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

TEST REPORT

For

August Home

657 Bryant Street,
San Francisco, CA 94107, USA

FCC ID: 2AB6UASL05-5G
IC: 12163A-ASL055G

Report Type:	**Product Type:**
Original Report	Wi-Fi Smart Lock
Reviewed By:	Christian McCaig Test Engineer
Report Number:	R2209203-247
Report Date:	2022-10-19

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ACCREDITED
CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2209203-247	Original Report	2022-10-19

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *August Home, Inc.*, and their product model: ASL05-5G, FCC ID: 2AB6UASL05-5G, IC: 12163A-ASL055G or the "EUT" as referred to in this report. It is a battery-powered Wi-Fi Smart Lock.

1.2 Objective

This report is prepared on behalf of *August Home, Inc.*, in accordance with Part 2, Subpart J, and Part 15, Subparts B and 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, 6 dB Bandwidth, Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

1.3 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 DTS Meas Guidance v05r2: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

1.4 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 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.5 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.

1.6 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2017 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 17025:2017 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 17025:2017 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: (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 DTS Meas Guidance v05r02.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test software used was WICED provided by *August Home, Inc.*, the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
802.11b	2412	18
	2437	18
	2462	18
8002.11g	2412	16
	2437	16
	2462	16
8002.11n20	2412	15
	2437	15
	2462	15
BLE	2402	default
	2440	default
	2480	default

Data Rates Tested:
802.11b mode: 1Mbps
802.11g mode: 6Mbps
802.11n HT20 mode: MCS0
BLE: 1Mbps

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 DTS Meas Guidance v05r02 section 6.0:

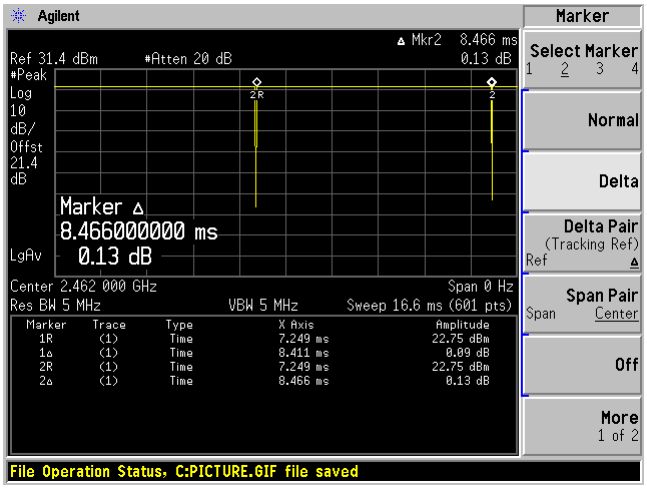
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data is being acquired (i.e., no transmitter off-time is to be considered).

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	8.411	8.466	99.35	0.03
802.11g	1.391	1.451	95.86	0.18
802.11n20	0.1632	0.2136	76.40	1.17
BLE	0.3867	0.6225	62.12	2.07

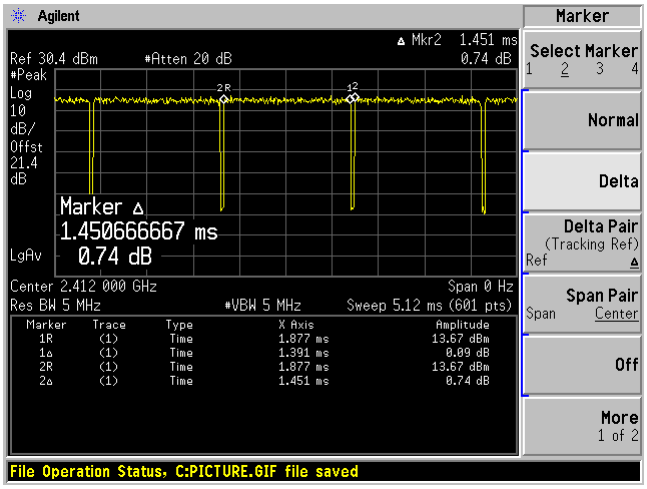
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

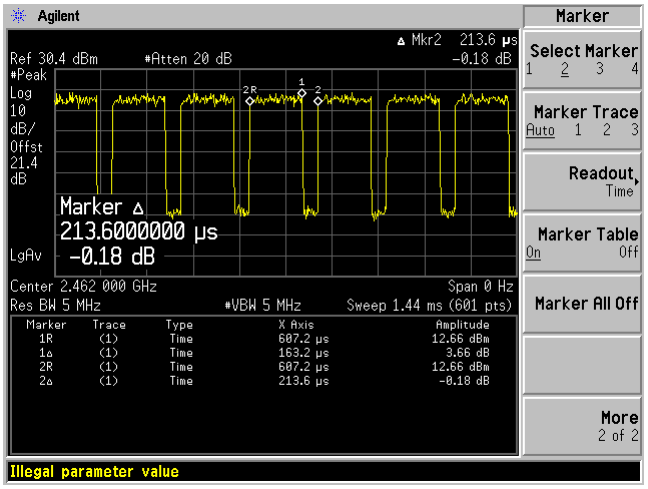
802.11b mode



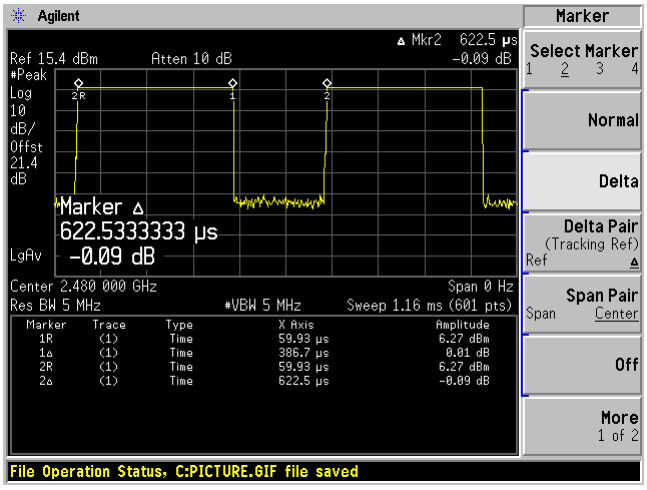
802.11g mode



802.11n20 mode



BLE



2.4 Equipment Modifications

A hole was cut in the side of the EUT with a RF cable coming out to connect antenna ports to power spectrum analyzer.

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E7450

2.6 Support Equipment

N/A

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Type C Cable	< 1 m	Laptop	EUT
RF Cable	< 1 m	EUT	PSA

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 §6.8	Antenna Requirement	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	N/A[1]
FCC §2.1091, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant[2]
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247 (d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9 and §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2 (1)	6 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4 (4)	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) ISEDC RSS-247 §5.2 (2)	Power Spectral Density	Compliant

Note[1]: EUT is battery-powered

4 FCC §15.203 & ISEDC RSS-Gen §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.

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 §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 WNC antenna.

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
2.4GHz Wi-Fi/BLE	2400-2480	-0.87

5 FCC §2.1091, §15.247(i) & ISEDC 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

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 MPE Results

2.4 GHz Wi-Fi

Maximum output power at antenna input terminal (dBm):	19.91
Maximum output power at antenna input terminal (mW):	97.95
Tuned up output power at antenna input terminal (dBm):	20.91
Tuned up output power at antenna input terminal (mW):	123.31
Prediction distance (cm):	20
Prediction frequency (MHz):	2462
Maximum Antenna Gain, typical (dBi):	-0.87
Maximum Antenna Gain (numeric):	0.82
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.02
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 tuned up power density at the distance of 20 cm is 0.02 mW/cm^2. Limit is 1.0 mW/cm^2.

BLE

Maximum peak output power at antenna input terminal (dBm):	6.24
Maximum peak output power at antenna input terminal (mW):	4.21
Tuned up output power at antenna input terminal (dBm):	7.24
Tuned up output power at antenna input terminal (mW):	5.30
Prediction distance (cm):	20
Prediction frequency (MHz):	2480
Maximum Antenna Gain, typical (dBi):	-0.87
Maximum Antenna Gain (numeric):	0.82
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.00086
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 0.00086 mW/cm^2. Limit is 1.0 mW/cm^2.

Note: Client declares that no combination of Bluetooth, 2.4 GHz Wi-Fi and 5GHz Wi-Fi cannot transmit simultaneously.

5.4 RF exposure evaluation exemption for IC

2.4 GHz Wi-Fi

20.91 – 0.87 dBi = 20.04 dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.684 W = 34.29 dBm

2.4 GHz BLE

7.24 – 0.87 dBi = 6.37 dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.676 W = 34.28 dBm

Therefore the RF exposure is not required.

Note: Client declares that no combination of Bluetooth, 2.4 GHz Wi-Fi and 5GHz Wi-Fi cannot transmit simultaneously.

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

6.1 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	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

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.

6.2 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.

6.3 Test Procedure

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 or 1/T / Sweep = Auto

6.4 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

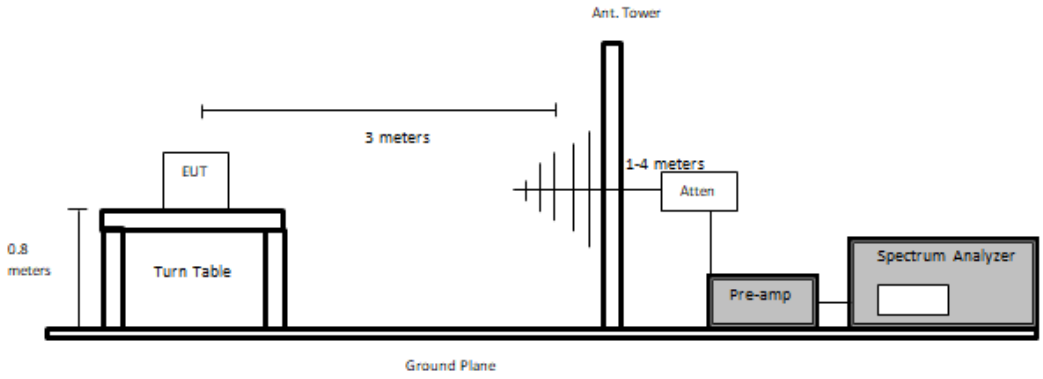
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

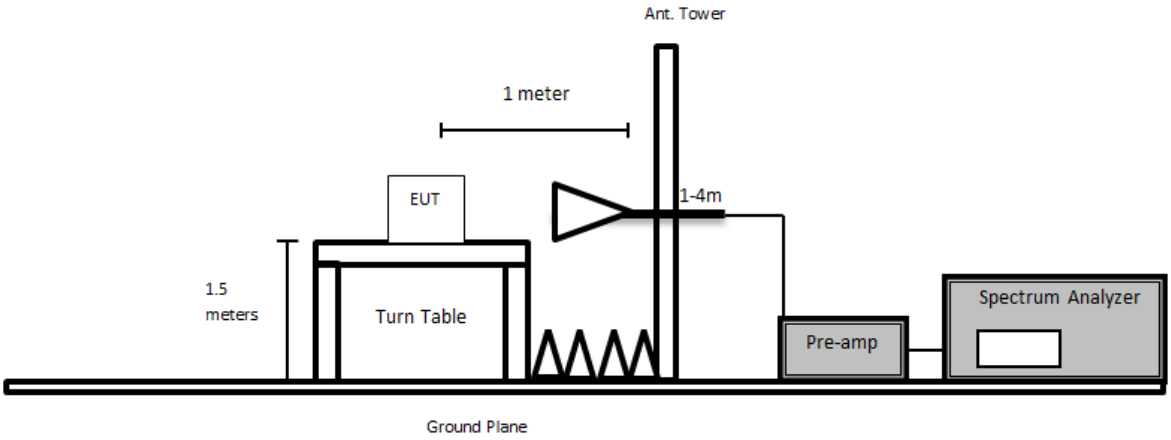
6.5 Test Setup Block Diagram

Below 1GHz:

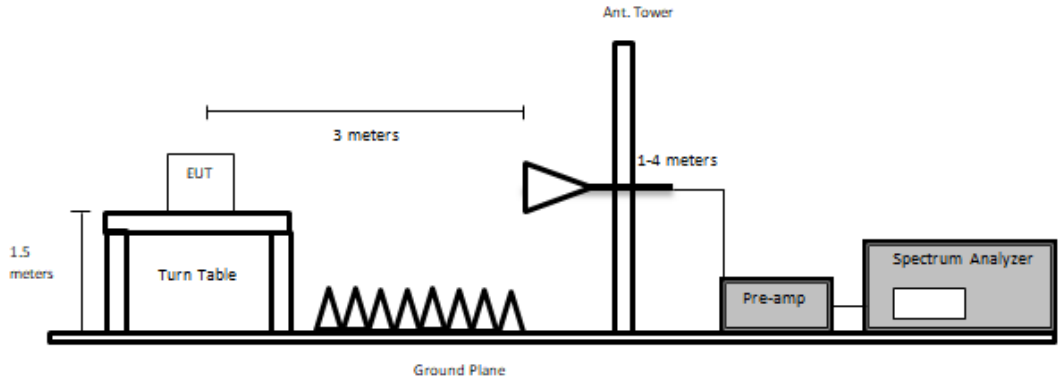


Above 1GHz:

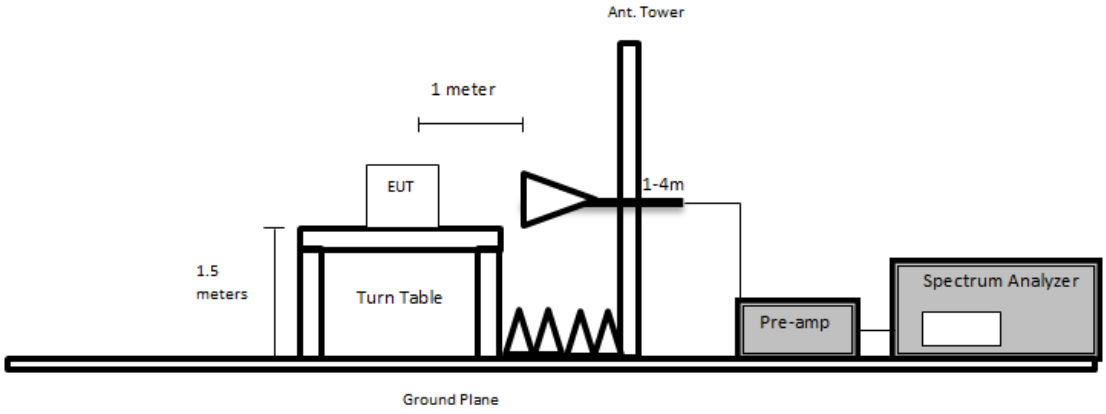
At 1 meter for 1-18GHz



At 3 meters for 1-18GHz



At 1 meters for 18-26.5 GHz



6.6 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
Rohde and Schwarz	Analyzer, Signal	FSQ26 1155.5001K26	200749	2019-03-14	2 years
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2018-02-26	2 years
EMCO	Antenna, Horn	3115	9511-4627	2018-03-28	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2019-04-10	1 year
Insulated Wire INC	2.92mm (M) X2, 1501 Armor Neoprene, 396	KPS-1501AN-3960-KPS	DC 1807	2018-03-13	2 years
-	SMA cable	-	C0002	Each time[1]	N/A
UTiFlex	High Frequency Cable	-	223458-001	Each time[1]	N/A
UTiFlex	High Frequency Cable	-	223458-002	Each time[1]	N/A
HP/Agilent	Pre-Amplifier	8449B	3008A01978	2018-08-17	1 year
Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2018-02-14	2 years
A.R.A.	Antenna, Horn	DRG-118/A	1132	2018-02-13	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.*

6.7 Test Environmental Conditions

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

The testing was performed by Corey Phan 2019-08-05 to 2019-08-08 in 5m chamber 3.

