



Canada

EMC & RF Test Report

As per

RSS-247 Issue 2:2017 & FCC Part 15 Subpart 15.247

Unlicensed Intentional Radiators

on the

Haleon BTP

Issued by:

TÜV SÜD Canada Inc.
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Testing produced for



See Appendix A for full client & EUT details.



Registration #
6844A-3



Testing Laboratory
Certificate #2955.02



R-14023, G-20072
C-14498, T-20060



Registration #
CA6844



Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Report Scope

This report addresses the EMC verification testing and test results of the **Haleon BTP** module, with 2.4 GHz BLE transmitter in 1 Mbps and 2 Mbps modes. This unit is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:


RSS-247 Issue 2:2017

FCC Part 15 Subpart C 15.247

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc. accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc., unless otherwise stated.


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Summary

The results contained in this report relate only to the item(s) tested.

EUT:	Haleon BTP
FCC Certification #, FCC ID:	2ADCB-HALEON
Industry Canada Certification #, IC:	6715C-HALEON
EUT passed all tests performed	Yes
Tests conducted by	Raymond Au
Report reviewed by	Amir Emami


For testing dates, see "Testing Environmental Conditions and Dates".

Client	Acuity Brands Lighting, Inc	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for Intentional Operation	QuasiPeak Average	Pass See Justification
FCC 15.207 RSS-GEN (Table 3)	Power Line Conducted Emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-GEN (Table 4)	Spurious Radiated Emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-247 5.2(a)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-247 5.4(d)	Max Output Power	< 1 Watt	Pass
FCC 15.247(b)4 RSS-247 5.4(d)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-247 5.5	Antenna Conducted Spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-247 5.2(b)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
Overall Result			Pass

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties.

Client	Acuity Brands Lighting, Inc	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Notes, Justifications, or Deviations

The following notes, justifications for tests not performed or deviations from the above listed specifications apply:

For the antenna requirements specified in FCC 15.203 (RSS-247 section 5.4(d)), the EUT uses a chip antenna soldered onto the PCB, model Johanson 2450AT18B100, with 0.5 dBi peak gain. It is located within its enclosure, and is not meant to be replicable by the user.

The EUT is tested in both 1 Mbps and 2 Mbps data modes.


All testing is performed while constantly transmitting modulated data at its maximum power.

For the Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2483.5 MHz.

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it. However, the 15.247 (d) requirement of power density were met and are detailed later in this test report.

The EUT PCB was tested positioned in the three orthogonal axes. Worst case results are presented, and occurs with the PCB positioned upright (with the rounded side upwards) during BLE testing. See exhibits for test photos.

The EUT was configured to 100% duty cycle for testing purposes. However, as declared by the manufacturer, in production, the EUT has a maximum fixed (source based) duty cycle of 4.88% (4.88ms on time/100ms). The duty cycle cannot be changed or modified by either the device or the end user. As per C63.10 Section 7.5 and KDB 558074 Section 8.1, for the average radiated emission measurements of the band edges and of the spurious emissions in the restricted bands, the duty cycle correction factor of 4.88% [$20\log(4.88\%) = -26.23\text{dB}$] may be applied to the measurements to obtain the average.

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Sample Calculation(s)

Radiated Emission Test

E-Field Level = Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain

E-Field Level = 50dB μ V + 10dB/m + 2dB – 20dB

E-Field Level = 42dB μ V/m

Margin = Limit – E-Field Level

Margin = 50dB μ V/m – 42dB μ V/m

Margin = 8.0 dB (pass)

Power Line Conducted Emission Test

E-Field Level = Received Signal + Attenuation Factor + Cable Loss + LISN Factor


E-Field Level = 50dB μ V + 10dB + 2.5dB + 0.5dB

E-Field Level = 63dB μ V

Margin = Limit – E-Field Level


Margin = 73dB μ V – 63dB μ V

Margin = 10.0 dB (pass)

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Applicable Standards, Specifications and Methods

- ANSI C63.4:2014 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- ANSI C63.10:2013 American National Standard For Testing Unlicensed Wireless Devices
- CFR 47 FCC 15 Subpart C Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
- CISPR 32:2012 Electromagnetic Compatibility of Multimedia Equipment – Emission Requirements
- FCC KDB 558074: 2019 FCC KDB 558074 Digital Transmission Systems, measurements and procedures
- FCC KDB 447498: 2015 RF exposure procedures and equipment authorization policies for mobile and portable devices
- ICES-003 Issue 6 2019 Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
- RSS-GEN Issue 5 2019 General Requirements and Information for the Certification of Radio Apparatus
- RSS-247 Issue 2:2017 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- ISO 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Document Revision Status

Revision	Date	Description	Initials
000	August 10, 2021	Initial Release	RA

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

DTS – Digital Transmission System
LISN – Line Impedance Stabilization Network
NCR – No Calibration Required
NSA – Normalized Site Attenuation
N/A – Not Applicable
RF – Radio Frequency

AE – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

Antenna Port – Port, other than a broadcast receiver tuner port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.


BW – Bandwidth. Unless otherwise stated, this refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

ITE – Information Technology Equipment. Has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer.


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Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab near Toronto, Ontario. The testing lab has calibrated 3m semi-anechoic chambers which allow measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The testing lab also has a calibrated 10m Open Area Test Site (OATS). The chambers are equipped with a turntable that is capable of testing devices up to 5000lb in weight and are equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. This facility is capable of testing products that are rated for single phase or 3-phase AC input and DC capability is also available. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the vertical ground plane if applicable.

Calibrations and Accreditations


The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Innovation, Science and Economic Development Canada (ISED, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-14023, G-20072, C-14498, and T-20060). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc. is accredited to ISO 17025 by A2LA with Testing Certificate #2955.02. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or biennial basis as listed for each respective test.

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Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (°C)	Humidity (%)	Pressure (kPa)
July 13, 2021	Radiated Emissions (1 – 4 GHz)	RA	23.6	64.5	99.9
July 14, 2021	Radiated Emissions (Frequencies other than 1 – 4 GHz)	RA	24.5	60.3	99.9
July 16, 2021	Antenna Conducted Emissions	RA	24.4	57.1	101.8
July 19, 2021	Power Line Conducted Emissions	RA	24.6	61.3	99.8

Client	Acuity Brands Lighting, Inc	 Canada
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Detailed Test Results Section

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
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6dB Bandwidth of Digitally Modulated Systems

Purpose

The purpose of this test is to ensure that the bandwidth occupied exceeds a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently wide. This also helps prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information.

Limits and Method

The limit is as specified in FCC Part 15.247(a)2 and RSS-247 5.2(a).

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz. This should be measured with a 100 kHz RBW and a 300 kHz VBW.

The method is given in FCC KDB 558074 Section 8.1 and ANSI C63.10.

Results


The EUT passed.

For 1 Mbps:

The minimum 6 dB Bandwidth measured was 688 kHz
The maximum 99% Occupied Bandwidth was 1.04 MHz.


For 2 Mbps:

The minimum 6 dB Bandwidth measured was 1.356 MHz
The maximum 99% Occupied Bandwidth was 2.10 MHz.

Client	Acuity Brands Lighting, Inc	
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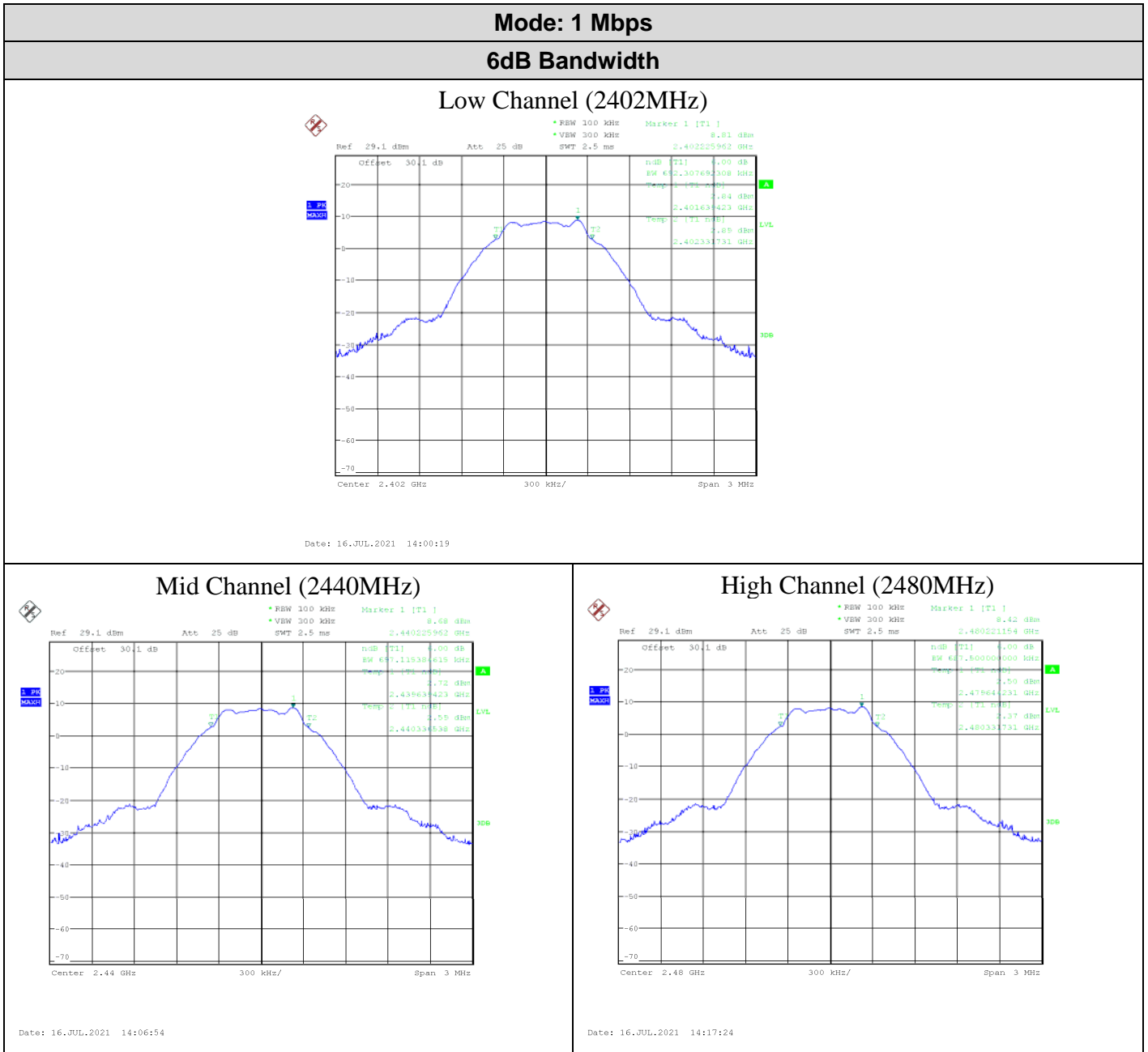
Mode: 1 Mbps			
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.692	1.04
Mid	2440	0.697	1.04
High	2480	0.688	1.04


Mode: 2 Mbps			
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.356	2.10
Mid	2440	1.356	2.10
High	2480	1.356	2.10

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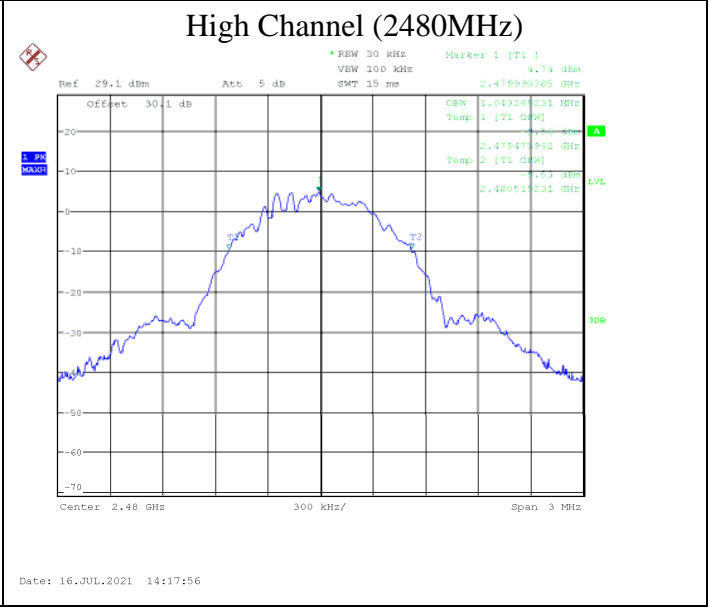
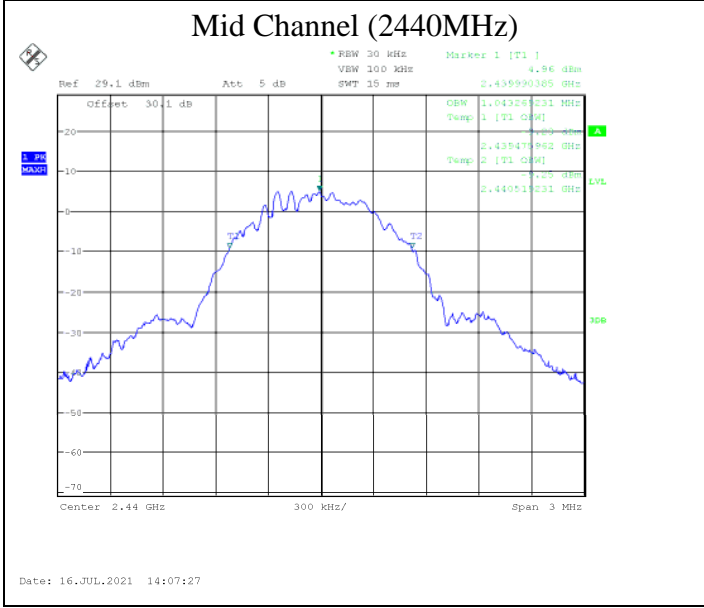
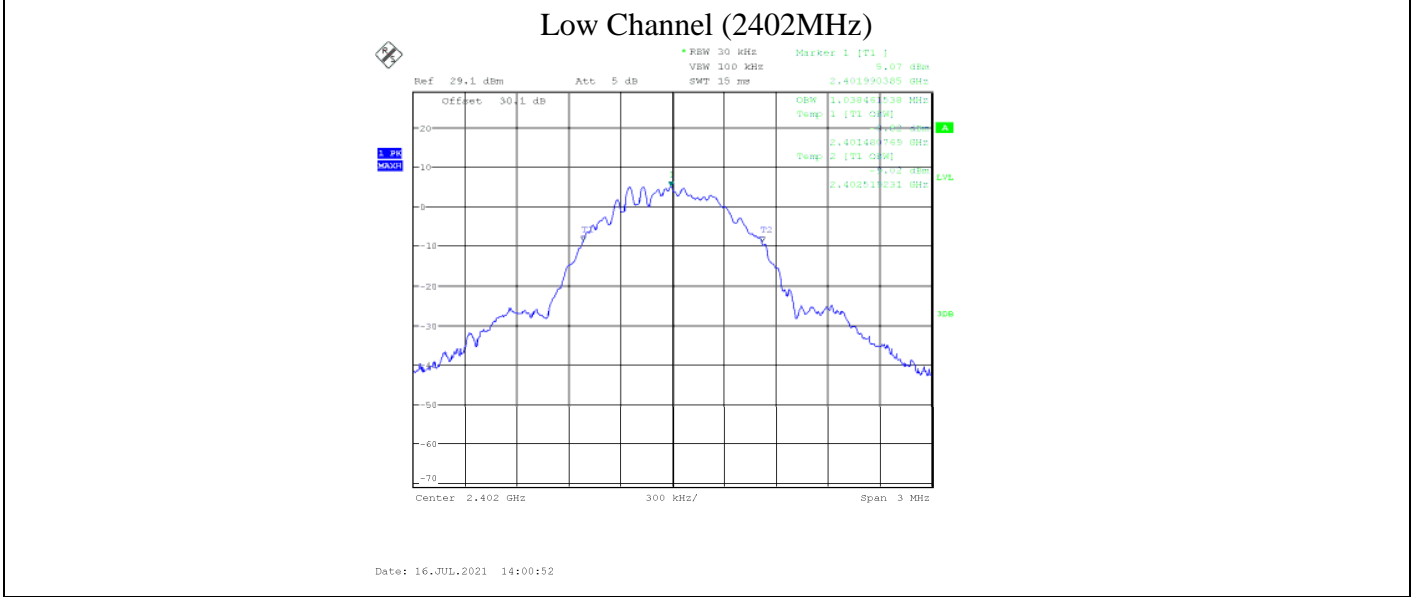
Graphs

The graphs shown below show the OBW of the device during the conducted measurement operation of the EUT. This is measured by a max hold on the spectrum analyzer.




Client	Acuity Brands Lighting, Inc	
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Mode: 1 Mbps
99% Bandwidth



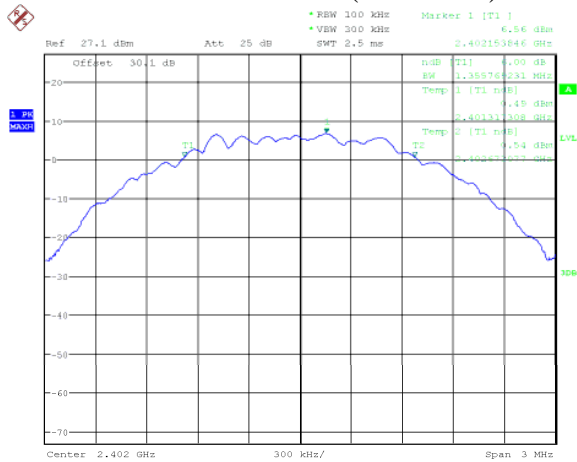
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Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Mode: 2 Mbps

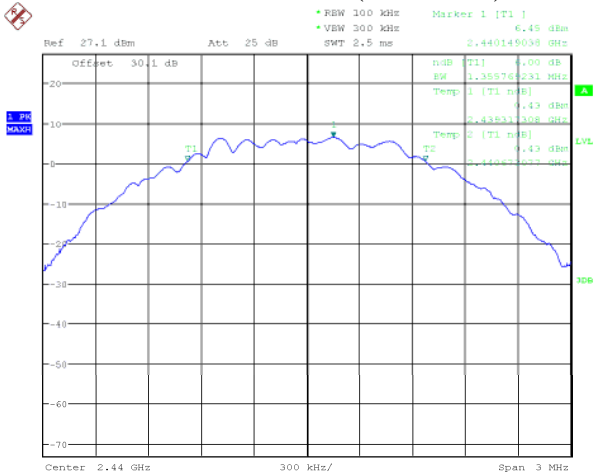
6dB Bandwidth

Low Channel (2402MHz)



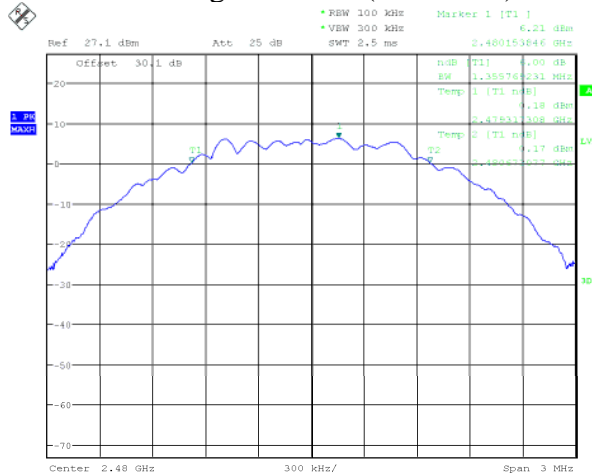
Date: 16.JUL.2021 14:43:01

Mid Channel (2440MHz)




