS	Fixed Reviewer's comments	2017-10-10

1 General Description

1.1 General Statements

Bay area Compliance Laboratory Corp. [BACL] hereby makes the following Statements:

- The Unit(s) described in this Test Report were received at BACL's facilities on 19 April 2017 and was in working condition upon arrival. Testing was performed on the Unit(s) described in this Test Report from 19 April 2017 to 19 September 2017.
- The Test Results reported herein apply only to the Unit(s) actually tested, and to substantially identical Units.
- This Test Report must not be used to claim product endorsement by A2LA, or any agency of the U.S. Government, or by any other foreign government.
- This Test Report is the property of BACL, and shall not be reproduced, except in full, without prior written approval of BACL.

1.2 Objective

This CIIPC report is prepared on behalf of *Trimble Inc.,* in accordance with Part 2, Subpart J, Part 15, Subparts B and C, and ISED RSS-247 Issue 2, February 2017 to show compliance with multi-transmitter requirements.

This project is a Permissive Change II submission for the purpose of changing BT/Wi-Fi module to allow co-location with UHF radio and the Cellular module in R10-2 host and add 2 new antennas as well.

1.3 Agent for the Responsible Party

None

1.4 Responsible Party

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1.5 Related Submittal(s)/Grant(s)

FCC Part 15, Subpart C, Equipment DSS with FCC ID: JUP-WL18DBMOD, ISED: 1756A-WL18DBMOD

1.6 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Trimble* Inc. and their product: *Wi-Fi/BT module, Model: WL1837MOD FCC ID: JUP-WL18DBMOD, ISED: 1756A-WL18DBMOD* or the "EUT" as referred to in this report. The EUT is a Wi-Fi/BT Module.

Note: Tested product: WL1837MOD, and WL1837MOD installed in host model number: R10-2.

1.7 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013 and TIA-603D, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.

1.8 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	±1.48 dB
Unwanted Emissions, conducted	±1.57 dB
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 %
Time	±2 %
Duty Cycle	±3 %

1.9 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 Industry 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.

1.10 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 (Industry Canada):
    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 (Info-Communications Development Authority (IDA)):

1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2

2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA 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: (Industry Canada - IC) 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 & Teleterminal Equipment (R&TTE) Directive 1995/5/EC 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 Development Authority - IDA) 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 TIA-603D.
The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

2.2 EUT Exercise Software

The EUT and support equipment were pre-installed with exercising software by *Trimble Inc.* The exercising software was installed on the laptop. CSGSuite, WebGui and Putty were used for configuring Wi-Fi/Bluetooth Module and UHF Module operations.

The software used was provided by *Trimble Navigation Limited*, the software complies with the standard requirements being tested against.

2.3 Equipment Modifications

For **Host R10-2,** a pre-certified Wi-Fi/Bluetooth transceiver module (FCC ID: Z64-WL18DBMOD, ISED: 451I-WL18DBMOD) was installed together with a pre-certified UHF module (FCC ID: KEAXDLM, ISED: 2368B-XDLM), a pre-certified Cellular/UMTS transceiver module (FCC ID: QIPPHS8-P, ISED: 7830A-PHS8P) in the host device. This is for the purpose of radio co-location testing.

For **Host SPS986,** a pre-certified Wi-Fi/Bluetooth transceiver module (FCC ID: Z64-WL18DBMOD, ISED: 451I-WL18DBMOD) was installed together with a pre-certified UHF module (FCC ID: KEAXDLM, ISED: 2368B-XDLM), a 900MHz FHSS module (model name: 80385-B) in the host device. This is for the purpose of radio co-location testing.

2.4 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	120503
Dell	Laptop	E6410	28J04Q1

2.5 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
DC power/data	2	EUT	AC/DC, PC

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & ISED Rules	Description of Test	Results
FCC §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §2.1091 ISED RSS-102	RF Exposure	Compliant
FCC §15.207 ISED RSS-Gen §8.8	AC Line Conducted Emissions	Compliant

4 FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions

4.1 Applicable Standards

As per FCC §15.35(d): 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 show 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 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	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 when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (µv/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for license-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

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(4), 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.

4.2 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.

4.3 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

4.4 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

4.5 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	2016-02-04	2 years
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	27 Months
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2017-03-13	1 year
IW	AOBOR Hi frequency Co AX Cable	KPS-1501N-3960-KPS	-	2017-04-27	1 year
-	SMA cable	-	C0002	Each time[1]	N/A
-	N-Type Cable	-	C00012	Each time[1]	N/A
-	N-Type Cable	-	C00014	Each time[1]	N/A
Agilent	Pre-Amplifier	8449B	3008A01978	2016-10-06	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2017-03-27	2 years
A.R.A.	Antenna, Horn	DRG-118/A	1132	2015-09-21	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 *attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

4.6 Test Environmental Conditions

Temperature:	20-22 ºC
Relative Humidity:	44-50 %
ATM Pressure:	102.5 kPa

The testing was performed by Vincent Licata from 2017-09-18 to 2017-09-19 in 5m chamber 3.

4.7 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:

Module is connected to the Patch antenna

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, channel**
-1.59	2390	Horizontal	g mode, low channel

Module is connected to the embedded antenna

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, channel**
-0.63	4824	Horizontal	b mode, low channel

Co-Location

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, channel**
-0.45	4874	Vertical	Co-Location

