FCC PART 15.407
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Roku, Inc.

1155 Coleman Ave
San Jose, CA 95110

FCC ID: TC2-R1038
IC: 5959A-R1035

Report Type:	**Product Description:**
Class II Permissive Change	Speaker Built-in Set-top-box

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Report Number:	R2201181-407
Report Date:	2022-10-11
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ACCREDITED
CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2201181-407	C2PC	2022-10-11

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test report was prepared on behalf of *Roku, Inc..,* and their product model: *9102X, FCC ID: TC2-R1038, IC: 5959A-R1035,* or the "EUT" as referred to in this report. It is a Speaker Built-in Set-top-box with Wi-Fi and Bluetooth radio functionalities. It operates in the 2.4 GHz and 5 GHz bands.

1.2 Objective

This report was prepared on behalf of Roku, Inc in accordance with FCC CFR47 §15.407 and ISEDC RSS-247 Issue 2, February2017.

The objective was to determine compliance with FCC Part 15.407 and ISEDC RSS-247 rules for Output Power, Antenna Requirements, AC Line Conducted Emissions, Emission Bandwidth, Power spectral density, Conducted and Radiated Spurious Emissions.

This project is a Permissive Change II submission for the purpose of enabling DFS bands (5.3 GHz and 5.6GHz).

1.3 Related Submittal(s)/Grant(s)

N/A

1.4 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz, and FCC KDB 789033 D02 General UNII Test Procedure New Rules v02r01.

1.5 Measurement Uncertainty

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

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

1.6 Test Facility Registrations

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

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with 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.

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

2 EUT Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

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

The worst-case data rates are determined by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test software used was Teraterm. The software is compliant with the standard requirements being tested against.

Please refer to the following power setting table.

Modulation	Frequency (MHz)	Power Setting Port A	Power Setting Port B
802.11a	5260	80	80
	5300	82	80
	5320	72	80
	5500	75	75
	5580	70	70
	5700	72	68
	5720	72	68
802.11ac/n 20	5260	65	65
	5300	68	68
	5320	68	68
	5500	58	58
	5580	52	52
	5700	52	52
	5720	52	52

*Data rates tested:
802.11a mode: 6Mbps
802.11ac20 VHT20: MCS0

2.3 Duty Cycle Correction Factor

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 section B:

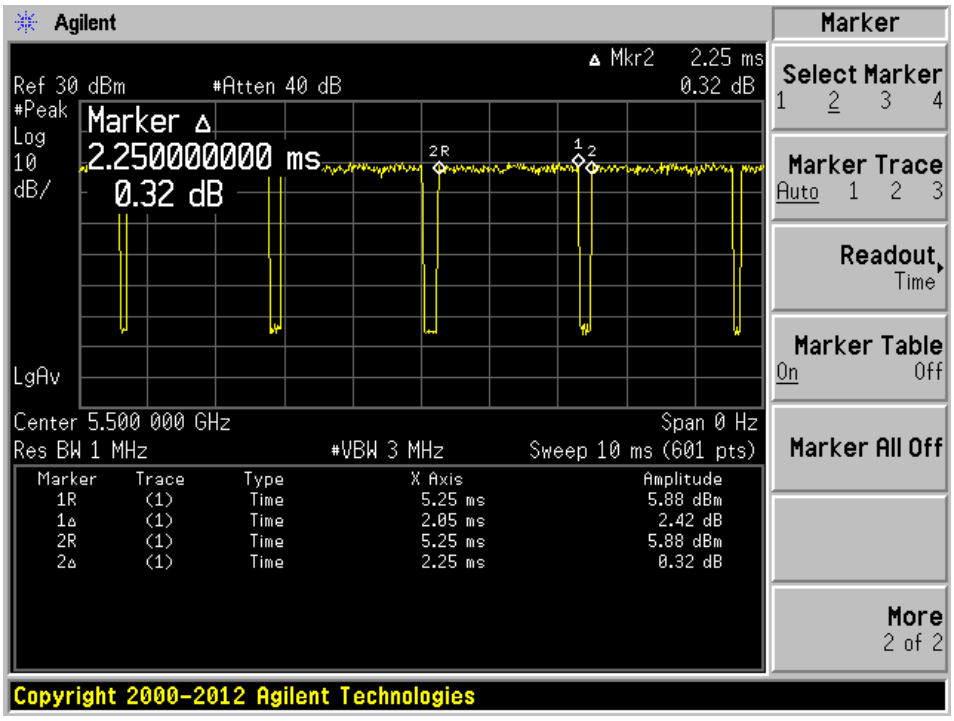
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11a	2.05	2.253	90.90	0.82
802.11n/ac20	1.9	2.05	92.68	0.66

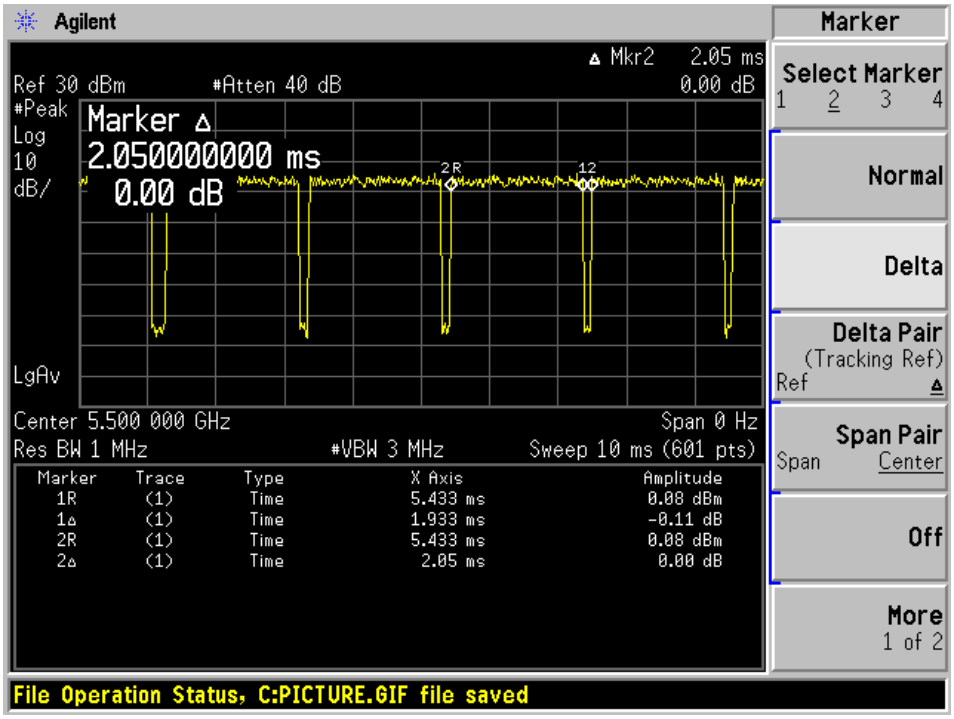
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

802.11a mode



802.11ac20 mode



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.6 Support Equipment

Manufacturer	Description	Model
-	Debug board	-

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	<2M	Laptop	Debug Board
Serial Pin	<2M	EUT	Debug Board
Power	<2M	EUT	Outlet

3 Summary of Test Results

FCC and ISEDC Rules	Description of Test	Result
FCC §2.1091, §15.407(f), ISEDC RSS-102	RF Exposure	Compliant
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Power Line Conducted Emissions	Compliant[1]
FCC §2.1053, §15.205, §15.209, 15.407(b) ISEDC RSS-247 §6.2	Spurious Radiated Emissions	Compliant
FCC §15.407(e) ISEDC RSS-Gen §6.2	Emission Bandwidth	Compliant
FCC §407(a) ISEDC RSS-247 §6.2	Output Power	Compliant
FCC §2.1051, §15.407(b) ISEDC RSS-247 §6.2	Band Edges	Compliant
FCC §15.407(a) ISEDC RSS-247 §6.2	Power Spectral Density	Compliant
FCC §2.1051, §15.407(b) ISEDC RSS-247 §6.2	Spurious Emissions at Antenna Terminals	Compliant
FCC §15.407(h) ISEDC RSS-247 §6.3	Dynamic Frequency Selection	Compliant

Note[1]: Please refer to Test Report R2005041-NII for test results.

4 FCC §2.1091, §15.407(f) & ISEDC RSS-102 - RF Exposure

4.1 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.

4.2 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 $\lambda/2\pi$. 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 $\lambda/4$ 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 $\lambda/4$.

As for devices with antennas of length greater than $\lambda/4$ where the gain is not well defined, but always less than that of a half-wave dipole (length $\lambda/2$), 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).

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

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

4.3 RF exposure evaluation exemption for FCC

<table>
<tr><td colspan="3">Prediction frequency (GHz)</td><td colspan="2">5.7</td></tr>
<tr><td colspan="3">Maximum ERP (dBm)</td><td colspan="2">17.84</td></tr>
<tr><td colspan="3">Maximum ERP (mW)</td><td colspan="2">60.81</td></tr>
<tr><td colspan="3">Prediction distance (cm)</td><td colspan="2">20</td></tr>
<tr><td colspan="3">Maximum antenna gain (dBi)</td><td colspan="2">3.58</td></tr>
<tr><td rowspan="5">0.3 GHz ≤ f < 1.5 GHz</td><td>ERP_{20 cm} (mW)</td><td>x</td><td colspan="2">SAR-based Exemption Threshold</td></tr>
<tr><td rowspan="4">-</td><td rowspan="4">-</td><td rowspan="2">d ≤ 20 cm</td><td>P_{th} (mW)</td></tr>
<tr><td>-</td></tr>
<tr><td rowspan="2">20 cm < d ≤ 40 cm</td><td>P_{th} (mW)</td></tr>
<tr><td>-</td></tr>
<tr><td rowspan="5">1.5 GHz ≤ f ≤ 6 GHz</td><td>ERP_{20 cm} (mW)</td><td>x</td><td colspan="2">SAR-based Exemption Threshold</td></tr>
<tr><td rowspan="4">3060</td><td rowspan="4">2.665</td><td rowspan="2">d ≤ 20 cm</td><td>P_{th} (mW)</td></tr>
<tr><td>-</td></tr>
<tr><td rowspan="2">20 cm < d ≤ 40 cm</td><td>P_{th} (mW)</td></tr>
<tr><td>3060</td></tr>
</table>

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

Note: Maximum ERP (dBm) = Maximum ERP (dBm) – 2.15dB

Radio Co-location

The device supports the following radio co-location configurations.

	Wi-Fi Radio 5G
BT	X
Wi-Fi Radio 1 2.4G	X
Wi-Fi Radio 1 5G	

Worst Case Colocation Bluetooth and 5 GHz Wi-Fi Radio 2:

Frequency Band	Max Conducted Power(dBm)	Evaluated Distance (cm)	ERP (mW)	ERP Threshold (mW)	Ratios	Sum of Ratios	Limit
Worst Case							
2.4 GHz Classic Bluetooth	11.81	20	15.7	3060	0.51%	2.5%	100%
5 GHz Wi-Fi Radio 2	16.41	20	60.81	3060	1.99%		

Worst Case Colocation 2.4 GHz Wi-Fi Radio 1 and 5 GHz Wi-Fi Radio 2:

Frequency Band	Max Conducted Power(dBm)	Evaluated Distance (cm)	ERP (mW)	ERP Threshold (mW)	Ratios	Sum of Ratios	Limit
Worst Case							
2.4 GHz Wi-Fi Radio 1	23.14	20	315.5	3060	10.31%	12.3%	100%
5 GHz Wi-Fi Radio 2	16.41	20	60.81	3060	1.99%		

4.4 RF exposure evaluation exemption for IC

5 GHz Wi-Fi: 802.11a, 5700 MHz

Maximum EIRP = 19.99 dBm (99.77 mW), which is less than $1.31\times10^{-2}f^{0.6834}$ = 4.525 W = 36.55dBm

Therefore, the RF exposure Evaluation is not required.

5 FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements

5.1 Applicable Standards

According to FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

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

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

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

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

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

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

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

5.2 Antenna List

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)	Antenna Type
5GHz Wi-Fi(Ant a)	5250-5350, 5470-5725	1.91	Trace Antenna
5GHz Wi-Fi(Ant b)	5250-5350, 5470-5725	3.58	Trace Antenna

Note: The antenna gain was provided by the manufacturer.
Note: Per antenna test report provided by the manufactuer: ant a = ANT1, ant b = ANT2.

6 FCC §15.209, §15.407(b) & ISEDC RSS-247 §6.2 - Spurious Radiated Emissions

6.1 Applicable Standard

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: 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 Note 1	3
88 - 216	150 Note 1	3
216 - 960	200 Note 1	3
Above 960	500	3

Note 1: 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 Part 15.407 (b)

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(3) For transmitters operating in the 5.47 -5.725 GHz band: All emissions outside of the 5.47-5725 GHz band shall not exceed an ei.r.p. of -27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall noet exceed an e.i.r.p. of -27 dBm/MHz.

(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(7) The provisions of §15.205 apply to intentional radiators operating under this section.

As per ISEDC RSS-247 §6.2

For transmitters operating in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, any unwanted emissions that fall into the band 5250- 5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz. Otherwise, the transmission is considered as intentional and the devices shall implement dynamic frequency selection (DFS) and transmitter power control (TPC) as per the requirements for the band 5250-5350 MHz

For devices with both operating frequencies and channel bandwidths contained within the band 5250-5350 MHz, the device shall comply with the following:

1. All emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. if the equipment is intended for outdoor use; or
2. All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. and any emissions within the band 5150-5250 MHz shall meet the power spectral density limits of Section 6.2.1. The device shall be labelled “for indoor use only.”

For devices with operating frequencies in the band 5250-5350 MHz but having a channel bandwidth that overlaps the band 5150-5250 MHz, the devices’ unwanted emission shall not exceed -27 dBm/MHz e.i.r.p. outside the band 5150-5350 MHz and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device shall be labelled “for indoor use only.”

For transmitters operating in the band 5470-5725 MHz, emissions outside the band shall not exceed -27 dBm/MHz e.i.r.p.

For the band 5725-5850 MHz, emissions at frequencies from the band edges to 10 MHz above or below the band edges shall not exceed -17 dBm/MHz e.i.r.p. For emissions at frequencies more than 10 MHz above or below the band edges, the emissions power shall not exceed -27 dBm/MHz.

6.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15.407 and ISEDC RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

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

6.3 Test Procedure

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 is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter or 1.5 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 3MHz / Sweep = 100ms
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

6.4 Corrected Amplitude and Margin Calculation

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

CA = Ai + AF + CL + Atten – Ga

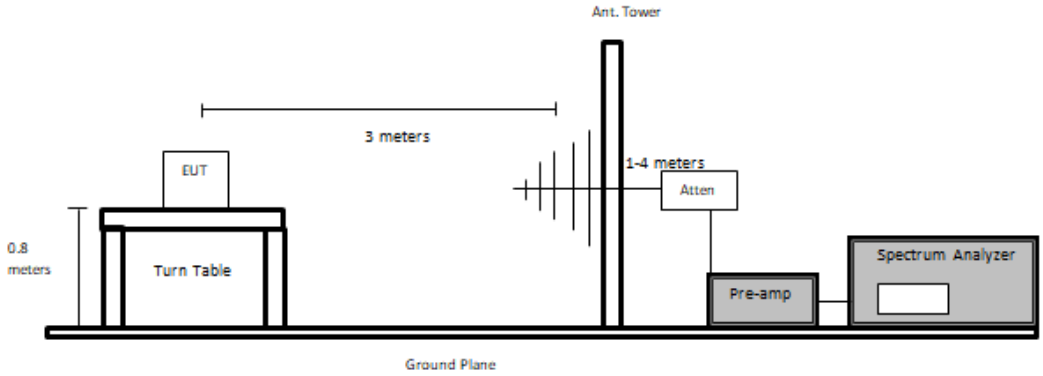
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

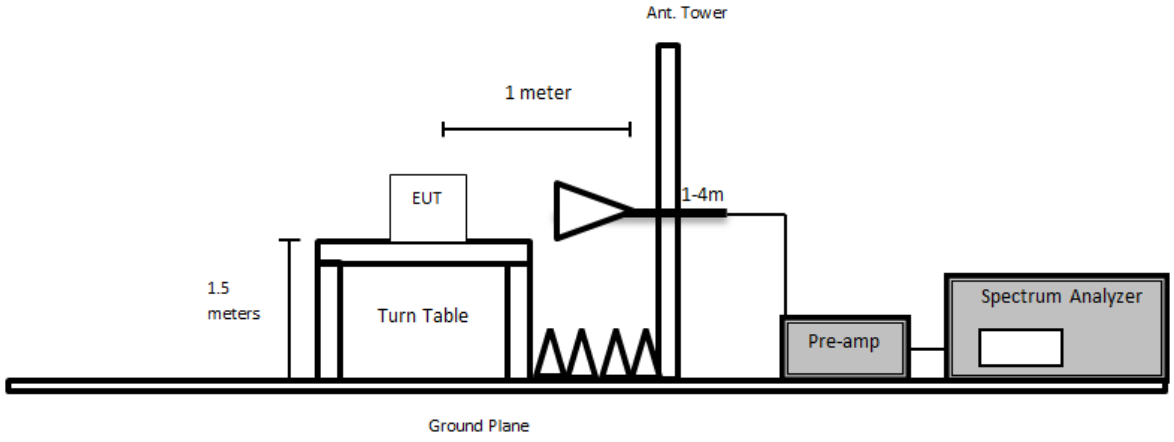
Margin = Corrected Amplitude – Limit

6.5 Test Setup Block Diagram

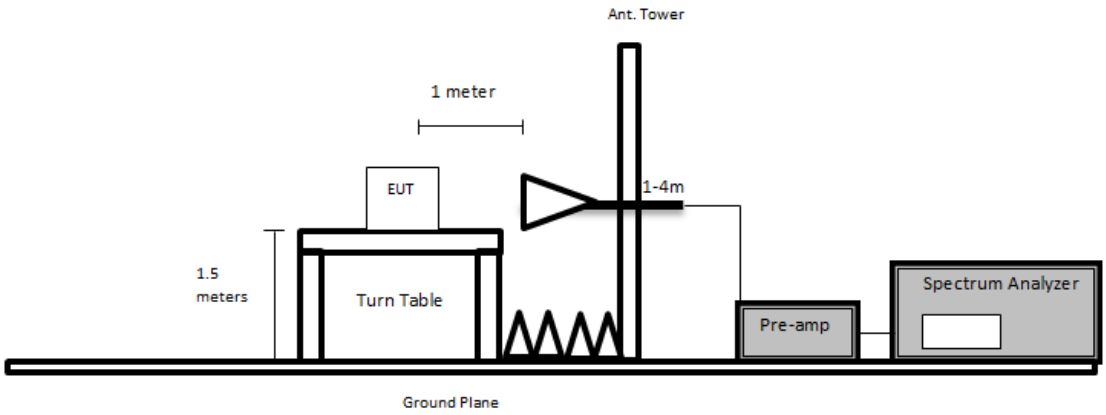
Below 1GHz:



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



18 GHz to 40 GHz (Asset #91 and #90 Antennas used):



6.6 Test Equipment List and Details

BACL No	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250 238	2021-06-23	1 year
1060	BACL	Temp and Humi Chamber	BTH-150-40	30078	2021-09-23	1 year
-	Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/A
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2021-11-22	2 years
1101	IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs on Both Sides	KPS-1571AN-2400	DC 1922	2021-07-06	1 year
90	Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2021-04-12	2 years
91	Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2020-03-08	2 years
827	AH Systems	Preamplifier	PAM 1840 VH	170	2021-03-08	1 year
1077	Insulted Wire Corp	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-03-03	1 year
287	HP	Spectrum Analyzer 46 GHz	E4446A	US44300 386	2021-04-27	1 year
1228	Pasternack	Coaxial Cable, RG213	PE3496-800CM	2111301	2021-11-30	1 year
459	HP	Amplifier, Pre	8447D	2443A04 374	2021-11-02	1 year
658	Agilent	Pre-Amplifier	8449B	3008A01 13	2021-05-06	1 year
1192	ETS Lindgren	Antenna, Horn	3117	00218973	2021-09-14	2 years
	-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cables and attenuators 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".*

6.7 Test Environmental Conditions

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

The testing was performed by Deepak Mishra from 2022-02-02 to 2022-02-16 in 5m chamber 3.

6.8 Summary of Test Results

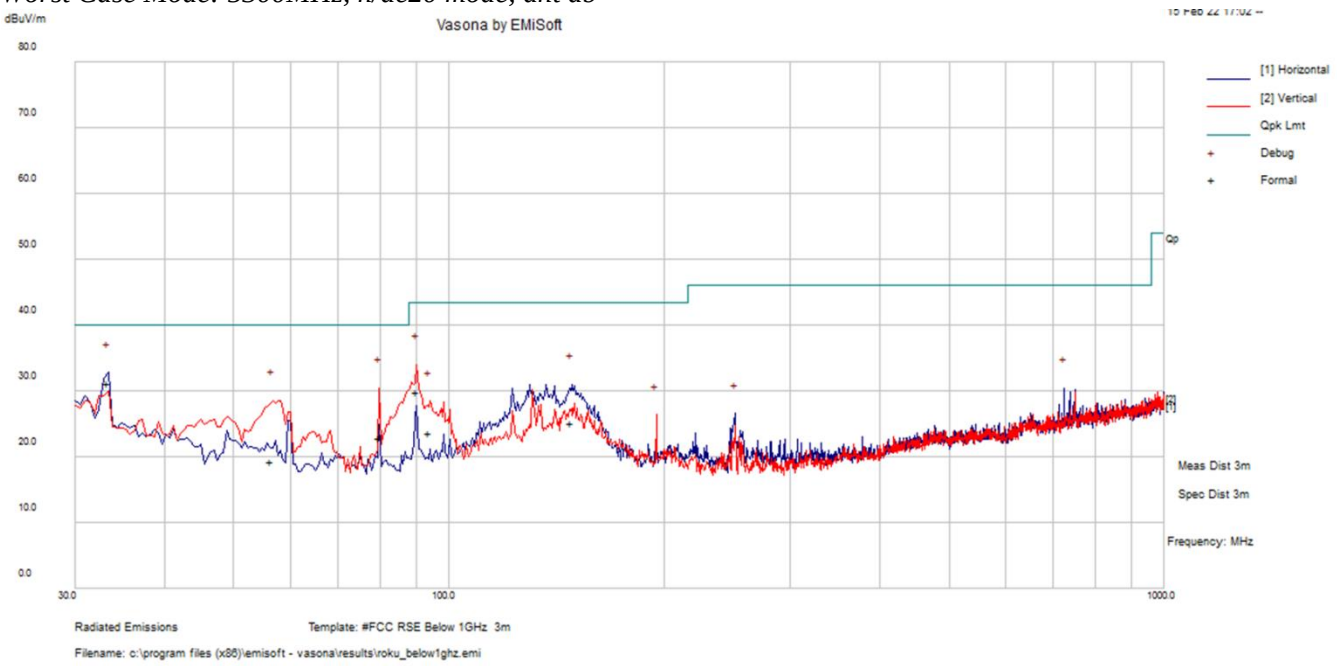
According to the data hereinafter, the EUT complied with the FCC Part 15.407 and RSS-247 standards' radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-0.83	10600	Vertical	802.11a mode, 5300 MHz, ant a

6.9 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz at 3 meters

Worst Case Mode: 5300MHz, n/ac20 mode, ant ab



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
33.3115	31.36	30.95	31.25	129	H	40	40	-8.75	Pass
89.9995	40.33	18.83	29.81	115	V	167	43.5	-13.69	Pass
79.998	33.77	11.62	22.91	124	V	183	40	-17.09	Pass
56.46925	30.76	7.66	19.37	199	V	29	40	-20.63	Pass
148.5023	30.84	18.76	25.12	213	H	246	43.5	-18.38	Pass
93.8655	33.17	13.61	23.63	103	V	141	43.5	-19.87	Pass