Date: 16.JUL.2021 15:16:15

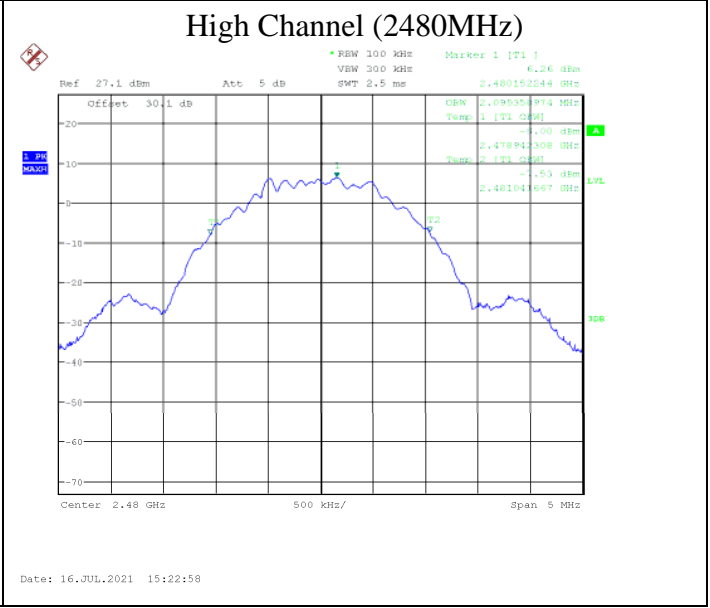
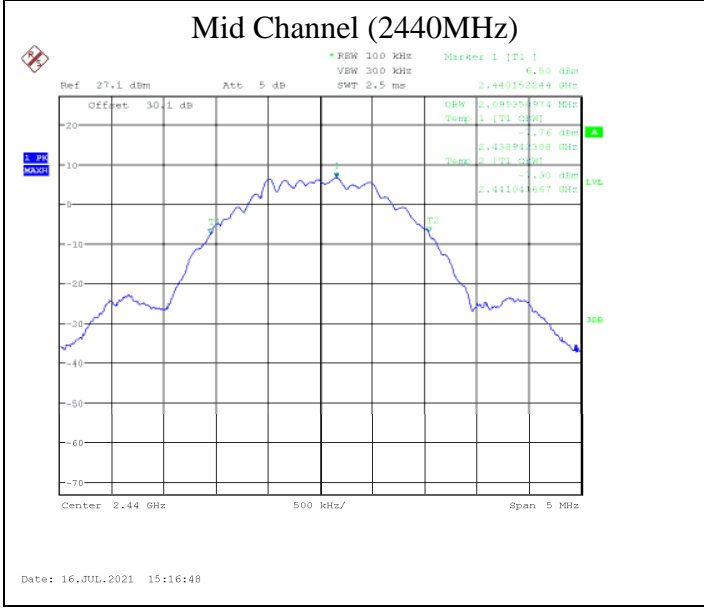
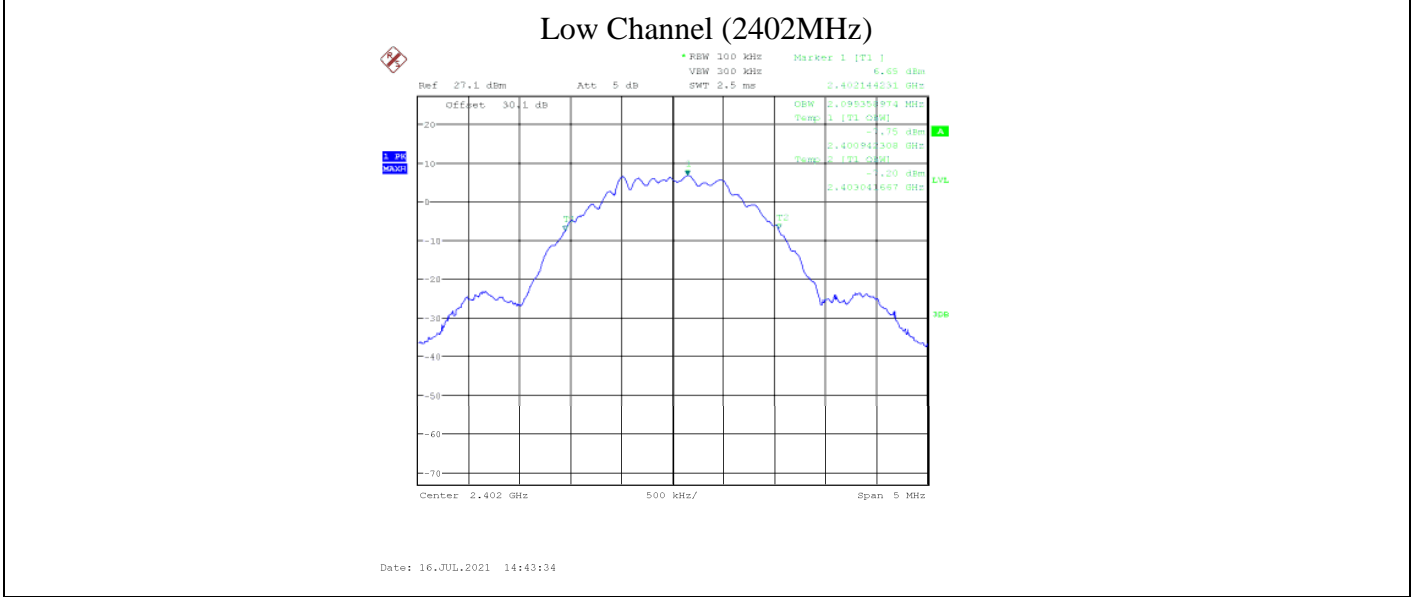
High Channel (2480MHz)




Date: 16.JUL.2021 15:22:25

Client	Acuity Brands Lighting, Inc	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Mode: 2 Mbps
99% Bandwidth




Note: See exhibits for photos showing the test set-up.

Client	Acuity Brands Lighting, Inc	
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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133
Attenuator 20 dB	3M-20	Weinschel	NCR	NCR	GEMC 280

Client	Acuity Brands Lighting, Inc	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Maximum Peak Envelope Conducted Power

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, the maximum power does not exceed an amount which may create an excessive power level.

Limits and Method

The limits are defined in FCC Part 15.247(b) and RSS-247 5.4(d).
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt (30 dBm).


The method is given in FCC KDB 558074 Section 9.1.2 and ANSI C63.10.

Results

The EUT passed.

Mode: 1 Mbps			
Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
Low	2402	9.91	9.79
Mid	2440	9.82	9.59
High	2480	9.54	8.99

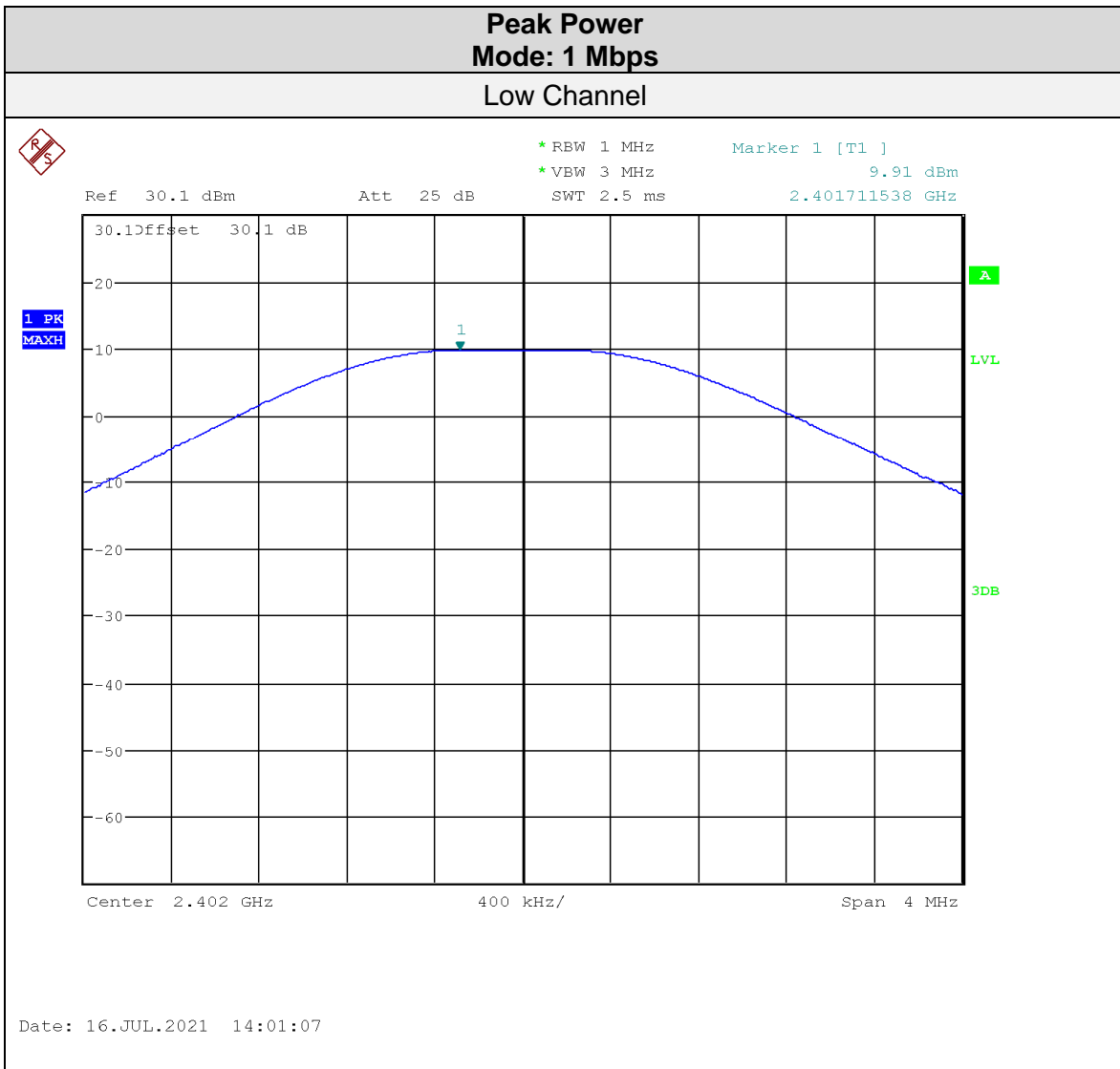
Mode: 2 Mbps			
Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
Low	2402	10.01	10.02
Mid	2440	9.88	9.73
High	2480	9.66	9.25


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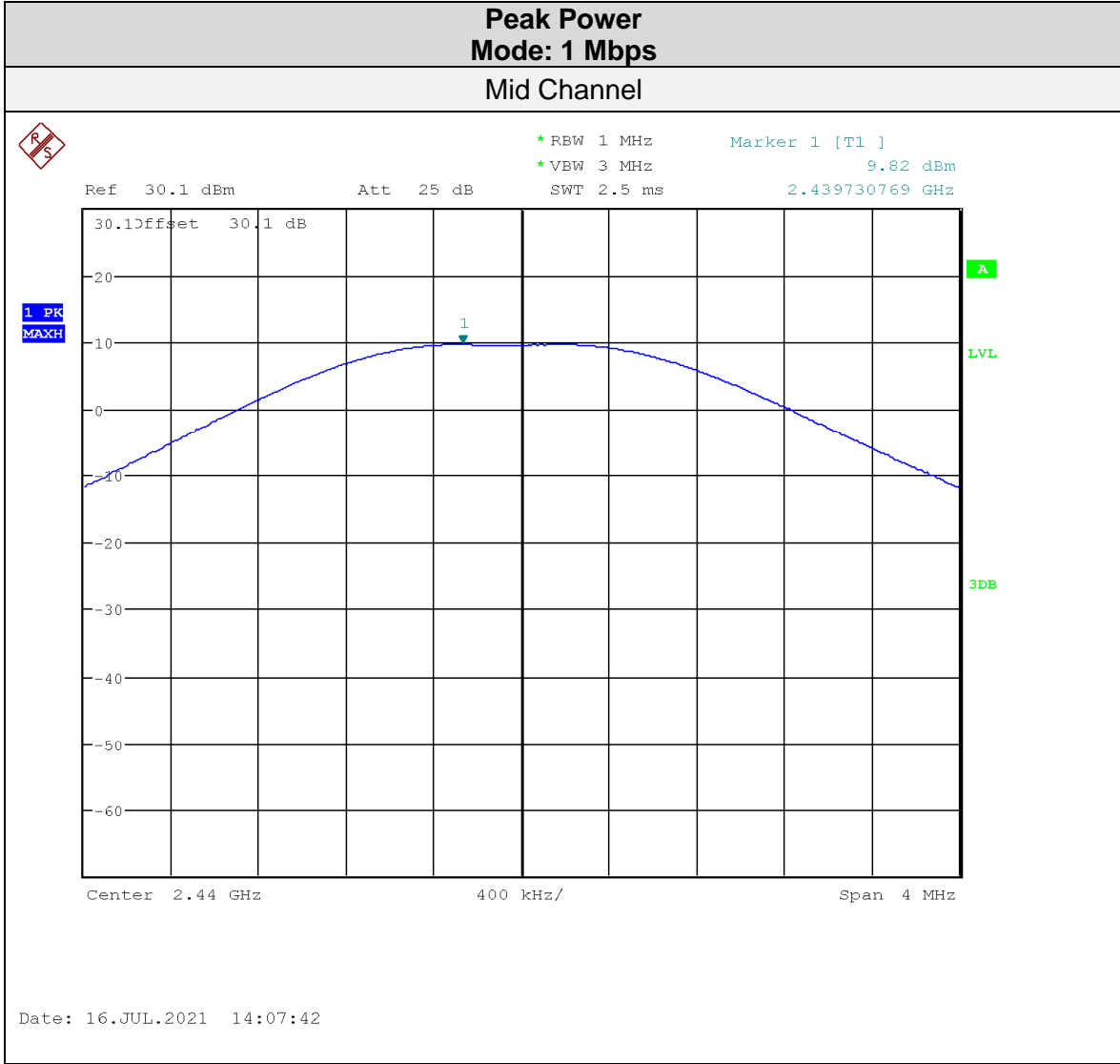
Note: The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer


Graphs

The graphs shown below show the peak power output of the device during the conducted measurement operation of the EUT. The measurement RBW is \geq than the DTS bandwidth.




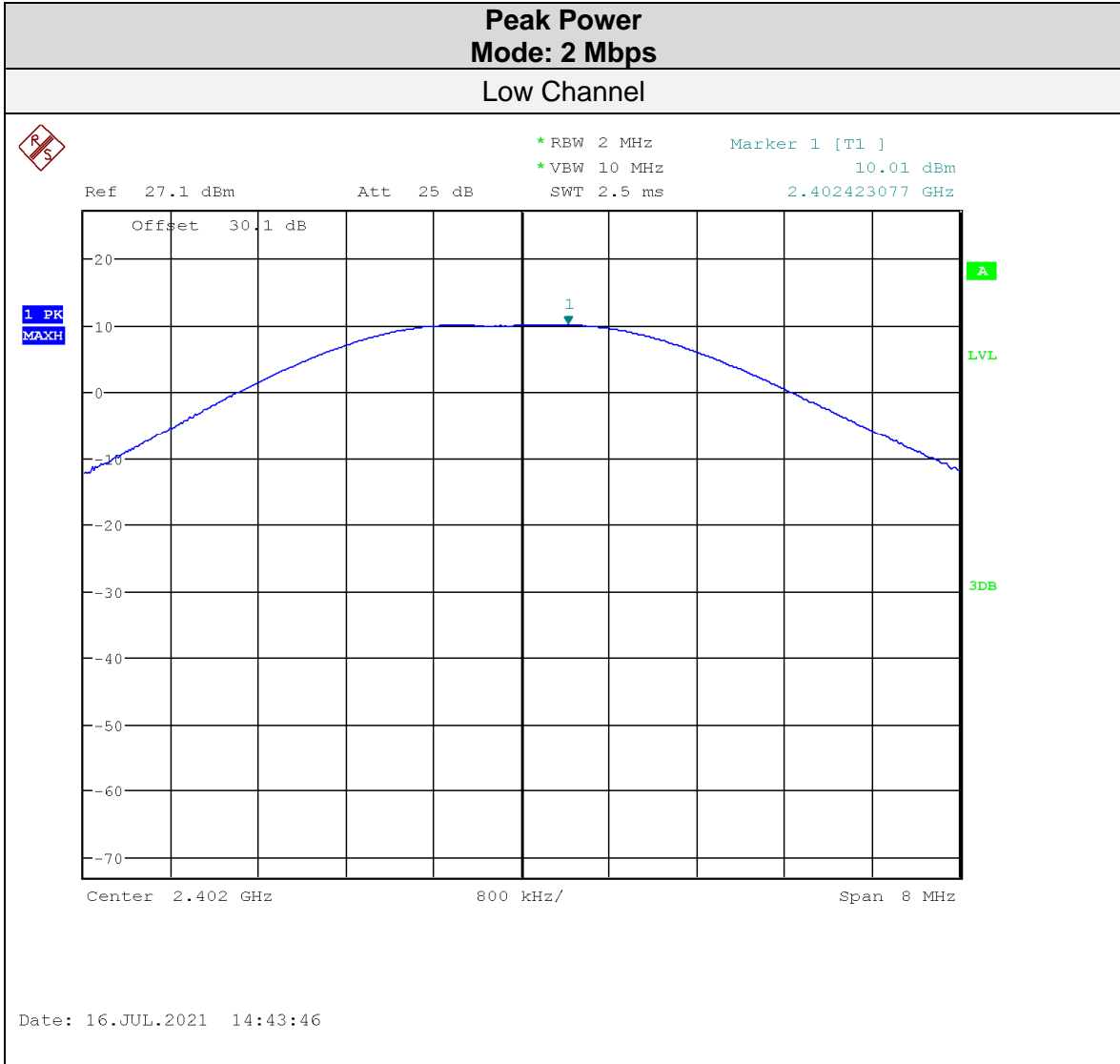
Client	Acuity Brands Lighting, Inc	
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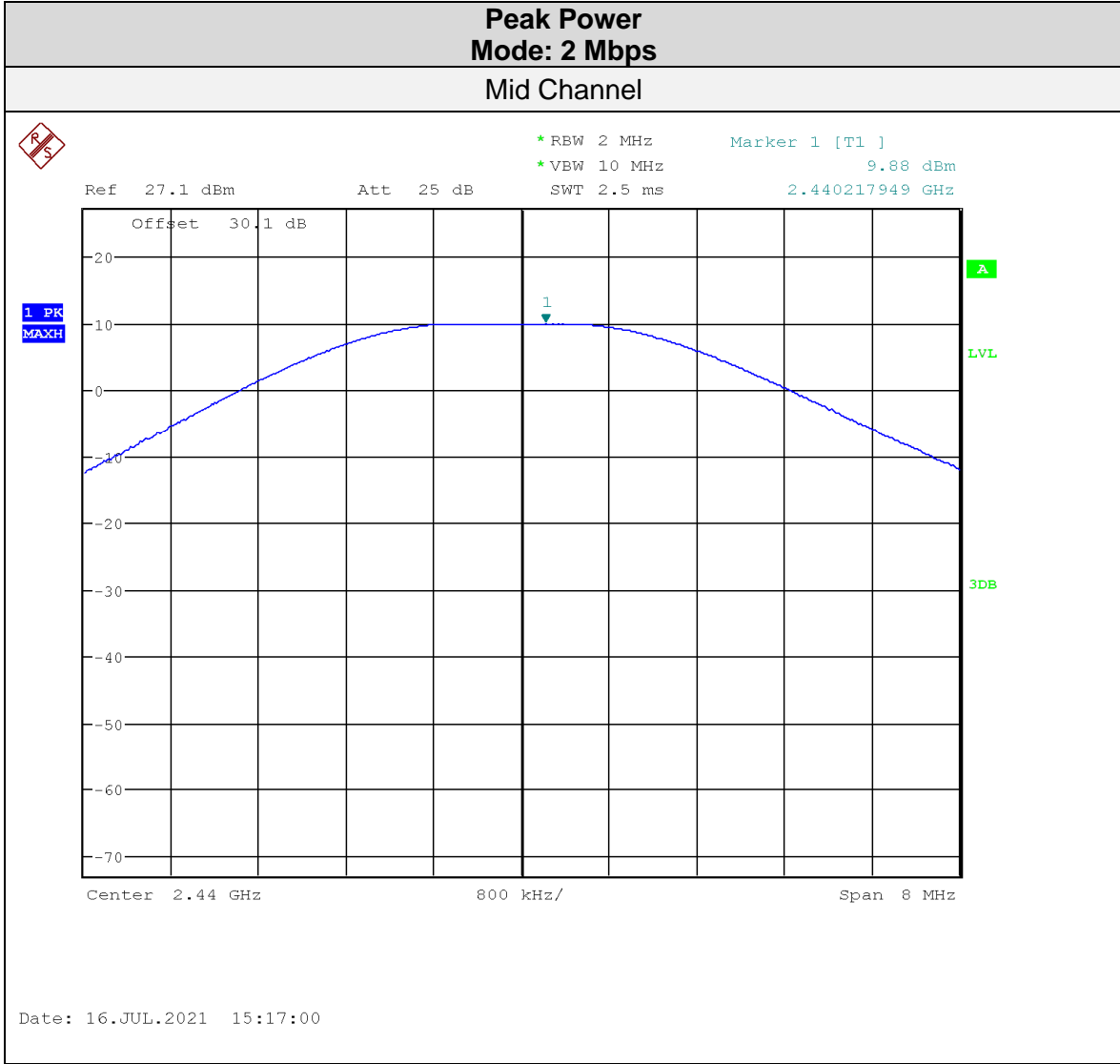
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




See exhibits for photos showing the test set-up.

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Client	Acuity Brands Lighting, Inc	
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Antenna Spurious Conducted Emissions (-20 dBc Requirement)

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.


Limits and Method

The limits are defined in 15.247(d) and RSS-247 5.5. In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10th harmonic. This -20 dBc requirement also applies at the ‘band edge’ or 2.4 GHz and 2.4835 GHz.

The method is given in FCC KDB 558074 Section 11 and ANSI C63.10

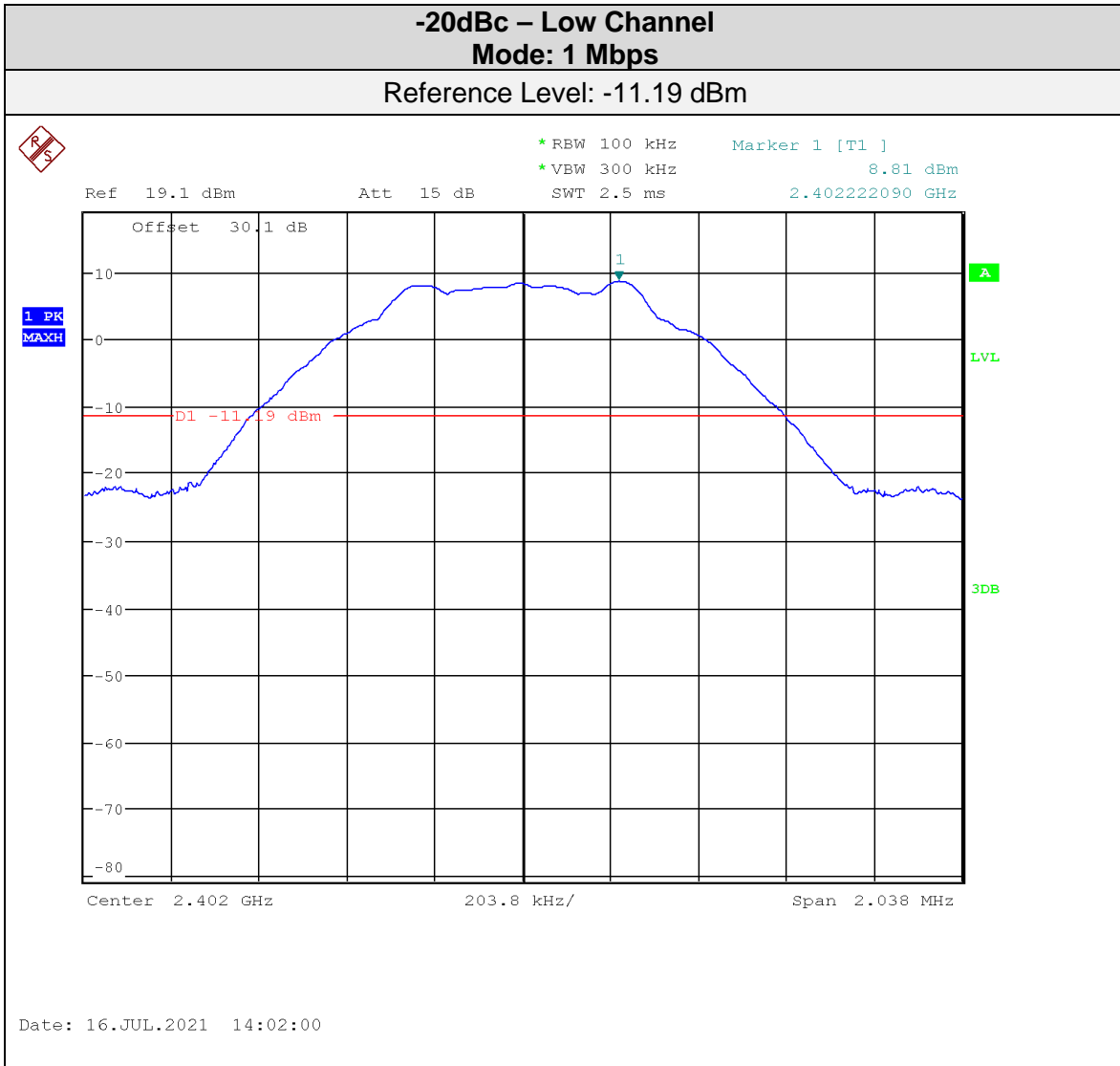
Results


The EUT passed. Low, middle and high bands were measured. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band and for the higher band edge at 2.4835 GHz in the high band.