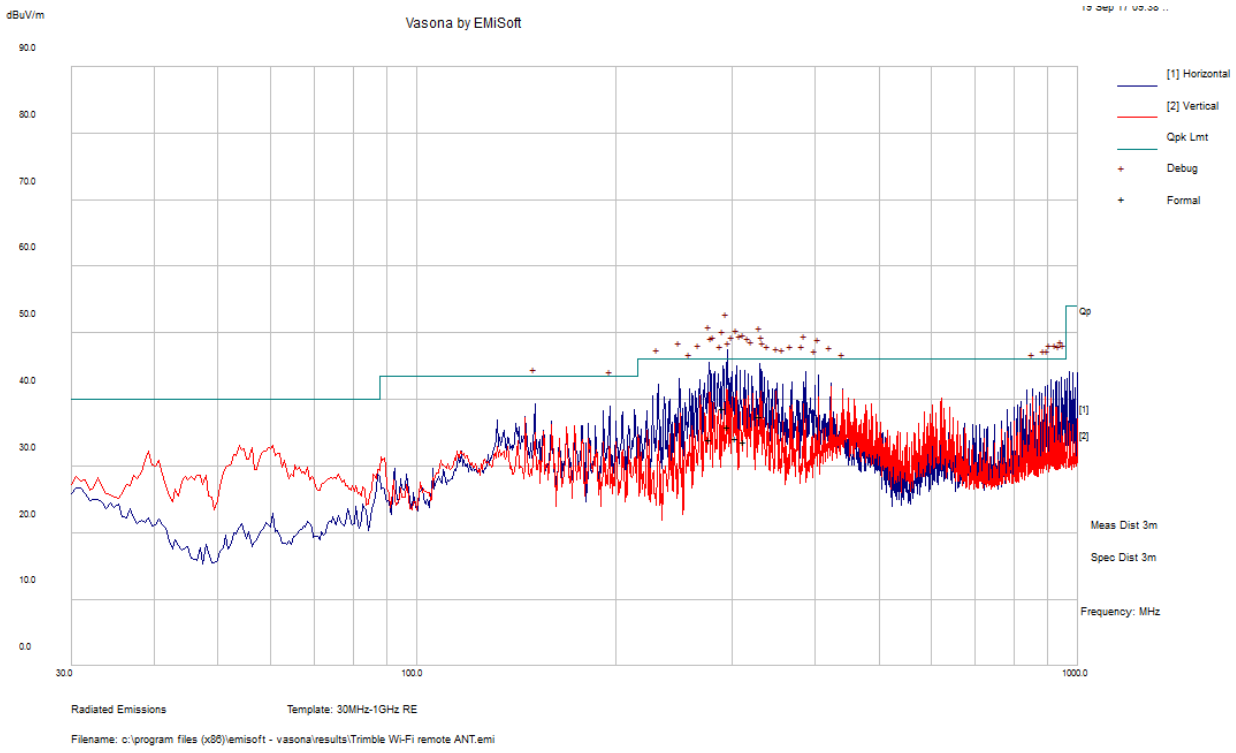
Please refer to the following table and plots for specific test result details

4.8 Radiated Emissions Test Results

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

With Patch antenna

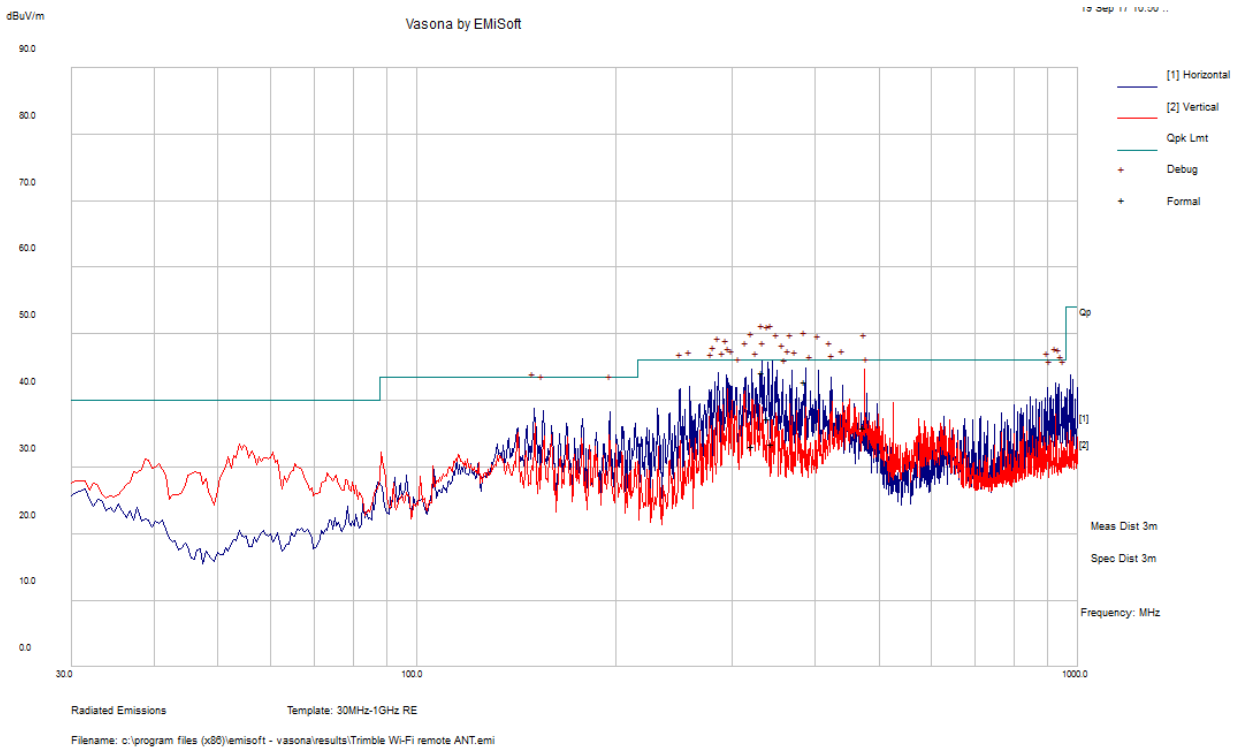
2.4 GHz Wi-Fi



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
294.8888	35.91	H	272	152	46	-10.09	QP
276.8878	34.08	H	137	183	46	-11.92	QP
330.8768	37.49	H	247	138	46	-8.51	QP
304.0675	34.14	V	99	330	46	-11.86	QP
290.5705	38.76	H	143	133	46	-7.24	QP
312.887	33.74	H	294	201	46	-12.26	QP

With Embedded antenna

2.4 GHz Wi-Fi



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
344.3815	33.45	H	281	326	46	-12.55	QP
333.0033	44.2	H	298	149	46	-1.8	QP
340.1338	37.25	H	122	335	46	-8.75	QP
386.9703	42.9	H	247	337	46	-3.1	QP
321.3833	33.13	V	107	258	46	-12.87	QP
474.7688	36.02	V	99	75	46	-9.98	QP