6.8 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**
-3.4	37.4645	Vertical	b mode, high channel

BLE

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**channel**
-3.32	2483.5	Vertical	high channel

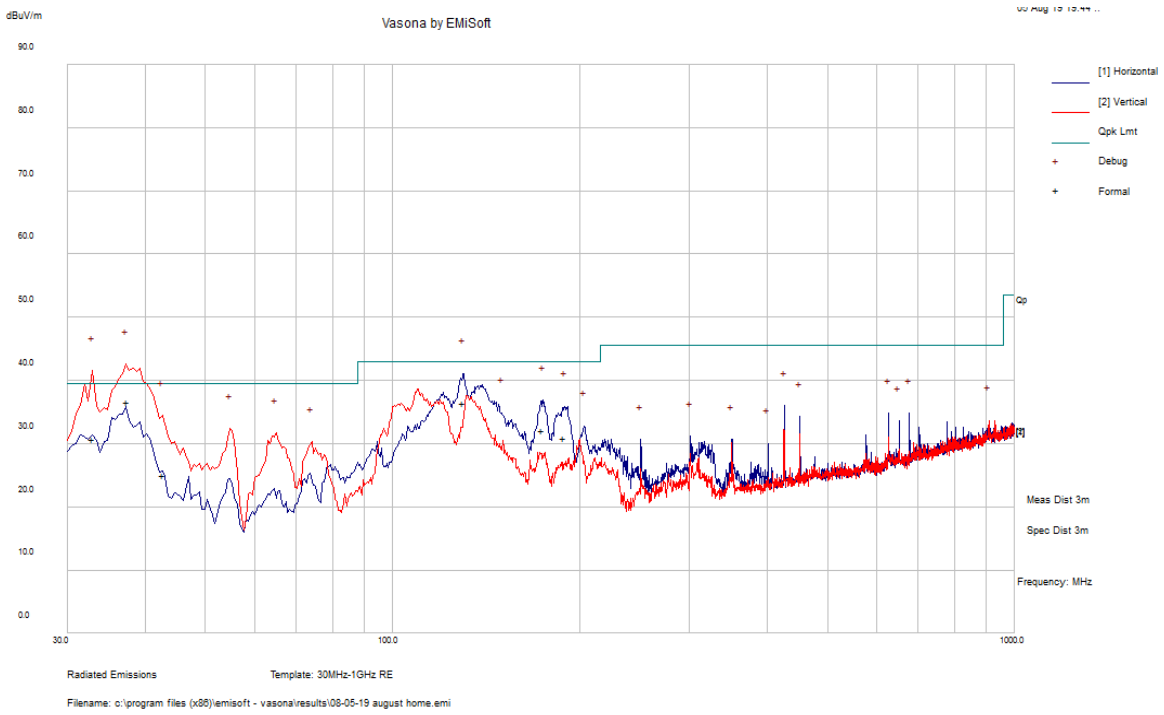
Please refer to the following table and plots for specific test result details

6.9 Radiated Emissions Test Results

Note: Pre-scan was performed in order to determine worst-case orientation of device[shown in Test Setup Photos] with respect to measurement antenna. Plots/data shown represent measurements made in worst-case orientation.

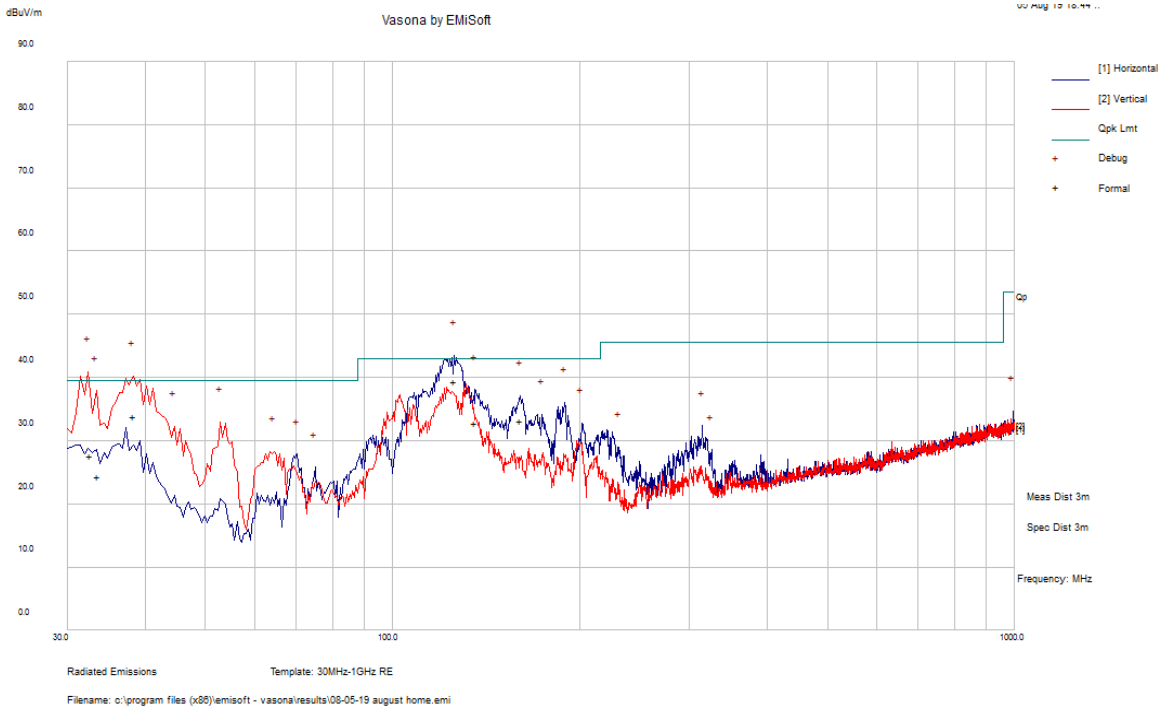
1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters

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
37.4645	36.6	104	V	267	40	-3.4	QP
32.9545	30.76	126	V	299	40	-9.24	QP
129.7408	36.45	125	H	118	43.5	-7.05	QP
42.79025	24.96	130	V	253	40	-15.04	QP
174.3383	32.19	153	H	136	43.5	-11.31	QP
188.8323	30.91	163	H	176	43.5	-12.59	QP

BLE



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
32.66175	27.7	110	V	227	40	-12.3	QP
38.3345	33.92	105	V	220	40	-6.08	QP
125.7725	39.46	138	H	112	43.5	-4.04	QP
33.64375	24.38	116	V	121	40	-15.62	QP
135.9073	32.78	200	H	255	43.5	-10.72	QP
160.6495	33.21	178	H	140	43.5	-10.29	QP

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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											
2390	53.45	321	100	H	28.07	5.72	36.16	51.07	74	-22.93	PK
2390	40.35	321	100	H	28.07	5.72	36.16	37.97	54	-16.03	AV
2390	55.94	202	100	V	28.89	5.72	36.16	54.39	74	-19.61	PK
2390	42.97	202	100	V	28.89	5.72	36.16	41.42	54	-12.58	AV
4824	45.53	0	100	H	33.14	7.31	35.90	50.07	74	-23.93	PK
4824	33.24	0	100	H	33.14	7.31	35.90	37.78	54	-16.22	AV
4824	45.4	0	100	V	33.14	7.31	35.90	49.94	74	-24.06	PK
4824	32.52	0	100	V	33.14	7.31	35.90	37.06	54	-16.94	AV
Middle Channel 2437 MHz											
4874	44.63	0	100	H	33.32	7.35	35.80	49.50	74	-24.50	PK
4874	32.28	0	100	H	33.32	7.35	35.80	37.15	54	-16.85	AV
4874	44.39	0	100	V	33.32	7.35	35.80	49.26	74	-24.74	PK
4874	31.82	0	100	V	33.32	7.35	35.80	36.69	54	-17.31	AV
High Channel 2462 MHz											
2483.5	49.57	0	100	H	29.17	5.85	36.15	48.44	74	-25.56	PK
2483.5	35.1	0	100	H	29.17	5.85	36.15	33.97	54	-20.03	AV
2483.5	60.07	0	157	V	29.10	5.85	36.15	58.87	74	-15.14	PK
2483.5	39.51	0	157	V	29.10	5.85	36.15	38.31	54	-15.70	AV
4924	45.16	0	100	H	33.35	7.54	35.80	50.25	74	-23.76	PK
4924	32.47	0	100	H	33.35	7.54	35.80	37.56	54	-16.45	AV
4924	45.01	0	100	V	33.35	7.54	35.80	50.10	74	-23.91	PK
4924	32.36	0	100	V	33.35	7.54	35.80	37.45	54	-16.56	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											
2390	62.86	60	100	H	28.07	5.72	36.16	60.48	74	-13.52	PK
2390	45.45	60	100	H	28.07	5.72	36.16	43.07	54	-10.93	AV
2390	66.23	220	100	V	28.89	5.72	36.16	64.68	74	-9.32	PK
2390	49.71	220	100	V	28.89	5.72	36.16	48.16	54	-5.84	AV
4824	45.67	0	100	H	33.14	7.31	35.90	50.21	74	-23.79	PK
4824	32.72	0	100	H	33.14	7.31	35.90	37.26	54	-16.74	AV
4824	45.44	0	100	V	33.14	7.31	35.90	49.98	74	-24.02	PK
4824	32.54	0	100	V	33.14	7.31	35.90	37.08	54	-16.92	AV
Middle Channel 2437 MHz											
4874	45.83	0	100	H	33.32	7.35	35.80	50.70	74	-23.30	PK
4874	31.97	0	100	H	33.32	7.35	35.80	36.84	54	-17.16	AV
4874	44.88	0	100	V	33.32	7.35	35.80	49.75	74	-24.25	PK
4874	31.83	0	100	V	33.32	7.35	35.80	36.70	54	-17.30	AV
High Channel 2462 MHz											
2483.5	48.40	0	100	H	29.17	5.85	36.15	47.27	74	-26.73	PK
2483.5	33.76	0	100	H	29.17	5.85	36.15	32.63	54	-21.37	AV
2483.5	52.00	0	100	V	29.10	5.85	36.15	50.80	74	-23.21	PK
2483.5	39.67	0	100	V	29.10	5.85	36.15	38.47	54	-15.54	AV
4924	45.47	0	100	H	33.35	7.54	35.80	50.56	74	-23.45	PK
4924	32.34	0	100	H	33.35	7.54	35.80	37.43	54	-16.58	AV
4924	45.06	0	100	V	33.35	7.54	35.80	50.15	74	-23.86	PK
4924	32.33	0	100	V	33.35	7.54	35.80	37.42	54	-16.59	AV

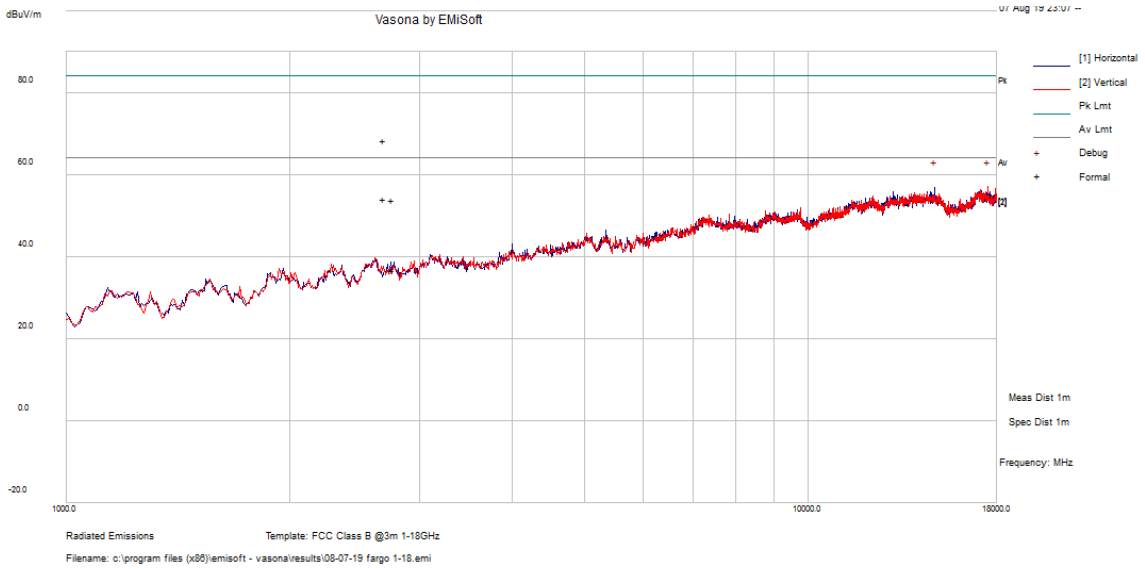
802.11n20 mode

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											
2390	62.06	81	176	H	28.07	5.72	36.16	59.68	74	-14.32	PK
2390	43.66	81	176	H	28.07	5.72	36.16	41.28	54	-12.72	AV
2390	65.46	215	100	V	28.89	5.72	36.16	63.91	74	-10.09	PK
2390	48.03	215	100	V	28.89	5.72	36.16	46.48	54	-7.52	AV
4824	44.86	0	100	H	33.14	7.31	35.90	49.40	74	-24.60	PK
4824	32.09	0	100	H	33.14	7.31	35.90	36.63	54	-17.37	AV
4824	45.1	0	100	V	33.14	7.31	35.90	49.64	74	-24.36	PK
4824	32.03	0	100	V	33.14	7.31	35.90	36.57	54	-17.43	AV
Middle Channel 2437 MHz											
4874	44.32	0	100	H	33.32	7.35	35.80	49.19	74	-24.81	PK
4874	31.64	0	100	H	33.32	7.35	35.80	36.51	54	-17.49	AV
4874	44.6	0	100	V	33.32	7.35	35.80	49.47	74	-24.53	PK
4874	33.67	0	100	V	33.32	7.35	35.80	38.54	54	-15.46	AV
High Channel 2462 MHz											
2483.5	49.57	0	100	H	29.17	5.85	36.15	48.44	74	-25.56	PK
2483.5	34.15	0	100	H	29.17	5.85	36.15	33.02	54	-20.98	AV
2483.5	54.5	0	100	V	29.10	5.85	36.15	53.30	74	-20.71	PK
2483.5	40.05	0	100	V	29.10	5.85	36.15	38.85	54	-15.16	AV
4924	44.94	0	100	H	33.35	7.54	35.80	50.03	74	-23.98	PK
4924	32.1	0	100	H	33.35	7.54	35.80	37.19	54	-16.82	AV
4924	45.16	0	100	V	33.35	7.54	35.80	50.25	74	-23.76	PK
4924	32.09	0	100	V	33.35	7.54	35.80	37.18	54	-16.83	AV