2) 1–18 GHz measured at 1 meter

5260-5320 MHz ant a

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
5260 MHz a mode											
10520	59.08	168	150	V	38.15	13.35	38.24	72.34	78	-5.66	Peak
10520	57.66	112	207	H	38.15	13.35	38.24	70.92	78	-7.08	Peak
15780	53.61	47	170	V	41.26	11.06	37.99	67.94	84	-16.06	Peak
15780	50.55	71	150	H	41.26	11.06	37.99	64.88	84	-19.12	Peak
15780	44.42	47	170	V	41.26	11.06	37.99	58.76	64	-5.24	Ave
15780	41.11	71	150	H	41.26	11.06	37.99	55.44	64	-8.56	Ave
5300 MHz a mode											
10600	61.96	166	150	V	38.14	13.35	38.24	75.22	84	-8.78	Peak
10600	58.29	111	201	H	38.14	13.35	38.24	71.55	84	-12.45	Peak
10600	49.92	166	150	V	38.14	13.35	38.24	63.17	64	-0.83	Ave
10600	48.57	111	201	H	38.14	13.35	38.24	61.83	64	-2.17	Ave
15900	54.59	45	150	V	41.32	11.06	38.10	68.87	84	-15.13	Peak
15900	52.44	34	200	H	41.32	11.06	38.10	66.72	84	-17.28	Peak
15900	42.89	45	150	V	41.32	11.06	38.10	57.17	64	-6.83	Ave
15900	42.64	34	200	H	41.32	11.06	38.10	56.92	64	-7.08	Ave
5320 MHz a mode											
5350	69.47	140	150	V	35.242	8.999	38.142	75.569	78	-2.431	Peak
5350	70.32	319	150	H	35.242	8.999	38.142	76.419	78	-1.581	Peak
5350	51.06	140	150	V	35.242	8.999	38.142	57.16	64	-6.83	Ave
5350	51.66	319	150	H	35.242	8.999	38.142	57.76	64	-6.23	Ave
10640	53.57	165	150	V	38.19	13.64	38.05	67.35	84	-16.65	Peak
10640	51.82	58	172	H	38.19	13.64	38.05	65.60	84	-18.40	Peak
10640	42.49	165	150	V	38.19	13.64	38.05	56.27	64	-7.73	Ave
10640	40.85	58	172	H	38.19	13.64	38.05	54.63	64	-9.37	Ave
15960	49.21	160	150	V	41.59	11.06	38.10	63.77	84	-20.24	Peak
15960	49.47	32	197	H	41.59	11.06	38.10	64.03	84	-19.98	Peak
15960	38.95	160	150	V	41.59	11.06	38.10	53.51	64	-10.49	Ave
15960	38.85	32	197	H	41.59	11.06	38.10	53.41	64	-10.59	Ave

5260-5320 MHz ant b

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
5260 MHz a mode											
10520	52.70	15	150	V	38.15	13.35	38.24	65.96	78	-12.04	Peak
10520	53.60	337	150	H	38.15	13.35	38.24	66.86	78	-11.14	Peak
15780	54.04	63	150	V	41.26	11.06	37.99	68.37	84	-15.63	Peak
15780	57.08	85	248	H	41.26	11.06	37.99	71.41	84	-12.59	Peak
15780	43.41	63	150	V	41.26	11.06	37.99	57.75	64	-6.25	Ave
15780	46.26	85	248	H	41.26	11.06	37.99	60.59	64	-3.41	Ave
5300 MHz a mode											
10600	52.27	51	150	V	38.14	13.35	38.24	65.53	84	-18.47	Peak
10600	51.58	338	150	H	38.14	13.35	38.24	64.84	84	-19.16	Peak
10600	42.22	51	150	V	38.14	13.35	38.24	55.48	64	-8.52	Ave
10600	40.76	338	150	H	38.14	13.35	38.24	54.01	64	-9.99	Ave
15900	57.70	75	206	V	41.32	11.06	38.10	71.98	84	-12.02	Peak
15900	59.93	81	243	H	41.32	11.06	38.10	74.21	84	-9.79	Peak
15900	47.33	75	206	V	41.32	11.06	38.10	61.61	64	-2.39	Ave
15900	47.23	81	243	H	41.32	11.06	38.10	61.51	64	-2.49	Ave
5300 MHz a mode											
5350	67.52	70	176	V	35.242	8.999	38.142	73.619	78	-4.381	Peak
5350	69.65	278	150	H	35.242	8.999	38.142	75.749	78	-2.251	Peak
5350	52.19	70	176	V	35.242	8.999	38.142	58.29	64	-5.70	Ave
5350	52.41	278	150	H	35.242	8.999	38.142	58.50	64	-5.49	Ave
10640	50.11	51	150	V	38.19	13.64	38.05	63.89	84	-20.11	Peak
10640	48.82	5	150	H	38.19	13.64	38.05	62.60	84	-21.40	Peak
10640	38.59	51	150	V	38.19	13.64	38.05	52.37	64	-11.63	Ave
10640	36.77	5	150	H	38.19	13.64	38.05	50.55	64	-13.45	Ave

5260-5320 MHz ant ab

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
5260 MHz n/ac20 mode											
10520	58.87	164	150	V	38.15	13.35	38.24	72.13	78	-5.87	Peak
10520	57.15	112	208	H	38.15	13.35	38.24	70.41	78	-7.59	Peak
15780	54.85	42	150	V	41.26	11.06	37.99	69.18	84	-14.82	Peak
15780	55.89	92	233	H	41.26	11.06	37.99	70.22	84	-13.78	Peak
15780	41.71	42	150	V	41.26	11.06	37.99	56.04	64	-7.96	Ave
15780	45.22	92	233	H	41.26	11.06	37.99	59.56	64	-4.44	Ave
5300 MHz n/ac20 mode											
10600	57.14	160	159	V	38.14	13.35	38.24	70.40	84	-13.60	Peak
10600	58.05	107	205	H	38.14	13.35	38.24	71.31	84	-12.69	Peak
10600	46.42	160	159	V	38.14	13.35	38.24	59.68	64	-4.32	Ave
10600	46.25	107	205	H	38.14	13.35	38.24	59.50	64	-4.50	Ave
15900	56.89	62	150	V	41.32	11.06	38.10	71.17	84	-12.83	Peak
15900	59.70	88	245	H	41.32	11.06	38.10	73.98	84	-10.02	Peak
15900	45.65	62	150	V	41.32	11.06	38.10	59.93	64	-4.07	Ave
15900	47.22	88	245	H	41.32	11.06	38.10	61.50	64	-2.50	Ave
5320 MHz n/ac20 mode											
5350	70.61	140	170	V	35.242	8.999	38.142	76.709	78	-1.291	Peak
5350	69.74	0	150	H	35.242	8.999	38.142	75.839	78	-2.161	Peak
5350	56.09	140	170	V	35.242	8.999	38.142	62.19	64	-1.80	Ave
5350	53.45	0	150	H	35.242	8.999	38.142	59.54	64	-4.45	Ave
10640	50.11	51	150	V	38.19	13.64	38.05	63.89	84	-20.11	Peak
10640	48.82	5	150	H	38.19	13.64	38.05	62.60	84	-21.40	Peak
10640	38.59	51	150	V	38.19	13.64	38.05	52.37	64	-11.63	Ave
10640	36.77	5	150	H	38.19	13.64	38.05	50.55	64	-13.45	Ave
15960	48.90	51	150	V	41.59	11.06	38.10	63.46	84	-20.55	Peak
15960	50.66	85	250	H	41.59	11.06	38.10	65.22	84	-18.78	Peak
15960	38.68	51	150	V	41.59	11.06	38.10	53.23	64	-10.77	Ave
15960	41.20	85	250	H	41.59	11.06	38.10	55.75	64	-8.25	Ave

5470-5725 MHz ant a

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
5500 MHz a mode											
5470	63.10	138	129	V	35.21	8.999	37.94	69.38	78	-8.83	Peak
5470	66.19	49	150	H	35.21	8.999	37.94	72.47	78	-5.74	Peak
5470	47.61	138	129	V	35.21	8.999	37.94	53.89	64	-10.11	Ave
5470	50.49	49	150	H	35.21	8.999	37.94	56.76	64	-7.24	Ave
11000	48.47	190	150	V	38.35	13.64	37.92	62.53	84	-21.47	Peak
11000	47.95	359	150	H	38.35	13.64	37.92	62.01	84	-21.99	Peak
11000	37.49	190	150	V	38.35	13.64	37.92	51.55	64	-12.45	Ave
11000	37.51	359	150	H	38.35	13.64	37.92	51.57	64	-12.43	Ave
16500	49.08	33	150	V	41.75	11.02	38.16	63.69	78	-14.51	Peak
16500	49.14	87	150	H	41.75	11.02	38.16	63.75	78.2	-14.45	Peak
5580 MHz a mode											
11160	48.21	1	150	V	38.51	13.64	37.81	62.55	84	-21.46	Peak
11160	48.15	145	108	H	38.51	13.64	37.81	62.49	84	-21.52	Peak
11160	37.21	1	150	V	38.51	13.64	37.81	51.55	64	-12.45	Ave
11160	37.21	145	150	H	38.51	13.64	37.81	51.54	64	-12.46	Ave
16740	48.44	0	150	V	41.62	11.40	37.85	63.61	78	-14.59	Peak
16740	48.79	159	150	H	41.62	11.40	37.85	63.96	78	-14.24	Peak
5700 MHz a mode											
5725	65.79	163	150	V	35.154	9.469	37.903	72.51	78	-5.69	Peak
5725	69.64	65	150	H	35.154	9.469	37.903	76.36	78	-1.84	Peak
11400	48.51	337	150	V	38.63	13.88	37.78	63.24	84	-20.76	Peak
11400	48.97	0	150	H	38.63	13.88	37.78	63.70	84	-20.30	Peak
11400	37.52	337	150	V	38.63	13.88	37.78	52.25	64	-11.75	Ave
11400	37.40	0	150	H	38.63	13.88	37.78	52.13	64	-11.87	Ave
17100	49.76	304	127	V	41.63	11.40	37.56	65.22	78	-12.98	Peak
17100	49.30	301	113	H	41.63	11.40	37.56	64.76	78	-13.44	Peak
5720 MHz a mode											
17160	50.23	0	150	V	41.63	11.4	37.56	65.7	78	-12.98	Peak
17160	50.85	0	150	H	41.63	11.4	37.56	66.32	78	-13.44	Peak

5470-5725 MHz ant b

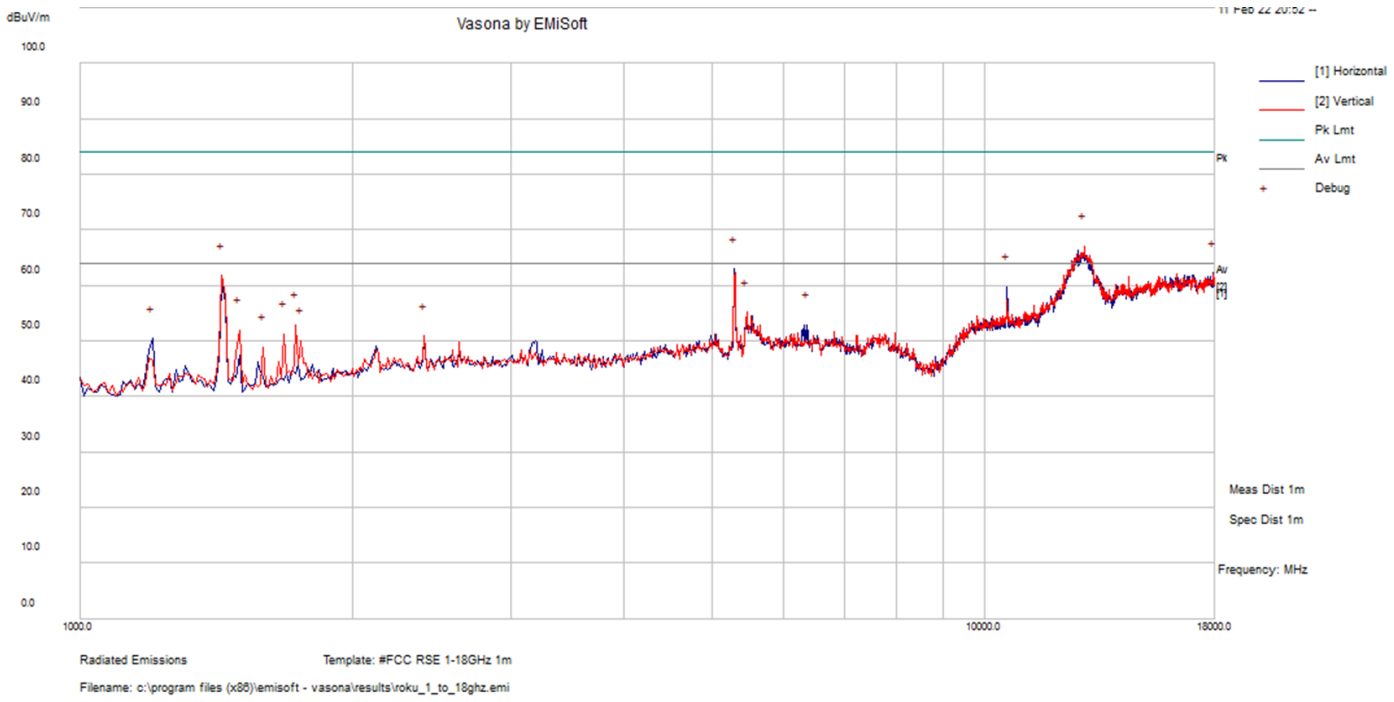
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
5500 MHz a mode											
5470	68.62	195	150	V	35.21	8.999	37.94	74.90	78	-3.31	Peak
5470	70.27	274	150	H	35.21	8.999	37.94	76.55	78	-1.66	Peak
5470	50.77	195	150	V	35.21	8.999	37.94	57.05	64	-6.95	Ave
5470	53.53	274	150	H	35.21	8.999	37.94	59.80	64	-4.20	Ave
11000	49.40	51	150	V	38.35	13.64	37.92	63.46	84	-20.54	Peak
11000	48.20	108	150	H	38.35	13.64	37.92	62.26	84	-21.74	Peak
11000	38.98	51	150	V	38.35	13.64	37.92	53.04	64	-10.96	Ave
11000	37.25	108	150	H	38.35	13.64	37.92	51.31	64	-12.69	Ave
16500	48.60	156	150	V	41.75	11.02	38.16	63.21	78.2	-14.99	Peak
16500	49.06	11	150	H	41.75	11.02	38.16	63.67	78.2	-14.53	Peak
5580 MHz a mode											
11160	50.85	17	150	V	38.51	13.64	37.81	65.19	84	-18.82	Peak
11160	49.80	183	240	H	38.51	13.64	37.81	64.14	84	-19.87	Peak
11160	38.95	17	150	V	38.51	13.64	37.81	53.29	64	-10.71	Ave
11160	39.55	183	150	H	38.51	13.64	37.81	53.89	64	-10.11	Ave
16740	48.96	91	145	V	41.62	11.40	37.85	64.13	78.2	-14.07	Peak
16740	49.38	216	156	H	41.62	11.40	37.85	64.55	78.2	-13.65	Peak
5700 MHz a mode											
5725	61.79	194	150	V	35.154	9.469	37.903	68.51	78	-9.69	Peak
5725	63.89	265	150	H	35.154	9.469	37.903	70.61	78	-7.59	Peak
11400	46.70	0	150	V	38.63	13.88	37.78	61.43	84	-22.57	Peak
11400	46.88	0	150	H	38.63	13.88	37.78	61.61	84	-22.39	Peak
11400	36.15	0	150	V	38.63	13.88	37.78	50.88	64	-13.12	Ave
11400	36.21	0	150	H	38.63	13.88	37.78	50.94	64	-13.06	Ave
17100	49.05	237	203	V	41.63	11.40	37.56	64.51	78.2	-13.69	Peak
17100	49.00	0	128	H	41.63	11.40	37.56	64.46	78.2	-13.74	Peak
5720 MHz a mode											
17160	50.37	0	150	V	41.63	11.4	37.56	65.84	78	-12.98	Peak
17160	49.86	0	150	H	41.63	11.4	37.56	65.33	78	-13.44	Peak

5470-5725 MHz ant ab

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
5500 MHz n/ac20 mode											
5470	65.67	8	171	V	35.21	8.999	37.94	71.95	78	-6.26	Peak
5470	66.39	270	150	H	35.21	8.999	37.94	72.67	78	-5.54	Peak
5470	48.23	8	171	V	35.21	8.999	37.94	54.51	64	-9.49	Ave
5470	48.06	270	150	H	35.21	8.999	37.94	54.33	64	-9.67	Ave
11000	52.84	337	150	V	38.35	13.64	37.92	66.90	84	-17.10	Peak
11000	52.44	103	150	H	38.35	13.64	37.92	66.50	84	-17.50	Peak
11000	41.64	337	150	V	38.35	13.64	37.92	55.70	64	-8.30	Ave
11000	41.56	103	150	H	38.35	13.64	37.92	55.62	64	-8.38	Ave
16500	56.01	0	150	V	41.75	11.02	38.16	70.62	78	-7.58	Peak
16500	55.63	0	150	H	41.75	11.02	38.16	70.24	78	-7.96	Peak
5580 MHz n/ac20 mode											
11160	54.22	360	270	V	38.51	13.64	37.81	68.56	84	-15.45	Peak
11160	54.29	101	150	H	38.51	13.64	37.81	68.63	84	-15.38	Peak
11160	43.01	360	270	V	38.51	13.64	37.81	57.35	64	-6.65	Ave
11160	43.10	101	150	H	38.51	13.64	37.81	57.43	64	-6.57	Ave
16740	54.41	30	150	V	41.62	11.40	37.85	69.58	78	-8.62	Peak
16740	54.01	317	241	H	41.62	11.40	37.85	69.18	78	-9.02	Peak
5700 MHz n/ac20 mode											
5725	58.37	160	105	V	35.154	9.469	37.903	65.09	78	-13.11	Peak
5725	59.83	60	198	H	35.154	9.469	37.903	66.55	78	-11.65	Peak
11400	47.06	51	193	V	38.63	13.88	37.78	61.79	84	-22.21	Peak
11400	47.43	140	121	H	38.63	13.88	37.78	62.16	84	-21.84	Peak
11400	36.38	51	193	V	38.63	13.88	37.78	51.11	64	-12.89	Ave
11400	36.37	140	121	H	38.63	13.88	37.78	51.10	64	-12.90	Ave
17100	49.59	318	150	V	41.63	11.40	37.56	65.05	78	-13.15	Peak
17100	50.29	265	150	H	41.63	11.40	37.56	65.75	78	-12.45	Peak
5720 MHz n/ac20 mode											
17160	50.29	0	150	V	41.63	11.4	37.56	65.76	78	-12.98	Peak
17160	50.71	0	150	H	41.63	11.4	37.56	66.18	78	-13.44	Peak

3) 1 GHz – 18 GHz Worst Case Scan at 1 Meter

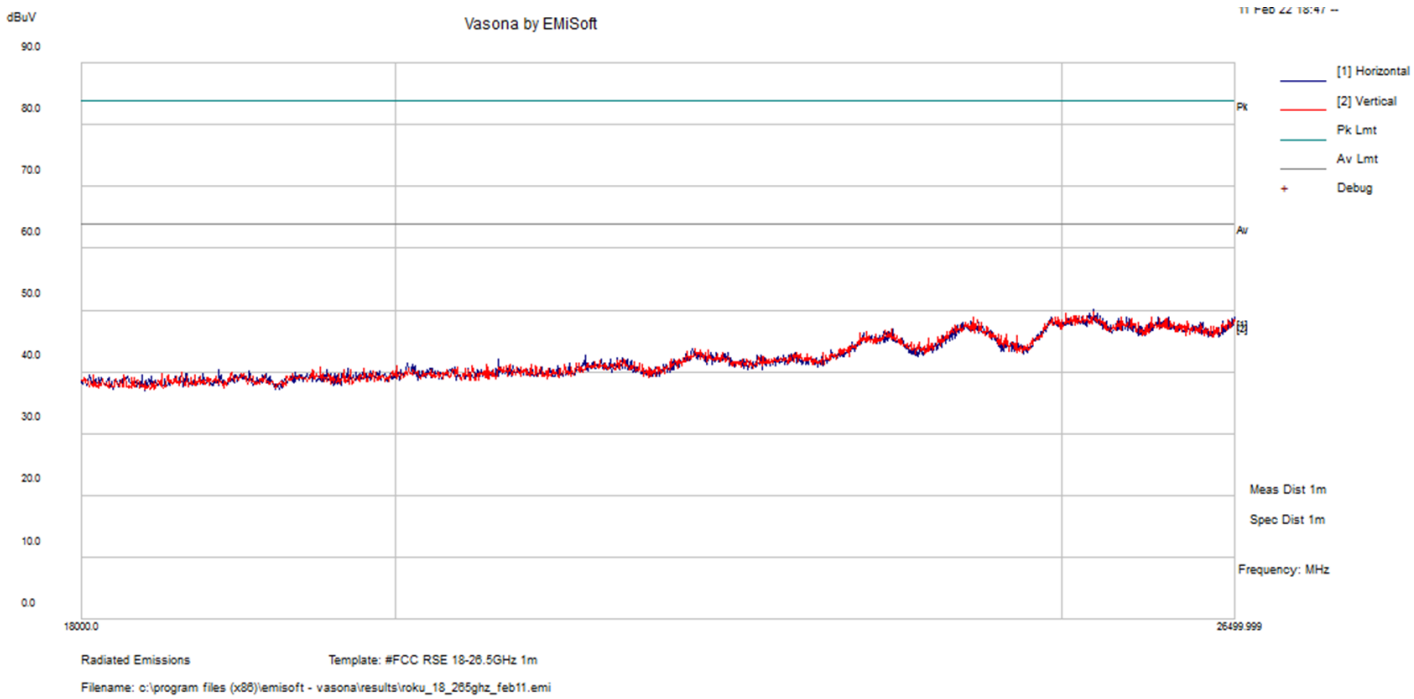
Worst Case Mode: 5300MHz, n/ac20 mode, ant ab



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
12910.728	45.27	18.93	64.2	228	V	338	84	-19.8	Peak
12910.728	35.28	18.93	54.21	228	V	338	64	-9.79	Ave

4) 18 GHz – 26.5 GHz Worst Case Scan at 1 Meter

Worst Case Mode: 5300MHz, n/ac20 mode, ant ab

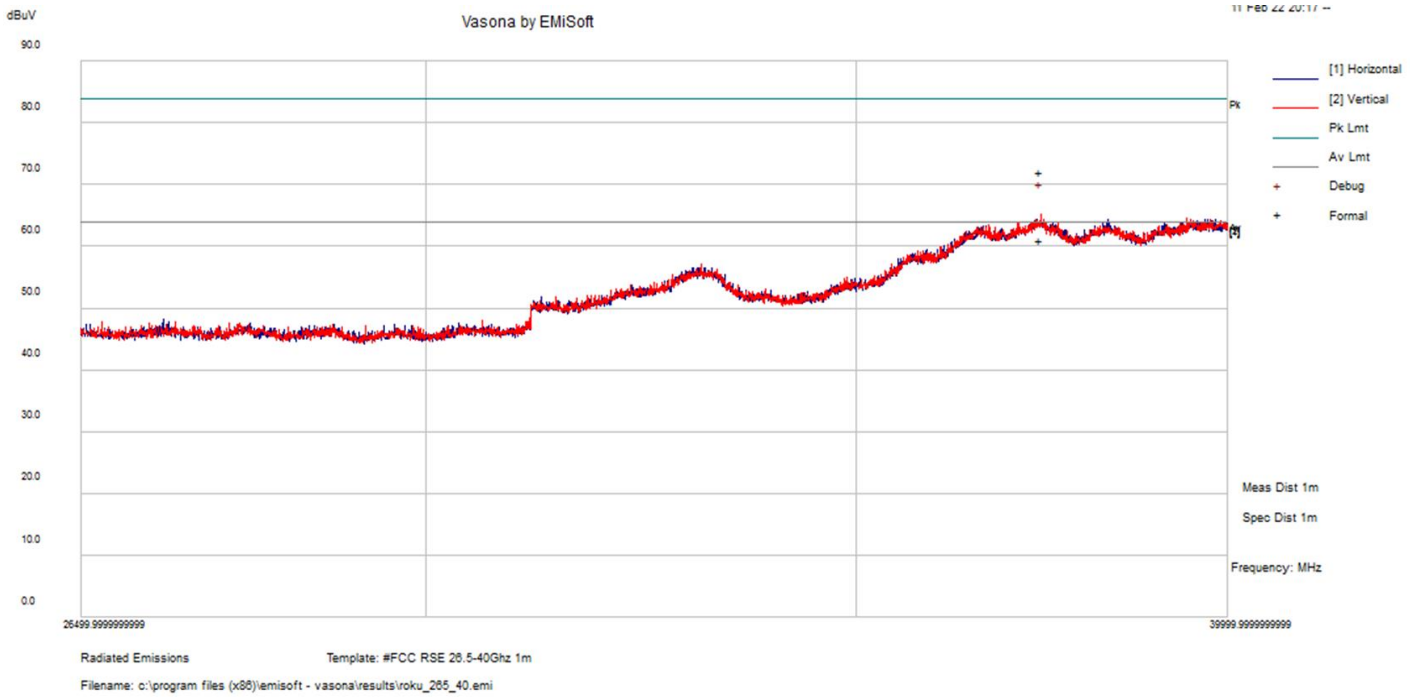


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
26462	36.13	23.07	59.20	300	V	0	64	-4.8	Ave

Note: Peak measurement was made and compared to average limit to show compliance.