2) 1–25 GHz Measured at 3 meters

With Patch antenna

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											
2412	68.13	25	223	H	28.94	6.29	0	103.36	-	-	PK
2412	65.27	25	223	H	28.94	6.29	0	100.50	-	-	AV
2412	68.38	40	236	V	28.93	6.29	0	103.60	-	-	PK
2412	65.29	40	236	V	28.93	6.29	0	100.51	-	-	AV
2390	55.47	340	100	H	28.94	6.76	36.588	54.58	74.00	-19.42	PK
2390	47.83	340	100	H	28.94	6.76	36.588	46.94	54.00	-7.06	AV
2390	52.25	95	300	V	28.93	6.76	36.588	51.35	74.00	-22.65	PK
2390	43.48	95	300	V	28.93	6.76	36.588	42.58	54.00	-11.42	AV
4824	50.33	56	224	H	32.53	9.62	36.36	56.12	74.00	-17.88	PK
4824	45.43	56	224	H	32.53	9.62	36.36	51.22	54.00	-2.78	AV
4824	49.87	119	105	V	32.53	9.62	36.36	55.66	74.00	-18.34	PK
4824	44.93	119	105	V	32.53	9.62	36.36	50.72	54.00	-3.28	AV
7236	44.02	0	100	V	36.88	12.21	36.38	56.73	74.00	-17.27	PK
7236	32.14	0	100	V	36.88	12.21	36.38	44.85	54.00	-9.15	AV
9648	45.94	0	100	V	37.81	13.82	36.43	61.14	74.00	-12.86	PK
9648	33.59	0	100	V	37.81	13.82	36.43	48.79	54.00	-5.21	AV
Middle Channel 2437 MHz											
2437	66.22	28	100	H	29.19	6.29	0.00	101.70	-	-	PK
2437	63.22	28	100	H	29.19	6.29	0.00	98.70	-	-	AV
2437	73.08	40	100	V	29.19	6.29	0.00	108.56	-	-	PK
2437	70.05	40	100	V	29.19	6.29	0.00	105.53	-	-	AV
4874	48.81	78	100	H	32.70	9.42	36.327	54.59	74.00	-19.41	PK
4874	40.55	78	100	H	32.70	9.42	36.327	46.33	54.00	-7.67	PK
4874	49.25	197	100	V	32.70	9.42	36.327	55.03	74.00	-18.97	PK
4874	42.89	197	100	V	32.70	9.42	36.327	48.67	54.00	-5.33	AV
7311	44.89	0	100	V	36.99	11.68	36.40	57.16	74.00	-16.84	PK
7311	32.64	0	100	V	36.99	11.68	36.40	44.91	54.00	-9.09	AV
9748	45.60	0	100	V	37.82	13.21	36.45	60.17	74.00	-13.83	PK
9748	33.68	0	100	V	37.82	13.21	36.45	48.25	54.00	-5.75	AV

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)	
High Channel 2462 MHz											
2462	62.02	35	100	H	29.15	6.35	0.00	97.52	-	-	PK
2462	59.06	35	100	H	29.15	6.35	0.00	94.56	-	-	AV
2462	72.19	42	156	V	29.19	6.35	0.00	107.72	-	-	PK
2462	69.27	42	156	V	29.19	6.35	0.00	104.80	-	-	AV
2483.5	50.05	35	100	H	29.25	6.84	36.59	49.55	74.00	-24.45	PK
2483.5	41.12	35	100	H	29.25	6.84	36.59	40.62	54.00	-13.38	AV
2483.5	54.76	0	108	V	29.18	6.84	36.59	54.19	74.00	-19.81	PK
2483.5	48.29	0	108	V	29.18	6.84	36.59	47.72	54.00	-6.28	AV
4924	46.58	0	100	H	32.70	8.58	36.33	51.53	74.00	-22.47	PK
4924	39.34	0	100	H	32.70	8.58	36.33	44.29	54.00	-9.71	AV
4924	48.17	197	100	V	32.70	8.58	36.33	53.12	74.00	-20.88	PK
4924	40.16	197	100	V	32.70	8.58	36.33	45.11	54.00	-8.89	AV
7386	44.63	0	100	V	37.10	12.30	36.41	57.62	74.00	-16.38	PK
7386	32.55	0	100	V	37.10	12.30	36.41	45.54	54.00	-8.46	AV
9848	45.37	0	100	V	37.98	13.76	36.45	60.66	74.00	-13.34	PK
9848	33.14	0	100	V	37.98	13.76	36.45	48.43	54.00	-5.57	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											
2412	69.58	23	151	H	28.94	6.29	0	104.81	-	-	PK
2412	60.39	23	151	H	28.94	6.29	0	95.62	-	-	AV
2412	69.91	3	100	V	28.93	6.29	0	105.13	-	-	PK
2412	60.58	3	100	V	28.93	6.29	0	95.80	-	-	AV
2390	72.49	31	100	H	28.94	6.76	36.588	71.60	74.00	-2.40	PK
2390	53.30	31	100	H	28.94	6.76	36.588	52.41	54.00	-1.59	AV
2390	65.47	73	100	V	28.93	6.76	36.588	64.57	74.00	-9.43	PK
2390	45.86	73	100	V	28.93	6.76	36.588	44.96	54.00	-9.04	AV
4824	45.89	0	100	H	32.53	9.62	36.36	51.68	74.00	-22.32	PK
4824	34.35	0	100	H	32.53	9.62	36.36	40.14	54.00	-13.86	AV
4824	45.74	0	100	V	32.53	9.62	36.36	51.53	74.00	-22.47	PK
4824	35.11	0	100	V	32.53	9.62	36.36	40.90	54.00	-13.10	AV
7236	43.84	0	100	V	36.88	12.21	36.38	56.55	74.00	-17.45	PK
7236	32.46	0	100	V	36.88	12.21	36.38	45.17	54.00	-8.83	AV
9648	45.28	0	100	V	37.81	13.82	36.43	60.48	74.00	-13.52	PK
9648	33.76	0	100	V	37.81	13.82	36.43	48.96	54.00	-5.04	AV
Middle Channel 2437 MHz											
2437	69.17	25	215	H	29.19	6.29	0.00	104.65	-	-	PK
2437	61.26	25	215	H	29.19	6.29	0.00	96.74	-	-	AV
2437	76.43	0	182	V	29.19	6.29	0.00	111.91	-	-	PK
2437	67.29	0	182	V	29.19	6.29	0.00	102.77	-	-	AV
4874	45.91	0	100	H	32.70	9.42	36.327	51.69	74.00	-22.31	PK
4874	34.02	0	100	H	32.70	9.42	36.327	39.80	54.00	-14.20	PK
4874	45.61	0	100	V	32.70	9.42	36.327	51.39	74.00	-22.61	PK
4874	34.09	0	100	V	32.70	9.42	36.327	39.87	54.00	-14.13	AV
7311	44.31	0	100	V	36.99	11.68	36.40	56.58	74.00	-17.42	PK
7311	32.98	0	100	V	36.99	11.68	36.40	45.25	54.00	-8.75	AV
9748	45.25	0	100	V	37.82	13.21	36.45	59.82	74.00	-14.18	PK
9748	33.91	0	100	V	37.82	13.21	36.45	48.48	54.00	-5.52	AV

