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

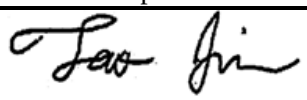
TEST REPORT
For

Grid Connect Inc.

1630 W Diehl Rd,
Naperville, IL, 60563

FCC ID: 2AFC3-PW240
IC: 22503-PW240

Report Type:	**Product Type:**
Original Report	30 Amp Switch

Prepared By:	Tao Jin Test Engineer	
Report Number:	R2208033-DTS	
Report Date:	2022-10-12	
Reviewed By:	Christian McCaig RF Lead Engineer	

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ACCREDITED
CERTIFICATE #3297.02

* This test report may contain data and test methods that are not covered by BACL's scope of accreditation as of the test report date shown above. These items are marked within the test report text with an asterisk "*"

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2208033-DTS	Original Report	2022-10-12

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test was prepared on behalf of *Grid Connect Inc*., and their product model: PW240, HVIN: GC-PW-IWO-30, FCC ID: 2AFC3-PW240, IC: 22503-PW240, the "EUT" as referred to in this report. The EUT is a 30 amp switch.

1.2 Mechanical Description

The EUT measured approximately 11 cm (L) x 11 cm (W) x 10.5 cm (H) and weighs approximately 1.00 kg.

The test data gathered are from typical production sample with BACL assigned serial numbers: R2208033-1.

1.3 Objective

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

The objective was to determine compliance with FCC Part 15.247 and ISEDC RSS-247 for Antenna Requirement, RF Exposure, AC Line Conducted Emissions, Emission Bandwidth, Radiated & Conducted Spurious Emissions, 100 kHz Band Edges, Maximum Output Power, and Peak Power Spectrum Density

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 15.247 Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.6 Measurement Uncertainty

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

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

1.7 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.

1.8 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 3297.02),*** 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 3297.03)*** 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 3297.01)*** 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 - ISED) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 15.247 Meas Guidance v05r02.

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

The worst-case configuration was selected based on the original test report, and verified to be lower than previous results at updated power setting by measuring the conducted output power or PSD.

2.2 EUT Exercise Software

The test utility used was the "ESP RF Test Tool 2.8", the software is compliant with the standard requirements being tested against.

Radio	Modulation	Frequency (MHz)	Power Setting
2.4 GHz Wi-Fi	802.11b	2412	Atten= "0"
		2437	Atten= "0"
		2462	Atten= "0"
	802.11g	2412	Atten= "4"
		2437	Atten= "0"
		2462	Atten= "2"
	802.11n20	2412	Atten= "4"
		2437	Atten= "0"
		2462	Atten= "2"
	802.11n40	2422	Atten= "4"
		2437	Atten= "0"
		2452	Atten= "5"
	BLE	2402	8
		2440	7
		2480	6

Data Rates Tested:
802.11b mode: 1Mbps
802.11g mode: 6Mbps
802.11n20 mode: MCS0
802.11n40 mode: MCS0
BLE mode: 1Mbps

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 15.247 Meas Guidance v05r02 section 6.0:

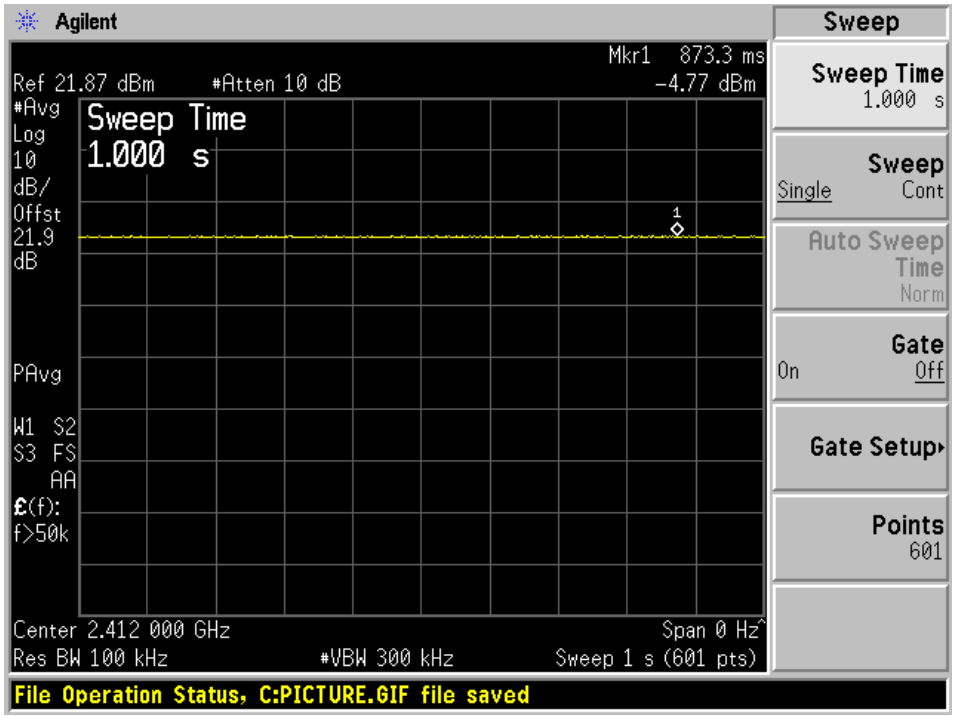
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized 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	Radio Frequency (MHz)	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	2412	-	-	100	0
802.11g	2412	-	-	100	0
802.11n20	2412	-	-	100	0
802.11n40	2422	-	-	100	0
BLE	2402	1.946	3.141	61.95	2.08

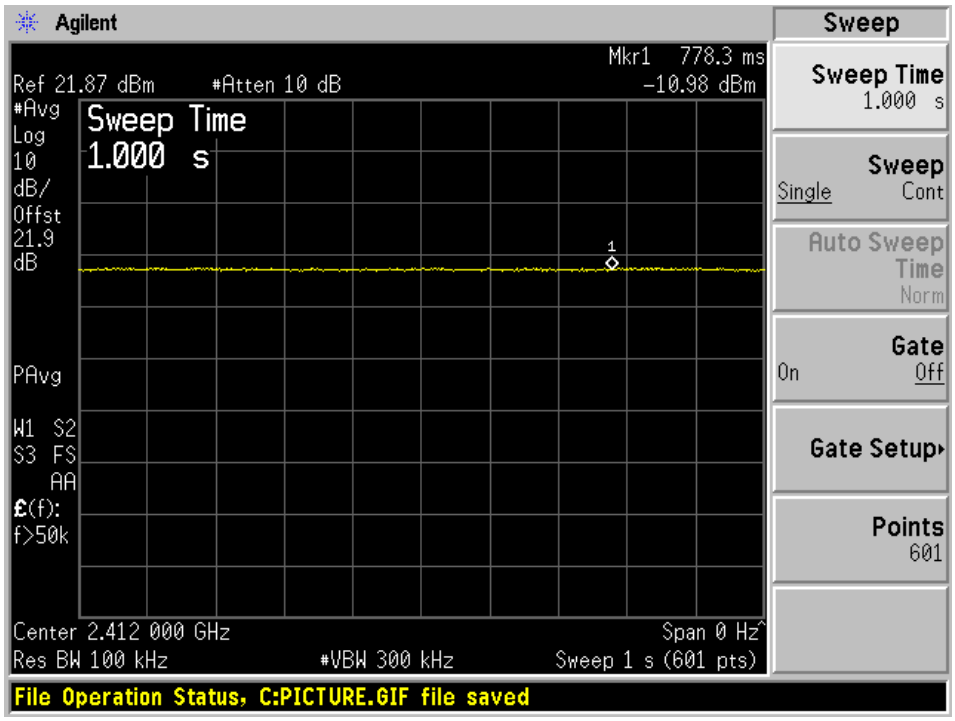
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

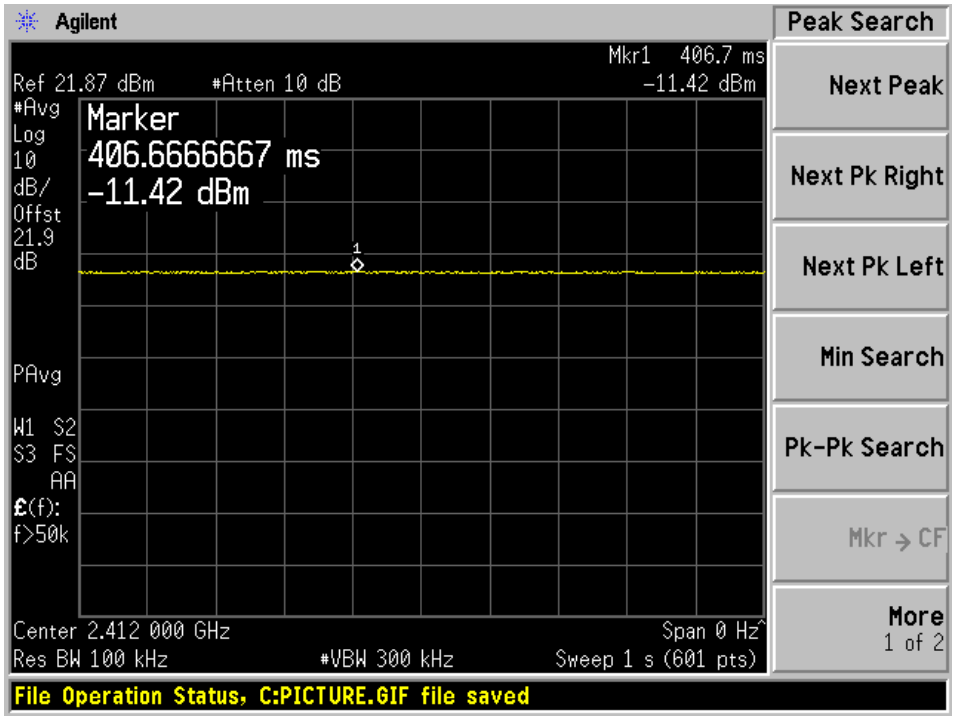
802.11b mode



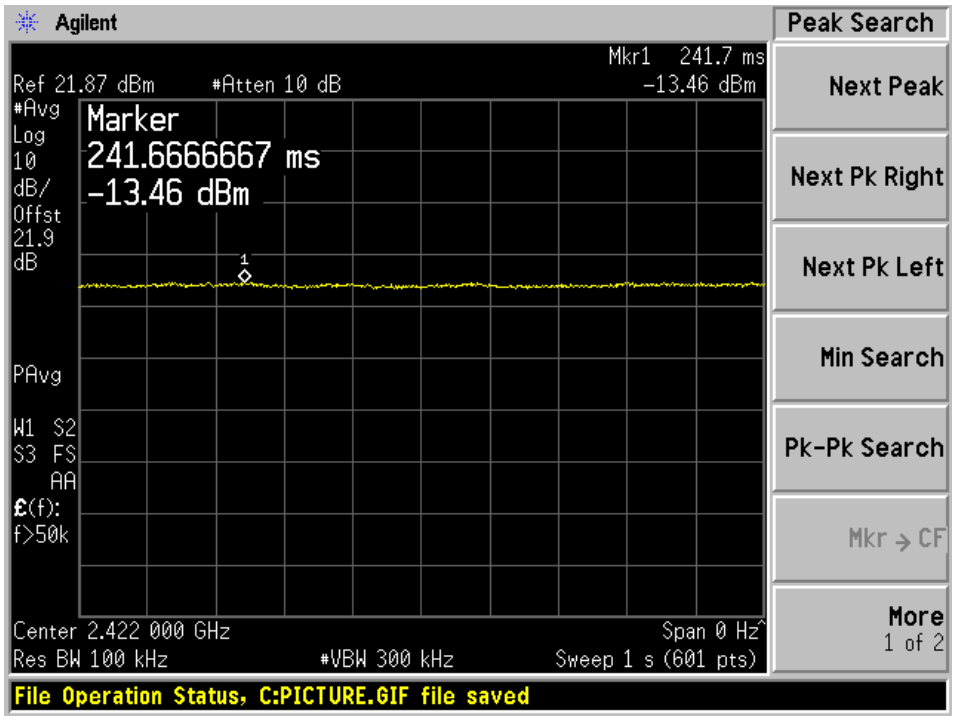
802.11g mode



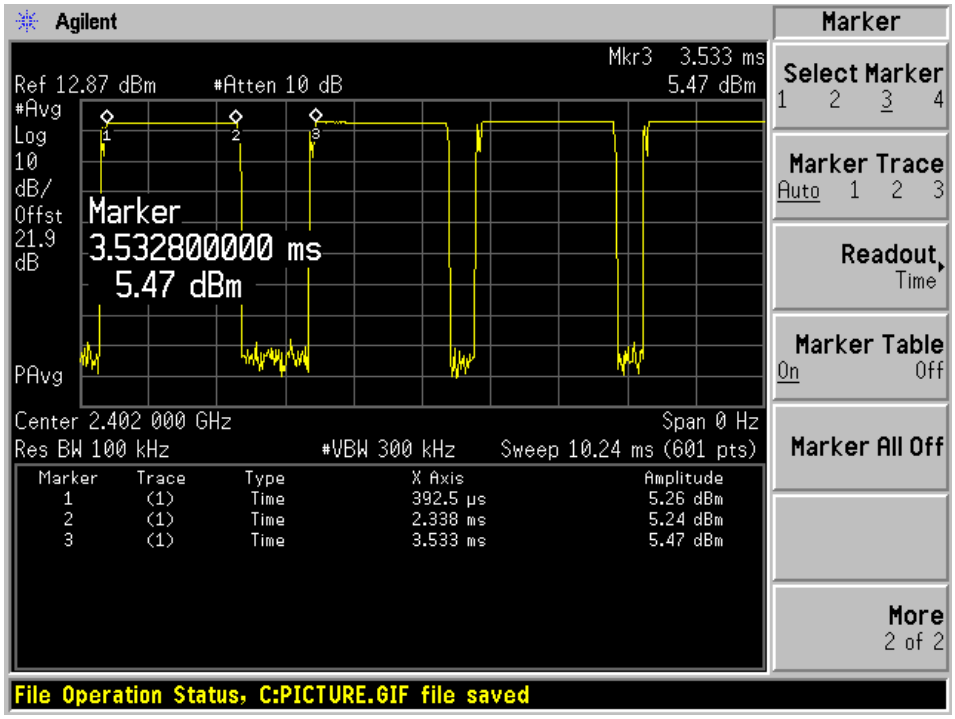
802.11n20 mode



802.11n40 mode



BLE mode



2.4 Equipment Modifications

None.

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Pro Book
GeeekPi	USB Isolator	ADUM3160

2.6 Remote Support Equipment

N/A

2.7 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
USB	< 1	EUT	USB Isolator

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirements	Compliant
FCC §2.1091, §15.247(i) ISED RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4 (4)	Maximum Peak Output Power	Compliant
FCC §2.1053, §15.35(b), §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9, §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(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
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant

BACL is responsible for all the information provided in this report, except when information is provided by the customer as identified in this report. Information provided by the customer, e.g., antenna gain, can affect the validity of results.

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

This radio transmitter 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

External/Internal/ Integral	Part Number	Antenna Type	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Internal	W24P-U	PCB	2400-2500 MHz	3.58

5 FCC §15.247(i) §2.1091 & ISED RSS-102 - RF Exposure

5.1 Applicable Standards

According to FCC KDB 447498 D04 Interim General RF Exposure Guidance v01, Section 2.1 RF Exposure Test Exemptions for Single Source,

2.1.1 General RF Exposure Test Exemption Considerations

RF exposure test exemptions provide means to obtain certification without the need of showing data (measurements, or analytical/numerical modeling) to demonstrate compliance. Hereafter, in this context, an RF source is referred to as "*exempt RF device*" in the sense that it is not required to show data demonstrating compliance to RF exposure limits.

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.[8] However, it is always possible, especially when the potential for exposure cannot be easily determined, that an RF exposure evaluation may become required according §§ 1.1307(c) and (d).

As detailed in Section 2.1.2, the 1 mW and SAR-based test exemption conditions are in terms of source-based available maximum time-averaged (matched conducted) output power for all operating configurations, adjusted for tune-up tolerance, and at the minimum *test separation distance* required for the particular RF exposure scenario under consideration. This minimum *test separation distance* is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. To qualify for SAR test exemption, the *test separation distances* applied must be fully explained and justified (typically in the SAR measurement, or SAR analysis report, according to KDB Pub. 865664) by showing the actual operating configurations and exposure conditions of the transmitter, and applicable host platform requirements (e.g., KDB Pubs. 648474, 616217, 941225)

When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for SAR test exemption.

If RF exposure testing requirements for a specific device are covered in a KDB Publication, those requirements must be satisfied before applying any SAR test exemption provisions. For example, this is the case for handheld PTT two-way radios, handsets, laptops, and tablets, etc.[9]

Finally, when 10-g extremity SAR applies, SAR test exemption may be considered by applying a factor of 2.5 to the SAR-based exemption thresholds.

2.1.2 1-mW Test Exemption

Per §1.1307(b)(3)(i)(A), a single RF source is *exempt RF device* (from the requirement to show data demonstrating compliance to RF exposure limits, as previously mentioned) if the available maximum time-averaged power is no more than 1 mW, regardless of separation distance.

This exemption applies to all operating configurations and exposure conditions, for the frequency range 100 kHz to 100 GHz, regardless of fixed, mobile, or portable device exposure conditions. This is a standalone exemption, and it cannot be applied in conjunction with any other test exemption.

2.1.3 SAR-Based Exemption

A more comprehensive exemption, considering a variable power threshold that depends on both the *separation distance* and power, is provided in §1.1307(b)(3)(ii)(B). This exemption is applicable to the frequency range between 300 MHz and 6 GHz, with *test separation distances* between 0.5 cm and 40 cm, and for all RF sources in fixed, mobile, and portable device exposure conditions.

Accordingly, a RF source is considered an *RF exempt device* if its available maximum time-averaged (matched conducted) power or its effective radiated power (ERP), whichever is greater, are below a specified threshold. This exemption threshold was derived based on general population 1-g SAR requirements and is detailed in Appendix C.

2.1.4 MPE-Based Exemption

An alternative to the SAR-based exemption is provided in §1.1307(b)(3)(ii)(C), for a much wider frequency range, from 300 kHz to 100 GHz, applicable for separation distances greater or equal to $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. The MPE-based test exemption condition is in terms of ERP, defined as the

[8] Specific test exemption thresholds for operations under occupational/controlled limits are not established.
[9] When SAR evaluation is required by the hotspot mode or UMPC mini-tablet procedures, that is, where an antenna is ≤ 2.5 cm from a surface or edge, the *test separation distance* from the phantom to the antenna or device enclosure, as appropriate, should be applied to determine SAR test exemption for such configurations, according to the criteria in this document. For that case, the *test separation distance* cannot be determined from the distance of the antenna to the device surface or edge.

According to ISED RSS-102 Issue 5 Section 2.5.1 Exemption Limits for Routine Evaluation-SAR Evaluation:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in table below,

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71	101	132	162	193
450	52	70	88	106	123
835	17	30	42	55	67
1900	7	10	18	34	60
2450	4	7	15	30	52
3500	2	6	16	32	55
5800	1	6	15	27	41

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223	254	284	315	345
450	141	159	177	195	213
835	80	92	105	117	130
1900	99	153	225	316	431
2450	83	123	173	235	309
3500	86	124	170	225	290
5800	56	71	85	97	106

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 FCC RF Exposure Exemption Evaluation Procedures

According to FCC KDB 447498 D04 Interim General RF Exposure Guidance v01, Annex B Exemptions for Single Source,

B.1 General

This appendix provides the exemption criteria and summarizes relevant parameters and usage considerations based on descriptions in FCC 19-126.

B.2 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of § 1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance. The 1 mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph § 1.1307(b)(3)(ii)(A). The 1 mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

B.3 MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table B.1 – THRESHOLD FOR SINGLE RF SOURCE SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L/2\pi$		$\lambda_H/2\pi$	W
0.3	-	1.34	159 m	-	35.6 m	1,920 R^2
1.34	-	30	35.6 m	-	1.6 m	3,450 R^2/f^2
30	-	300	1.6 m	-	159 mm	3.83 R^2
300	-	1,500	159 mm	-	31.8 mm	0.0128 $R^2 f$
1,500	-	100,000	31.8 mm	-	0.5 mm	19.2 R^2
Subscripts L and H are low and high; λ is wavelength. From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.						

The table applies to any RF source (i.e., single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least λ/2π. The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.

For mobile devices that are not exempt per Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] at distances from 20 cm to 40 cm and in 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in § 1.1310 is necessary if the ERP of the device is greater than ERP20cm in Formula (B.1) [repeated from § 2.1091(c)(1) and § 1.1307(b)(1)(i)(B)].

$$P_{th}\,(\text{mW}) = ERP_{20\,cm}\,(\text{mW}) = 2040f \quad 0.3\ \text{GHz} \le f < 1.5\ \text{GHz}$$
$$P_{th}\,(\text{mW}) = ERP_{20\,cm}\,(\text{mW}) = 3060 \quad 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \qquad \text{(B.1)}$$

If the ERP is not easily obtained, then the available maximum time-averaged power may be used (i.e., without consideration of ERP only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole.

SAR-based exemptions are constant at separation distances between 20 cm and 40 cm to avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 cm, considering the importance of reflections.

B.4 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of λ/4.

As for devices with antennas of length greater than λ/4 where the gain is not well defined, but always less than that of a half-wave dipole (length λ/2), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known.

The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{th}\ (\text{mW}) = ERP_{20\ \text{cm}}\,(d/20\ \text{cm})^{x} \quad d \le 20\ \text{cm}$$
$$P_{th}\ (\text{mW}) = ERP_{20\ \text{cm}} \quad 20\ \text{cm} < d \le 40\ \text{cm} \qquad \text{(B.2)}$$

Where

$$x = -\log_{10}\,(60/(ERP_{20\ \text{cm}}\sqrt{f}))$$

and f is in GHz, d is the separation distance (cm), and EPR20cm is per Formula (B.1).

The example values shown in Table B.2 are for illustration only.

Table B.2 – Example Power Thresholds (mW)

Frequency (MHz)	Distance (mm)										
		5	10	15	20	25	30	35	40	45	50
	300	39	65	88	110	129	148	166	184	201	217
	450	22	44	67	89	112	135	158	180	203	226
	835	9	25	44	66	90	116	145	175	207	240
	1900	3	12	26	44	66	92	122	157	195	236
	2450	3	10	22	38	59	83	111	143	179	219
	3600	2	8	18	32	49	71	96	125	158	195
	5800	1	6	14	25	40	58	80	106	136	169

5.3 RF exposure evaluation exemption for FCC

Prediction frequency (GHz)			2.462	
Maximum Output Power (dBm)			17.04	
Maximum ERP (dBm)			18.47	
Maximum ERP (mW)			70.31	
Prediction distance (cm)			20	
Maximum antenna gain (dBi)			3.58	
0.3 GHz ≤ f < 1.5 GHz	$ERP_{20\,cm}$ (mW)	x	SAR-based Exemption Threshold	
	-	-	$d \leq 20$ cm	P_{th} (mW)
				-
			20 cm < $d \leq 40$ cm	P_{th} (mW)
				-
1.5 GHz ≤ f ≤ 6 GHz	$ERP_{20\,cm}$ (mW)	x	SAR-based Exemption Threshold	
	3060	-	$d \leq 20$ cm	P_{th} (mW)
				-
			20 cm < $d \leq 40$ cm	P_{th} (mW)
				3060

As shown in the table above, the EUT's ERP is lower than the SAR-based Exemption Threshold. SAR testing for this device is exempted.

5.4 RF exposure evaluation exemption for IC

Maximum EIRP = 17.04 dBm + 3.58 dBi = 20.62dBm (115.35mW), which is less than $1.31\times10^{-2}f^{0.6834}$ = 2.72 W = 34.35 dBm

Therefore, the RF exposure Evaluation is not required.

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

6.1 Applicable Standards

As per FCC §15.207 and ISEDC 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 ISEDC RSS-Gen §8.8 limits.

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

The EUT was connected with LISN-1 which provided 240 V / 60 Hz AC power.

EUT and accessories arranged and configured in a manner that tends to produce maximum emissions within the range of variations that can be expected under normal operating conditions.

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.

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 and 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:

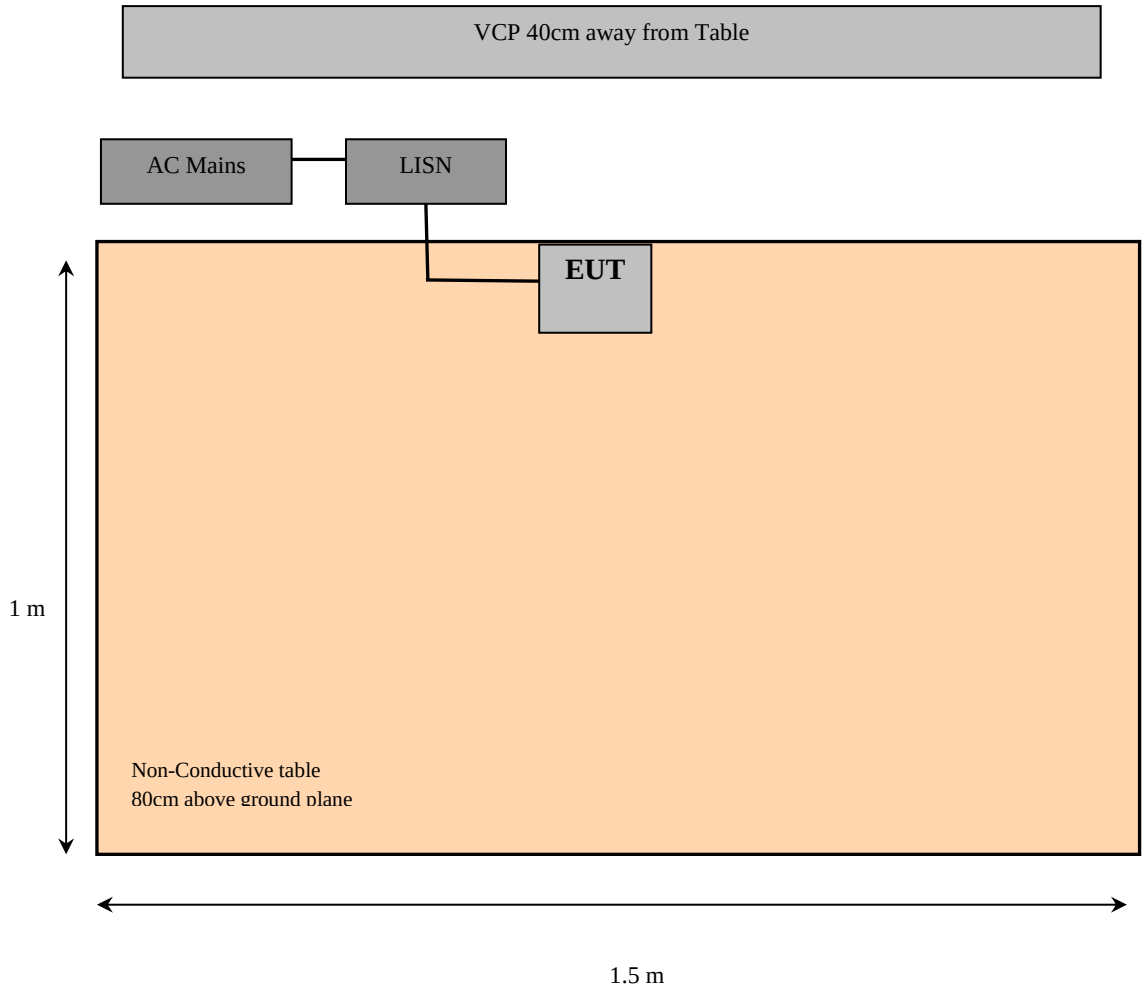
CA = Ai + CL + Atten

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

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
310	Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2022-04-19	1 year
680	Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2022-07-27	1 year
724	Solar Electronics Company	High Pass Filter	Type 7930-100	7930150202	2022-04-07	1 year
-	Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
732	FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2021-11-24	1 year
-	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 the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

6.7 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	51 %
ATM Pressure:	101.9 kPa

The testing was performed by Christian McCaig on 2022-09-28 in the Ground Plane test site.