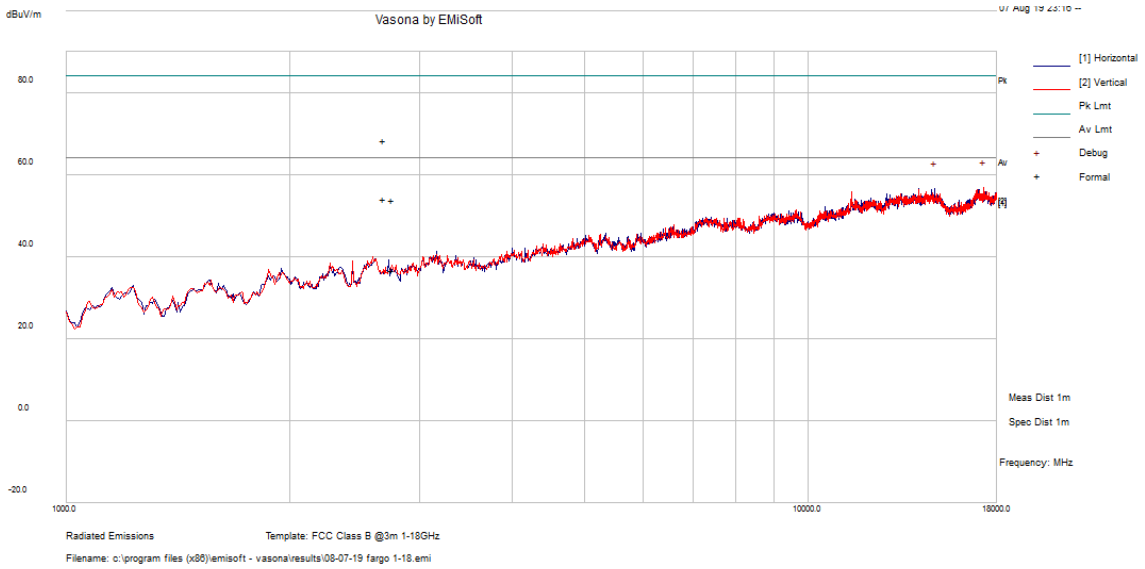
BLE

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 2402 MHz											
2390	49.06	0	100	H	29.19	5.05	36.16	47.14	74	-26.86	PK
2390	36.56	0	100	H	29.19	5.05	36.16	34.64	54	-19.36	AV
2390	49.29	0	100	V	29.19	5.05	36.16	47.37	74	-26.63	PK
2390	36.48	0	100	V	29.19	5.05	36.16	34.56	54	-19.44	AV
4804	46.48	0	100	H	33.14	7.31	35.90	51.02	74	-22.98	PK
4804	33.70	0	100	H	33.14	7.31	35.90	38.24	54	-15.76	AV
4804	46.98	0	100	V	33.14	7.31	35.90	51.52	74	-22.48	PK
4804	33.57	0	100	V	33.14	7.31	35.90	38.11	54	-15.89	AV
Middle Channel 2440 MHz											
4880	45.76	0	100	H	33.32	7.35	35.80	50.63	74	-23.37	PK
4880	32.97	0	100	H	33.32	7.35	35.80	37.84	54	-16.16	AV
4880	45.55	0	100	V	33.32	7.35	35.80	50.42	74	-23.58	PK
4880	32.92	0	100	V	33.32	7.35	35.80	37.79	54	-16.21	AV
High Channel 2480 MHz											
2483.5	55.52	184	100	H	29.19	5.17	36.15	53.73	74	-20.27	PK
2483.5	49.30	184	100	H	29.19	5.17	36.15	47.51	54	-6.49	AV
2483.5	58.26	330	100	V	29.19	5.17	36.15	56.47	74	-17.53	PK
2483.5	52.47	330	100	V	29.19	5.17	36.15	50.68	54	-3.32	AV
4960	46.01	0	100	H	33.35	7.54	35.80	51.10	74	-22.91	PK
4960	32.83	0	100	H	33.35	7.54	35.80	37.92	54	-16.09	AV
4960	45.90	0	100	V	33.35	7.54	35.80	50.99	74	-23.02	PK
4960	32.67	0	100	V	33.35	7.54	35.80	37.76	54	-16.25	AV

1 GHz – 18 GHz 2.4 GHz Wi-Fi Worst Case Scan at 1 Meter

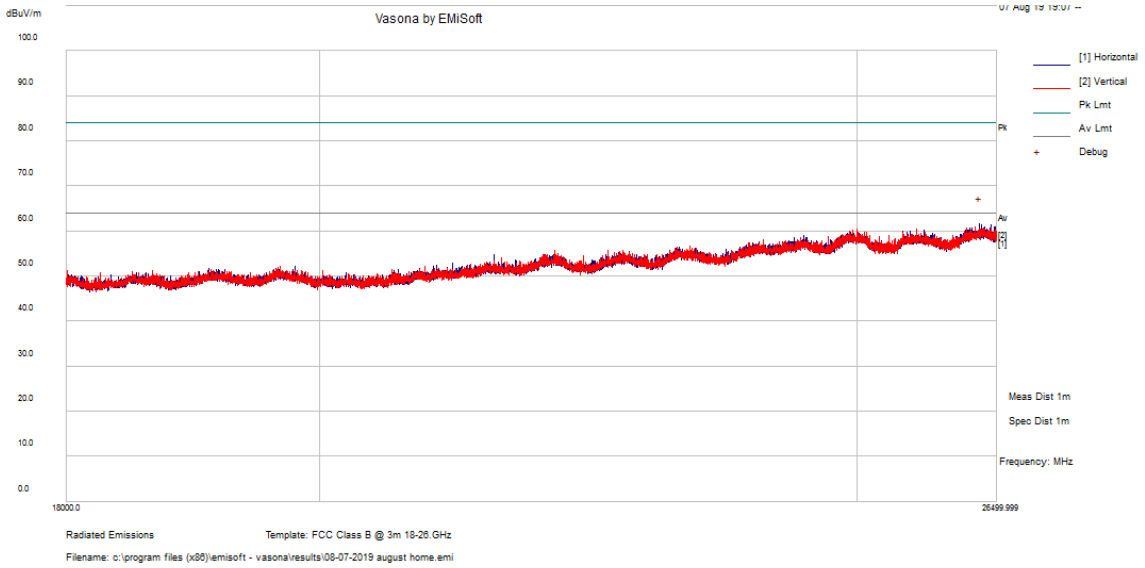


1 GHz – 18 GHz BLE Worst Case Scan at 1 Meter

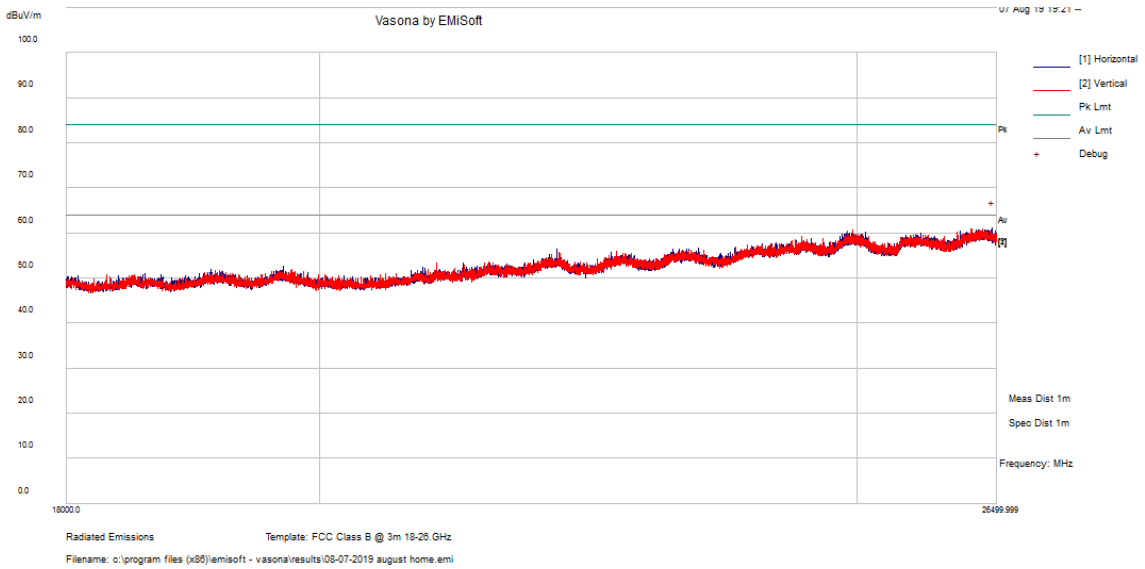


Note: 2.4GHz Notch filter has been added.

18 GHz – 26.5 2.4 GHz Wi-Fi Worst Case GHz Scan at 1 Meter



18 GHz – 26.5 GHz BLE Worst Case GHz Scan at 1 Meter



7 FCC §15.247(a) (2) & ISEDC RSS-247 §5.2 -Emission Bandwidth

7.1 Applicable Standards

According to ECFR §15.247(a) (2) and ISEDC RSS-247 §5.2, systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

7.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2019-03-19	1 year
-	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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

7.4 Test Environmental Conditions

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

The testing was performed by Christian McCaig on 2019-08-05 in RF site.

7.5 Test Results

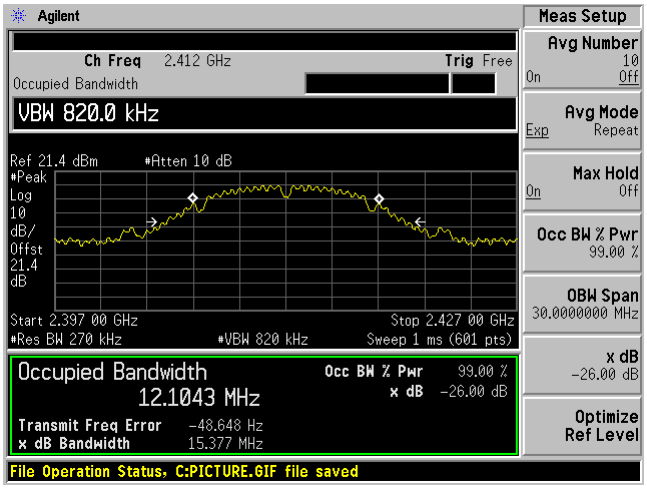
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
802.11b mode				
Low	2412	12.1043	9088	500
Middle	2437	12.0885	8643	500
High	2462	12.0847	8125	500
802.11g mode				
Low	2412	17.0163	16451	500
Middle	2437	17.0131	16416	500
High	2462	17.0336	16536	500
802.11n-20 mode				
Low	2412	17.8963	17657	500
Middle	2437	17.8820	17718	500
High	2462	17.8651	17626	500
BLE				
Low	2402	1.0521	721.905	500
Middle	2440	1.0522	719.785	500
High	2480	1.0512	716.493	500

Please refer to the following plots for detailed test results.