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)	
High Channel 2462 MHz											
2462	61.84	47	100	H	29.15	6.35	0.00	97.34	-	-	PK
2462	52.90	47	100	H	29.15	6.35	0.00	88.40	-	-	AV
2462	73.57	345	183	V	29.19	6.35	0.00	109.10	-	-	PK
2462	64.18	345	183	V	29.19	6.35	0.00	99.71	-	-	AV
2483.5	62.36	37	100	H	29.25	6.84	36.59	61.86	74.00	-12.14	PK
2483.5	43.61	37	100	H	29.25	6.84	36.59	43.11	54.00	-10.89	AV
2483.5	70.89	0	113	V	29.18	6.84	36.59	70.32	74.00	-3.68	PK
2483.5	52.14	0	113	V	29.18	6.84	36.59	51.57	54.00	-2.43	AV
4924	45.66	0	100	H	32.70	8.58	36.33	50.61	74.00	-23.39	PK
4924	34.76	0	100	H	32.70	8.58	36.33	39.71	54.00	-14.29	AV
4924	46.07	0	100	V	32.70	8.58	36.33	51.02	74.00	-22.98	PK
4924	35.10	0	100	V	32.70	8.58	36.33	40.05	54.00	-13.95	AV
7386	44.43	0	100	V	37.10	12.30	36.41	57.42	74.00	-16.58	PK
7386	32.88	0	100	V	37.10	12.30	36.41	45.87	54.00	-8.13	AV
9848	45.26	0	100	V	37.98	13.76	36.45	60.55	74.00	-13.45	PK
9848	33.29	0	100	V	37.98	13.76	36.45	48.58	54.00	-5.42	AV

With Embedded antenna

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											
2412	66.18	299	166	H	28.94	6.29	0	101.41	-	-	PK
2412	63.02	299	166	H	28.94	6.29	0	98.25	-	-	AV
2412	57.49	156	292	V	28.93	6.29	0	92.71	-	-	PK
2412	54.46	156	292	V	28.93	6.29	0	89.68	-	-	AV
2390	53.10	299	100	H	28.94	6.76	36.588	52.21	74.00	-21.79	PK
2390	46.20	299	100	H	28.94	6.76	36.588	45.31	54.00	-8.69	AV
2390	49.59	156	100	V	28.93	6.76	36.588	48.69	74.00	-25.31	PK
2390	40.28	156	100	V	28.93	6.76	36.588	39.38	54.00	-14.62	AV
4824	51.67	224	105	H	32.53	9.62	36.36	57.46	74.00	-16.54	PK
4824	47.58	224	105	H	32.53	9.62	36.36	53.37	54.00	-0.63	AV
4824	51.44	218	100	V	32.53	9.62	36.36	57.23	74.00	-16.77	PK
4824	47.12	218	100	V	32.53	9.62	36.36	52.91	54.00	-1.09	AV
7236	44.66	0	100	H	36.88	12.21	36.38	57.37	74.00	-16.63	PK
7236	33.03	0	100	H	36.88	12.21	36.38	45.74	54.00	-8.26	AV
9648	45.60	0	100	H	37.81	13.82	36.43	60.80	74.00	-13.20	PK
9648	34.26	0	100	H	37.81	13.82	36.43	49.46	54.00	-4.54	AV
Middle Channel 2437 MHz											
2437	67.02	45	100	H	29.19	6.29	0.00	102.50	-	-	PK
2437	64.07	45	100	H	29.19	6.29	0.00	99.55	-	-	AV
2437	59.33	157	100	V	29.19	6.29	0.00	94.81	-	-	PK
2437	56.34	157	100	V	29.19	6.29	0.00	91.82	-	-	AV
4874	51.73	212	100	H	32.70	9.42	36.327	57.51	74.00	-16.49	PK
4874	47.11	212	100	H	32.70	9.42	36.327	52.89	54.00	-1.11	PK
4874	51.68	225	100	V	32.70	9.42	36.327	57.46	74.00	-16.54	PK
4874	46.99	225	100	V	32.70	9.42	36.327	52.77	54.00	-1.23	AV
7311	44.72	0	100	H	36.99	11.68	36.40	56.99	74.00	-17.01	PK
7311	33.27	0	100	H	36.99	11.68	36.40	45.54	54.00	-8.46	AV
9748	46.38	0	100	H	37.82	13.21	36.45	60.95	74.00	-13.05	PK
9748	34.29	0	100	H	37.82	13.21	36.45	48.86	54.00	-5.14	AV

