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ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST AND MEASUREMENT REPORT

For

UVCeed, LLC

1680 South Ocean Blvd., Manalapan, FL 33462

FCC ID: 2A4BD-UV01
IC: 28235-UV01

Report Type:	**Product Type:**
Original Report	UV C LED Sanitizer

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CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2203302-247	Original Report	2022-05-02

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test report was prepared on behalf of *UVCeed, LLC,* and their product model: *UV01* with FCC ID: 2A4BD-UV01, IC: 28235-UV01. The device will be referred to as the "EUT" throughout this report. It is a UV C LED Sanitizer that utilizes a BLE radio operating within the 2400-2483.5 MHz frequency range.

1.2 Mechanical Description of EUT

UV01 measures approximately 79 mm (Length), 59 mm (Width), and 5 mm (Height) and weighs approximately 30 g.

The data gathered are from production samples provided by UVCeed, LLC serial numbers as follows:
Conducted Sample S/N: R2203302-1
Radiated Sample S/N: R2203302-2

1.3 Objective

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

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

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.6 Measurement Uncertainty

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

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

1.7 Test Facility Registrations

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

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

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

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

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2017 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02)*****,** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2017 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report.

BACL's ISO/IEC 17025:2017 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

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

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

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

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

5 Other
- For Water Coolers (ver. 3.0)

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

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

2 System Test Configuration

2.1 Justification

The EUT was configured for testing in accordance to ANSI C63.10.

2.2 EUT Exercise Software

TeraTerm was used to transmit signals for all the channels. The software used are compliant with the standard requirements being tested against. The following channels and power settings were selected for testing.

Channel Frequency (MHz)	Power Settings Tested
2402	-4, 0, & 4
2426	-4, 0, & 4
2480	-4, 0, & 4

2.3 Duty Cycle Correction Factor

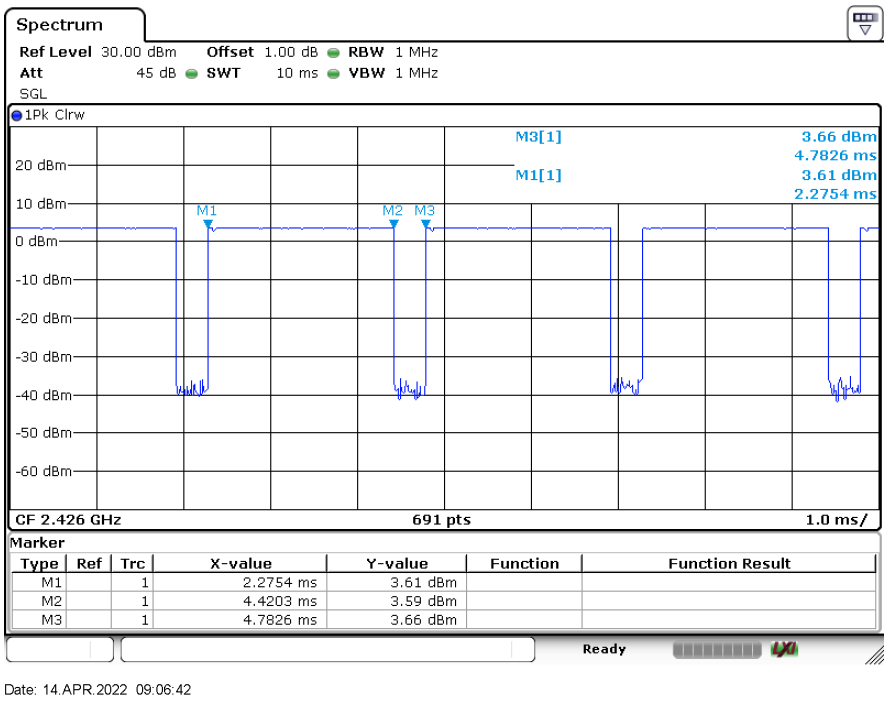
According to KDB 558074 D01 DTS Meas Guidance v05r02 section 6.0:

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

Radio frequency (MHz)	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
2426	2.15	2.51	0.86	0.67

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

Please refer to the following plots.



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.6 Remote Support Equipment

Manufacturer	Description	Model
Culvert	Debug Board	Culvert Dongle

2.7 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
USB to Micro USB	< 1 m	Laptop	Debug Board
USB C to USB C	< 1 m	Debug Board	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirements	Compliant
FCC §2.1093, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	N/A[1]
FCC §15.209, §15.247(d) ISEDC RSS-247 §5.5 RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2 RSS-Gen §6.7	6 dB & 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4	Maximum Output Power	Compliant
FCC §15.247(e) ISEDC RSS-247 §5.2(2)	Peak Power Spectral Density	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant

Note[1]: Device is battery powered and cannot transmit while charging.

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

4.1 Applicable Standards

According to FCC §15.203:

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

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

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

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

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

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

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

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

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

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

4.2 Antenna Description

External/Internal/ Integral	Frequency Range (MHz)	Antenna Type	Maximum Antenna Gain (dBi)
Integral	2400-2483.5 MHz	PCB	0

Antenna gain is information provided by customer.

5 FCC §2.1093, §15.247(i) & ISEDC RSS-102 - RF Exposure

5.1 Applicable Standards

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

2.1.1 General RF Exposure Test Exemption Considerations

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

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

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

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

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

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

2.1.2 1-mW Test Exemption

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

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

2.1.3 SAR-Based Exemption

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

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

2.1.4 MPE-Based Exemption

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

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

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

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

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

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

5.2 FCC RF Exposure Exemption Evaluation Procedures

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

B.1 General

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

B.2 Blanket 1 mW Blanket Exemption

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

B.3 MPE-based Exemption

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

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

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

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

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

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

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

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

B.4 SAR-based Exemption

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

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

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

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

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

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

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

Where

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

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

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

Table B.2 – Example Power Thresholds (mW)

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

5.3 RF exposure evaluation exemption for FCC

Prediction frequency (GHz)			2.402	
Maximum output power (dBm)			4	
Maximum output power (mW)			2.51	
Prediction distance (cm)			0.5	
Maximum antenna gain (dBi)			0	
0.3 GHz ≤ f < 1.5 GHz	$ERP_{20\,cm}$ (mW)	x	SAR-based Exemption Threshold	
	-	-	$d \leq 20$ cm	P_{th} (mW)
				-
			20 cm < $d \leq 40$ cm	P_{th} (mW)
				-
1.5 GHz ≤ f ≤ 6 GHz	$ERP_{20\,cm}$ (mW)	x	SAR-based Exemption Threshold	
	3060	1.90	$d \leq 20$ cm	P_{th} (mW)
				2.77
			20 cm < $d \leq 40$ cm	P_{th} (mW)
				-

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: Max Power > ERP in this case, therefore Max Power was compared to threshold.

5.4 RF exposure evaluation exemption for IC

Maximum power = 4 dBm (2.51 mW), which is less than 4 mW. Therefore, ISED SAR testing is not required.

Note: Manufacturer declare maximum rated power is 4dBm.

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

6.1 Applicable Standards

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

As Per FCC §15.205(a) and RSS-Gen except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

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

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

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

As per ISEDC RSS-Gen 8.9,

Except when the requirements applicable to a given device state otherwise, emission from licence-exempt transmitters shall company with the field strength limits shown in the table below. Additional, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits for Licence-Exemption Transmitters at Frequencies above 30 MHz

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

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

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

As per ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

6.2 Test Setup

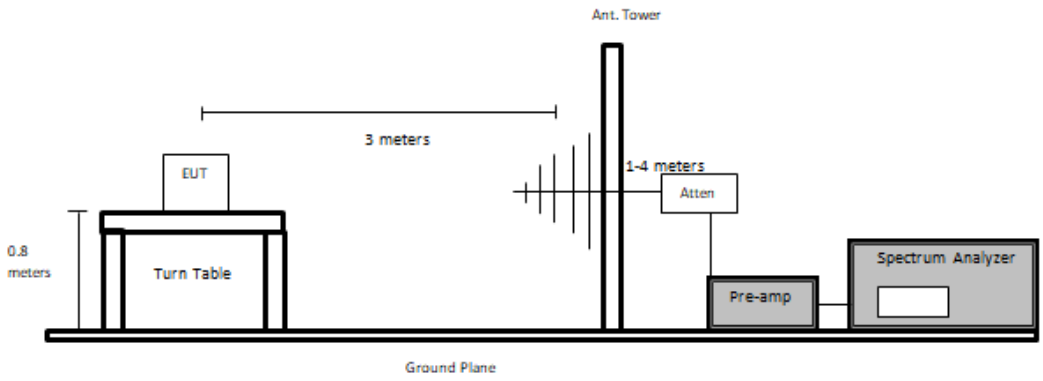
The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C and ISEDC RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

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

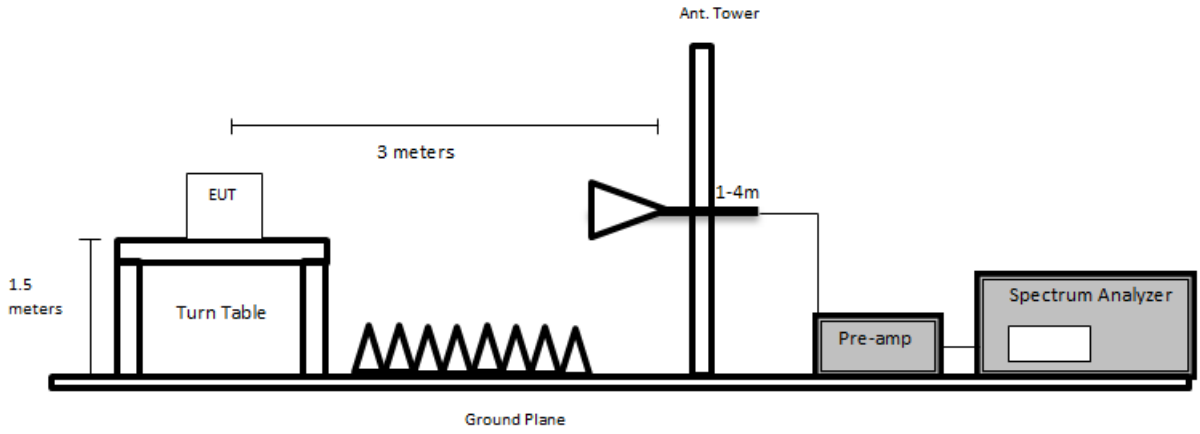
6.3 Test Setup Block Diagrams

Below 1 GHz:

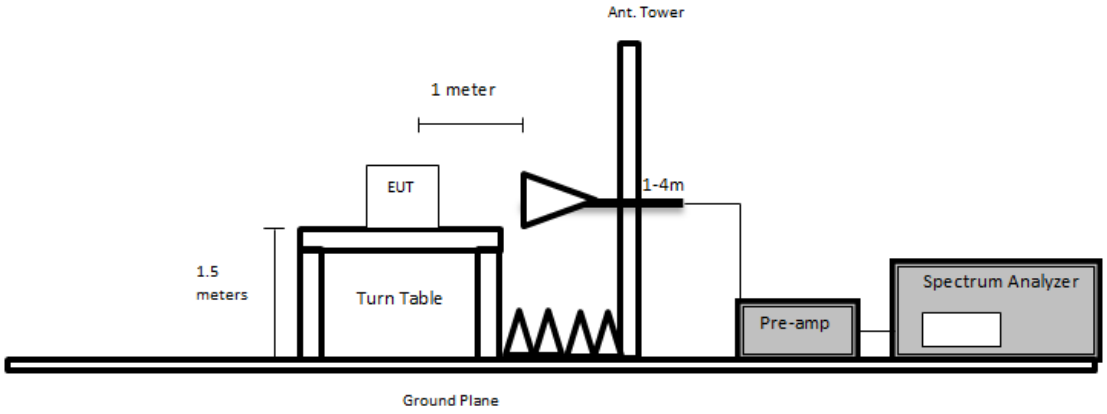


Above 1 GHz:

At 3 meters:



At 1 meter:



6.4 Test Procedure

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

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

The EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna 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 = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

6.5 Corrected Amplitude & Margin Calculation

For emissions below 1 GHz,

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

CA = S.A. Reading + Correction Factor

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

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

Correction Factor = AF + CL + Atten – Ga

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

Margin = Corrected Amplitude – Limit

For emission above 1 GHz,

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

CA = Ai + AF + CL + Atten – Ga

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

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

Margin = Corrected Amplitude – Limit

6.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
310	Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950.03	100338	2021-11-18	1 year
811	Keysight Technologies	RF Limiter	11867A	MY42243 052	2021-11-30	1 year
287	Agilent	Spectrum Analyzer	E4446A	US44300 386	2021-04-27	1 year
-	Sunol Science Corp	System Controller	SC110V	122303-1	N/R	N/A
658	HP	Pre-Amplifier	8449B OPT HO2	3008A01 13	2021-05-06	1 year
827	AH Systems	Preamplifier	PAM 1840 VH	170	2021-08-03	1 year
91	Wisewave	Horn Antenna	ARH-4223-02	10555-02	2022-03-08	2 years
1192	ETS Lindgren	Antenna, Horn	3117	00218973	2021-09-14	2 years
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2021-11-22	2 years
459	HP	Pre Amplifier	8447D	2443A04 374	2021-11-02	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	Notch Filter	-	-	Each time[1]	N/A
1077	Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-03-03	14 months
1228	Pasternack	Times Microwave LMR 400 UltraFex Coaxial Cable 35\'	PE3496-800CM	2111301	2021-11-30	1 year
601	Micro-Coax	High Frequency Cable	UFA147A	223458-001	2021-08-03	1 year

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".*

6.7 Test Environmental Conditions

Temperature:	19 ºC
Relative Humidity:	34 %
ATM Pressure:	102.2 kPa

The testing was performed by Christian McCaig on 2022-04-11, and 2022-04-20 at 5 meter chamber 3.

6.8 Summary of Test Results

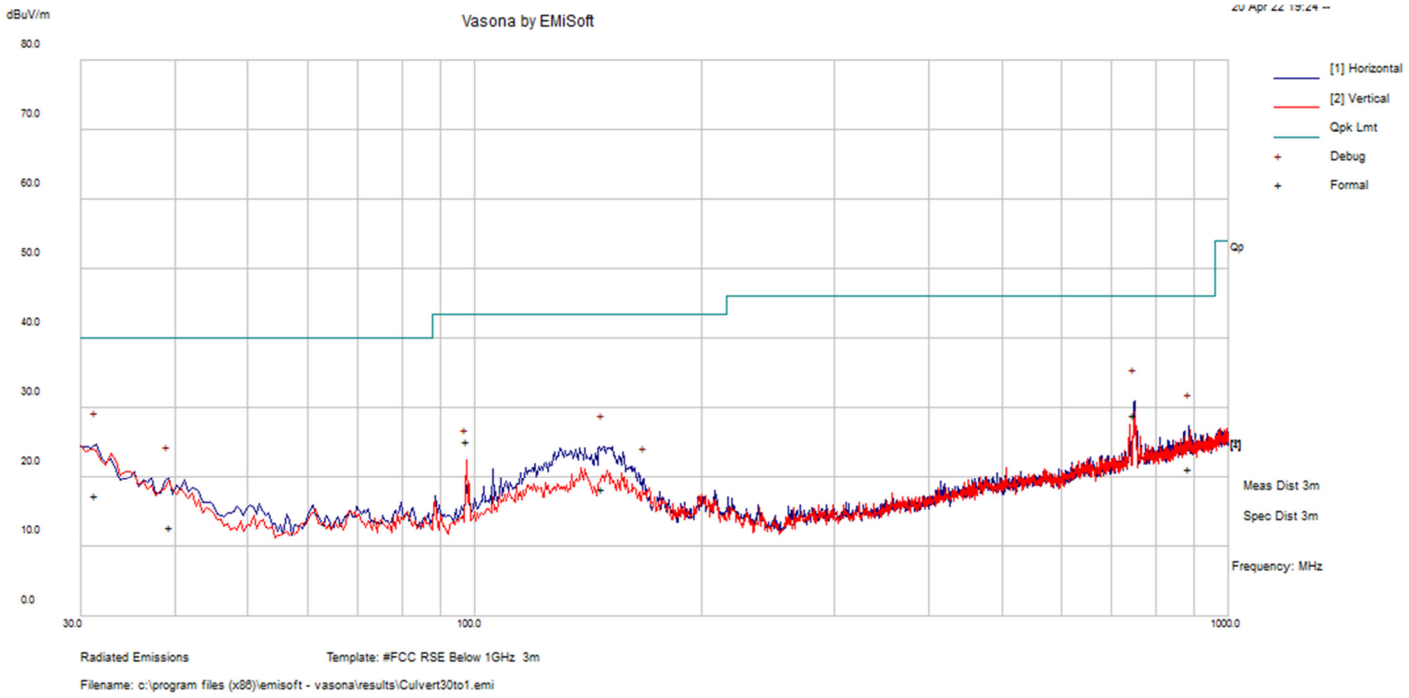
According to the data hereinafter, the EUT complied with FCC Part 15C and ISEDC RSS-247 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Transmitting Channel (MHz)**
-7.78	4804	H	2402

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

6.9 Radiated Emissions Test Results

1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters (Low Channel [2402 MHz], Power Setting: "4")



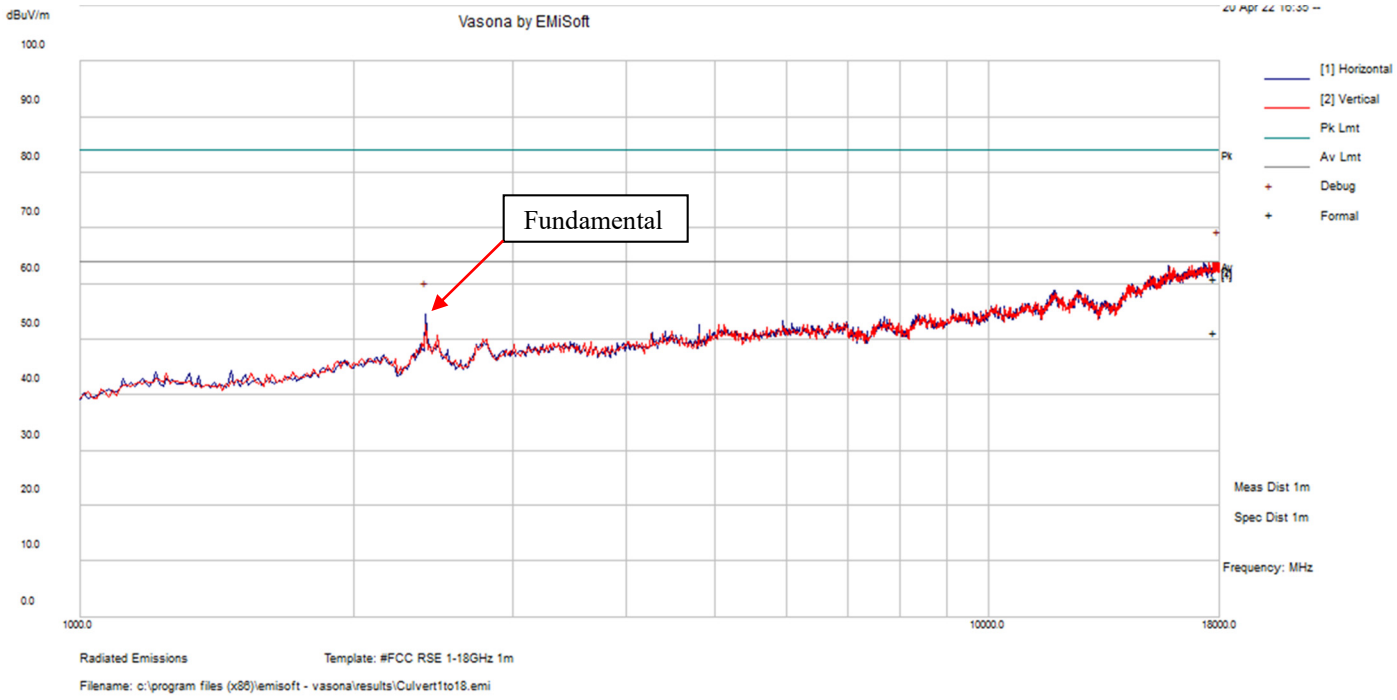
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
749.583	25.69	3.3	28.99	126	H	190	46	-17.01	Pass
31.39075	15.79	1.41	17.2	136	H	291	40	-22.8	Pass
885.53475	16.48	4.7	21.18	168	H	158	46	-24.82	Pass
147.60025	23.89	-5.73	18.16	260	H	291	43.5	-25.34	Pass
39.48875	17.56	-4.84	12.72	207	H	222	40	-27.28	Pass
97.6345	33.65	-8.49	25.16	113	V	171	43.5	-18.34	Pass