6.8 Summary of Test Results

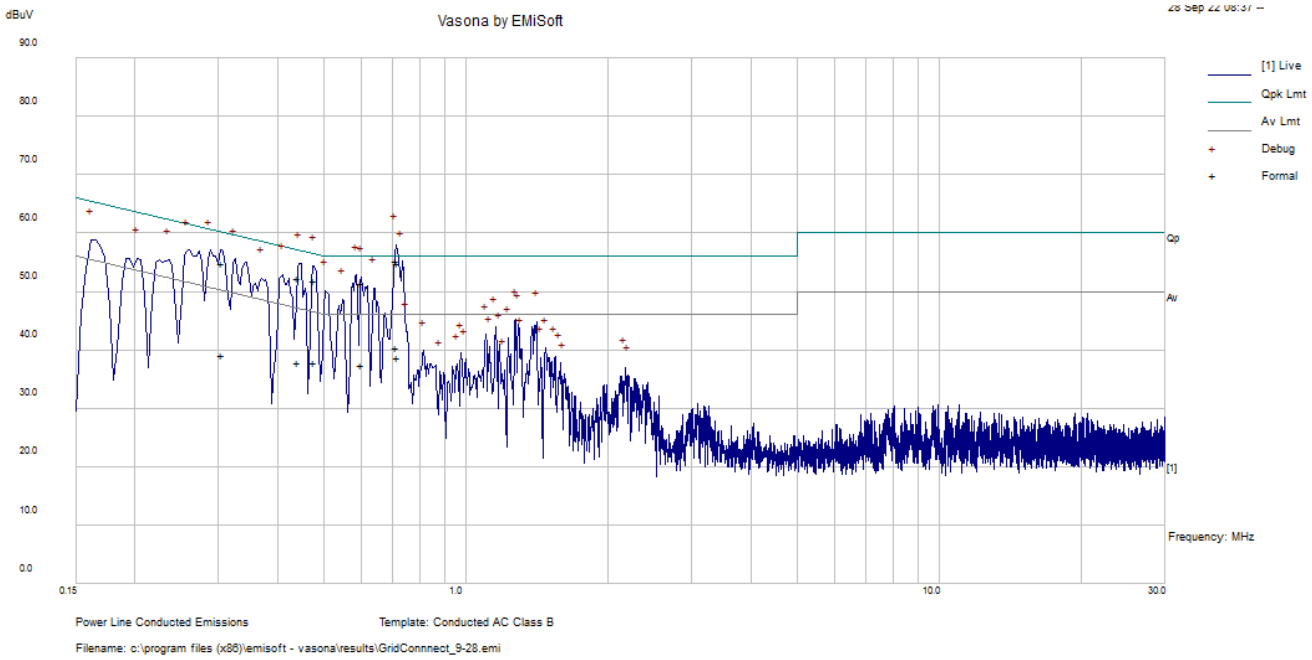
According to the recorded data in following table, the EUT complied with the FCC 15C and ISEDC RSS-Gen standard's conducted emissions limits, with the margin reading of:

Connection: Connected to 240 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-0.7	0.714528	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

Worst Case: 802.11b, High Channel

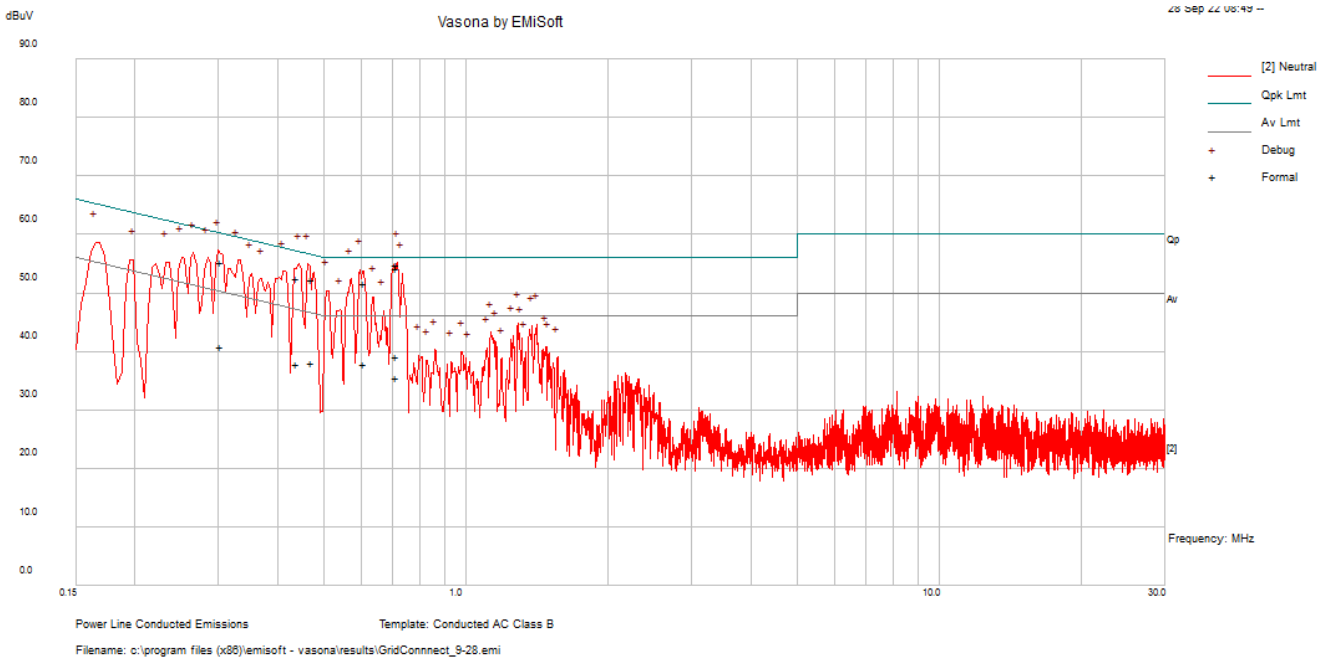
240 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.718221	54.8	Line	56	-1.2	Quasi Peak
0.714528	**55.3**	**Line**	**56**	**-0.7**	**Quasi Peak**
0.476878	51.8	Line	56.39	-4.59	Quasi Peak
0.441927	52.38	Line	57.03	-4.64	Quasi Peak
0.602282	51.55	Line	56	-4.45	Quasi Peak
0.306012	54.81	Line	60.08	-5.26	Quasi Peak

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.718221	38.69	Line	46	-7.31	Ave.
0.714528	40.33	Line	46	-5.67	Ave.
0.476878	37.77	Line	46.39	-8.63	Ave.
0.441927	37.82	Line	47.03	-9.21	Ave.
0.602282	37.34	Line	46	-8.66	Ave.
0.306012	39.07	Line	50.08	-11.01	Ave.

240 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.711698	54.96	Neutral	56	-1.04	Quasi Peak
0.473868	52.21	Neutral	56.45	-4.24	Quasi Peak
0.440253	52.48	Neutral	57.06	-4.58	Quasi Peak
0.607968	51.59	Neutral	56	-4.41	Quasi Peak
0.714312	54.21	Neutral	56	-1.79	Quasi Peak
0.303022	55.27	Neutral	60.16	-4.89	Quasi Peak

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.711698	39.08	Neutral	46	-6.92	Ave.
0.473868	38.13	Neutral	46.45	-8.32	Ave.
0.440253	37.89	Neutral	47.06	-9.17	Ave.
0.607968	37.82	Neutral	46	-8.18	Ave.
0.714312	35.46	Neutral	46	-10.54	Ave.
0.303022	40.81	Neutral	50.16	-9.35	Ave.

7 FCC §15.35(b), §15.205, §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10- Spurious Radiated Emissions

7.1 Applicable Standards

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

As Per FCC §15.205(a) 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 ISED 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 ISED 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.

7.2 Test Setup

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

The spacing between the peripherals was 10 centimeters.

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

7.3 Test Procedure

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

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

The EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meters, and the EUT was placed on a turntable, which was 0.8 meters and 1.5 meters 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

7.4 Corrected Amplitude and Margin Calculation

For emissions below 1 GHz,

The Corrected Amplitude (CA) is calculated by adding the Correction Factor to the S.A. Reading. The basic equation is as follows:

CA = S.A. Reading + Correction Factor

For example, a corrected amplitude of 40.3 dBuV/m = S.A. Reading (32.5 dBuV) + Correction Factor (7.8 dB/m)

The Correction Factor is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) together. This calculation is done in the measurement software, and reported in the test result section. The basic equation is as follows:

Correction Factor = AF + CL + Atten – Ga

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

For emission above 1 GHz,

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

CA = Ai + AF + CL + Atten – Ga

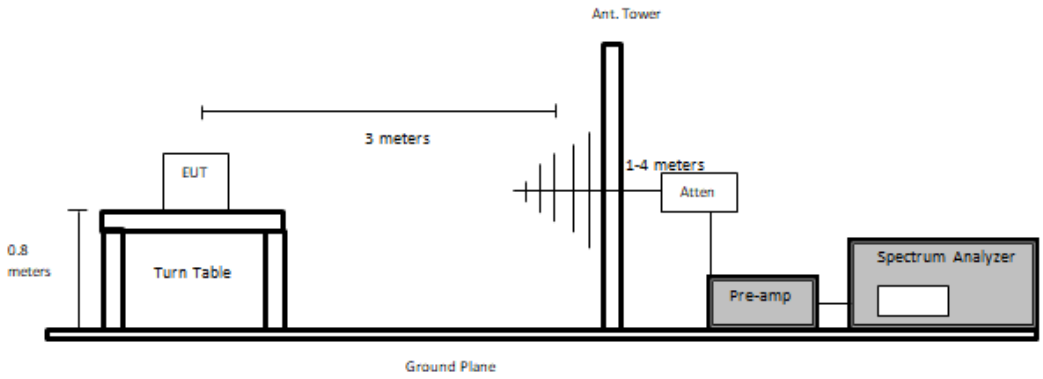
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

Margin = Corrected Amplitude – Limit

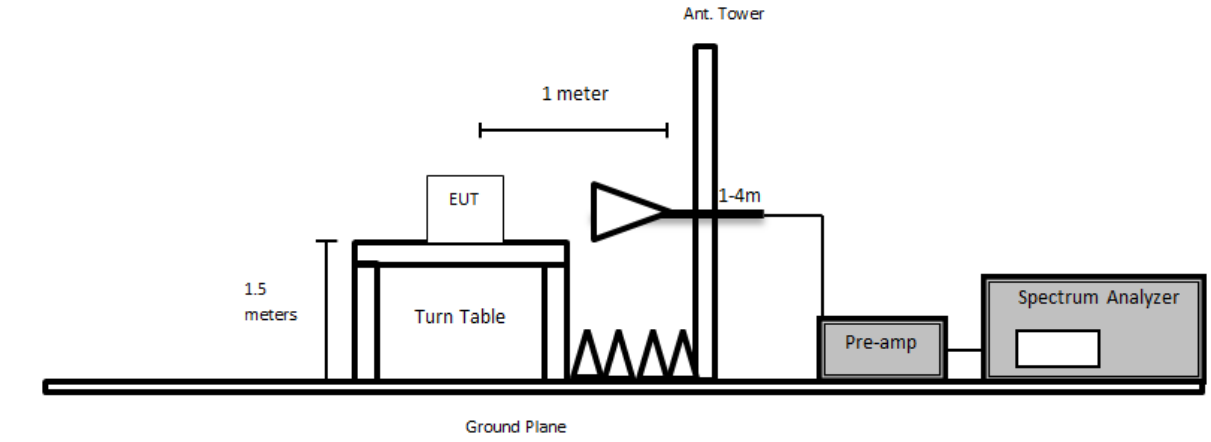
7.5 Test Setup Block Diagram

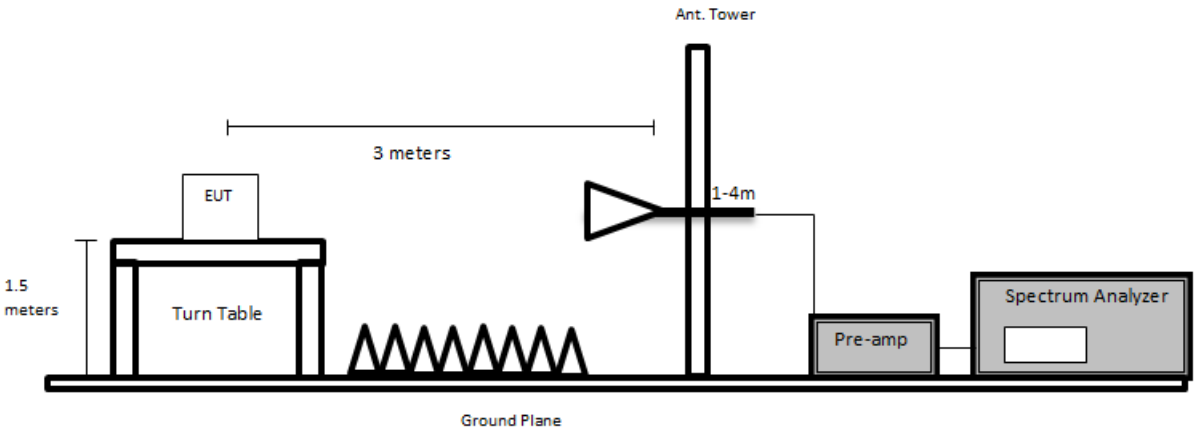
Below 1GHz (Asset #321 Antenna used):



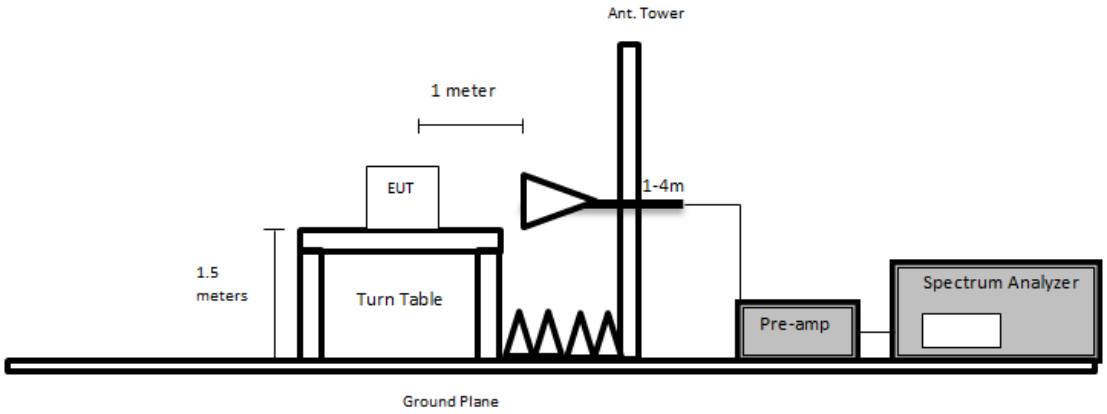
Above 1GHz:

1 GHz to 18 GHz (Asset #1192 Antenna used):





18 GHz to 26.5 GHz (Asset #91 Antenna used):



7.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
310	Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950.03	100338	2022-04-19	1 year
624	Agilent	Analyzer, Spectrum	E4446A	MY48250 238	2022-08-01	1 year
320	Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
827	AH Systems	Preamplifier	PAM 1840 VH	170	2021-08-03	13 months
316	Sonoma Instruments	Preamplifier 10 kHz - 2.5 GHz	317	260406	2022-05-12	1 year
658	HP/Agilent	Pre-Amplifier	8449B OPT HO2	3008A011 3	2022-07-22	1 year
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2021-11-22	2 years
1192	ETS Lindgren	Horn Antenna	3117	00218973	2021-09-14	2 years
91	Wisewave	Antenna, Horn 18-26.5GHz	ARH-4223-02	10555-02	2022-03-08	2 years
1228	Pasternack	Coaxial Cable, RG213	PE3496-800CM	2111301	2021-11-30	1 year
1222	Fairview Microwave	Coaxial Cable 6”	FMC229085-06	BACL210 8031	2021-08-03	13 months
603	CarlisleIT	Ultiflex RF Microwave Cable Assembly	UFB142C-1-1800-200200	223458-004	2022-04-26	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	Notch filters	-	-	Each time[1]	N/A
N/A	Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Note[1]: cable and notch filters included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 “A2LA Policy on Metrological Traceability”.*

7.7 Test Environmental Conditions

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

The testing was performed by Deepak Mishra from 2022-08-26 to 2022-09-03 in 5m chamber 3.

7.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.209, 15.247 and ISEDC RSS-247 standards' radiated emissions limits, and had the worst margin of:

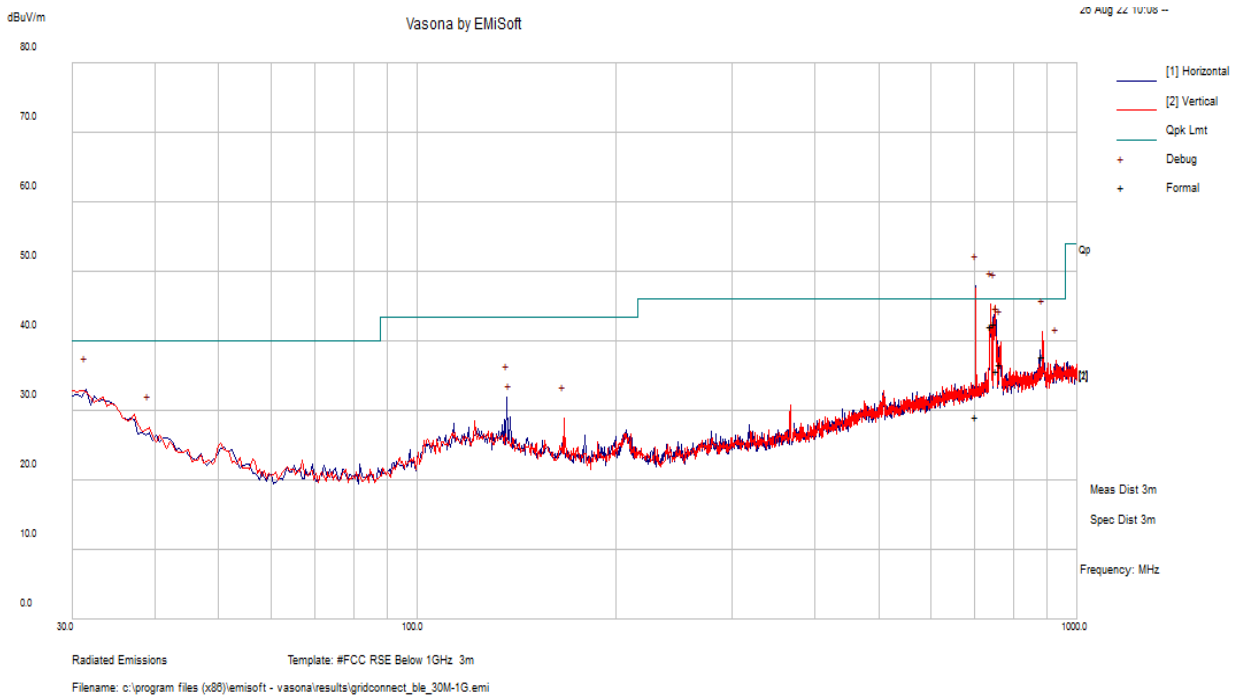
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Worst-case Configuration Tested**
-0.242	2483.5	Horizontal	802.11g mode, 2462 MHz

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

7.9 Radiated Emissions Test Results

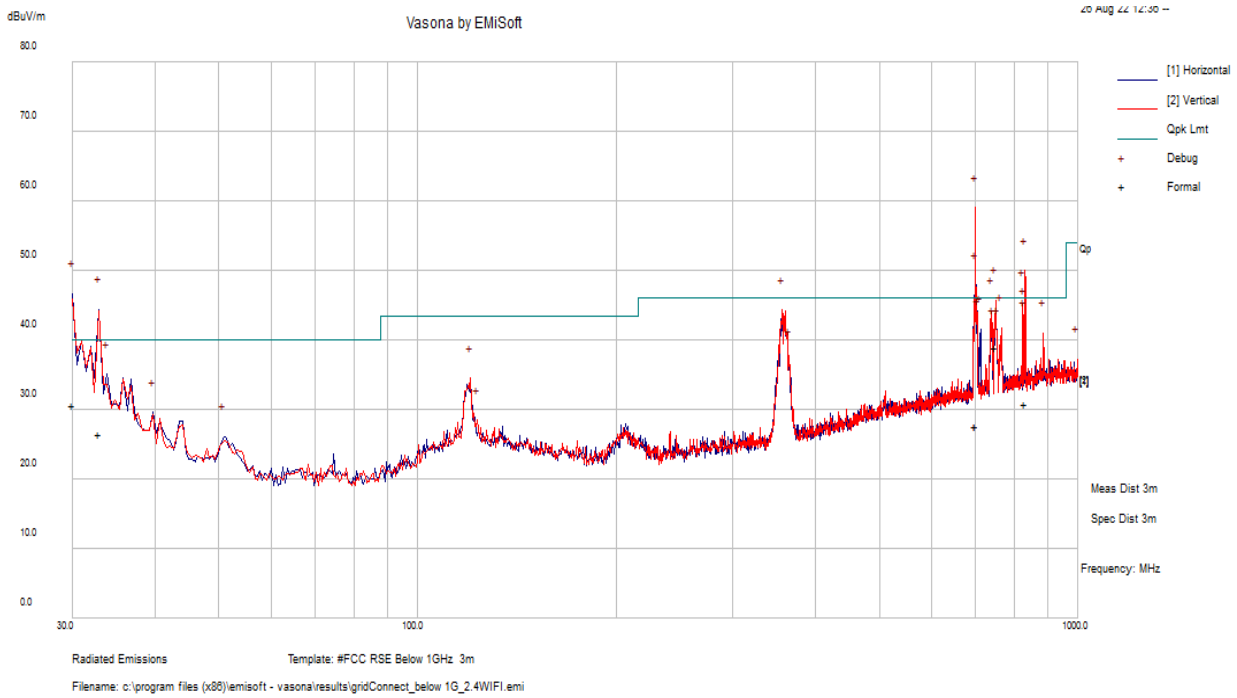
1) 30 MHz – 1 GHz Worst Case, Measured at 3 meter

BLE, Middle Channel



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
701.804	28.04	1.06	29.10	152	H	23	46	-16.90	QP
739.539	40.53	1.62	42.16	153	V	334	46	-3.84	QP
750.153	40.58	1.87	42.45	150	V	215	46	-3.55	QP
885.913	34.60	3.20	37.80	234	V	286	46	-8.20	QP
755.298	33.77	1.87	35.64	263	H	208	46	-10.36	QP
764.998	34.73	1.97	36.70	279	V	284	46	-9.30	QP

802.11b, High Channel



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
698.798	26.64	1.00	27.63	160	V	28	46	-18.37	QP
30.000	31.40	-0.78	30.63	152	H	23	40	-9.37	QP
32.959	29.07	-2.60	26.47	165	H	197	40	-13.53	QP
831.063	28.25	2.58	30.83	199	V	107	46	-15.17	QP
700.290	26.65	1.03	27.69	162	H	16	46	-18.31	QP
749.800	37.05	1.86	38.92	117	V	118	46	-7.08	QP

2) 1–26.5 GHz, BLE measured at 1 Meter, 2.4Wifi measured at 3 meters

BLE

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 2402 MHz											
2390	50.480	22	300	H	32.228	8.700	37.896	53.512	84	-30.488	Peak
2390	49.820	140	300	V	32.228	8.700	37.896	52.852	84	-31.148	Peak
2390	38.632	22	300	H	32.228	8.700	37.896	41.664	64	-22.336	Ave
2390	37.732	140	300	V	32.228	8.700	37.896	40.764	64	-23.236	Ave
4804	48.160	112	151	H	34.709	13.190	36.701	59.358	84	-24.642	Peak
4804	47.750	118	158	V	34.709	13.190	36.701	58.948	84	-25.052	Peak
4804	35.322	112	151	H	34.709	13.190	36.701	46.520	64	-17.480	Ave
4804	35.322	118	158	V	34.709	13.190	36.701	46.520	64	-17.480	Ave
Middle Channel Frequency: 2440 MHz											
4880	48.260	360	305	H	34.709	11.900	36.796	58.073	84	-25.927	Peak
4880	48.900	180	278	V	34.709	11.900	36.796	58.713	84	-25.287	Peak
4880	35.642	360	305	H	34.709	11.900	36.796	45.455	64	-18.545	Ave
4880	35.762	180	278	V	34.709	11.900	36.796	45.575	64	-18.425	Ave
High Channel Frequency: 2480 MHz											
2483.5	57.120	338	240	H	32.665	9.240	38.075	60.950	84	-23.050	Peak
2483.5	50.260	200	276	V	32.665	9.240	38.075	54.090	84	-29.910	Peak
2483.5	48.802	3338	240	H	32.665	9.240	38.075	52.632	64	-11.368	Ave
2483.5	37.872	200	276	V	32.665	9.240	38.075	41.702	64	-22.298	Ave
4960	48.480	19	125	H	34.709	12.090	36.905	58.374	84	-25.626	Peak
4960	48.250	47	253	V	34.709	12.090	36.905	58.144	84	-25.856	Peak
4960	35.242	19	125	H	34.709	12.090	36.905	45.136	64	-18.864	Ave
4960	43.412	47	253	V	34.709	12.090	36.905	53.306	64	-10.694	Ave

802.11b

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 2412 MHz											
2390	60.140	156	292	H	32.228	5.520	38.154	59.734	74	-14.266	Peak
2390	56.140	87	249	V	32.228	5.520	38.154	55.734	74	-18.266	Peak
2390	49.570	156	292	H	32.228	5.520	38.154	49.164	54	-4.836	Ave
2390	43.920	87	249	V	32.228	5.520	38.154	43.514	54	-10.486	Ave
4824	50.050	267	170	H	34.709	7.950	37.125	55.584	74	-18.416	Peak
4824	51.233	219	170	V	34.709	7.950	37.125	56.767	74	-17.233	Peak
4824	39.740	267	170	H	34.709	7.950	37.125	45.274	54	-8.726	Ave
4824	42.350	219	170	V	34.709	7.950	37.125	47.884	54	-6.116	Ave
Middle Channel Frequency: 2437 MHz											
4874	50.260	325	227	H	34.709	7.950	37.027	55.892	74	-18.108	Peak
4874	51.430	341	198	V	34.709	7.950	37.027	57.062	74	-16.938	Peak
4874	39.510	325	227	H	34.709	7.950	37.027	45.142	54	-8.858	Ave
4874	42.900	341	198	V	34.709	7.950	37.027	48.532	54	-5.468	Ave
High Channel Frequency: 2462 MHz											
2483.5	56.690	178	287	H	32.665	5.520	38.075	56.800	74	-17.200	Peak
2483.5	51.290	360	240	V	32.665	5.520	38.075	51.400	74	-22.600	Peak
2483.5	45.520	178	287	H	32.665	5.520	38.075	45.630	54	-8.370	Ave
2483.5	38.960	360	240	V	32.665	5.520	38.075	39.070	54	-14.930	Ave
4924	52.040	253	261	H	34.709	7.950	37.027	57.672	74	-16.328	Peak
4924	52.560	340	169	V	34.709	7.950	37.027	58.192	74	-15.808	Peak
4924	43.490	253	261	H	34.709	7.950	37.027	49.122	54	-4.878	Ave
4924	43.760	340	169	V	34.709	7.950	37.027	49.392	54	-4.608	Ave

802.11g

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 2412 MHz											
2390	70.790	194	300	H	29.434	3.600	38.154	65.670	74	-8.330	Peak
2390	65.310	94	300	V	29.434	3.600	38.154	60.190	74	-13.810	Peak
2390	57.090	194	300	H	29.434	3.600	38.154	51.970	54	-2.030	Ave
2390	51.133	94	300	V	29.434	3.600	38.154	46.013	54	-7.987	Ave
4824	70.790	194	300	H	29.434	3.600	38.154	65.670	74	-8.330	Peak
4824	65.310	94	300	V	29.434	3.600	38.154	60.190	74	-13.810	Peak
4824	57.090	194	300	H	29.434	3.600	38.154	51.970	54	-2.030	Ave
4824	51.133	94	300	V	29.434	3.600	38.154	46.013	54	-7.987	Ave
Middle Channel Frequency: 2437 MHz											
4874	48.340	0	165	H	34.709	7.950	37.027	53.972	74	-20.028	Peak
4874	48.960	139	300	V	34.709	7.950	37.027	54.592	74	-19.408	Peak
4874	35.760	0	165	H	34.709	7.950	37.027	41.392	54	-12.608	Ave
4874	35.990	139	300	V	34.709	7.950	37.027	41.622	54	-12.378	Ave
High Channel Frequency: 2462 MHz											
2483.5	70.210	201	280	H	29.434	3.600	38.075	65.169	74	-8.831	Peak
2483.5	61.100	10	205	V	29.434	3.600	38.075	56.059	74	-17.941	Peak
2483.5	58.799	201	280	H	29.434	3.600	38.075	53.758	54	-0.242	Ave
2483.5	49.102	10	205	V	29.434	3.600	38.075	44.061	54	-9.939	Ave
4924	50.650	330	179	H	32.875	5.340	37.027	51.838	74	-22.162	Peak
4924	52.900	262	170	V	32.875	5.340	37.027	54.088	74	-19.912	Peak
4924	40.228	330	179	H	32.875	5.340	37.027	41.416	54	-12.584	Ave
4924	40.681	262	170	V	32.875	5.340	37.027	41.869	54	-12.131	Ave

802.11n20

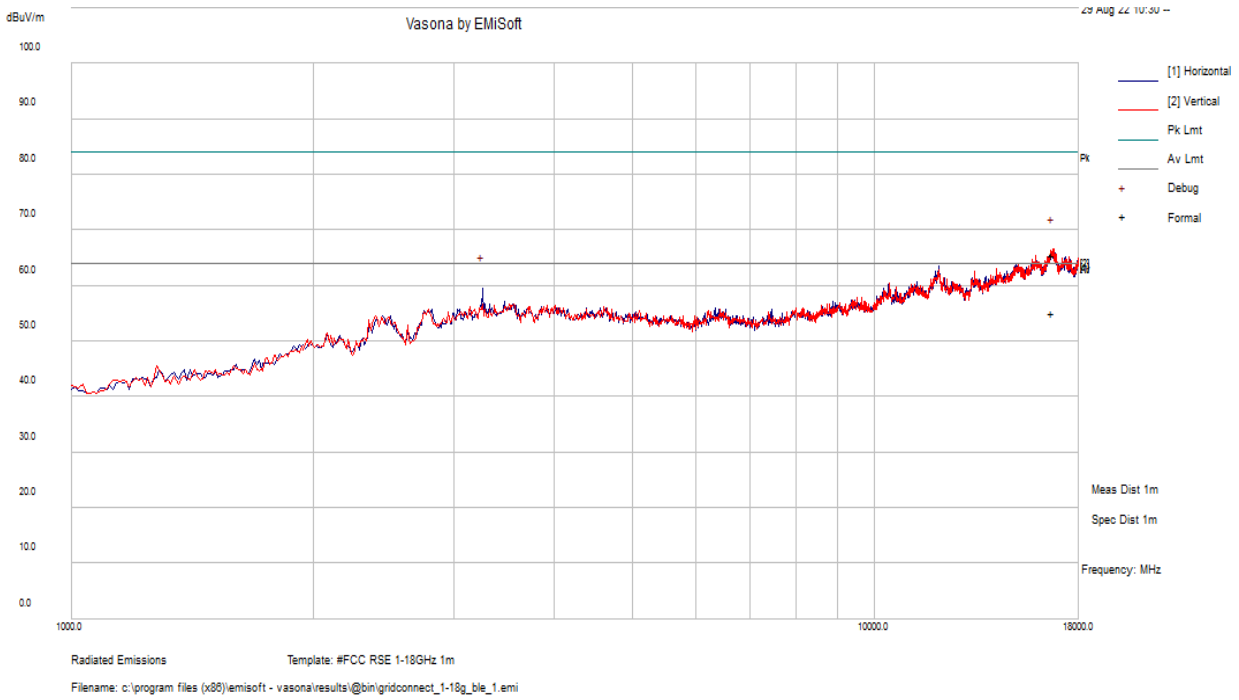
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 2412 MHz											
2390	70.690	198	253	H	29.434	3.600	38.154	65.570	74	-8.430	Peak
2390	64.970	85	300	V	29.434	3.600	38.154	59.850	74	-14.150	Peak
2390	57.853	198	253	H	29.434	3.600	38.154	52.733	54	-1.267	Ave
2390	52.494	85	300	V	29.434	3.600	38.154	47.374	54	-6.626	Ave
4824	49.820	330	248	H	32.875	5.340	37.125	50.910	74	-23.090	Peak
4824	49.290	357	156	V	32.875	5.340	37.125	50.380	74	-23.620	Peak
4824	37.480	330	248	H	32.875	5.340	37.125	38.570	54	-15.430	Ave
4824	37.846	357	156	V	32.875	5.340	37.125	38.936	54	-15.064	Ave
Middle Channel Frequency: 2437 MHz											
4874	50.170	329	285	H	32.875	5.340	37.027	51.358	74	-22.642	Peak
4874	51.370	241	122	V	32.875	5.340	37.027	52.558	74	-21.442	Peak
4874	37.958	329	285	H	32.875	5.340	37.027	39.146	54	-14.854	Ave
4874	40.063	241	122	V	32.875	5.340	37.027	41.251	54	-12.749	Ave
High Channel Frequency: 2462 MHz											
2483.5	68.360	342	260	H	29.434	3.600	38.075	63.319	74	-10.681	Peak
2483.5	65.280	102	281	V	29.434	3.600	38.075	60.239	74	-13.761	Peak
2483.5	56.382	342	260	H	29.434	3.600	38.075	51.341	54	-2.659	Ave
2483.5	52.309	102	281	V	29.434	3.600	38.075	47.268	54	-6.732	Ave
4924	50.630	243	210	H	32.875	5.340	37.027	51.818	74	-22.182	Peak
4924	50.100	357	290	V	32.875	5.340	37.027	51.288	74	-22.712	Peak
4924	39.290	243	210	H	32.875	5.340	37.027	40.478	54	-13.522	Ave
4924	38.797	357	290	V	32.875	5.340	37.027	39.985	54	-14.015	Ave