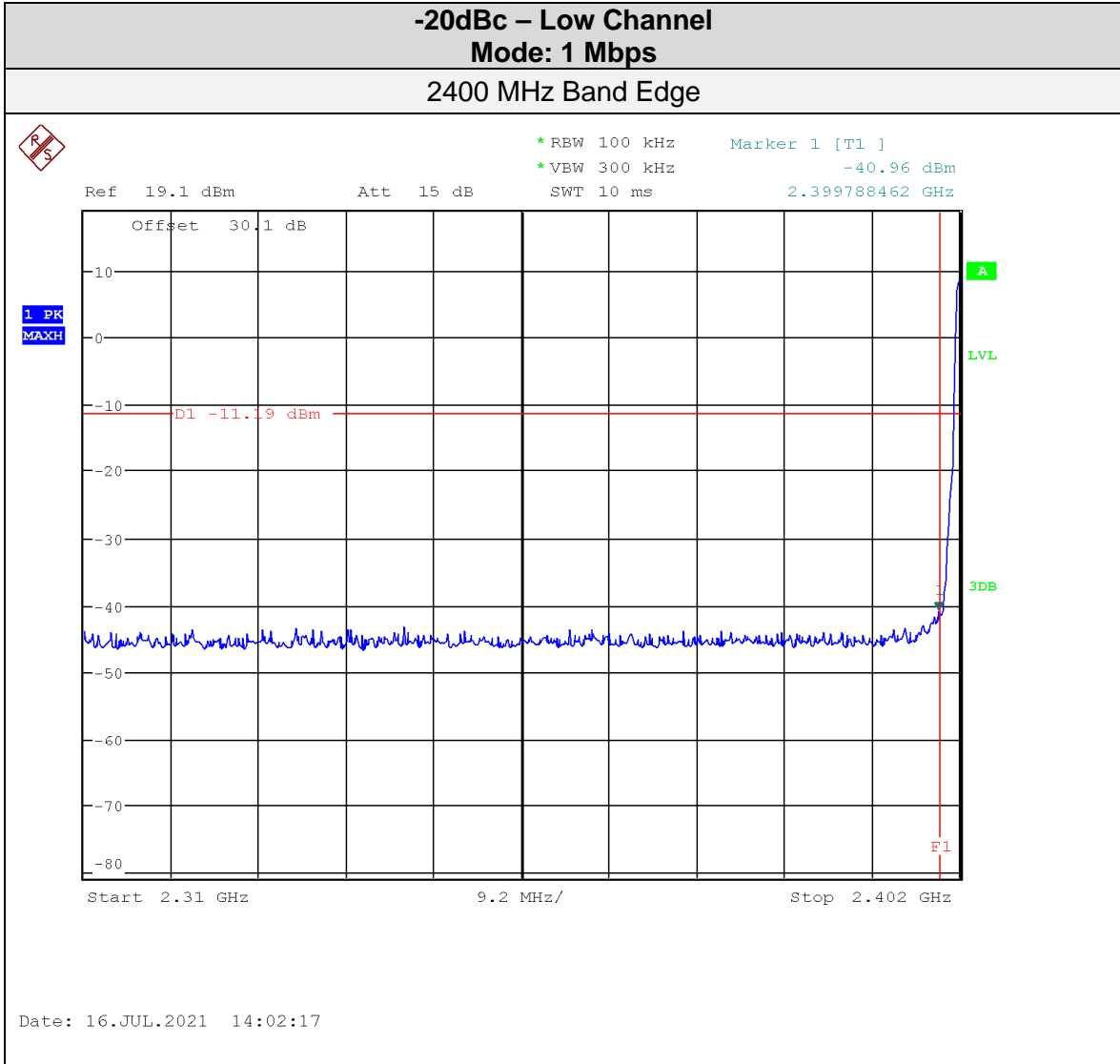
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Graphs

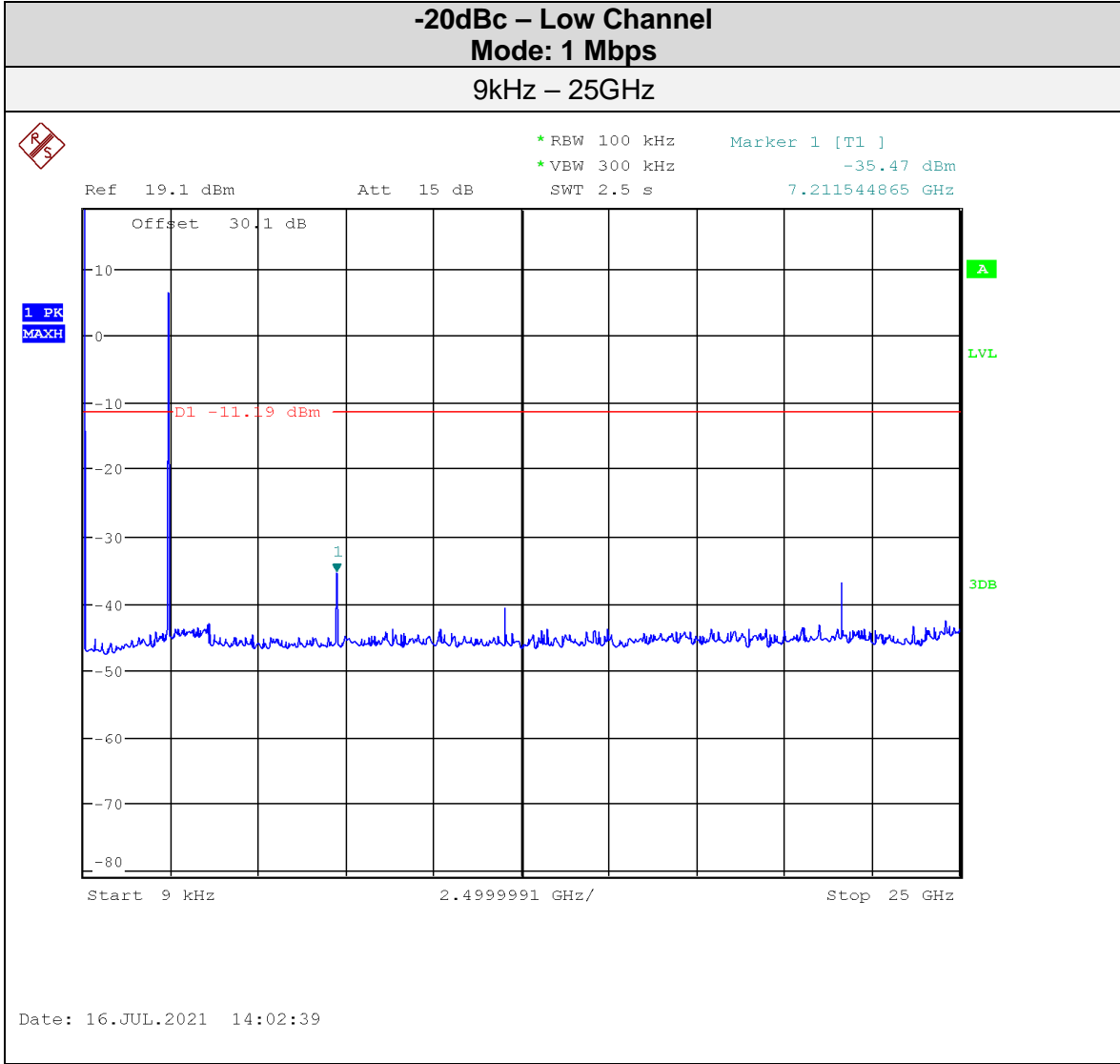
The graphs shown below show the power output of the device during the conducted measurement operation of the EUT.




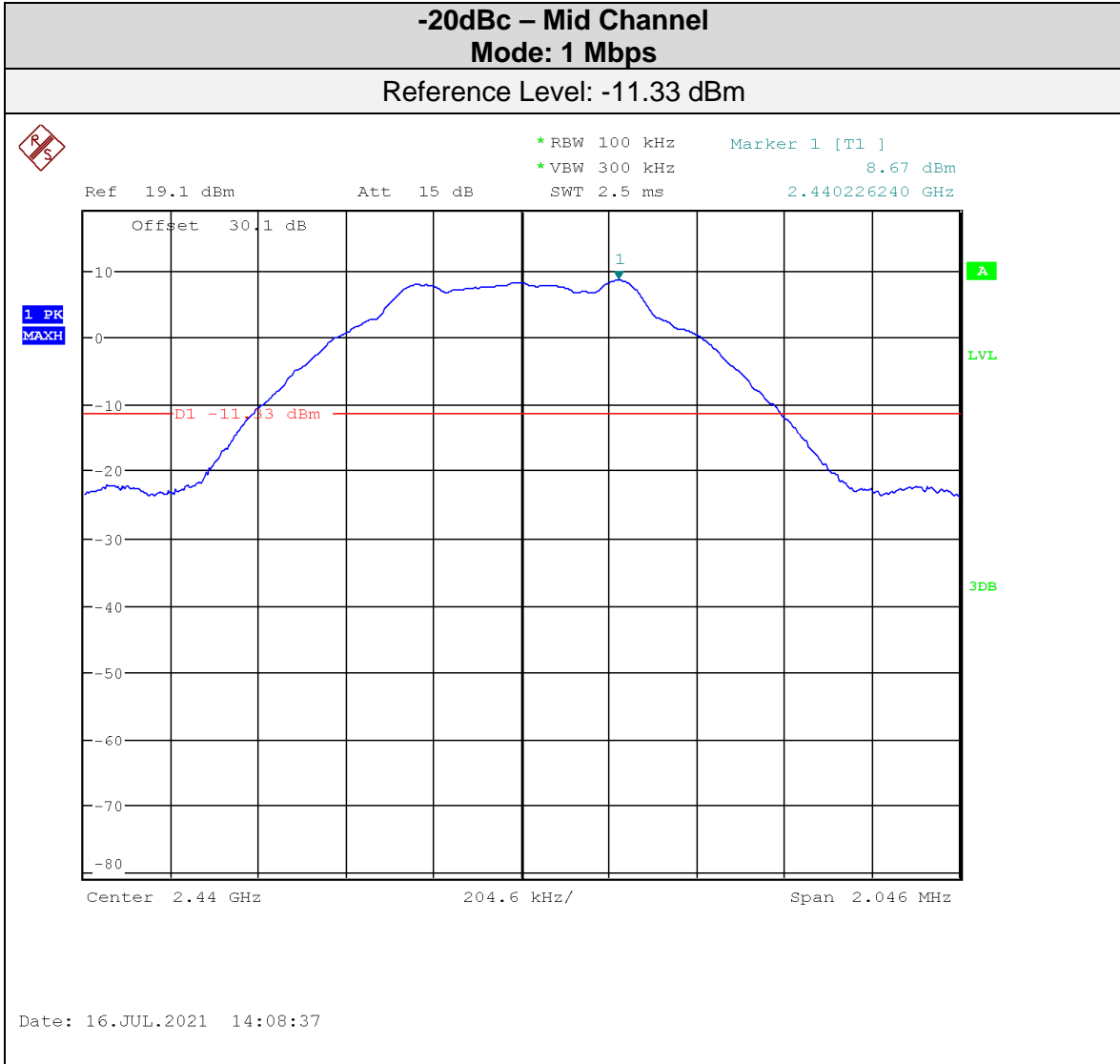
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




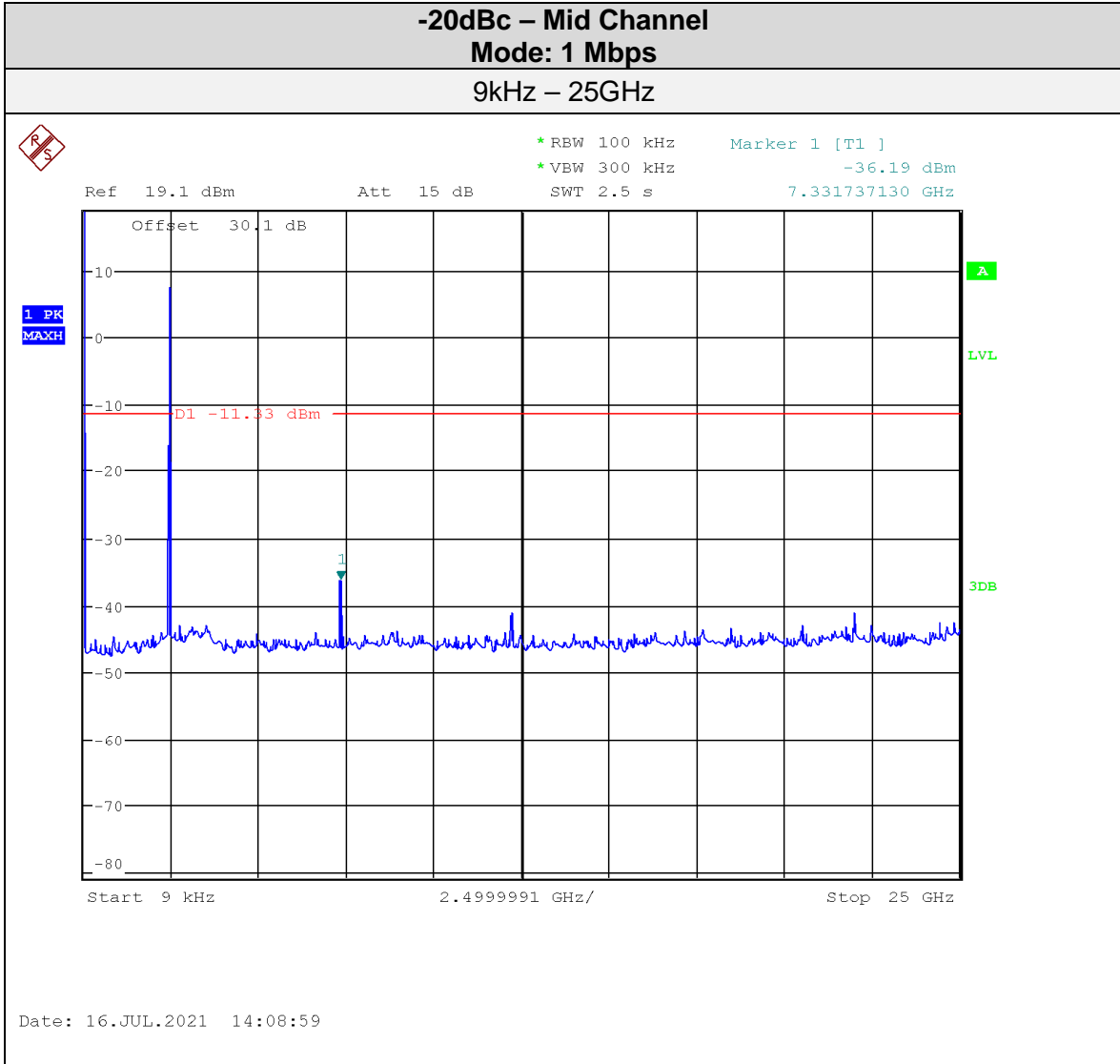
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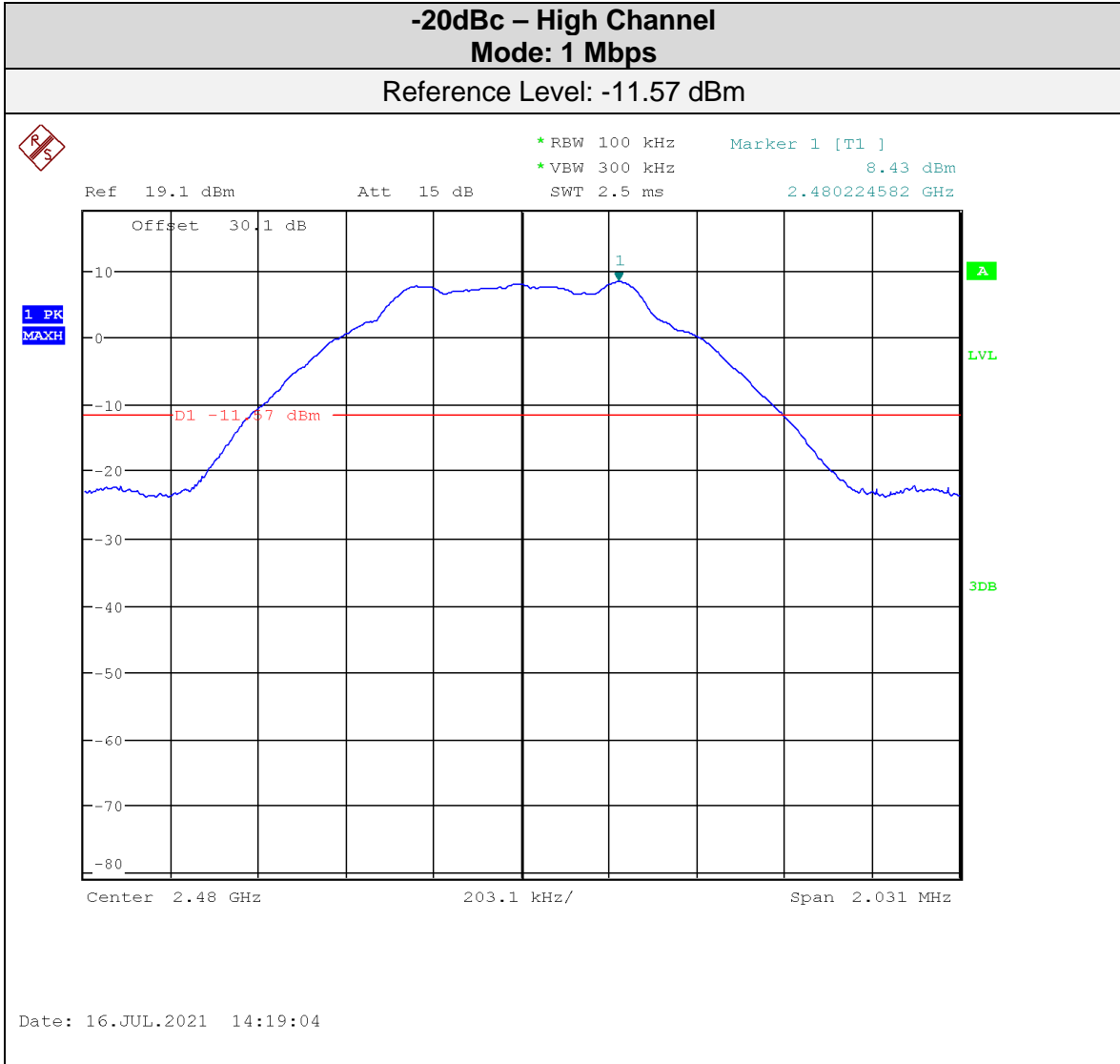
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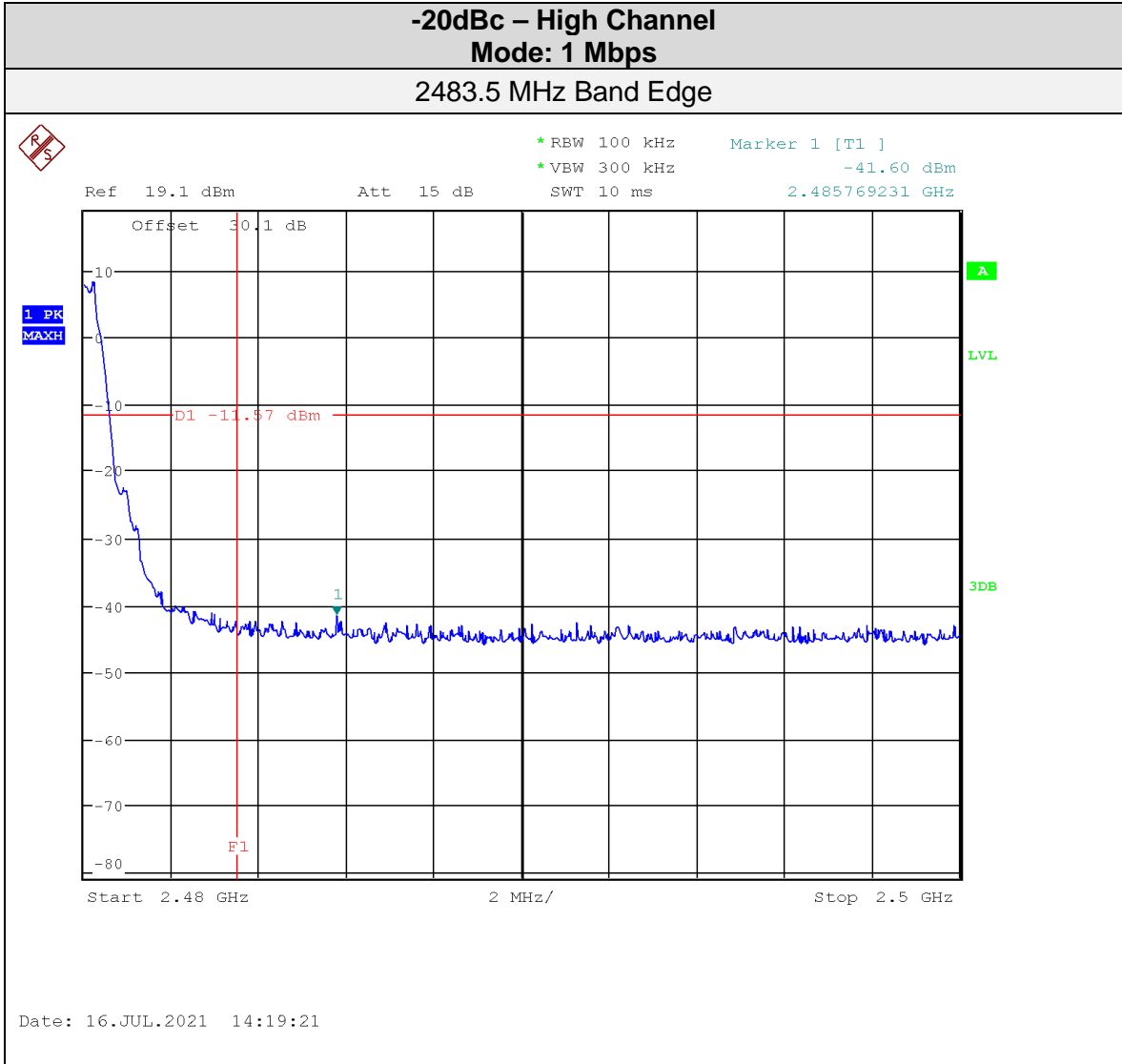
Client	Acuity Brands Lighting, Inc	
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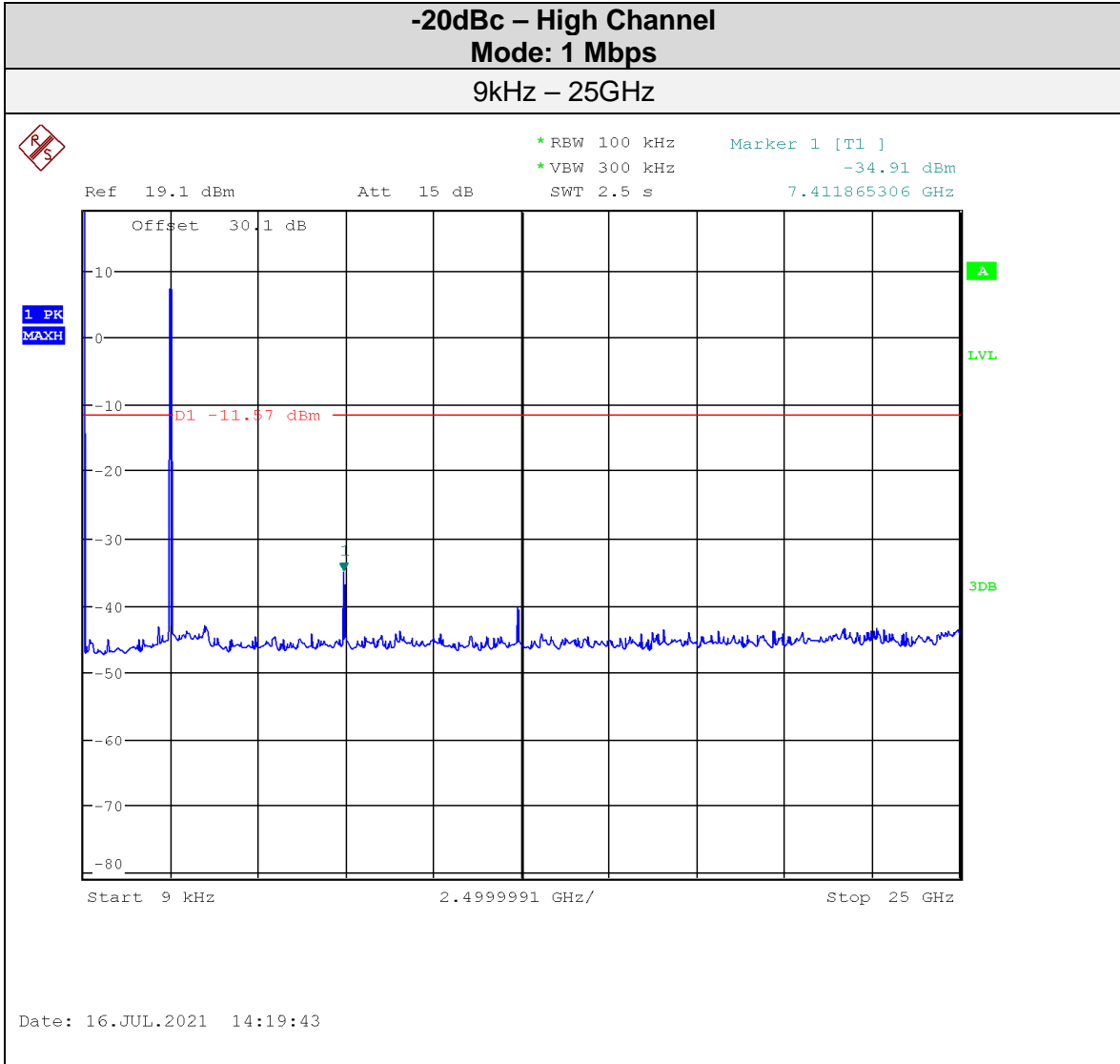
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
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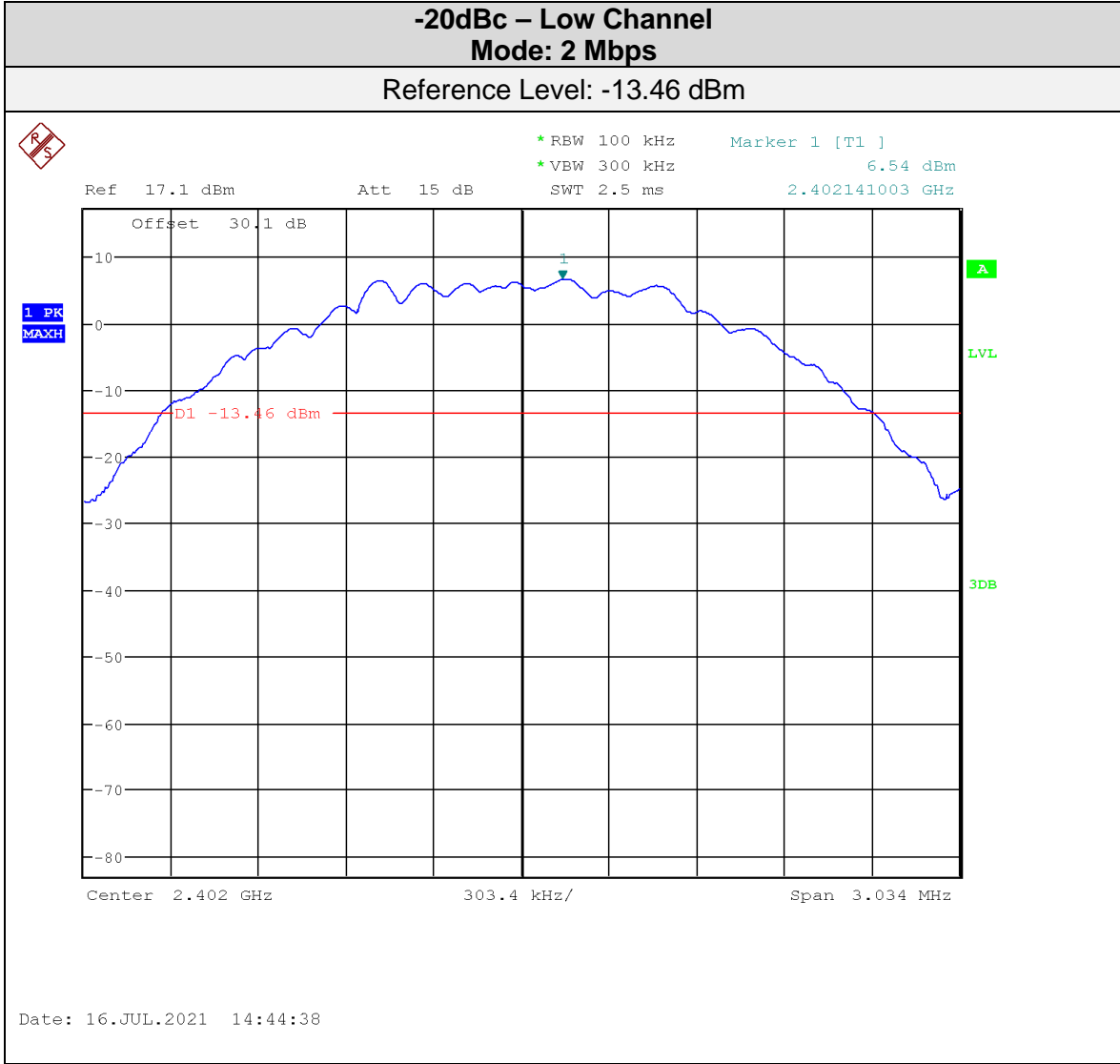
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