2) 1–26.5 GHz, Measured at 3 Meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 2402 MHz											
2390	52.39	20	160	H	32.6	4.913	39.242	50.66	74	-23.34	Peak
2390	55.25	120	160	V	32.6	4.913	39.242	53.52	74	-20.48	Peak
2390	39.77	20	160	H	32.6	4.913	39.242	38.04	54	-15.96	Ave
2390	42.28	120	160	V	32.6	4.913	39.242	40.56	54	-13.45	Ave
4804	48.25	30	150	H	35	8.336	35.707	55.88	74	-18.12	Peak
4804	47.82	0	150	V	35	8.336	35.707	55.45	74	-18.55	Peak
4804	38.60	30	150	H	35	8.336	35.707	46.23	54	-7.78	Ave
4804	38.54	0	150	V	35	8.336	35.707	46.17	54	-7.83	Ave
Middle Channel Frequency: 2426 MHz											
4852	46.91	220	150	H	35.3	8.336	35.707	54.839	74	-19.161	Peak
4852	47.94	270	150	V	35.3	8.336	35.707	55.869	74	-18.131	Peak
4852	37.28	220	150	H	35.3	8.336	35.707	45.213	54	-8.787	Ave
4852	37.12	270	150	V	35.3	8.336	35.707	45.044	54	-8.956	Ave
High Channel Frequency: 2480 MHz											
2483.5	57.69	225	150	H	32.665	5.983	39.242	57.10	74	-16.90	Peak
2483.5	65.22	265	150	V	32.665	5.983	39.242	64.63	74	-9.37	Peak
2483.5	39.75	225	150	H	32.665	5.983	39.242	39.15	54	-14.85	Ave
2483.5	44.44	265	150	V	32.665	5.983	39.242	43.85	54	-10.15	Ave
4960	47.38	0	150	H	35.4	8.336	35.707	55.41	74	-18.59	Peak
4960	47.13	180	150	V	35.4	8.336	35.707	55.16	74	-18.84	Peak
4960	37.44	0	150	H	35.4	8.336	35.707	45.47	54	-8.53	Ave
4960	57.69	225	150	H	32.665	5.983	39.242	57.10	74	-16.90	Peak

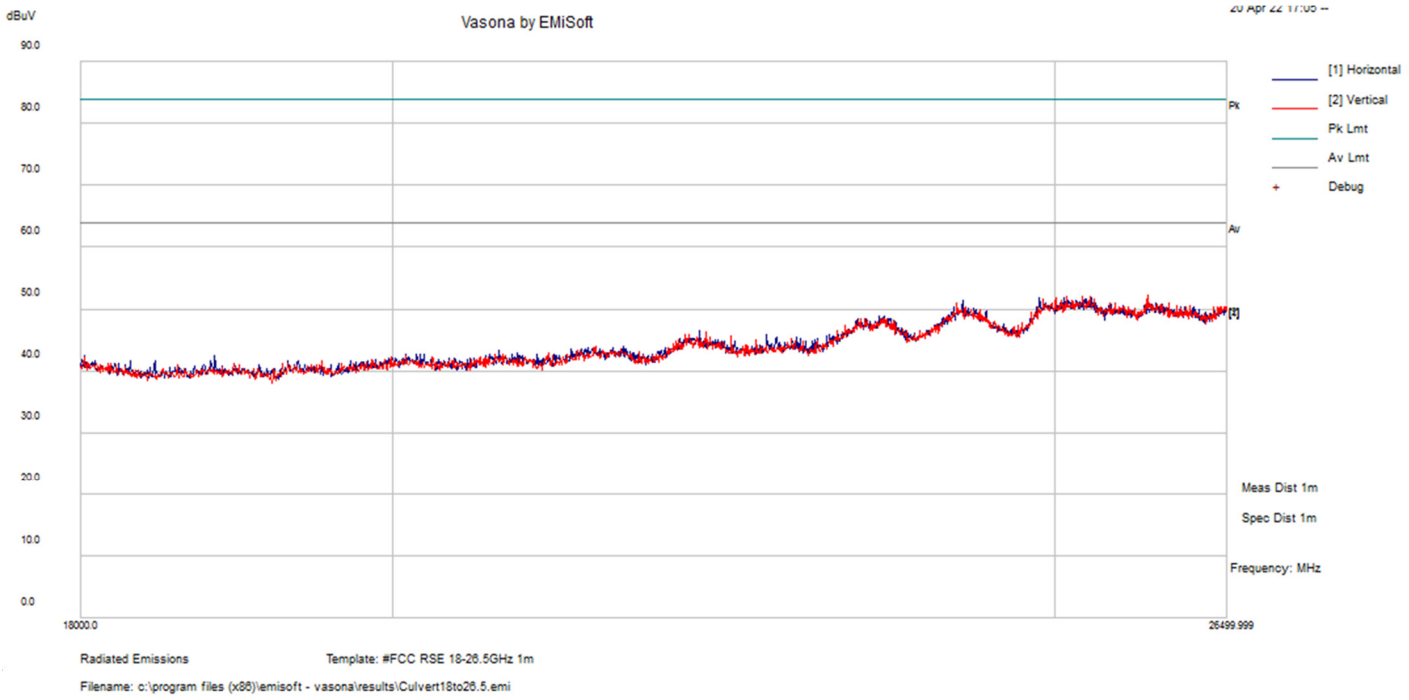
Note: Testing shows compliance with worst-case power setting: “4”

3) 1 – 18 GHz Worst Case scan, Measured at 1 meter (Low Channel [2402 MHz], Power Setting: "4"



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
17775.288	45.67	15.39	61.06	246	H	267	84	-22.94	Peak
17775.288	35.79	15.39	51.18	246	H	267	64	-12.82	Ave

4) 18 – 26.5 GHz Worst Case scan, Measured at 1 meter (Low Channel [2402 MHz], Power Setting: "4"



7 FCC §15.247(a) (2) & ISEDC RSS-247 §5.2, RSS-Gen §6.7 - Emission Bandwidth

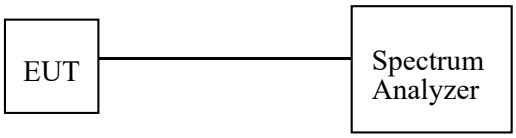
7.1 Applicable Standards

According to FCC §15.247(a) (2) and ISEDC RSS-247 §5.2: the minimum 6 dB bandwidth shall be 500 kHz.

7.2 Measurement Procedure

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

7.3 Test Setup Diagram



7.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
912	Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 months
-	-	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".*

7.5 Test Environmental Conditions

Temperature:	21º C
Relative Humidity:	39 %
ATM Pressure:	102.0 kPa

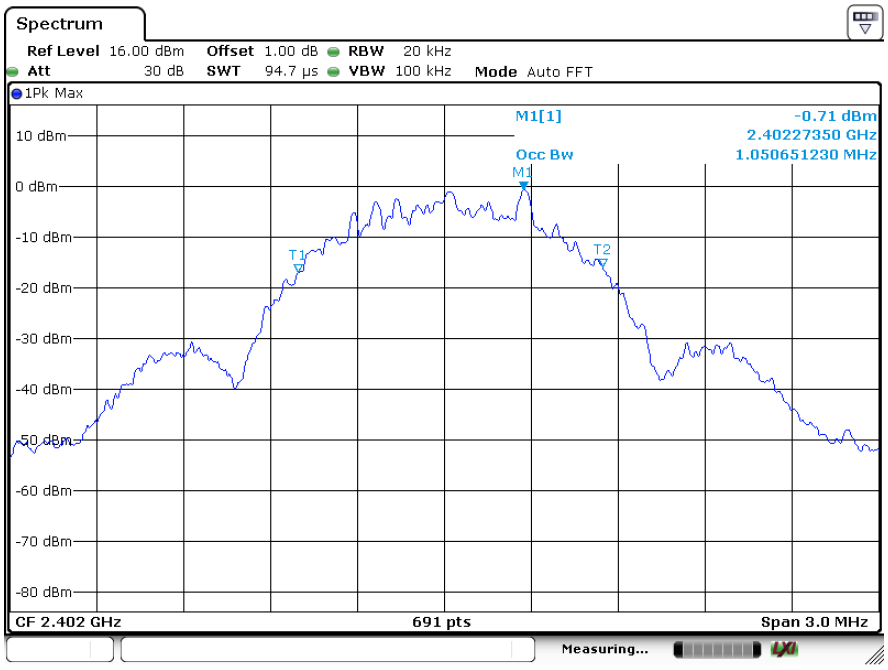
The testing was performed by Christian McCaig on 2022-04-14 at RF test site.

7.6 Test Results

Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (kHz)	6 dB OBW Limit (kHz)
Low	2402	1.05	725	> 500
Middle	2426	1.05	716	> 500
High	2480	1.05	721	> 500

Please refer to the following plots for detailed test results.

99% OBW, Low Channel: 2402 MHz



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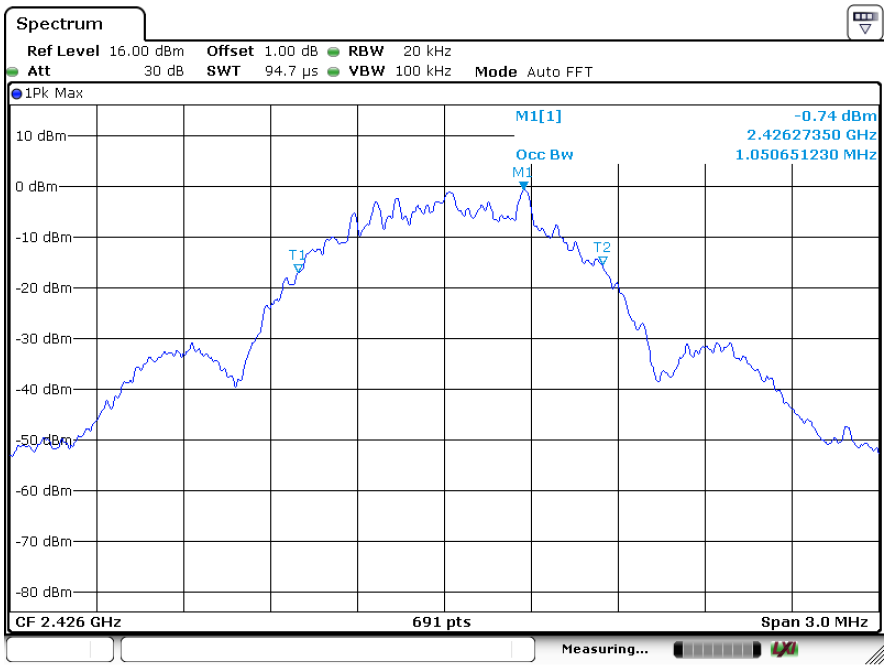
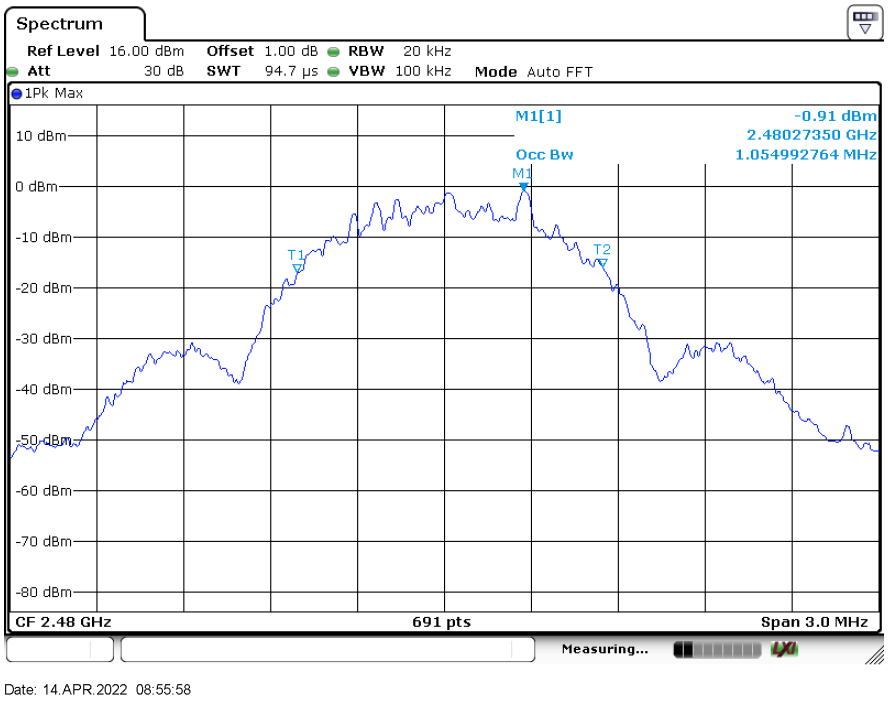
99% OBW, Middle Channel: 2426 MHz