802.11n40

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 2422 MHz											
2390	70.020	196	300	H	29.434	3.600	38.066	64.988	74	-9.012	Peak
2390	62.890	91	300	V	29.434	3.600	38.066	57.858	74	-16.142	Peak
2390	57.864	196	300	H	29.434	3.600	38.066	52.832	54	-1.168	Ave
2390	51.892	91	300	V	29.434	3.600	38.066	46.860	54	-7.140	Ave
4844	49.350	330	248	H	32.875	5.340	37.125	50.440	74	-23.560	Peak
4844	19.380	357	156	V	32.875	5.340	37.125	20.470	74	-53.530	Peak
4844	38.150	330	248	H	32.875	5.340	37.125	39.240	54	-14.760	Ave
4844	38.340	357	156	V	32.875	5.340	37.125	39.430	54	-14.570	Ave
Middle Channel Frequency: 2437 MHz											
4874	50.350	329	285	H	32.875	5.340	37.027	51.538	74	-22.462	Peak
4874	51.970	241	122	V	32.875	5.340	37.027	53.158	74	-20.842	Peak
4874	38.658	329	285	H	32.875	5.340	37.027	39.846	54	-14.154	Ave
4874	40.347	241	122	V	32.875	5.340	37.027	41.535	54	-12.465	Ave
High Channel Frequency: 2452 MHz											
2483.5	68.960	202	270	H	29.434	3.600	38.075	63.919	74	-10.081	Peak
2483.5	59.380	193	272	V	29.434	3.600	38.075	54.339	74	-19.661	Peak
2483.5	58.536	202	270	H	29.434	3.600	38.075	53.495	54	-0.505	Ave
2483.5	48.872	193	272	V	29.434	3.600	38.075	43.831	54	-10.169	Ave
4904	51.360	243	210	H	32.875	5.340	37.027	52.548	74	-21.452	Peak
4904	50.630	357	290	V	32.875	5.340	37.027	51.818	74	-22.182	Peak
4904	39.847	243	210	H	32.875	5.340	37.027	41.035	54	-12.965	Ave
4904	38.378	357	290	V	32.875	5.340	37.027	39.566	54	-14.434	Ave

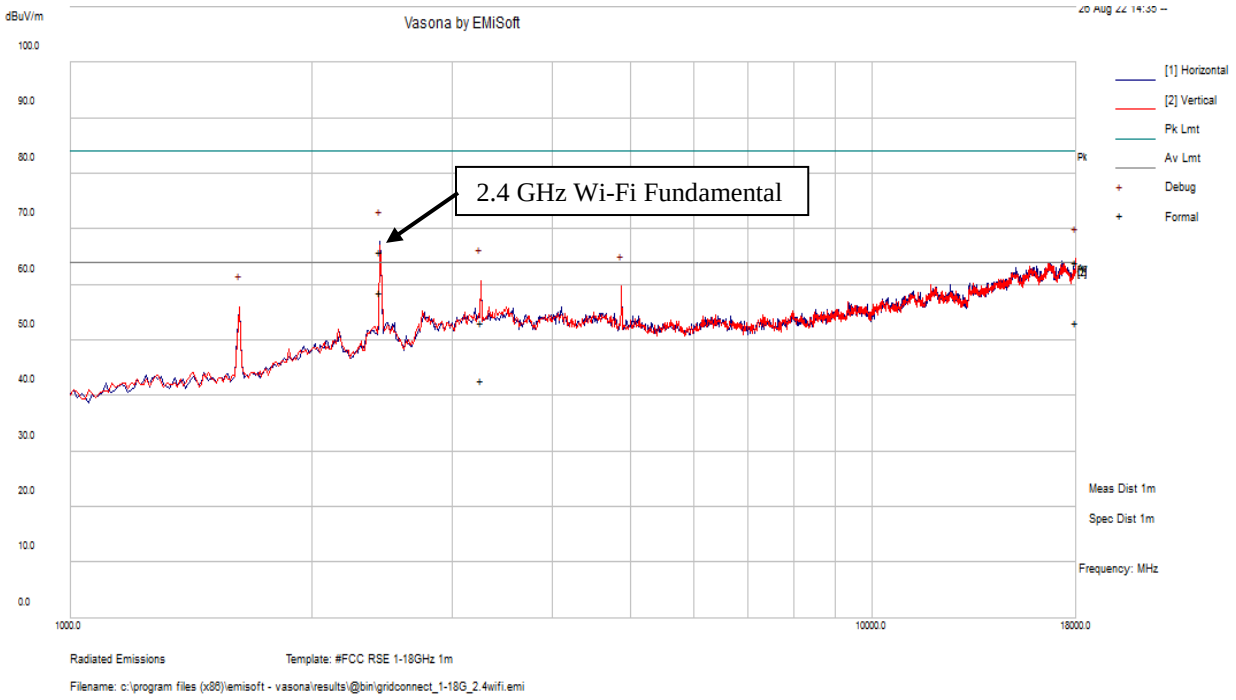
3) 1 – 18 GHz Worst Case, Measured at 1 meter

BLE, Middle Channel



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
16703.13	45.32	20.09	65.41	V	105	122	84	-18.59	Peak
16703.13	34.97	20.09	55.06	V	105	122	64	-8.94	Avg.

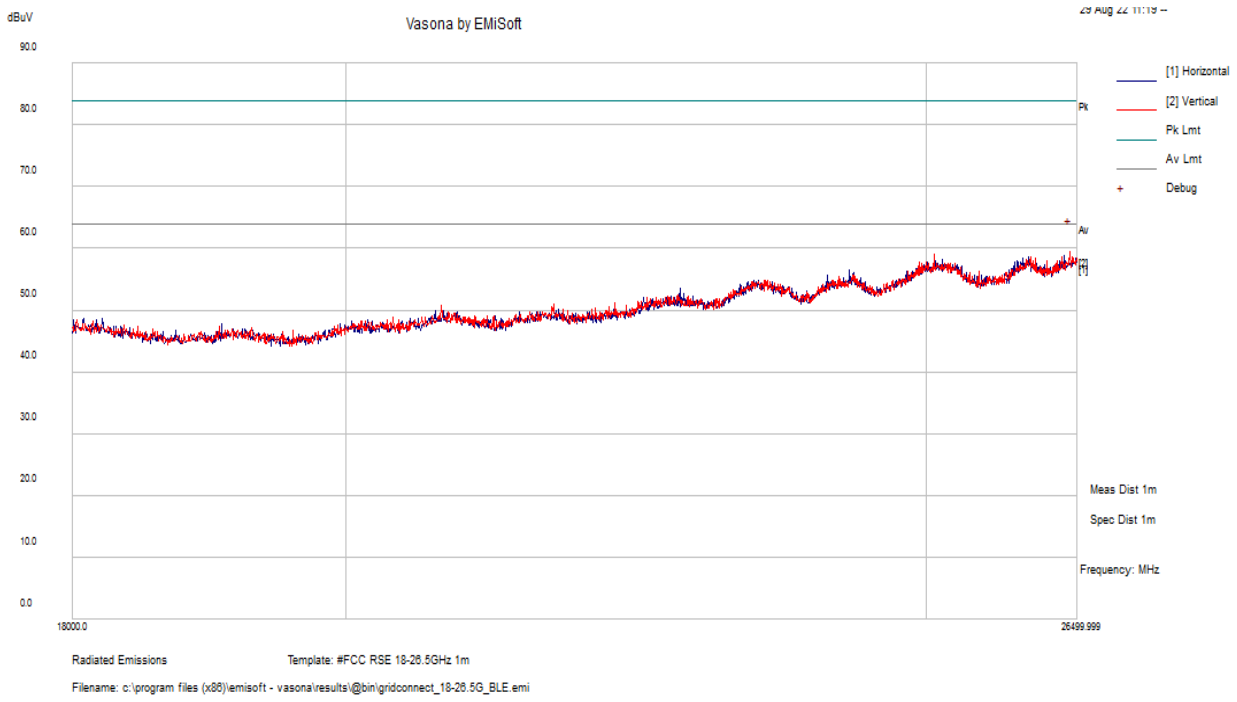
802.11b, High Channel



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
17991.02	46.16	17.89	64.05	V	146	253	84	-19.95	Peak
17991.02	35.31	17.89	53.20	V	146	253	64	-10.80	Avg.

4) 18 - 26.5 GHz Worst Case, Measured at 1 meter

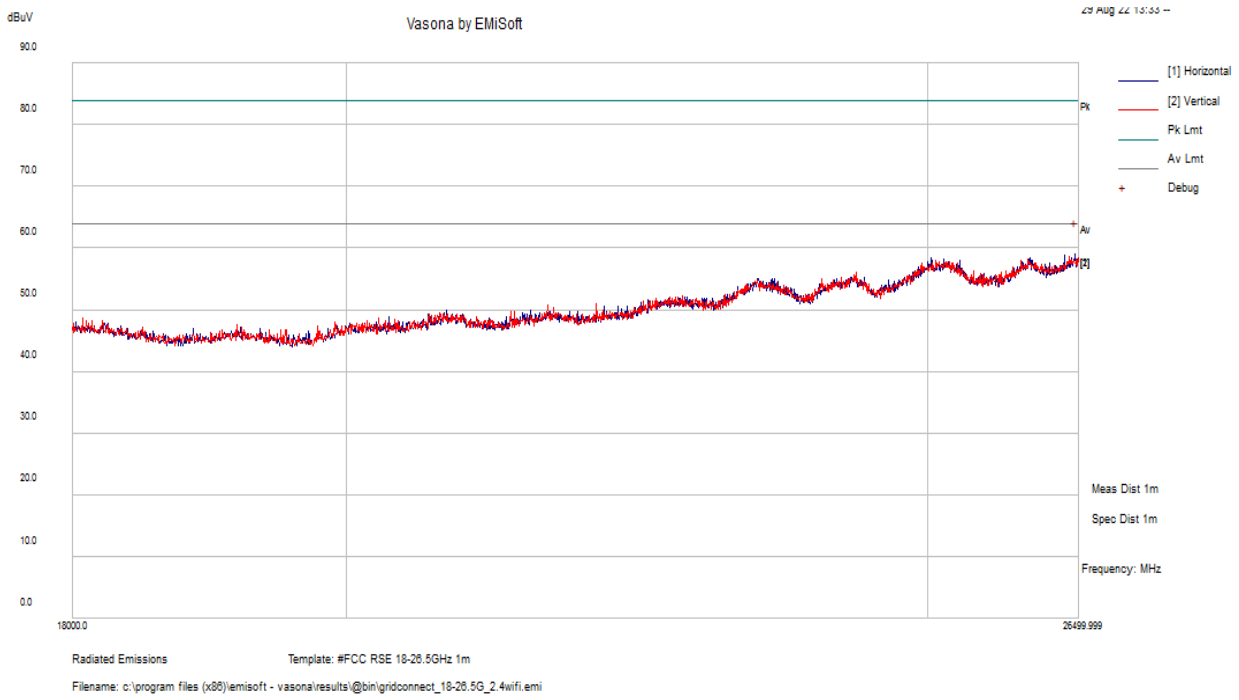
BLE, Middle Channel



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
26420.31	36.43	23.14	59.57	V	100	0	64	-4.43	Peak

Note: Peak measurement made on worst-case emission and compared to average limit to show compliance.

802.11b, High Channel



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
26462.81	35.97	23.07	59.04	H	100	0	64	-4.96	Peak

Note: Peak measurement made on worst-case emission and compared to average limit to show compliance.

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

8.1 Applicable Standards

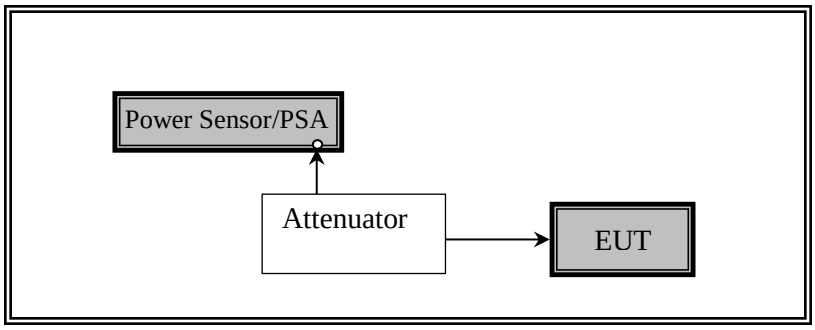
According to FCC §15.247(b) (3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to RSS-247 §5.4: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

8.2 Measurement Procedure

The measurements are based on ANSI C63.10-2013, Section 11.9.2.3 for Wifi and 11.9.1.1 for BLE.

8.3 Test Setup Block Diagram



8.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2022-08-01	1 year
424	Agilent	Spectrum Analyzer	E4440A	US45303156	2021-12-06	1 year
697	ETS- Lindgren	Power Sensor	7002-006	160097	2021-02-21	2 years
-	-	RF cable	-	-	Each time[1]	N/A
-	-	20 dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

8.5 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	51 %
ATM Pressure:	101.3 KPa

The testing was performed by Tao Jin on 2022-09-07 in RF site.

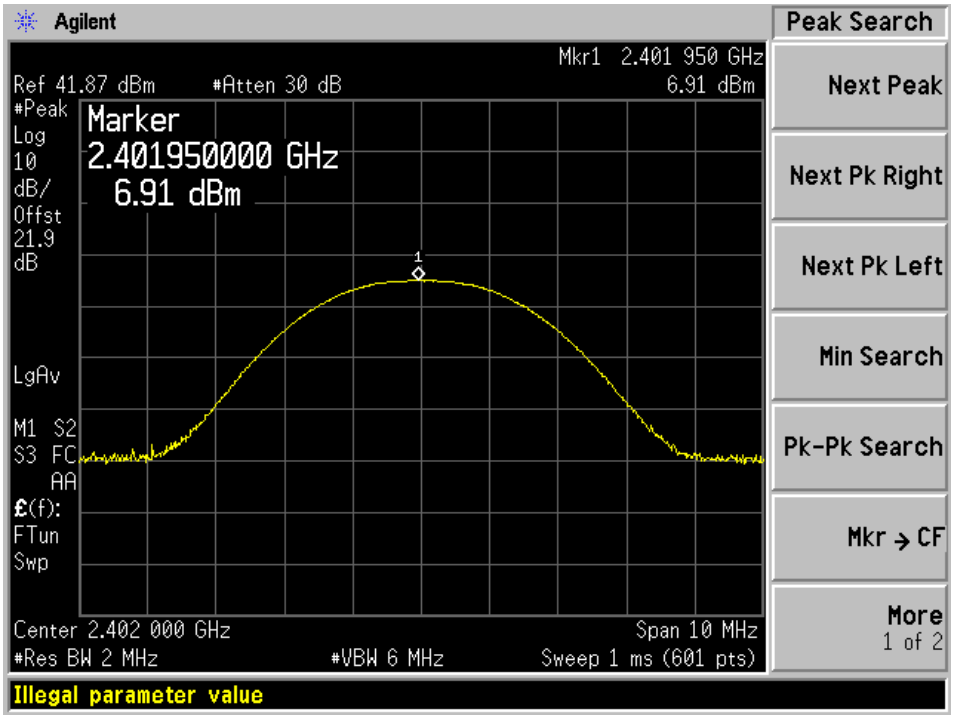
8.6 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Output Power Limit (dBm)	EIRP (dBm)	EIRP Limit (dBm)	Result
802.11b						
Low	2412	16.75	< 30	20.33	< 36	Pass
Middle	2437	17.01	< 30	20.59	< 36	Pass
High	2462	17.04	< 30	20.62	< 36	Pass
802.11g						
Low	2412	14.19	< 30	17.77	< 36	Pass
Middle	2437	15.82	< 30	19.4	< 36	Pass
High	2462	15.17	< 30	18.75	< 36	Pass
802.11 n20						
Low	2412	14.27	< 30	17.85	< 36	Pass
Middle	2437	15.75	< 30	19.33	< 36	Pass
High	2462	14.98	< 30	18.56	< 36	Pass
802.11 n40						
Low	2422	13.69	< 30	17.27	< 36	Pass
Middle	2437	15.17	< 30	18.75	< 36	Pass
High	2452	12.91	< 30	16.49	< 36	Pass
BLE						
Low	2402	6.91	< 30	10.49	< 36	Pass
Middle	2440	8.60	< 30	12.18	< 36	Pass
High	2480	6.62	< 30	10.2	< 36	Pass

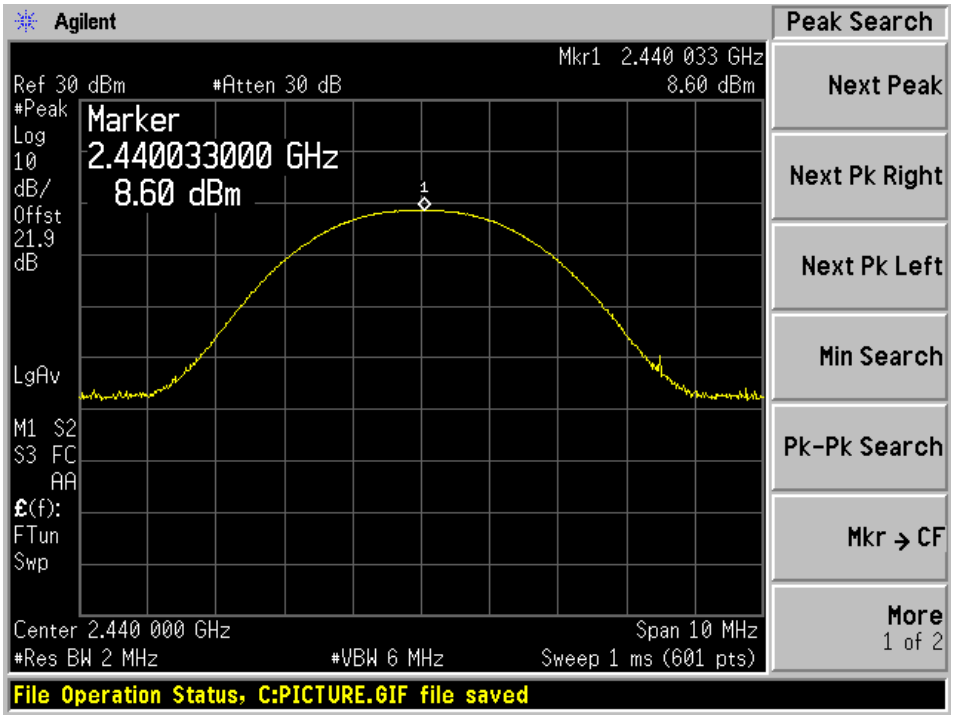
Note: EIRP(dBm) = Conducted Output Power(dBm) + Antenna Gain (dBi)
Note: Antenna gain provided by client.

Please refer to the following plots for detailed test results

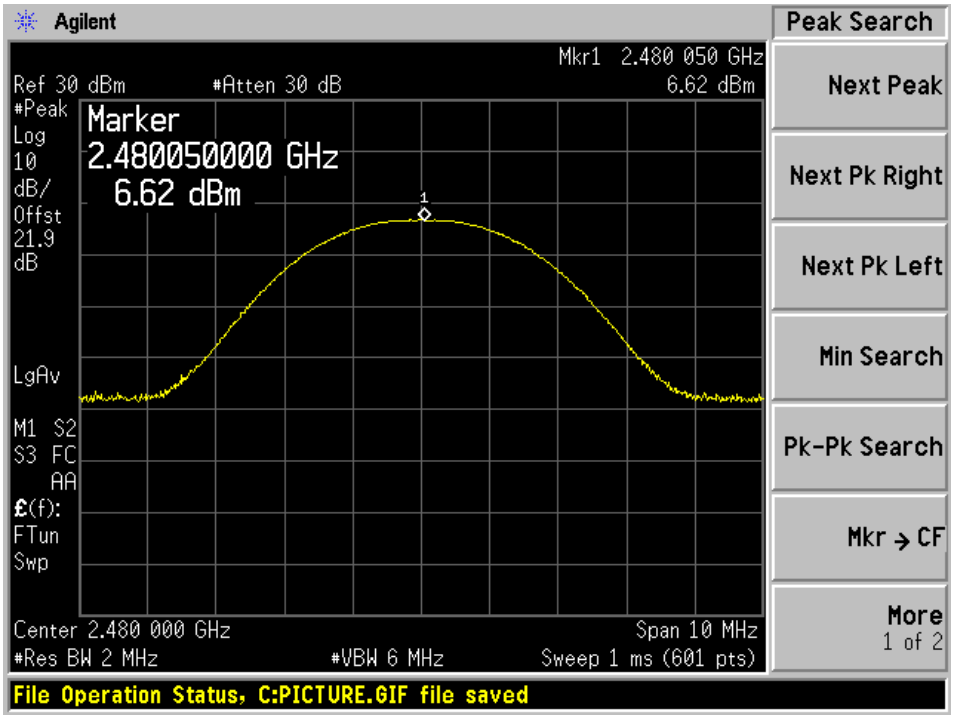
BLE Low Channel: 2402 MHz



BLE Middle Channel: 2440 MHz



BLE High Channel: 2480 MHz



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

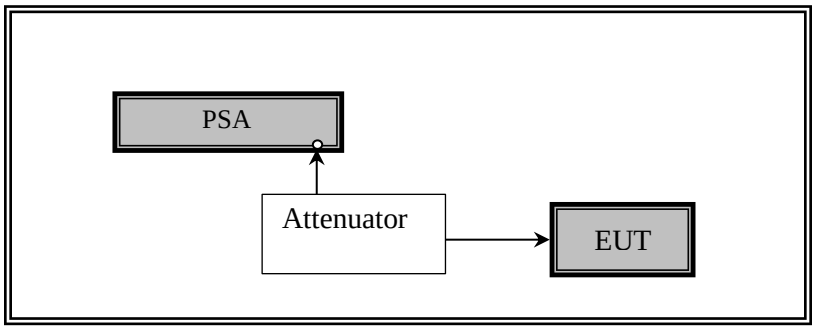
9.1 Applicable Standards

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

9.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 15.247 Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8.2: DTS bandwidth

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
424	Agilent	Spectrum Analyzer	E4440A	US45303156	12/06/2021	1 year
	-	RF cable	-	-	Each time[1]	N/A
	-	20 dB 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.*

9.5 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	51 %
ATM Pressure:	101.2 KPa

The testing was performed by Tao Jin on 2022-09-02 in RF site.

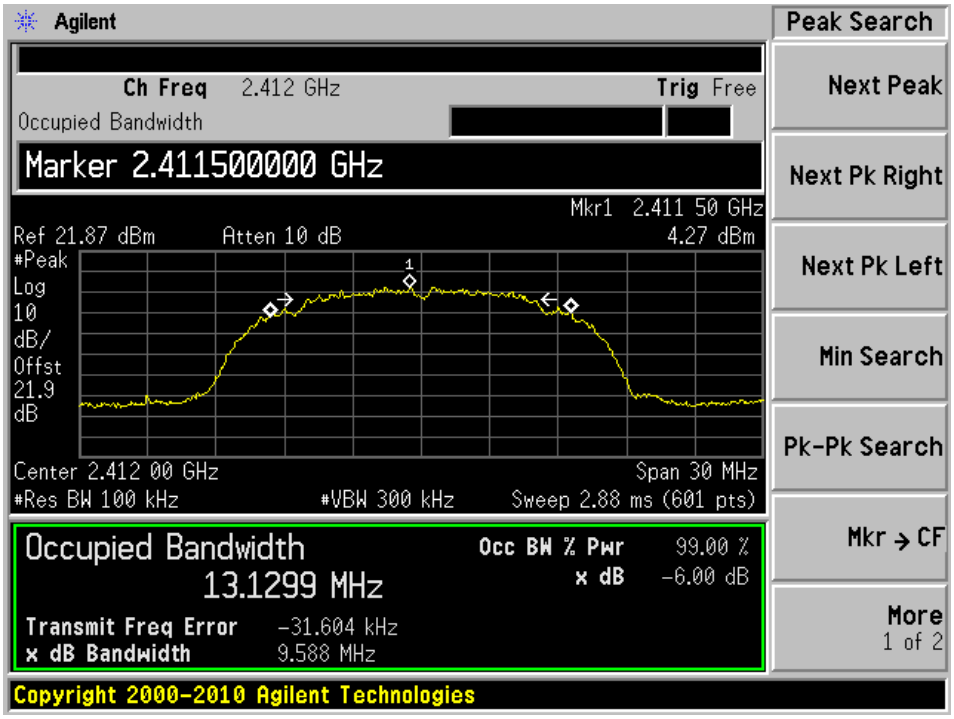
9.6 Test Results

Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	6 dB OBW Limit (kHz)	Result
802.11b					
Low	2412	9.588	13.104	≥ 500	Pass
Middle	2437	9.578	13.117	≥ 500	Pass
High	2462	9.591	13.121	≥ 500	Pass
802.11g					
Low	2412	16.453	16.486	≥ 500	Pass
Middle	2437	16.454	16.488	≥ 500	Pass
High	2462	16.456	16.489	≥ 500	Pass
802.11n20					
Low	2412	17.062	17.220	≥ 500	Pass
Middle	2437	17.072	17.211	≥ 500	Pass
High	2462	17.078	17.220	≥ 500	Pass
802.11n40					
Low	2422	32.944	34.443	≥ 500	Pass
Middle	2437	33.255	34.461	≥ 500	Pass
High	2452	33.233	34.496	≥ 500	Pass
BLE					
Low	2402	0.615	1.0325	≥ 500	Pass
Middle	2440	0.618	1.0321	≥ 500	Pass
High	2480	0.618	1.0316	≥ 500	Pass

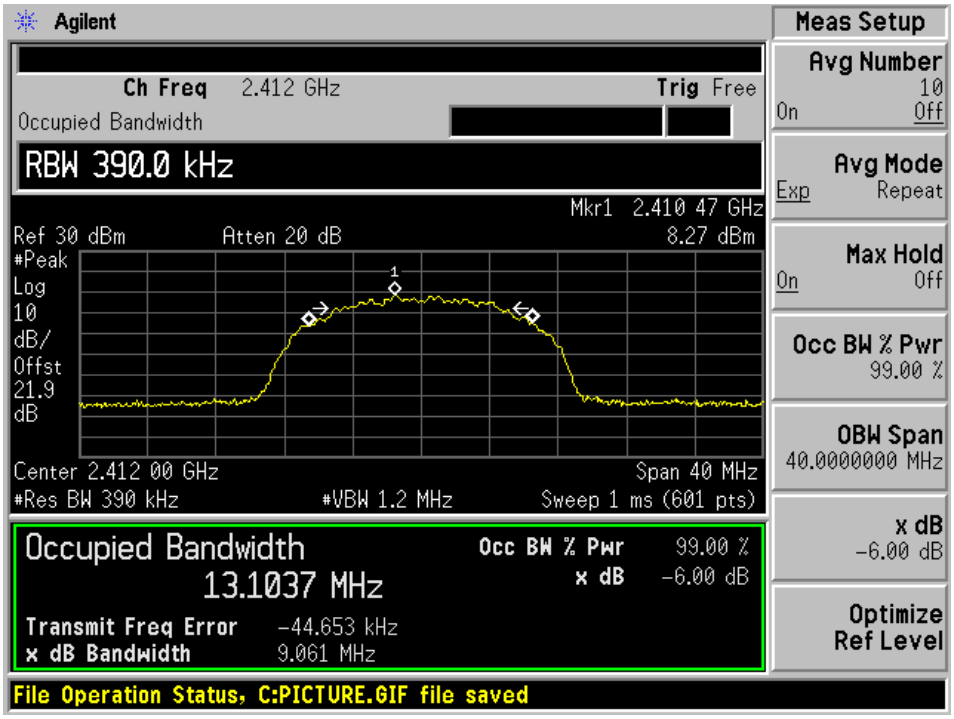
Please refer to the following plots for detailed test results:

802.11b mode

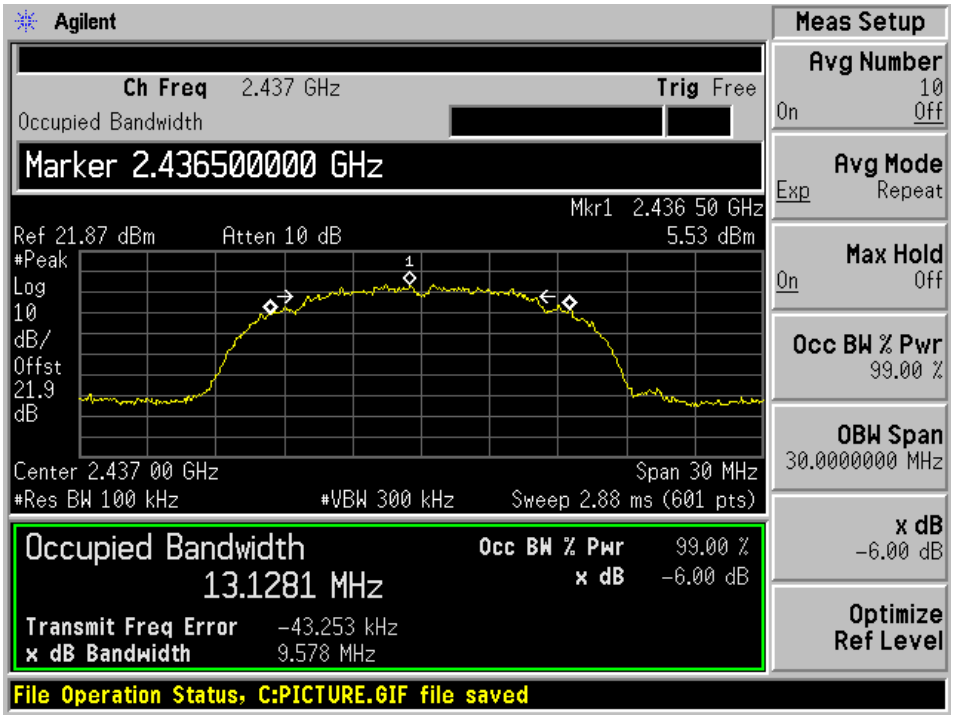
Low Channel 6 dB BW



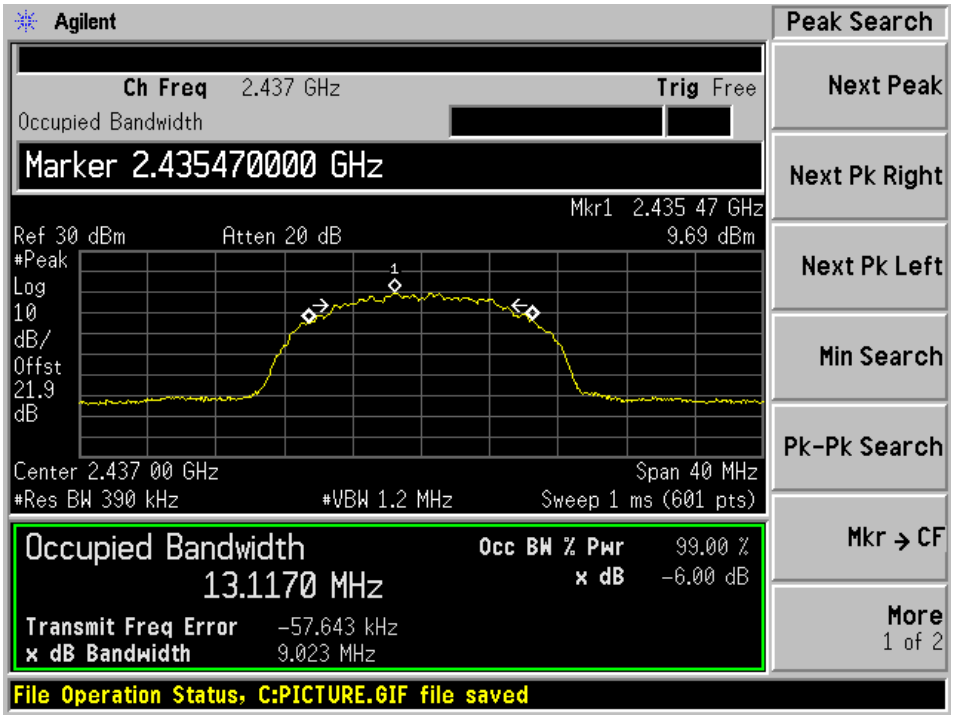
Low Channel 99% OBW



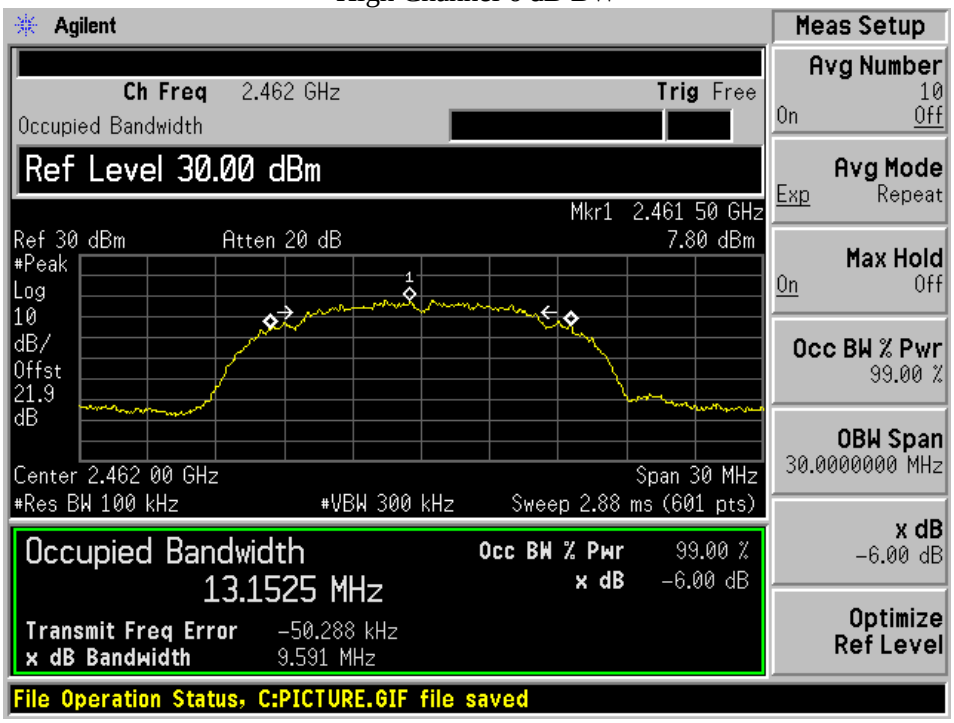
Mid Channel 6 dB BW



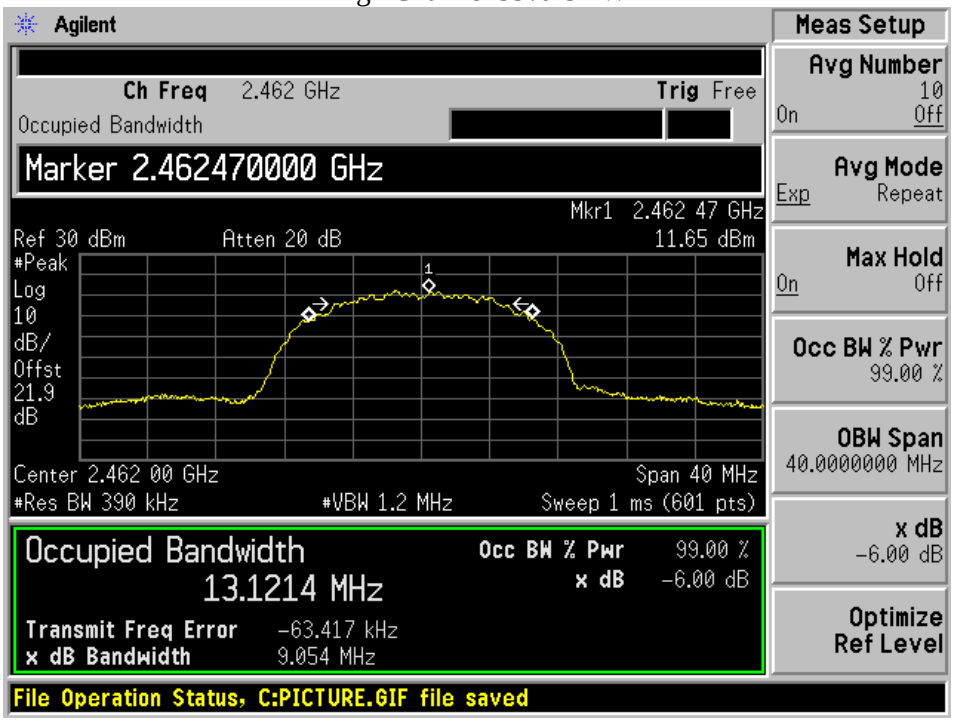
Mid Channel 99% OBW



High Channel 6 dB BW

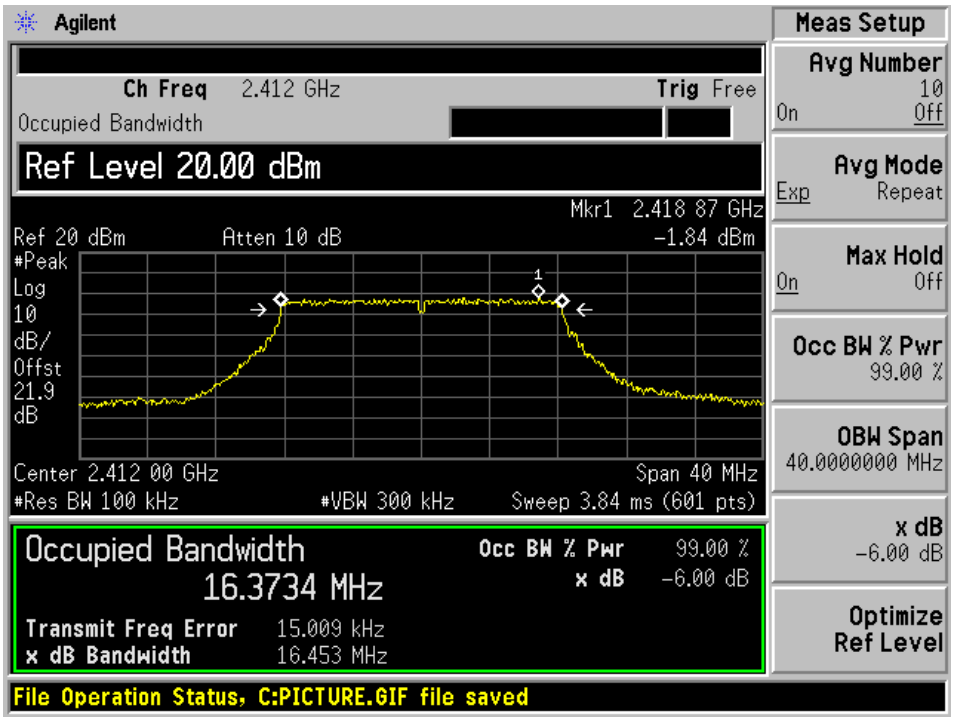


High Channel 99% OBW

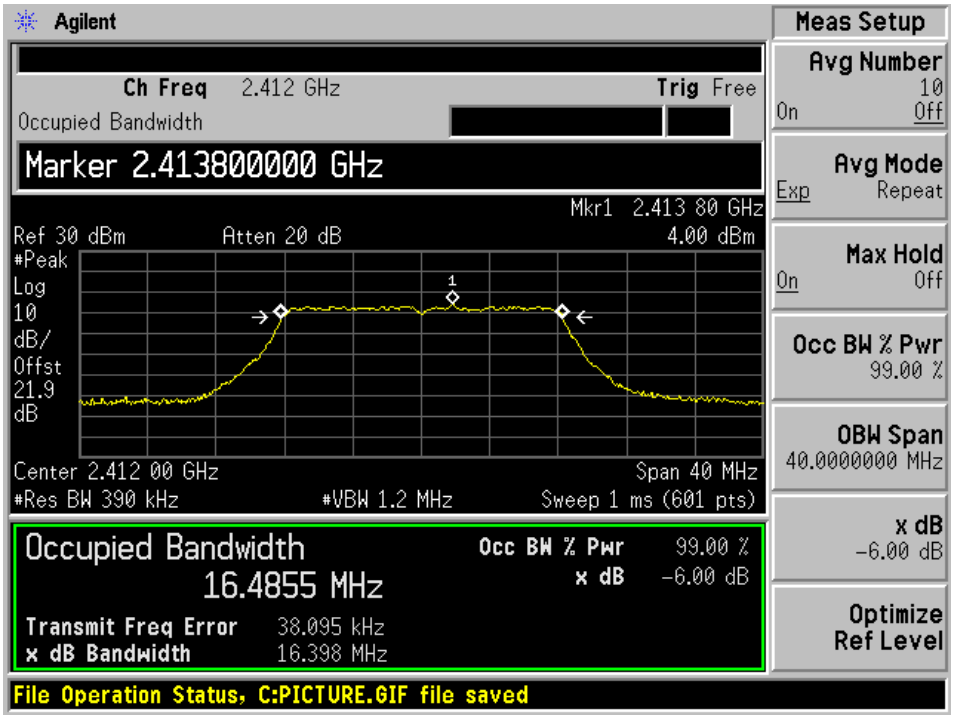


802.11g mode

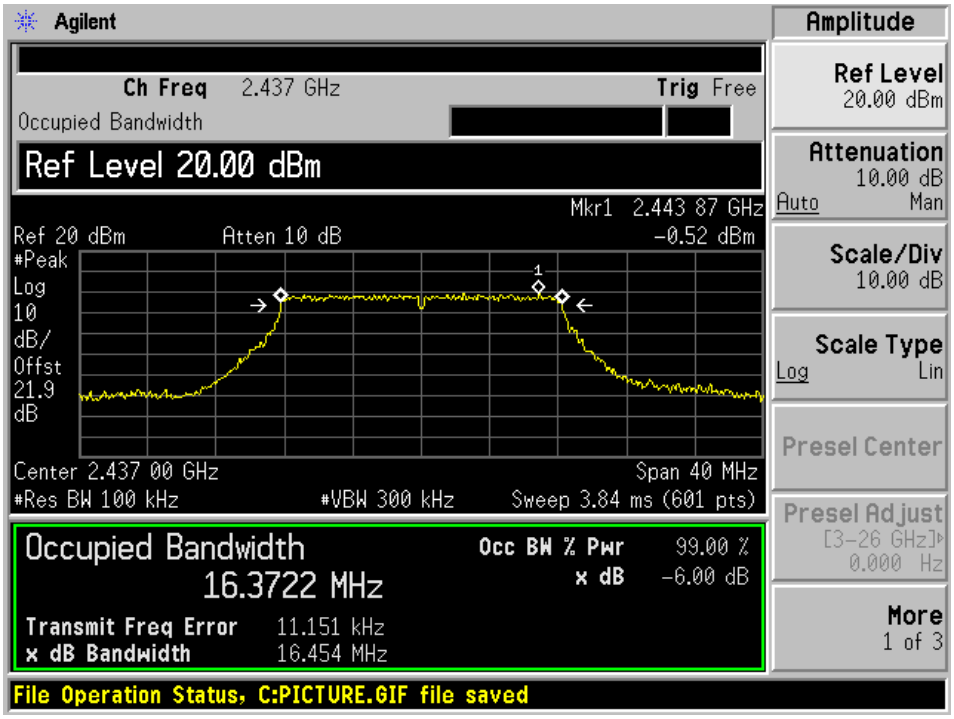
Low Channel 6 dB BW



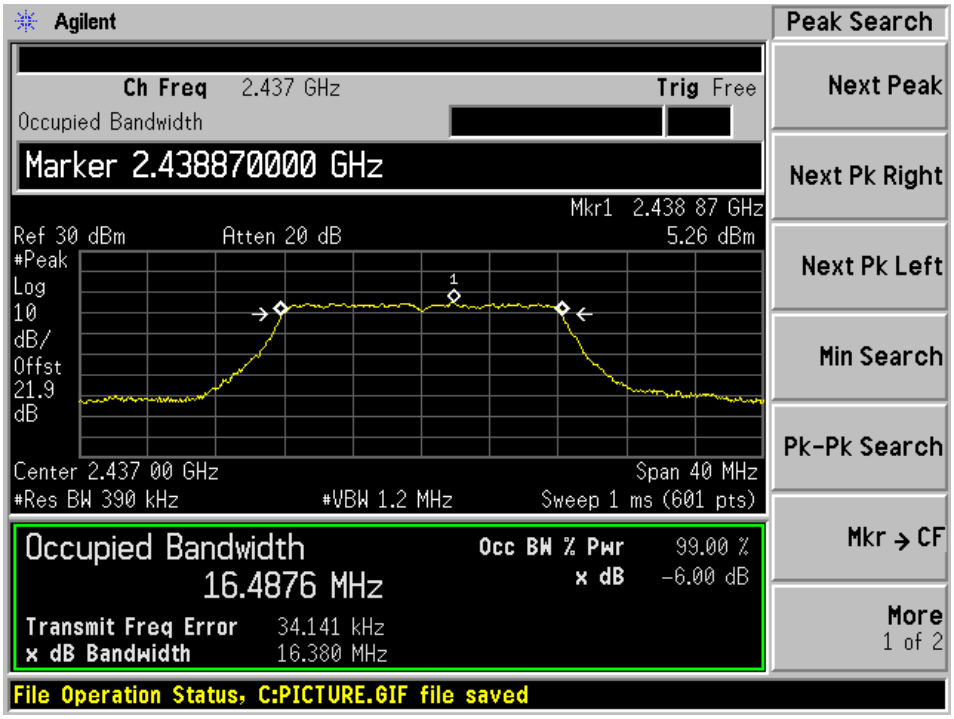
Low Channel 99% OBW



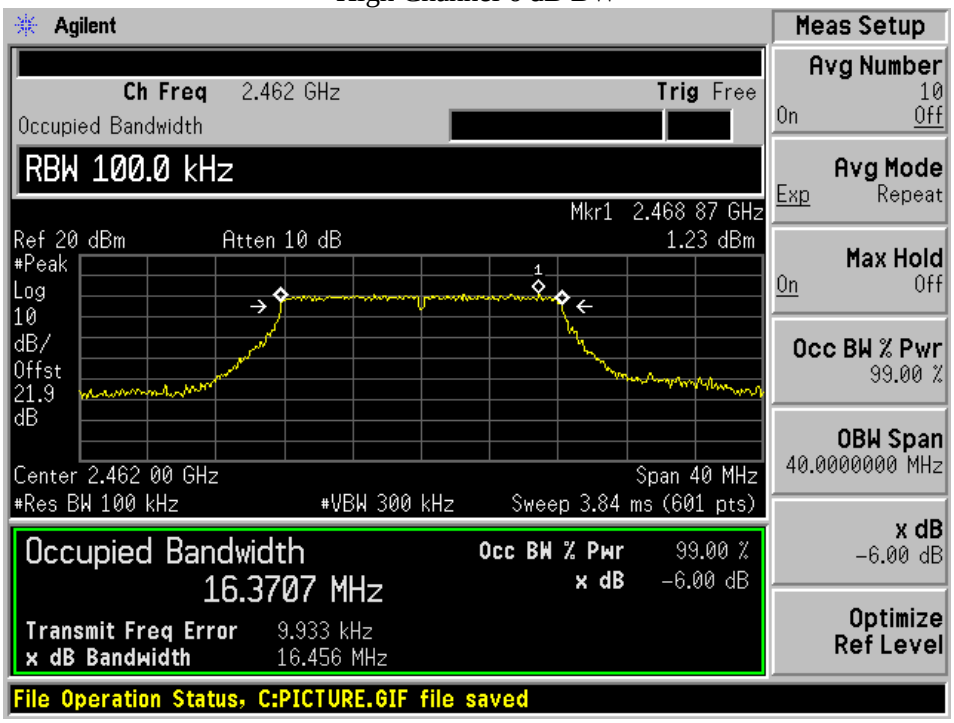
Mid Channel 6 dB BW



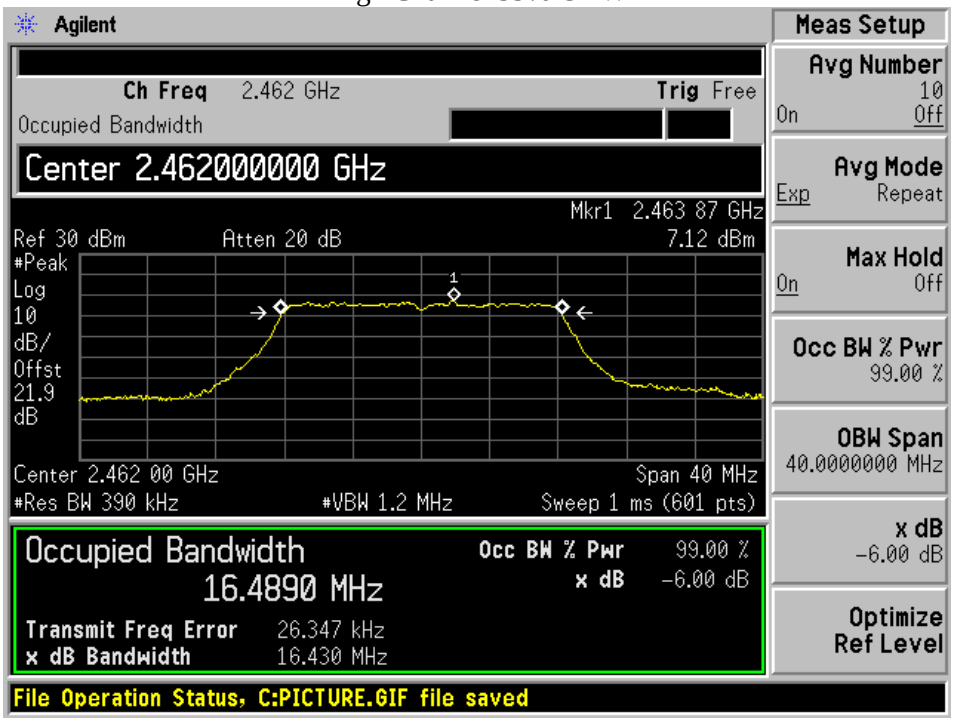
Mid Channel 99% OBW



High Channel 6 dB BW

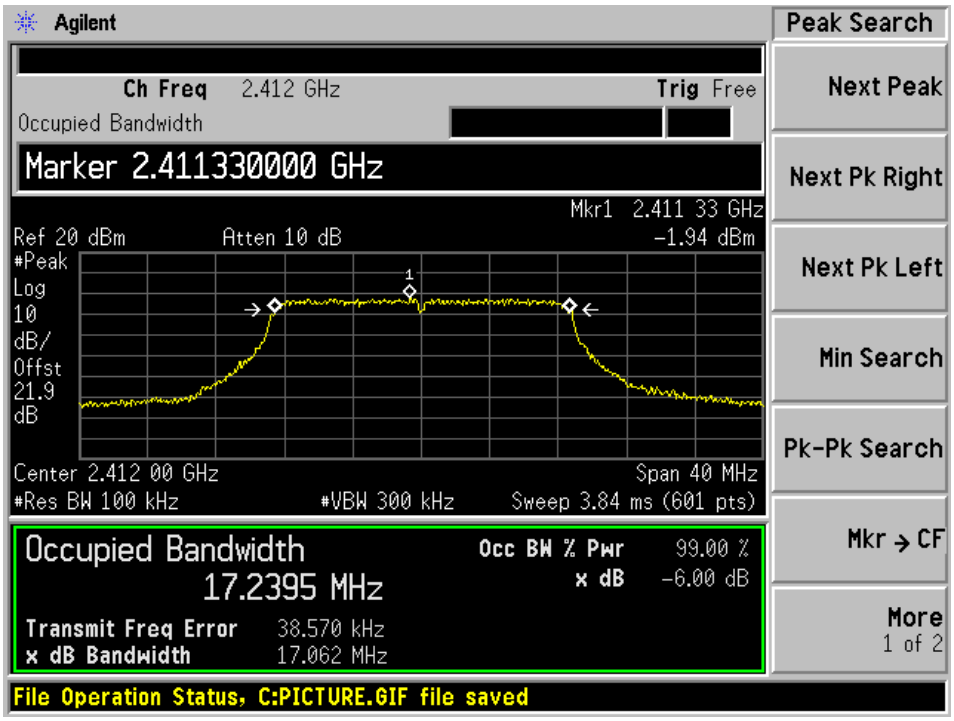


High Channel 99% OBW

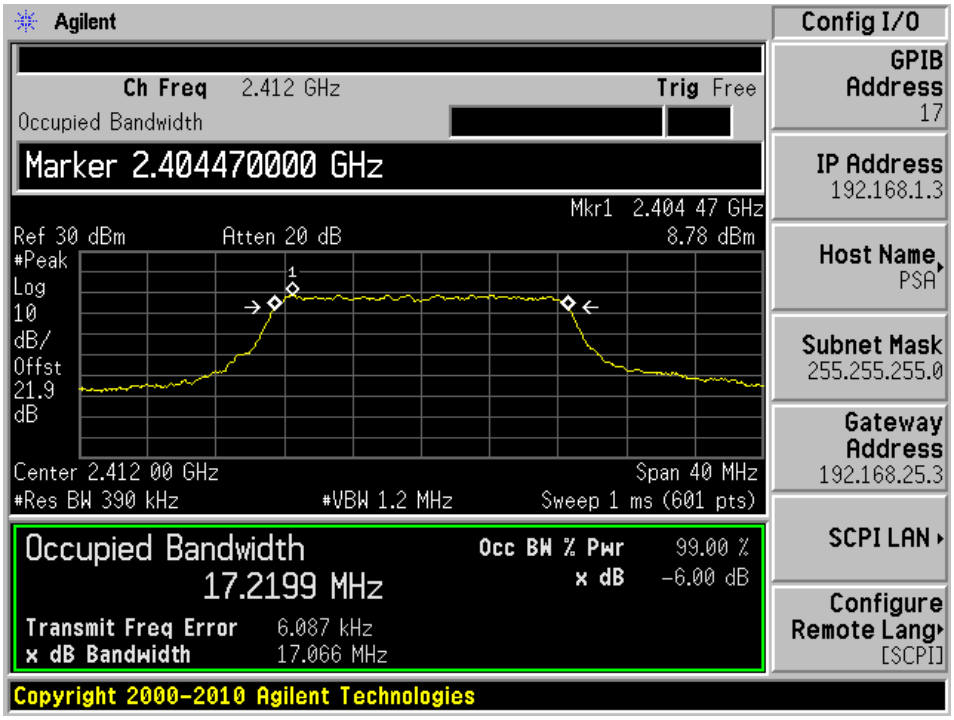


802.11n20 mode

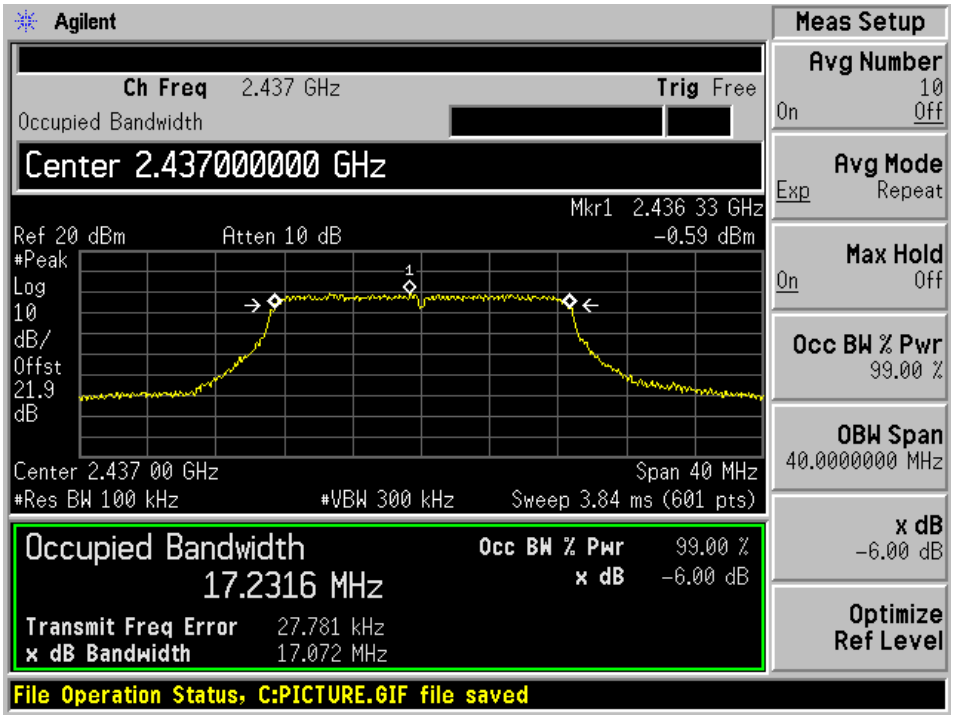
Low Channel 6 dB BW



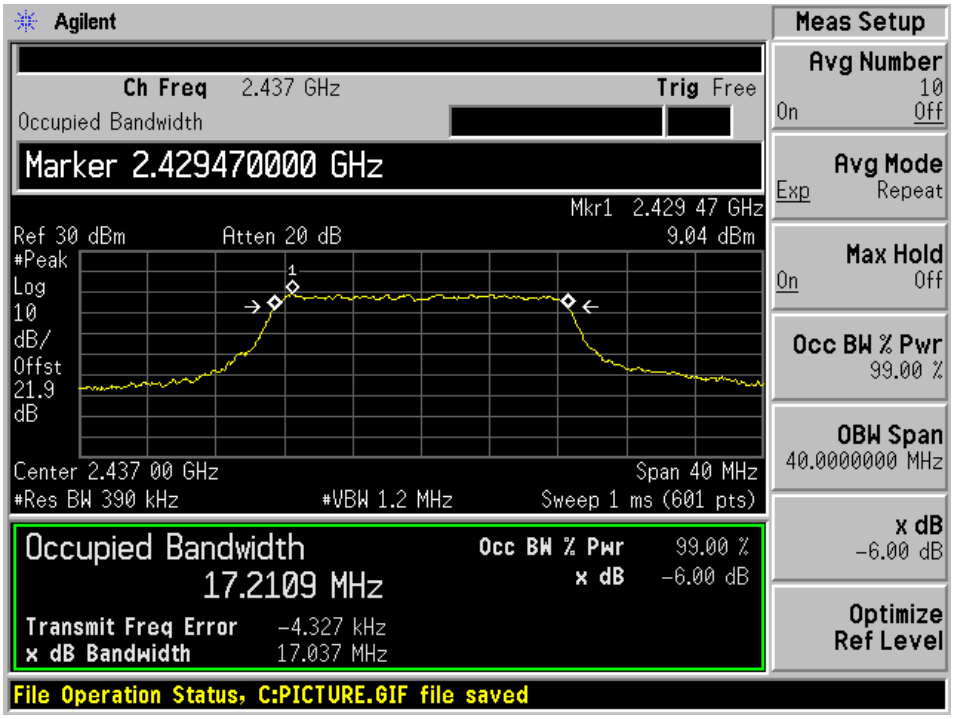
Low Channel 99% OBW



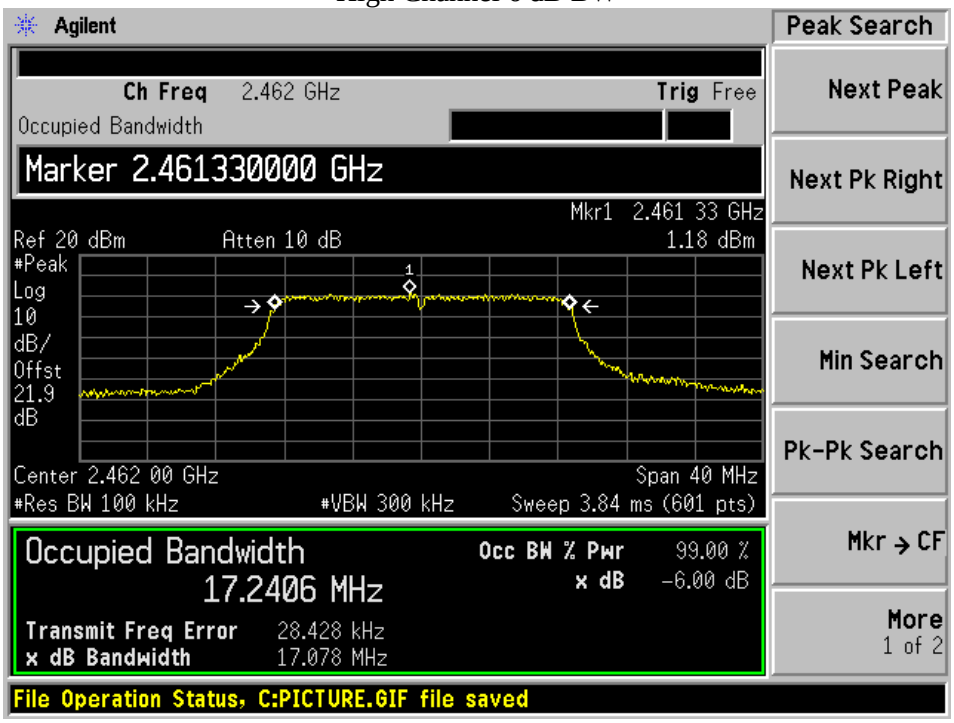
Mid Channel 6 dB BW



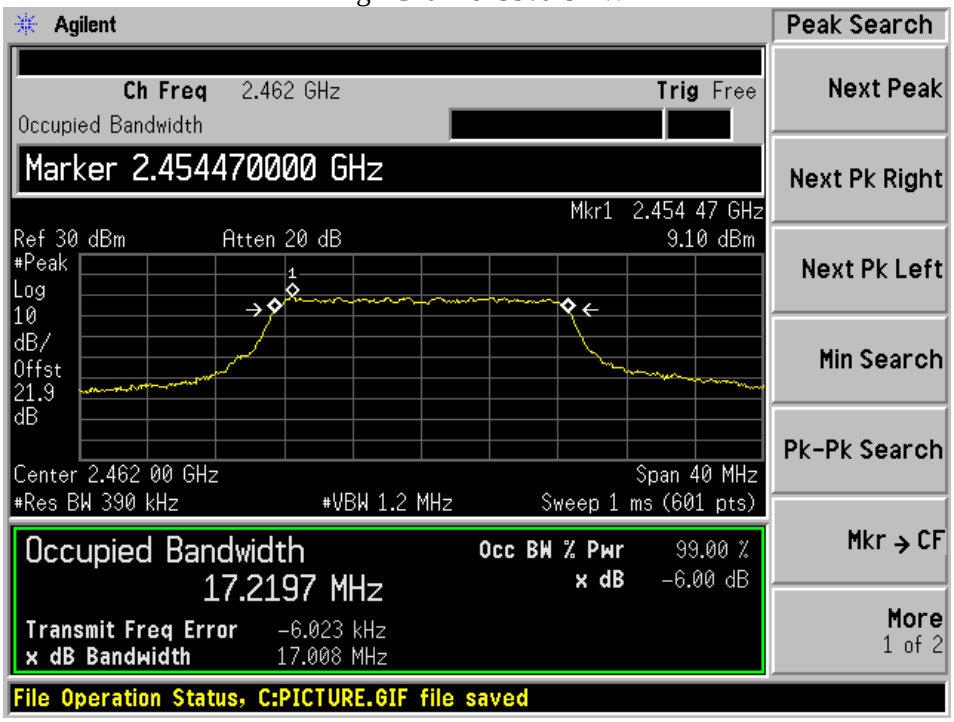
Mid Channel 99% OBW



High Channel 6 dB BW