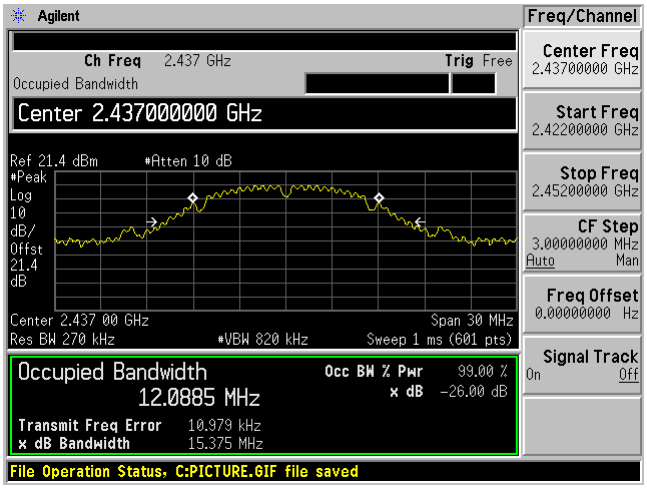
99% OBW

802.11b mode

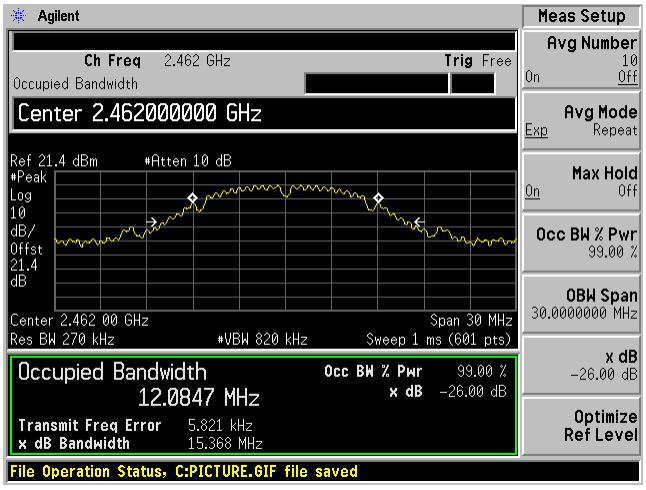
Low Channel 2412 MHz



Middle Channel 2437 MHz

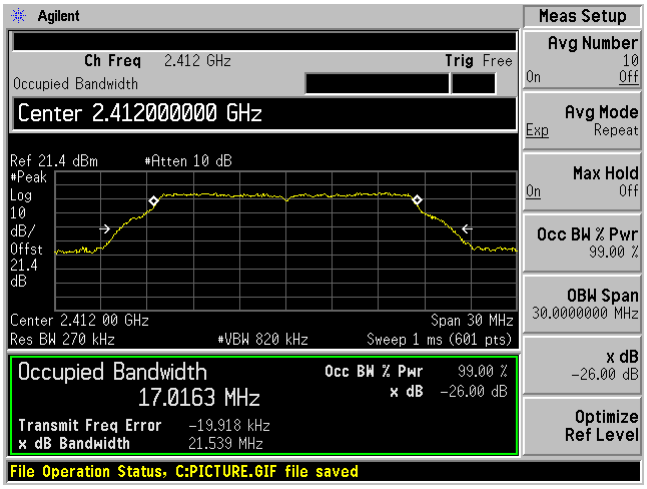


High Channel 2462 MHz

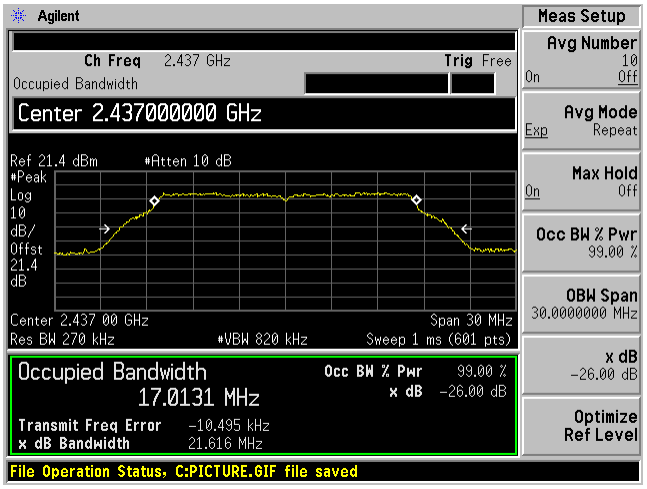


802.11g mode

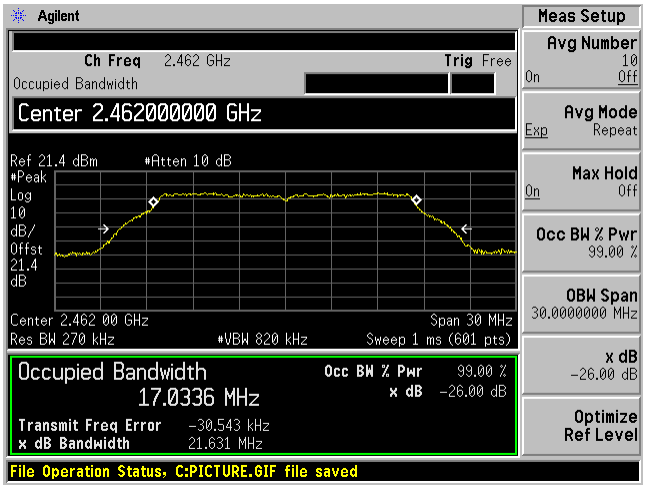
Low Channel 2412 MHz



Middle Channel 2437 MHz

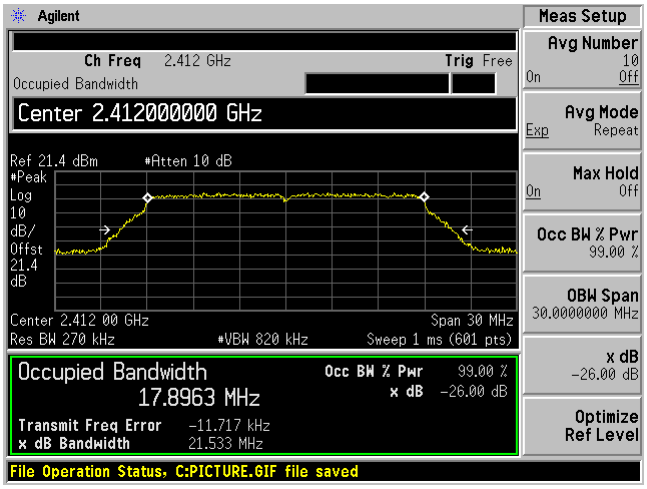


High Channel 2462 MHz

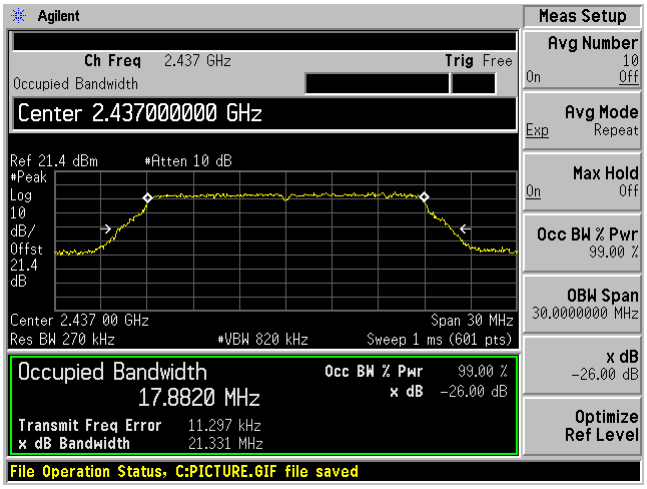


802.11n20 mode

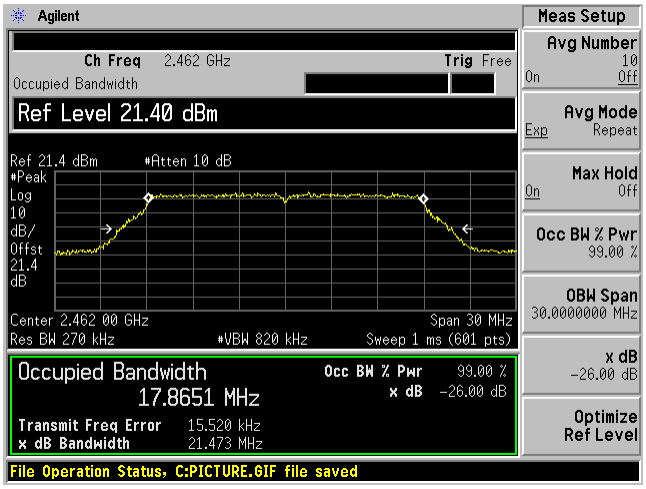
Low Channel 2412 MHz



Middle Channel 2437 MHz

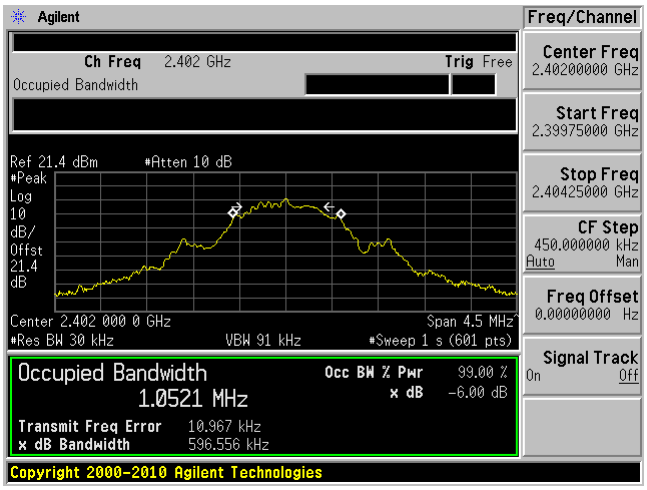


High Channel 2462 MHz

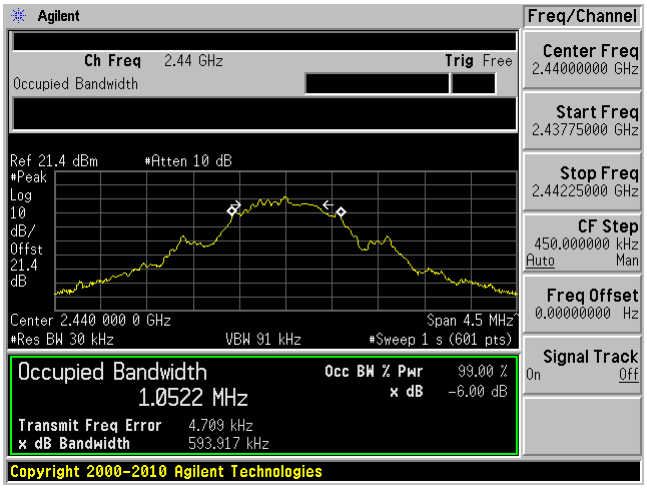


BLE

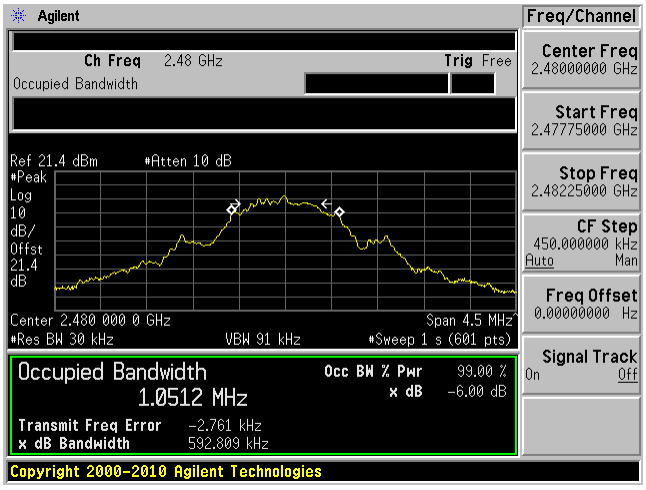
Low Channel 2402 MHz



Middle Channel 2440 MHz



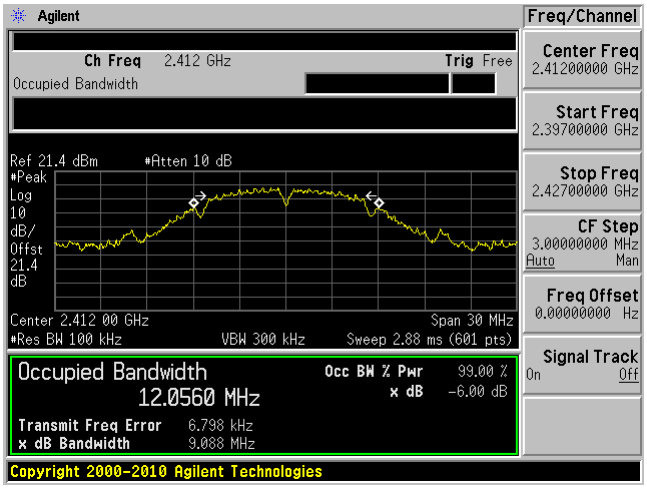
High Channel 2480 MHz



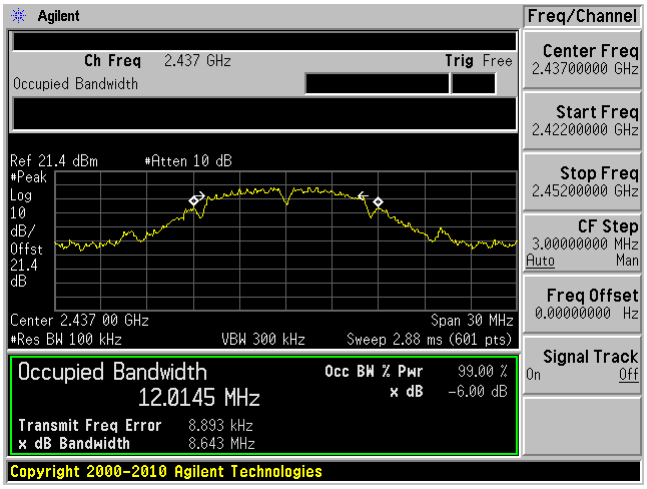
6dB OBW

802.11b mode

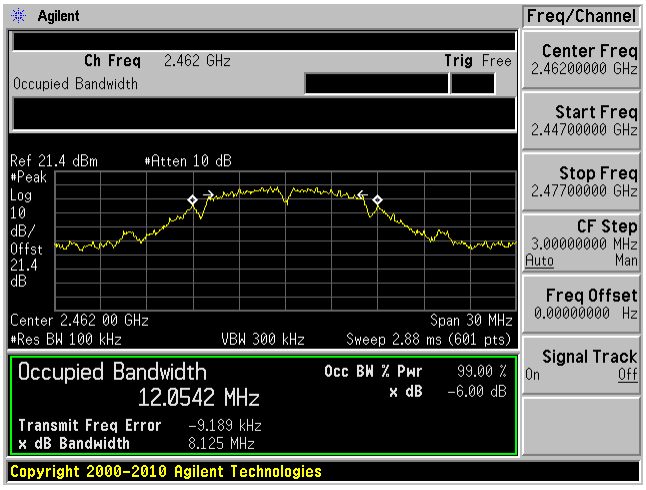
Low Channel 2412 MHz



Middle Channel 2437 MHz

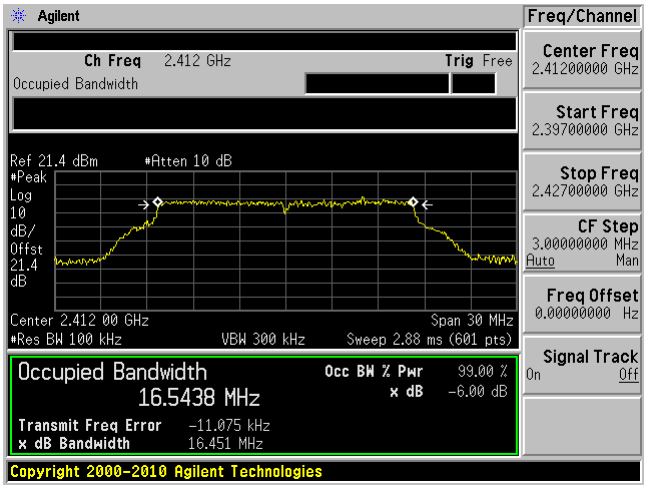


High Channel 2462 MHz

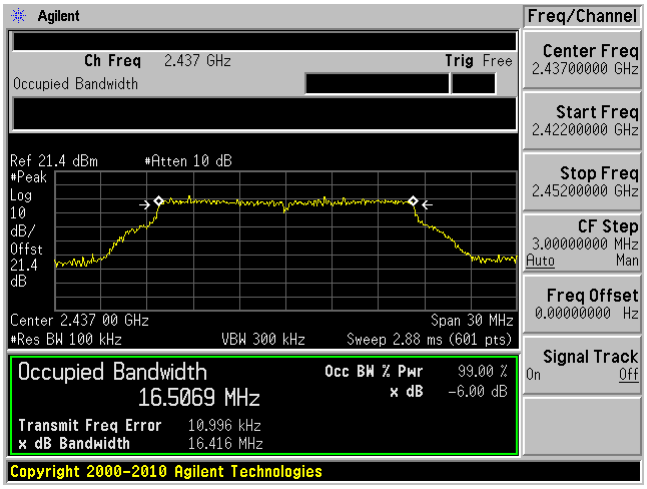


802.11g mode

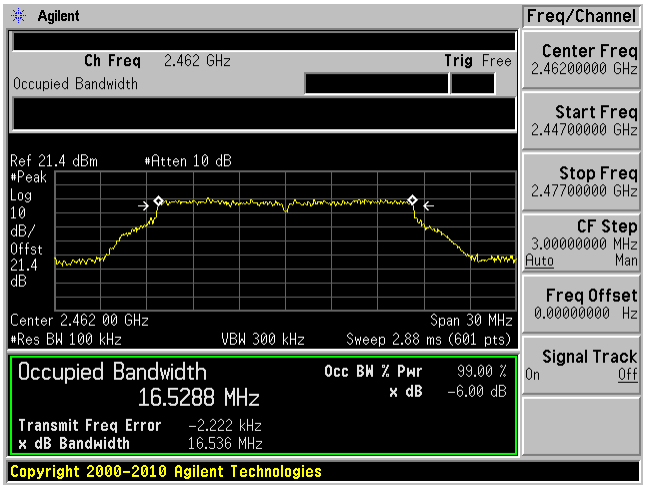
Low Channel 2412 MHz



Middle Channel 2437 MHz

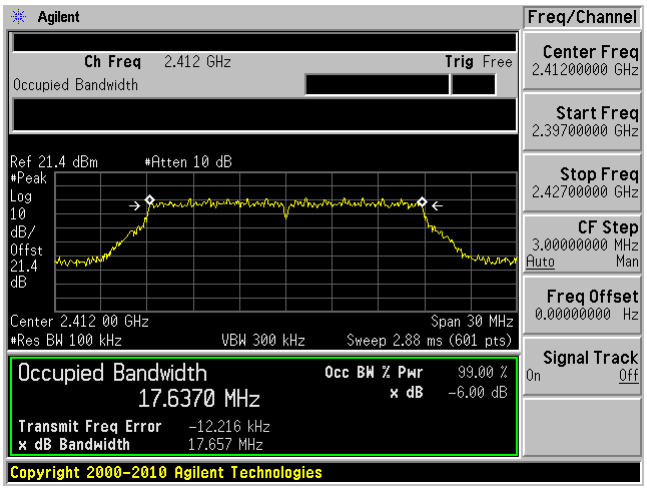


High Channel 2462 MHz

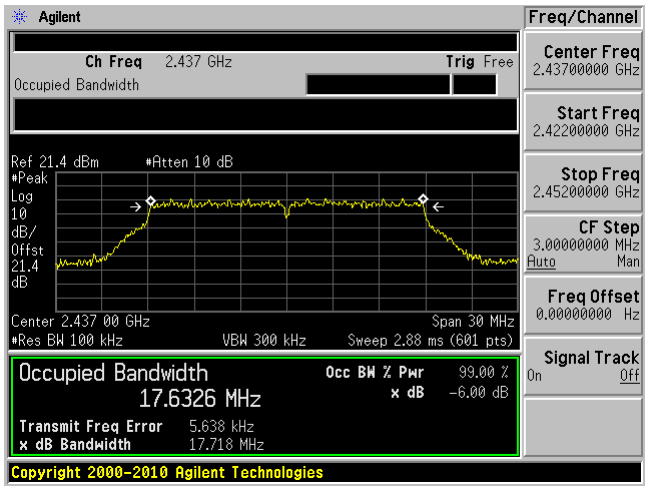


802.11n20 mode

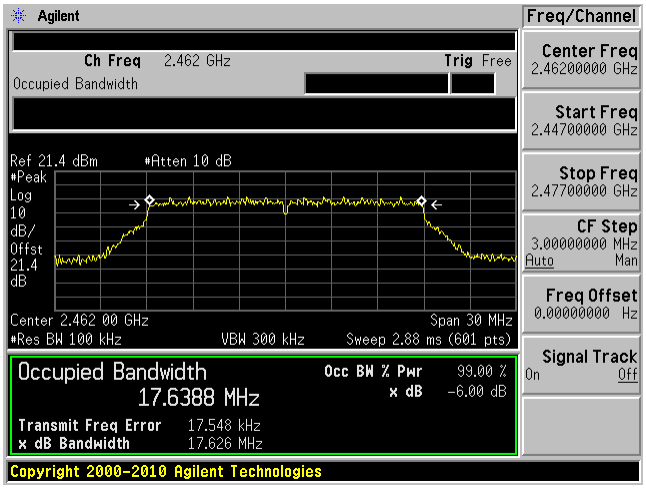
Low Channel 2412 MHz



Middle Channel 2437 MHz

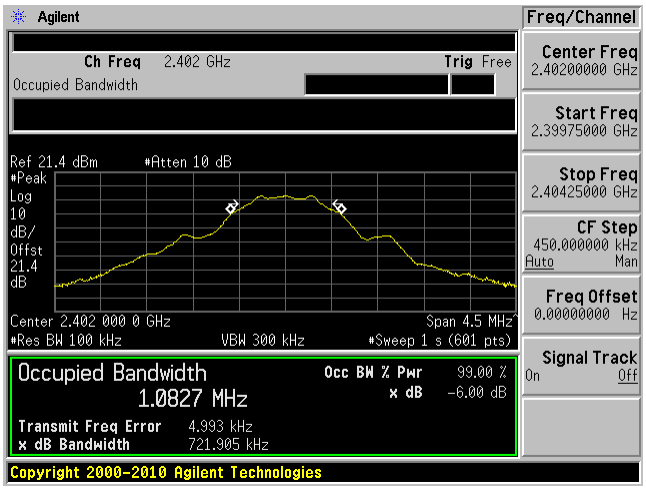


High Channel 2462 MHz

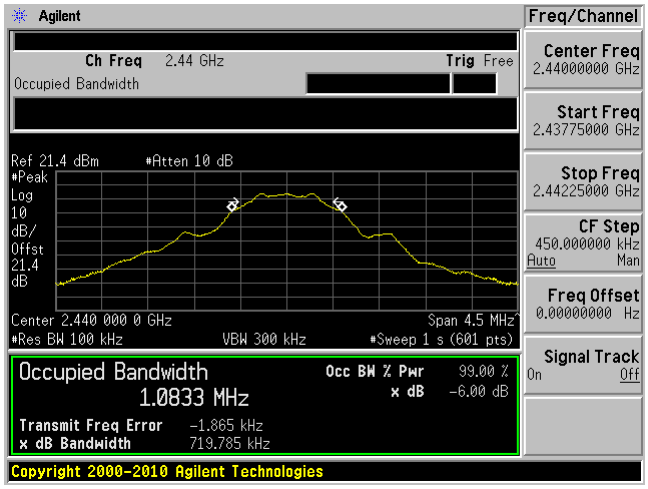


BLE

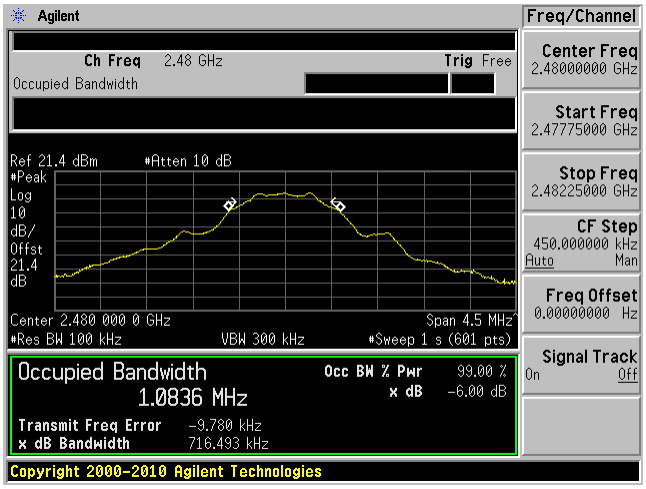
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



8 FCC §15.247(b) (3) & ISEDC RSS-247 §5.4 (4) - Output Power Measurement

8.1 Applicable Standards

According to ECFR §15.247(b) (3) and ISEDC RSS-247 §5.4 (4) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

According to ISEDC RSS-247 §5.4: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the e.i.r.p. shall not exceed 4 W

8.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2019-03-19	1 year
ETS- Lingerin	Power Sensor	7002-006	160097	2018-12-31	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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

8.4 Test Environmental Conditions