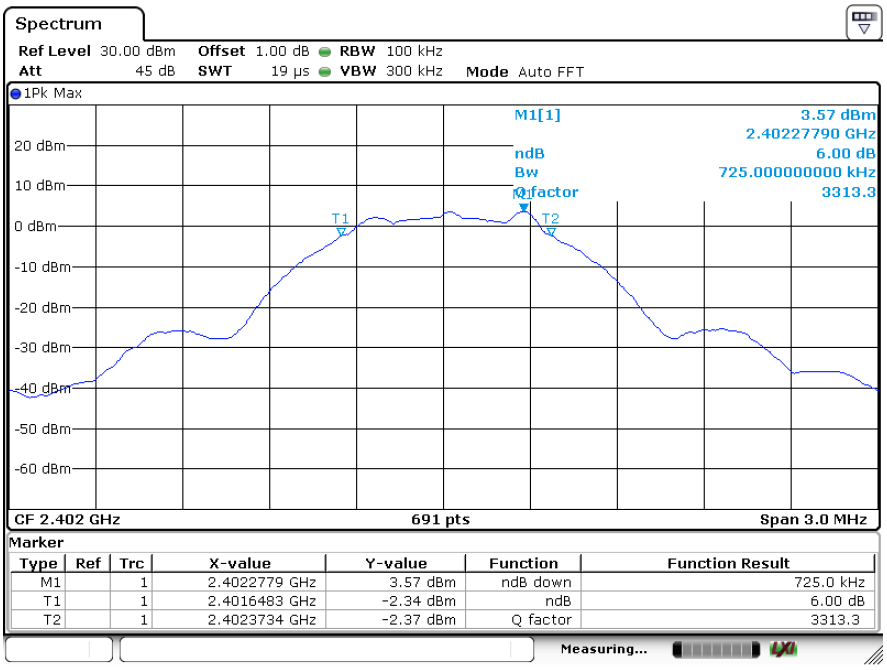


Date: 14.APR.2022 08:56:26

99% OBW, High Channel: 2480 MHz



6 dB OBW, Low Channel: 2402 MHz



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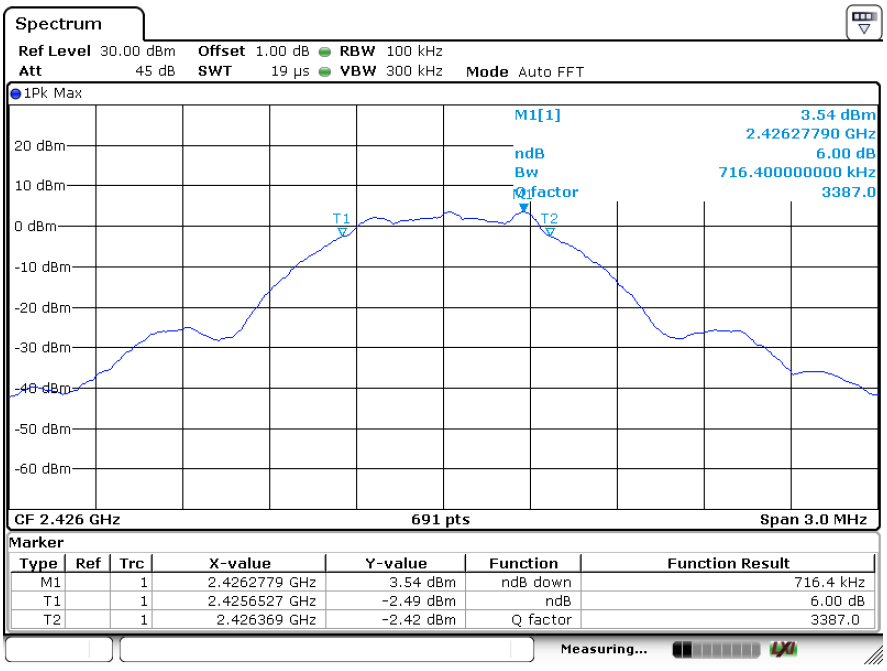
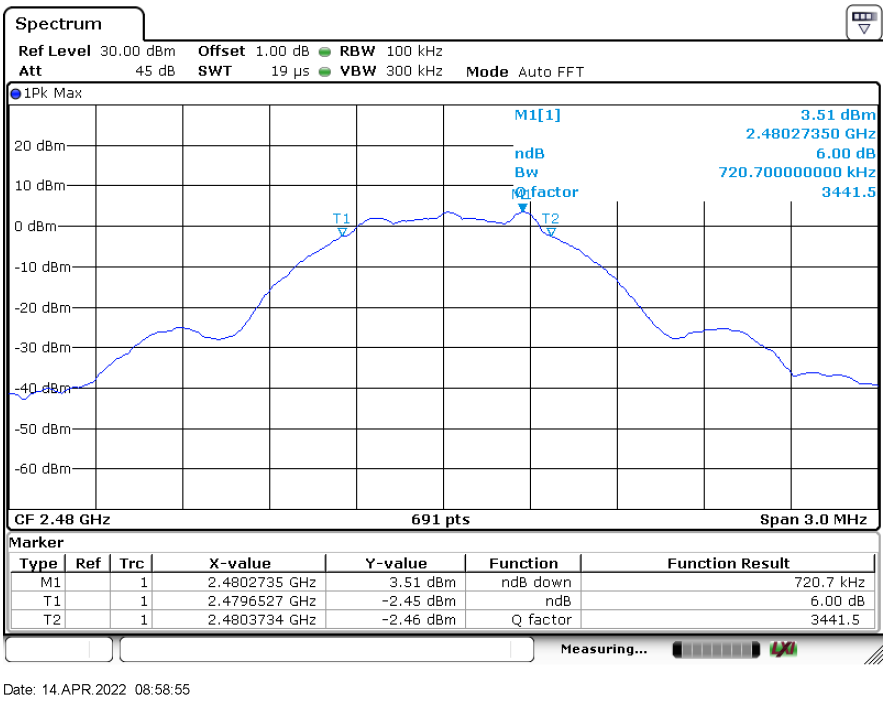
6 dB OBW, Middle Channel: 2426 MHz



Date: 14.APR.2022 08:58:29

6 dB OBW, High Channel: 2480 MHz



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

8.1 Applicable Standards

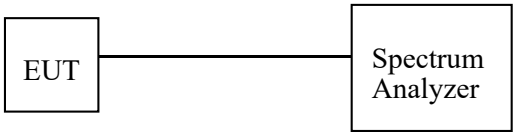
According to FCC §15.247(b) (3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted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

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

8.2 Measurement Procedure

The measurements are based on ANSI C63.10-2013, Section 11.9.2.2.2.

8.3 Test Setup Diagram



8.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
912	Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 months
-	-	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".*

8.5 Test Environmental Conditions

Temperature:	21º C
Relative Humidity:	39 %
ATM Pressure:	102.0 kPa

The testing was performed by Christian McCaig on 2022-04-14 at RF test site.

8.6 Test Results

Power Setting: "-4"

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/ISEDC Limit (dBm)
Low	2402	-5.00	< 30
Middle	2426	-5.12	< 30
High	2480	-5.51	< 30

Power Setting: "0"

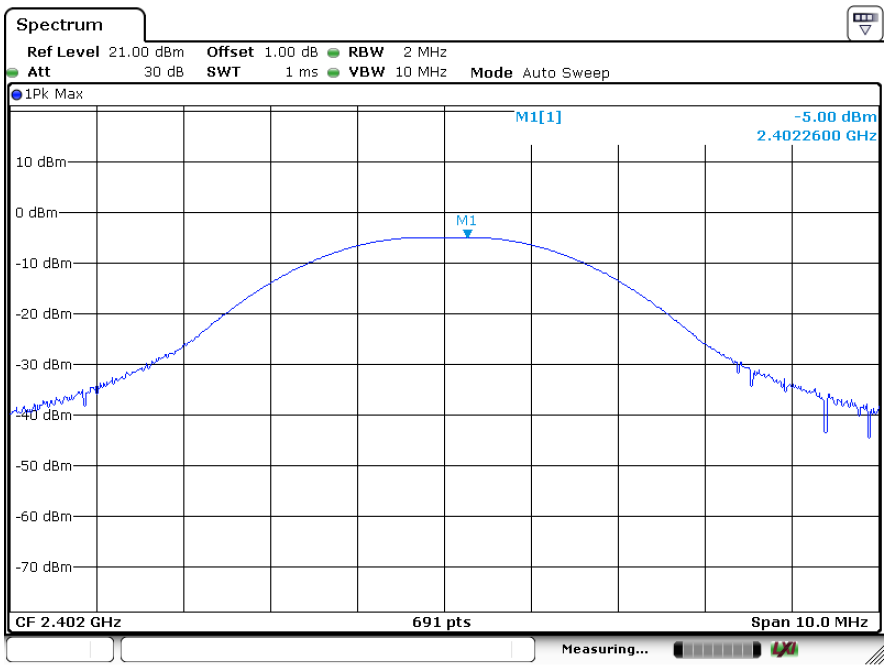
Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/ISEDC Limit (dBm)
Low	2402	-0.59	< 30
Middle	2426	-0.71	< 30
High	2480	-1.06	< 30