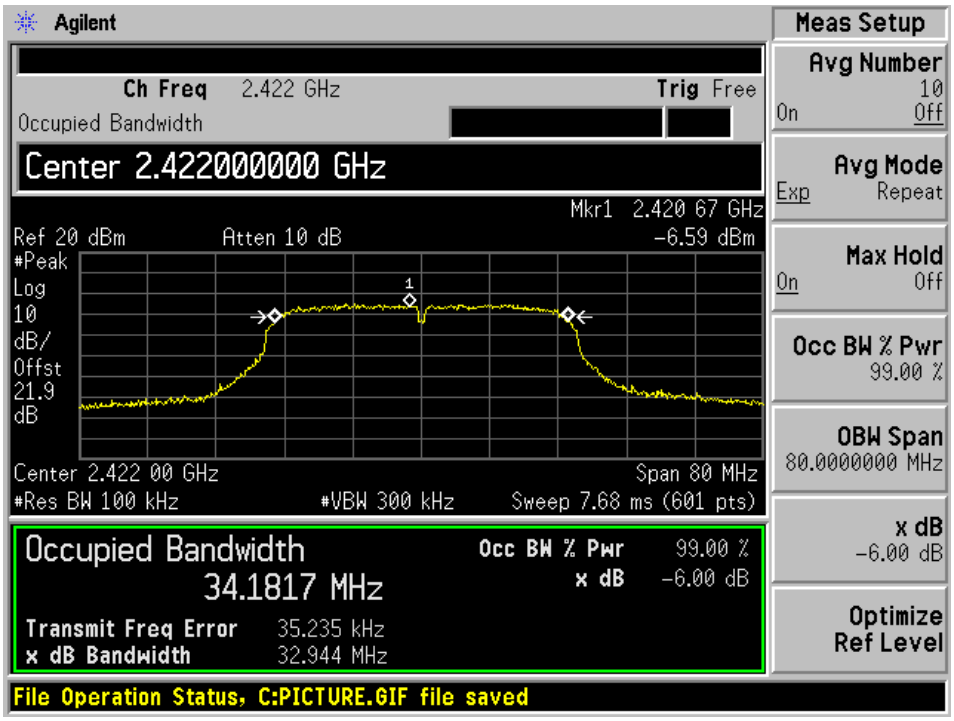


High Channel 99% OBW

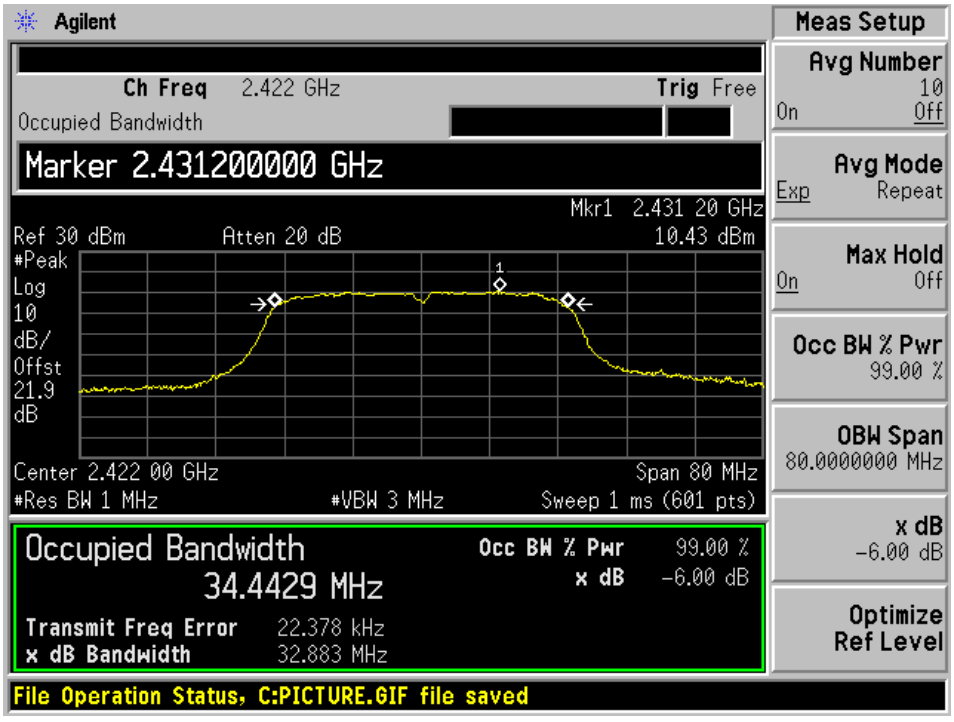


802.11n40 mode

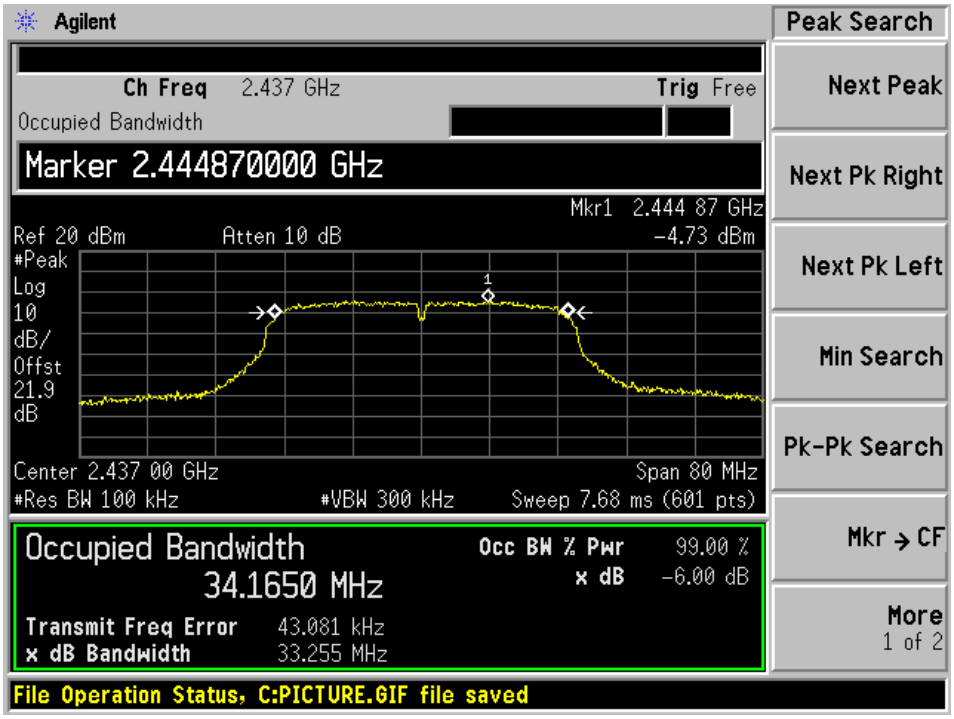
Low Channel 6 dB BW



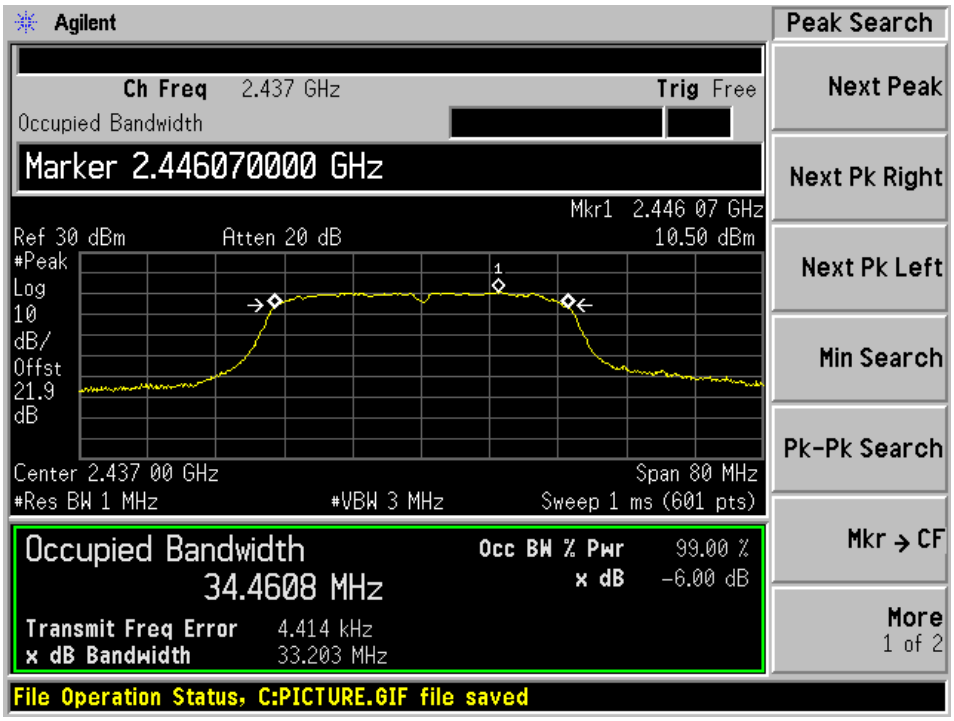
Low Channel 99% OBW



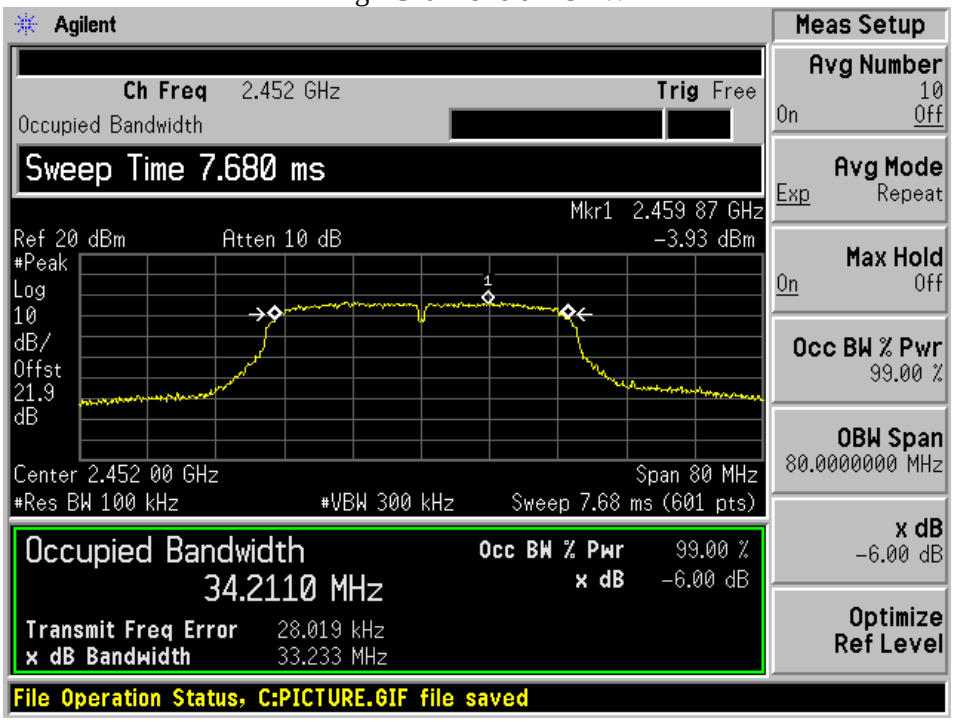
Mid Channel 6 dB BW



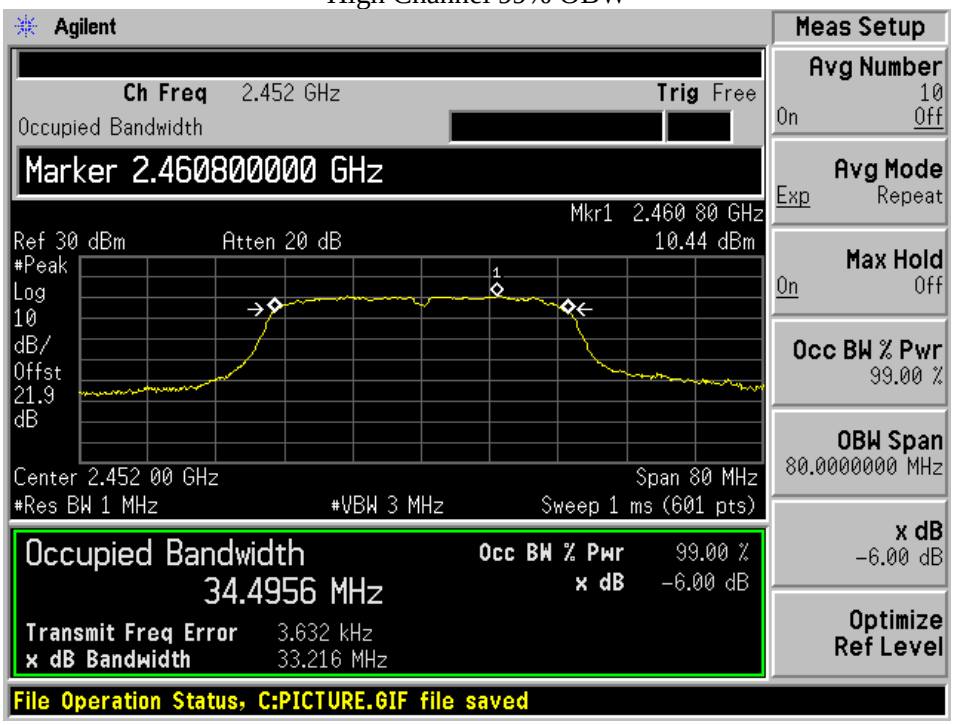
Mid Channel 99% OBW



High Channel 6 dB OBW

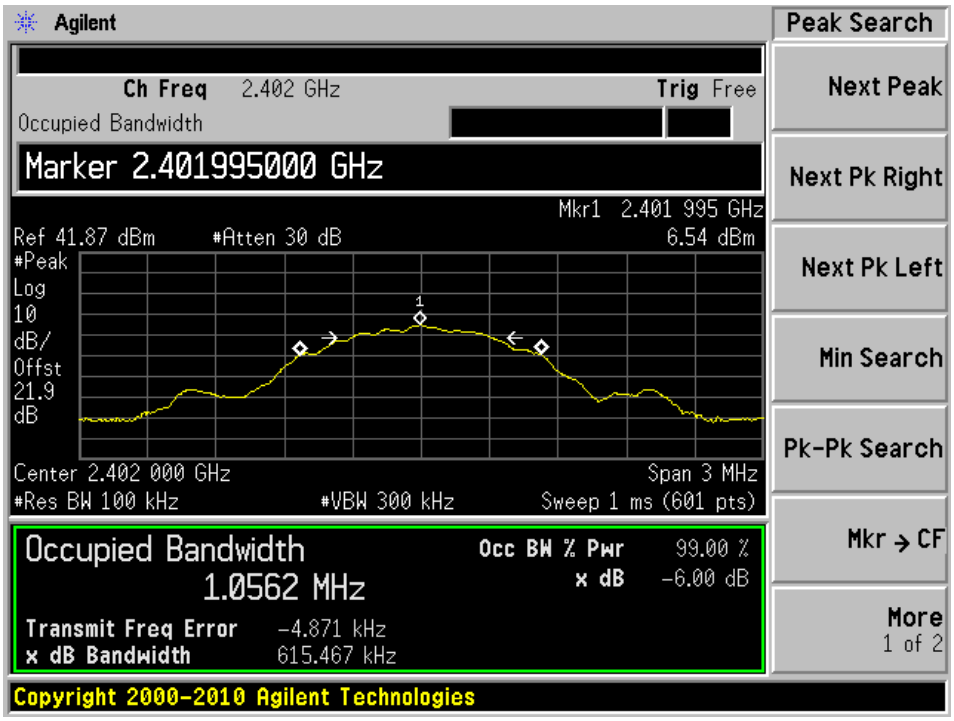


High Channel 99% OBW

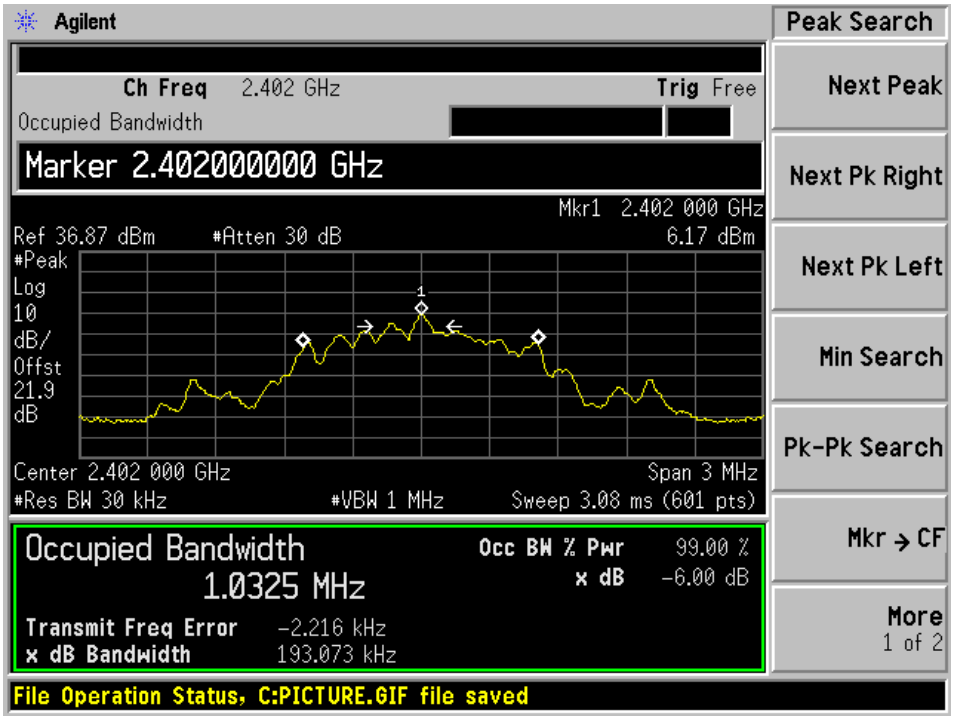


BLE mode

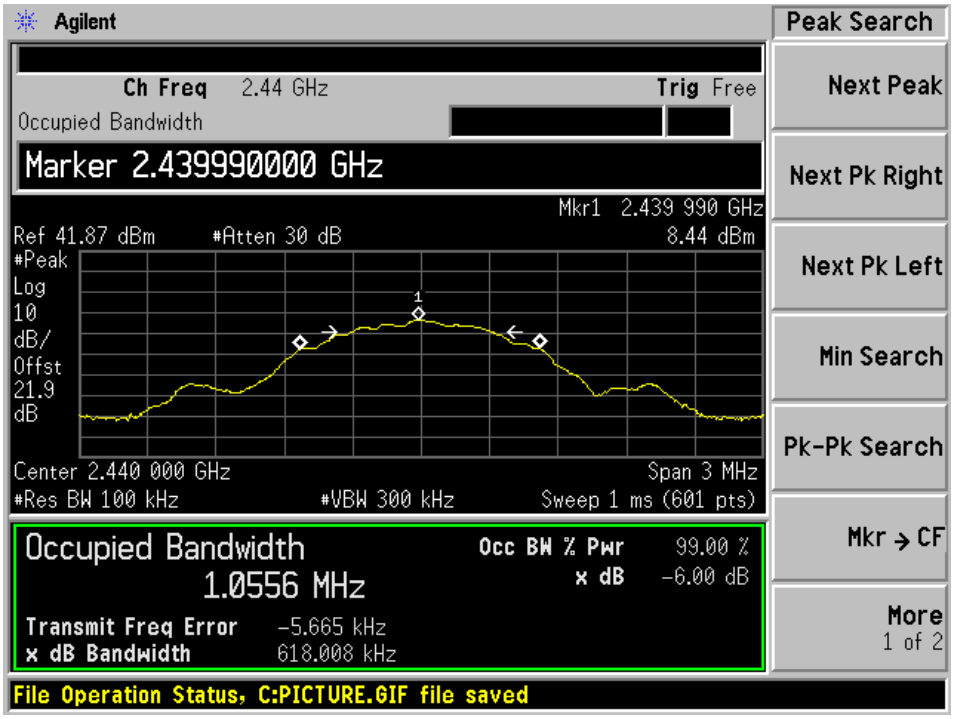
Low Channel 6 dB BW



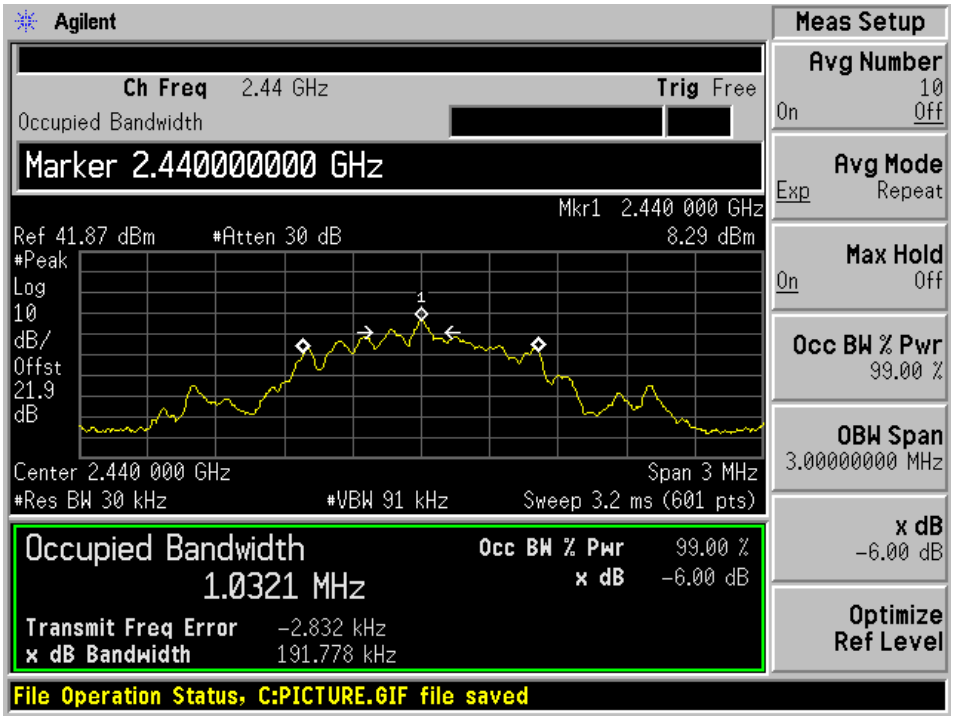
Low Channel 99% OBW



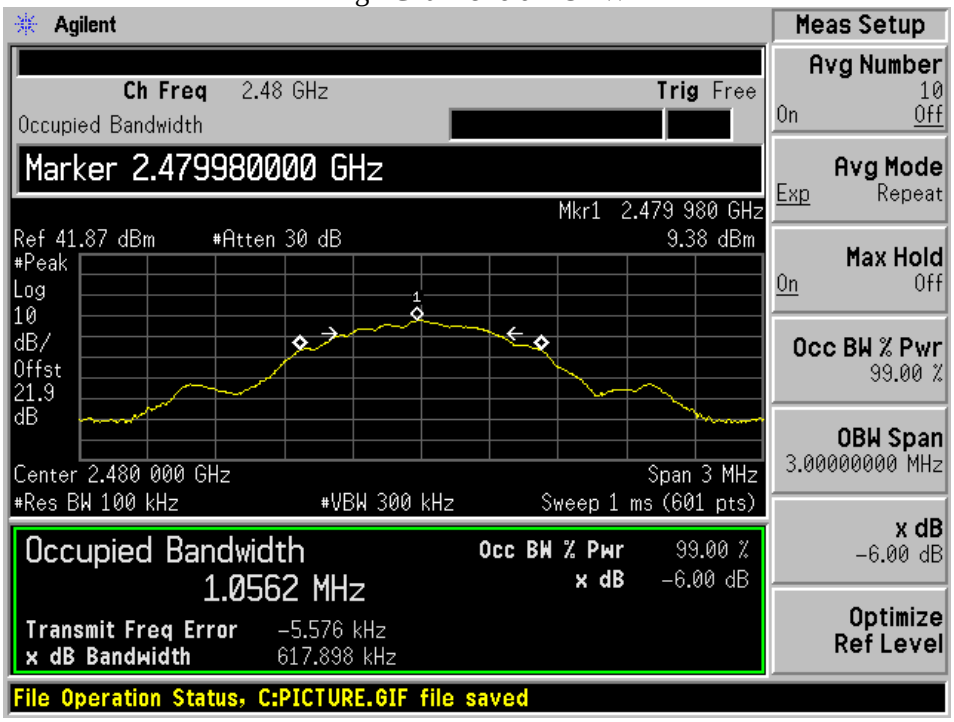
Mid Channel 6 dB BW



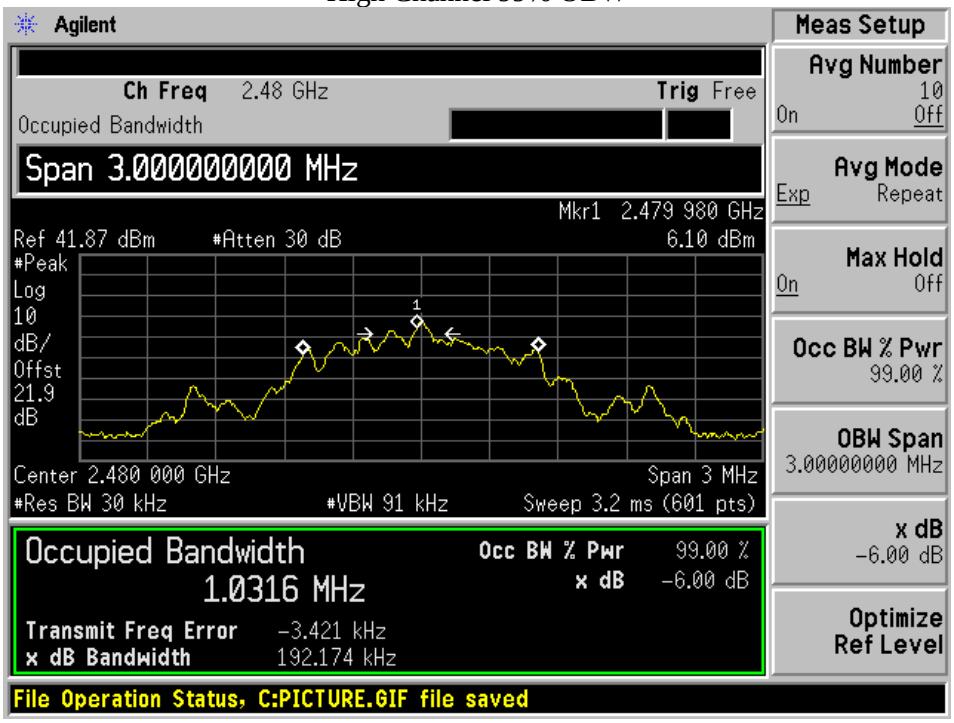
Mid Channel 99% OBW



High Channel 6 dB OBW



High Channel 99% OBW



10 FCC §15.247(d) & ISEDC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges

10.1 Applicable Standards

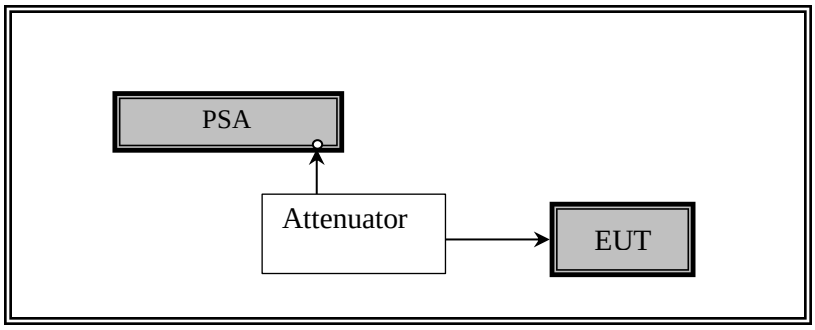
According to ECFR §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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.