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

The testing was performed by Christian McCaig on 2019-08-05 in RF site.

8.5 Test Results

Average Output Power

Channel	Frequency (MHz)	Conducted Average Power (dBm)	Conducted OP Limit (dBm)	EIRP (dBm)	EIRP Limit (dBm)
802.11b mode					
1	2412	19.68	30	18.88	36
6	2437	19.90	30	19.1	36
11	2462	19.91	30	19.11	36
802.11g mode					
1	2412	14.76	30	13.96	36
6	2437	14.96	30	14.16	36
11	2462	15.05	30	14.25	36
802.11n-HT20 mode					
1	2412	15.25	30	14.45	36
6	2437	15.19	30	14.39	36
11	2462	15.36	30	14.56	36

Note: Duty Cycle correction factor has already been added to the measurement.
Note: EIRP(dBm) = Conducted Power(dBm) + Antenna Gain(dBi)

Peak Output Power

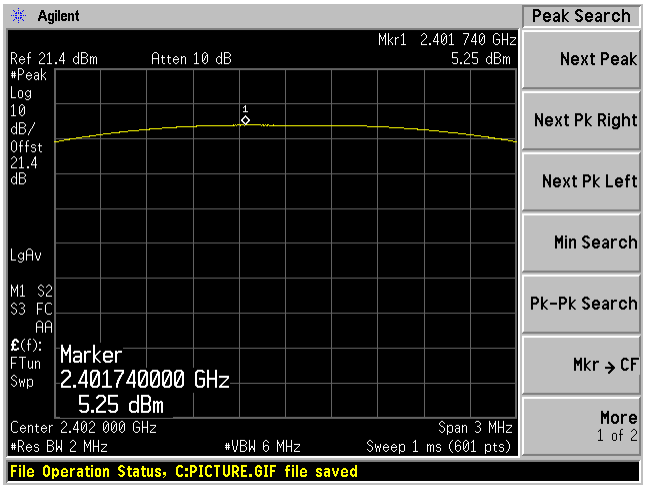
Channel	Frequency (MHz)	Conducted Peak Power (dBm)	Conducted OP Limit (dBm)	EIRP (dBm)	EIRP Limit (dBm)
BLE					
Low	2402	5.25	30	4.45	36
Middle	2440	6.08	30	5.28	36
High	2480	6.24	30	5.44	36

Note: EIRP(dBm) = Conducted Power(dBm) + Antenna Gain(dBi)

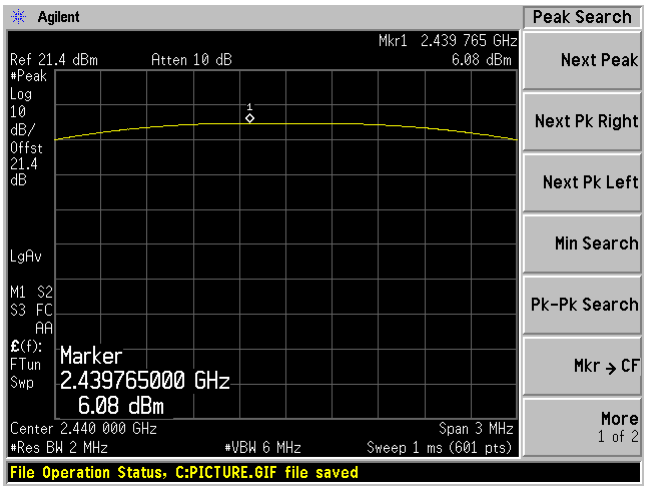
Please refer to the following plots for detailed test results.

BLE

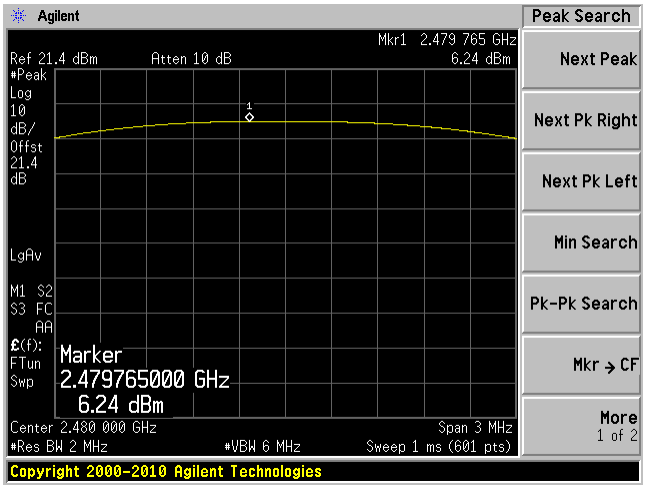
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



9 FCC §15.247(d) and ISEDC RSS-247 §5.5 – 100 kHz Bandwidth of Band Edges

9.1 Applicable Standards

According to ECFR §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

According to 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.

9.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2019-03-19	1 year
-	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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

9.4 Test Environmental Conditions

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

The testing was performed by Christian McCaig on 2019-08-05 in RF site.

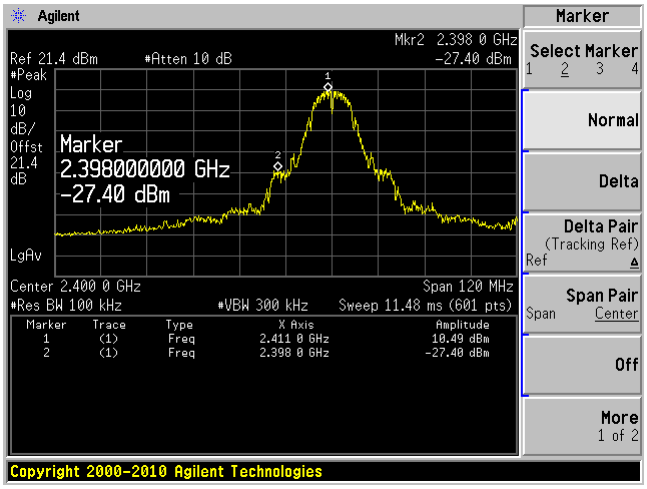
9.5 Test Results

Mode	Channel	Bandedge attenuation from fundamental (dB)	Limit (dB)	Results
B	Low	37.89	>30	Pass
	High	55.2	>30	Pass
G	Low	42.54	>30	Pass
	High	48.39	>30	Pass
N20	Low	42.31	>30	Pass
	High	48.01	>30	Pass
BLE	Low	59.14	>30	Pass
	High	65.17	>30	Pass

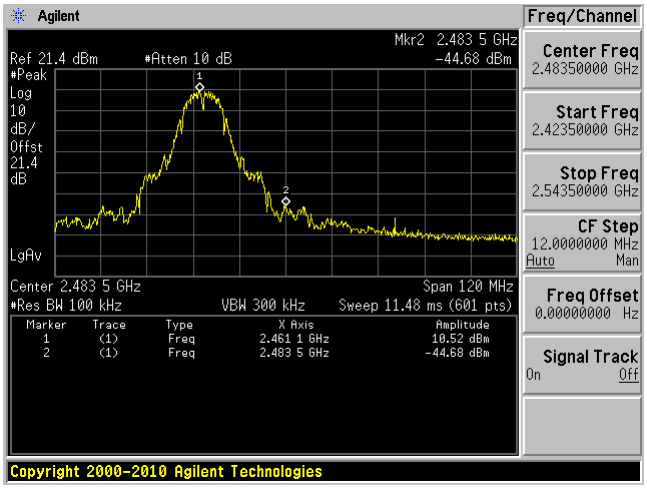
Please refer to the following plots for detailed test results