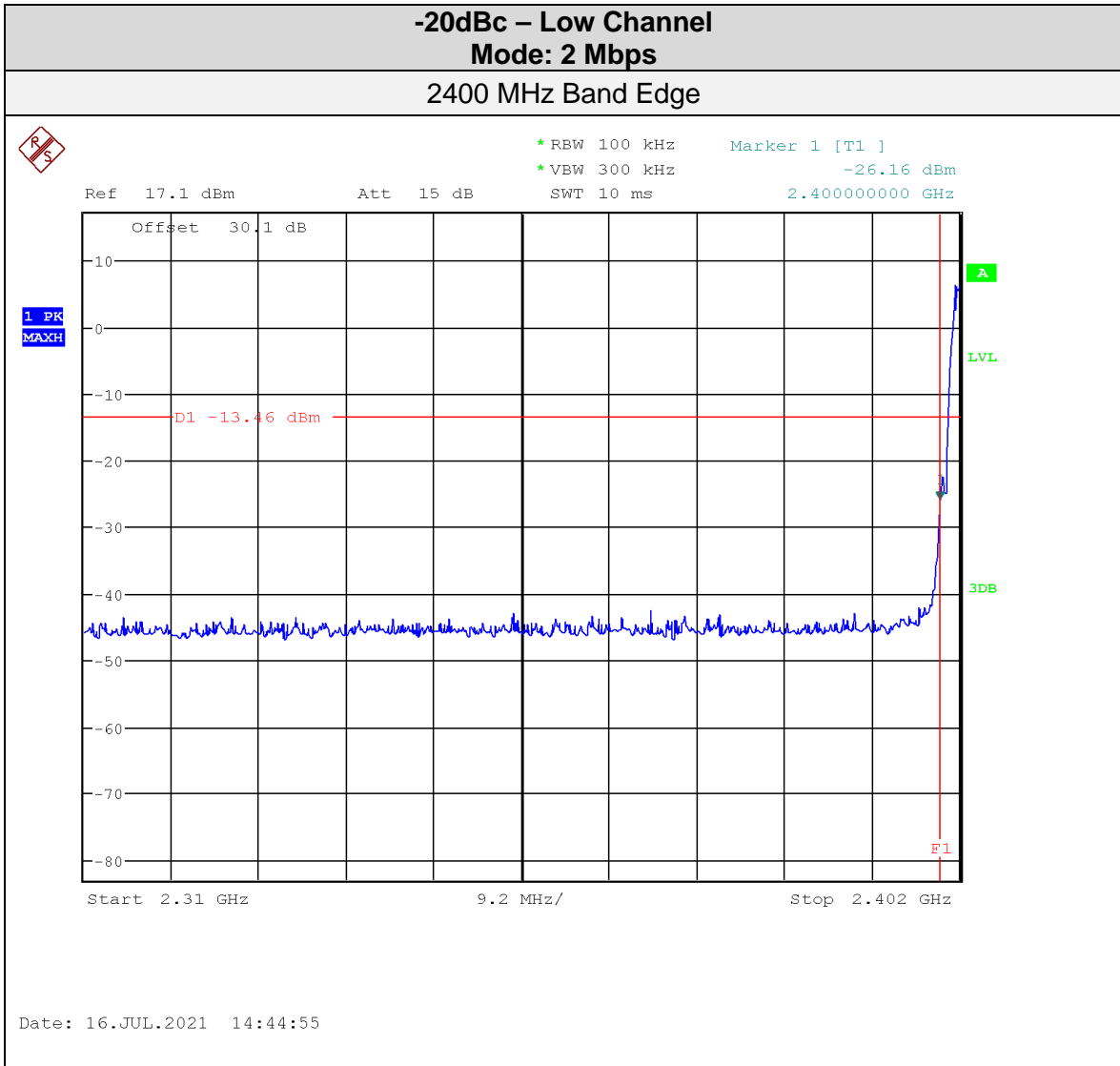
Client	Acuity Brands Lighting, Inc	 Canada
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




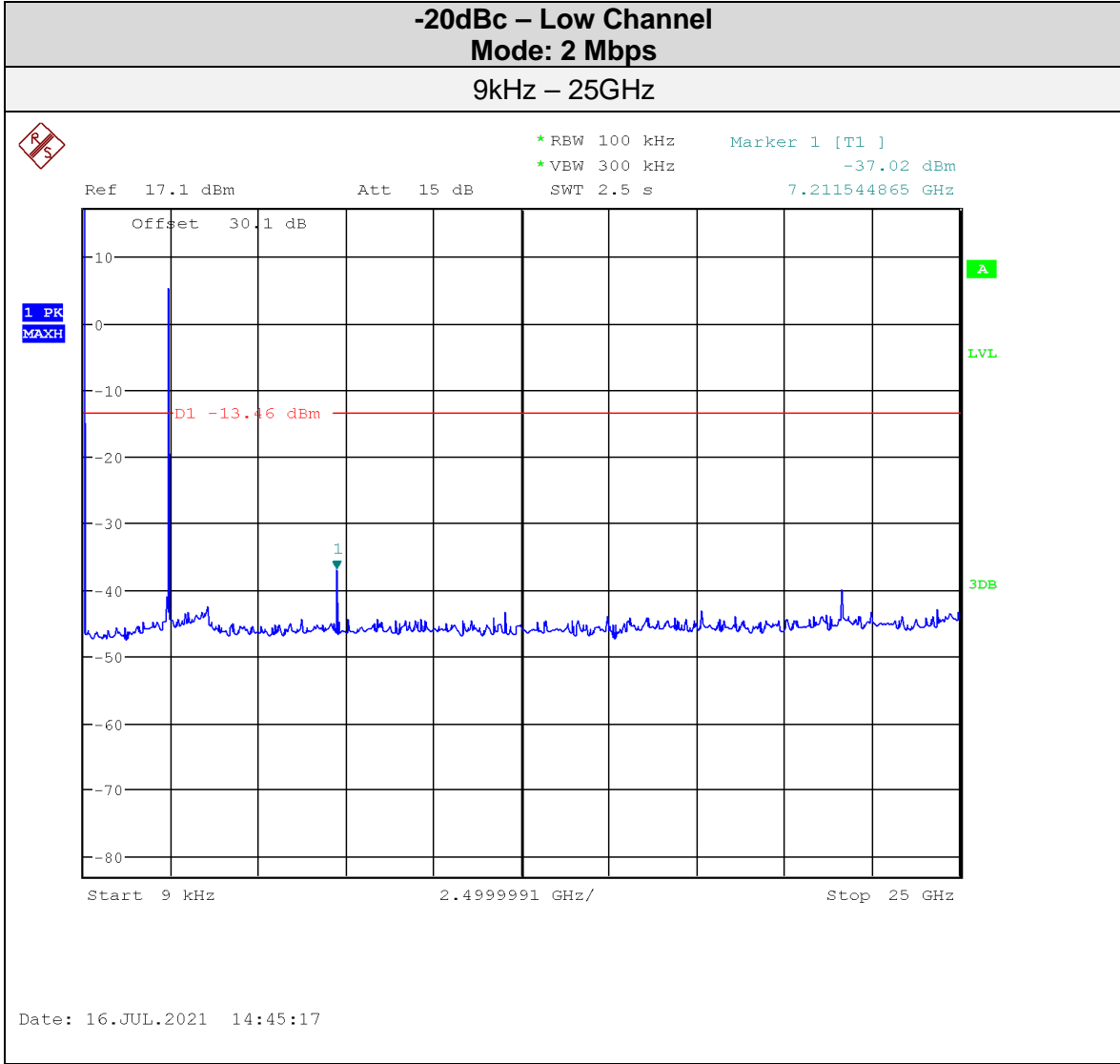
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




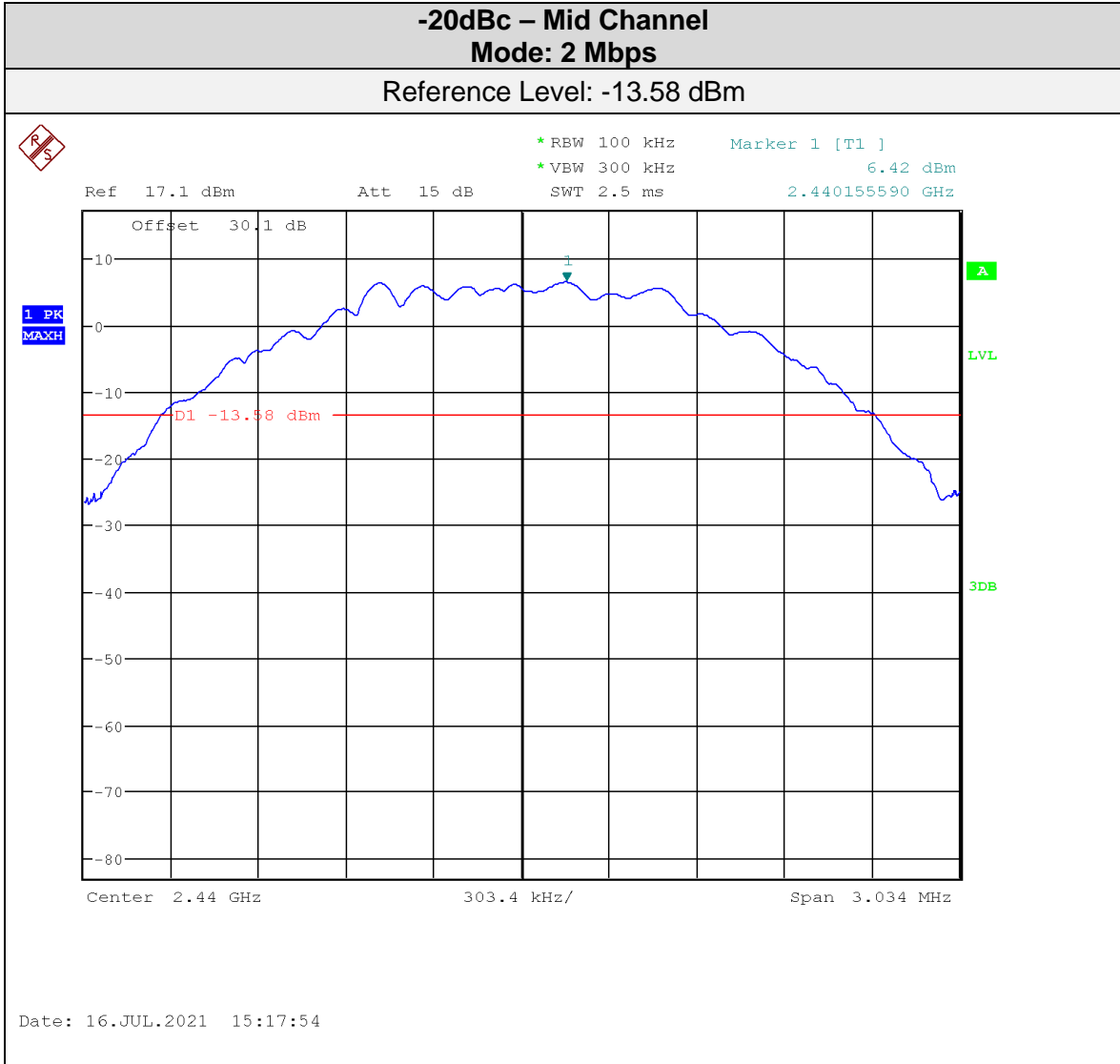
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