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 15.247 Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8.7: Band-edge measurements

10.3 Test Setup Block Diagram



10.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
424	Agilent	Spectrum Analyzer	E4440A	US45303156	12/06/2021	1 year
	-	RF cable	-	-	Each time[1]	N/A
	-	20 dB 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.*

10.5 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	51 %
ATM Pressure:	101.2 KPa

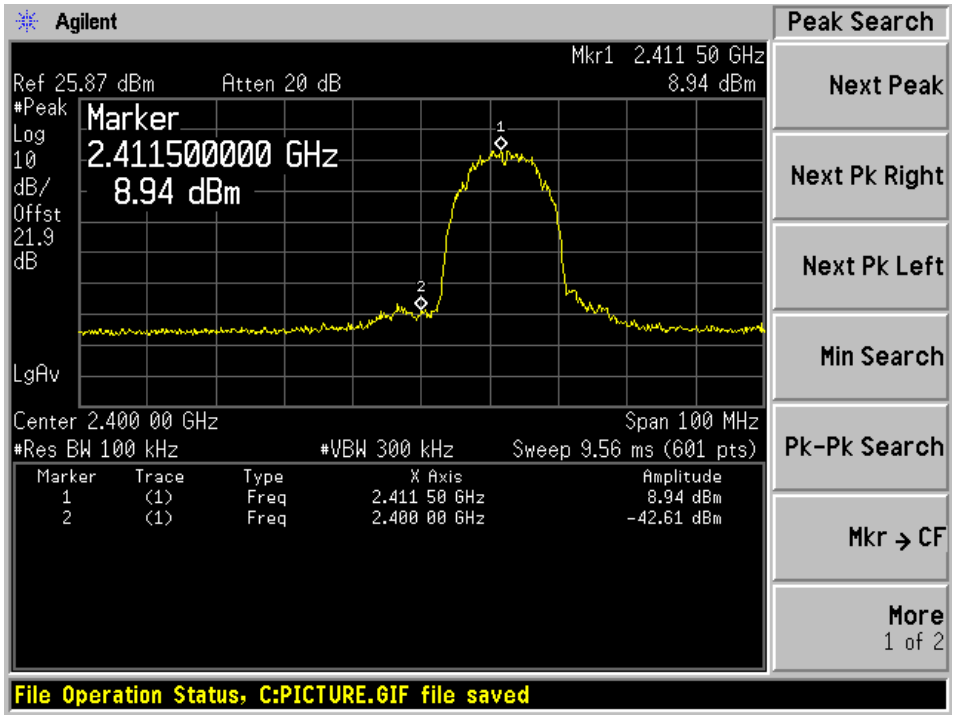
The testing was performed by Tao Jin on 2022-09-02 in RF site.

10.6 Test Results

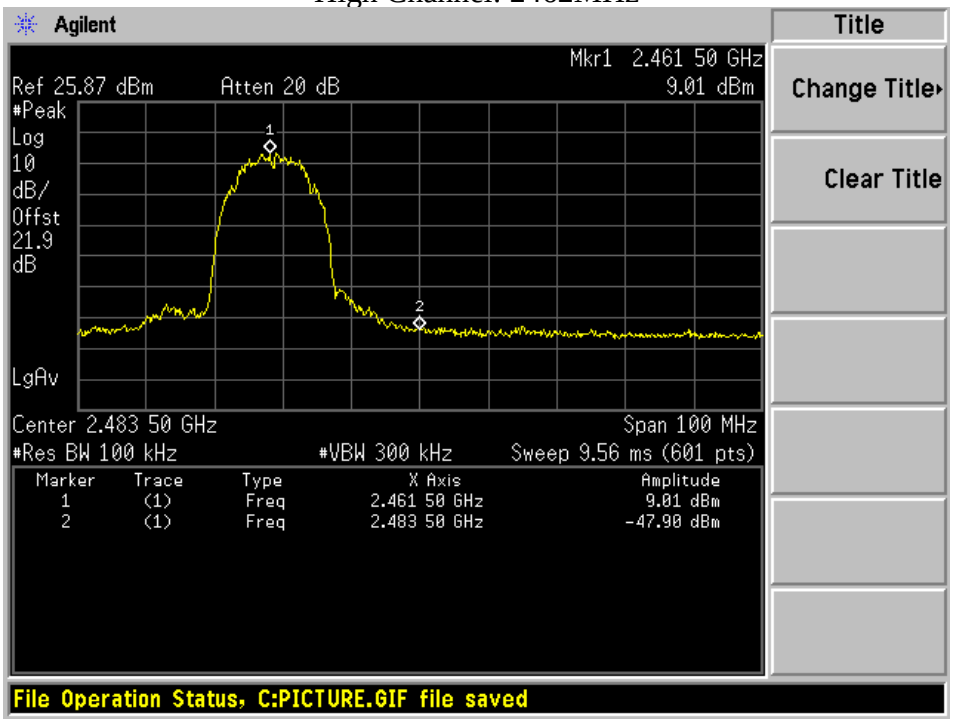
Please refer to the following plots.

802.11b mode

Low Channel: 2412MHz

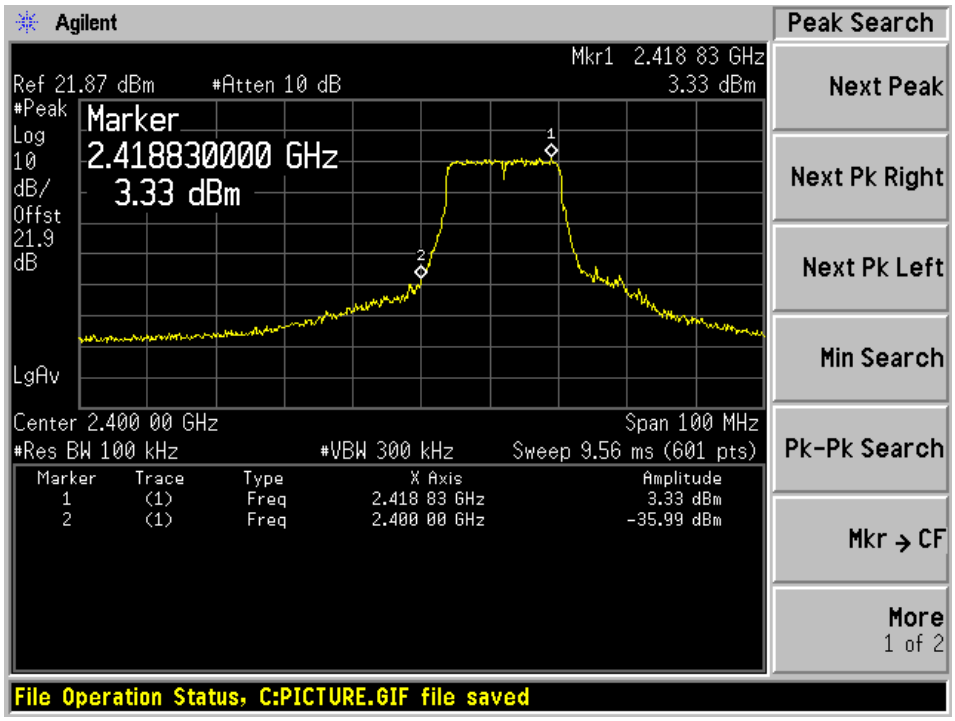


High Channel: 2462MHz

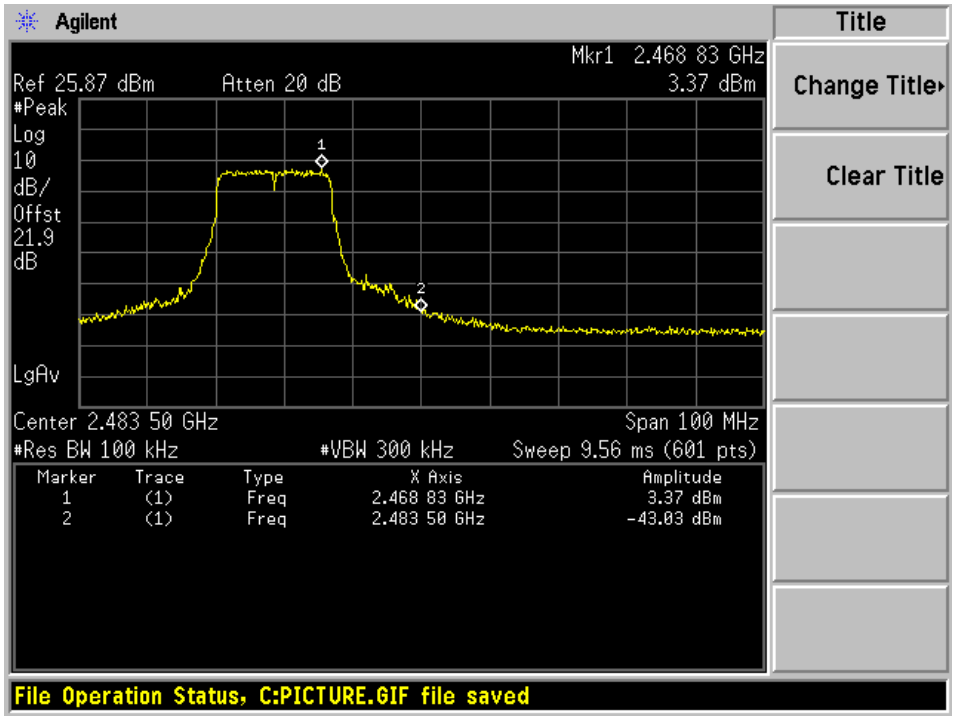


802.11g mode

Low Channel: 2412MHz

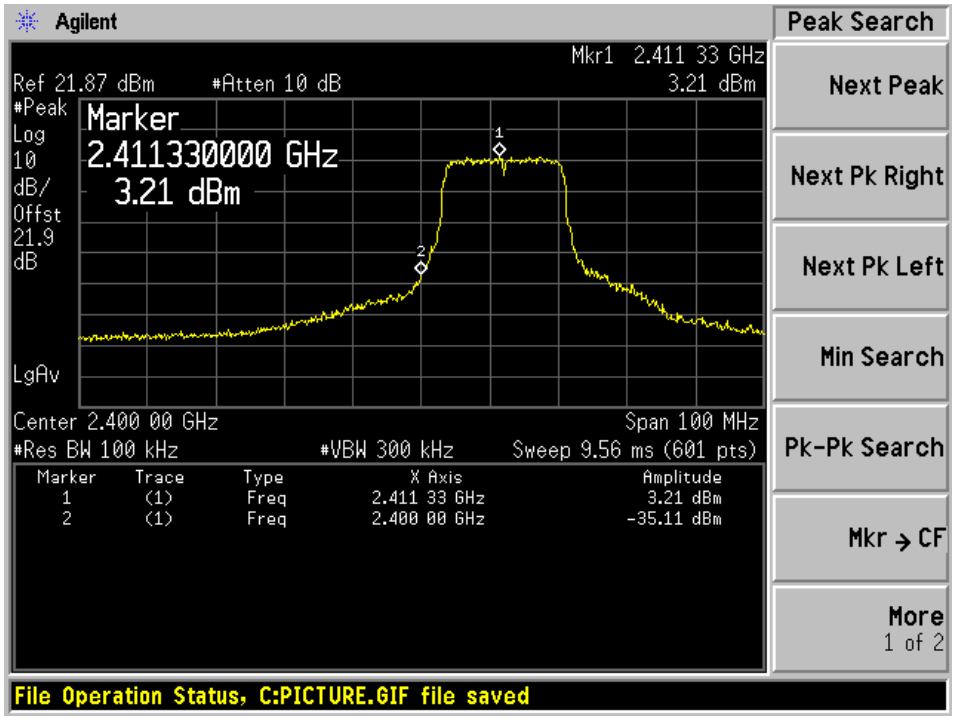


High Channel: 2462MHz

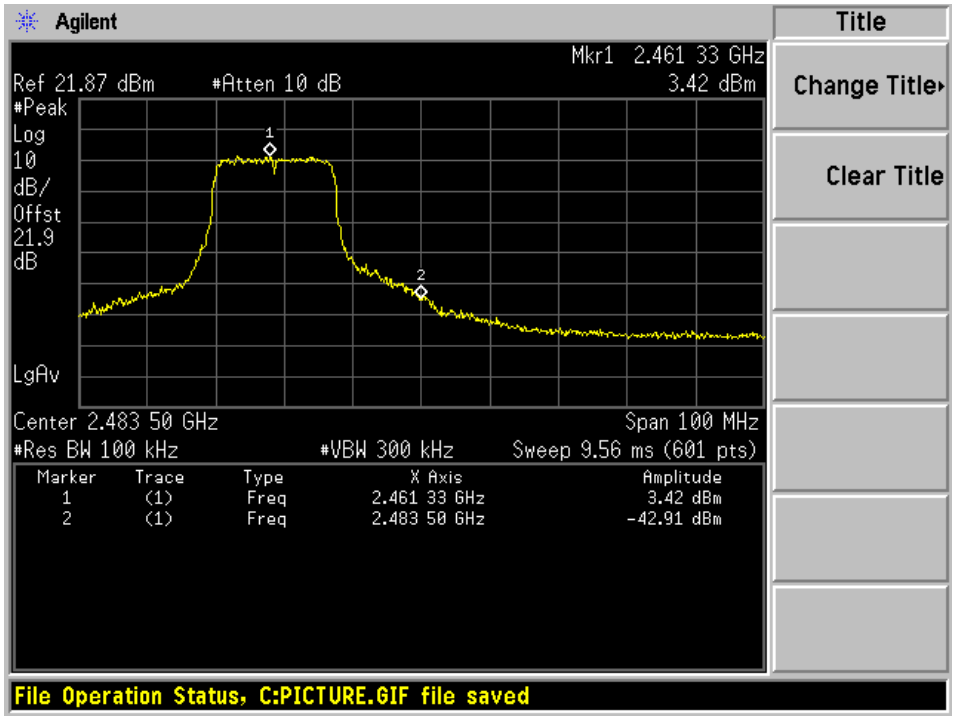


802.11n20 mode

Low Channel: 2412MHz

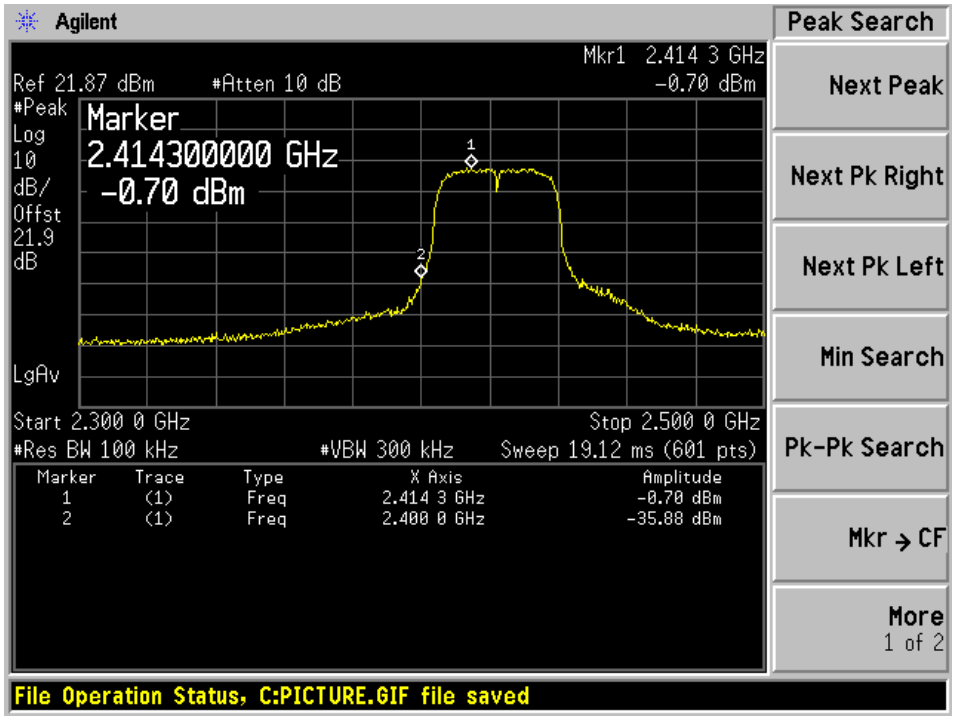


High Channel: 2462MHz

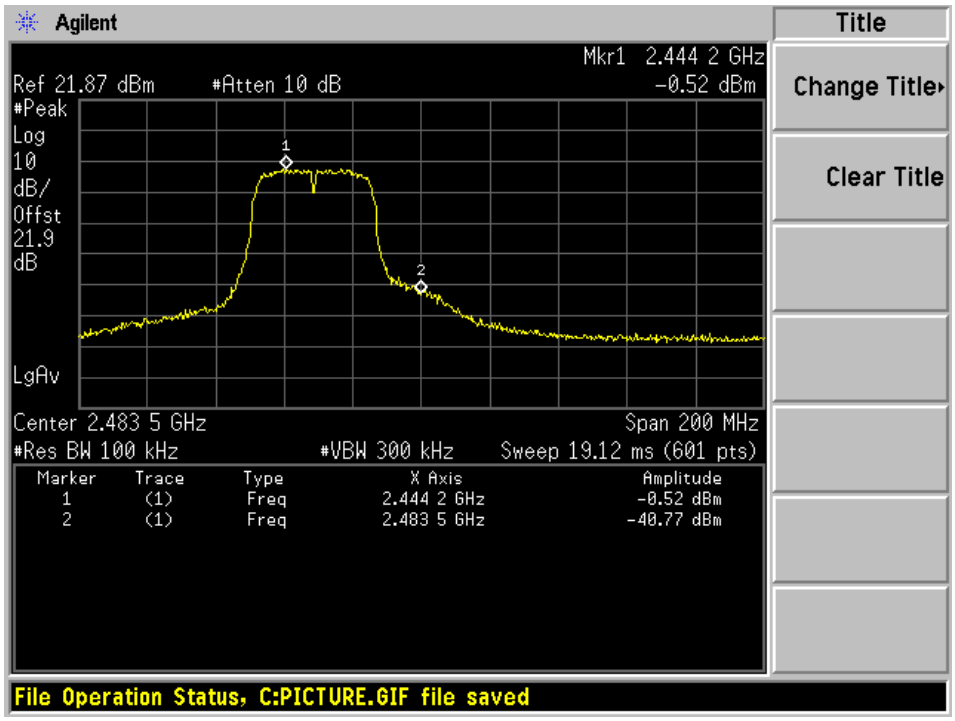


802.11n40 mode

Low Channel: 2422MHz

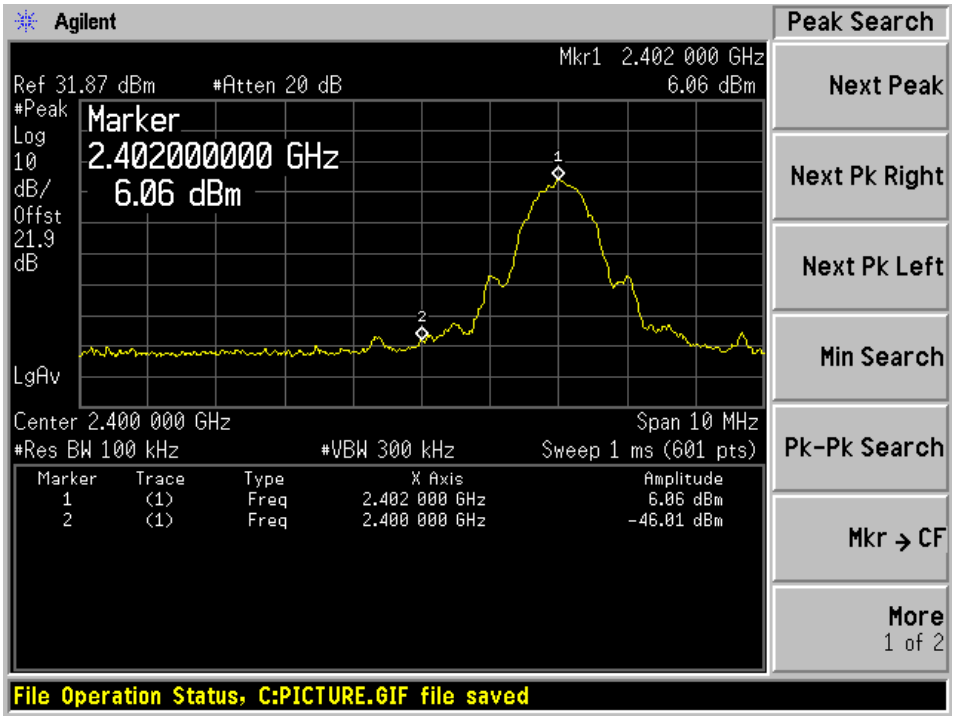


High Channel: 2452MHz

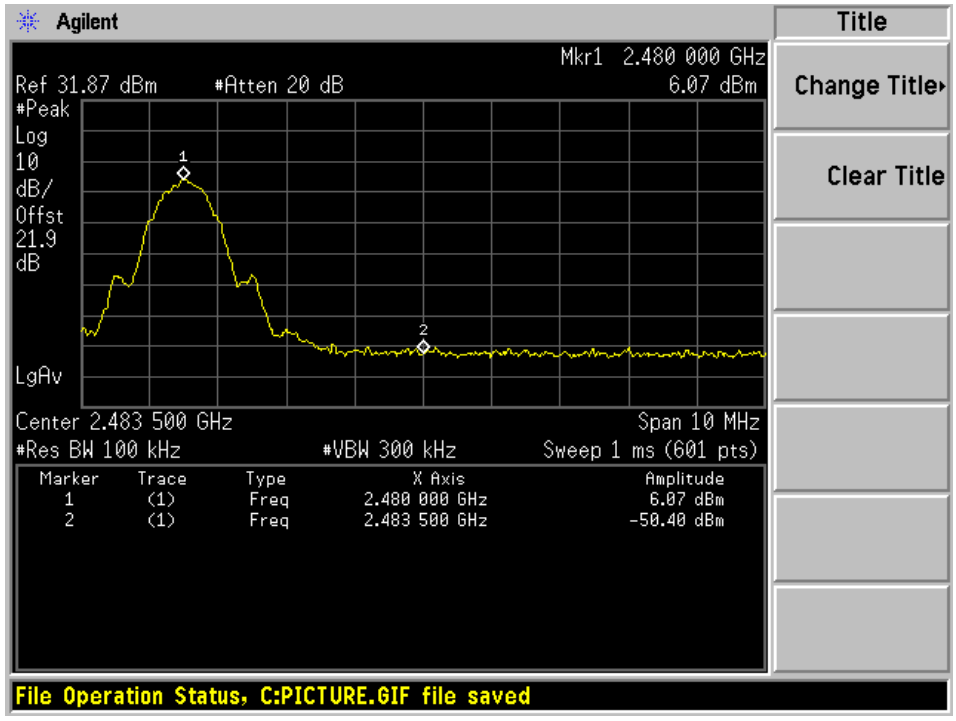


BLE mode

Low Channel: 2402MHz



High Channel: 2480MHz



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

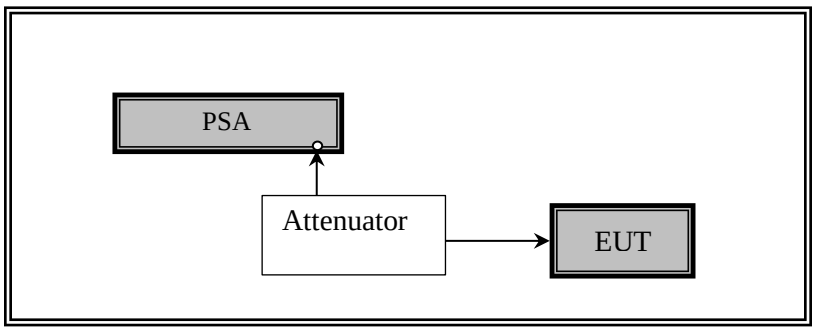
10.1 Applicable Standards

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 15.247 Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8.4: Maximum power spectral density level in the fundamental emission.

10.3 Test Setup Block Diagram



10.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
424	Agilent	Spectrum Analyzer	E4440A	US45303156	2021-12-06	1 year
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2022-08-01	1 year
	-	RF cable	-	-	Each time[1]	N/A
	-	RF cable	-	-	Each time[1]	N/A
	-	20 dB 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.*

10.5 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	51 %
ATM Pressure:	101.3 KPa

The testing was performed by Tao Jin on 2022-09-07 in RF site.

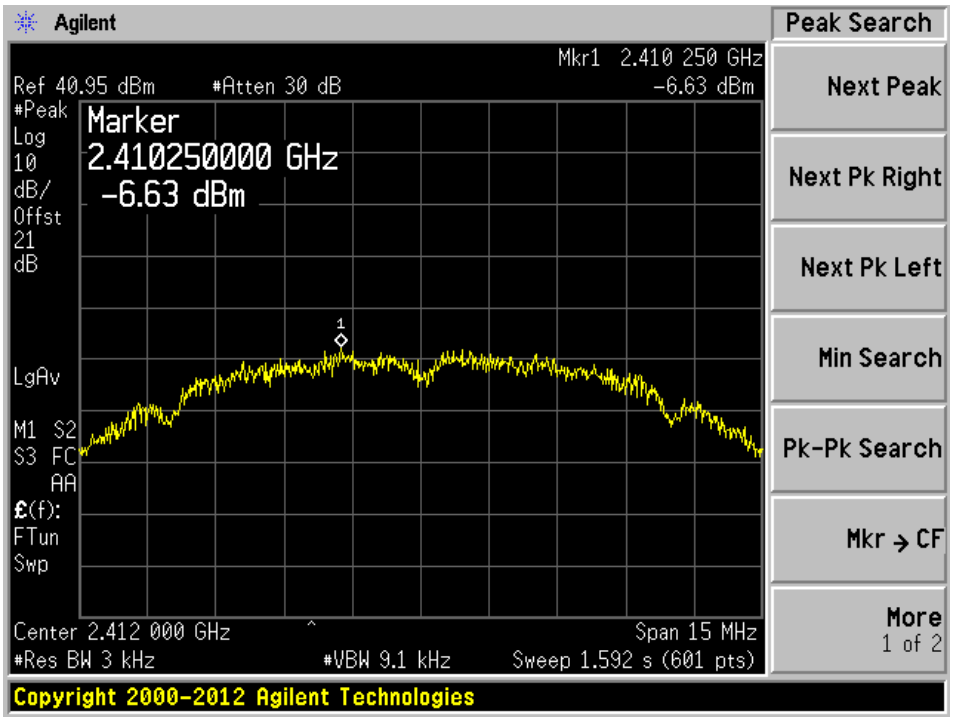
10.6 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-6.63	8
Middle	2437	-6.57	8
High	2462	-6.61	8
802.11g mode			
Low	2412	-13.98	8
Middle	2437	-12.35	8
High	2462	-12.96	8
802.11n20 mode			
Low	2412	-14.05	8
Middle	2437	-12.23	8
High	2462	-12.84	8
802.11n40 mode			
Low	2422	-15.02	8
Middle	2437	-13.42	8
High	2452	-14.29	8
BLE mode			
Low	2402	6.10	8
Middle	**2440**	**7.79**	**8**
High	2480	6.03	8

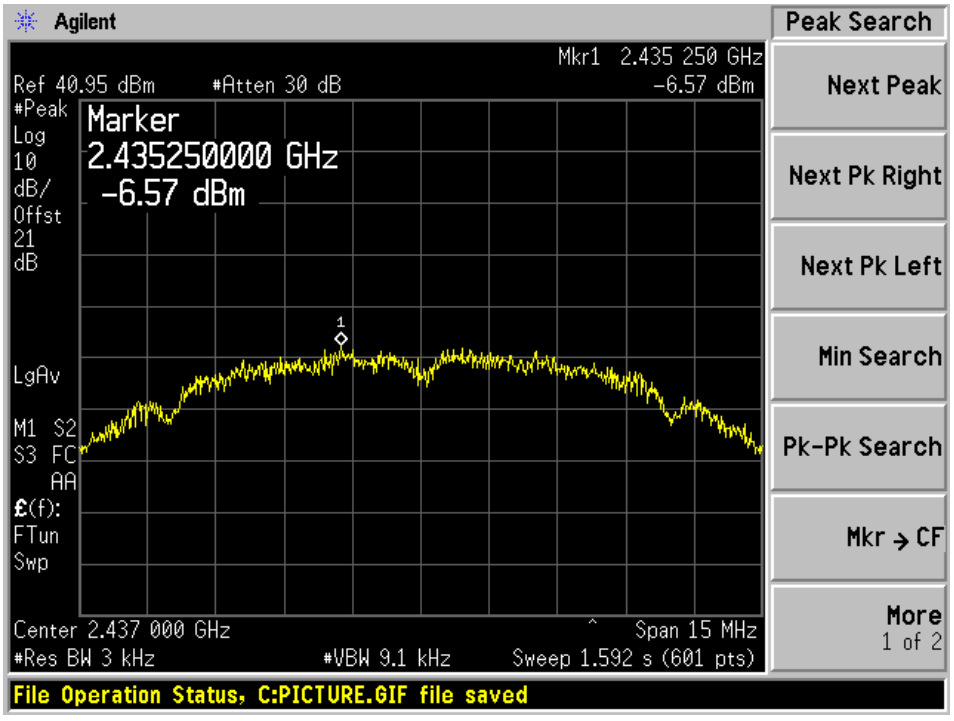
Please refer to the following plots for detailed test results