802.11b mode

Low Channel 2412 MHz

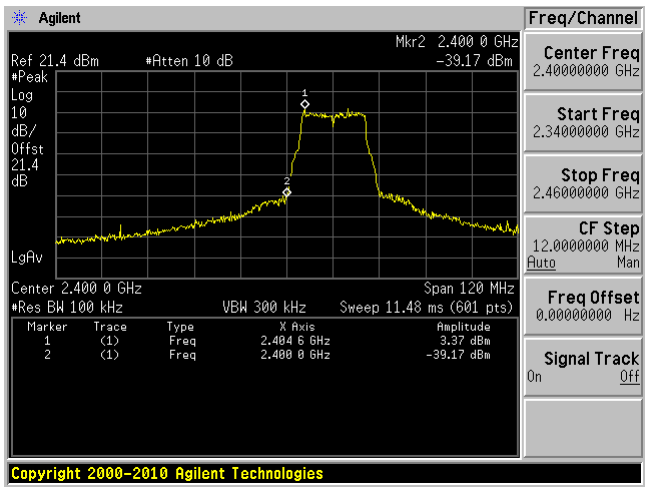


High Channel 2462 MHz

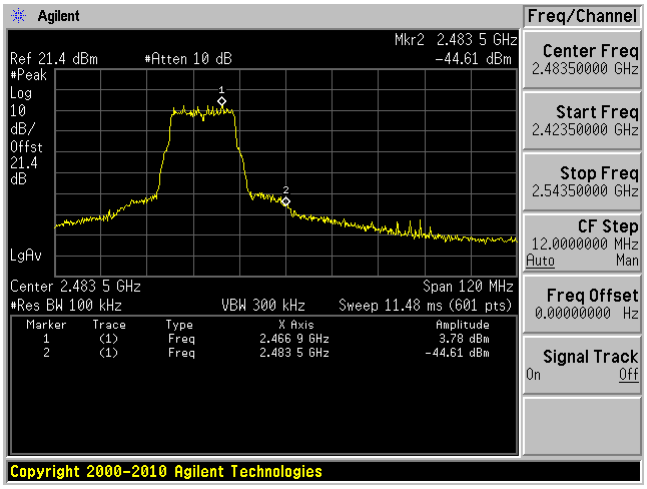


802.11g mode

Low Channel 2412 MHz

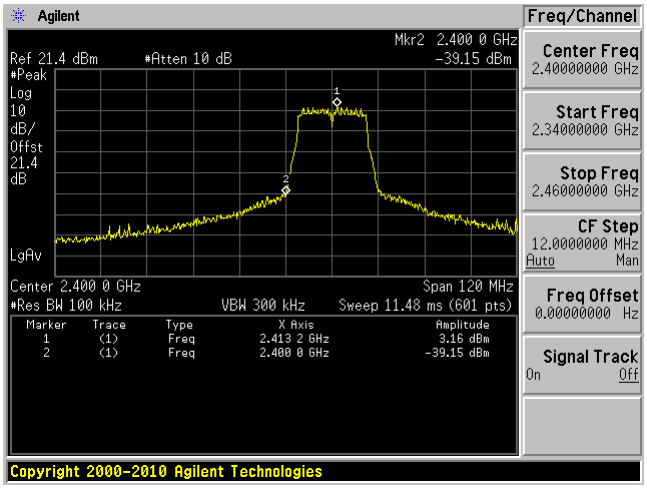


High Channel 2462 MHz

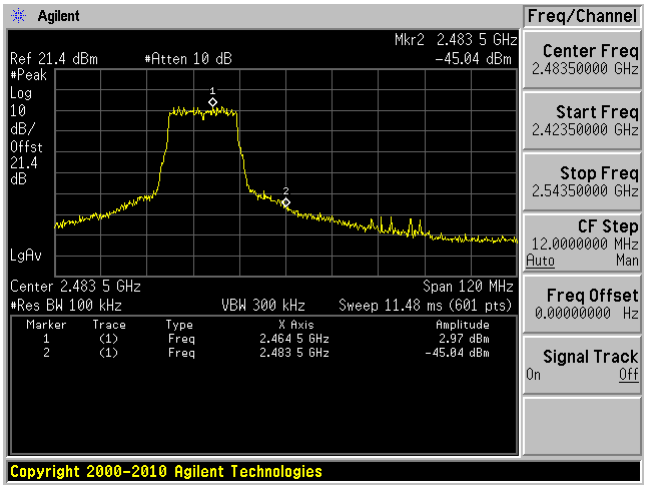


802.11n20 mode

Low Channel 2412 MHz

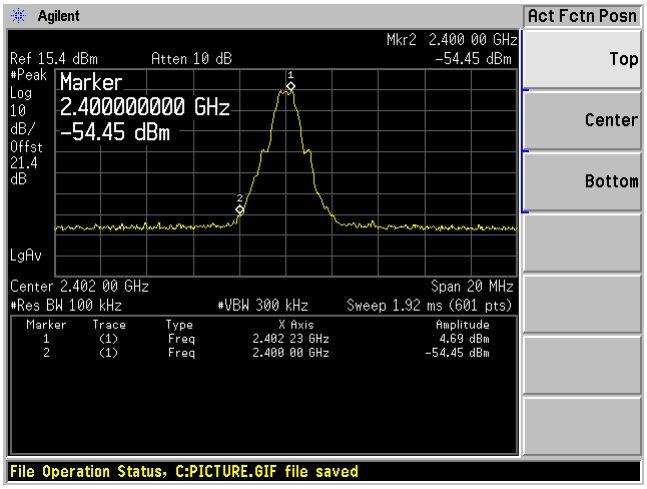


High Channel 2462 MHz

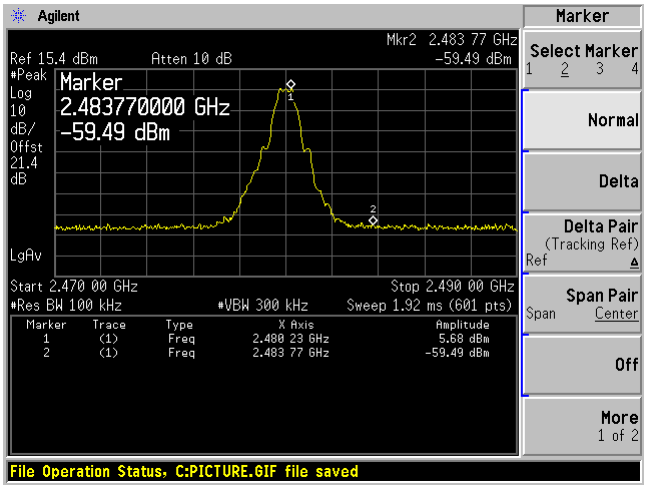


BLE

Low Channel 2402 MHz



High Channel 2480 MHz



10 FCC §15.247(e) & ISEDC RSS-247 §5.2(2) – Power Spectral Density

10.1 Applicable Standards

According to ECFR §15.247(e) and RSS-247 §5.2 (2) , for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 10: Maximum power spectral density level in the fundamental emission.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2019-03-19	1 year
-	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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

10.4 Test Environmental Conditions

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

The testing was performed by Christian McCaig on 2019-08-05 in RF site.

10.5 Test Results

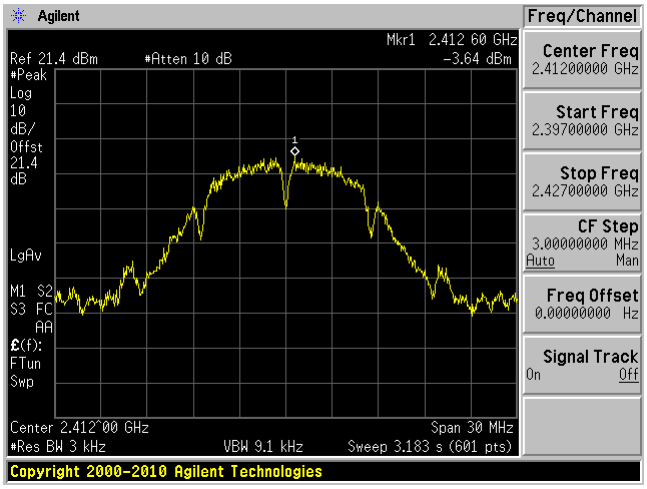
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-3.64	8
Middle	2437	-3.36	8
High	2462	-3.19	8
802.11g mode			
Low	2412	-10.42	8
Middle	2437	-10.26	8
High	2462	-10.74	8
802.11n-HT20 mode			
Low	2412	-11.55	8
Middle	2437	-10.84	8
High	2462	-11.79	8

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
BLE			
Low	2402	-9.48	8
Middle	2440	-8.73	8
High	2480	-8.18	8

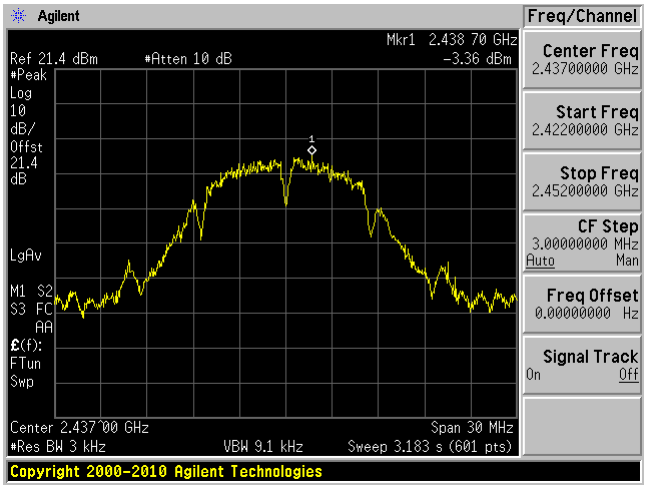
Please refer to the following plots for detailed test results