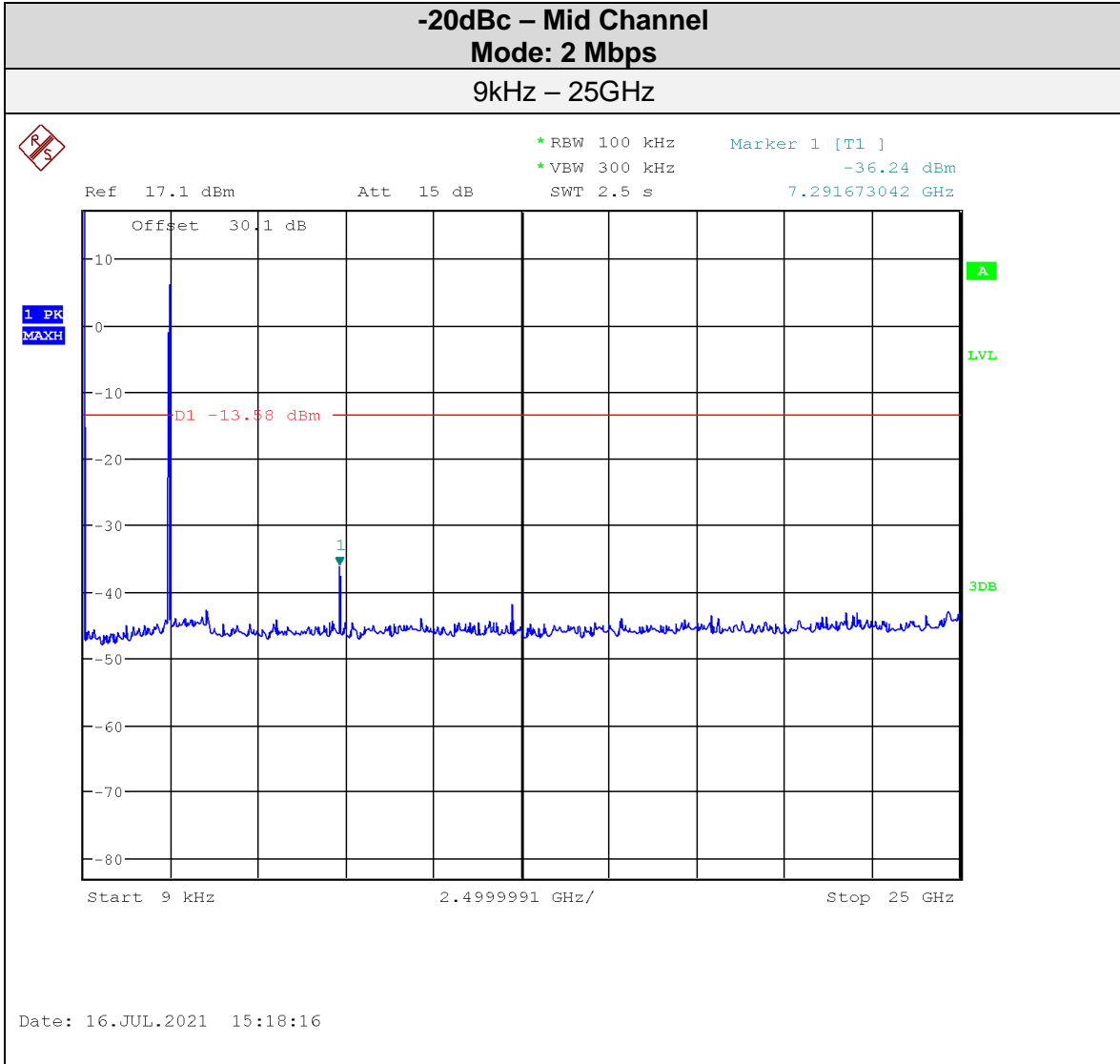
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




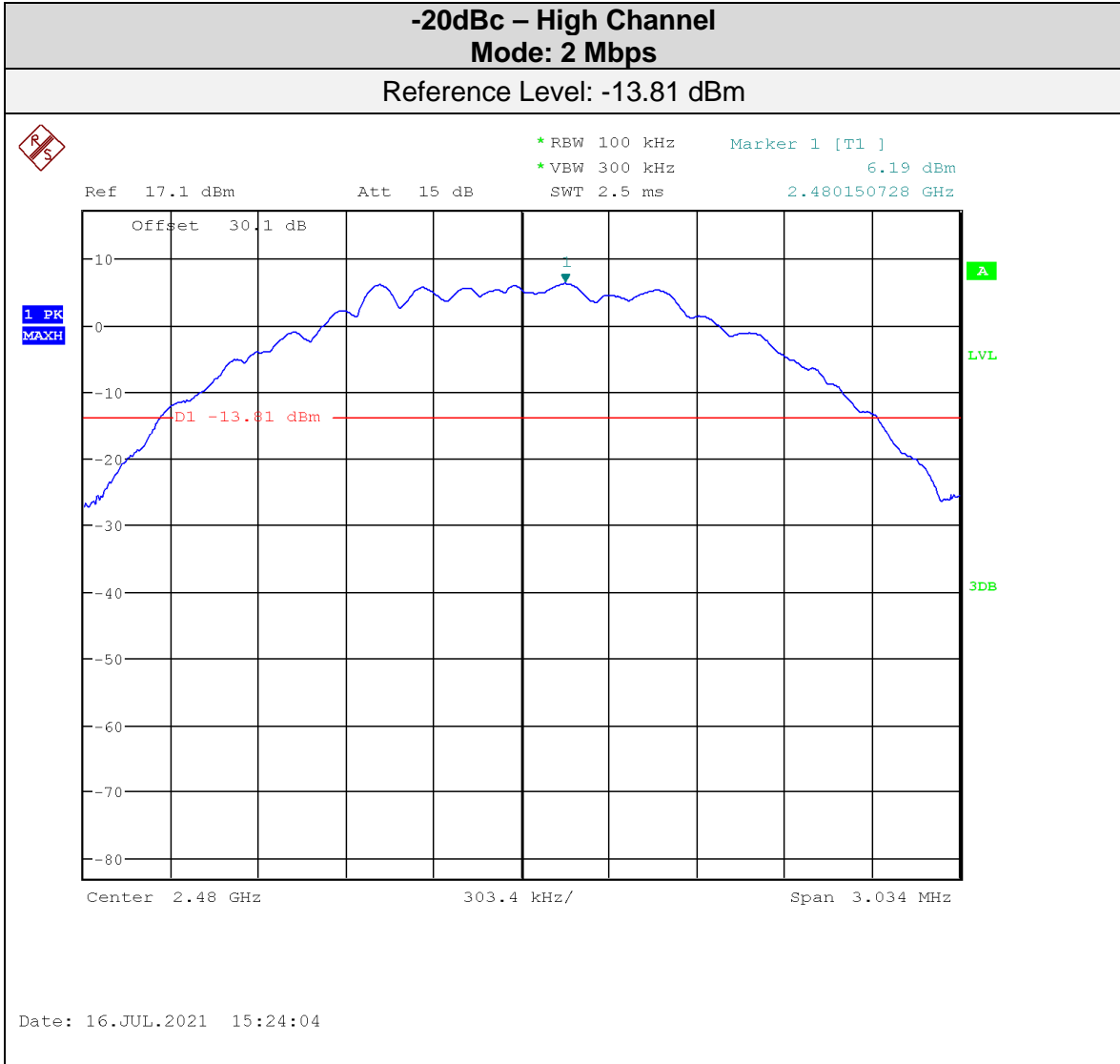
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




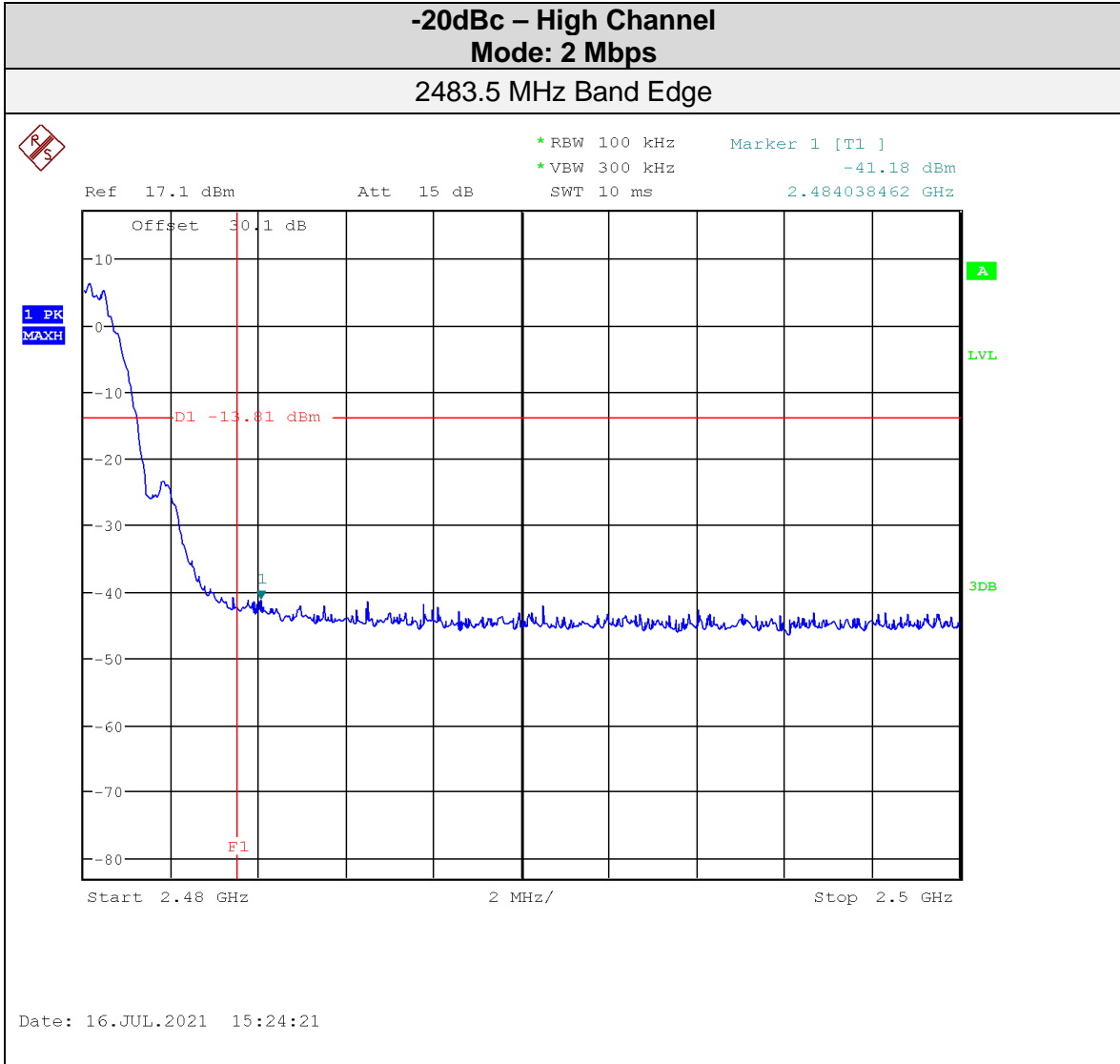
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




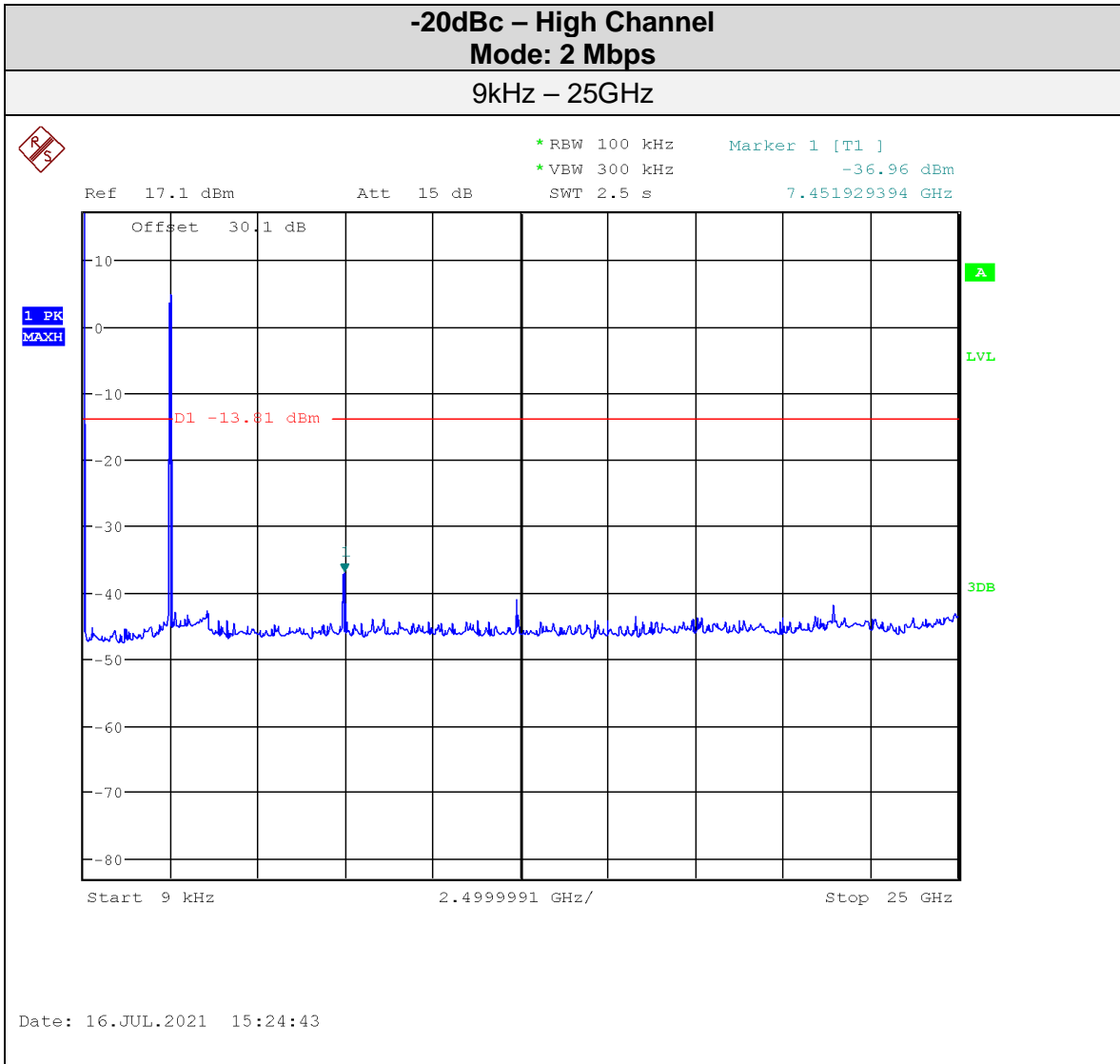
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

See exhibits for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133
Attenuator 20 dB	3M-20	Weinschel	NCR	NCR	GEMC 280

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Transmitter Spurious Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limits and Method

The method is as defined in FCC KDB 558074 Section 12.2 and ANSI C63.10.

The limits, as defined in 15.247(d) for unintentional radiated emissions, apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions must also meet the ‘Spurious Conducted Emissions’ requirements of -20 dBc or greater. See also ‘Antenna Spurious Conducted Emissions (-20dBc)’ for further details.


Frequency	Field Strength Limit ($\mu\text{V/m}$)	Field Strength at 3m ($\text{dB}\mu\text{V/m}$)
0.009 MHz – 0.490 MHz	2400/F(kHz) ^a (at 30m)	128.5 to 93.8 ^a
0.490 MHz – 1.705 MHz	24000/F(kHz) ^a (at 30m)	73.8 to 63.0 ^a
1.705 MHz – 30 MHz	30 ^a (at 30m)	69.5 ^a
30 MHz – 88 MHz	100 ^a (at 3m)	40.0 ^a
88 MHz – 216 MHz	150 ^a (at 3m)	43.5 ^a
216 MHz – 960 MHz	200 ^a (at 3m)	46.0 ^a
Above 960 MHz	500 ^a (at 3m)	54.0 ^a
Above 1000 MHz	500 ^b (at 3m)	54.0 ^b
Above 1000 MHz	5 mV/m ^c (at 3m)	74.0 ^c

^a Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

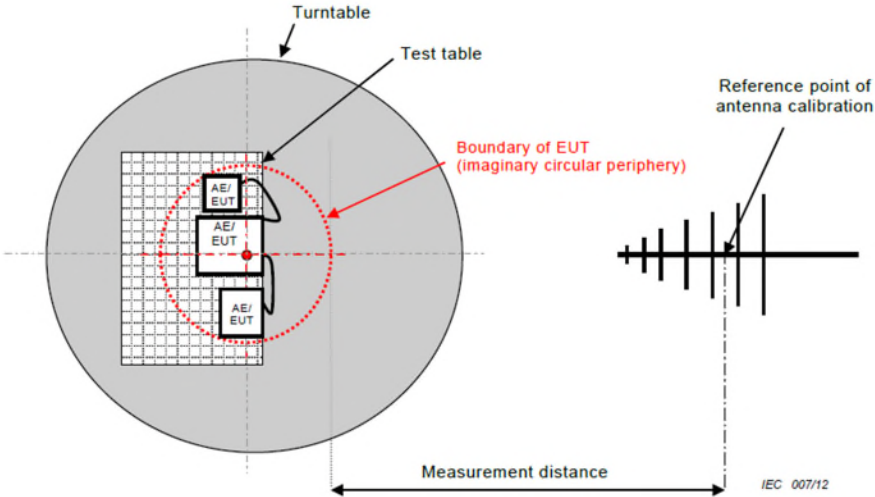
^b Limit is with 1 MHz measurement bandwidth and using an Average detector

^c Limit is with 1 MHz measurement bandwidth and using a Peak detector

Based on ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is $\pm 5.67\text{dB}$ for 30MHz – 1GHz and $\pm 4.58\text{dB}$ for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.


Preliminary Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0-360°. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of 24.835 GHz).


Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

Peak radiated output for low, middle and high channels and each of the orthogonal axes of the EUT were checked. The worst case was used for the spurious emissions for each mode.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Band-edge measurement graphs are shown for illustration purposes. See final measurement section for all measurements. Graphs for the worst-case, are presented.

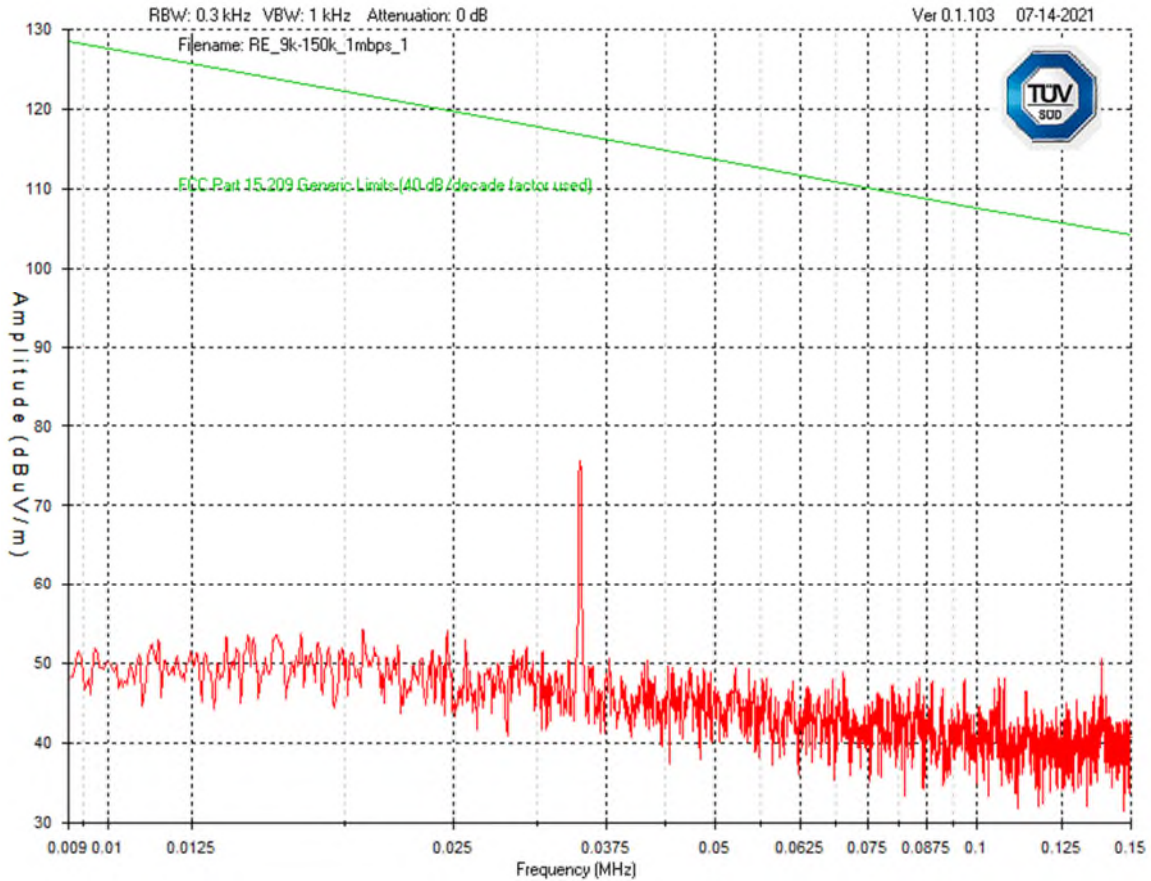
Note: A duty cycle correction factor of -26.23dB (from a duty cycle of 4.88% for the 2.4 GHz transmission) is applied to indicated measurements.