802.11b mode

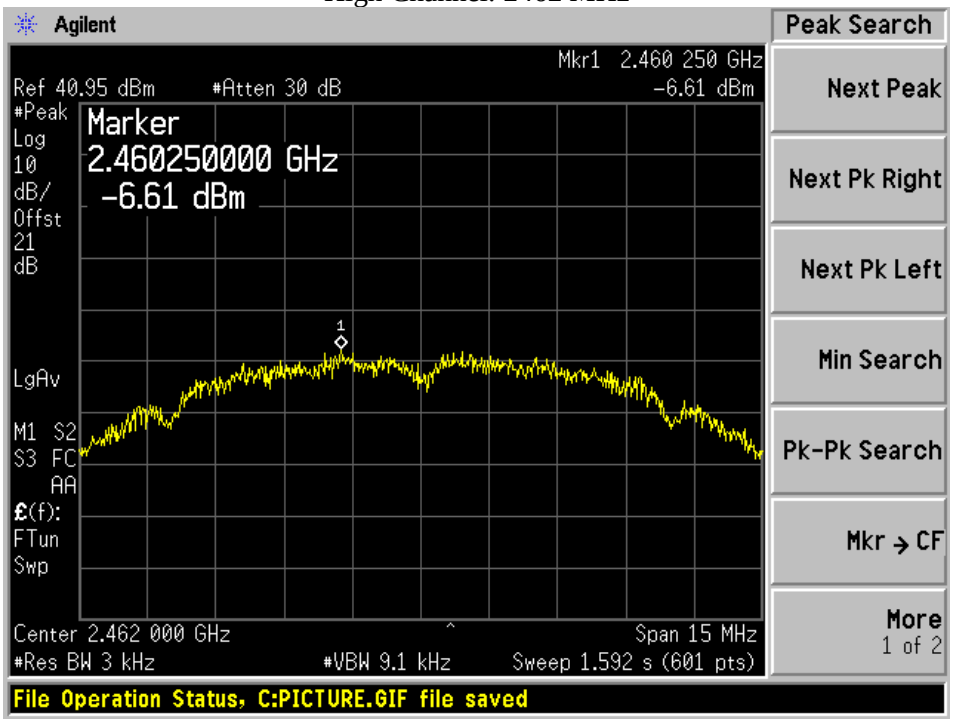
Low Channel: 2412 MHz



Mid Channel: 2437 MHz

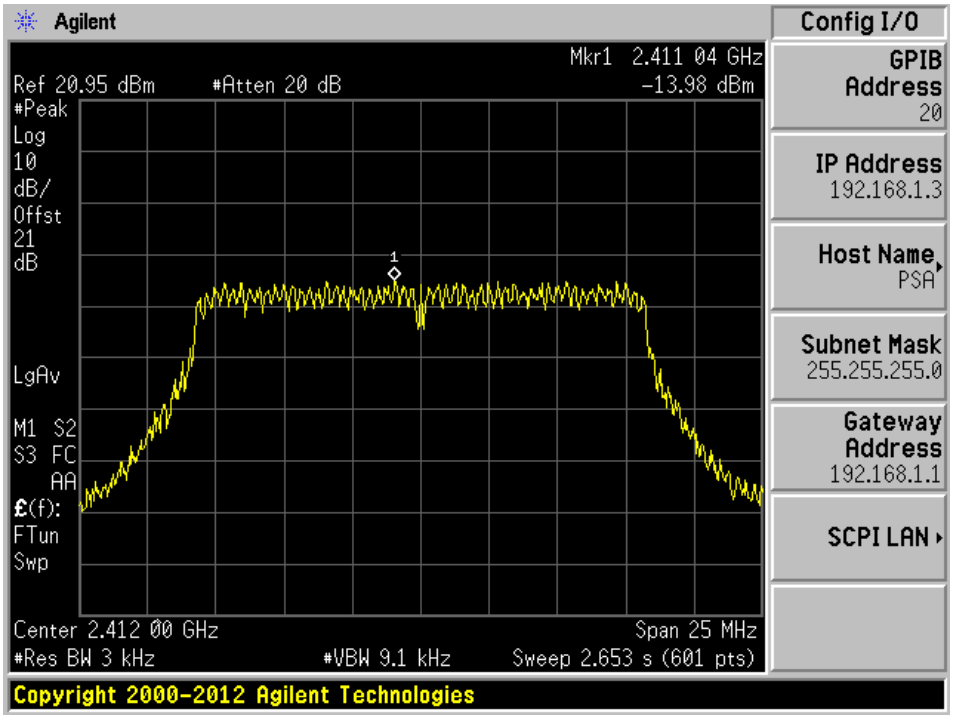


High Channel: 2462 MHz

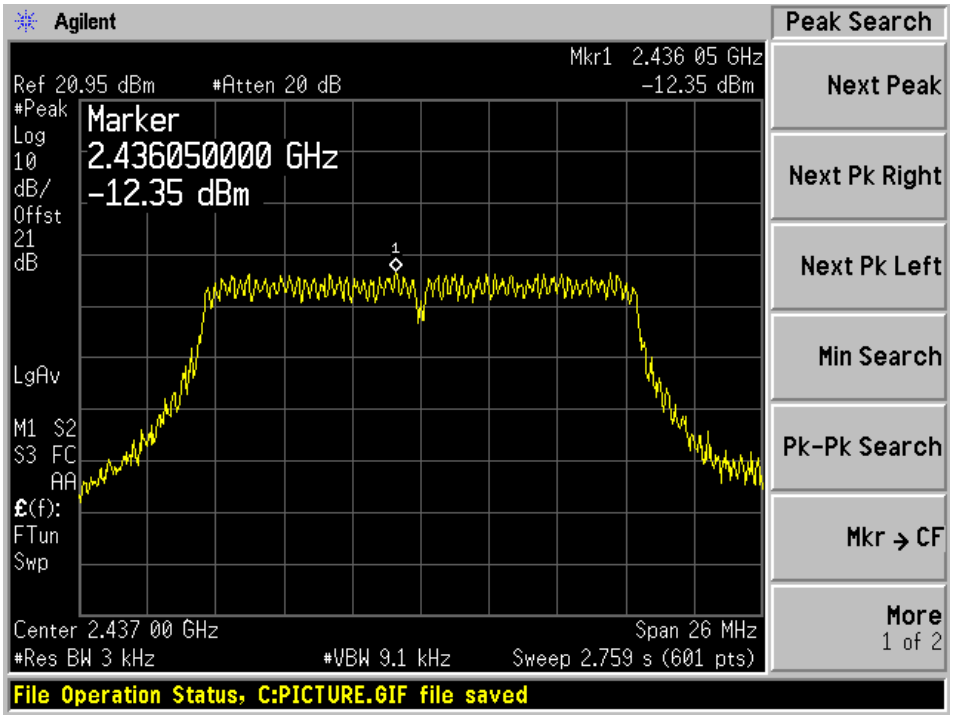


802.11g mode

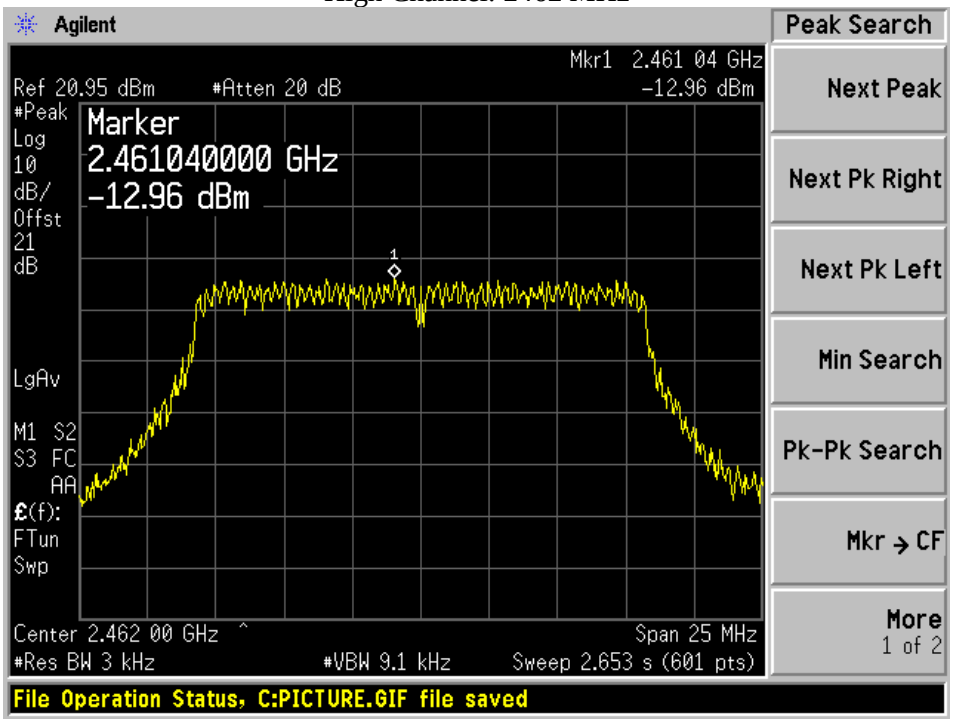
Low Channel: 2412 MHz



Mid Channel: 2437 MHz

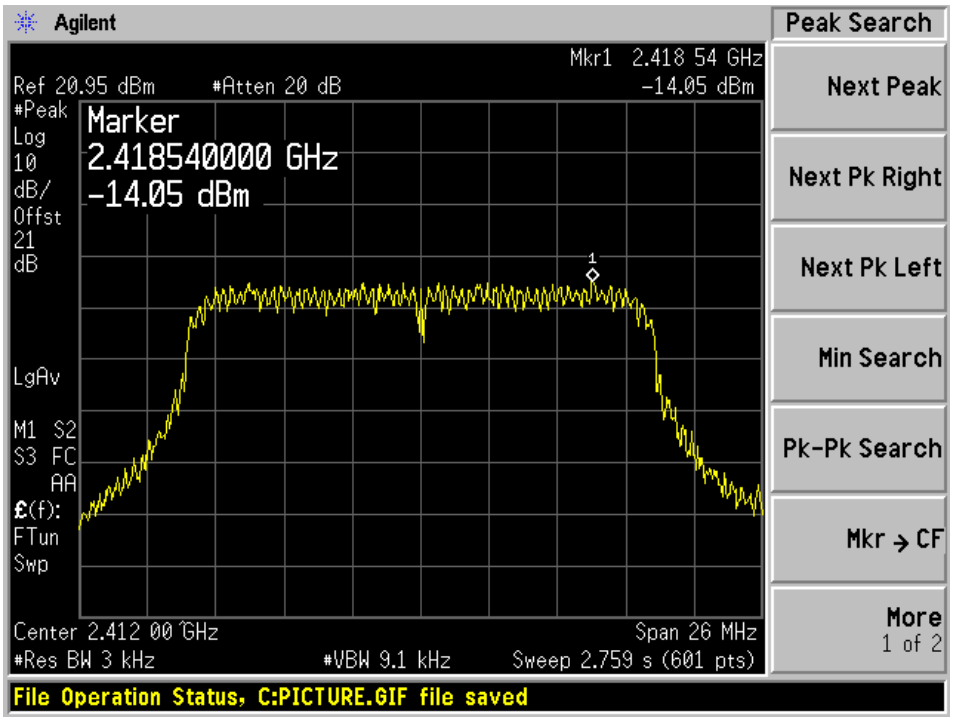


High Channel: 2462 MHz

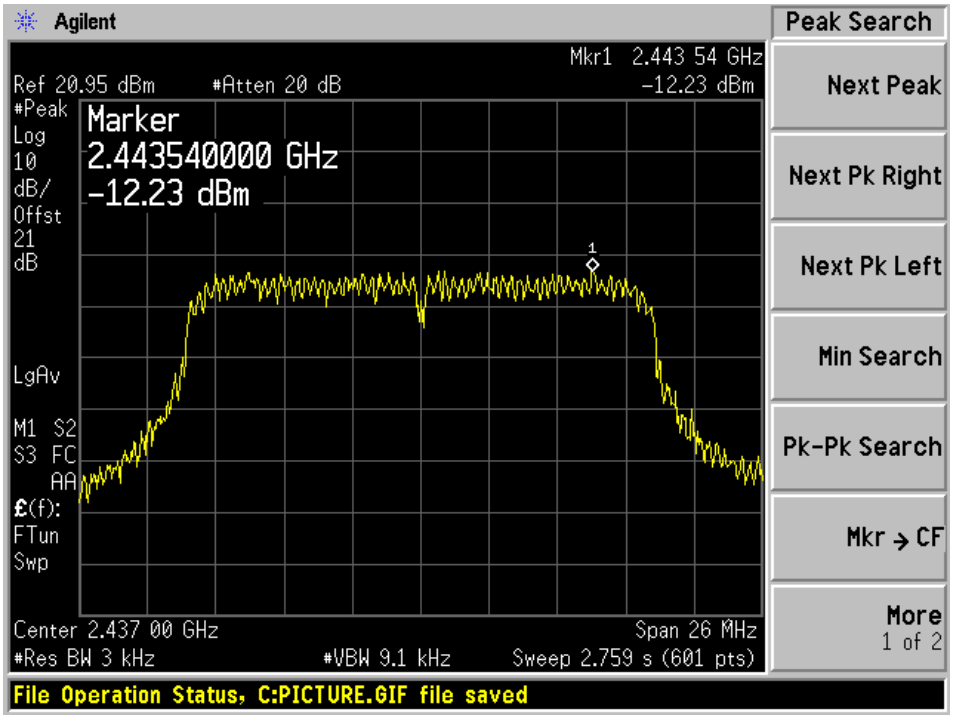


802.11n20 mode

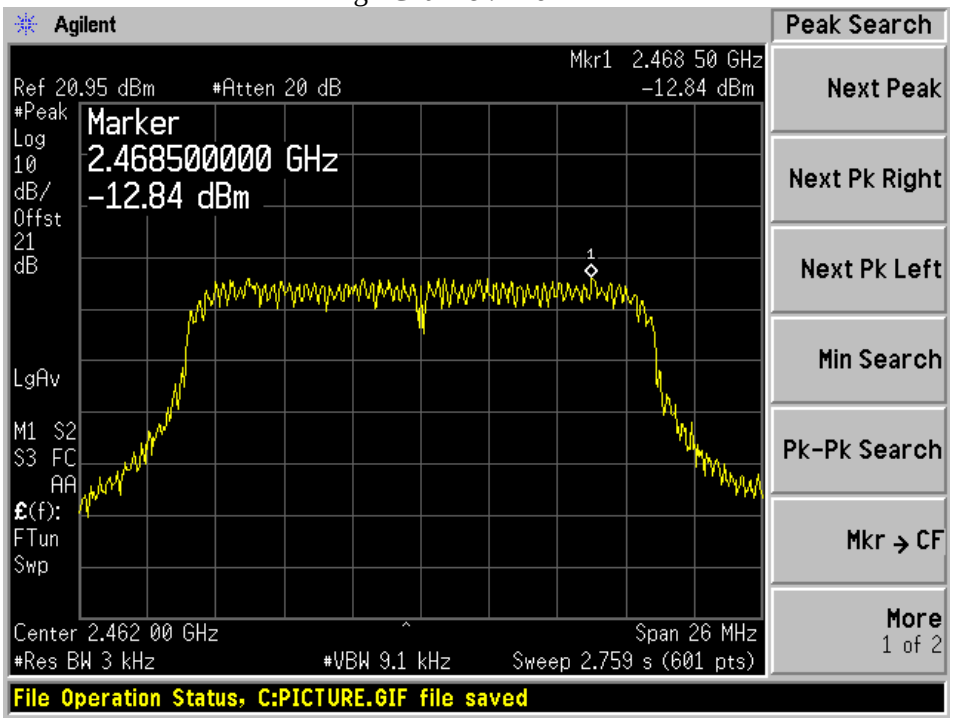
Low Channel: 2412 MHz



Mid Channel: 2437 MHz

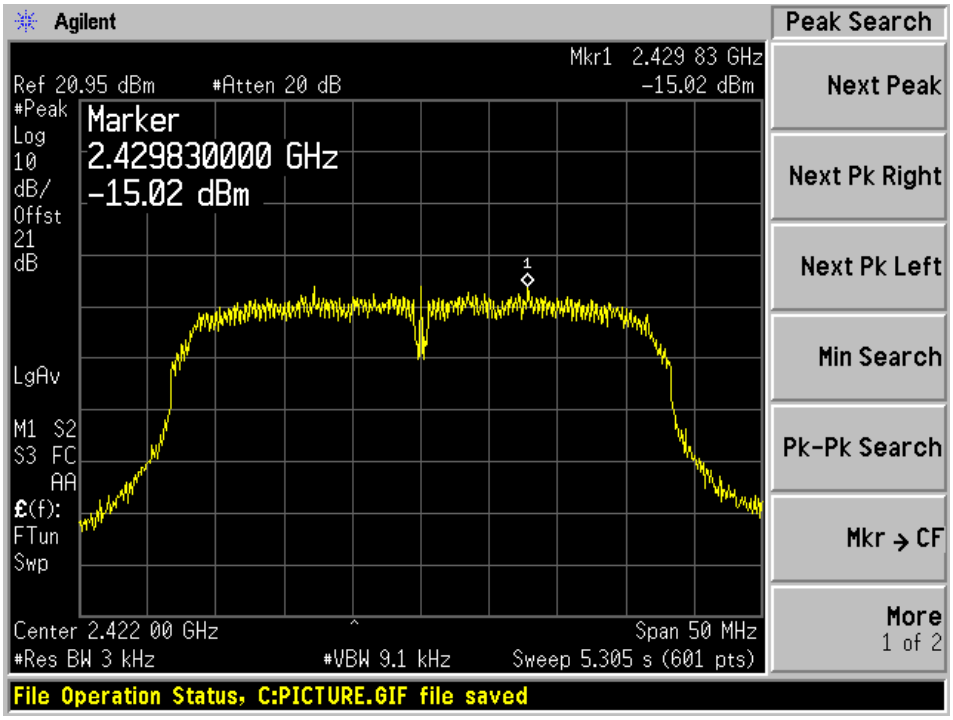


High Channel: 2462 MHz

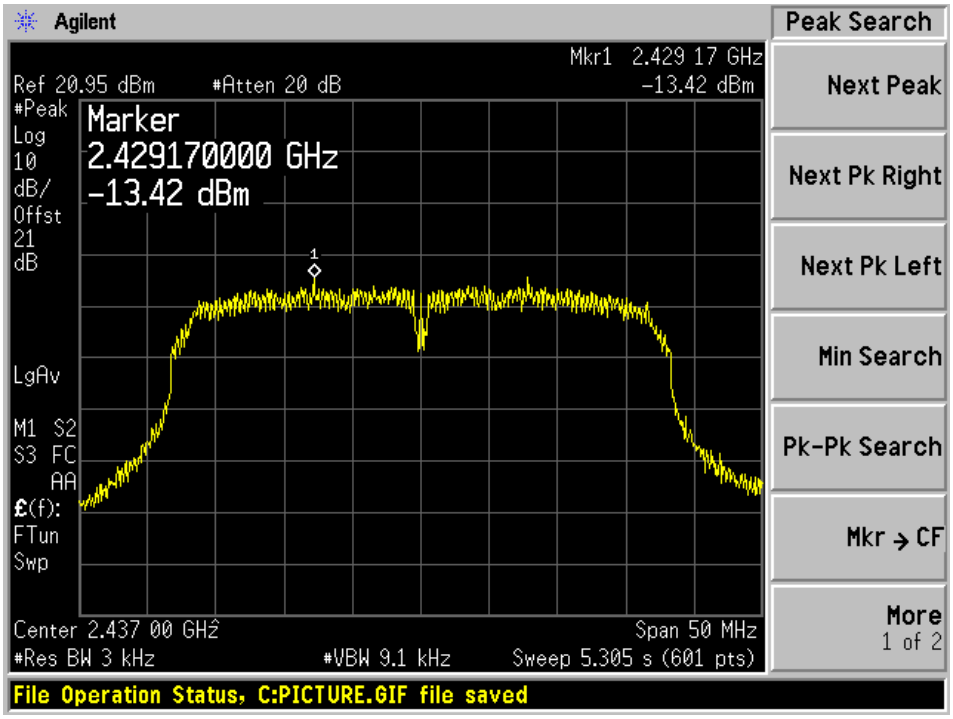


802.11n40 mode

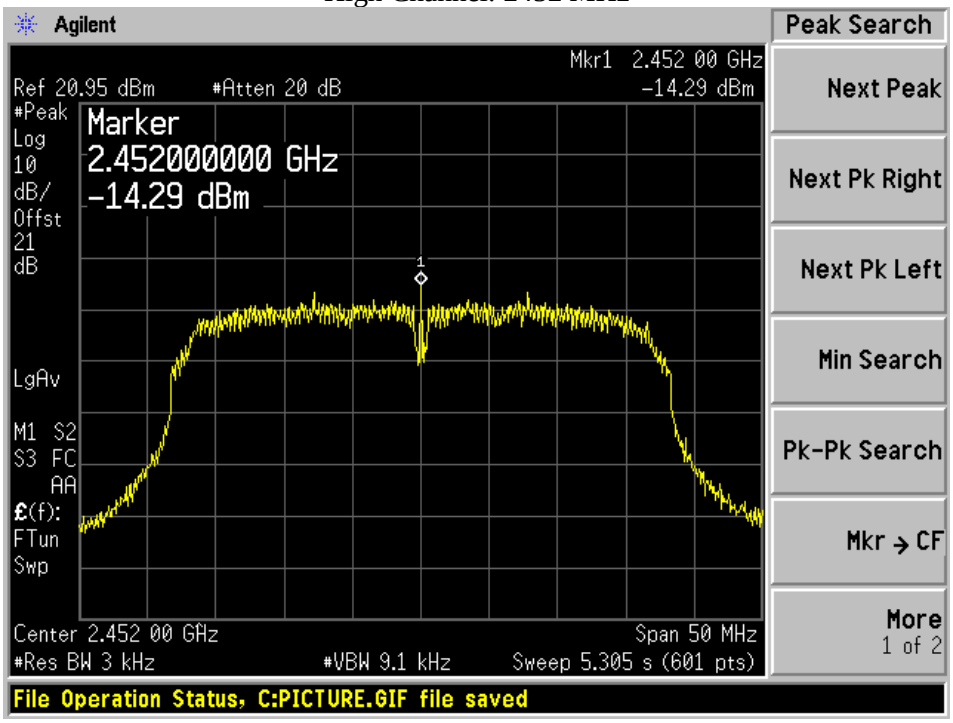
Low Channel: 2422 MHz



Mid Channel: 2437 MHz

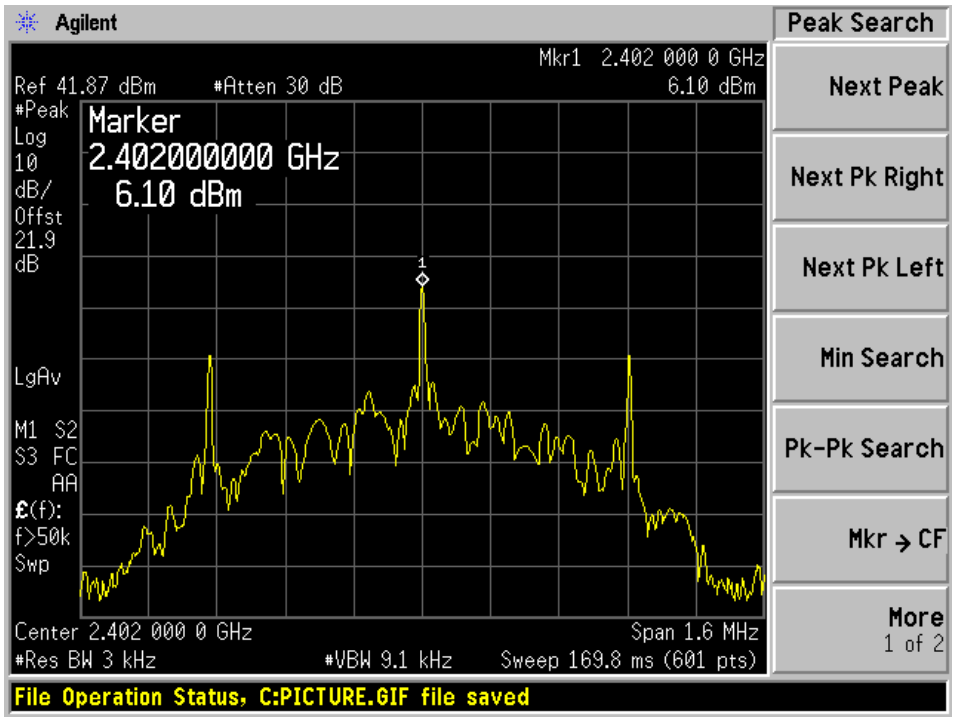


High Channel: 2452 MHz

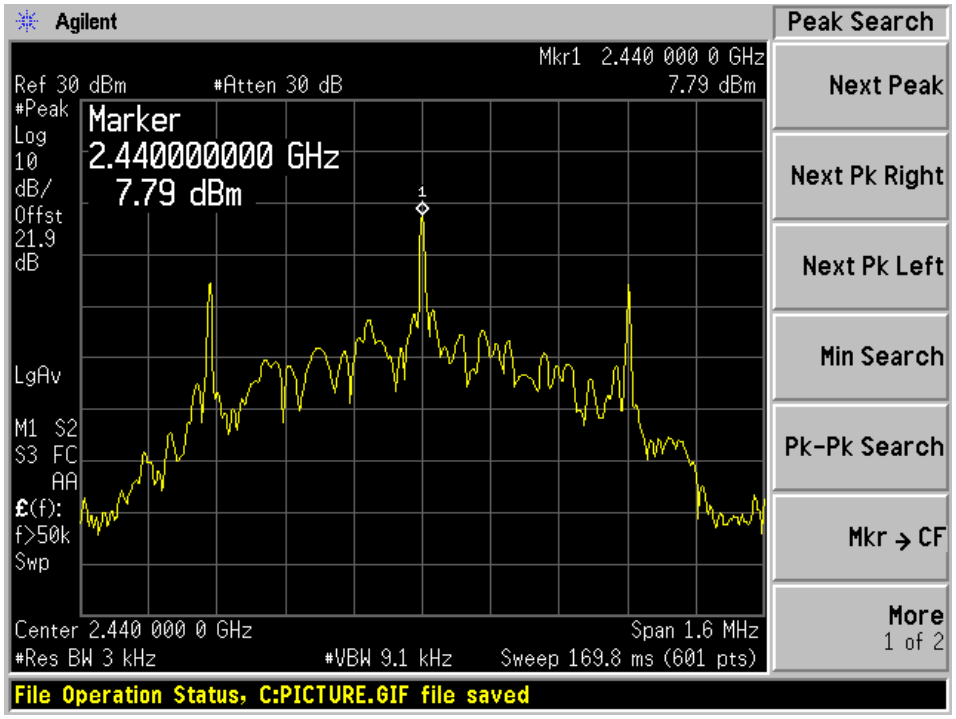


BLE mode

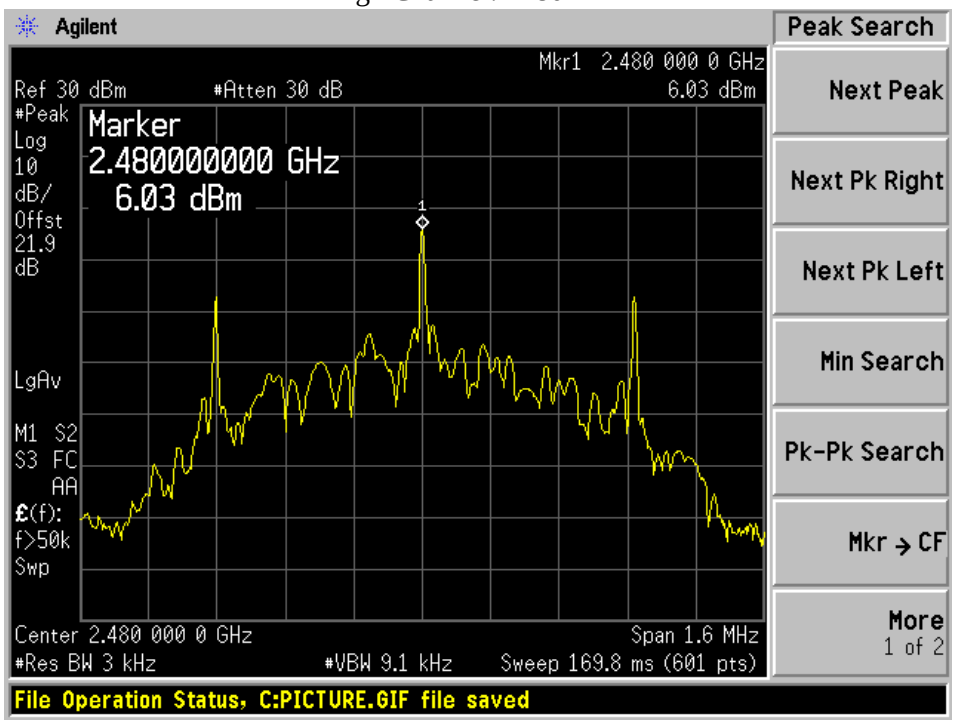
Low Channel: 2402 MHz



Mid 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

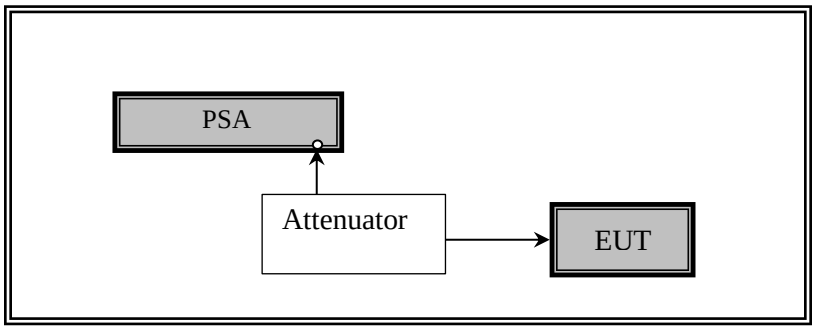
For ECFR §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the 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 Setup Block Diagram



11.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
424	Agilent	Spectrum Analyzer	E4440A	US45303156	12/06/2021	1 year
	-	RF cable	-	-	Each time[1]	N/A
	-	20 dB 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.*

11.5 Test Environmental Conditions

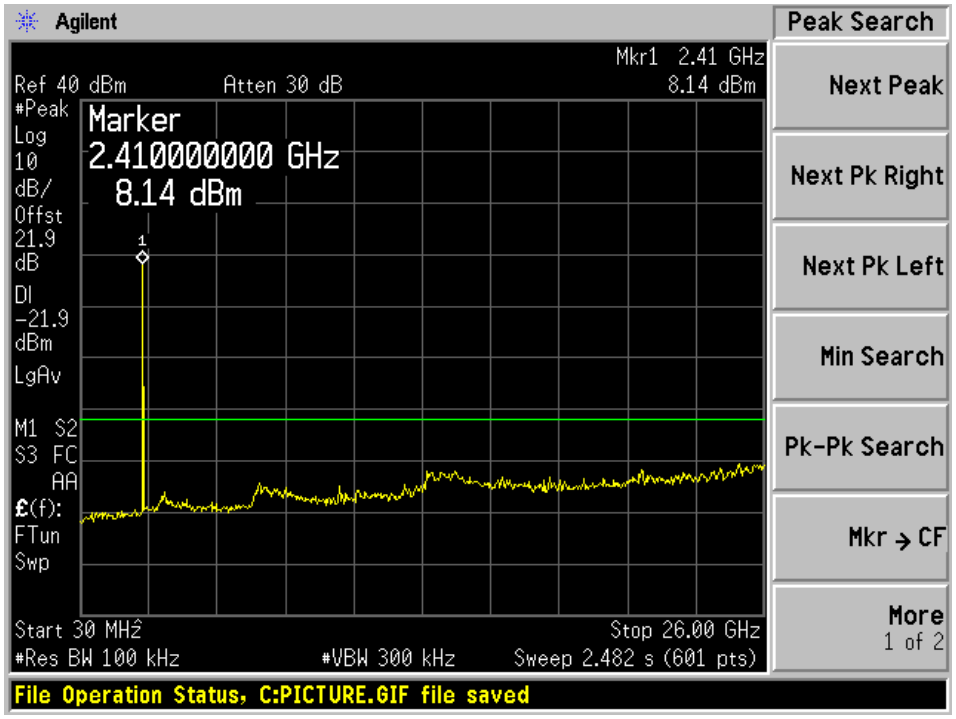
Temperature:	22º C
Relative Humidity:	51 %
ATM Pressure:	101.2 KPa

The testing was performed by Tao Jin on 2022-09-02 in RF site.