Power Setting: "4"

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/ISEDC Limit (dBm)
Low	2402	3.96	< 30
Middle	2426	3.85	< 30
High	2480	3.68	< 30

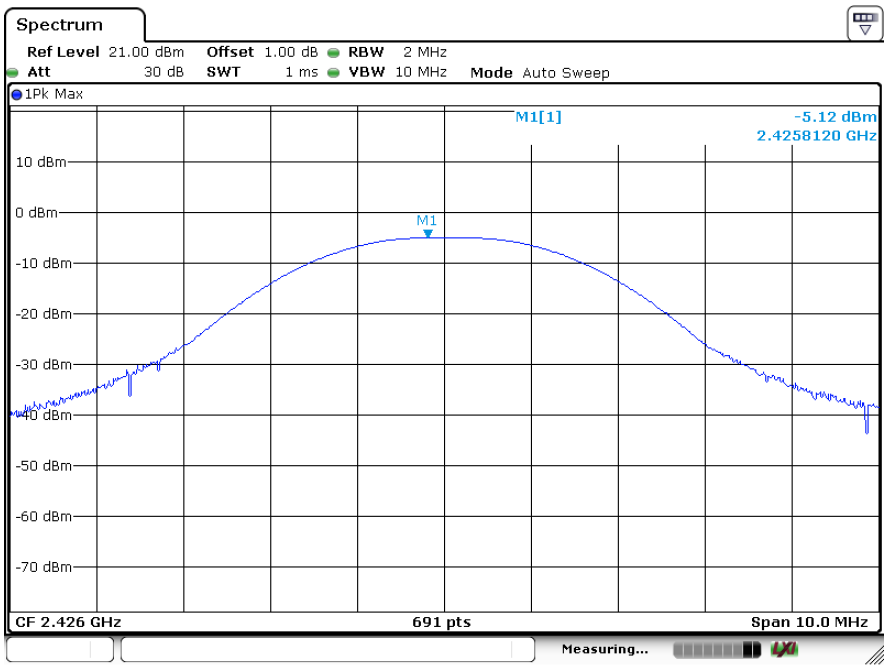
Power Setting: "-4"

Low Channel: 2402 MHz



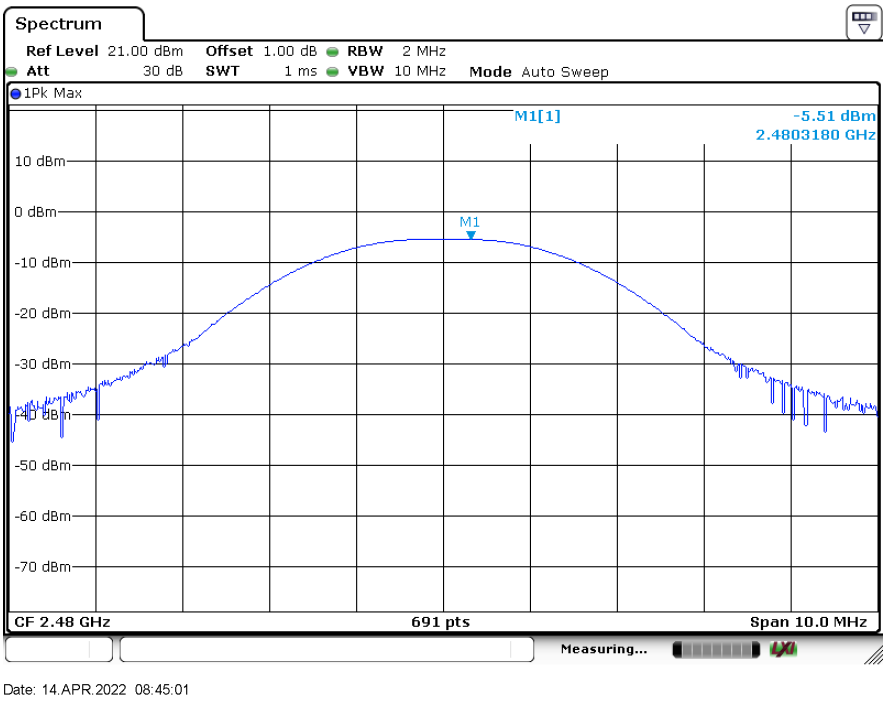
Date: 14.APR.2022 08:41:09

Middle Channel: 2426 MHz



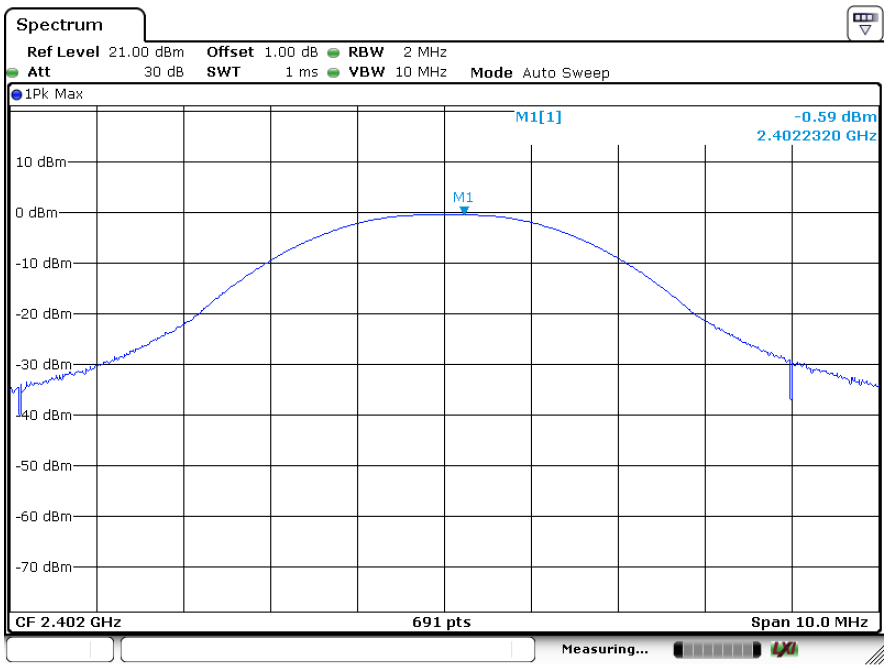
Date: 14.APR.2022 08:41:56

High Channel: 2480 MHz



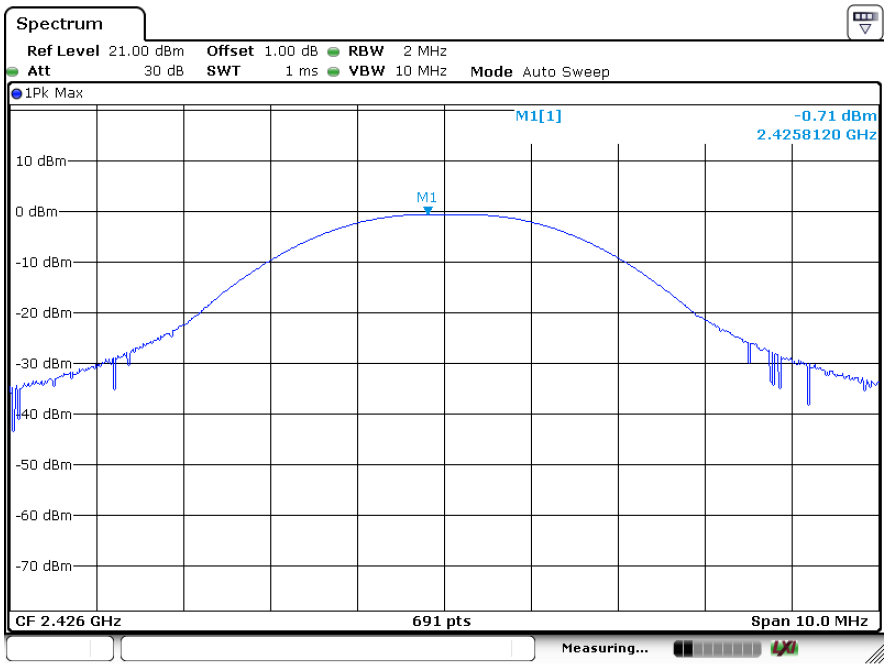
Power Setting: "0"