5) 26.5 GHz – 40 GHz Worst Case Scan at 1 Meter

Worst Case Mode: 5300MHz, n/ac20 mode, ant ab



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
37395.03	55.36	16.78	72.14	205	H	284	84	-11.86	Peak
37395.03	44.31	16.78	61.08	205	H	284	64	-2.92	Ave

7 FCC §15.407(e) & ISEDC RSS-247 §6.2 - 6 dB, 26 dB, & 99% - Occupied Bandwidth

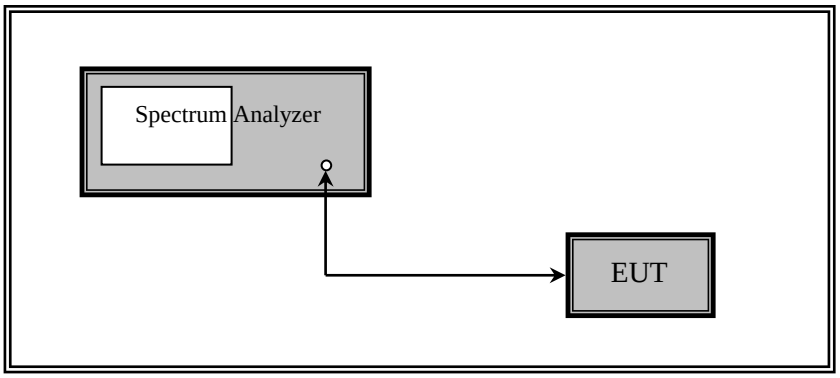
7.1 Applicable Standards

As per FCC §15.407(e) and ISEDC RSS-247 6.2.4(1): for equipment operating in the band 5725 – 5850 MHz, the minimum 6 dB bandwidth of U-NII devices shall be 500 kHz.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 or 26 dB from the reference level. Record the frequency difference as the minimum emission or emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

7.3 Test Setup Block Diagram



7.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY4825 0238	2021-06-23	1 year
1060	BACL	Temp and Humi Chamber	BTH-150-40	30078	2021-09-23	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 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".*

7.5 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Deepak Mishra from 2022-02-09 in RF site.

7.6 Test Results

Please refer to the following tables and plots.

5250 - 5350 MHz

Ant a

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
52	5260	16.6297	22.557
60	5300	16.6492	24.480
64	5320	16.5564	19.090
802.11n/ac20 mode			
52	5260	16.5891	20.119
60	5300	17.7369	20.093
64	5320	17.7010	20.038

Ant b

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
52	5260	16.5815	19.133
60	5300	16.5743	21.108
64	5320	16.5844	18.970
802.11n/ac20 mode			
52	5260	17.7454	20.024
60	5300	17.6956	19.965
64	5320	17.7408	19.774

5470MHz - 5725 MHz

Ant a

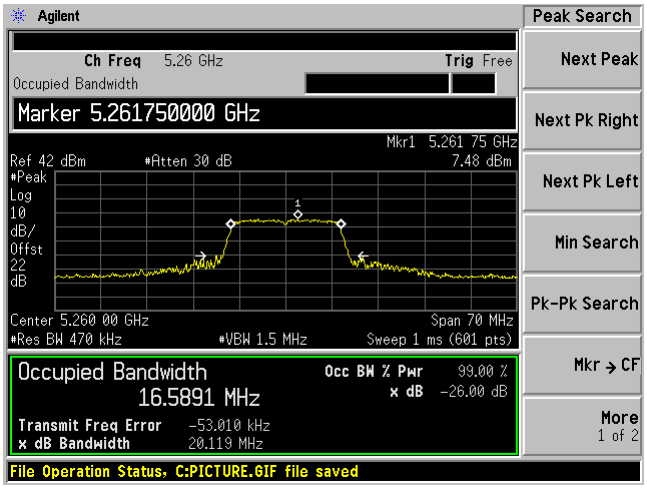
Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
100	5500	17.0559	29.621
116	5580	16.6753	21.605
140	5700	16.5678	19.210
144	5720	16.5530	19.106
802.11n/ac20 mode			
100	5500	17.7370	19.933
116	5580	17.7254	20.041
140	5700	17.6940	19.987
144	5720	17.7060	20.062

Ant b

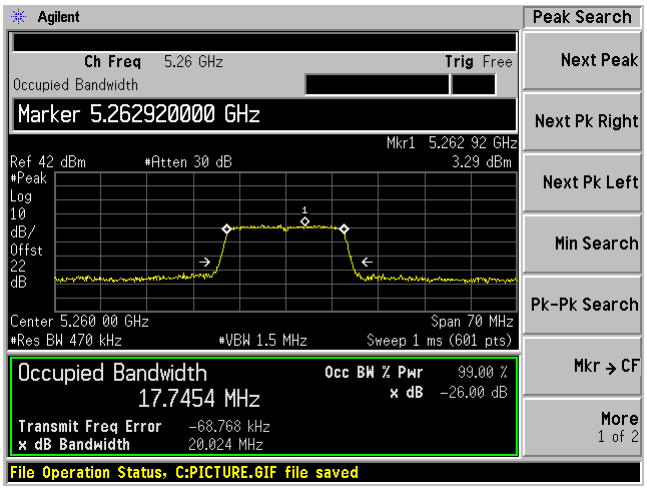
Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
100	5500	16.9495	27.962
116	5580	17.3351	33.481
140	5700	17.7737	34.897
144	5720	16.8706	29.116
802.11n/ac20 mode			
100	5500	17.7116	19.922
116	5580	17.7795	20.068
140	5700	17.8084	25.583
144	5720	17.6658	21.203