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Mode: 1 Mbps

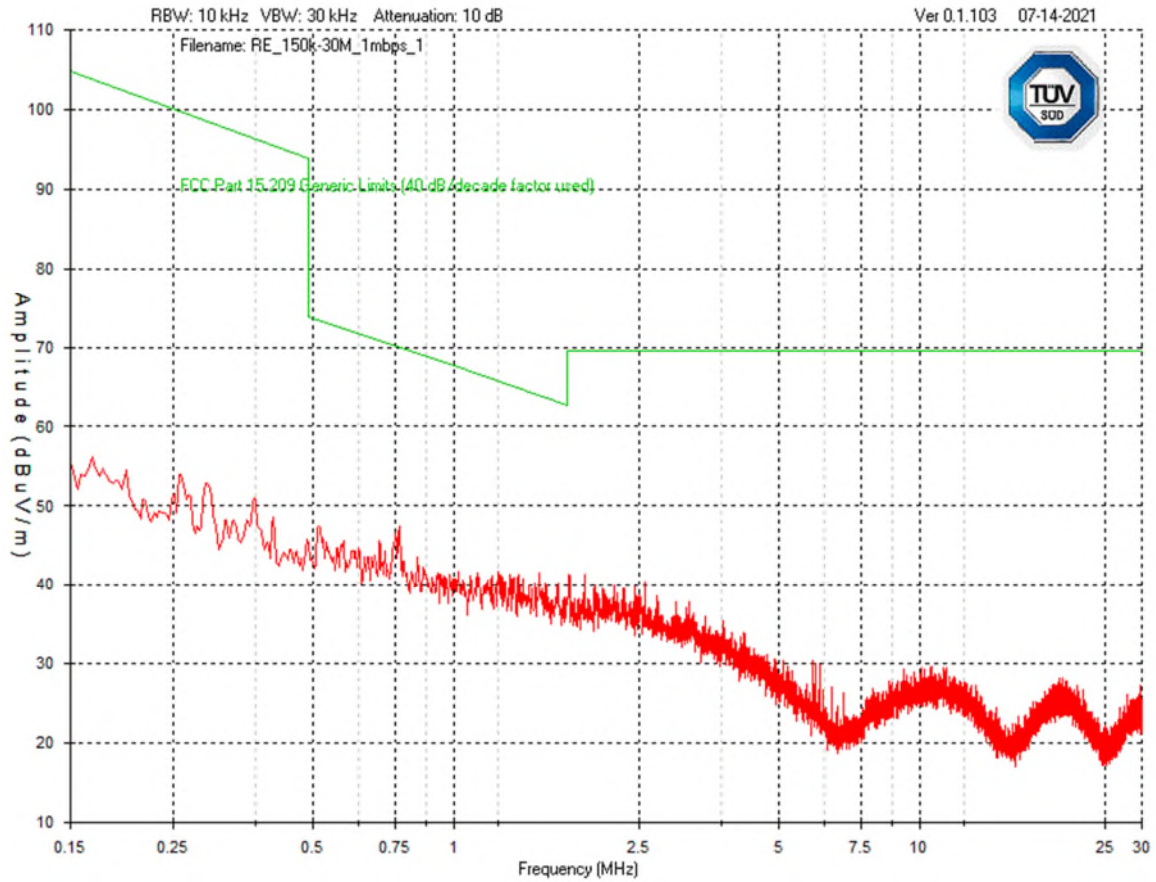
Spurious Emissions


High Channel
9 kHz – 150 kHz
Peak Emission Graph



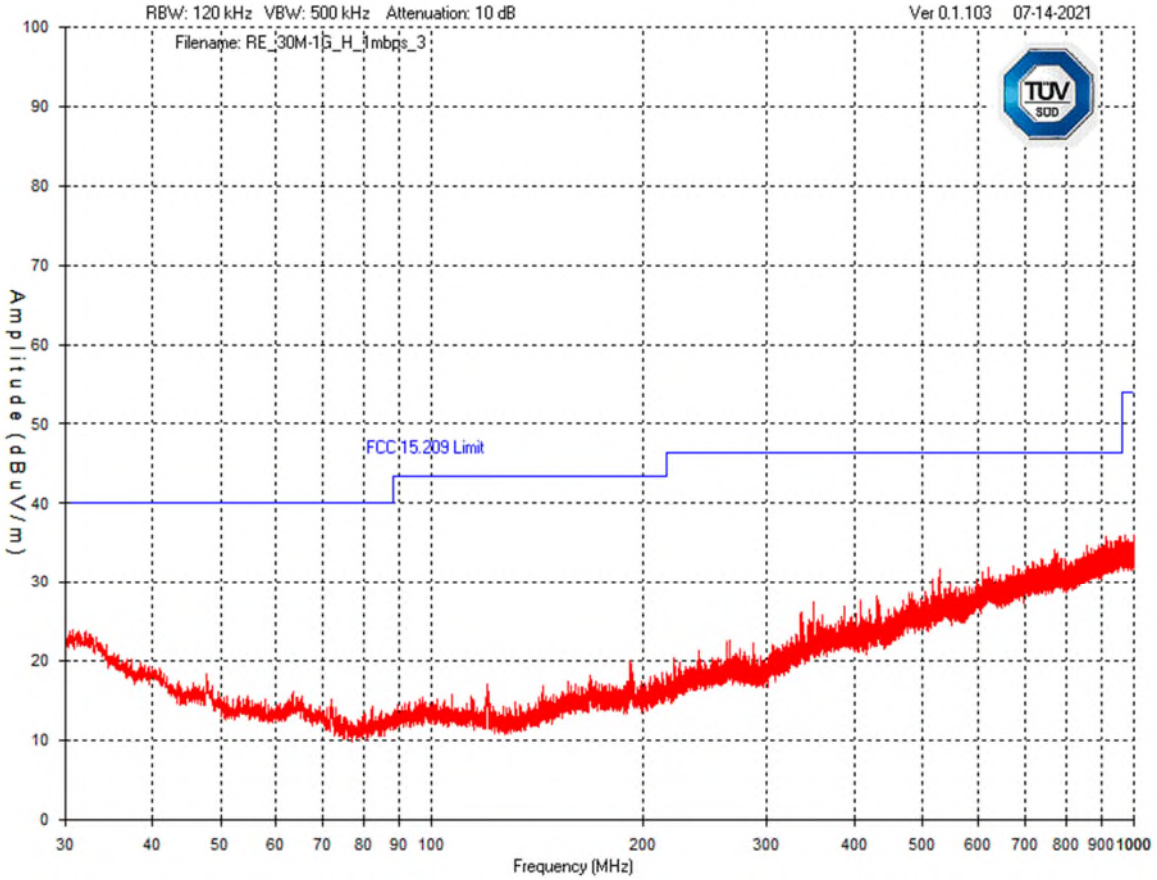
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel
150 kHz – 30 MHz
Peak Emission Graph



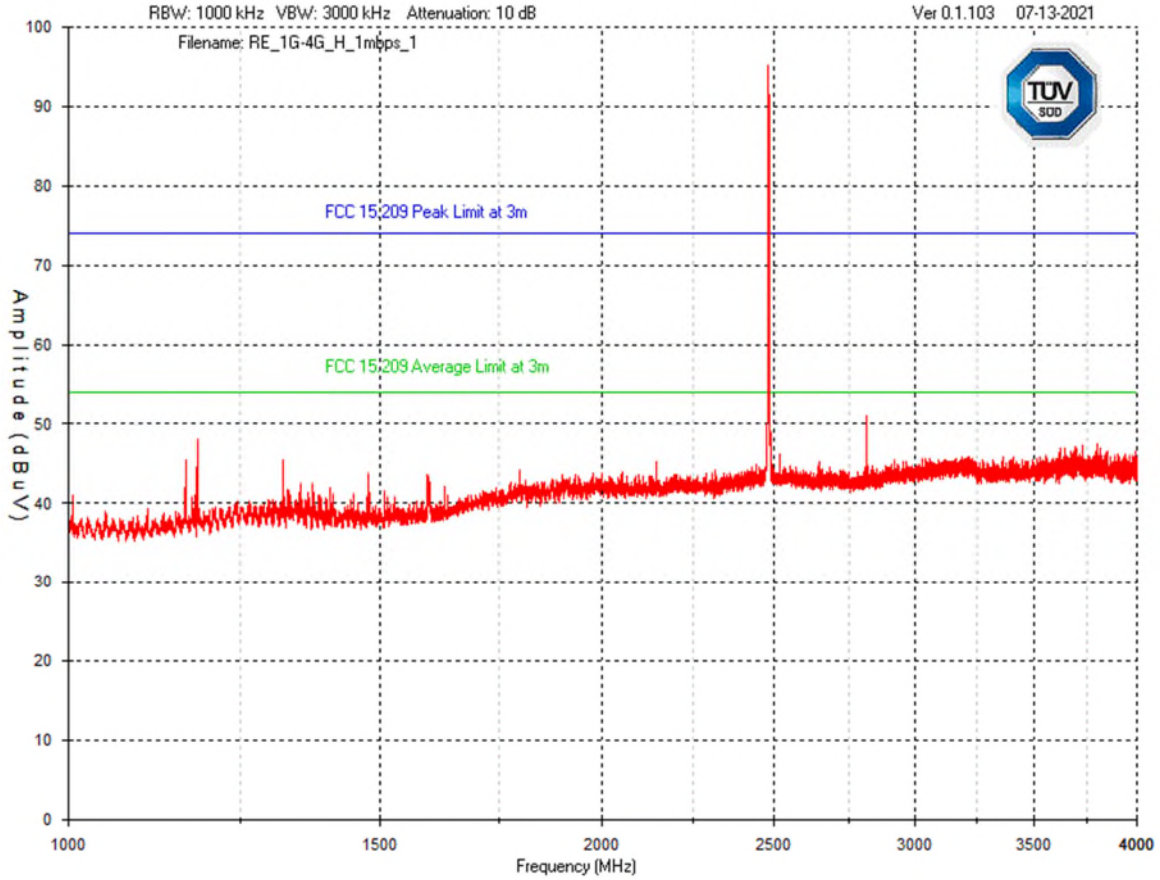
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



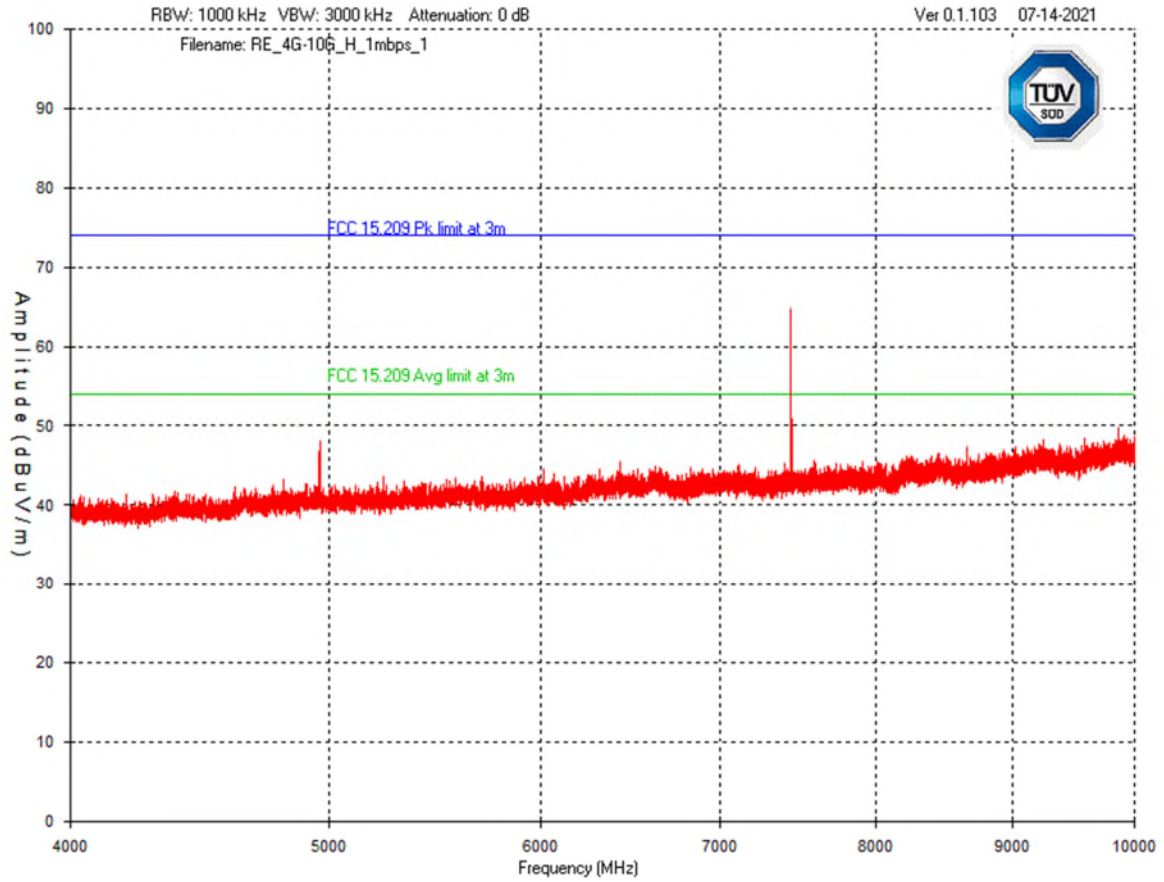
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 1 GHz – 4 GHz
Horizontal - Peak Emission Graph



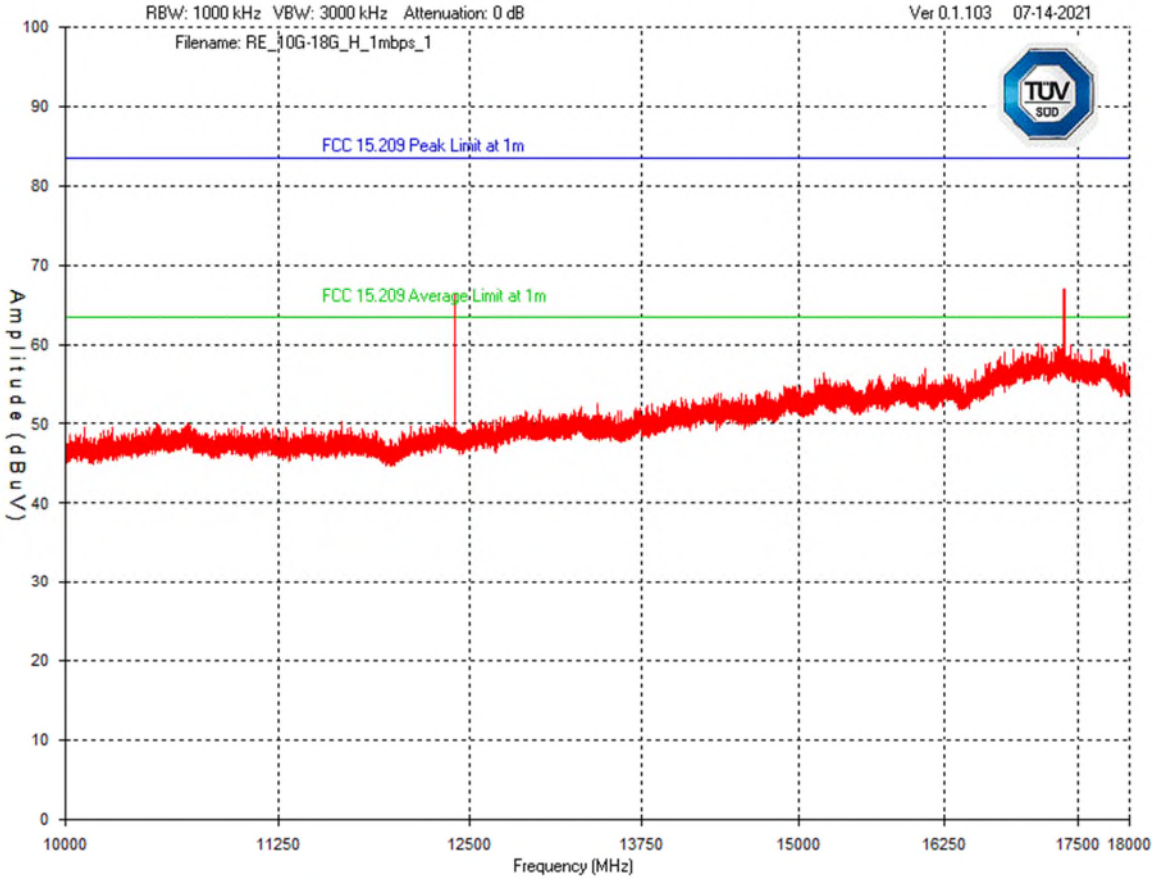
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

High Channel – 4 GHz – 10 GHz
Horizontal - Peak Emission Graph




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

High Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph

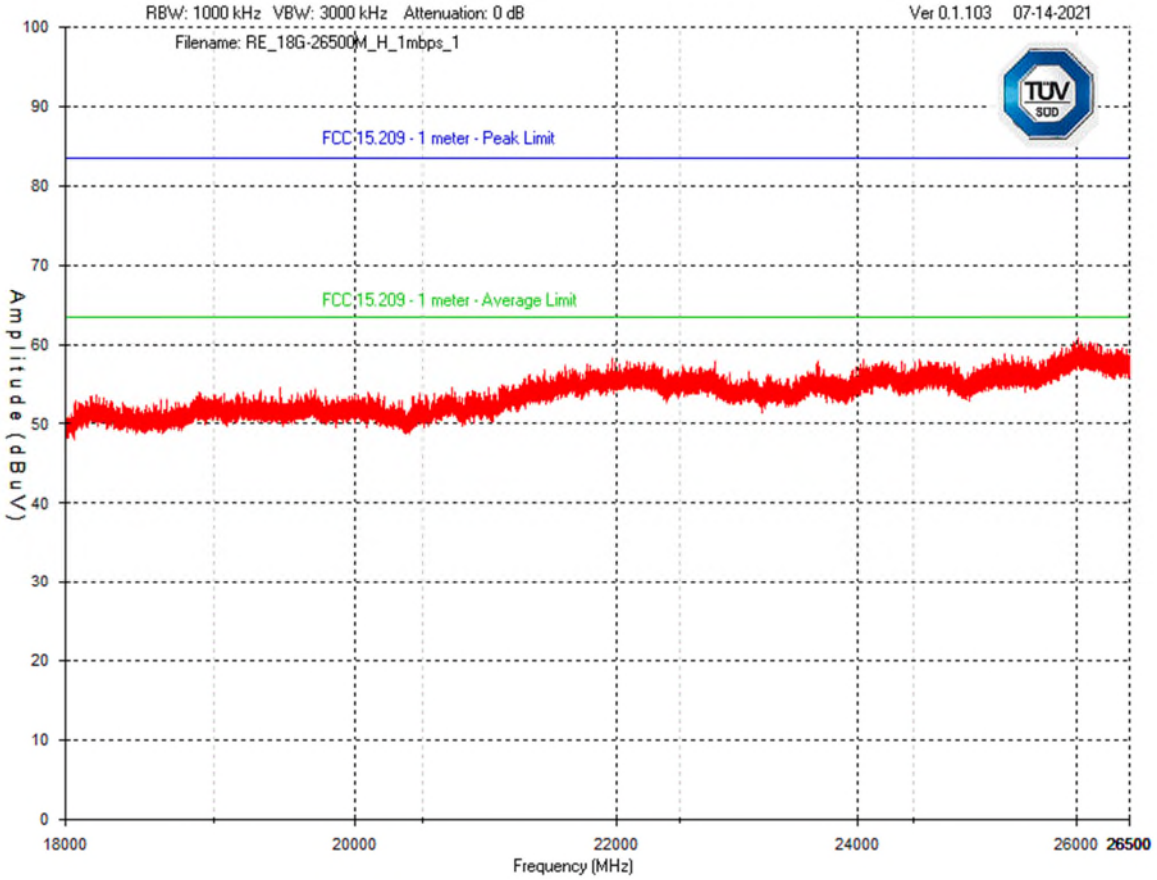


Plot was taken at a 1 meter distance.


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Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

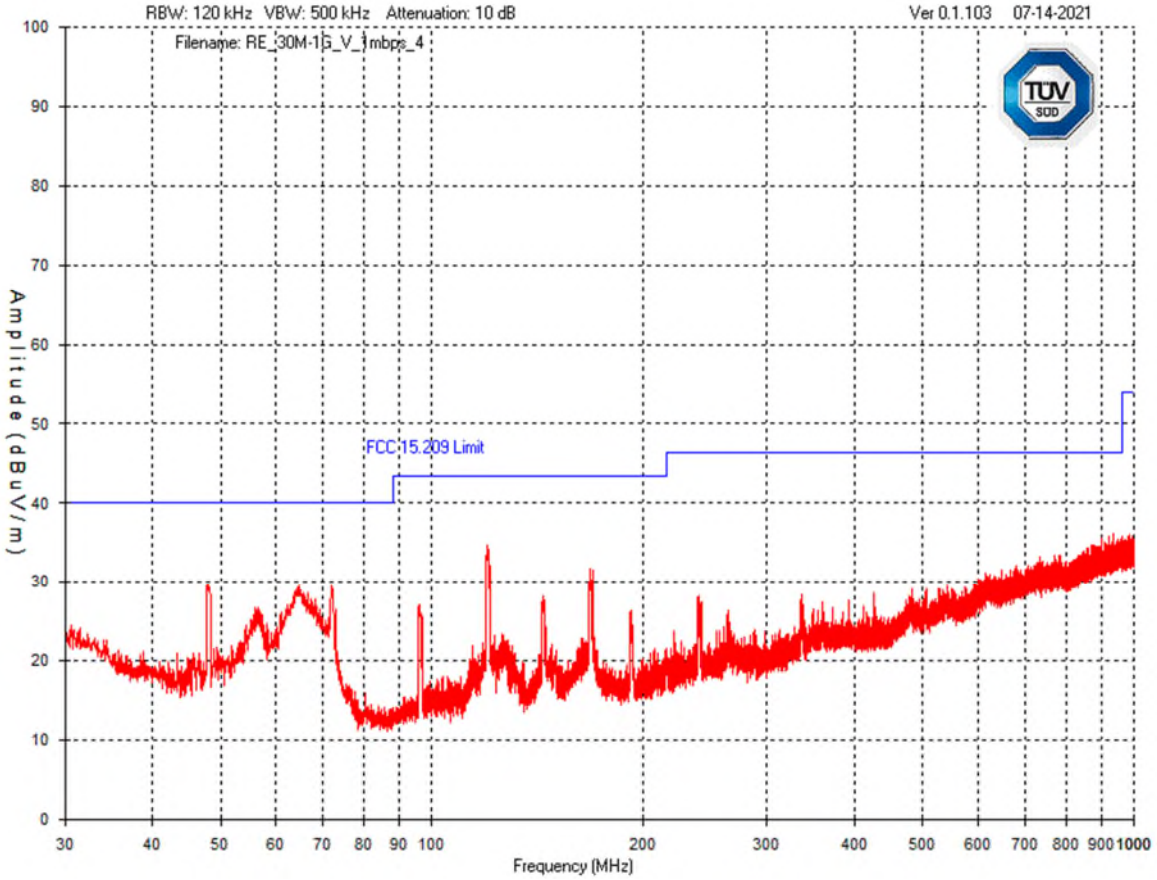
High Channel – 18 GHz – 26.5 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance.