802.11b mode

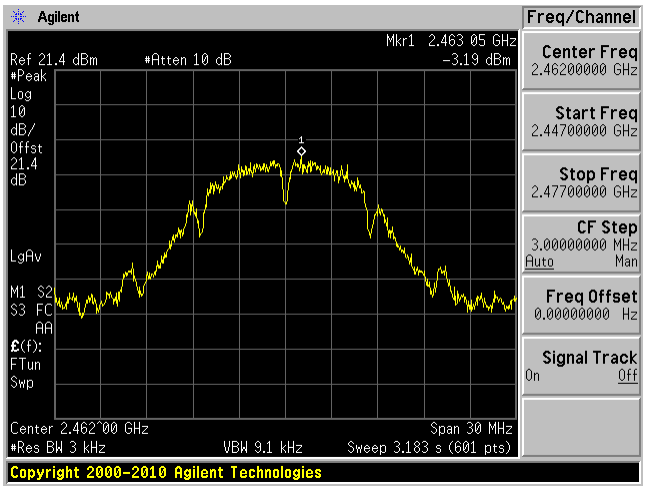
Low Channel 2412 MHz



Middle Channel 2437 MHz

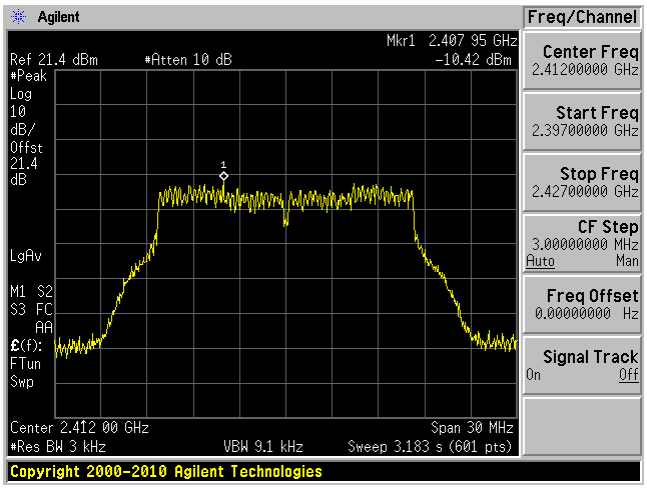


High Channel 2462 MHz

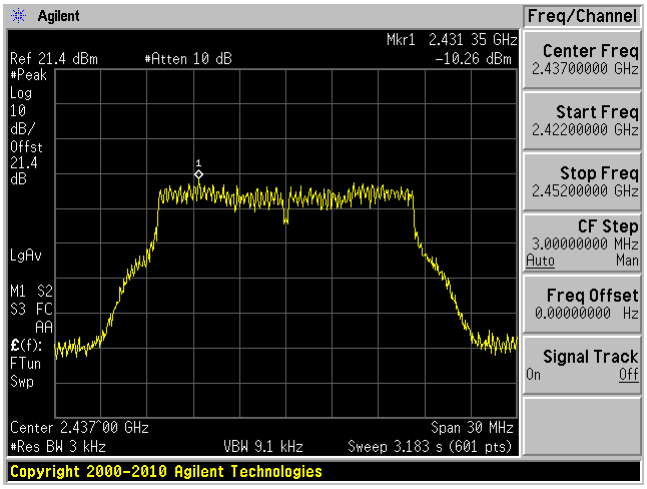


802.11g mode

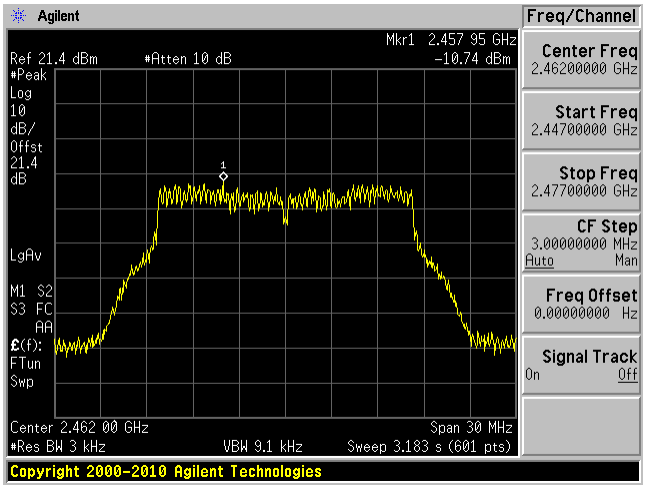
Low Channel 2412 MHz



Middle Channel 2437 MHz

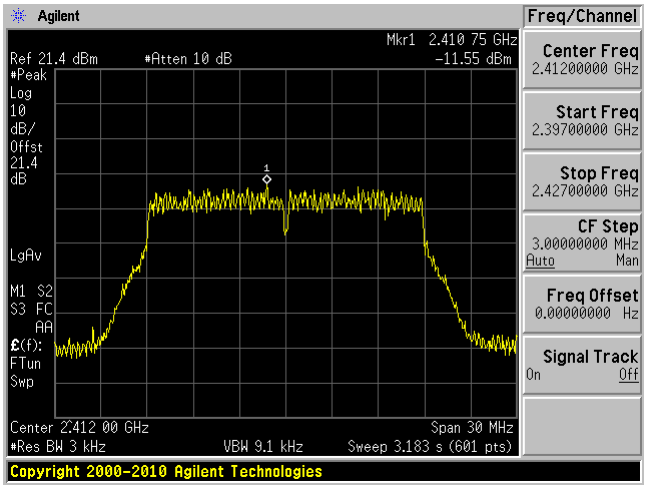


High Channel 2462 MHz

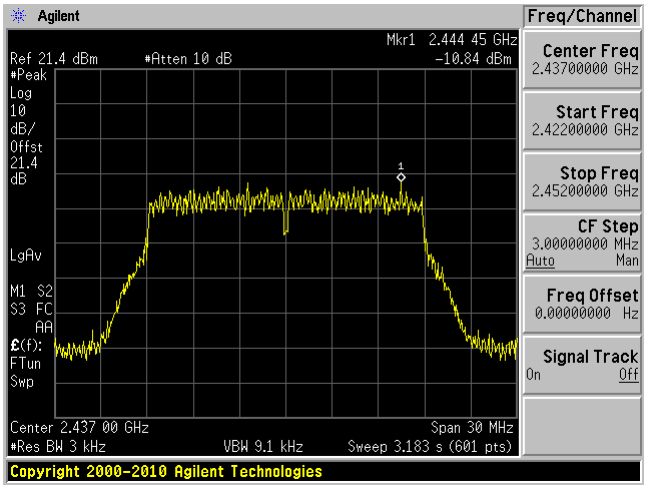


802.11n20 mode

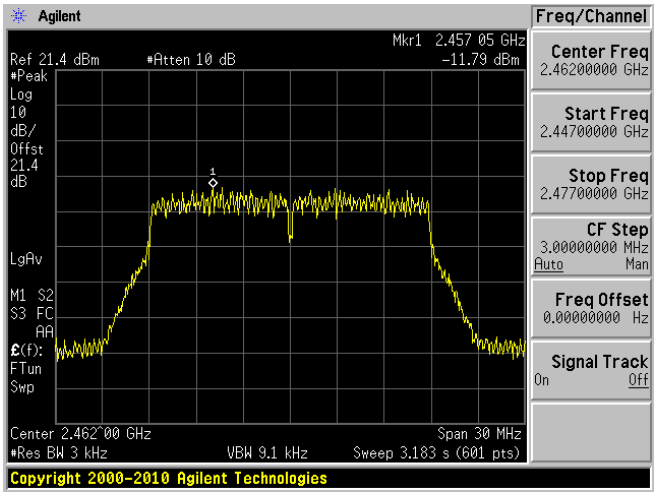
Low Channel 2412 MHz



Middle Channel 2437 MHz

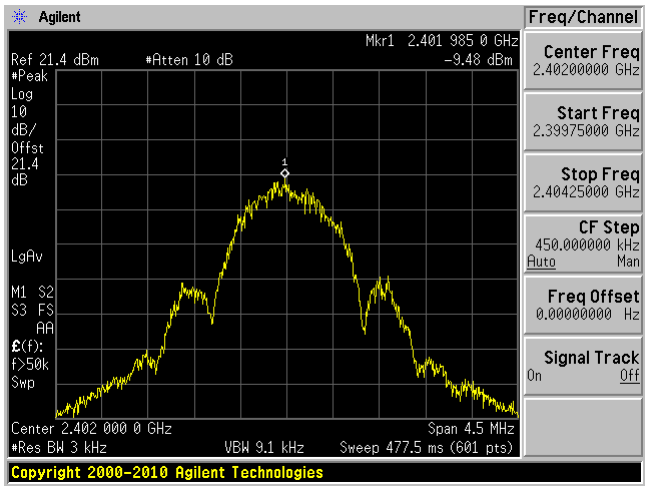


High Channel 2462 MHz

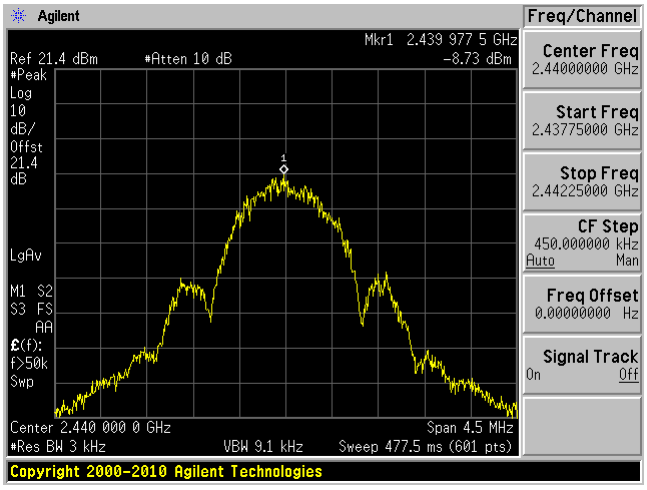


BLE

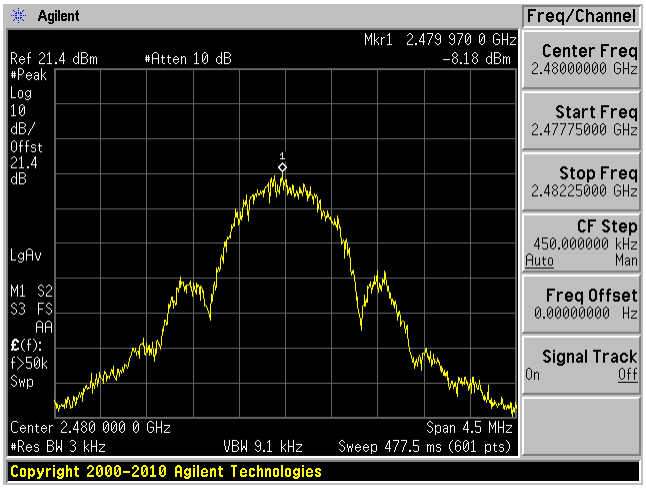
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



11 FCC §15.247(d) & ISEDC RSS-247 §5.5, RSS-GEN §8.9 – Spurious Emissions at Antenna Terminals

11.1 Applicable Standards

For ECFR §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-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.

11.2 Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2019-03-19	1 year
-	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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

11.4 Test Environmental Conditions

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

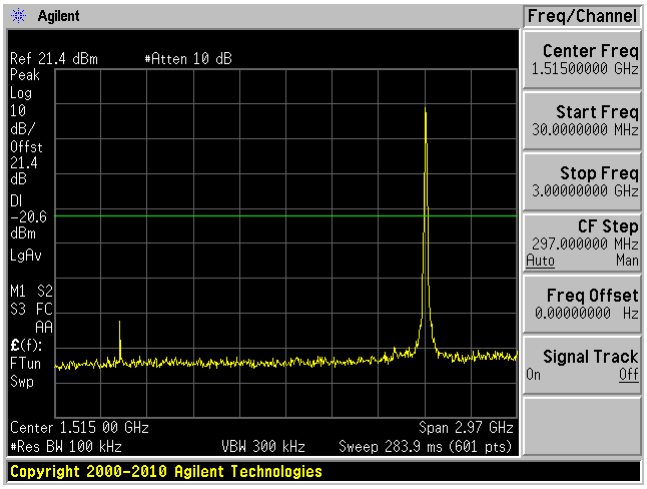
The testing was performed by Christian McCaig on 2019-08-05 in RF site.

11.5 Test Results

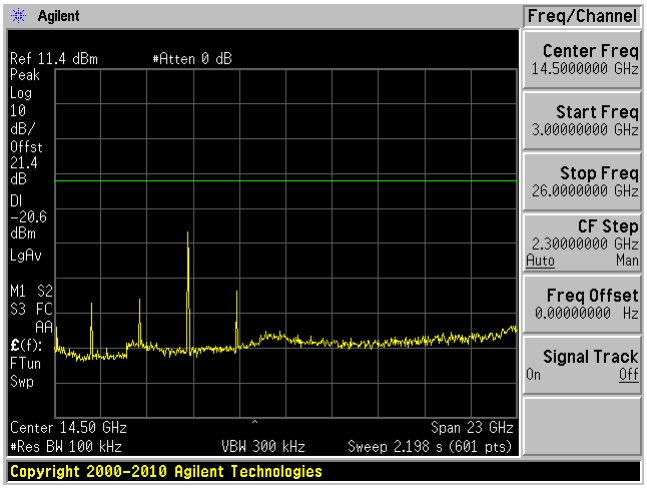
Please refer to following plots.

802.11b mode

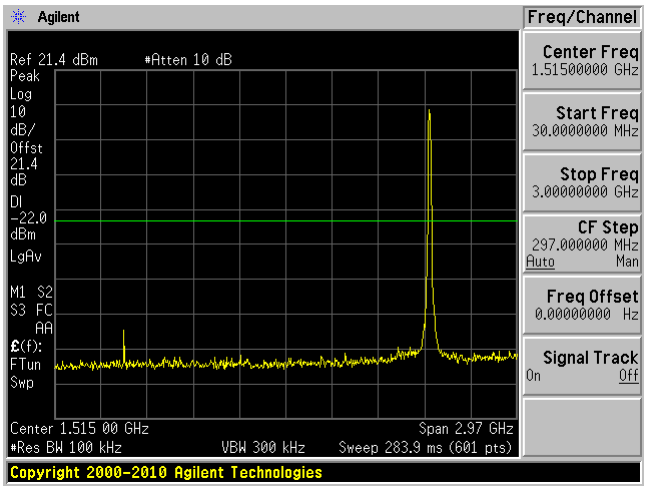
Low Channel 30MHz – 3 GHz



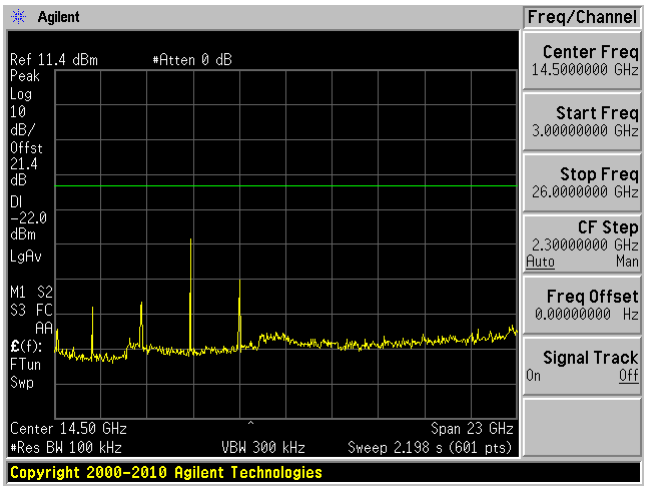
Low Channel 3 GHz – 26 GHz



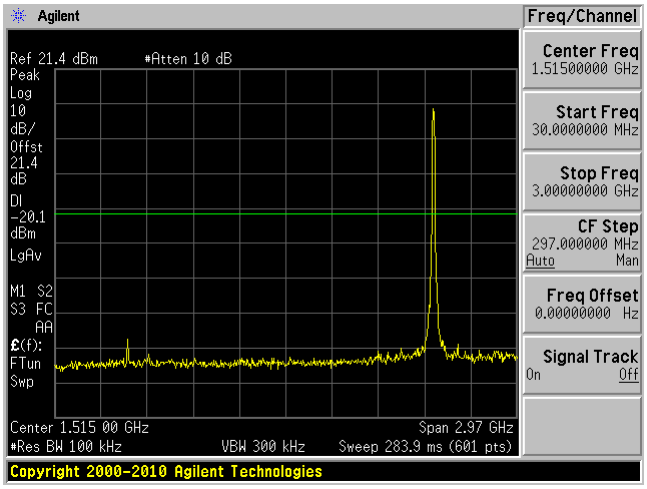
Middle Channel 30 MHz – 3 GHz



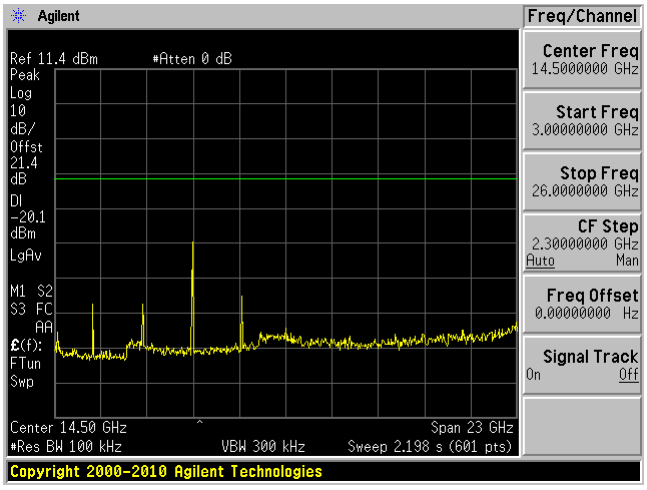
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

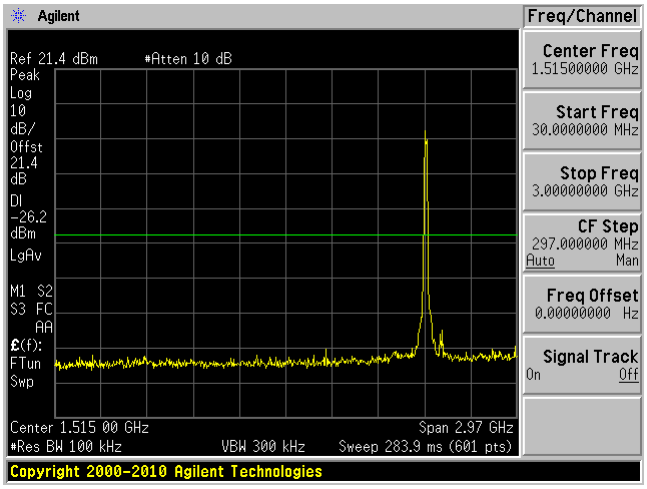


High Channel 3 GHz – 26 GHz

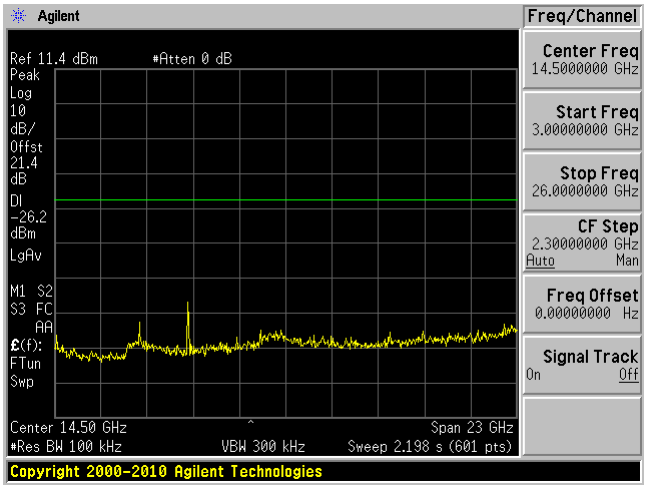


802.11g mode

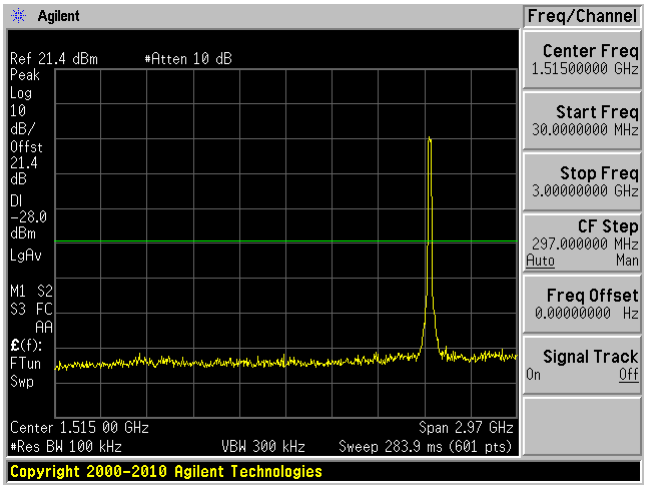
Low Channel 30 MHz – 3 GHz



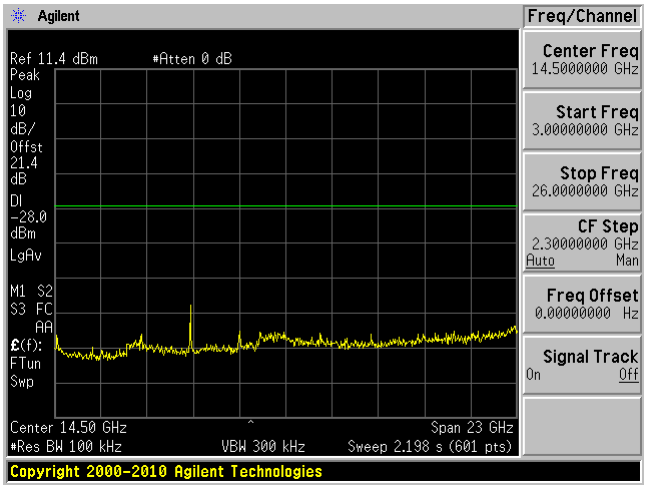
Low Channel 3 GHz – 26 GHz



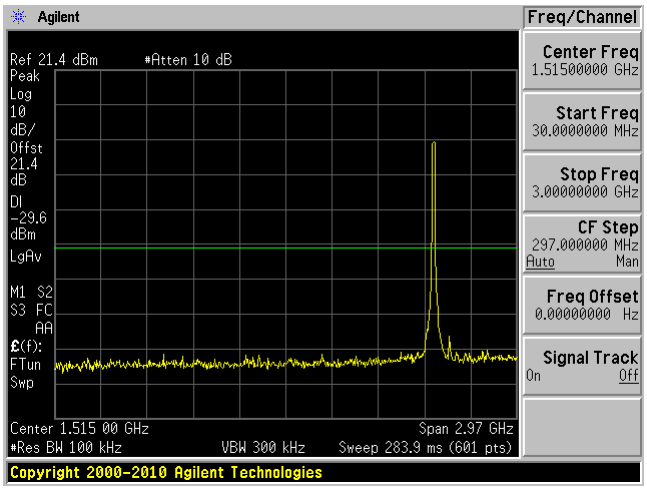
Middle Channel 30 MHz – 3 GHz



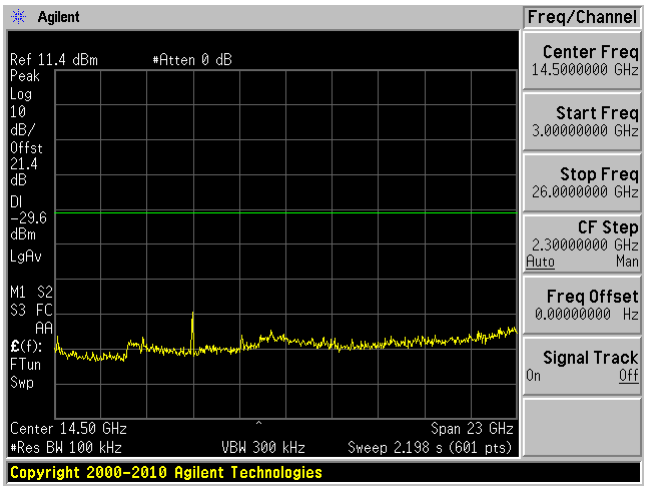
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