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)	
High Channel 2462 MHz											
2462	69.30	48	100	H	29.15	6.35	0.00	104.80	-	-	PK
2462	66.32	48	100	H	29.15	6.35	0.00	101.82	-	-	AV
2462	66.51	96	251	V	29.19	6.35	0.00	102.04	-	-	PK
2462	63.52	96	251	V	29.19	6.35	0.00	99.05	-	-	AV
2483.5	55.35	48	100	H	29.25	6.84	36.59	54.85	74.00	-19.15	PK
2483.5	49.34	48	100	H	29.25	6.84	36.59	48.84	54.00	-5.16	AV
2483.5	54.55	96	249	V	29.18	6.84	36.59	53.98	74.00	-20.02	PK
2483.5	48.52	96	249	V	29.18	6.84	36.59	47.95	54.00	-6.05	AV
4924	51.51	245	238	H	32.70	8.58	36.33	56.46	74.00	-17.54	PK
4924	46.91	245	238	H	32.70	8.58	36.33	51.86	54.00	-2.14	AV
4924	50.41	315	100	V	32.70	8.58	36.33	55.36	74.00	-18.64	PK
4924	45.65	315	100	V	32.70	8.58	36.33	50.60	54.00	-3.40	AV
7386	45.22	0	100	H	37.10	12.30	36.41	58.21	74.00	-15.79	PK
7386	33.21	0	100	H	37.10	12.30	36.41	46.20	54.00	-7.80	AV
9848	45.90	0	100	H	37.98	13.76	36.45	61.19	74.00	-12.81	PK
9848	33.92	0	100	H	37.98	13.76	36.45	49.21	54.00	-4.79	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											
2412	67.28	45	100	H	28.94	6.29	0	102.51	-	-	PK
2412	58.72	45	100	H	28.94	6.29	0	93.95	-	-	AV
2412	58.96	157	100	V	28.93	6.29	0	94.18	-	-	PK
2412	50.44	157	100	V	28.93	6.29	0	85.66	-	-	AV
2390	70.05	45	100	H	28.94	6.76	36.588	69.16	74.00	-4.84	PK
2390	51.25	45	100	H	28.94	6.76	36.588	50.36	54.00	-3.64	AV
2390	62.31	157	100	V	28.93	6.76	36.588	61.41	74.00	-12.59	PK
2390	42.51	157	100	V	28.93	6.76	36.588	41.61	54.00	-12.39	AV
4824	45.83	0	100	H	32.53	9.62	36.36	51.62	74.00	-22.38	PK
4824	35.57	0	100	H	32.53	9.62	36.36	41.36	54.00	-12.64	AV
4824	45.49	0	100	V	32.53	9.62	36.36	51.28	74.00	-22.72	PK
4824	35.21	0	100	V	32.53	9.62	36.36	41.00	54.00	-13.00	AV
7236	44.10	0	100	H	36.88	12.21	36.38	56.81	74.00	-17.19	PK
7236	32.60	0	100	H	36.88	12.21	36.38	45.31	54.00	-8.69	AV
9648	45.47	0	100	H	37.81	13.82	36.43	60.67	74.00	-13.33	PK
9648	34.01	0	100	H	37.81	13.82	36.43	49.21	54.00	-4.79	AV
Middle Channel 2437 MHz											
2437	70.71	47	100	H	29.19	6.29	0.00	106.19	-	-	PK
2437	61.86	47	100	H	29.19	6.29	0.00	97.34	-	-	AV
2437	62.98	156	100	V	29.19	6.29	0.00	98.46	-	-	PK
2437	53.95	156	100	V	29.19	6.29	0.00	89.43	-	-	AV
4874	48.67	239	100	H	32.70	9.42	36.327	54.45	74.00	-19.55	PK
4874	37.76	239	100	H	32.70	9.42	36.327	43.54	54.00	-10.46	PK
4874	47.75	227	100	V	32.70	9.42	36.327	53.53	74.00	-20.47	PK
4874	37.44	227	100	V	32.70	9.42	36.327	43.22	54.00	-10.78	AV
7311	44.94	0	100	H	36.99	11.68	36.40	57.21	74.00	-16.79	PK
7311	33.30	0	100	H	36.99	11.68	36.40	45.57	54.00	-8.43	AV
9748	45.27	0	100	H	37.82	13.21	36.45	59.84	74.00	-14.16	PK
9748	34.08	0	100	H	37.82	13.21	36.45	48.65	54.00	-5.35	AV

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)	
High Channel 2462 MHz											
2462	70.43	47	100	H	29.15	6.35	0.00	105.93	-	-	PK
2462	61.09	47	100	H	29.15	6.35	0.00	96.59	-	-	AV
2462	60.24	156	100	V	29.19	6.35	0.00	95.77	-	-	PK
2462	50.69	156	100	V	29.19	6.35	0.00	86.22	-	-	AV
2483.5	70.07	46	100	H	29.25	6.84	36.59	69.57	74.00	-4.43	PK
2483.5	51.82	46	100	H	29.25	6.84	36.59	51.32	54.00	-2.68	AV
2483.5	59.92	157	100	V	29.18	6.84	36.59	59.35	74.00	-14.65	PK
2483.5	41.39	157	100	V	29.18	6.84	36.59	40.82	54.00	-13.18	AV
4924	47.40	269	100	H	32.70	8.58	36.33	52.35	74.00	-21.65	PK
4924	37.03	269	100	H	32.70	8.58	36.33	41.98	54.00	-12.02	AV
4924	46.90	206	100	V	32.70	8.58	36.33	51.85	74.00	-22.15	PK
4924	36.26	206	100	V	32.70	8.58	36.33	41.21	54.00	-12.79	AV
7386	44.92	0	100	H	37.10	12.30	36.41	57.91	74.00	-16.09	PK
7386	33.73	0	100	H	37.10	12.30	36.41	46.72	54.00	-7.28	AV
9848	54.86	0	100	H	37.98	13.76	36.45	70.15	74.00	-3.85	PK
9848	34.41	0	100	H	37.98	13.76	36.45	49.70	54.00	-4.30	AV

Co-location test is in the Worst Case: 2.4 GHz BT/Wi-Fi, UHF and GSM850 co-location