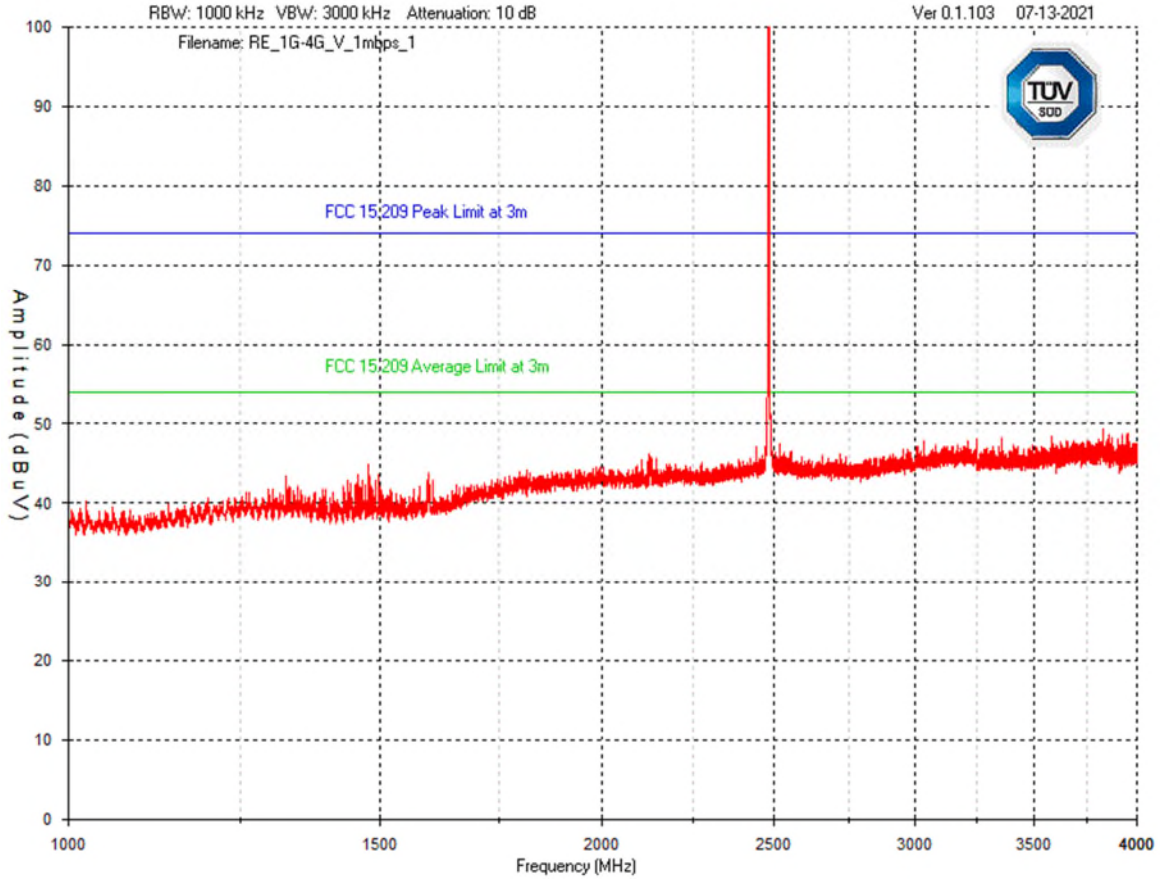
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 30 MHz – 1 GHz
Vertical - Peak Emission Graph



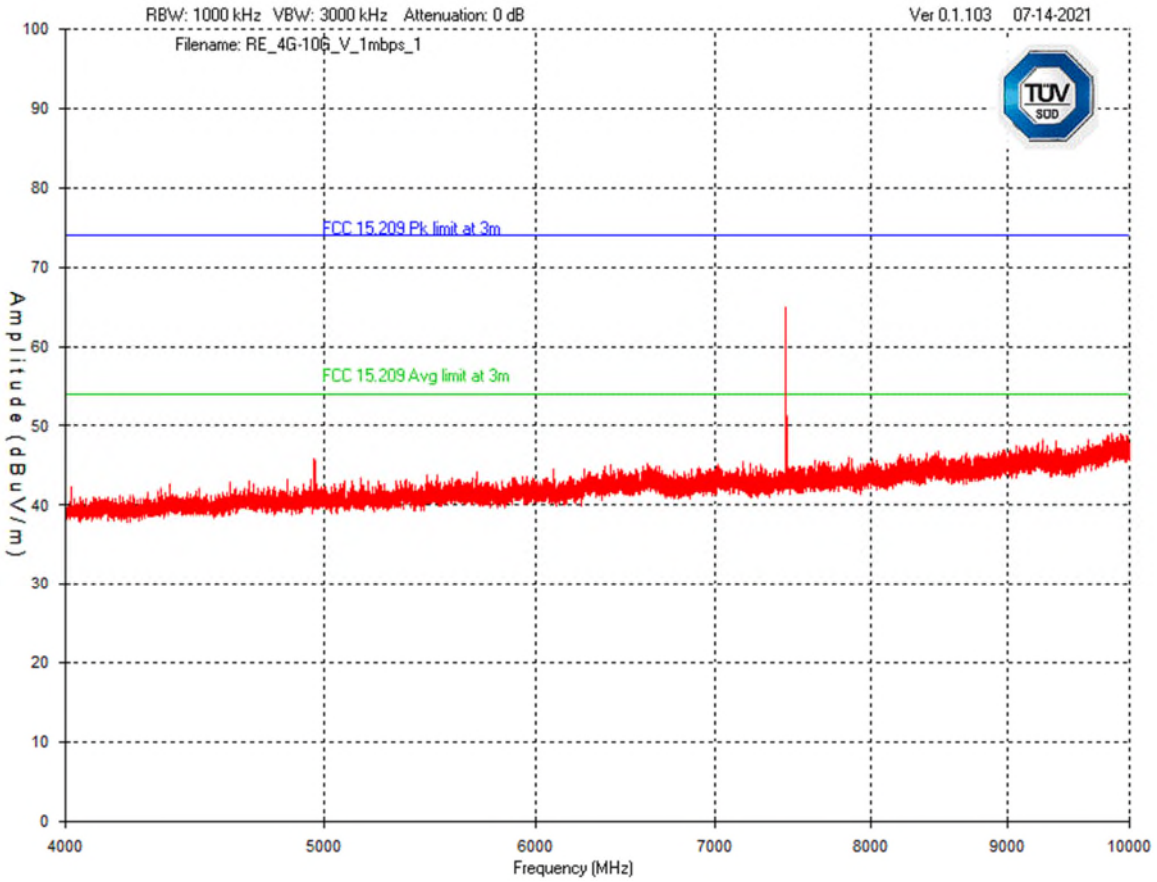
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 1 GHz – 4 GHz
Vertical - Peak Emission Graph



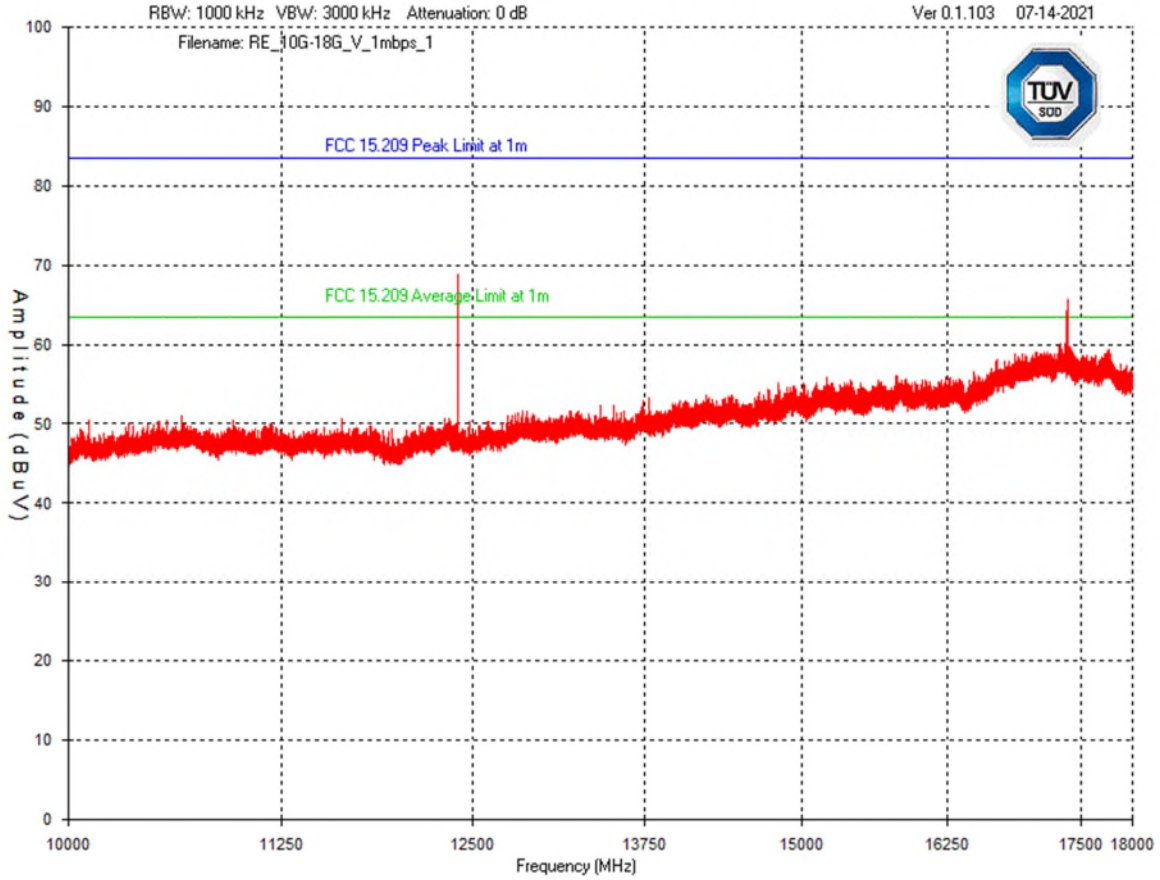
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

High Channel – 4 GHz – 10 GHz
Vertical - Peak Emission Graph




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

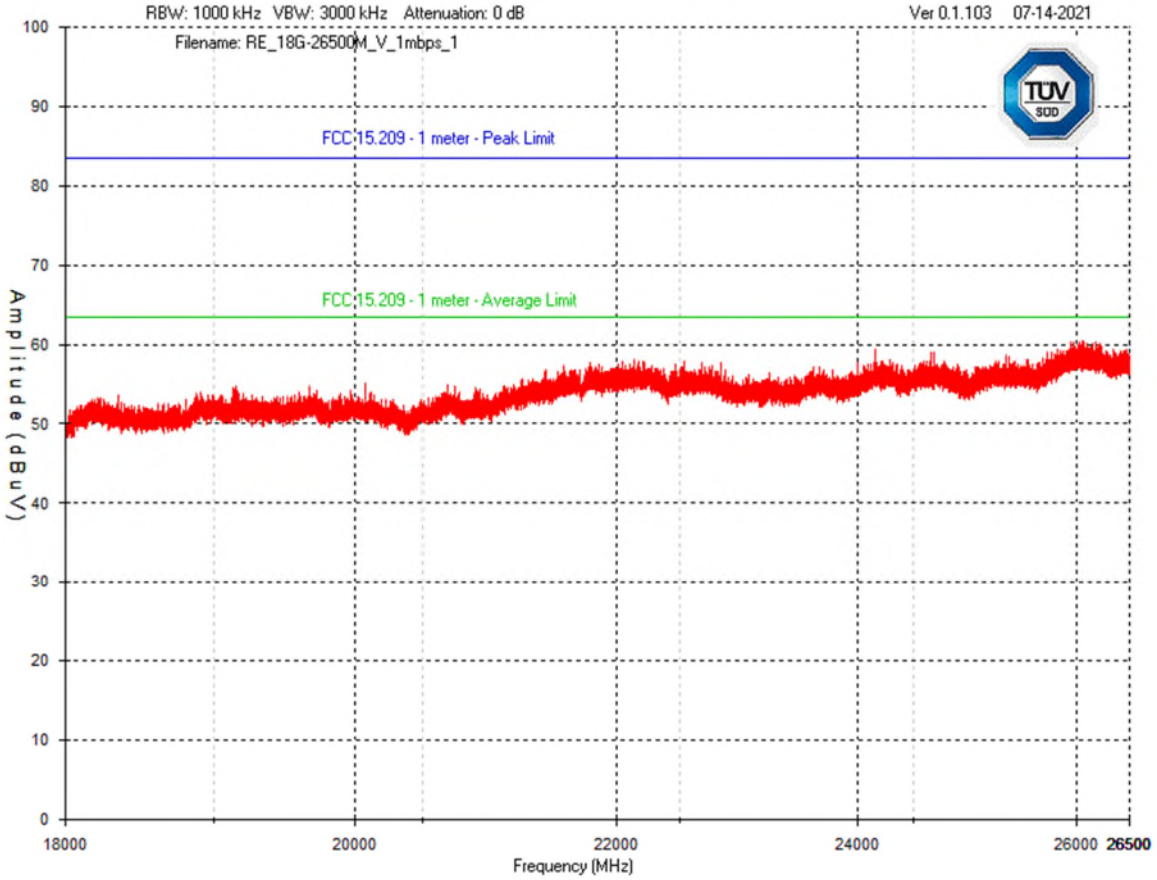
High Channel – 10 GHz – 18 GHz
Vertical - Peak Emission Graph




Plot was taken at a 1 meter distance.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

High Channel – 18 GHz – 26.5 GHz
Vertical - Peak Emission Graph

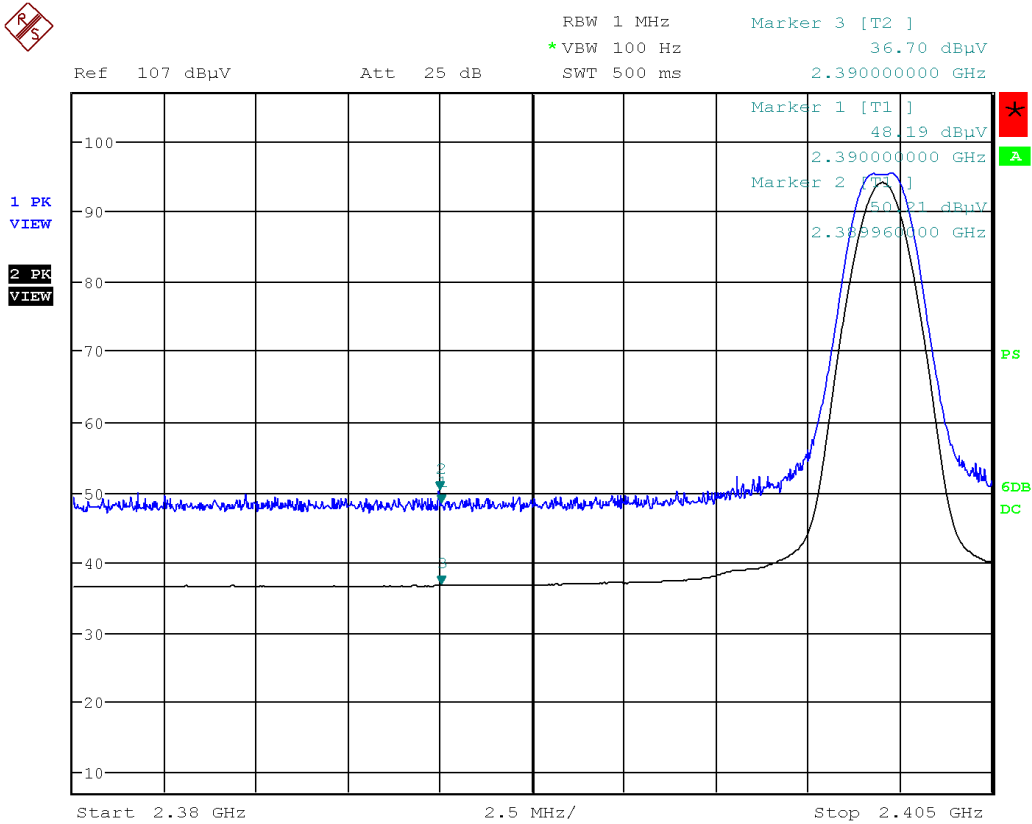


Plot was taken at a 1 meter distance.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Band Edges

**Band Edge – Low Channel
Horizontal – Peak & Average Emission**

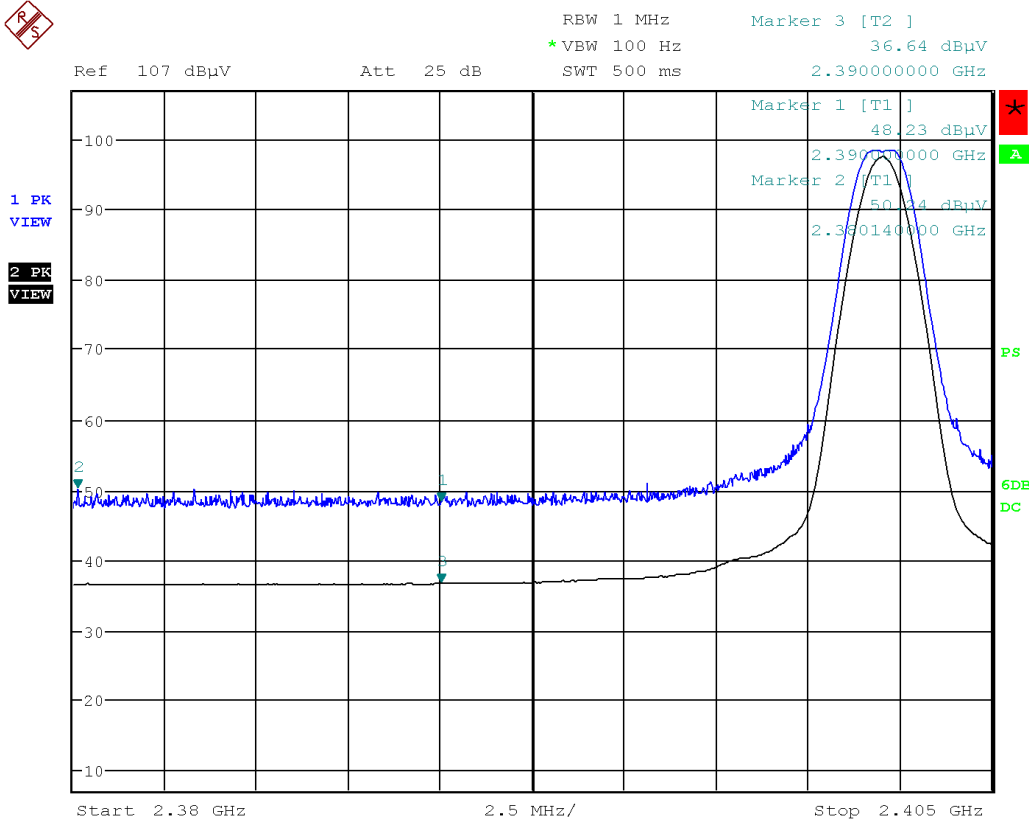


Date: 13.JUL.2021 19:32:18

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show the raw value. See the Final Measurements and Results section below for correct values.


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

**Band Edge – Low Channel
Vertical – Peak & Average Emission**

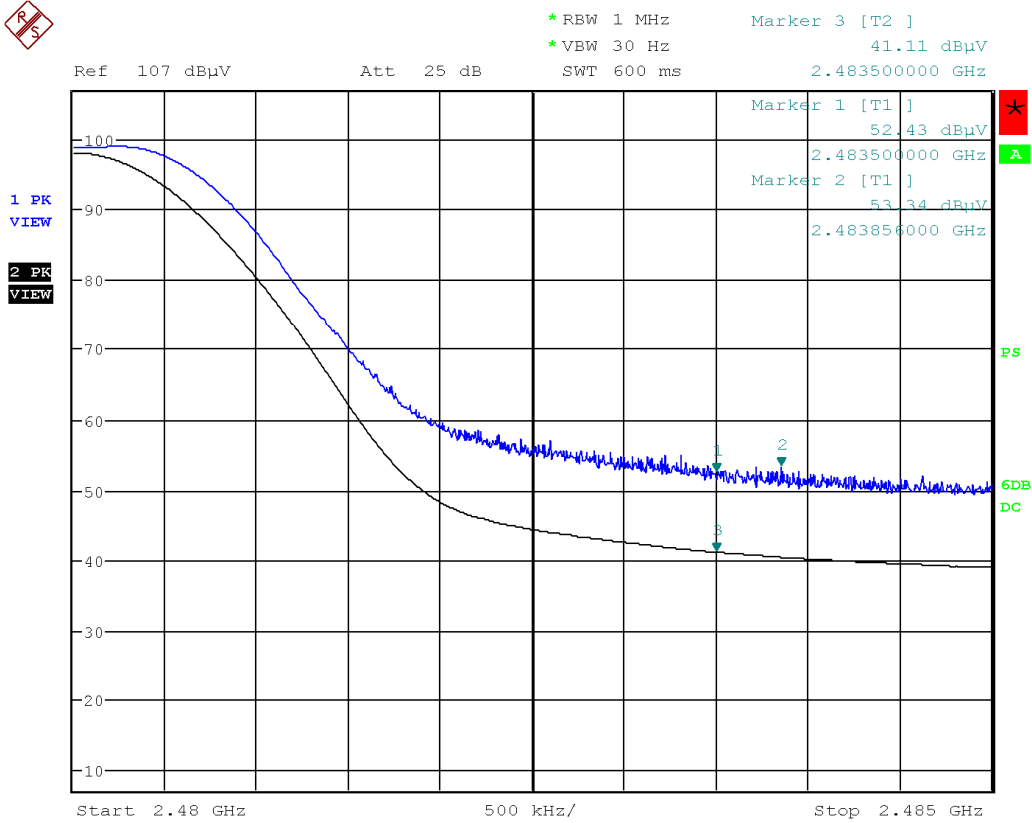


Date: 13.JUL.2021 19:41:50

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show the raw value. See the Final Measurements and Results section below for correct values.