5260 - 5320 MHz
802.11n/ac20 Mode

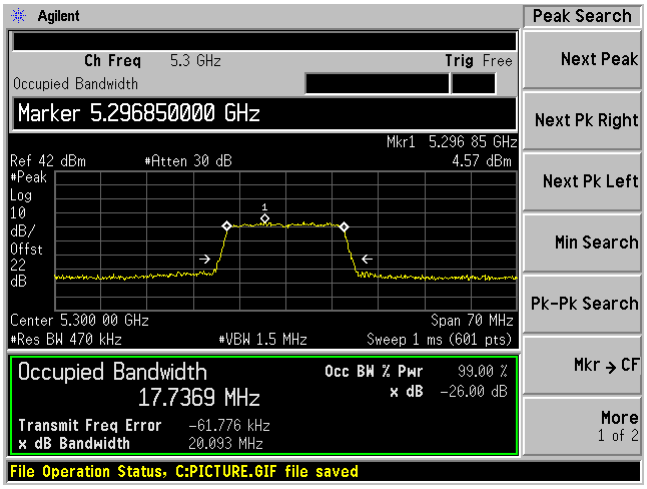
Low Channel ANT a



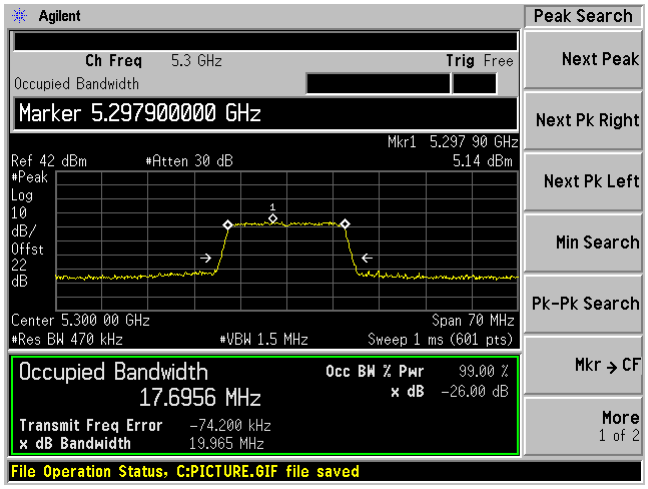
Low Channel ANT b



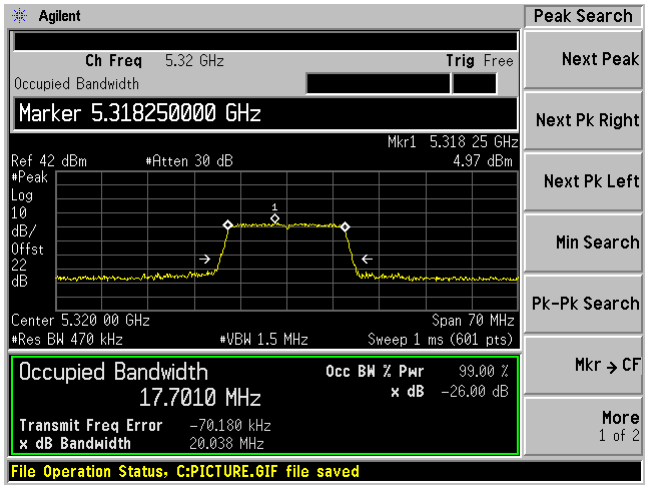
Mid Channel ANT a



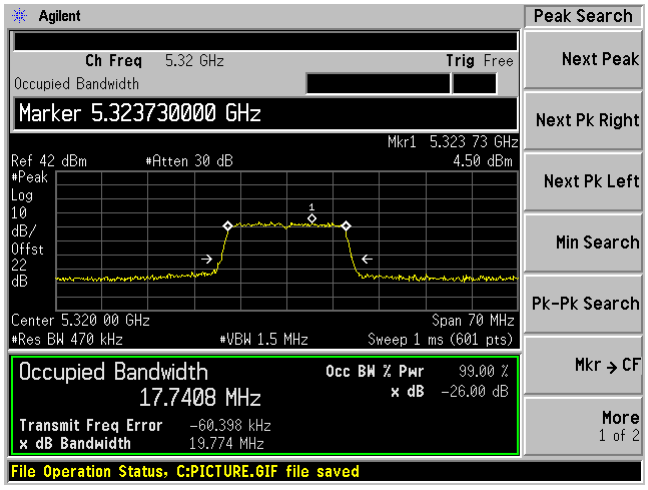
Mid Channel ANT b



High Channel ANT a

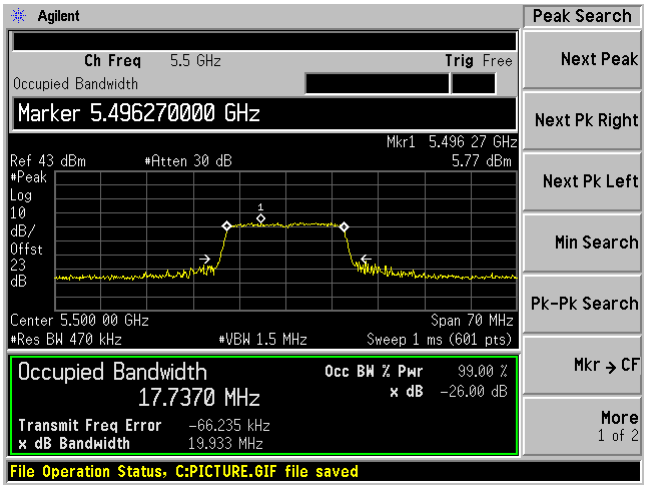


High Channel ANT b

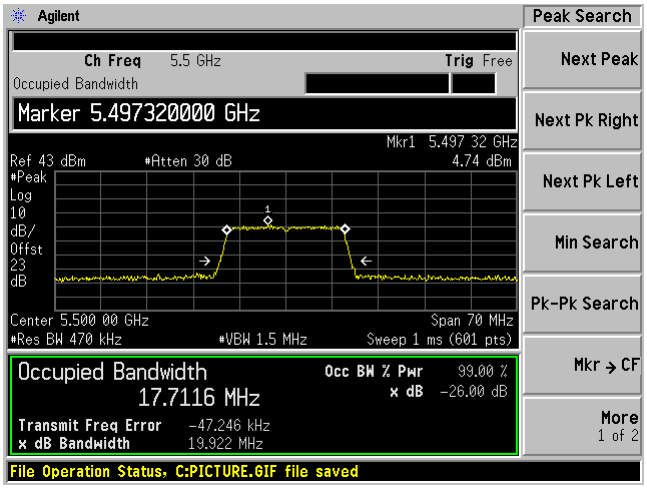


5500 - 5720 MHz
802.11n/ac20 Mode

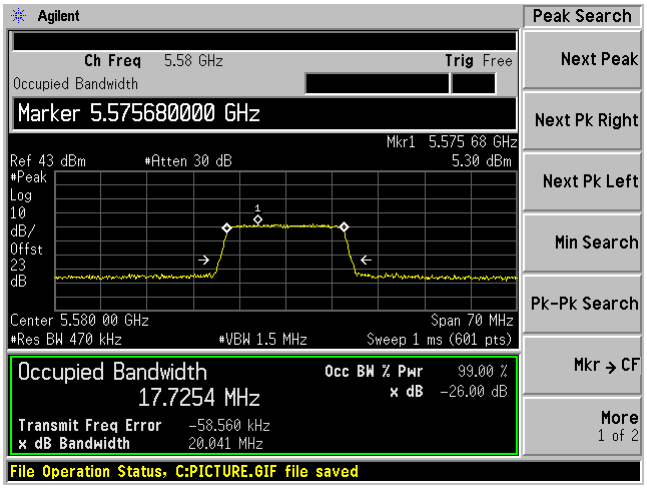
Low Channel ANT a



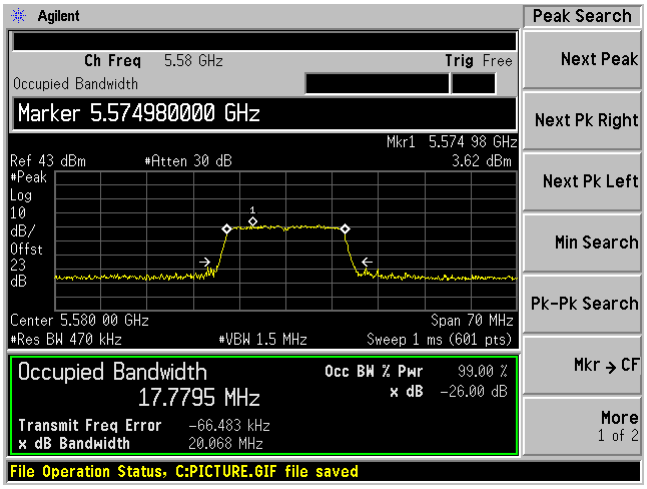
Low Channel ANT b



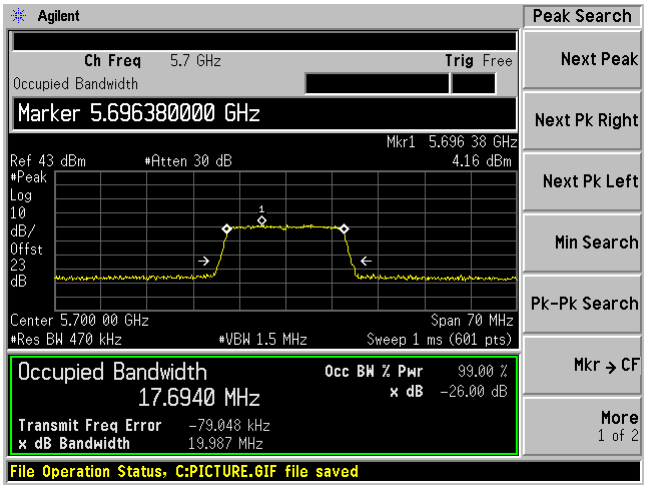
Mid Channel ANT a



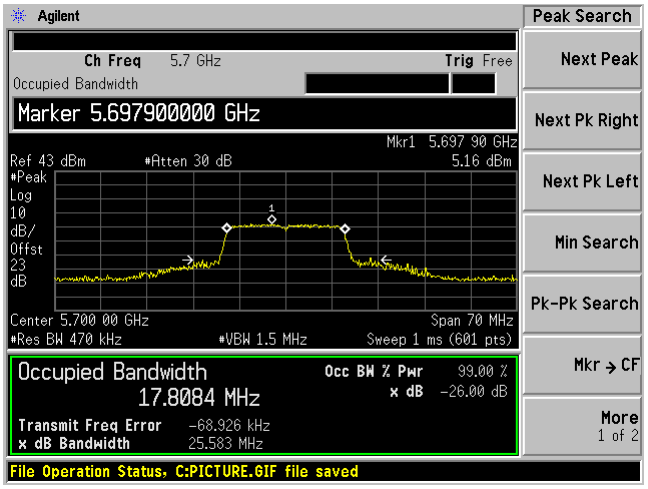
Mid Channel ANT b



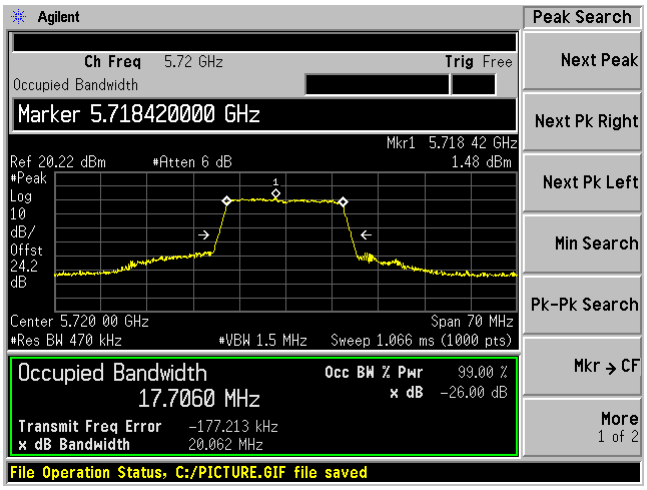
5700MHz ANT a



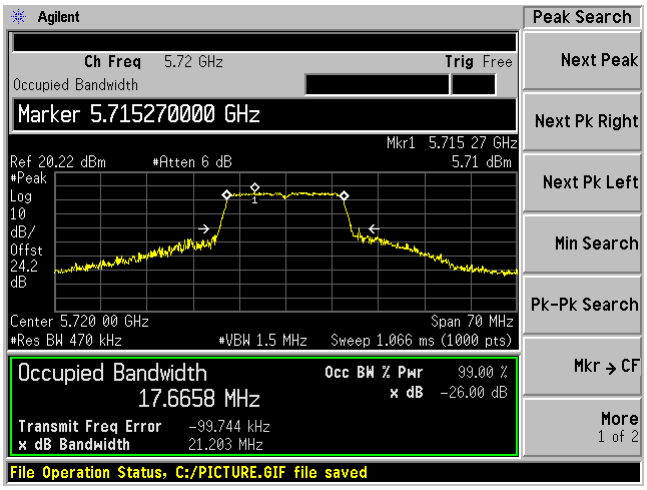
5700MHz ANT b



5720MHz ANT a

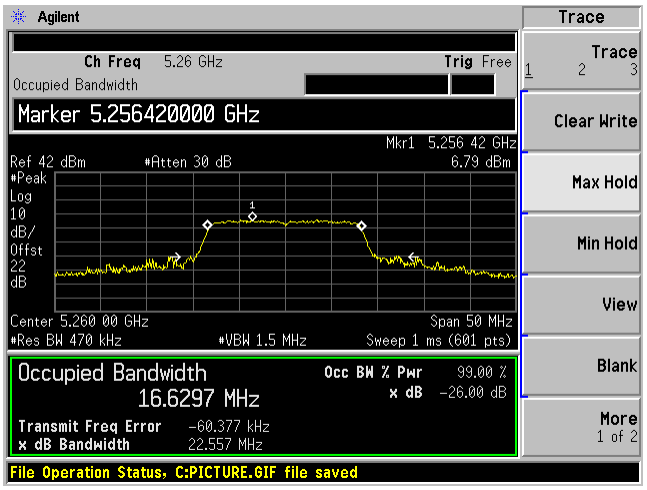


5720MHz ANT b

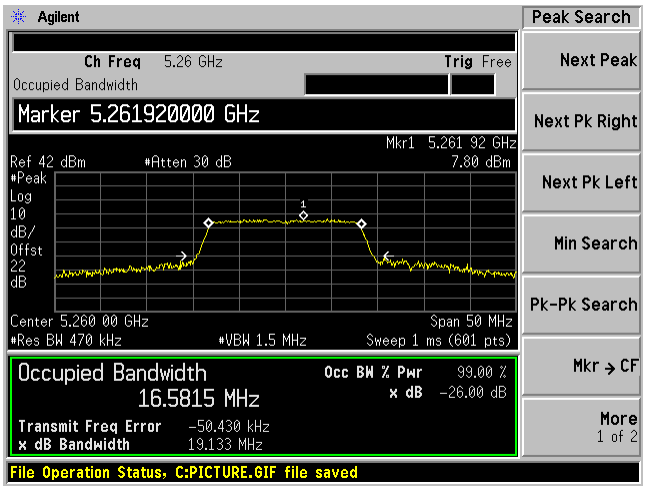


5260 - 5320 MHz
802.11a Mode

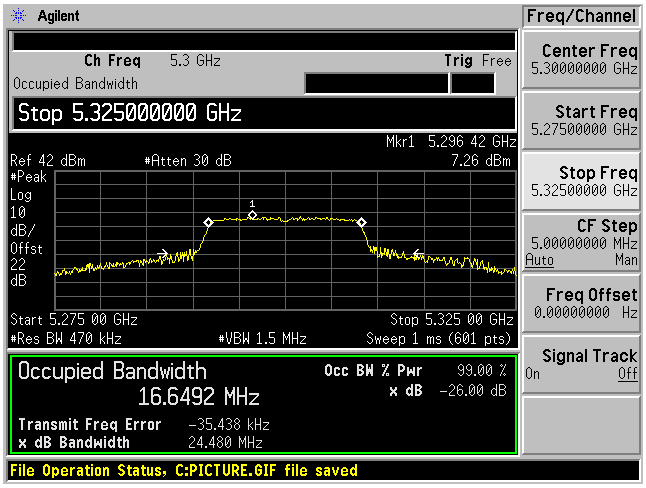
Low Channel ANT a



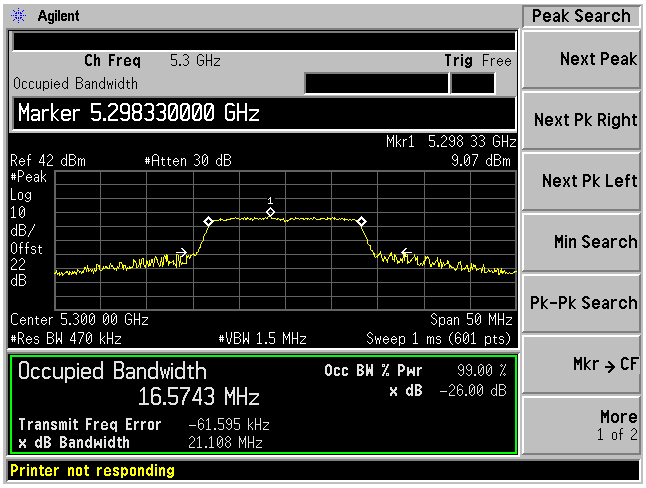
Low Channel ANT b



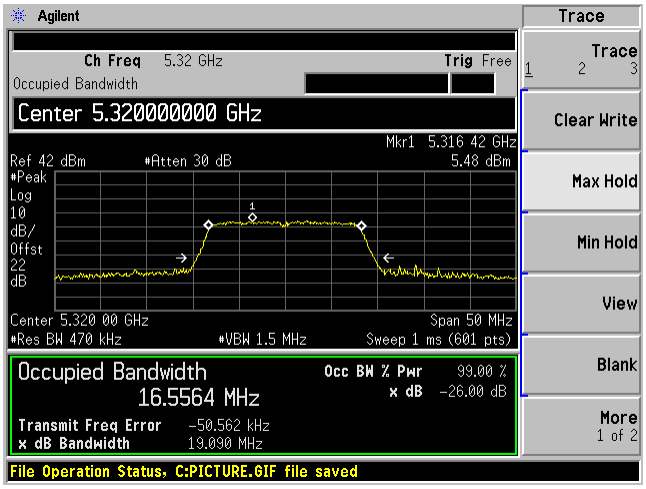
Mid Channel ANT a



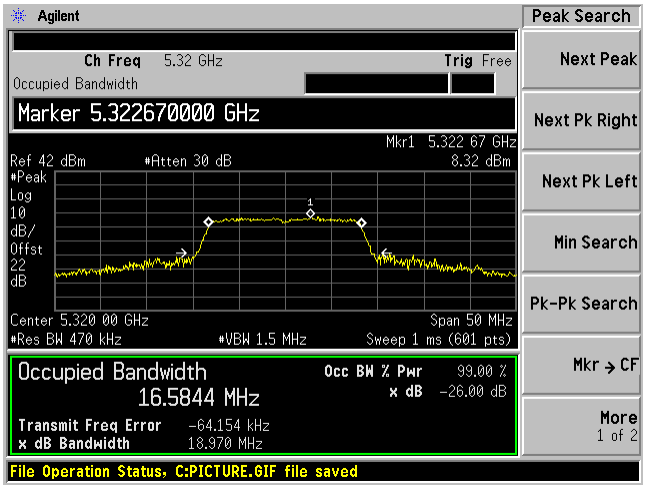
Mid Channel ANT b



High Channel ANT a

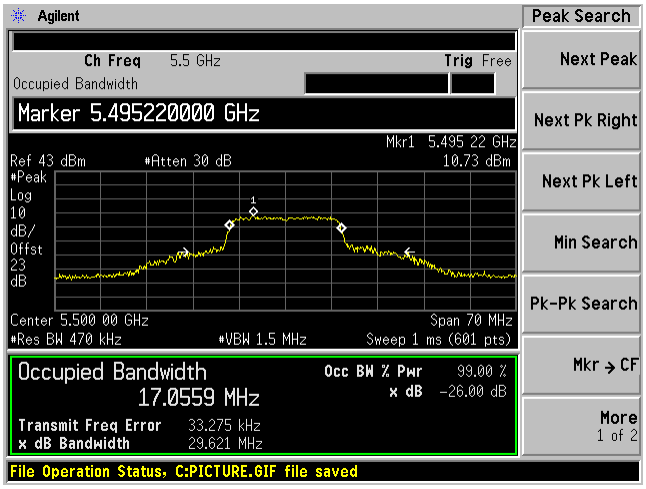


High Channel ANT b

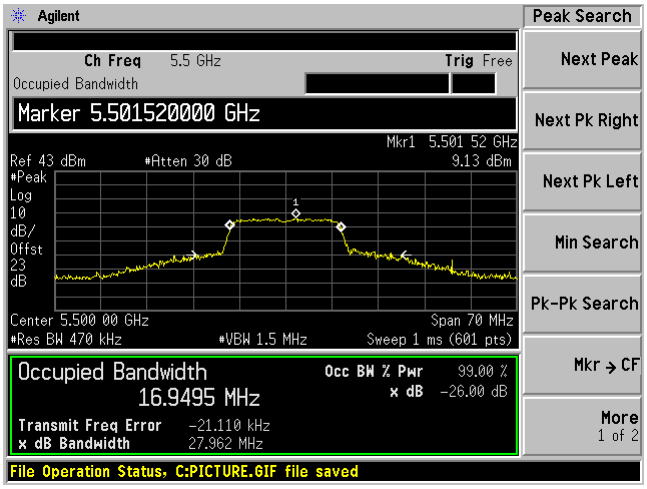


5500 - 5720 MHz
802.11a Mode

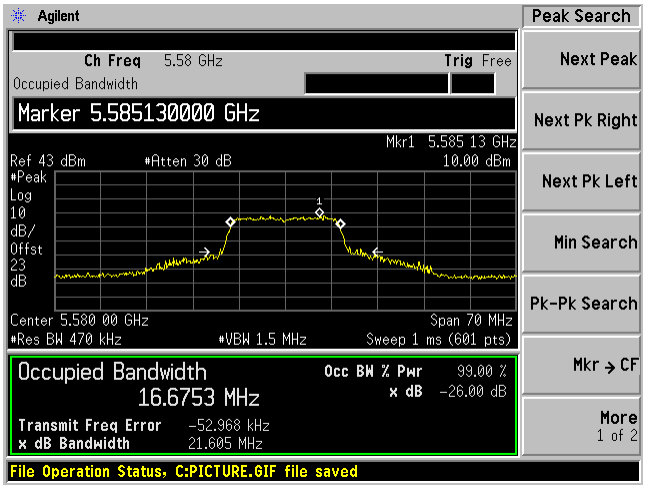
Low Channel ANT a



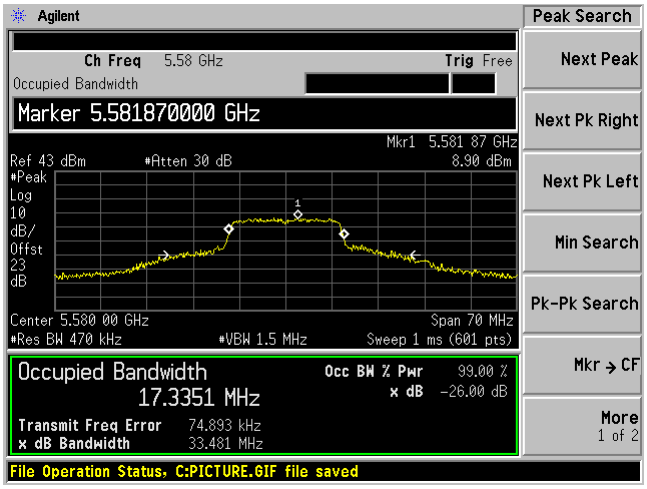
Low Channel ANT b



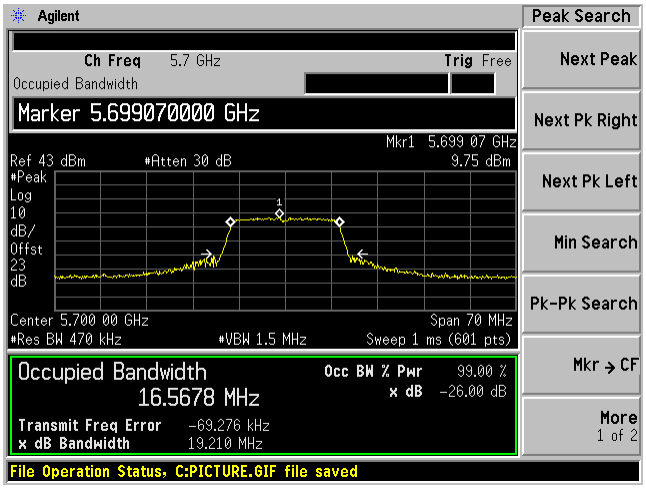
Middle Channel ANT a



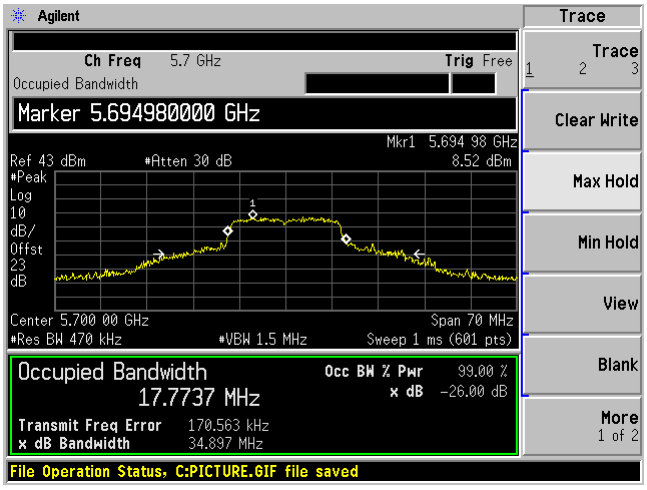
Middle Channel ANT b



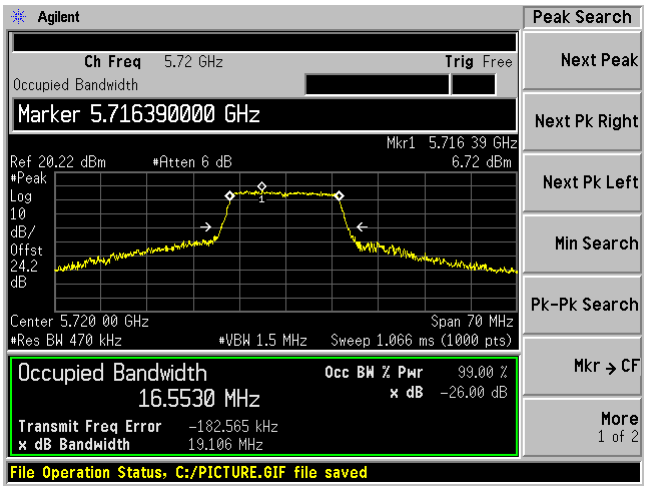
High Channel ANT a



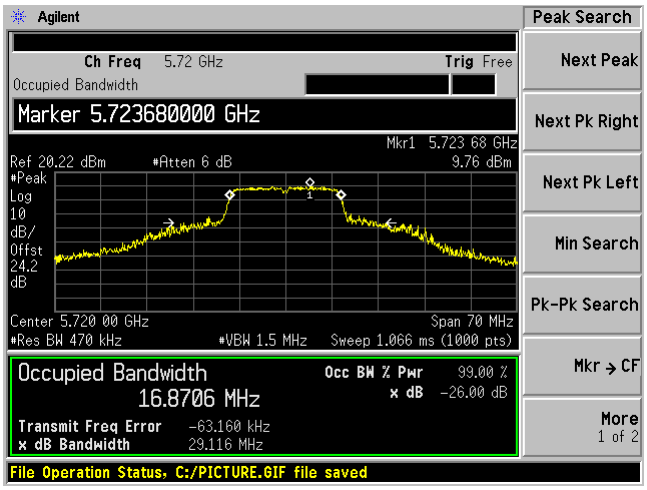
High Channel ANT b



5720MHz ANT a



5720MHz ANT b



8 FCC §407(a) & ISEDC RSS-247 §6.2 - Output Power

8.1 Applicable Standards

According to FCC §15.407(a):

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

According to ISEDC RSS-247 §6.2.1 for frequency band 5150-5250 MHz:

The maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10}B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

According to ISEDC RSS-247 §6.2.2 for frequency band 5250-5350 MHz:

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10}B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10}B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

According to ISEDC RSS-247 §6.2.3 for frequency band 5470-5600 MHz and 5650-5725 MHz:

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10}B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10}B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

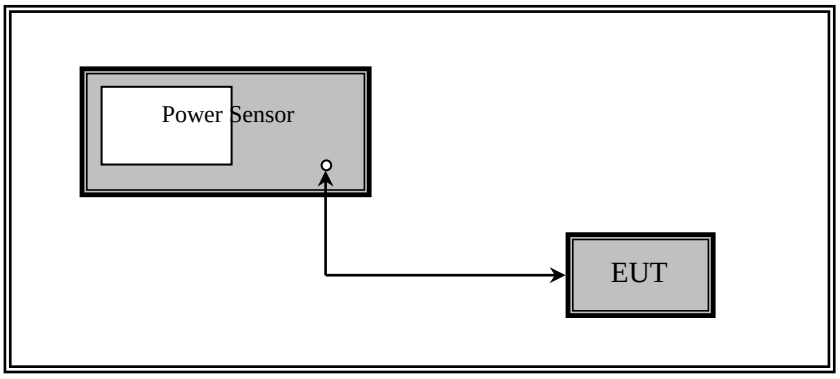
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

The maximum conducted output power shall not exceed 1 W. The power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

8.2 Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a power meter.

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
697	ETS- Lingerin	Power Sensor	7002-006	160097	2021-02-12	2 years
1060	BACL	Temp and Humi Chamber	BTH-150-40	30078	2021-09-23	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 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:	55 %
ATM Pressure:	102.2 KPa

The testing was performed by Deepak Mishra on 2022-02-08 in RF site.

8.6 Test Results

FCC

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total Power (dBm)	FCC Limit (dBm)
		ANT a	ANT b		
802.11a mode					
52	5260	14.83	15.57	-	23
60	5300	15.49	15.9	-	23
64	5320	13.04	15.68	-	23
100	5500	16.14	15.96	-	23
116	5580	16.75	16.15	-	23
140	5700	16.19	16.41	-	23
144	5720	12.33	15.22	-	23
802.11n/ac20 mode					
52	5260	11.06	11.68	14.39	23
60	5300	11.92	12.9	15.45	23
64	5320	11.91	12.6	15.28	23
100	5500	12.89	11.3	15.18	23
116	5580	12.14	11.42	14.81	23
140	5700	11.3	12.65	15.04	23
144	5720	7.58	10.36	12.20	23

Note: Duty cycle correction factor has already been added to the measurements.
Note: The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm. B was 99% OBW to represent worst case.
Note: When the directional gain is greater than 6dBi, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The directional antenna gain for 802.11n20/ac20 mode is 5.795 dBi calculated based on method specified in KDB 662911 D01

Note: The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm.
B was 99% OBW to present worst case.

IC Result:

Channel	Frequency (MHz)	Conducted Output Power (dBm)		EIRP (dBm)		IC EIRP Limit (dBm)
		ANT a	ANT b	ANT a	ANT b	
802.11a mode						
52	5260	14.83	15.57	16.73	19.15	30
60	5300	15.49	15.9	17.39	19.48	30
64	5320	13.04	15.68	14.94	19.26	30
100	5500	16.14	15.96	18.04	19.54	30
116	5580	16.75	16.15	18.65	19.73	30
140	5700	16.19	16.41	18.09	19.99	30
144	5720	12.33	15.22	14.23	18.8	30
802.11n/ac20 mode						
52	5260	11.06	11.68	17.27		30
60	5300	11.82	12.8	18.26		30
64	5320	11.91	12.6	18.17		30
100	5500	12.89	11.3	17.85		30
116	5580	12.14	11.42	17.56		30
140	5700	11.3	12.65	17.99		30
144	5720	7.58	10.36	15.27		30

Note: Duty cycle correction factor has already been added to the measurements
Note: For n/ac20 mode, EIRP is combined EIRP of both ports

9 FCC §15.407(a) & ISEDC RSS-247 §6.2 - Power Spectral Density

9.1 Applicable Standards

According to FCC §15.407(a):

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

According to ISEDC RSS-247 §6.2.1 for frequency band 5150-5250 MHz:

The maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

According to ISEDC RSS-247 §6.2.2 for frequency band 5250-5350 MHz:

The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

According to ISEDC RSS-247 §6.2.3 for frequency band 5470-5600 MHz and 5650-5725 MHz:

The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.
The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

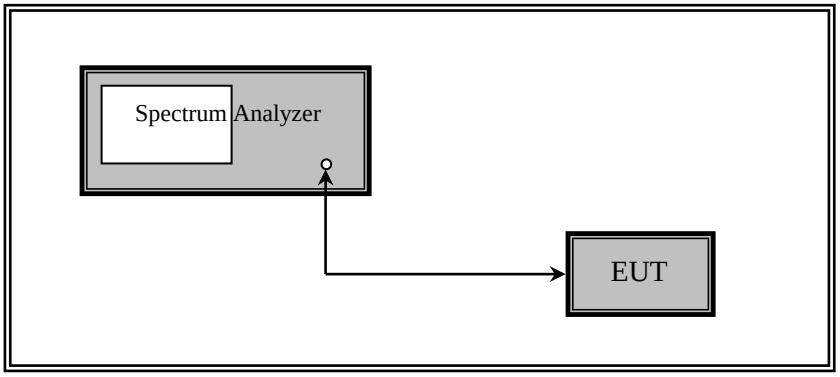
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

The maximum conducted output power shall not exceed 1 W. The power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

9.2 Measurement Procedure

(i) Set span to encompass the entire emission bandwidth (EBW) of the signal.
(ii) Set RBW = 1 MHz.
(iii) Set VBW ≥ 3 MHz.
(iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(v) Sweep time = auto.
(vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
(vii) If transmit duty cycle < 98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run".
(viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
(ix) Compute power by integrating the spectrum across the 26 dB EBW of the signal using the spectrum analyzer's band power measurement function with band limits set equal to the EBW band edges. If the spectrum analyzer does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the 26 dB EBW of the spectrum.

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
287	Agilent	Spectrum Analyzer	E4446A	US44300386	2021-04-27	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 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".*

9.5 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	50-55 %
ATM Pressure:	102.1-102.7 kPa

The testing was performed by Deepak Mishra on 2022-02-04 in RF site.

9.6 Test Results

FCC/IC:

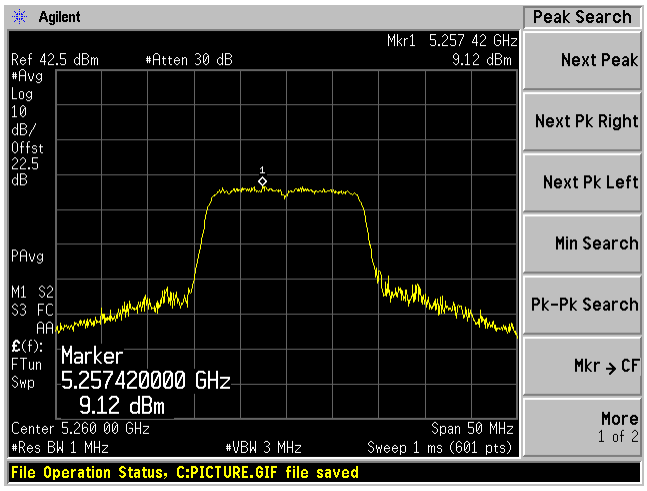
Channel	Frequency (MHz)	PSD (dBm/MHz)		Combined Corrected PSD (dBm/MHz)		FCC/IC Limit (dBm/MHz)
		ANT A	ANT B			
802.11a mode						
52	5260	9.12	9.77	-	-	11
60	5300	9.19	9.72	-	-	11
64	5320	6.67	9.71	-	-	11
100	5500	9.72	9.92	-	-	11
116	5580	8.78	9.6	-	-	11
140	5700	8.45	10.22	-	-	11
144	5720	2.217	5.306	-	-	11
802.11n/ac20 mode						
52	5260	4.18	5.62	7.97		11
60	5300	5.07	5.88	8.50		11
64	5320	4.87	5.66	8.29		11
100	5500	5.83	5.7	8.78		11
116	5580	5.75	5.52	8.65		11
140	5700	4.32	5.34	7.87		11
144	5720	-2.953	0.485	2.11		11

Note: Corrected PSD measurement includes Duty Cycle Correction factor into offset.
Note: When the directional gain is greater than 6dBi, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The directional antenna gain for 802.11n20/ac20 mode is 5.795 dBi calculated based on method specified in KDB 662911 D01.