Low Channel: 2402 MHz



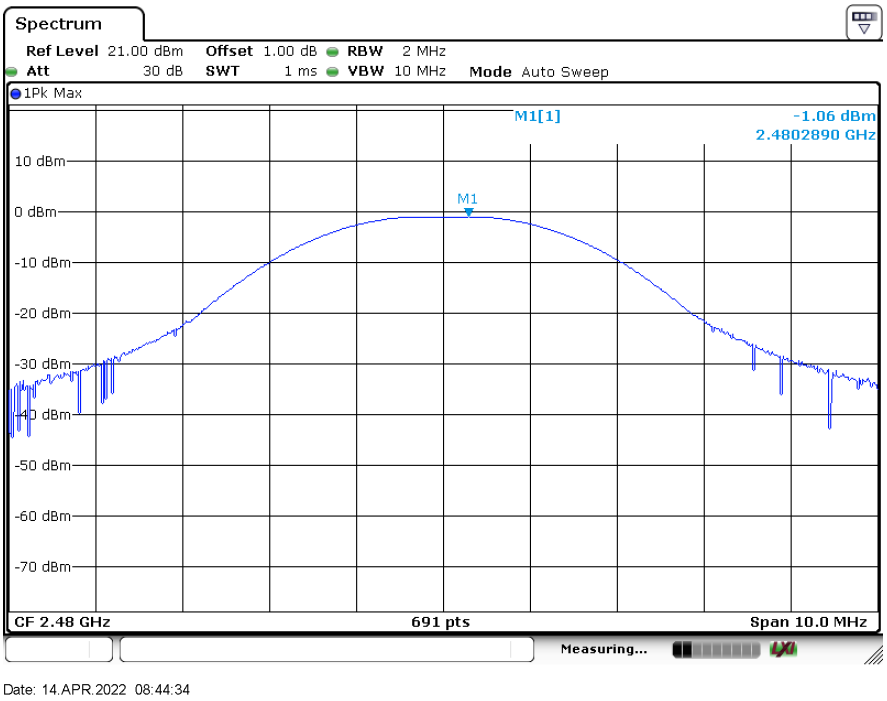
Date: 14.APR.2022 08:40:28

Middle Channel: 2426 MHz



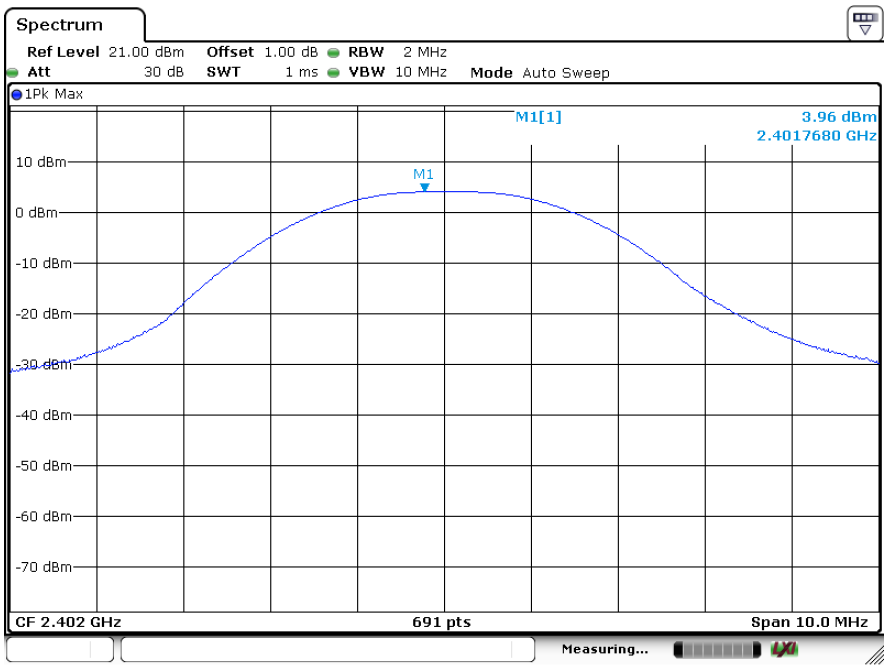
Date: 14.APR.2022 08:42:31

High Channel: 2480 MHz



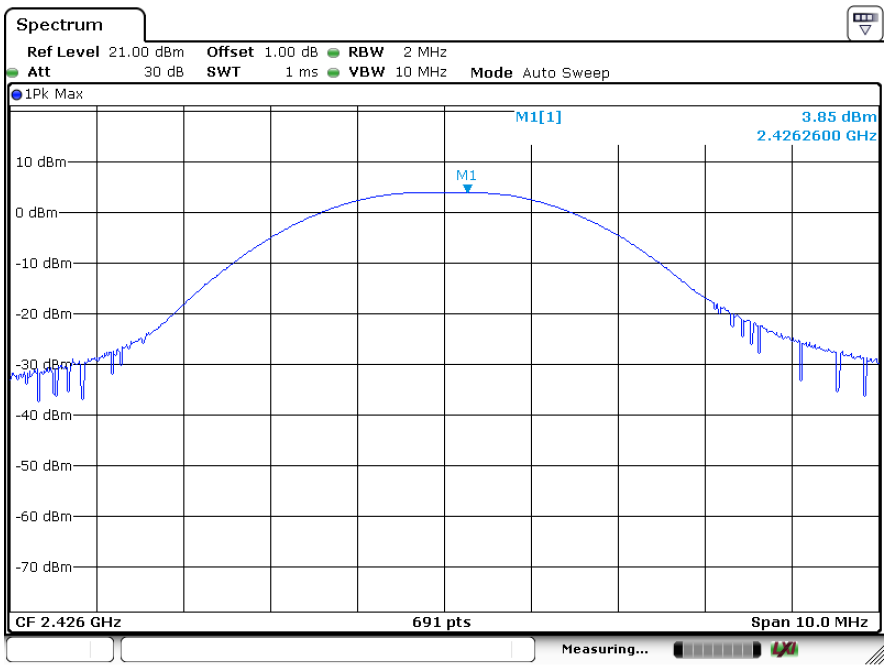
Power Setting: "4"

Low Channel: 2402 MHz



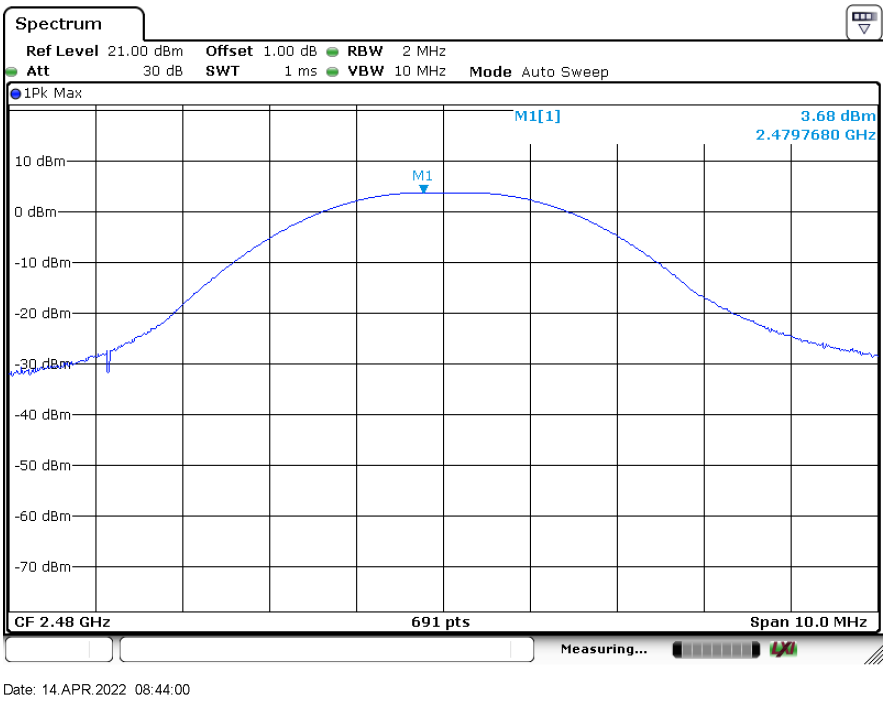
Date: 14.APR.2022 08:39:20

Middle Channel: 2426 MHz



Date: 14.APR.2022 08:43:25

High Channel: 2480 MHz



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

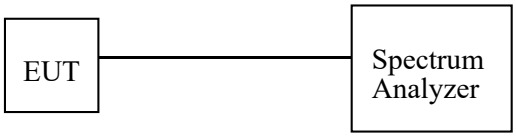
9.1 Applicable Standards

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

9.2 Measurement Procedure

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

9.3 Test Setup Diagram



9.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
912	Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 months
-	-	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".*

9.5 Test Environmental Conditions

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

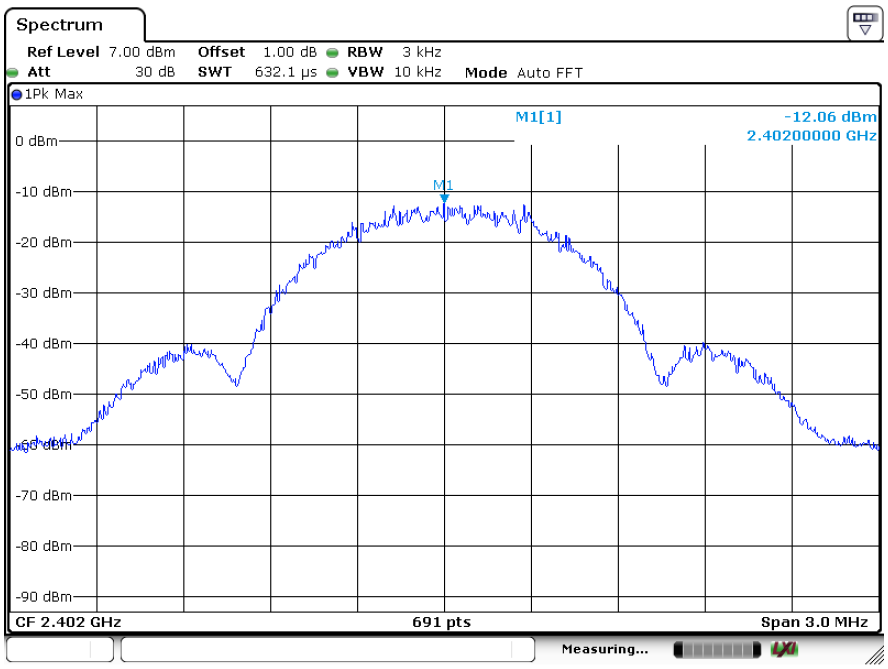
The testing was performed by Christian McCaig on 2022-04-14 at RF test site.

9.6 Test Results

Channel	Frequency (MHz)	Conducted PSD (dBm/3 kHz)	FCC/ISEDC Limit (dBm/3 kHz)
Low	2402	-12.06	< 8
Middle	2426	-12.17	< 8
High	2480	-12.17	< 8

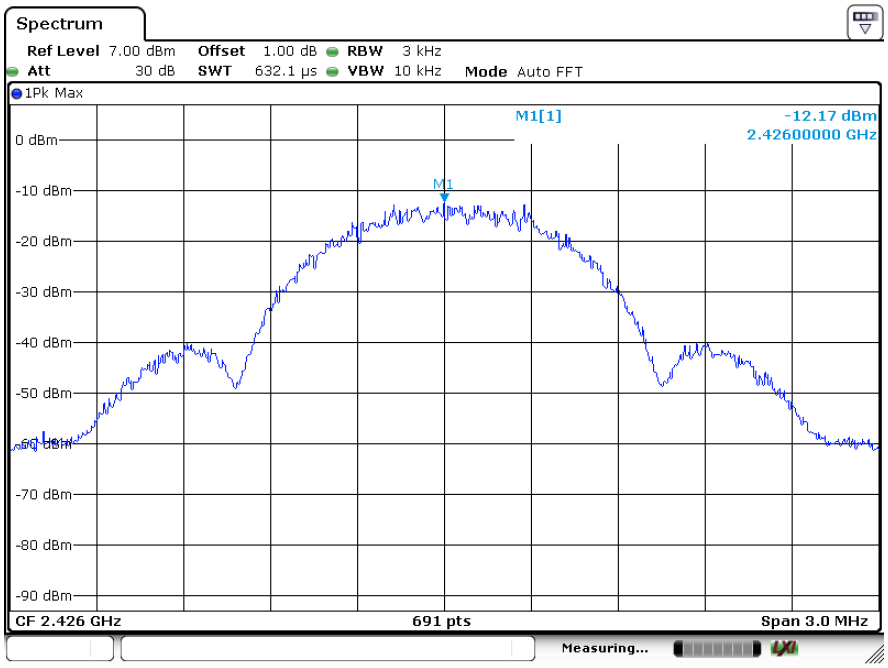
Note: Testing shows compliance with worst-case power setting: “4”.