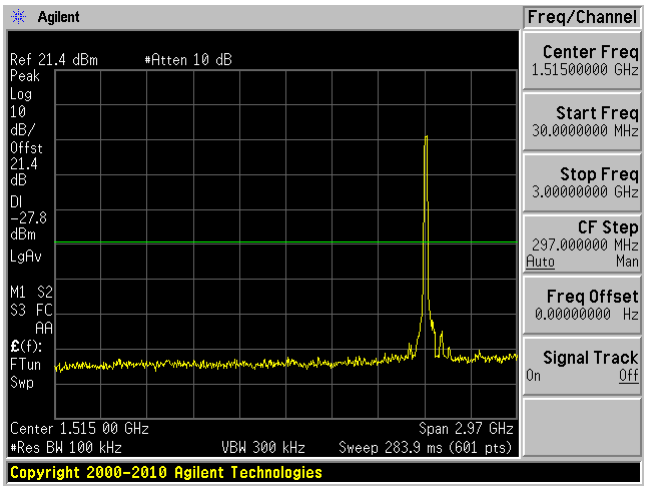


High Channel 3 GHz – 26 GHz

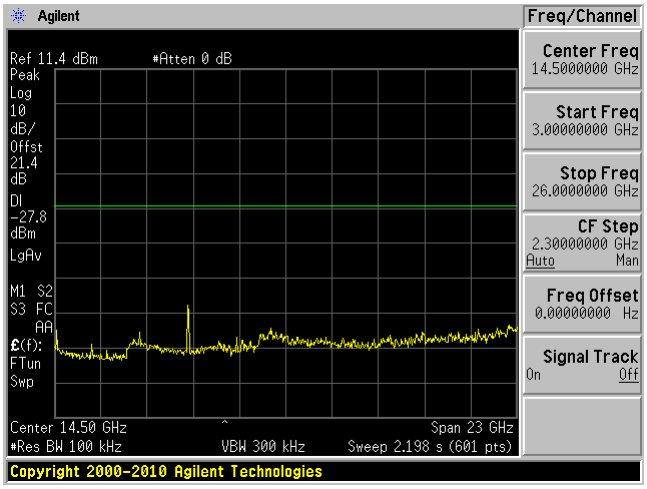


802.11n20 mode

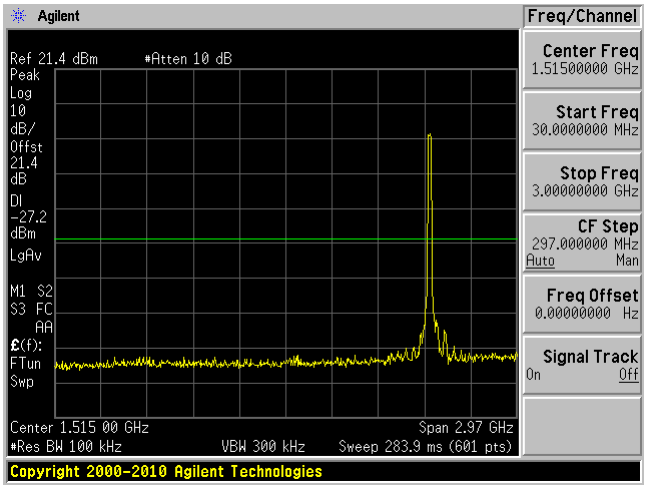
Low Channel 30 MHz – 3 GHz



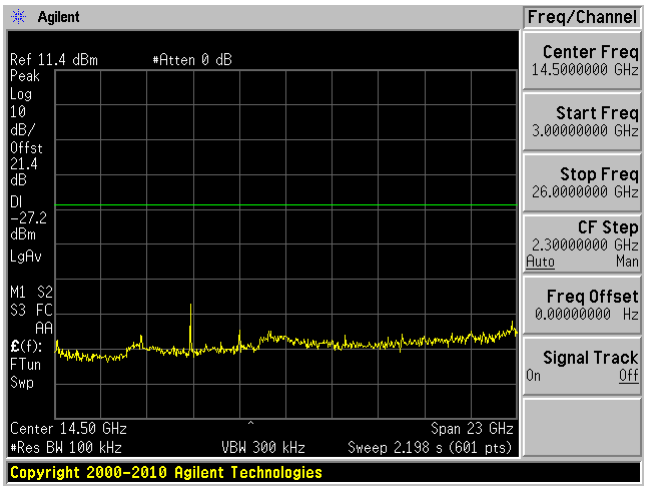
Low Channel 3 GHz – 26 GHz



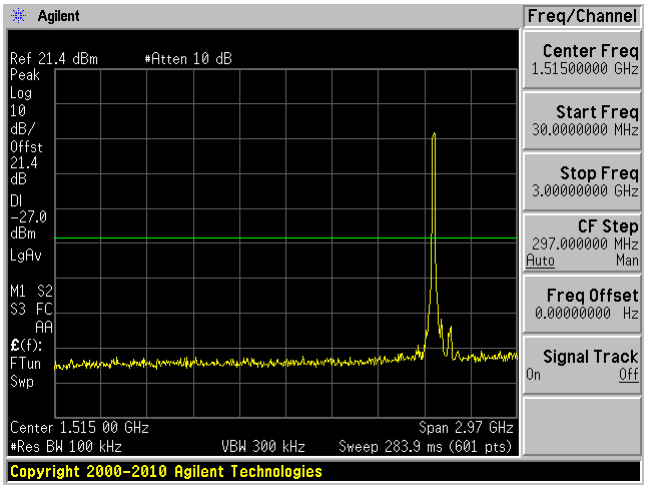
Middle Channel 30 MHz – 3 GHz



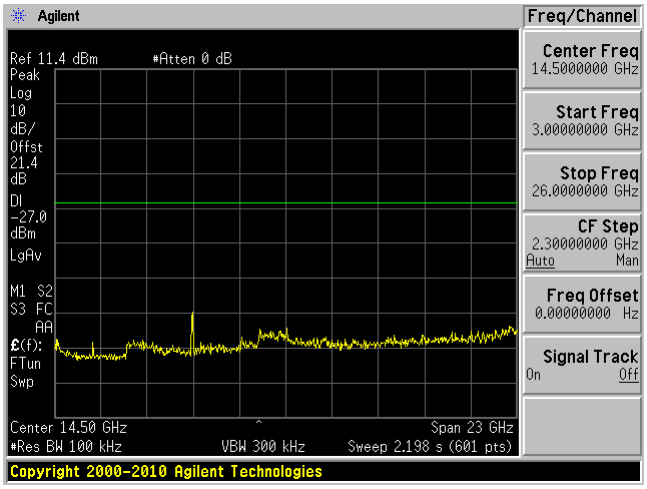
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

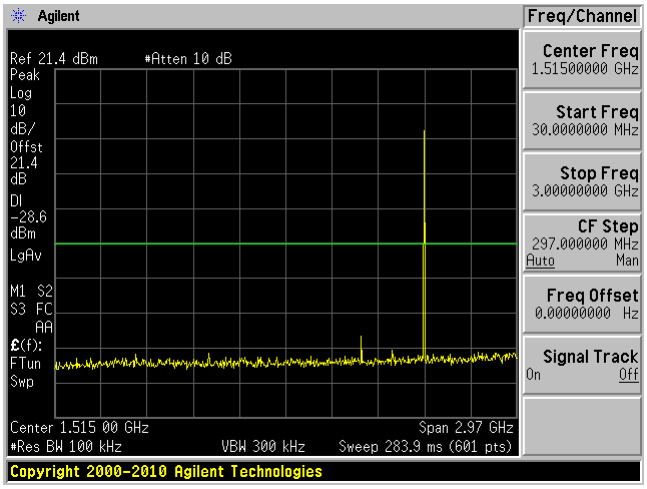


High Channel 3 GHz – 26 GHz

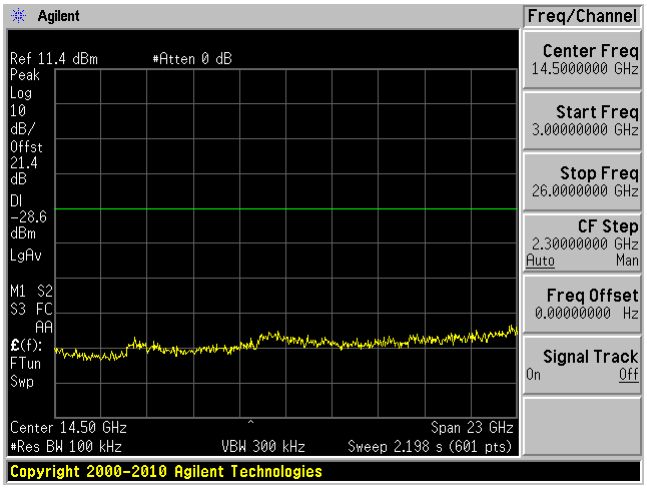


BLE

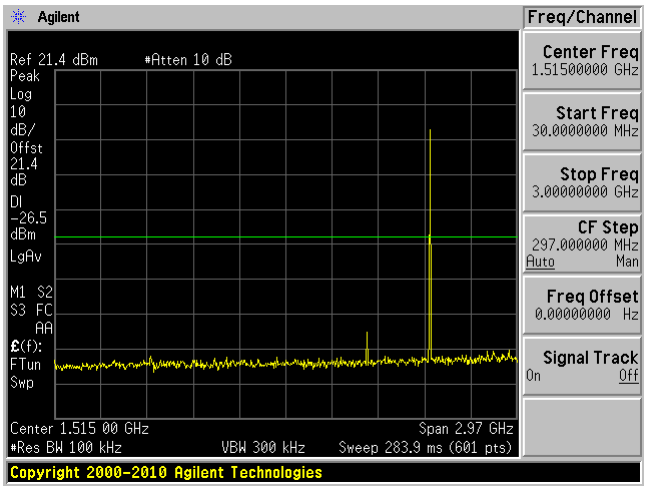
Low Channel 30 MHz – 3 GHz



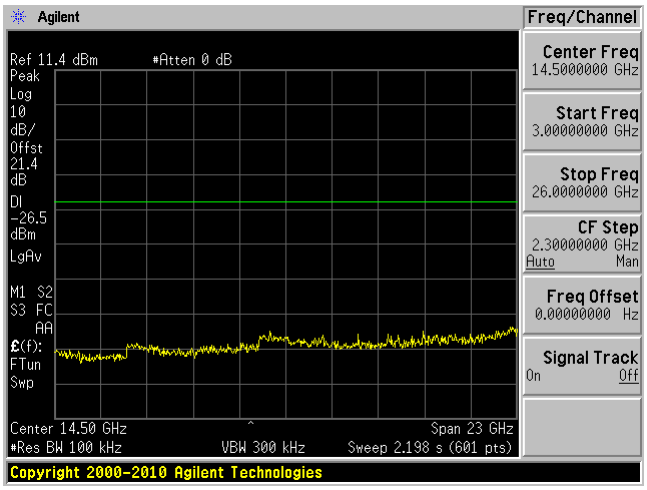
Low Channel 3 GHz – 26 GHz



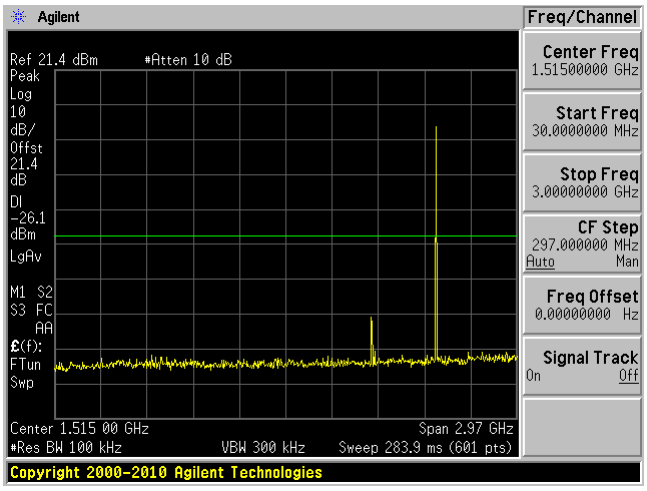
Middle Channel 30 MHz – 3 GHz



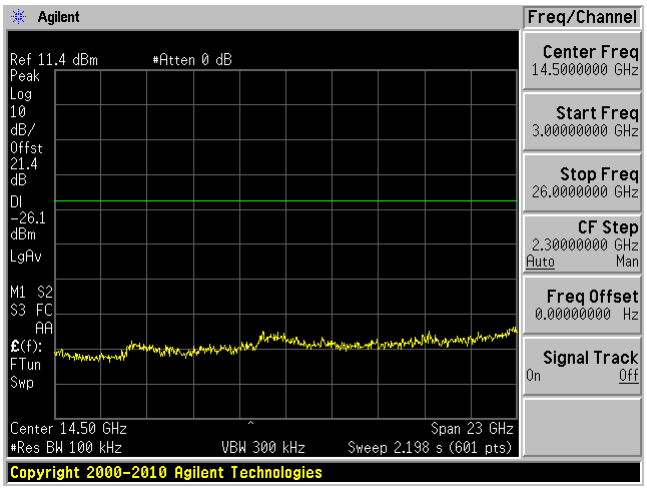
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz



High Channel 3 GHz – 26 GHz



12 Annex A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

13 Annex B (Normative) – EUT External Photographs

Please refer to the attachment.

14 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment.

15 Annex 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 17025:2017 *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 10th day of March 2021.

Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to November 30, 2022
Revised September 16, 2022

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

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

--- END OF REPORT ---