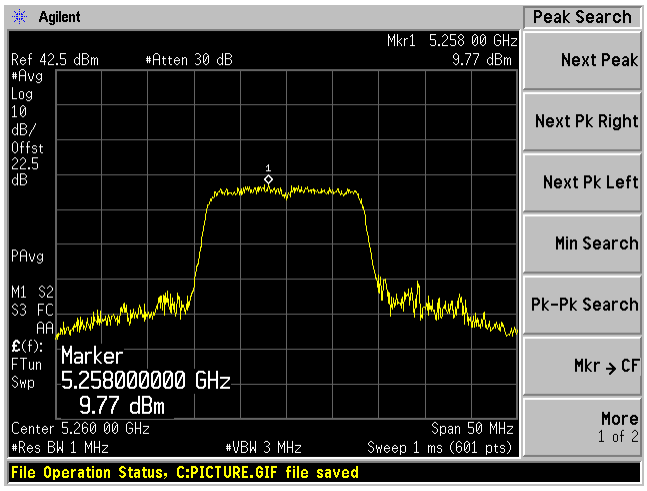
5250 - 5350 MHz

802.11a Mode

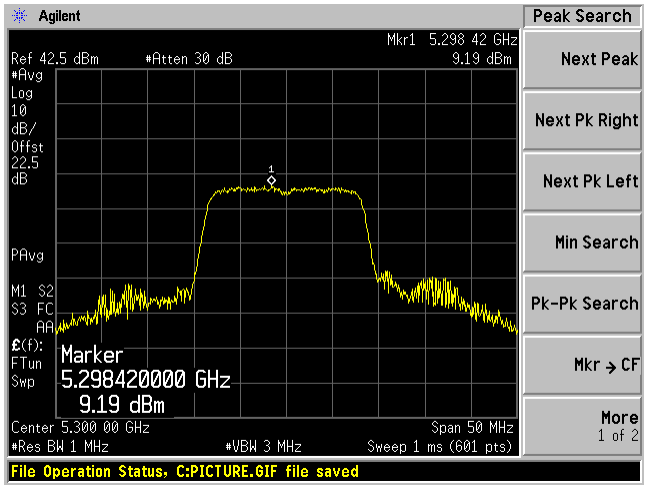
Low Channel ANT a



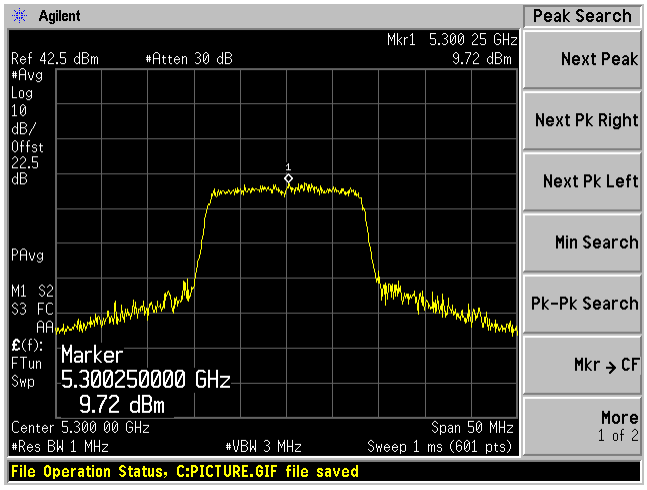
Low Channel ANT b



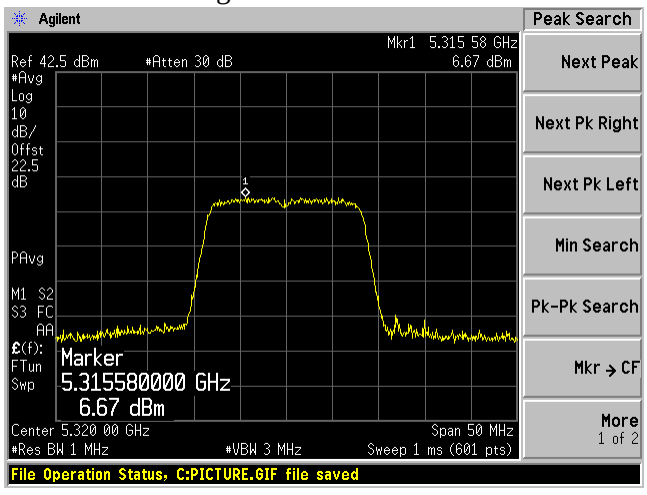
Mid Channel ANT a



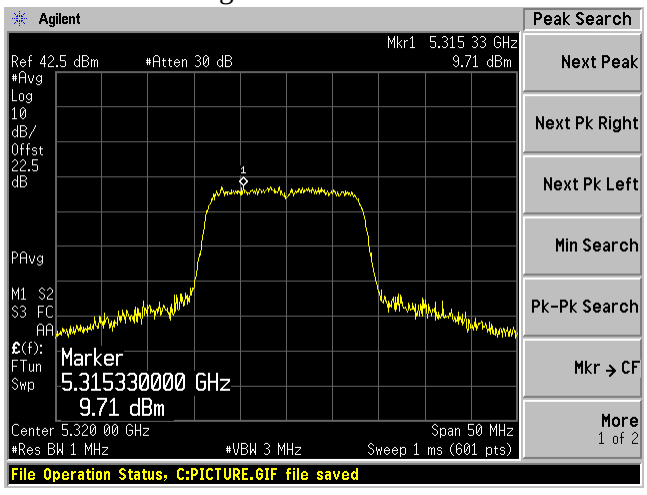
Mid Channel ANT b



High Channel ANT a

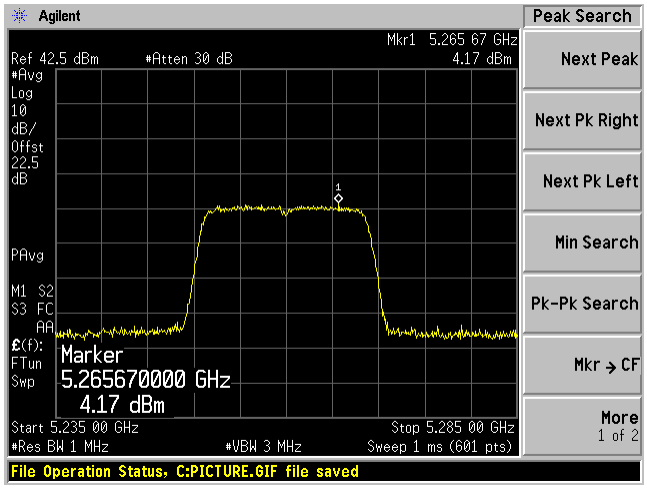


High Channel ANT b

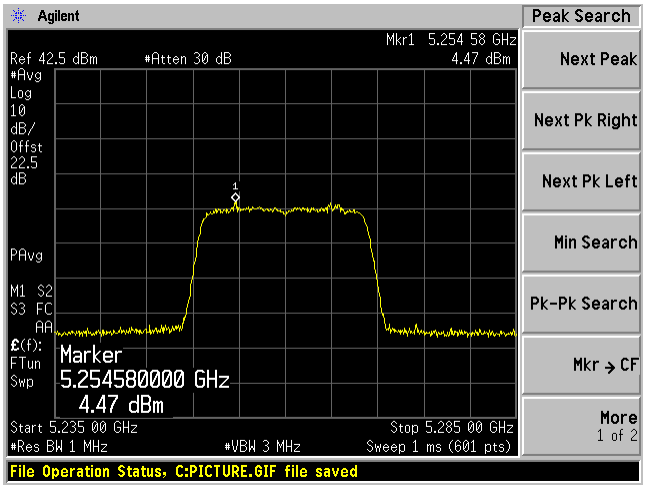


802.11n/ac20 Mode

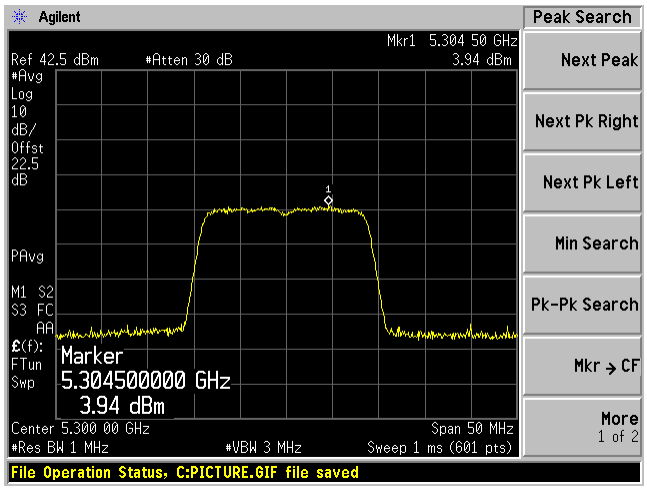
Low Channel ANT a



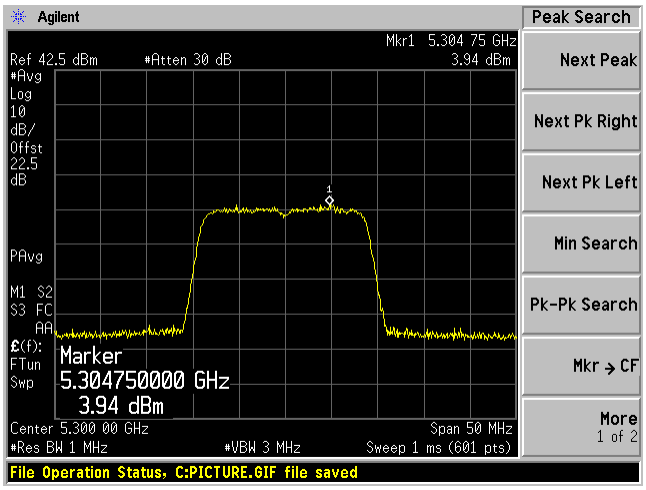
Low Channel ANT b



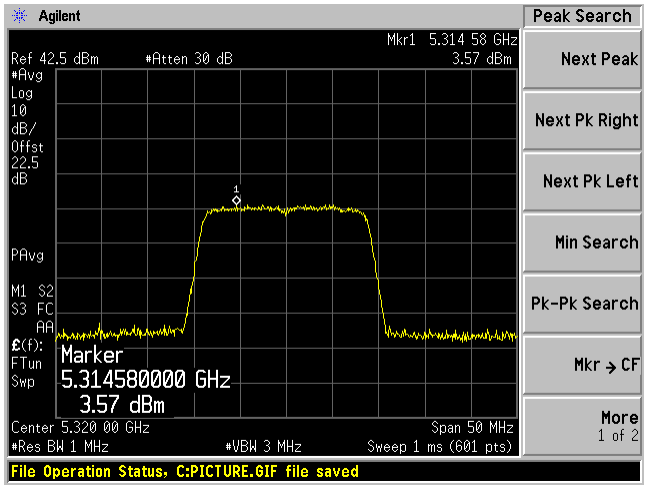
Mid Channel ANT a



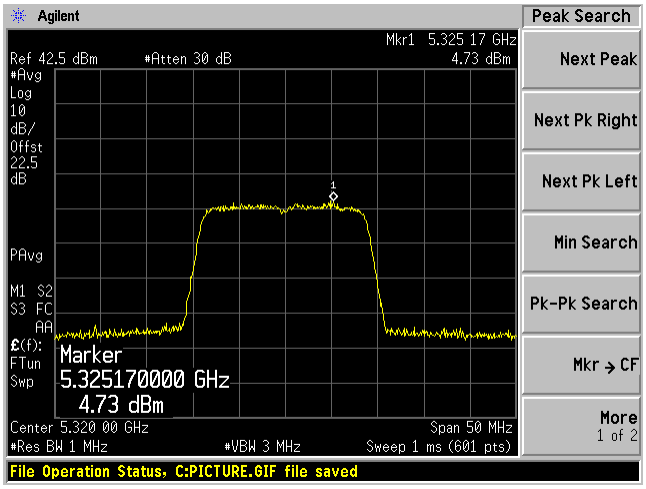
Mid Channel ANT b



High Channel ANT a



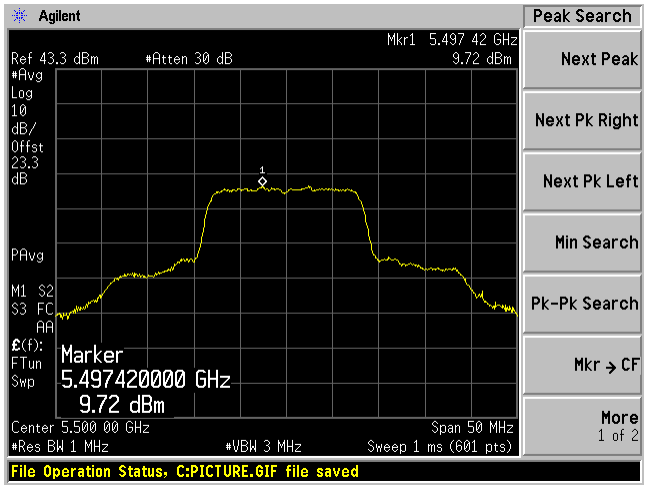
High Channel ANT b



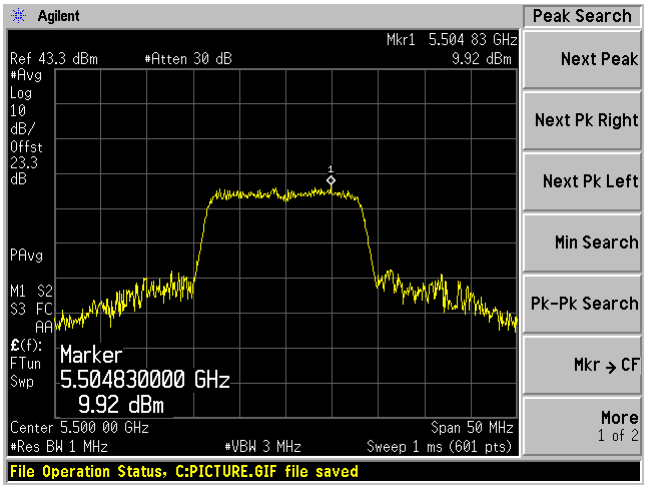
5470 - 5725 MHz

802.11a Mode

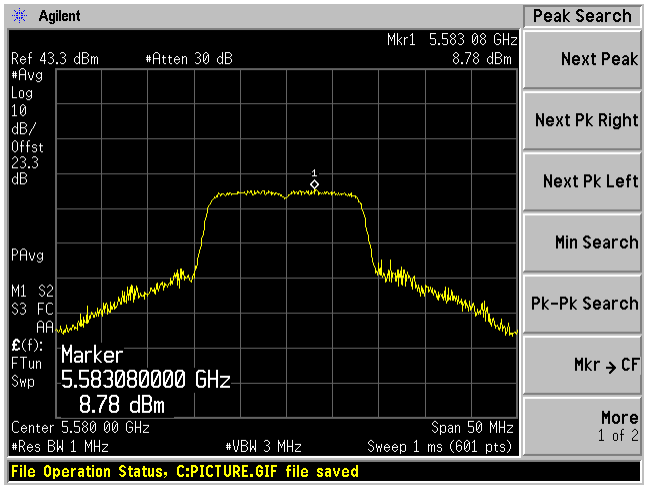
Low Channel ANT a



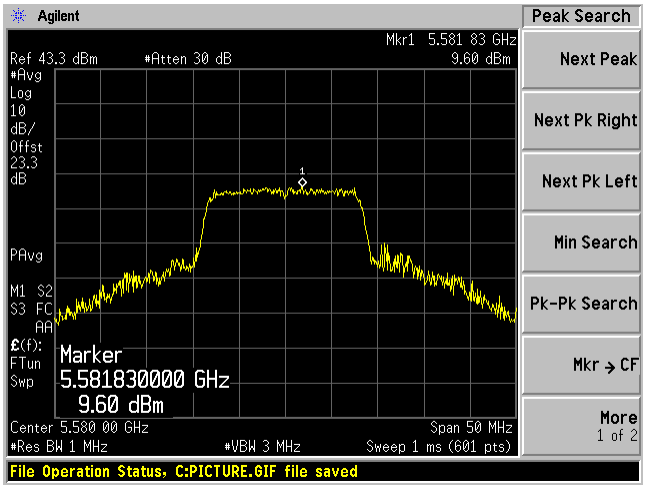
Low Channel ANT b



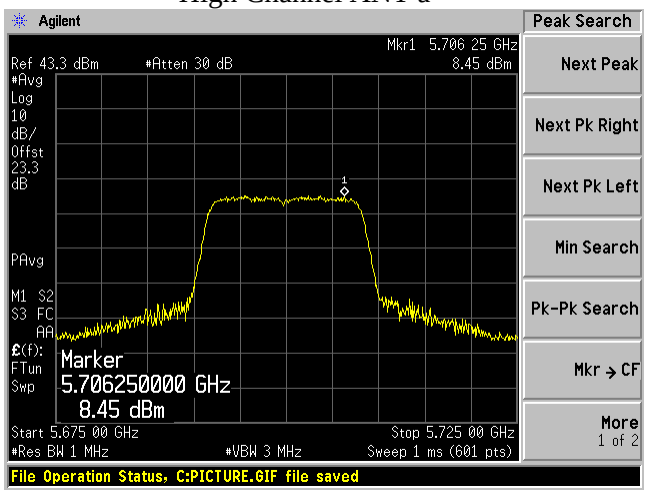
Mid Channel ANT a



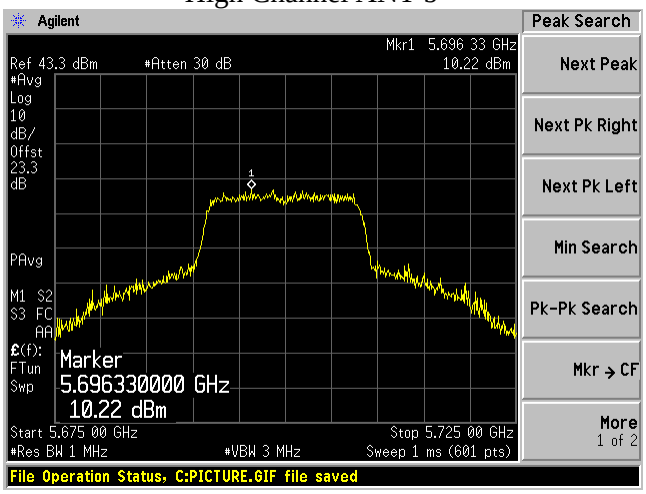
Mid Channel ANT b



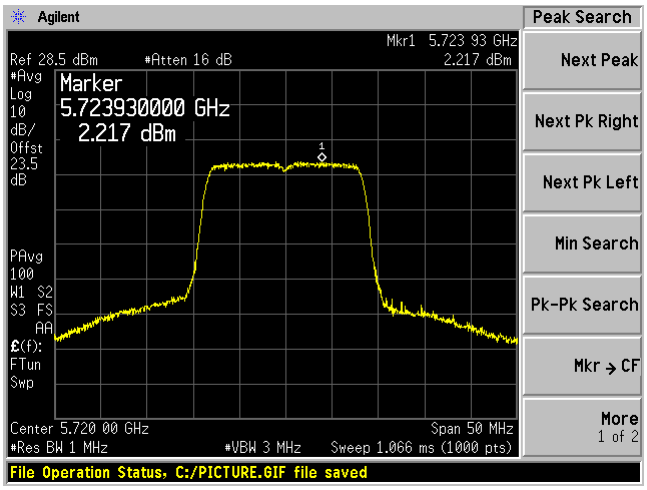
High Channel ANT a



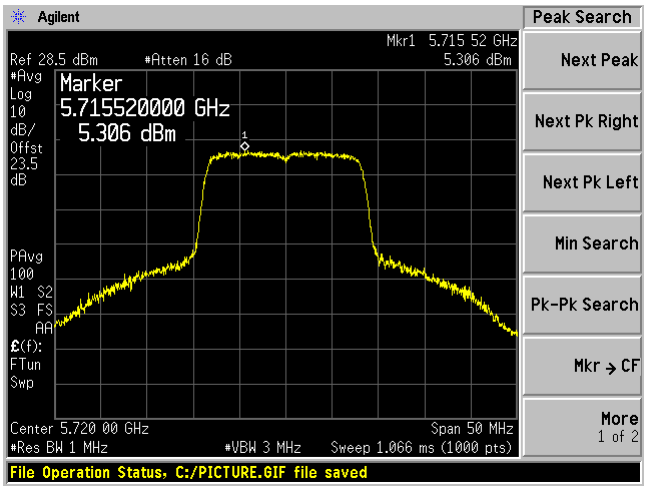
High Channel ANT b



5720MHz ANT a

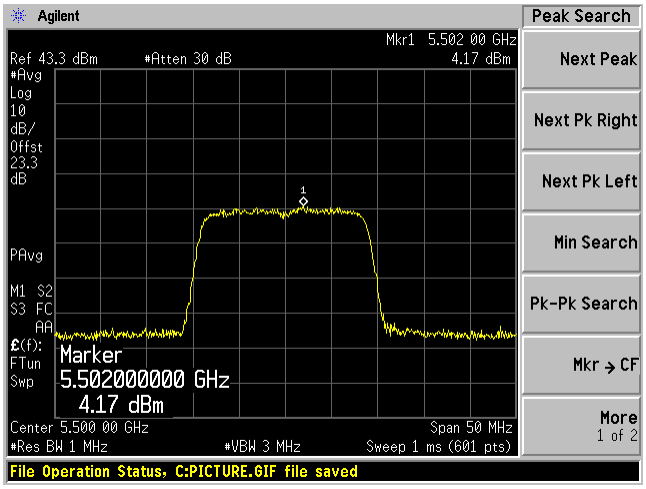


5720MHz ANT b

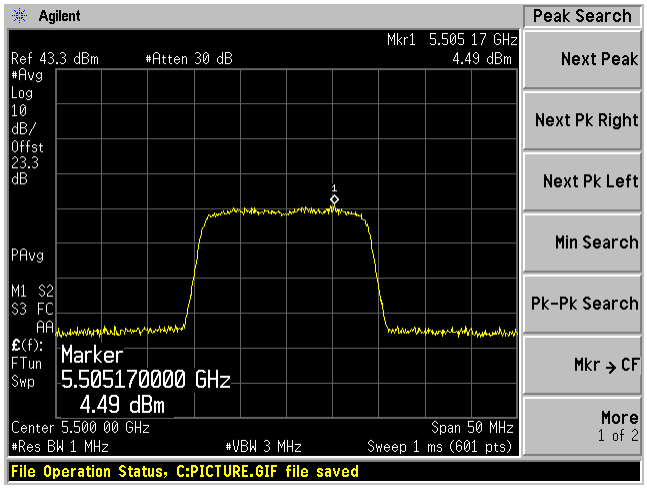


802.11n/ac20 Mode

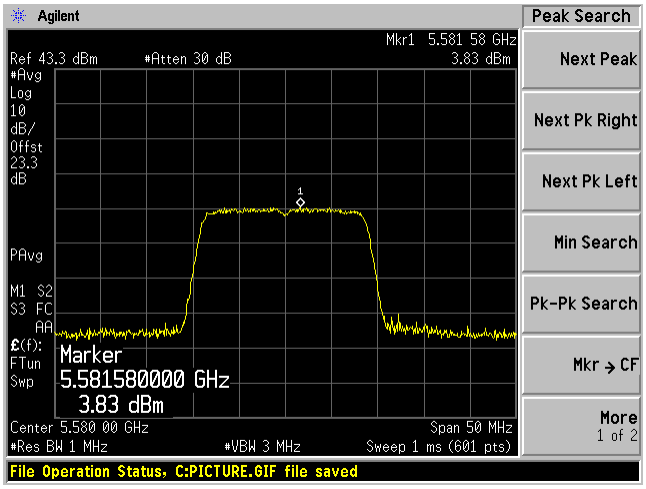
Low Channel ANT a



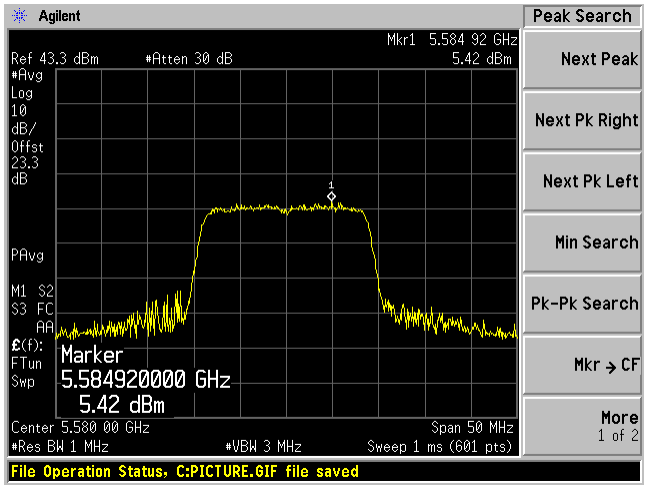
Low Channel ANT b



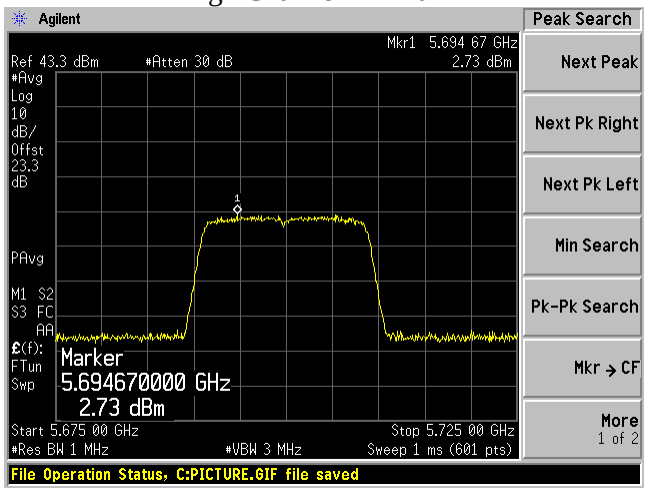
Mid Channel ANT a



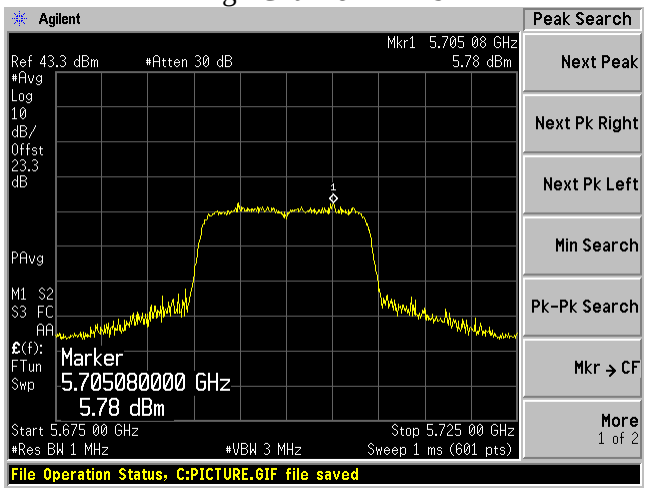
Mid Channel ANT b



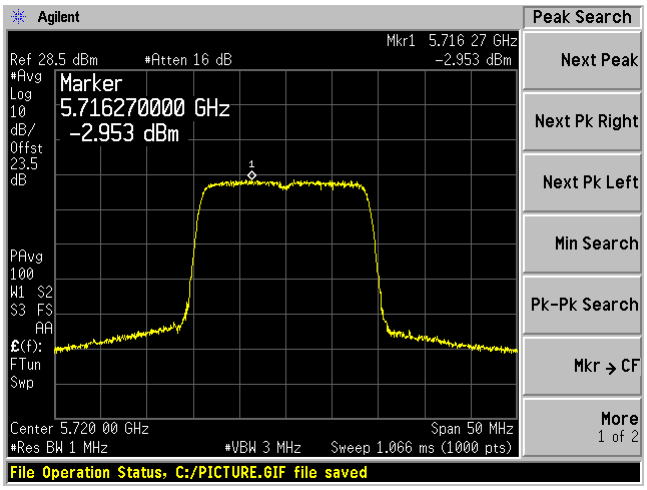
High Channel ANT a



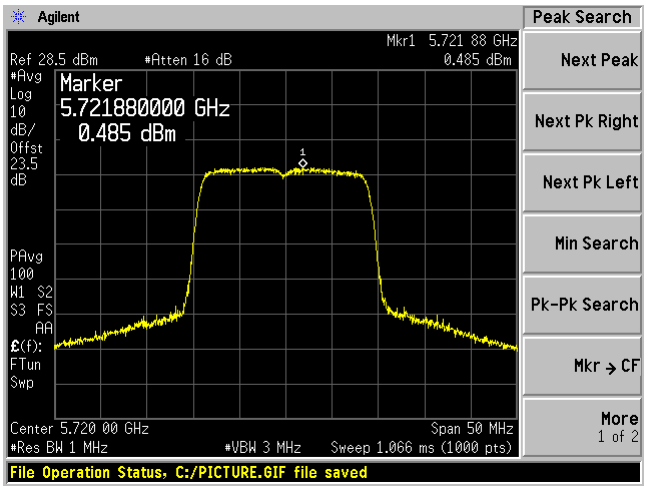
High Channel ANT b



5720MHz ANT a



5720MHz ANT b



10 FCC §15.407(b) & ISEDC RSS-247 §6.2 - Out of Band Emissions

10.1 Applicable Standards

According to FCC §15.407(b):

For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

The provisions of §15.205 apply to intentional radiators operating under this section.