30 MHz - 25GHz measured at 3 meters

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)	
Co-Location											
1648	60.30	158	300	H	26.71	5.35	36.87	55.49	74.00	-18.51	PK
1648	48.33	158	300	H	26.71	5.35	36.87	43.52	54.00	-10.48	AV
1648	61.22	203	244	V	26.71	5.35	36.87	56.41	74.00	-17.59	PK
1648	47.96	203	244	V	26.71	5.35	36.87	43.15	54.00	-10.85	AV
4874	63.22	326	251	H	32.70	8.58	38.33	66.17	74.00	-7.83	PK
4874	49.45	326	244	H	32.70	8.58	38.33	52.40	54.00	-1.60	AV
4874	63.87	169	251	V	32.70	8.58	38.33	66.82	74.00	-7.18	PK
4874	50.6	169	244	V	32.70	8.58	38.33	53.55	54.00	**-0.45**	AV
333	52.38	323	167	H	19.97	1.00	29.15	44.2	46.00	-1.8	QP
386	50.3	164	400	H	21.22	1.08	29.7	42.9	46.00	-3.1	QP

5 FCC §2.1091 & ISED RSS-102 - RF Exposure

5.1 Applicable Standards

According to FCC §2.1091 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 ISED RSS-102 must be followed concerning the exposure of humans to RF field

According to ISED RSS-102 Issue 5:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	-2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

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

Host R10-2

Single Transmitter MPE Evaluation

2.4GHz Bluetooth:

Maximum peak output power at antenna input terminal (dBm):	11.64
Maximum peak output power at antenna input terminal (mW):	14.588
Prediction distance (cm):	45
Prediction frequency (MHz):	2402
Maximum Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.585
Power density of prediction frequency at 45 cm (mW/cm^2):	0.0009
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

2.4GHz Wi-Fi:

Maximum peak output power at antenna input terminal (dBm):	20.62
Maximum peak output power at antenna input terminal (mW):	115.34
Prediction distance (cm):	45
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.585
Power density of prediction frequency at 45 cm (mW/cm^2):	0.0072
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

UHF:

Maximum peak output power at antenna input terminal (dBm):	33.04
Maximum peak output power at antenna input terminal (mW):	2013.7242
Prediction distance (cm):	45
Prediction frequency (MHz):	429.95
Maximum Antenna Gain, typical (dBi):	1.2
Maximum Antenna Gain (numeric):	1.318
Power density of prediction frequency at 45 cm (mW/cm^2):	0.1043
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.2866

GSM850/WCDMA Band 5:

Maximum peak output power at antenna input terminal (dBm):	33.8
Maximum peak output power at antenna input terminal (mW):	2398.8329
Prediction distance (cm):	45
Prediction frequency (MHz):	824.2
Maximum Antenna Gain, typical (dBi):	-2
Maximum Antenna Gain (numeric):	0.631
Power density of prediction frequency at 45 cm (mW/cm^2):	0.0595
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.5495

PCS1900/WCDMA Band 2:

Maximum peak output power at antenna input terminal (dBm):	30.5
Maximum peak output power at antenna input terminal (mW):	1122.0185
Prediction distance (cm):	45
Prediction frequency (MHz):	1880
Maximum Antenna Gain, typical (dBi):	-2
Maximum Antenna Gain (numeric):	0.631
Power density of prediction frequency at 45 cm (mW/cm^2):	0.0278
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Note: UHF Module: FCC ID: KEAXDLM, IC: 2368B-XDLM
GSM/WCDMA Module: FCC ID: QIPPHS8-P, IC: 7830A-PHS8P

Multi Transmitter MPE Evaluation

Bluetooth+Wi-Fi+UHF+GSM850/WCDMA Band 5=0.0009/1+0.0072/1+0.1043/0.2866+0.0595/0.5495 =0.4803<1.0

Bluetooth+Wi-Fi+UHF+PCS1900/WCDMA Band 2=0.0009/1+0.0151/1+0.1043/0.2866+0.0278/1=0.3998<1.0

Conclusion

In order to meet the multi-transmitter RF Exposure requirement, all transceiver modules must be installed with a separation distance of no less than **45** cm from all persons.

6.1 ISED MPE Results

Single Transmitter MPE Evaluation

2.4GHz Bluetooth:

Maximum peak output power at antenna input terminal (dBm):	11.64
Maximum peak output power at antenna input terminal (mW):	14.588
Prediction distance (cm):	45
Prediction frequency (MHz):	2402
Maximum Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.585
Power density of prediction frequency at 45 cm (W/m^2):	0.0091
ISED MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	5.35

2.4GHz Wi-Fi:

Maximum peak output power at antenna input terminal (dBm):	20.62
Maximum peak output power at antenna input terminal (mW):	115.345
Prediction distance (cm):	45
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.585
Power density of prediction frequency at 45 cm (W/m^2):	0.0719
ISED MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	5.404

UHF:

Maximum peak output power at antenna input terminal (dBm):	33.06
Maximum peak output power at antenna input terminal (mW):	2023.0192
Prediction distance (cm):	45
Prediction frequency (MHz):	429.95
Maximum Antenna Gain, typical (dBi):	1.2
Maximum Antenna Gain (numeric):	1.318
Power density of prediction frequency at 45 cm (W/m^2):	1.048
ISED MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	1.651

GSM850/WCDMA Band 5:

Maximum peak output power at antenna input terminal (mW):	2399
Prediction distance (cm):	45
Prediction frequency (MHz):	824.2
Maximum Antenna Gain, typical (dBi):	-2
Maximum Antenna Gain (numeric):	0.631
Power density of prediction frequency at 45 cm (W/m^2):	0.5948
ISED MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	2.576

PCS1900/WCDMA Band 2:

Maximum peak output power at antenna input terminal (mW):	1122
Prediction distance (cm):	45
Prediction frequency (MHz):	1880
Maximum Antenna Gain, typical (dBi):	-2
Maximum Antenna Gain (numeric):	0.631
Power density of prediction frequency at 45 cm (W/m^2):	0.2782
ISED MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	4.5258

Note: UHF Module: FCC ID: KEAXDLM, IC: 2368B-XDLM
GSM/WCDMA Module: FCC ID: QIPPHS8-P, IC: 7830A-PHS8P

Multi Transmitter MPE Evaluation

Bluetooth+Wifi+UHF+GSM850/WCDMA Band 5=0.0091/5.35+0.0719/5.404+1.048/1.651+0.5948/2.576 = 0.8806 < 1.0

Bluetooth+Wi-Fi+UHF+PCS1900/WCDMA Band 2=0.0091/5.35+0.0719/5.404+1.048/1.651+0.2782/4.5258 = 0.7112 < 1.0

Conclusion

In order to meet the multi-transmitter RF Exposure requirement, all transceiver modules must be installed with a separation distance of no less than **45** cm from all persons.