Low Channel: 2402 MHz



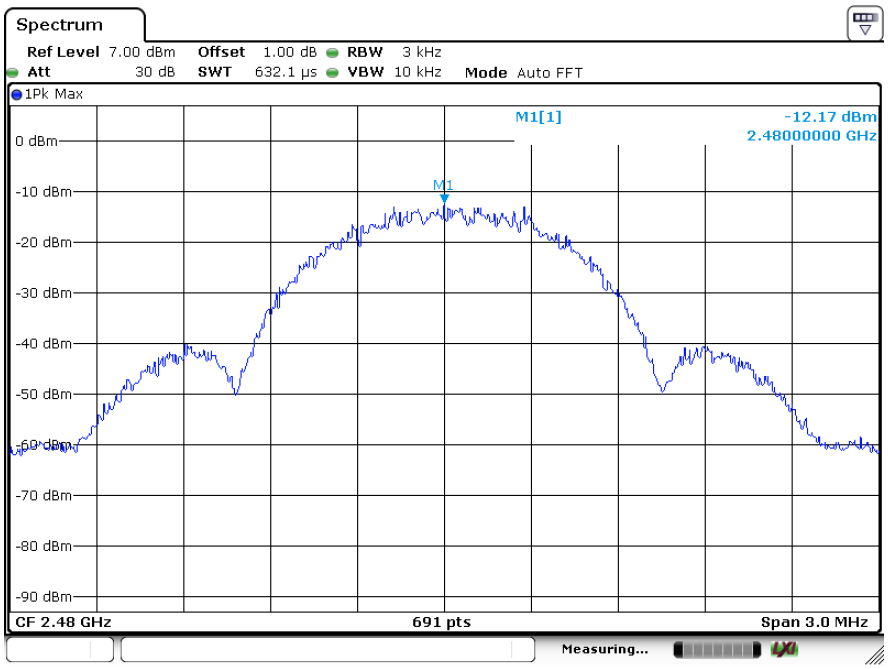
Date: 14.APR.2022 08:53:28

Middle Channel: 2426 MHz



Date: 14.APR.2022 08:54:00

High Channel: 2480 MHz



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

10.1 Applicable Standards

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

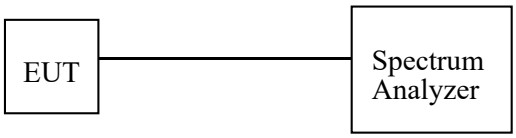
According to ISEDC RSS-247 §5.5.In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

10.2 Measurement Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW = 100 kHz
VBW = 300 kHz
Sweep = coupled
Detector function = peak
Trace = max hold

10.3 Test Setup Diagram



10.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
912	Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 months
-	-	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:	21º C
Relative Humidity:	39 %
ATM Pressure:	102.0 kPa

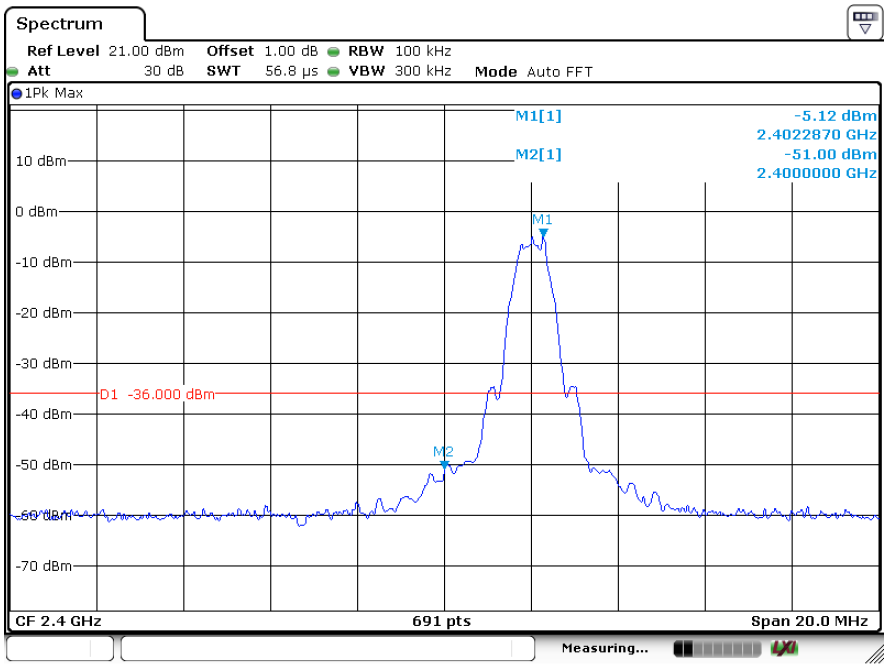
The testing was performed by Christian McCaig on 2022-04-14 at RF test site.

10.6 Test Results

Please refer to the following plots.

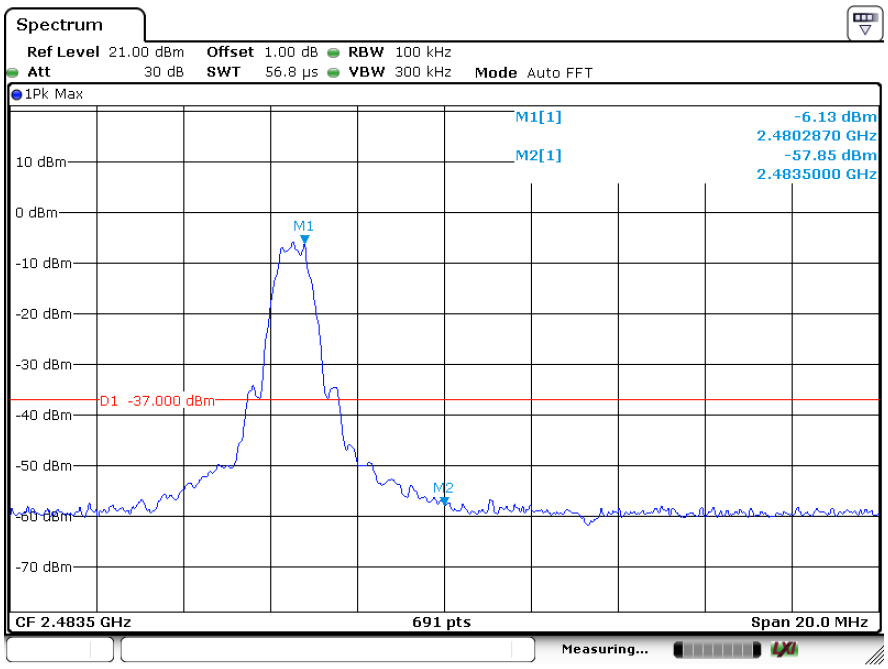
Power Setting: "-4"

Low Channel: 2402 MHz



Date: 14.APR.2022 08:51:02

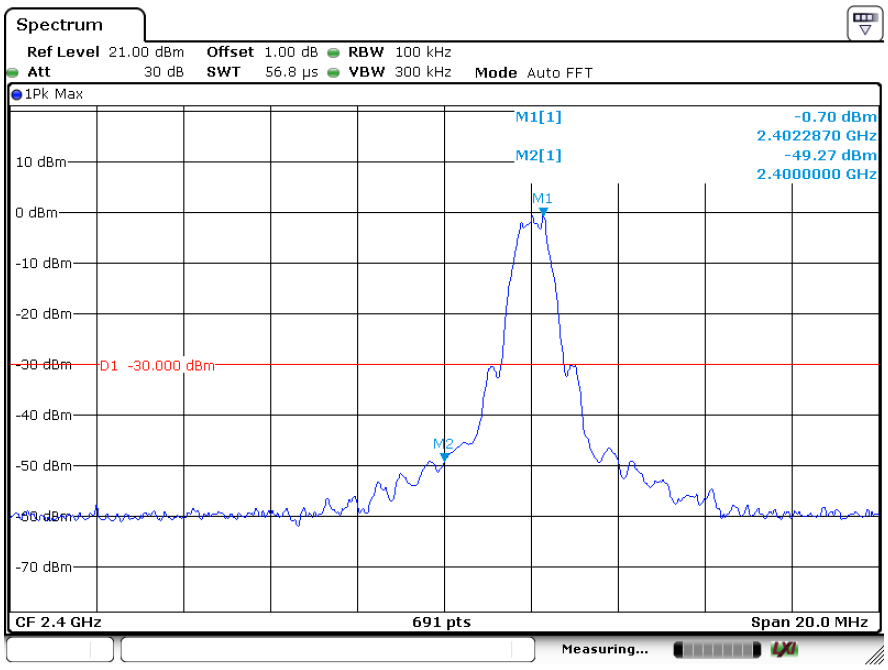
High Channel: 2480 MHz



Date: 14.APR.2022 08:46:54

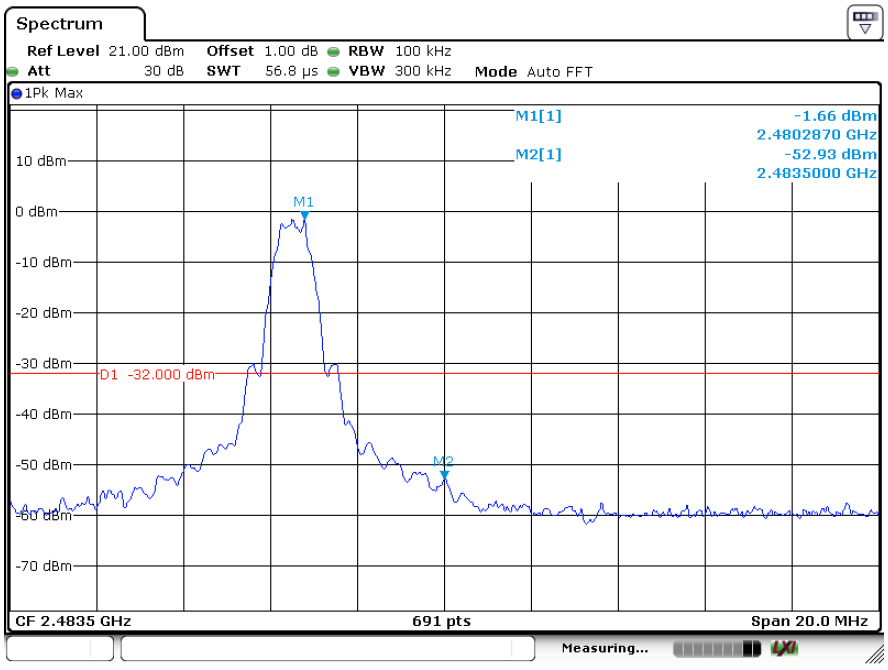
Power Setting: "0"