According to ISEDC RSS-247 §6.2.1 for devices operatinging in the frequency band 5150-5250 MHz:

For transmitters operating in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, any unwanted emissions that fall into the band 5250-5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz. Otherwise, the transmission is considered as intentional and the devices shall implement dynamic frequency selection (DFS) and transmitter power control (TPC) as per the requirements for the band 5250-5350 MHz.

According to ISEDC RSS-247 §6.2.2 for devices operatinging in the frequency band 5250-5350 MHz:

For devices with both operating frequencies and channel bandwidths contained within the band 5250-5350 MHz, the device shall comply with the following:

1. All emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. if the equipment is intended for outdoor use; or
2. All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. and any emissions within the band 5150-5250 MHz shall meet the power spectral density limits of Section 6.2.1. The device shall be labelled “for indoor use only.”

For devices with operating frequencies in the band 5250-5350 MHz but having a channel bandwidth that overlaps the band 5150-5250 MHz, the devices’ unwanted emission shall not exceed -27 dBm/MHz e.i.r.p. outside the band 5150-5350 MHz and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device shall be labelled “for indoor use only.”
According to ISEDC RSS-247 §6.2.3 for devices operatinging in the frequency band 5470-5600 MHz and 5650-5725 MHz. Emissions outside the band 5470-5725 MHz shall not exceed -27 dBm/MHz e.i.r.p.

According to ISEDC RSS-247 §6.2.4 for devices operatinging in the frequency band 5725-5850 MHz:

For the band 5725-5850 MHz, emissions at frequencies from the band edges to 10 MHz above or below the band edges shall not exceed -17 dBm/MHz e.i.r.p.
For emissions at frequencies more than 10 MHz above or below the band edges, the emissions power shall not exceed -27 dBm/MHz.

10.2 Measurement Procedure

Add a correction factor (antenna gain+ Attenuator loss+cable loss) to the offset of the spectrum analyzer.

Unwanted Emission Measurement:

Maximum emission levels are measured by setting the analyzer as follows:

i. RBW = 1 MHz
ii. VBW ≥ 3 MHz
iii. Detector = Peak
iv. Sweep time = auto
v. Trace mode = max hold

Integration Method:

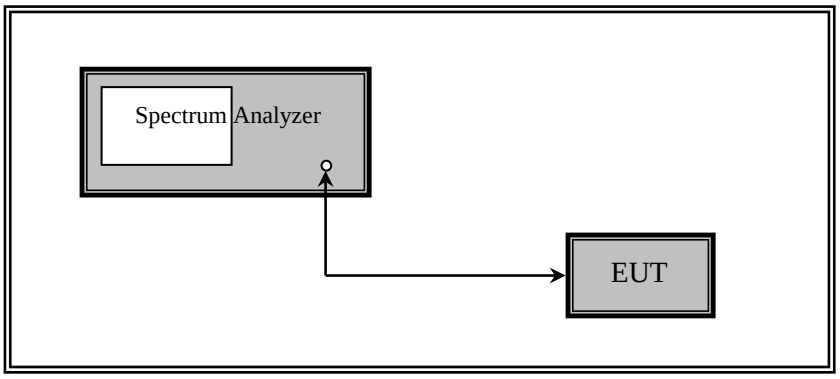
1. For peak emissions measurements, follow the procedures described in section H)5), "Procedures for Peak Unwanted Emissions Measurements above 1000 MHz", except for the following changes:

- Set RBW = 100 kHz
- Set VBW = 3RBW
- Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured. CAUTION: You must ensure that the spectrum analyzer or EMI receiver is set for peak-detection and max-hold for this measurement.

2. For average emissions measurements, follow the procedures described in section H)6), "Procedures for Average Unwanted Emissions Measurements above 1000 MHz", except for the following changes:

- Set RBW = 100 kHz
- Set VBW = 3RBW
- Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.

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
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2021-06-23	1 year
-	-	Notch Filter	-	-	Each time[1]	N/A
-	-	20 dB Attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A

Note[1]: equipment 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".*

10.5 Test Environmental Conditions

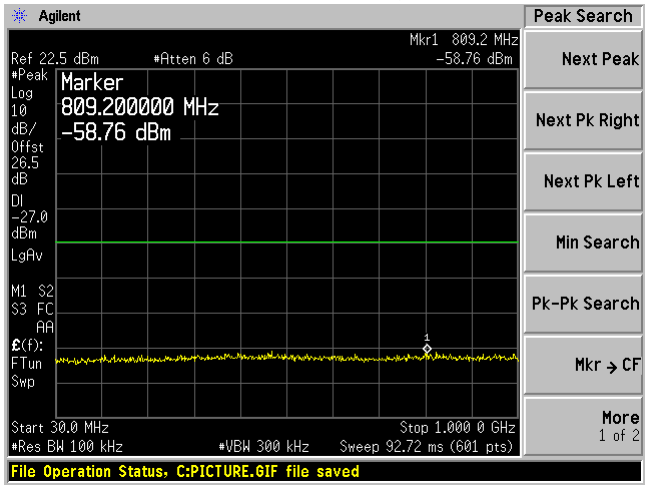
Temperature:	22-24 ºC
Relative Humidity:	50-55 %
ATM Pressure:	102.1-102.7 kPa

The testing was performed by Deepak Mishra from 2022-02-10 in RF site.