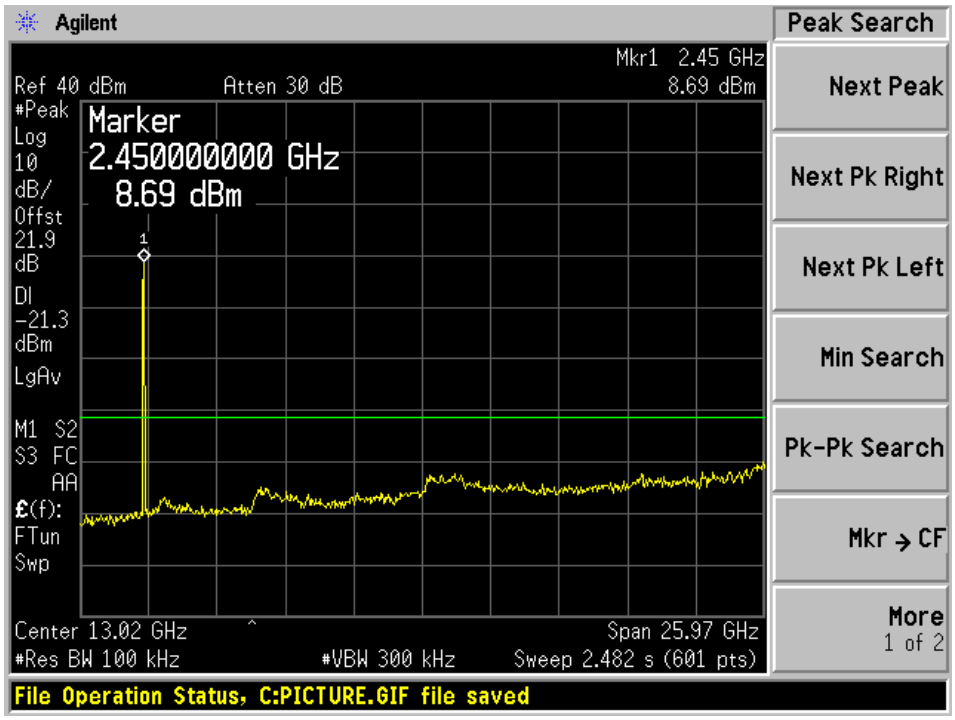
11.6 Test Results

802.11b mode

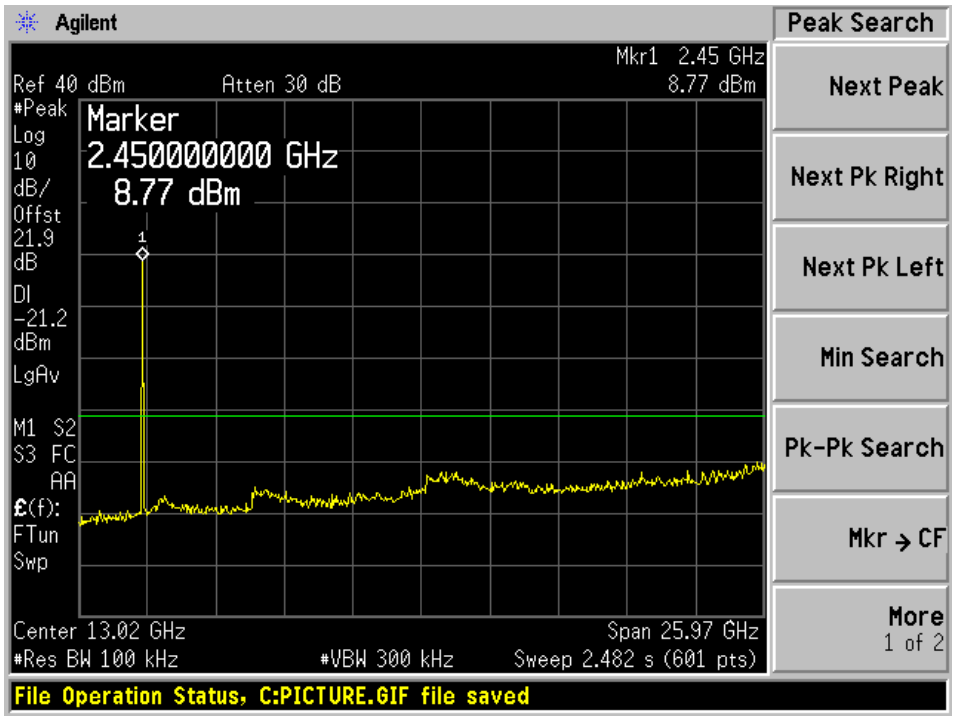
Low Channel: 2412 MHz



Mid Channel: 2437 MHz

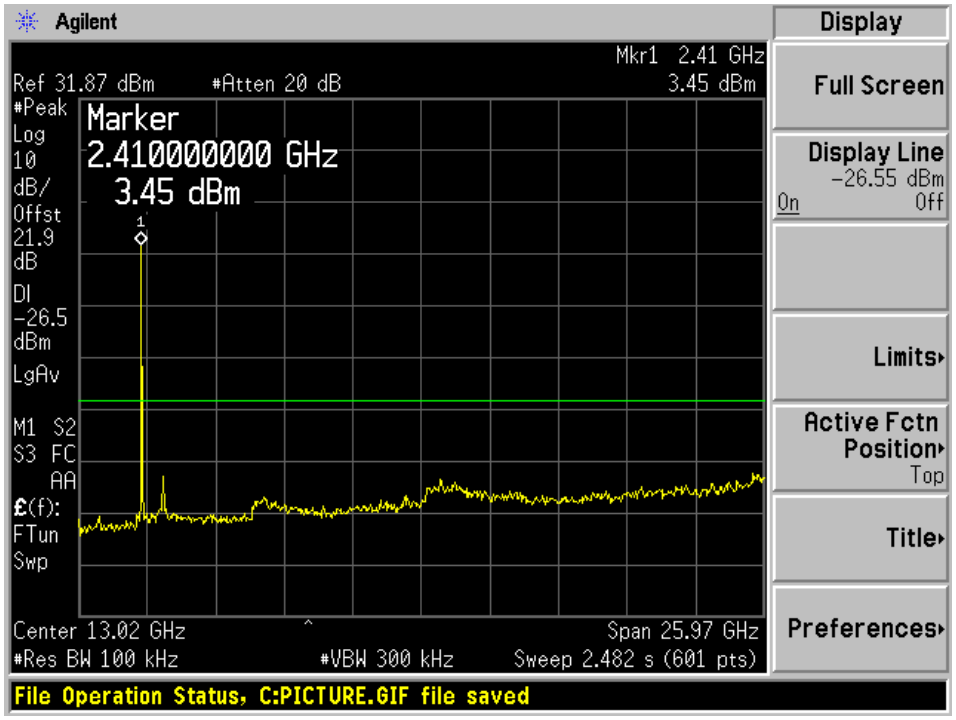


High Channel: 2462 MHz

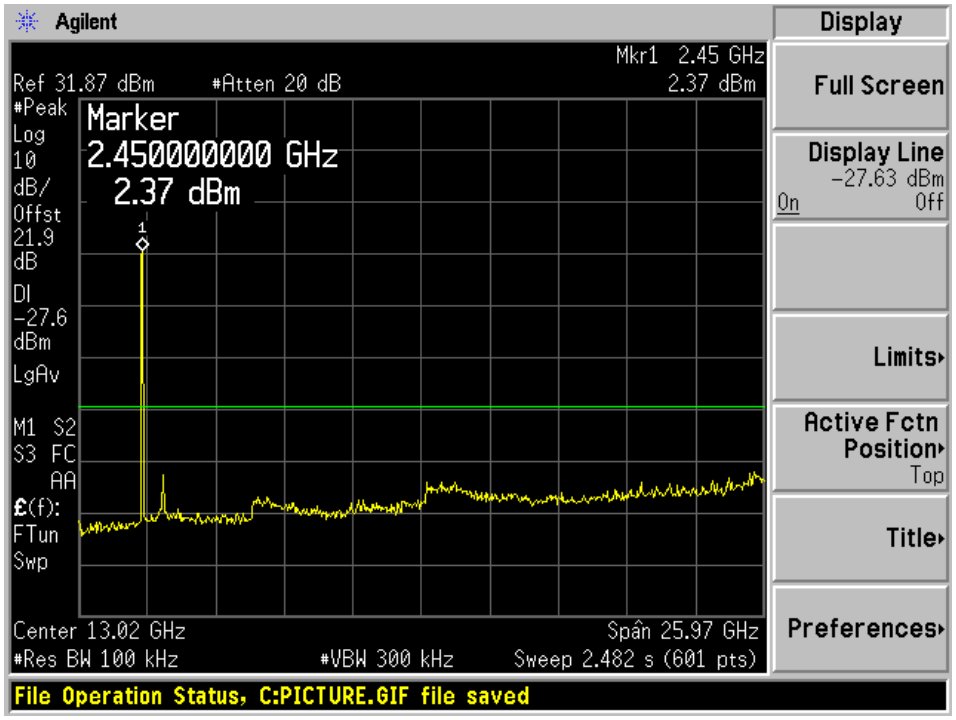


802.11g mode

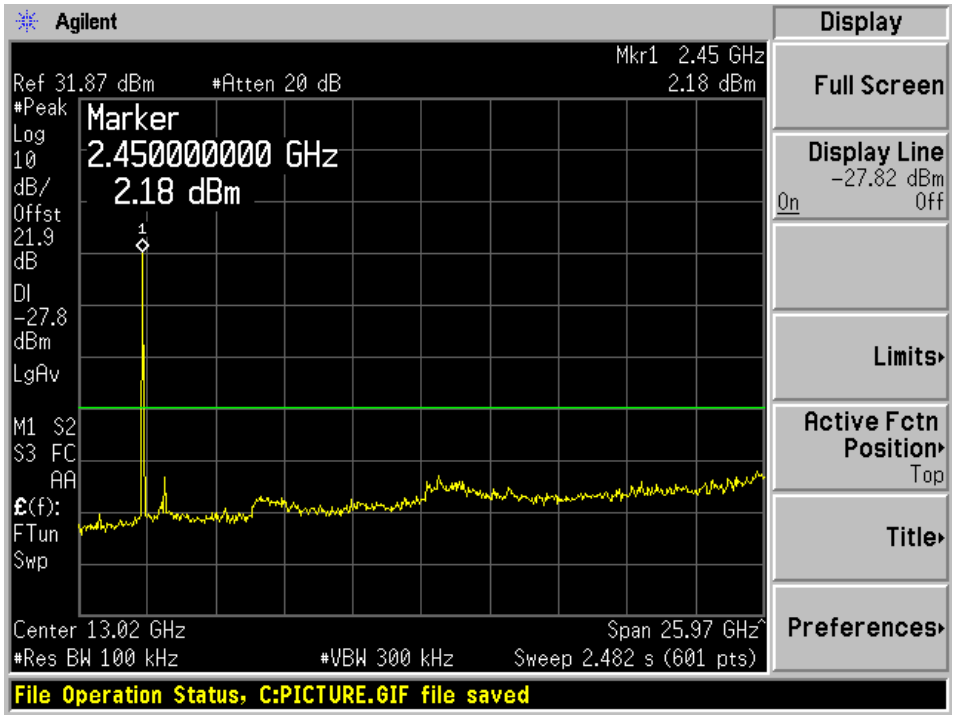
Low Channel: 2412 MHz



Mid Channel: 2437 MHz

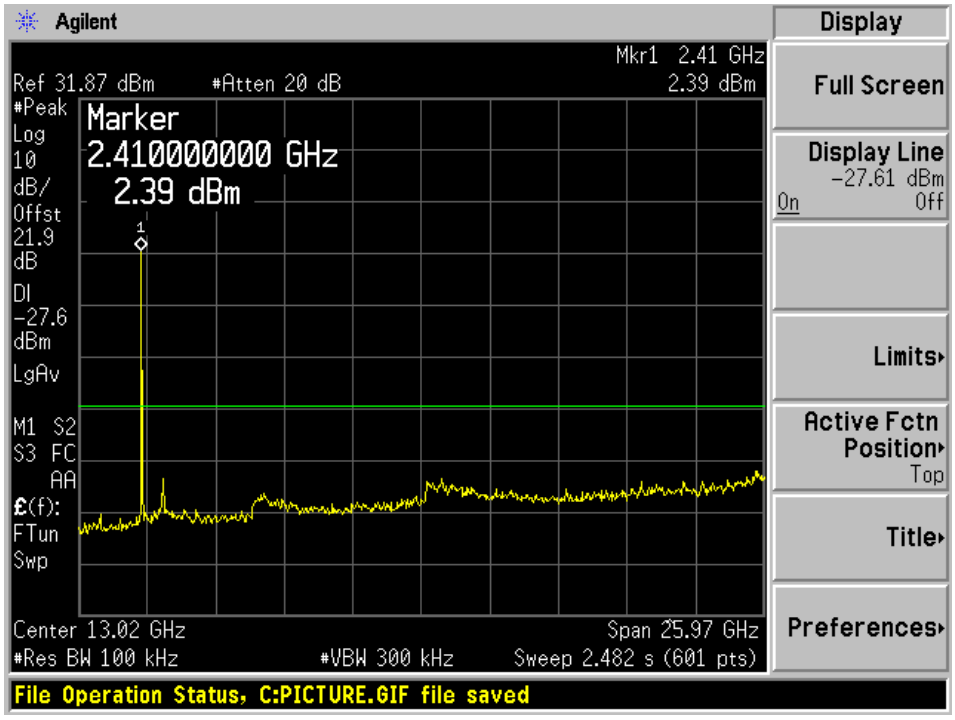


High Channel: 2462 MHz

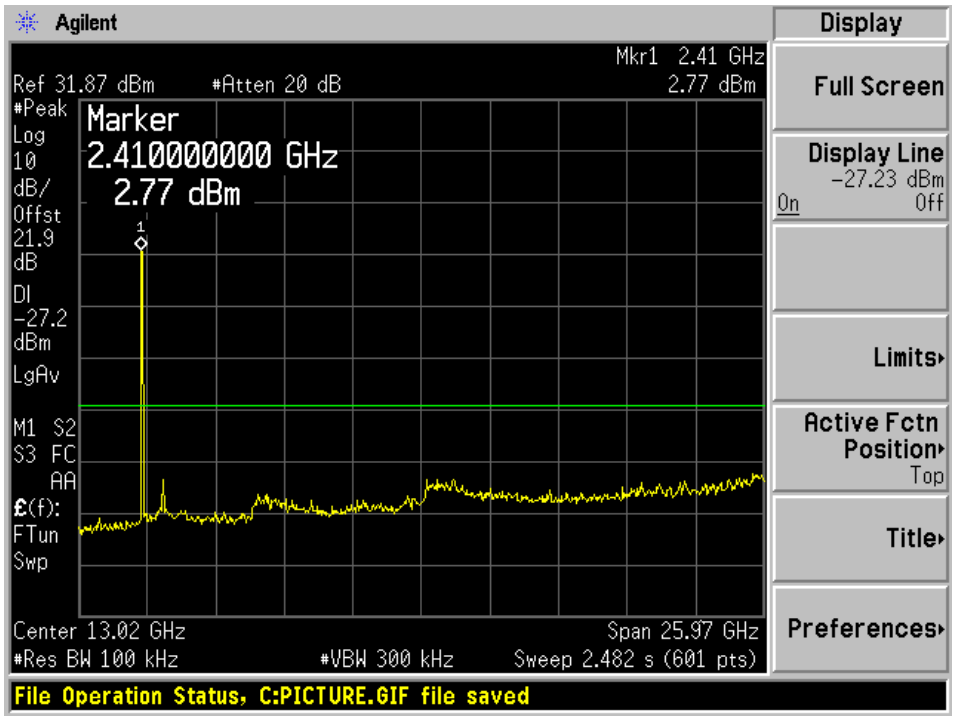


802.11n20 mode

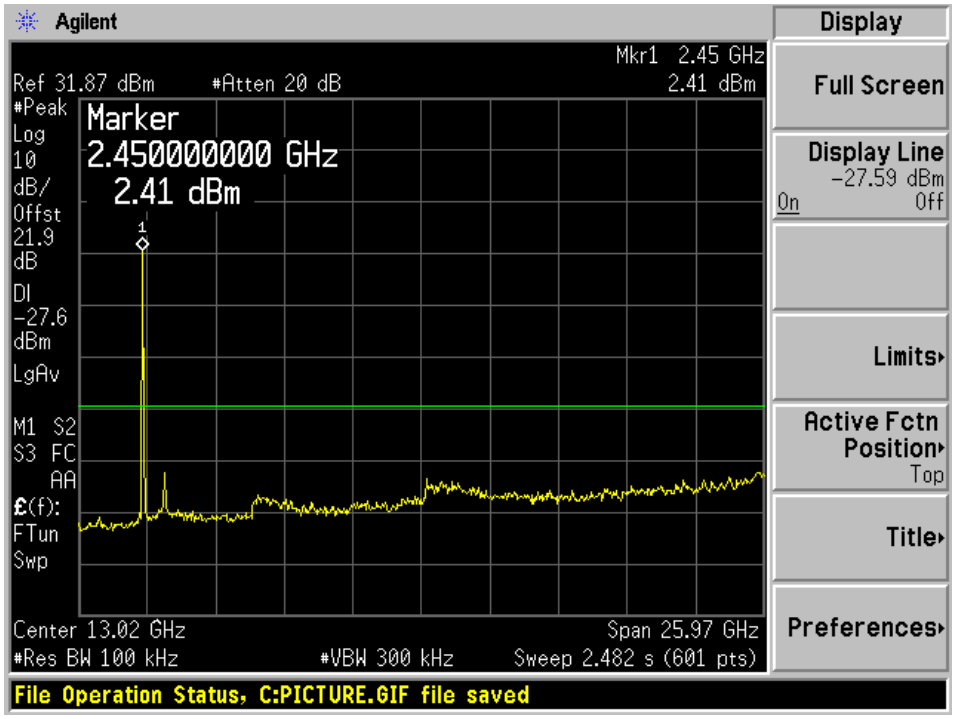
Low Channel: 2412 MHz



Mid Channel: 2437 MHz

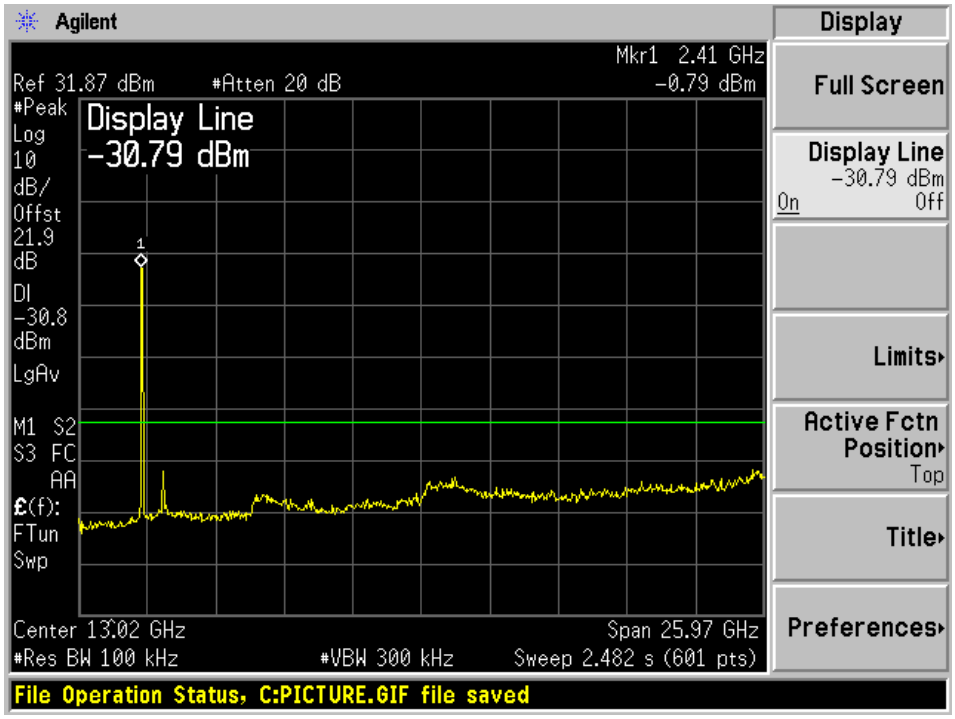


High Channel: 2462 MHz

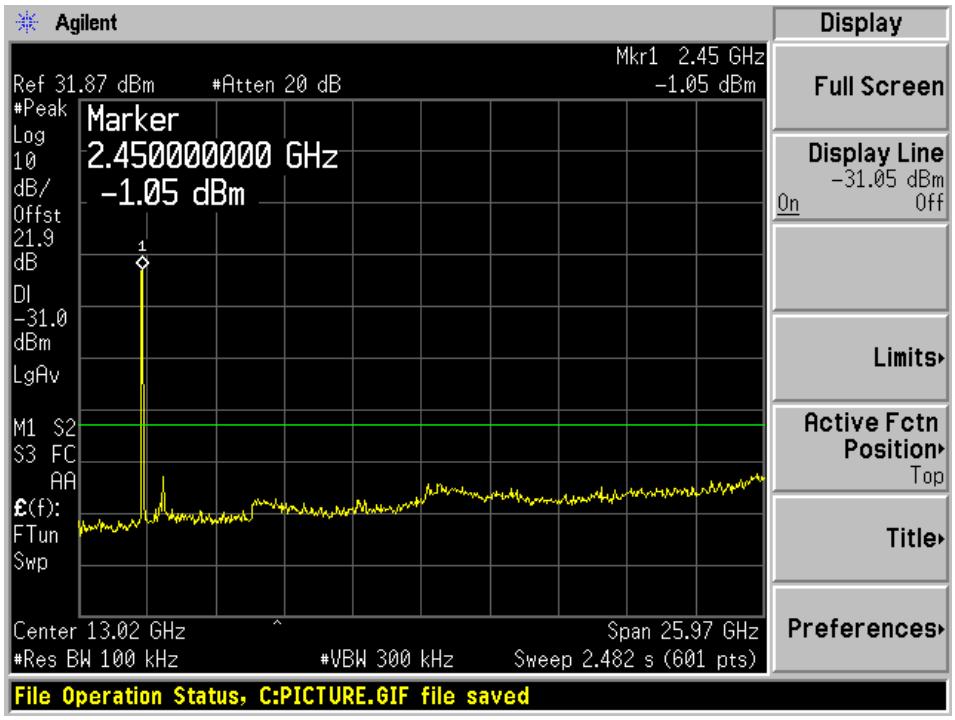


802.11n40 mode

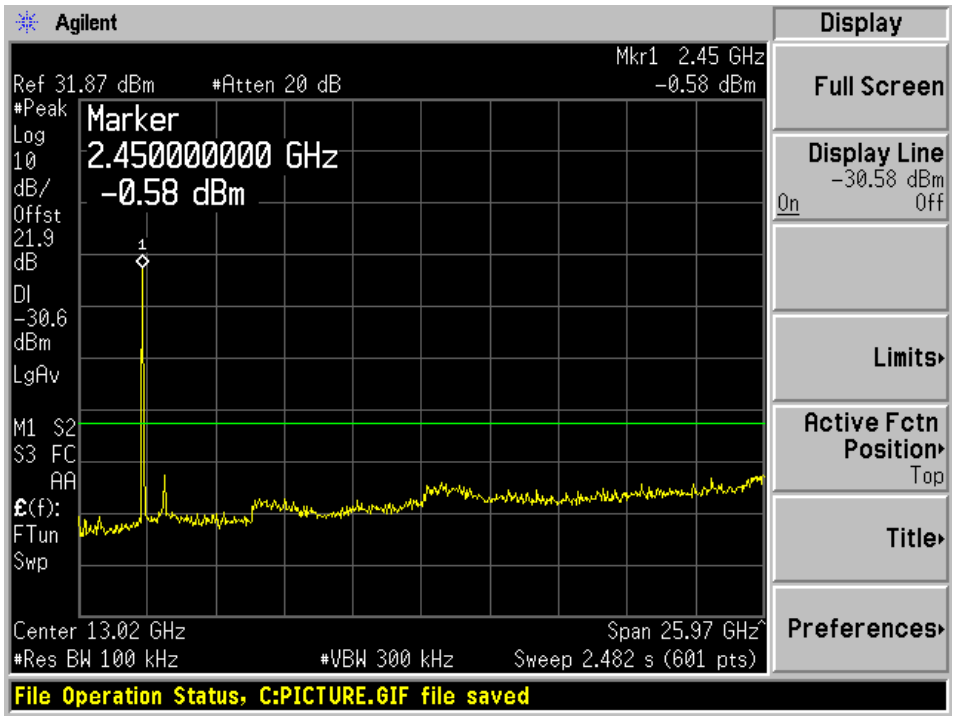
Low Channel 2422 MHz



Mid Channel 2437 MHz

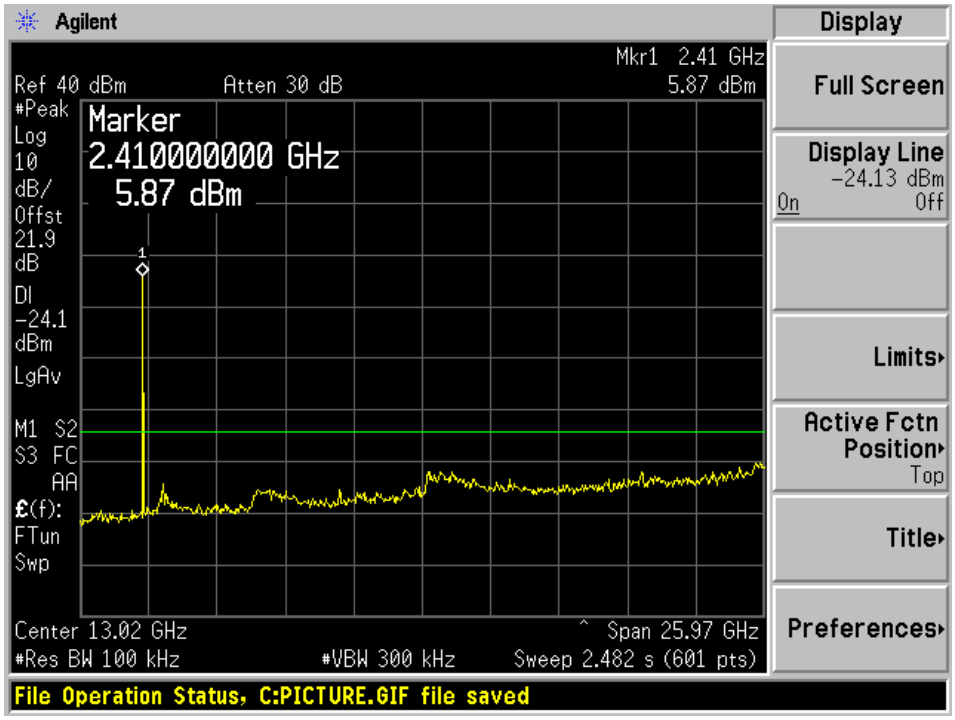


High Channel 2452 MHz

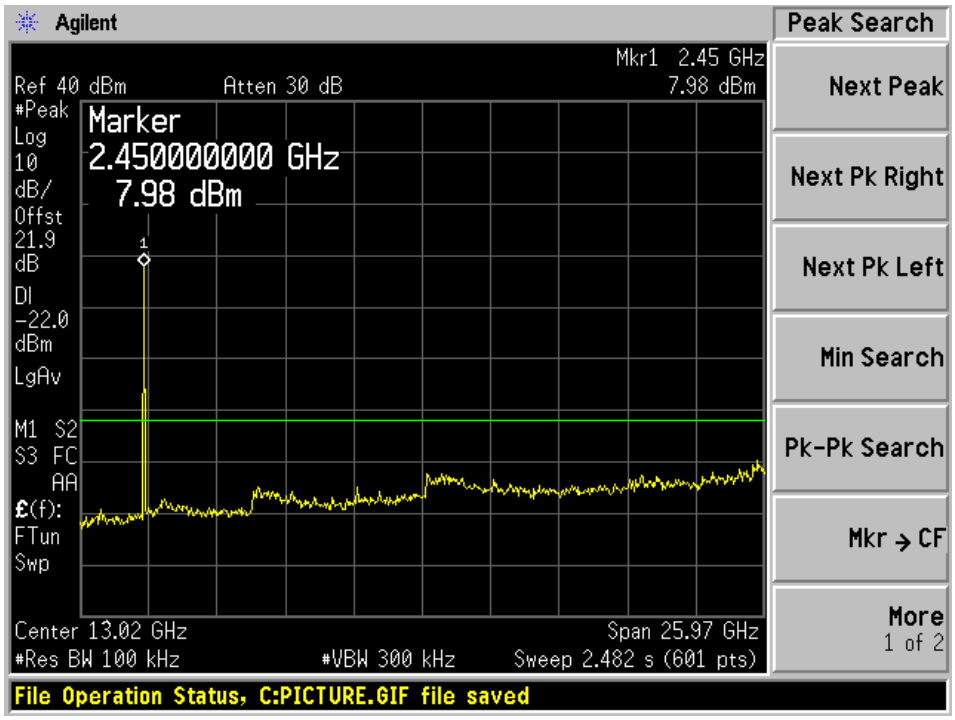


BLE mode

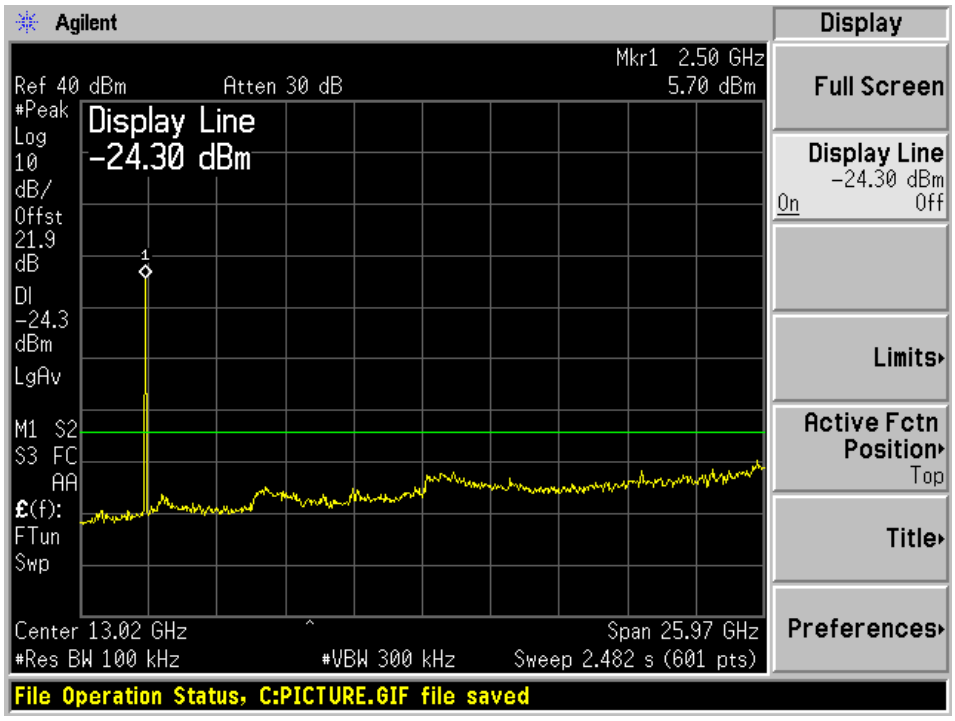
Low Channel 2402 MHz



Mid Channel 2440 MHz



High Channel 2480 MHz



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 ---