Low Channel: 2402 MHz



Date: 14.APR.2022 08:50:13

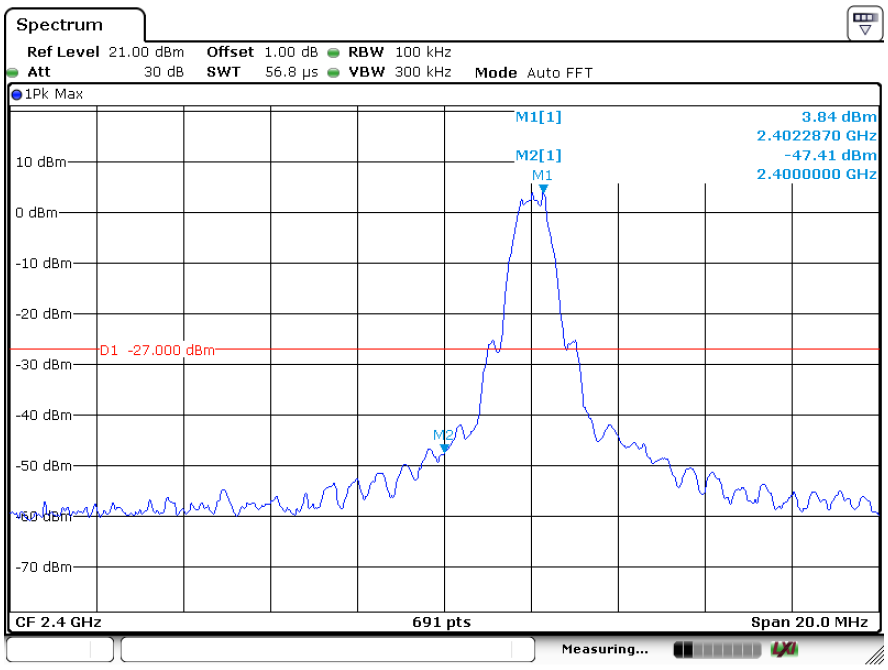
High Channel: 2480 MHz



Date: 14.APR.2022 08:47:56

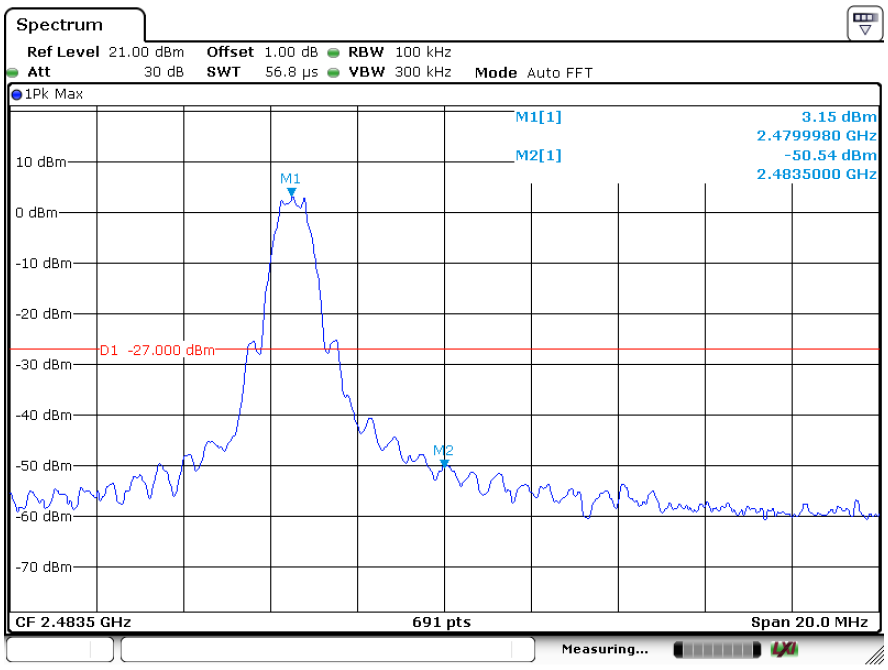
Power Setting: "4"

Low Channel: 2402 MHz



Date: 14.APR.2022 08:49:31

High Channel: 2480 MHz



Date: 14.APR.2022 08:48:43

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

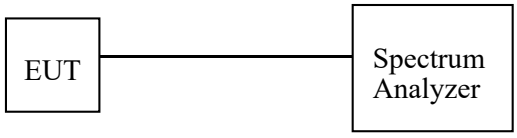
11.1 Applicable Standards

For FCC §15.247(d) and ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

11.2 Test Procedure

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

11.3 Test Setup Diagram



11.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
912	Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 months
-	-	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".*

11.5 Test Environmental Conditions

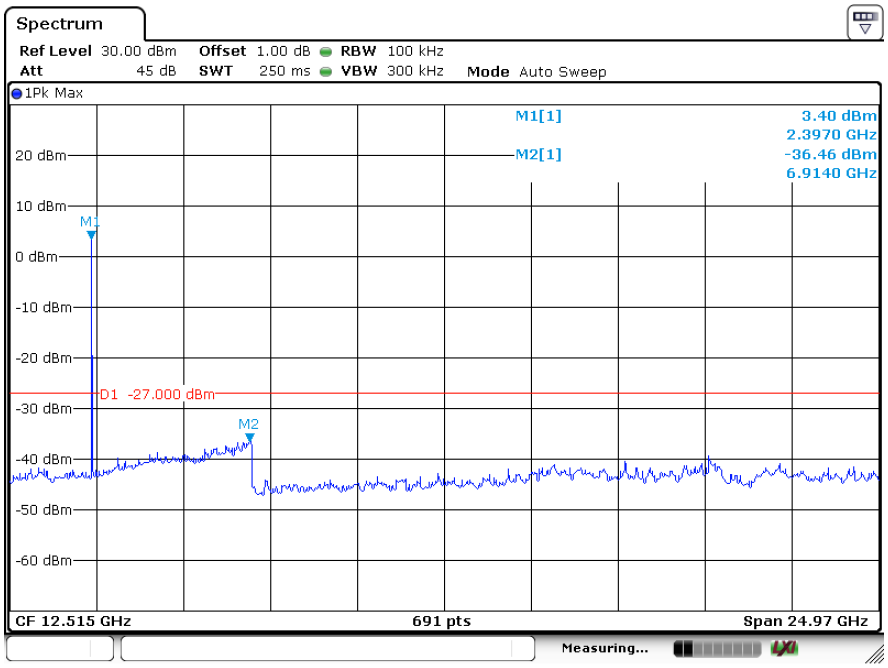
Temperature:	21° C
Relative Humidity:	39 %
ATM Pressure:	102.0 kPa

The testing was performed by Christian McCaig on 2022-04-14 at RF test site.

11.6 Test Results

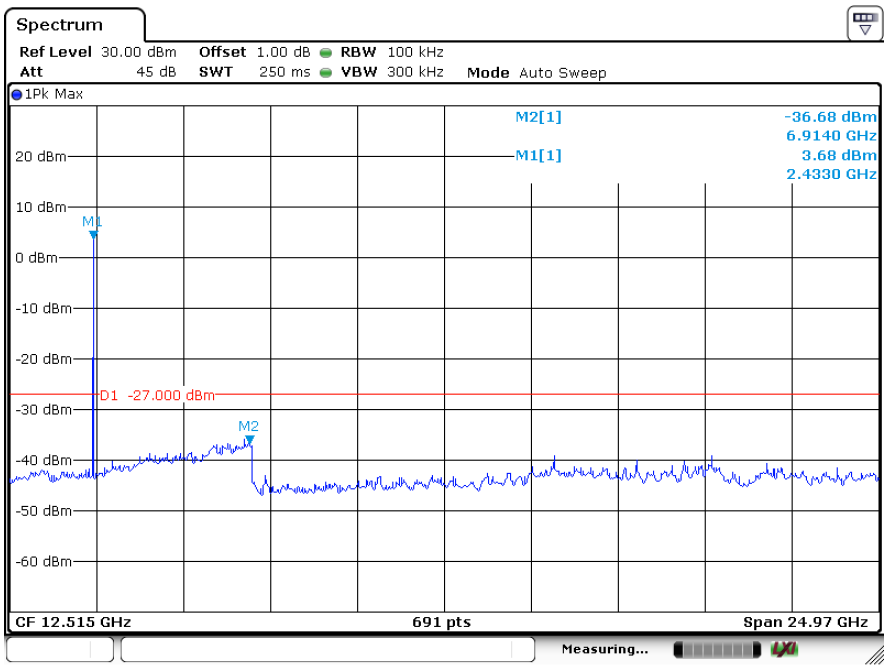
Please refer to the following plots.

Low Channel: 2402 MHz



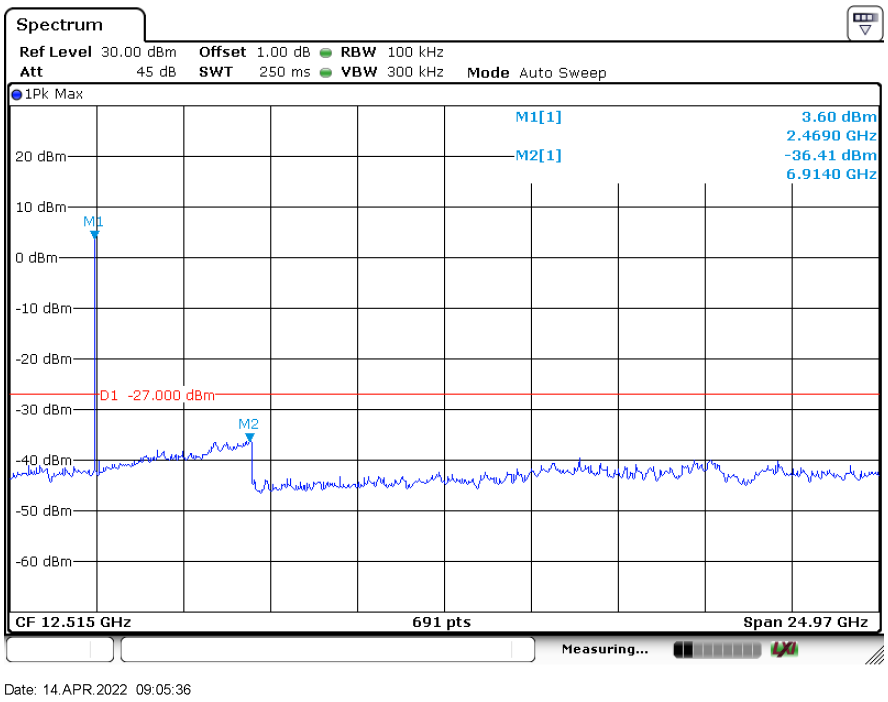
Date: 14.APR.2022 09:02:46

Middle Channel: 2426 MHz



Date: 14.APR.2022 09:01:53

High Channel: 2480 MHz



Note: Testing shows compliance with worst-case power setting: “4”

12 Annex A (Normative) - 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 September 30, 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 ---