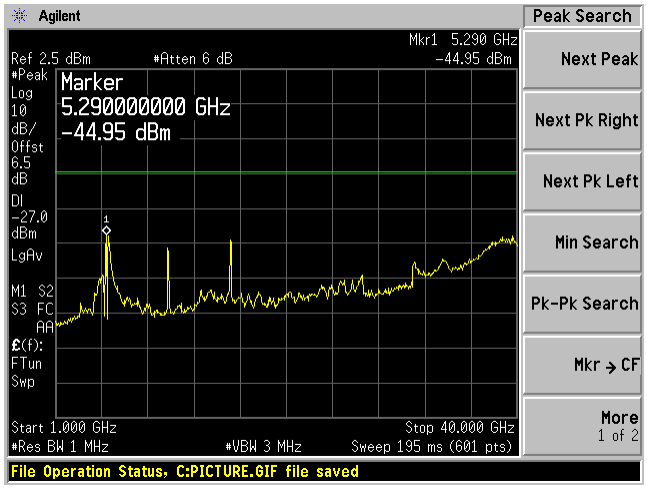
10.6 Test Results

5250 - 5350 MHz, 802.11a Mode, ANT a

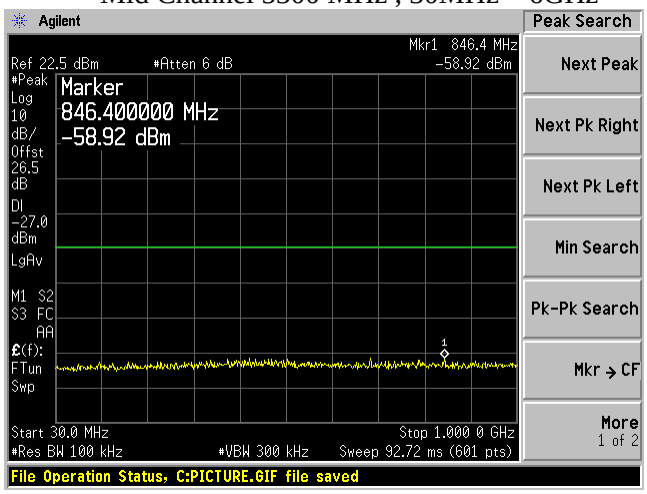
Low Channel 5260 MHz , 30MHz – 6GHz



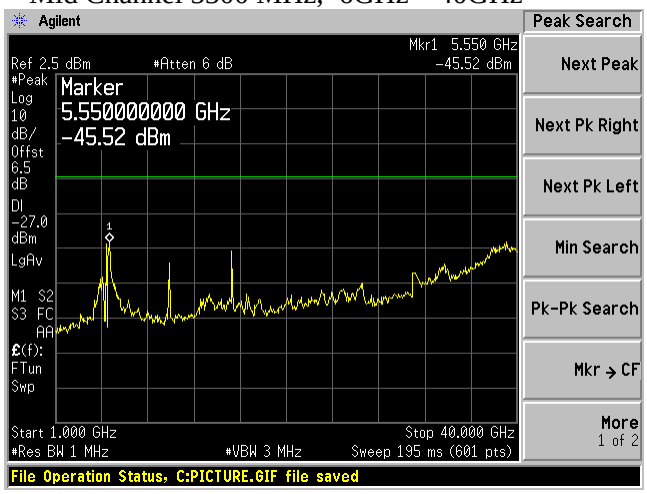
Low Channel 5260 MHz, 6GHz – 40GHz



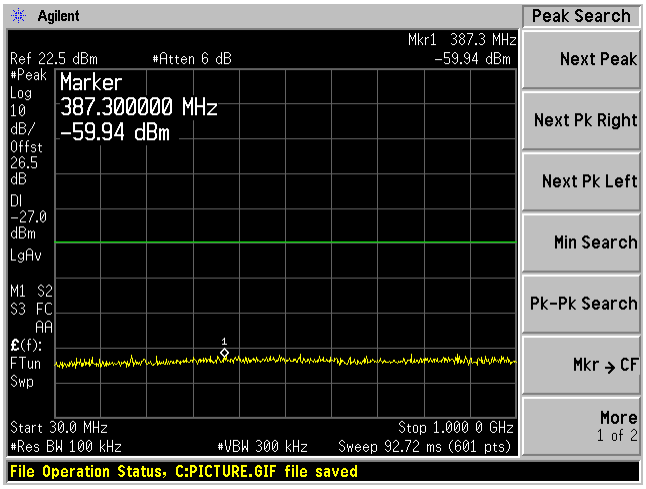
Mid Channel 5300 MHz , 30MHz – 6GHz



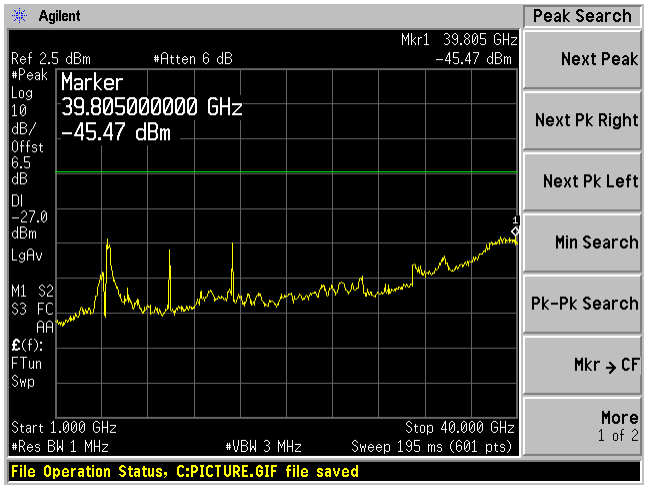
Mid Channel 5300 MHz, 6GHz – 40GHz



High Channel 5320 MHz , 30MHz – 6GHz

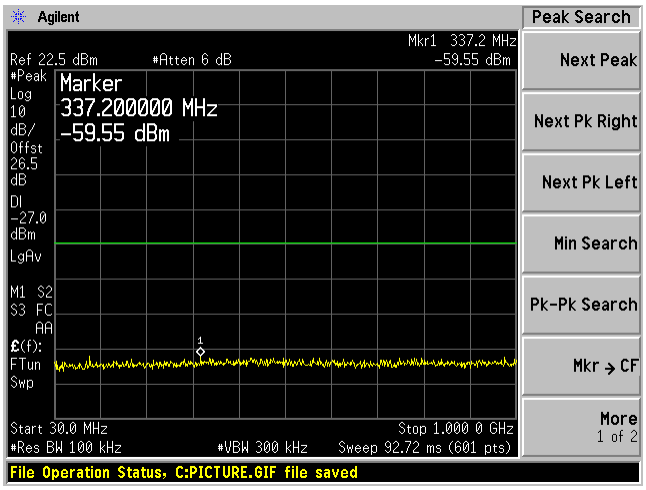


High Channel 5320 MHz, 6GHz – 40GHz

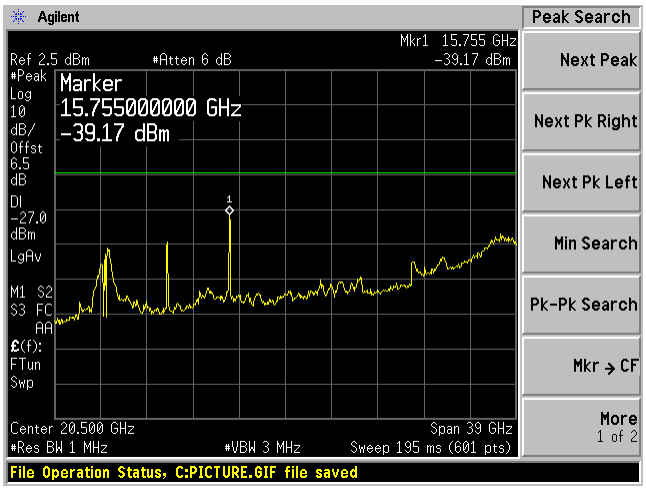


5250 - 5350 MHz, 802.11a Mode, ANT b

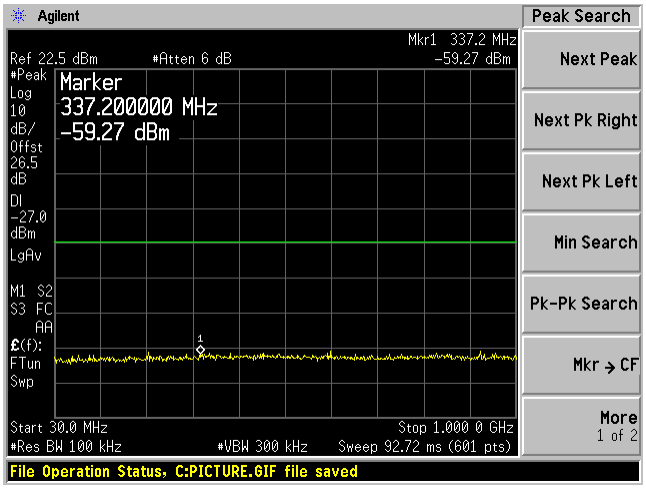
Low Channel 5260 MHz , 30MHz – 6GHz



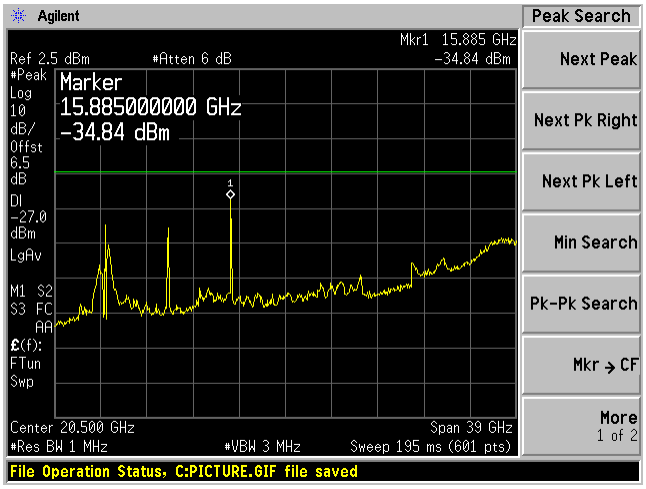
Low Channel 5260 MHz, 6GHz – 40GHz



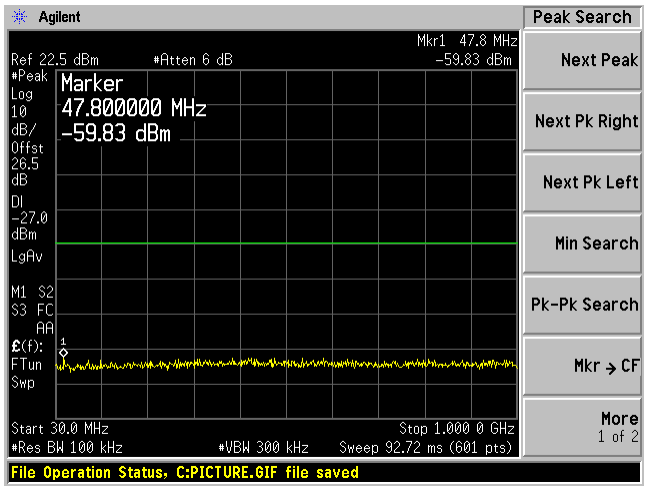
Mid Channel 5300 MHz , 30MHz – 6GHz



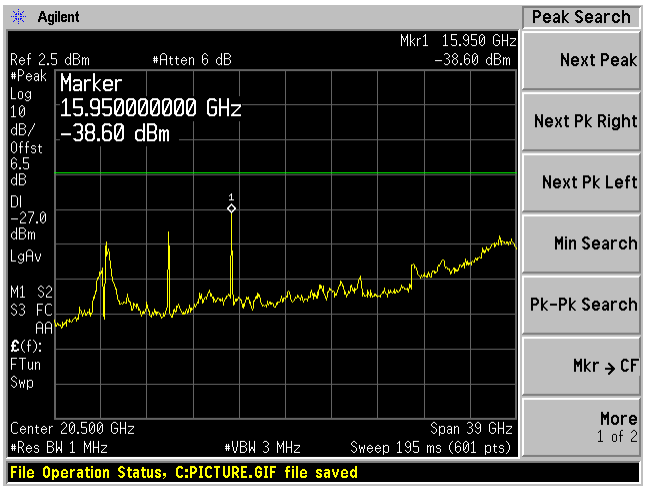
Mid Channel 5300 MHz, 6GHz – 40GHz



High Channel 5320 MHz , 30MHz – 6GHz

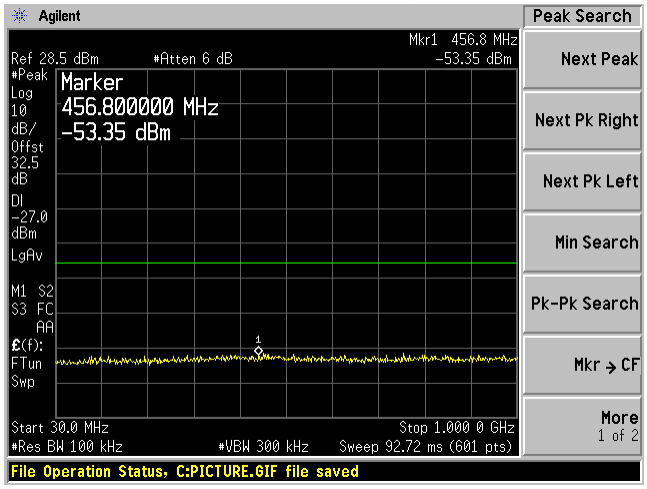


High Channel 5320 MHz, 6GHz – 40GHz

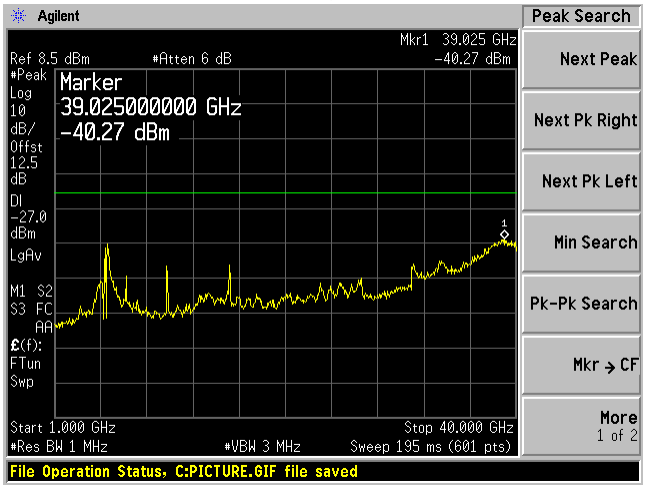


5250 - 5350 MHz, 802.11n/ac20 Mode, ANT a

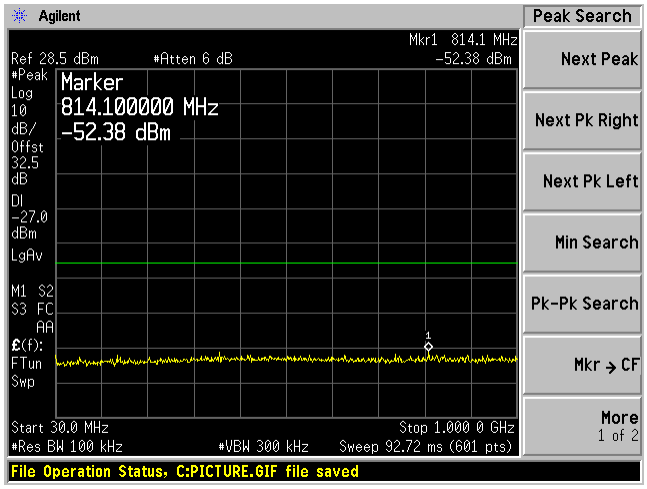
Low Channel 5260 MHz , 30MHz – 6GHz



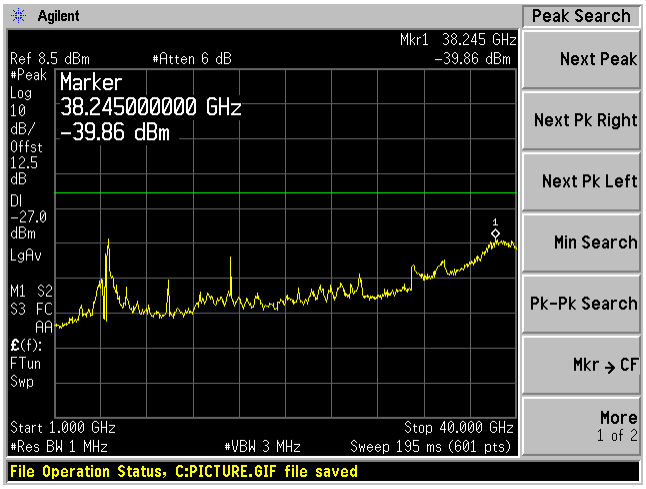
Low Channel 5260 MHz, 6GHz – 40GHz



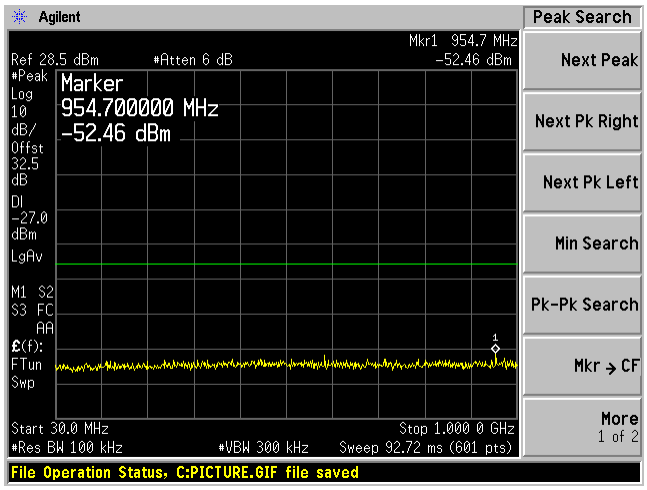
Mid Channel 5300 MHz , 30MHz – 6GHz



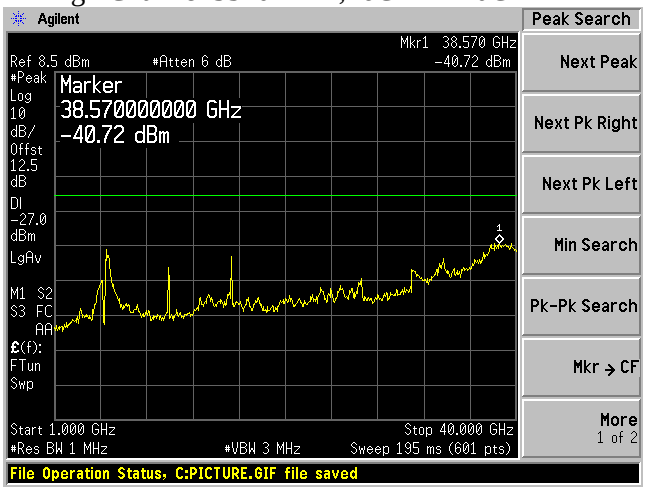
Mid Channel 5300 MHz, 6GHz – 40GHz



High Channel 5320 MHz , 30MHz – 6GHz

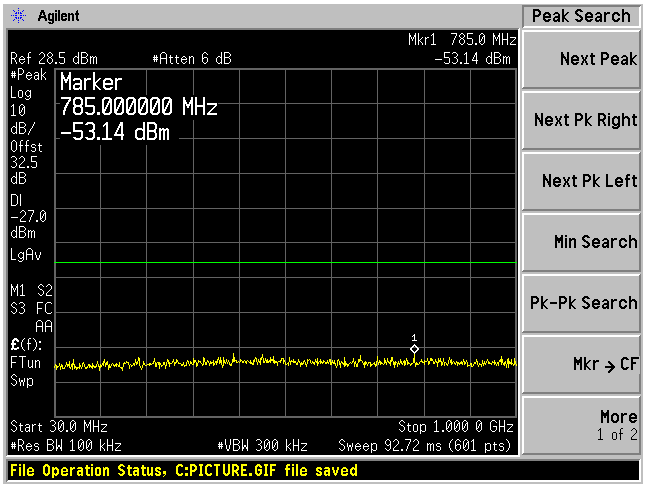


High Channel 5320 MHz, 6GHz – 40GHz

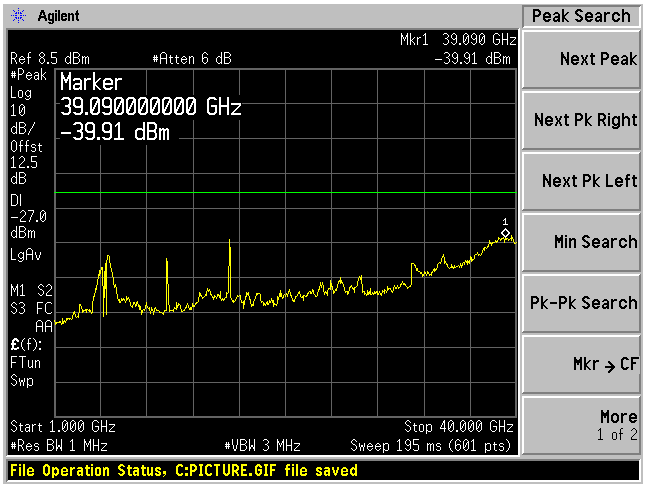


5250 - 5350 MHz, 802.11n/ac20 Mode, ANT b

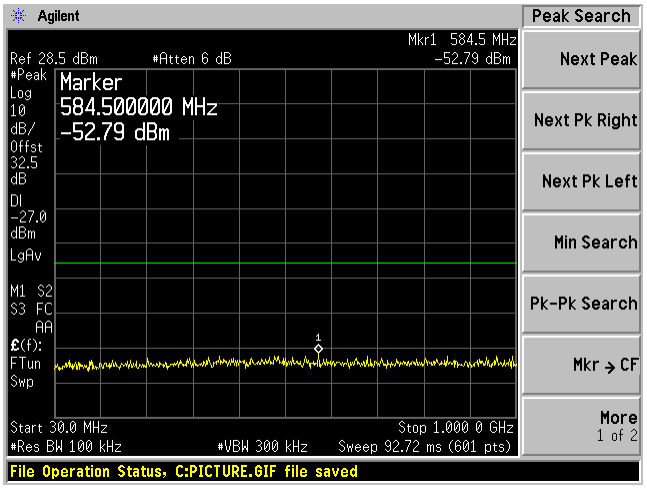
Low Channel 5260 MHz , 30MHz – 6GHz



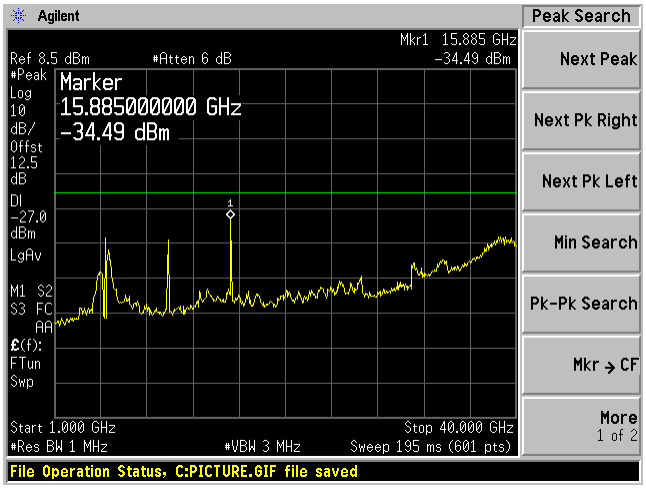
Low Channel 5260 MHz, 6GHz – 40GHz



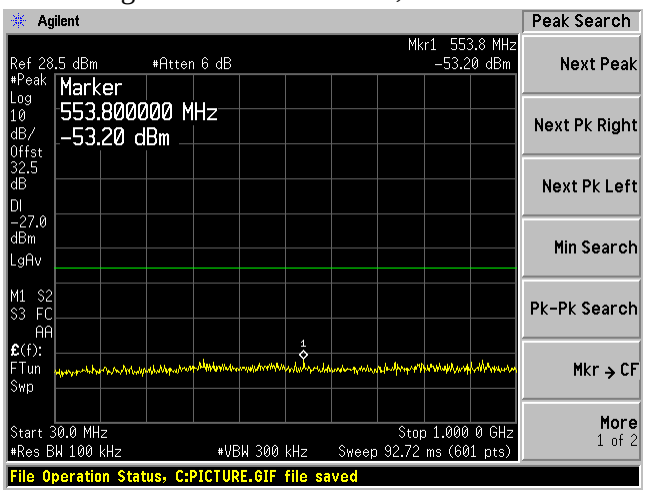
Mid Channel 5300 MHz , 30MHz – 6GHz



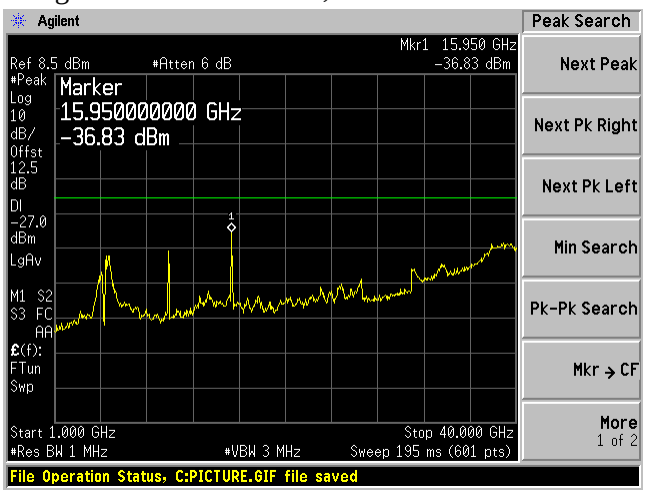
Mid Channel 5300 MHz, 6GHz – 40GHz



High Channel 5320 MHz , 30MHz – 6GHz

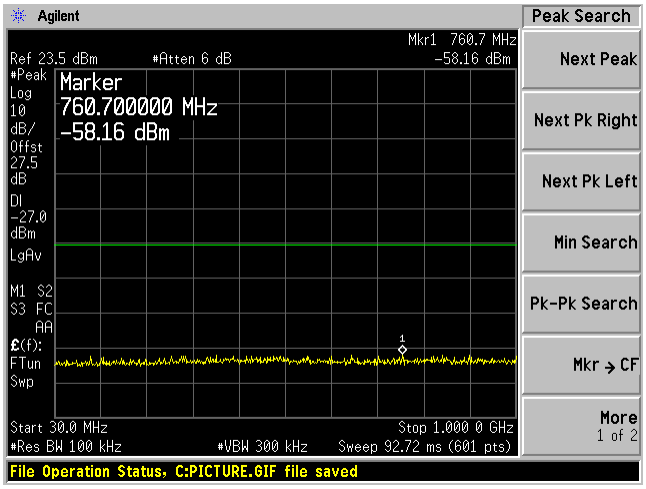


High Channel 5320 MHz, 6GHz – 40GHz

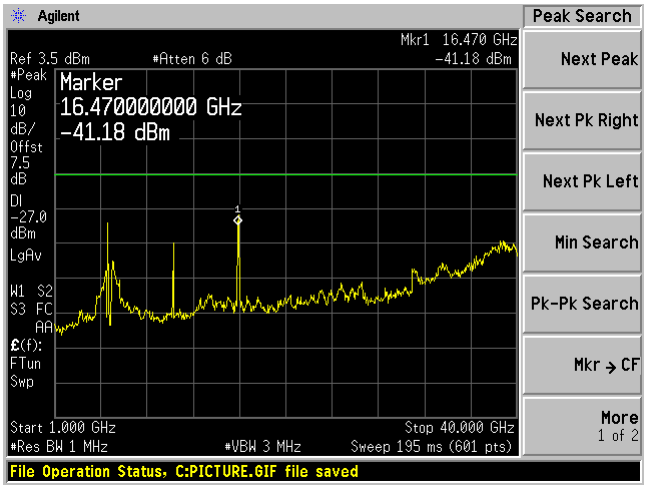


5470 - 5725 MHz, 802.11a Mode, ANTa

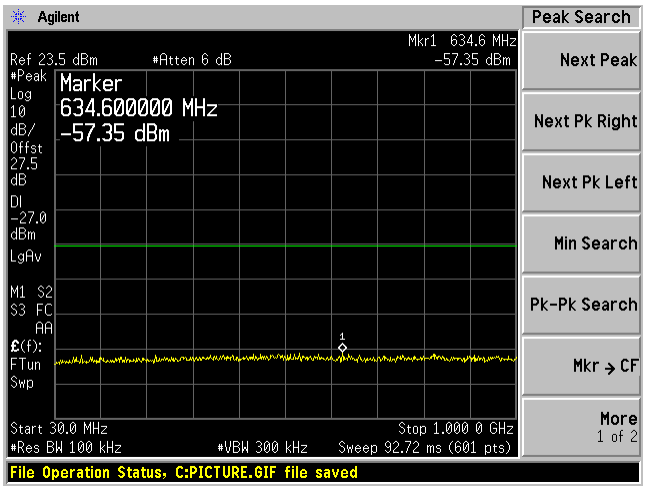
Low Channel 5500 MHz , 30MHz – 6GHz



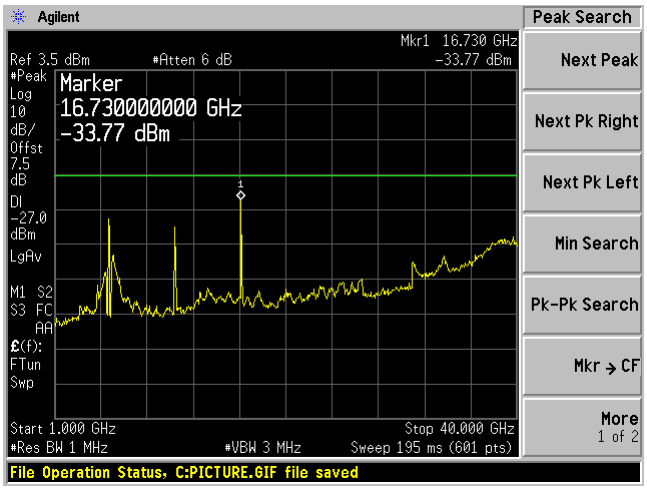
Low Channel 5500 MHz, 6GHz – 40GHz



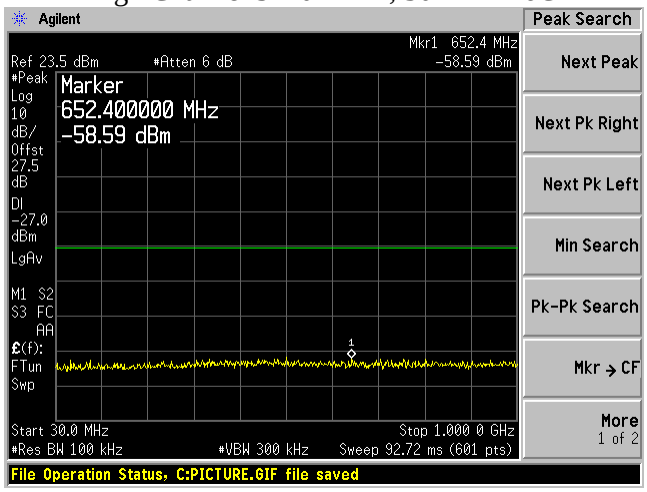
Mid Channel 5580 MHz , 30MHz – 6GHz



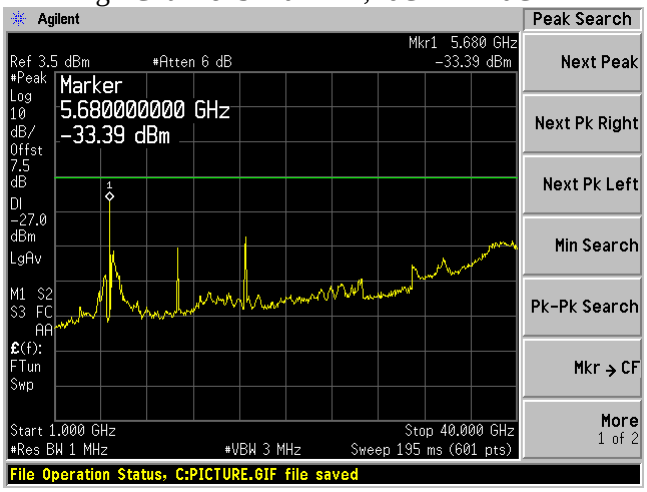
Mid Channel 5580 MHz, 6GHz – 40GHz



High Channel 5720 MHz , 30MHz – 6GHz

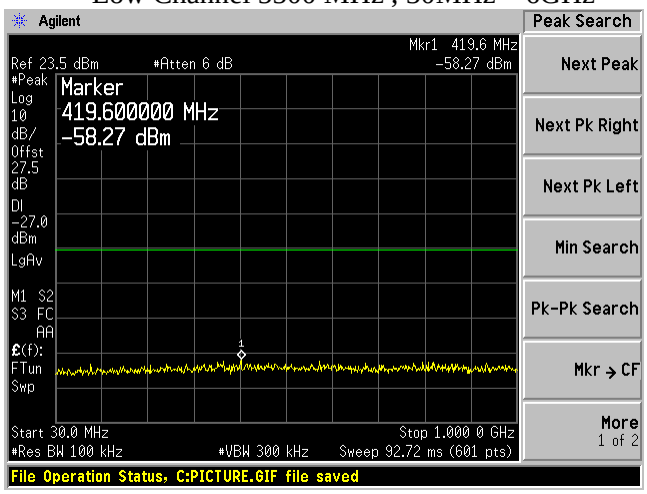


High Channel 5720 MHz, 6GHz – 40GHz

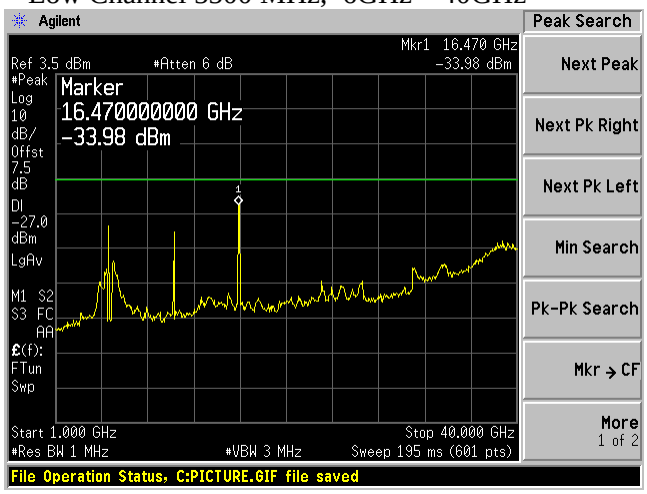


5470 - 5725 MHz, 802.11a Mode, ANT b

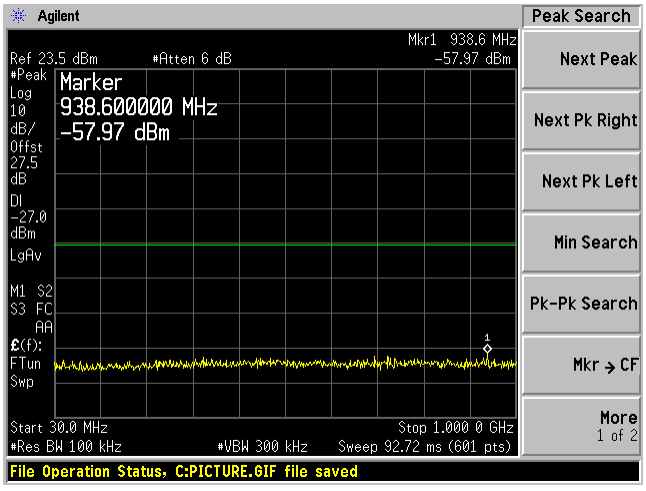
Low Channel 5500 MHz , 30MHz – 6GHz



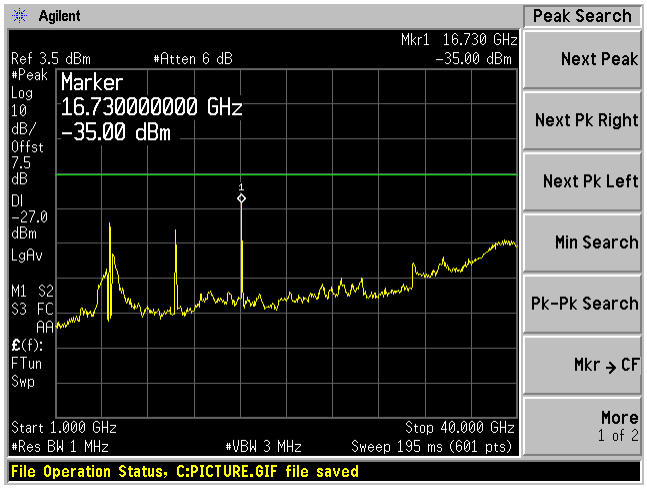
Low Channel 5500 MHz, 6GHz – 40GHz



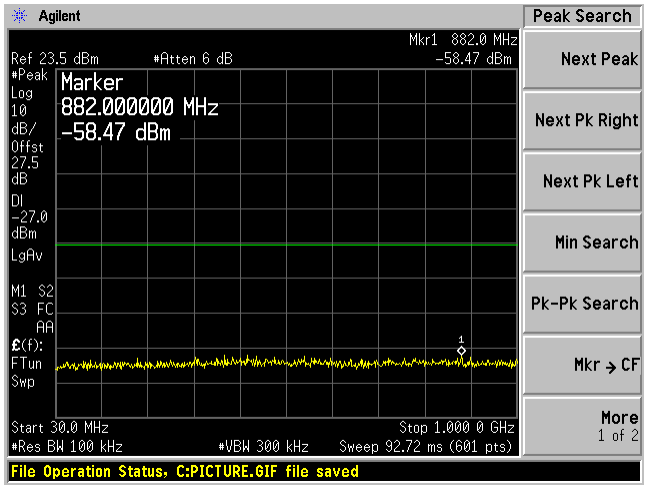
Mid Channel 5580 MHz , 30MHz – 6GHz



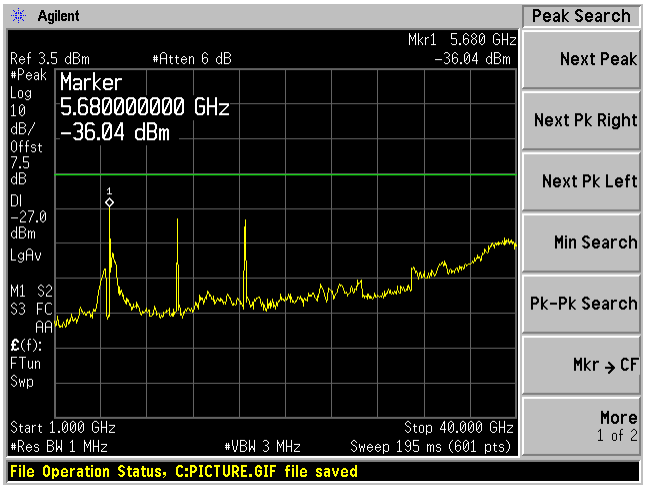
Mid Channel 5580 MHz, 6GHz – 40GHz



High Channel 5720 MHz , 30MHz – 6GHz

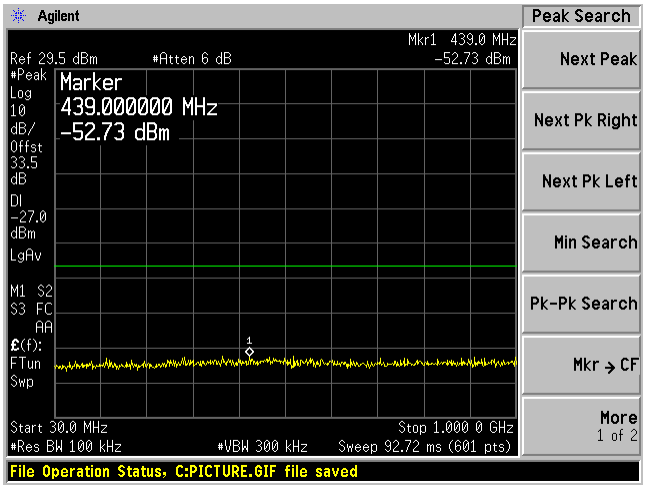


High Channel 5720 MHz, 6GHz – 40GHz

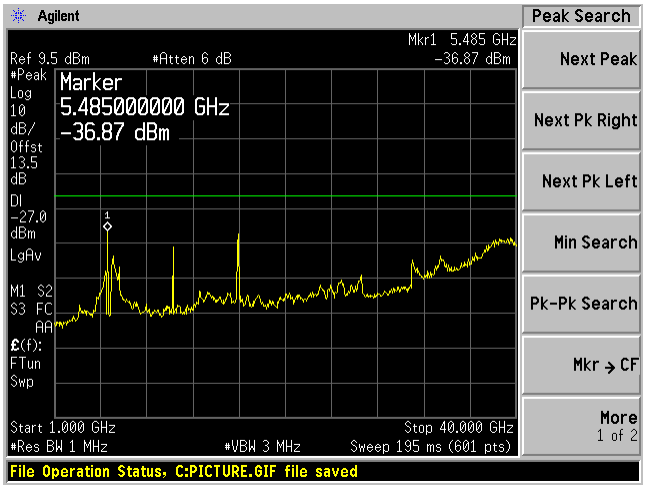


5470 - 5725 MHz, 802.11n/ac20 Mode, a

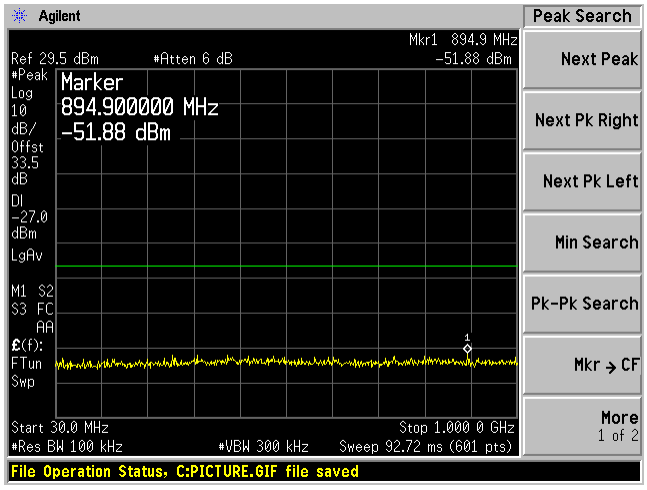
Low Channel 5500 MHz , 30MHz – 6GHz



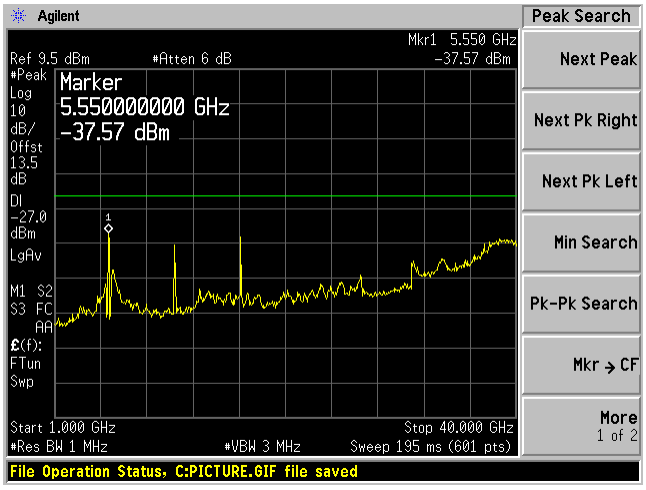
Low Channel 5500 MHz, 6GHz – 40GHz



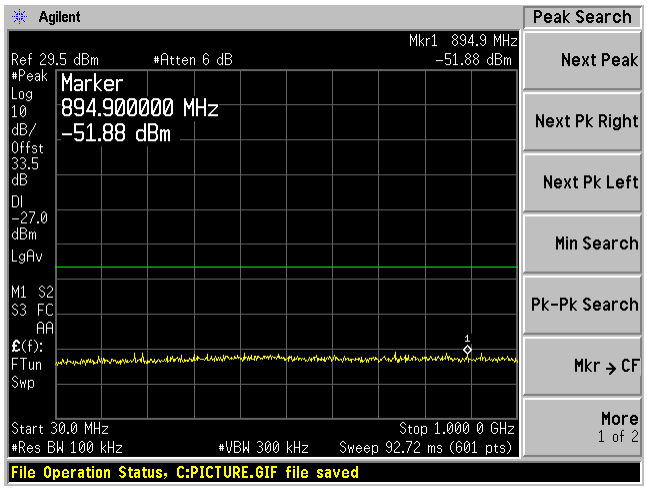
Mid Channel 5580 MHz , 30MHz – 6GHz



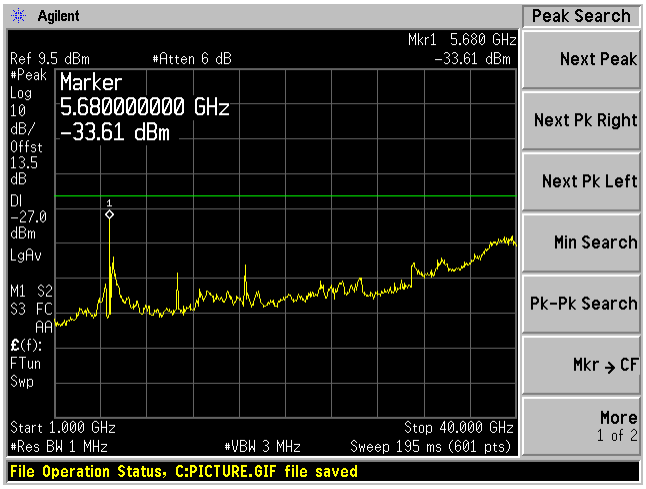
Mid Channel 5580 MHz, 6GHz – 40GHz



High Channel 5720 MHz , 30MHz – 6GHz

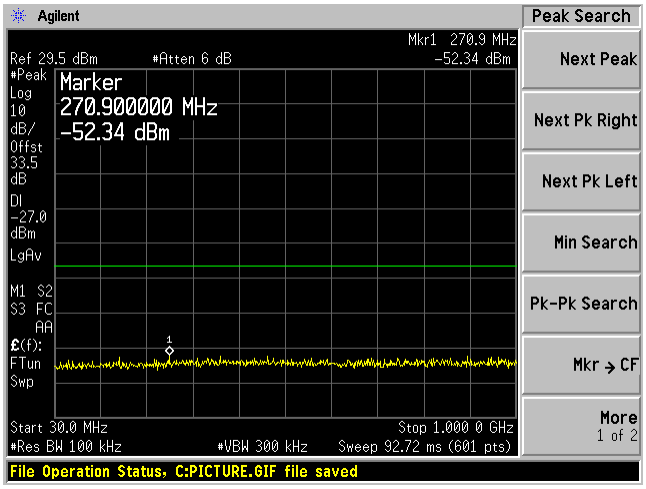


High Channel 5720 MHz, 6GHz – 40GHz

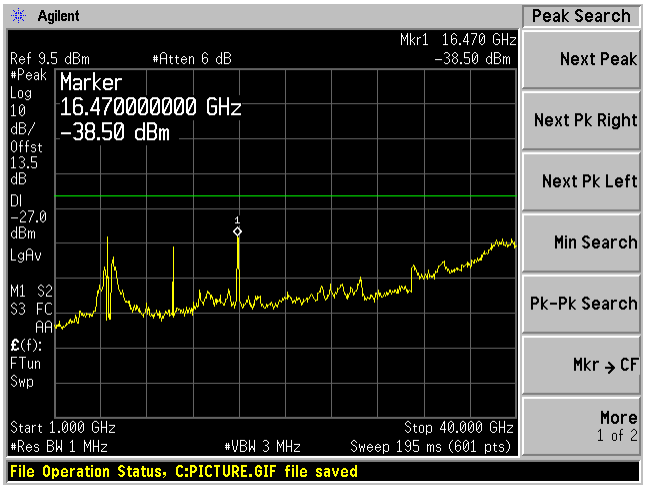


5470 - 5725 MHz, 802.11n/ac20 Mode, ANTb

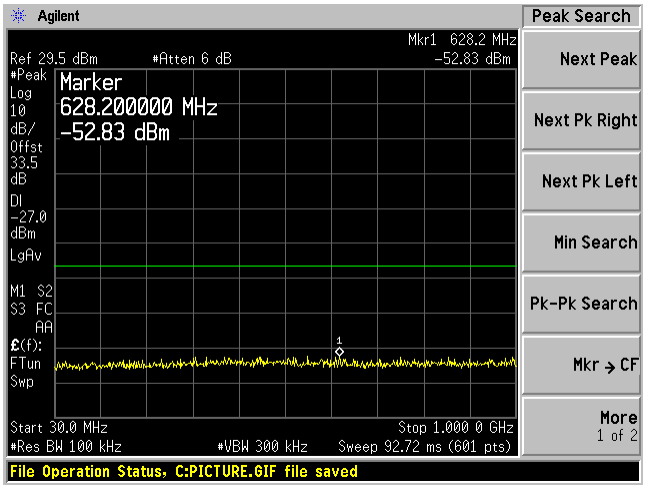
Low Channel 5500 MHz , 30MHz – 6GHz



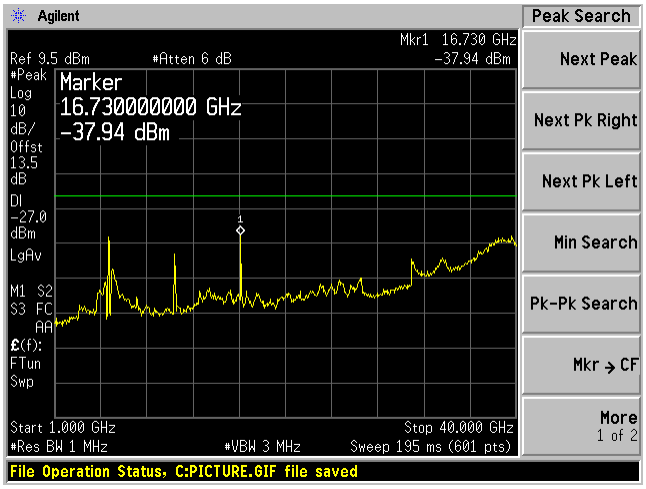
Low Channel 5500 MHz, 6GHz – 40GHz



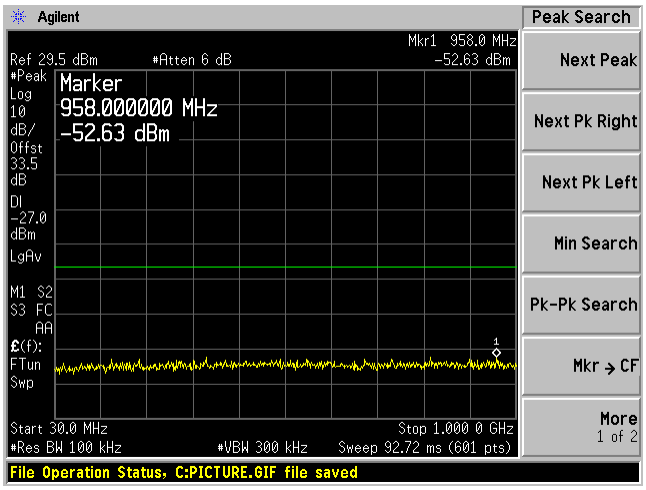
Mid Channel 5580 MHz , 30MHz – 6GHz



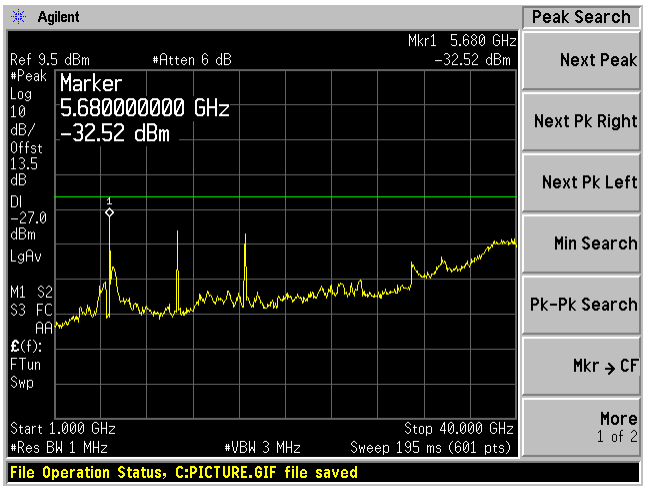
Mid Channel 5580 MHz, 6GHz – 40GHz



High Channel 5720 MHz , 30MHz – 6GHz



High Channel 5720 MHz, 6GHz – 40GHz