6 FCC §15.207 & ISED RSS-Gen §8.8 - AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and ISED RSS-Gen §8.8 Conducted limits:

For an intentional radiator that is designed to be connected to the public utility (AC) power line, 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, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note1	56 to 46 Note2
0.5-5	56	46
5-30	60	50

Note1: Decreases with the logarithm of the frequency.
Note2: A linear average detector is required

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used were FCC §15.207 and ISED RSS-Gen §8.8 limits.

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

The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cords of support equipment were connected to LISN-2.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data were recorded in the peak, quasi-peak, and average detection mode. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Corrected Amplitude & Margin Calculation

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

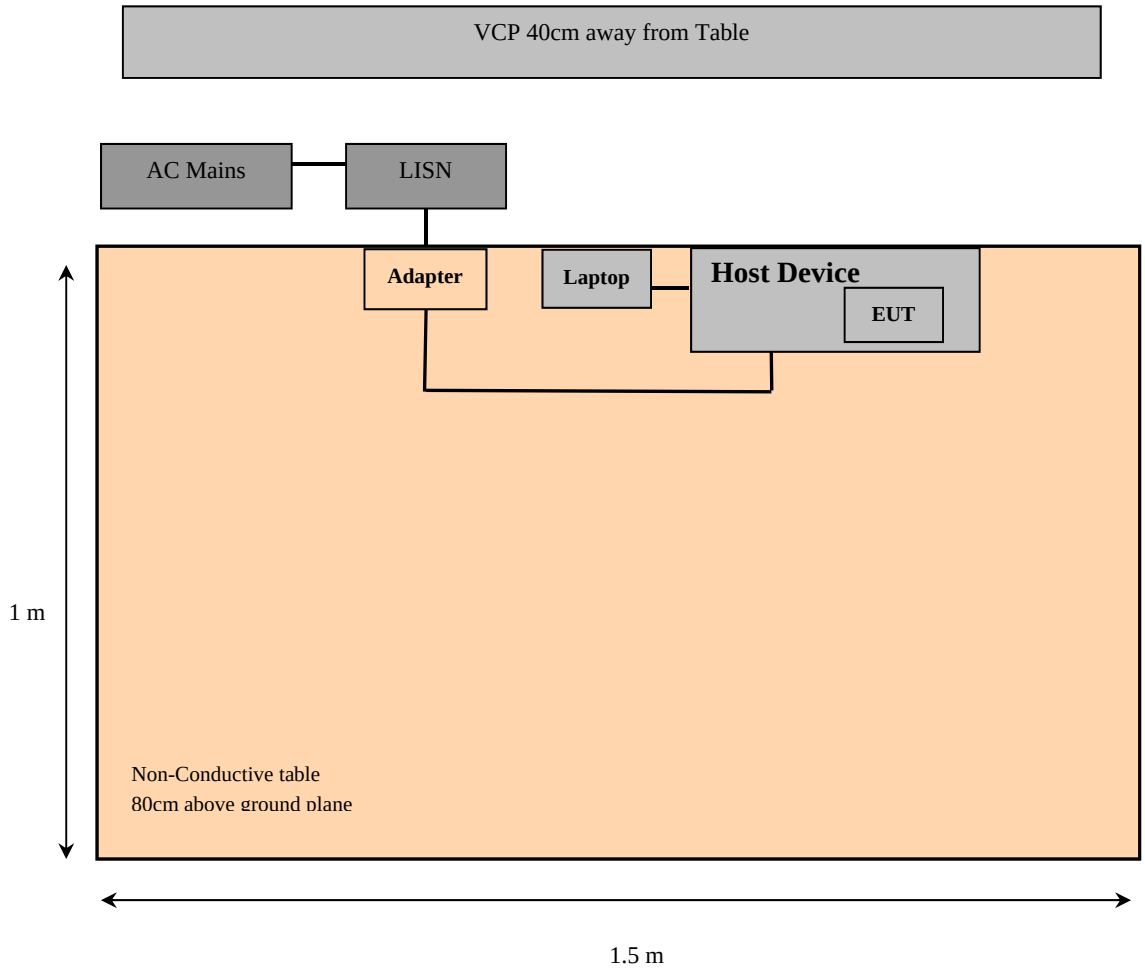
CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 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

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2016-02-04	2 years
Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101964	2016-07-22	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2017-03-13	1 Year
Wireless Solutions	Conducted Emission Cable	LMR 400	691	2016-06-29	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160131	2016-04-25	1year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

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".*

6.7 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	44 %
ATM Pressure:	102.5 kPa

The testing was performed by Xiao Lin on 2017-04-19 at Conducted Emission Test site.

6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C and ISED RSS-Gen standard's conducted emissions limits, with the margin reading of:

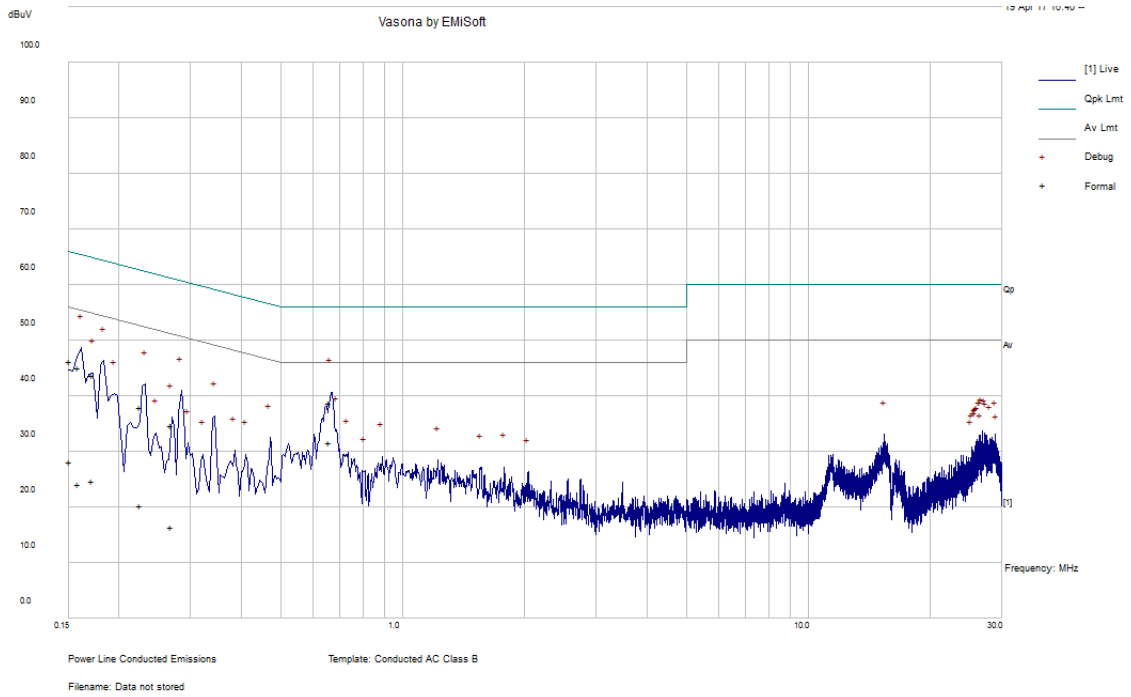
Co-location test is in the Worst Case: 2.4 GHz BT/Wi-Fi, UHF and GSM850 co-location

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-14.36	0.657657	Line	0.15-30

6.9 Conducted Emissions Test Results

2.4 GHz BT/Wi-Fi, UHF and GSM co-location

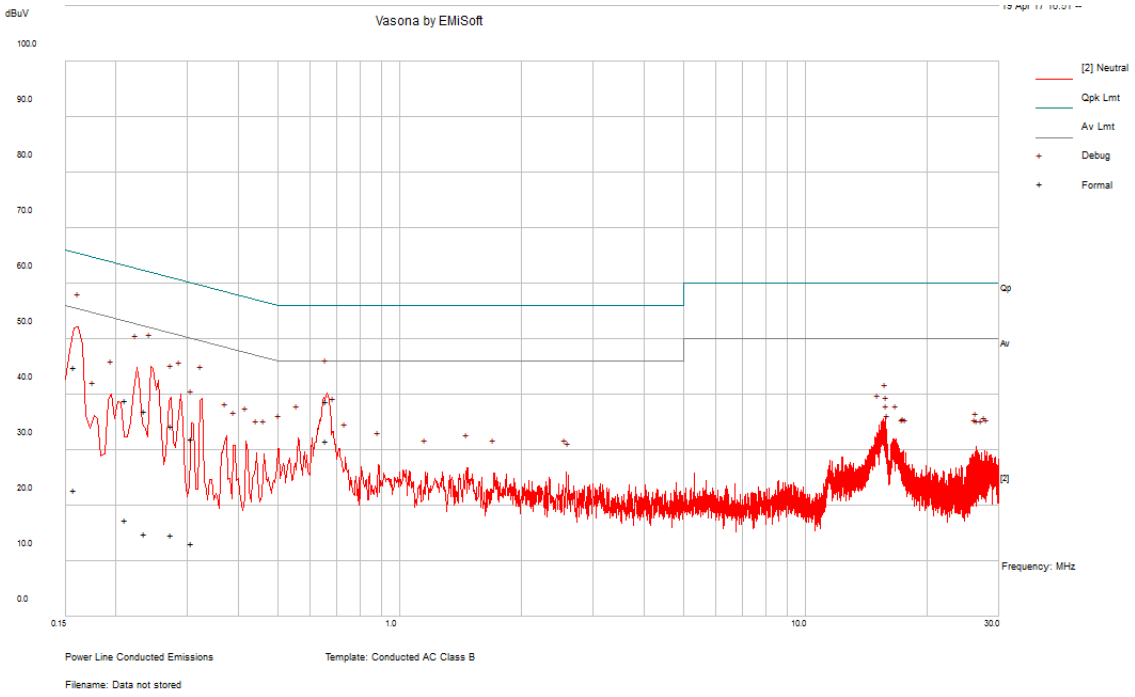
120 V, 60 Hz - Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.657657	28.7	Line	56	-17.2	QP
0.151241	36.62	Line	65.93	-19.6	QP
0.171848	33.95	Line	64.87	-21.16	QP
0.26853	24.84	Line	61.16	-26.4	QP
0.225757	28.22	Line	62.6	-24.51	QP
0.158583	35.45	Line	65.54	-20.35	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.657657	21.53	Line	46	-14.36	Ave.
0.151241	18.52	Line	55.93	-27.7	Ave.
0.171848	15.03	Line	54.87	-30.08	Ave.
0.26853	6.63	Line	51.16	-34.6	Ave.
0.225757	10.39	Line	52.6	-32.35	Ave.
0.158583	14.43	Line	55.54	-31.38	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.157901	35.17	Neutral	65.57	-20.67	QP
0.659362	28.74	Neutral	56	-17.15	QP
0.23499	27.23	Neutral	62.27	-25.16	QP
0.210716	29.19	Neutral	63.18	-24.15	QP
0.308029	22.02	Neutral	60.02	-28.03	QP
0.27462	24.42	Neutral	60.98	-26.62	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.157901	13.12	Neutral	55.57	-32.72	Ave.
0.659362	21.48	Neutral	46	-14.41	Ave.
0.23499	5.14	Neutral	52.27	-37.25	Ave.
0.210716	7.53	Neutral	53.18	-35.81	Ave.
0.308029	3.22	Neutral	50.02	-36.83	Ave.
0.27462	4.83	Neutral	50.98	-36.21	Ave.

7 Appendixes

Please see attachments.

Annex B – FCC and ISED Equipment Labeling Requirement
Annex C – Test Setup Photos
Annex D – EUT photos

---END OF REPORT---