11 FCC §15.407(h) & ISEDC RSS-247 §6.3 – Dynamic Frequency Selection

11.1 Applicable Standards

FCC CFR47 §15.407 (h), RSS-247 Issue 2 and KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v02.

Table 1: Applicability of DFS requirements prior to use of a channel

Requirement	Operational Mode		
	Master	Client (Without radar detection)	Client (With radar detection)
Non-Occupancy Period	Yes	Not Required	Yes
DFS Detection Threshold	Yes	Not Required	Yes
Channel Availability Check Time	Yes	Not Required	Not Required
U-NII Detection Bandwidth	Yes	Not Required	Yes

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not Required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not Required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

Table 3: Interference Threshold for Master and Client with Radar Detection

Maximum Transmit Power	Value (See Notes 1, 2 and 3)
EIRP≥ 200 milliwatt	-64 dBm
EIRP< 200 milliwatt and power spectral density < 10dBm/MHz	-62 dBm
EIRP< 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. **Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. **Note3**: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

Table 4: DFS Response Requirement Values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds ***See Note 1***.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. ***See Notes 1 and 2***.
U-NII Detection Bandwidth	Minimum 100% of the UNII 99% transmission power bandwidth. ***See Note 3***.

Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.

Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

Table 5: Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (Microseconds)	PRI (Microseconds)	Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Table 6: Long Pulse Radar Test Signal

Radar Type	Bursts	Chirp Width (MHz)	PRI (usec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

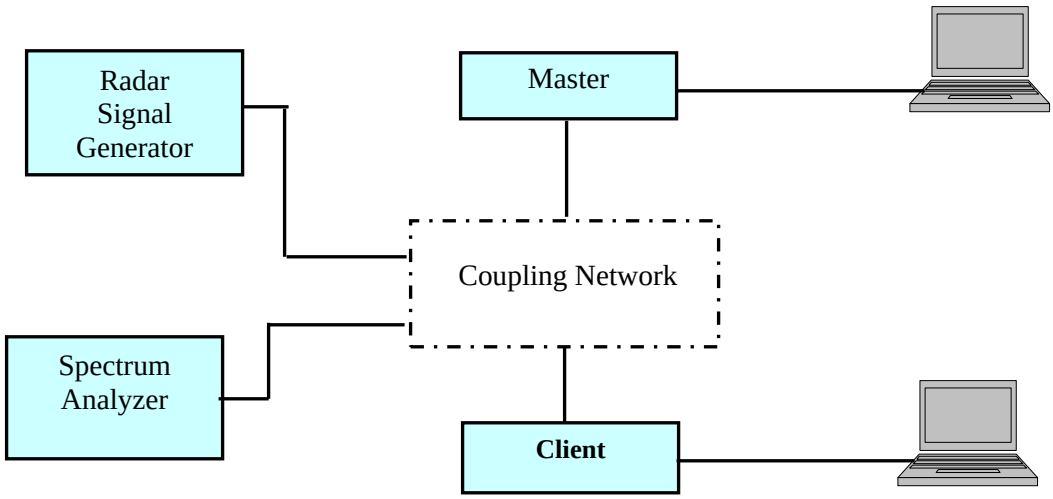
Table 7: Frequency Hopping Radar Test Signal

Radar Type	Pulse Width (usec)	PRI (usec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

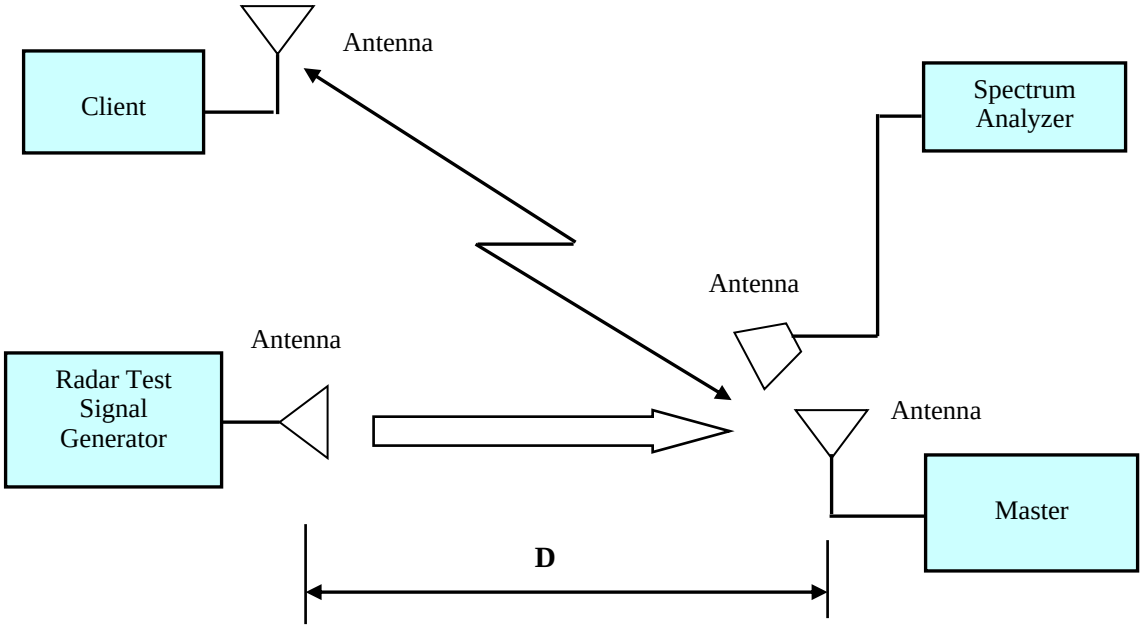
11.2 DFS Measurement System

BACL DFS measurement system consists of two subsystems: (1) The radar signal generating subsystem and (2) the traffic monitoring subsystem.

11.3 System Block Diagram



11.4 Radiated Method



11.5 Test Procedure

A spectrum analyzer is used as a monitor that verifies the EUT's status, which includes the Channel Closing Transmission Time and the Channel Move Time.

BACL use type 0 radar signal to test the channel move time and channel closing transmission time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = N * Dwell Time

N is the number of spectrum analyzer bins showing a device transmission
Dwell Time is the dwell time per bin (i.e. Dwell Time = S/B, S is the sweep time and B is the number of bin, i.e. 8192)

11.6 Test Equipment List and Details

Bacl No.	Manufacturer	Equipment Description	Model	S/N	Calibration Date	Calibration Interval
547	National Instruments	NI PXI-1042 8-Slot chassis	PXI-1042	V08X01EE1	N/A	N/A
-	National Instruments	Arbitrary Waveform Generator	PXI-5421	N/A	N/A	N/A
-	National Instruments	RF Upconverter	PXI-5610	N/A	N/A	N/A
-	ASCOR	Upconverter	AS-7206	N/A	N/A	N/A
424	Agilent	Analyzer, Spectrum	E4440A	US45303156	2021-12-06	1 year
187	A.R.A	Horn Antenna	DRG-118/A	1132	2022-03-17	2 years
473	EMCO	Horn Antenna	3115	9511-4627	2020-10-12	2 years
-	-	RF Cable	-	-	Each Time	Each Time

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".*

11.7 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	43 %
ATM Pressure:	101.9 kPa

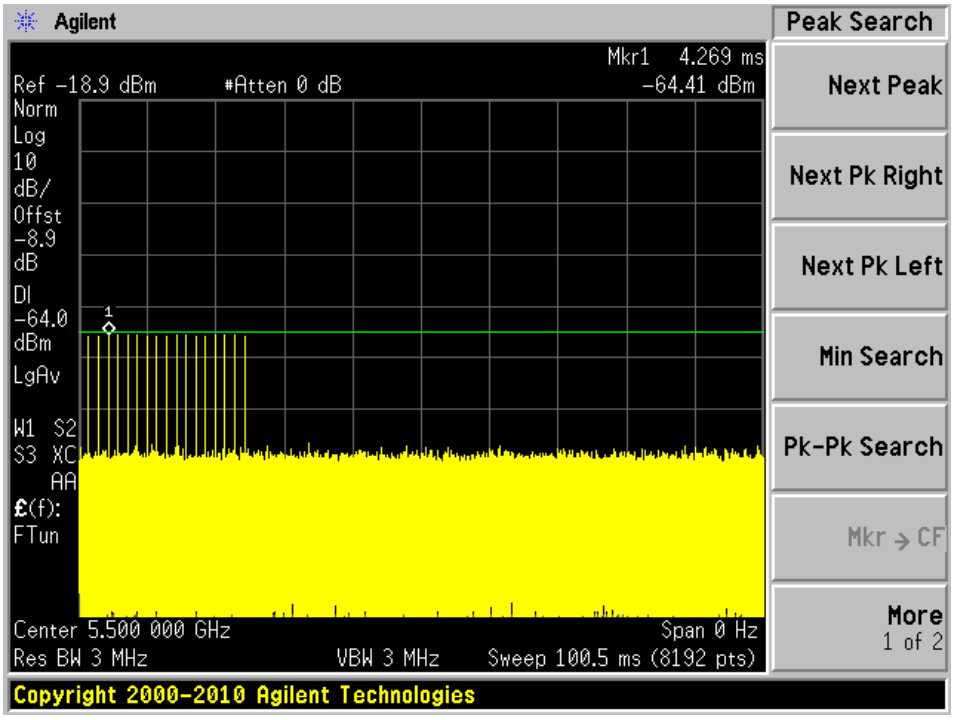
Testing was performed by Simon Ma on 2021-05-03 at the DFS testing site.

11.8 Test Results

Plots of Radar Waveforms

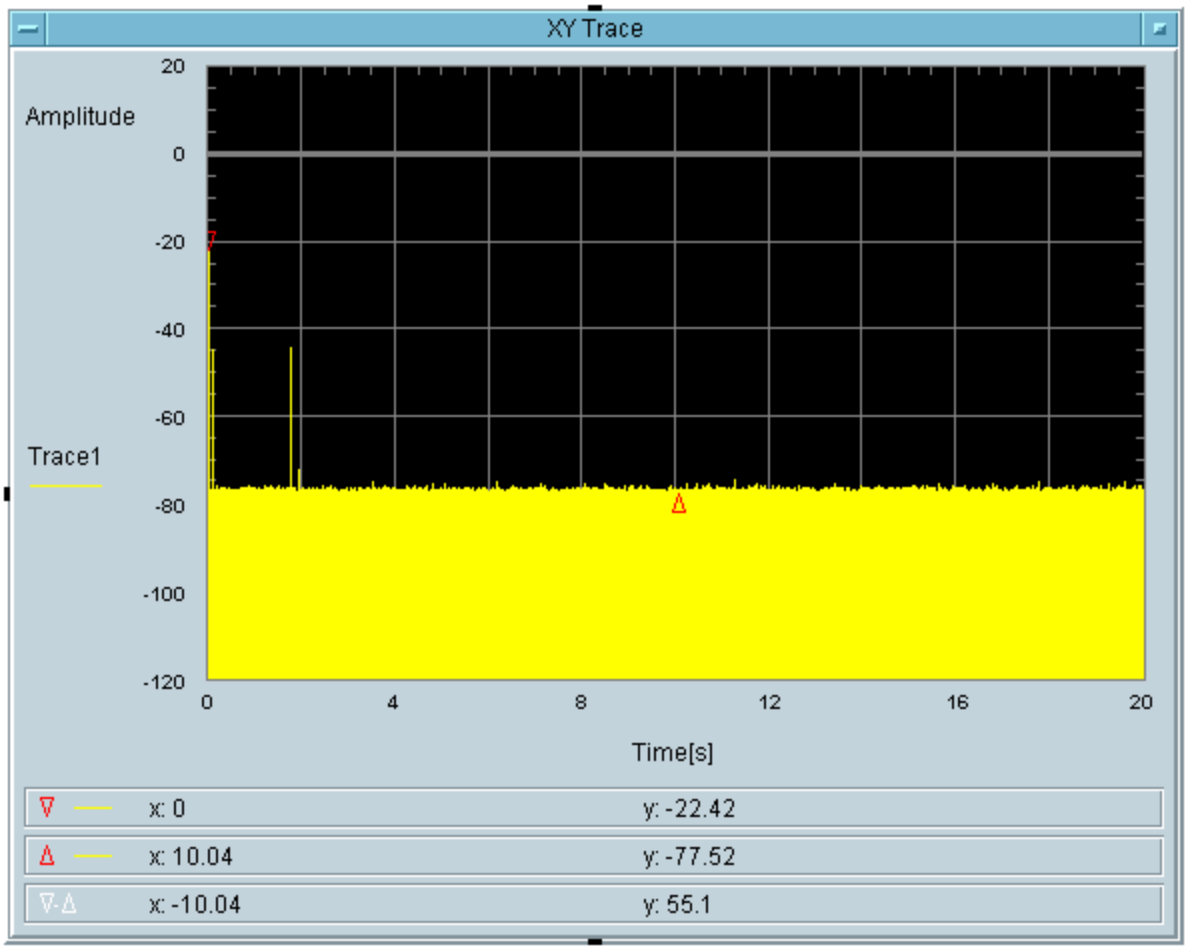
Radar Type 0

5500 MHz



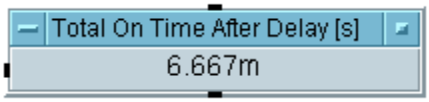
Frequency (MHz)	Bandwidth (MHz)	Radar Type	Results
5500	20	Type 0	Compliant

Type 0 radar channel move time less than 10s result:



Type 0 radar channel closing transmission time result:

Channel closing transmitting time (ms)	Limit (ms)	Result
20	200	Pass



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 ---