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Band Edge – High Channel Horizontal – Peak & Average Emission

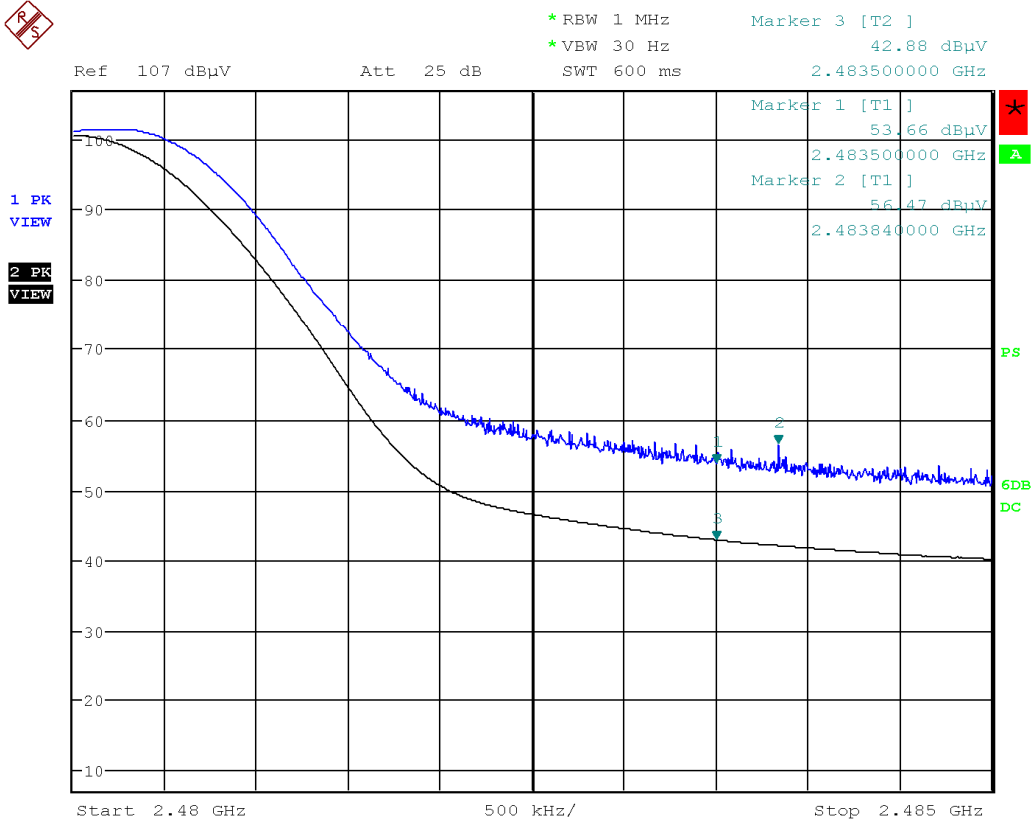


Date: 13.JUL.2021 20:20:50

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show the raw value. See the Final Measurements and Results section below for correct values.


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

**Band Edge – High Channel
Vertical – Peak & Average Emission**



Date: 13.JUL.2021 20:00:26

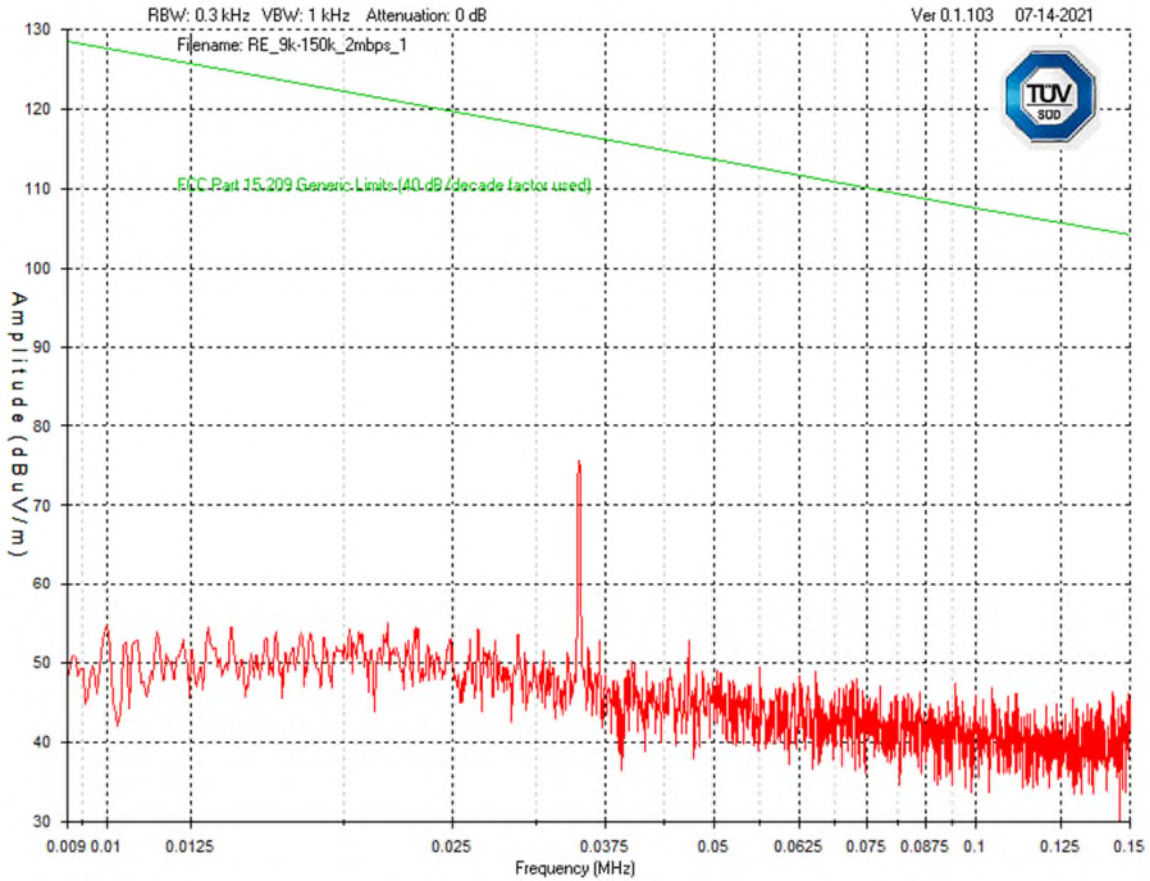
Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show the raw value. See the Final Measurements and Results section below for correct values.


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Mode: 2 Mbps

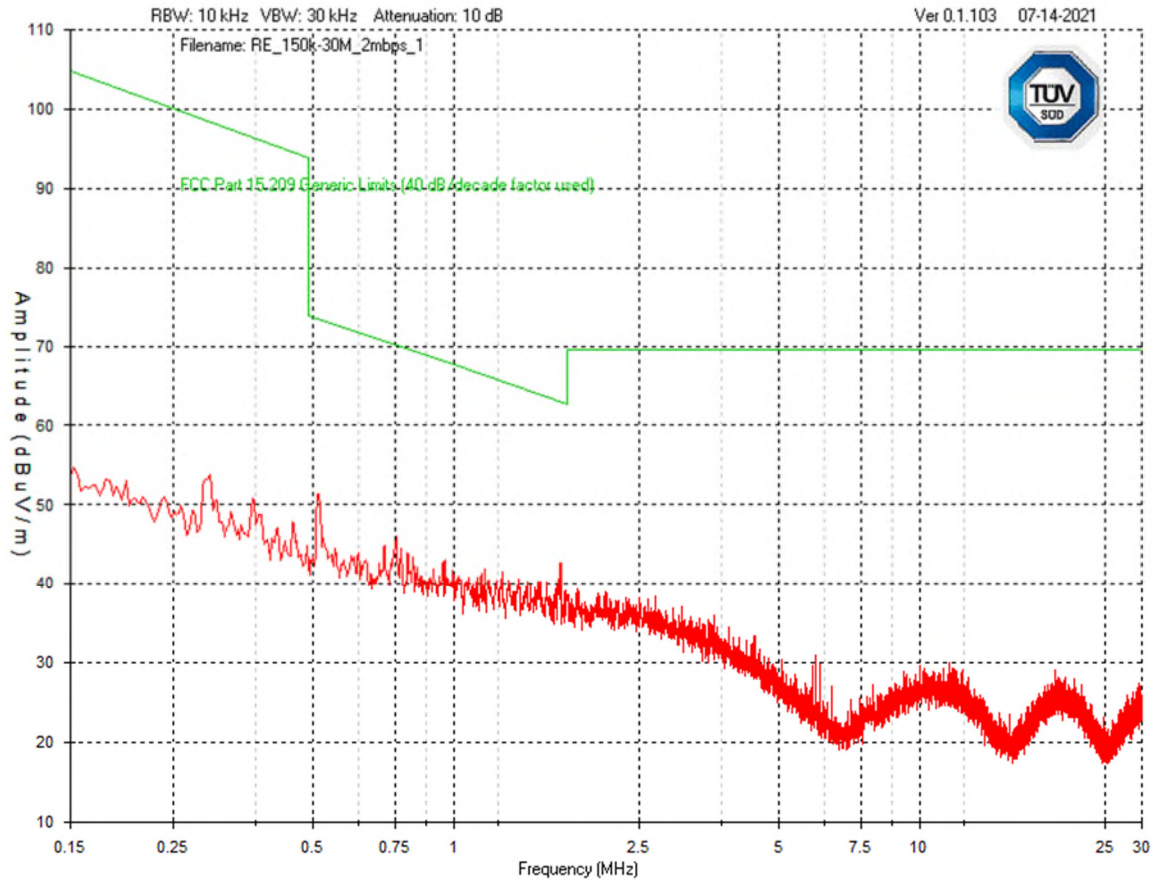
Spurious Emissions


High Channel
9 kHz – 150 kHz
Peak Emission Graph



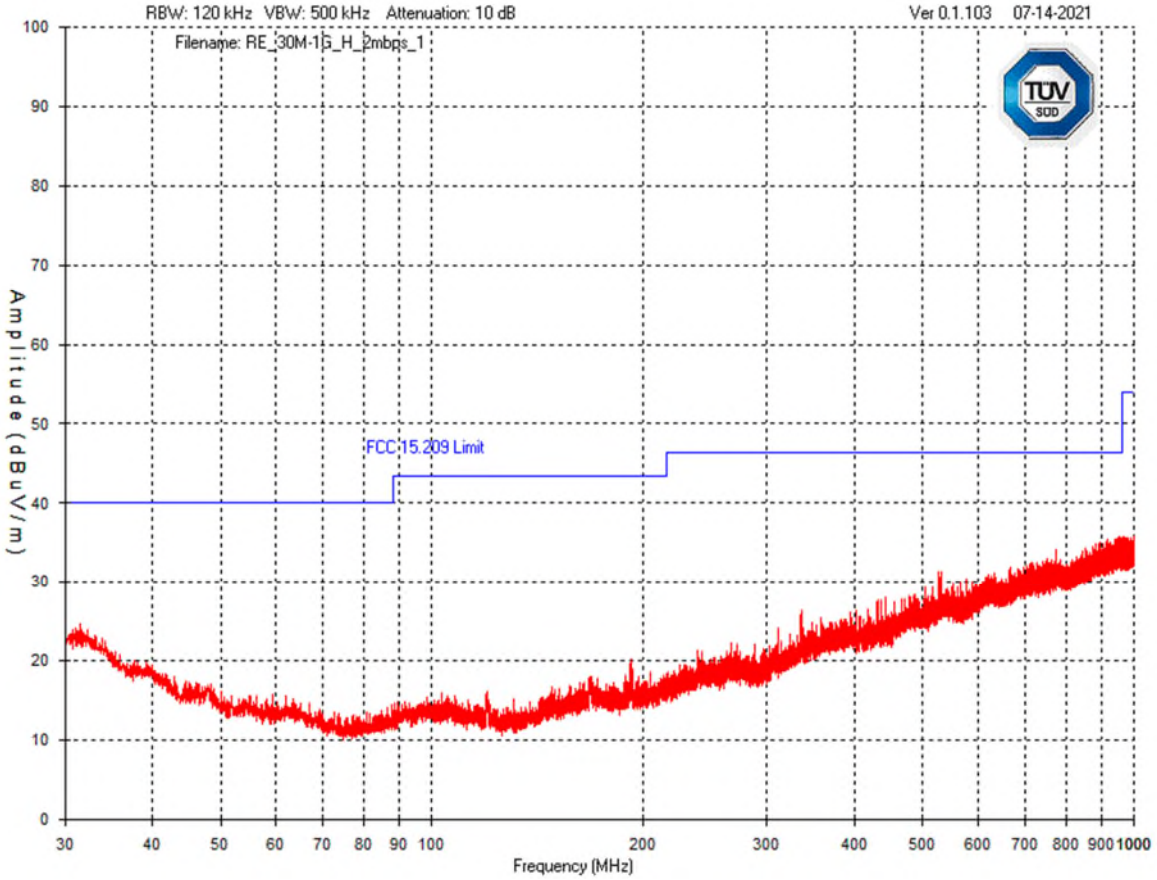
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel
150 kHz – 30 MHz
Peak Emission Graph



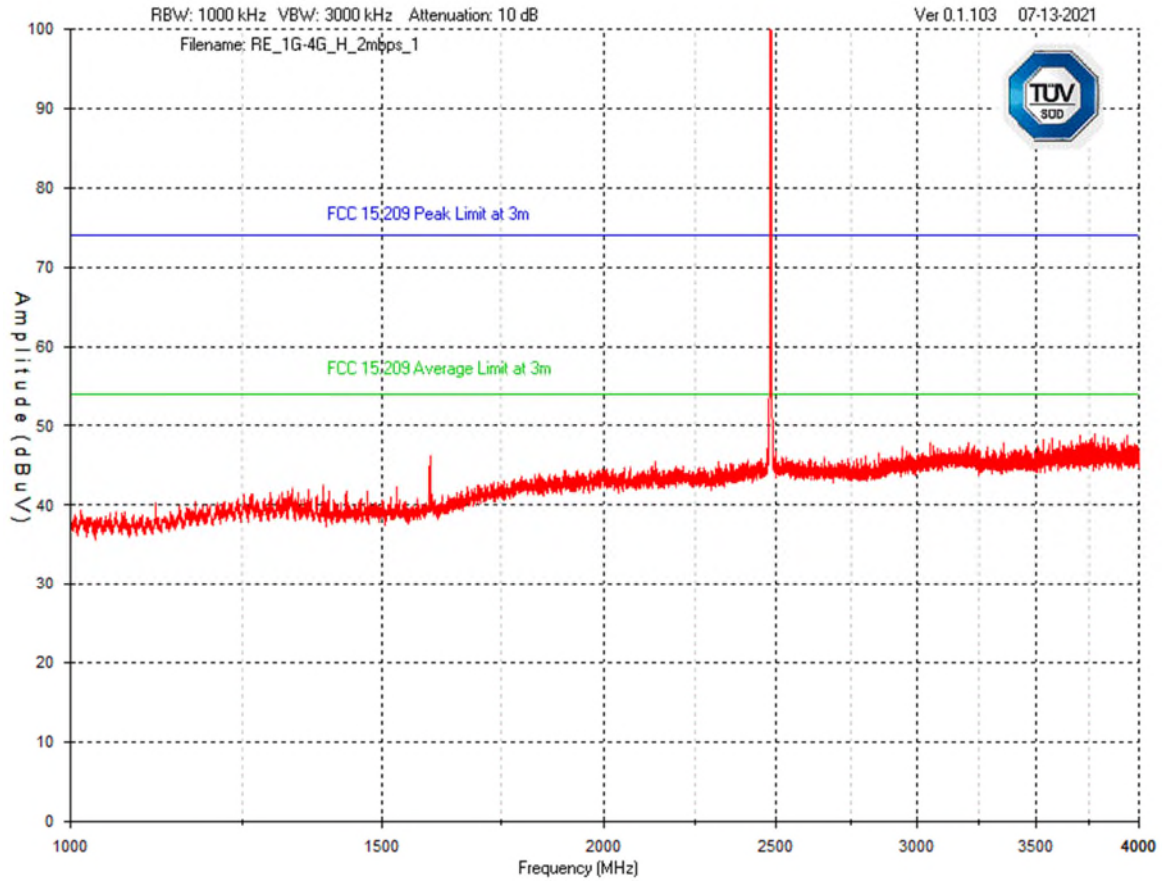
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



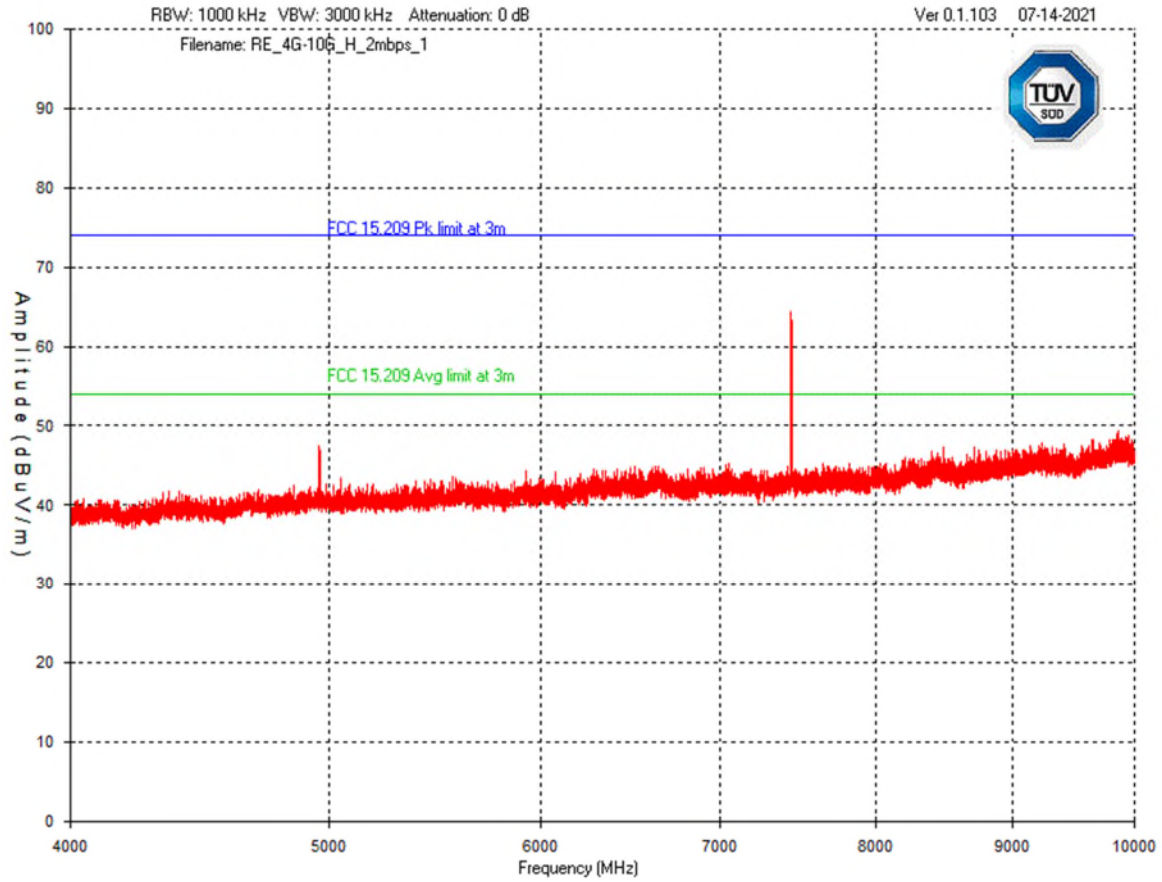
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 1 GHz – 4 GHz
Horizontal - Peak Emission Graph



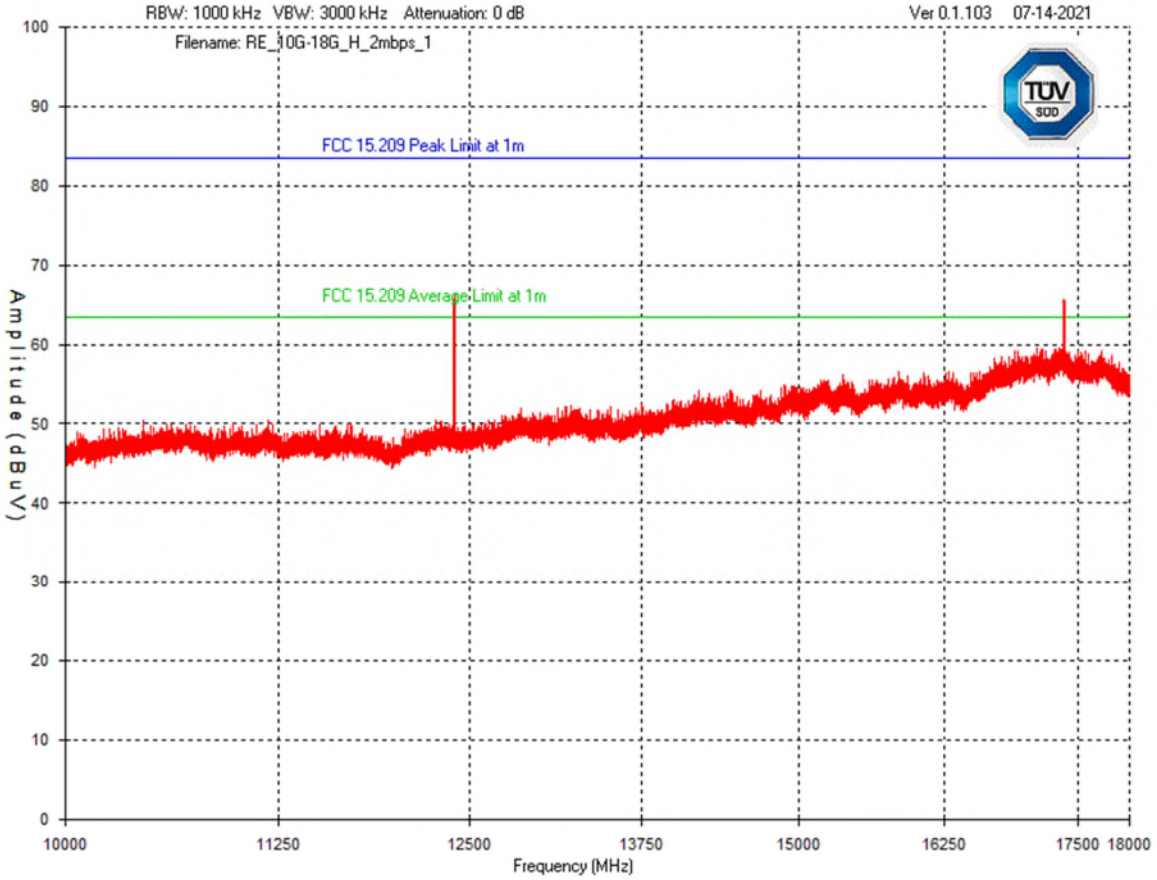
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

High Channel – 4 GHz – 10 GHz
Horizontal - Peak Emission Graph




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

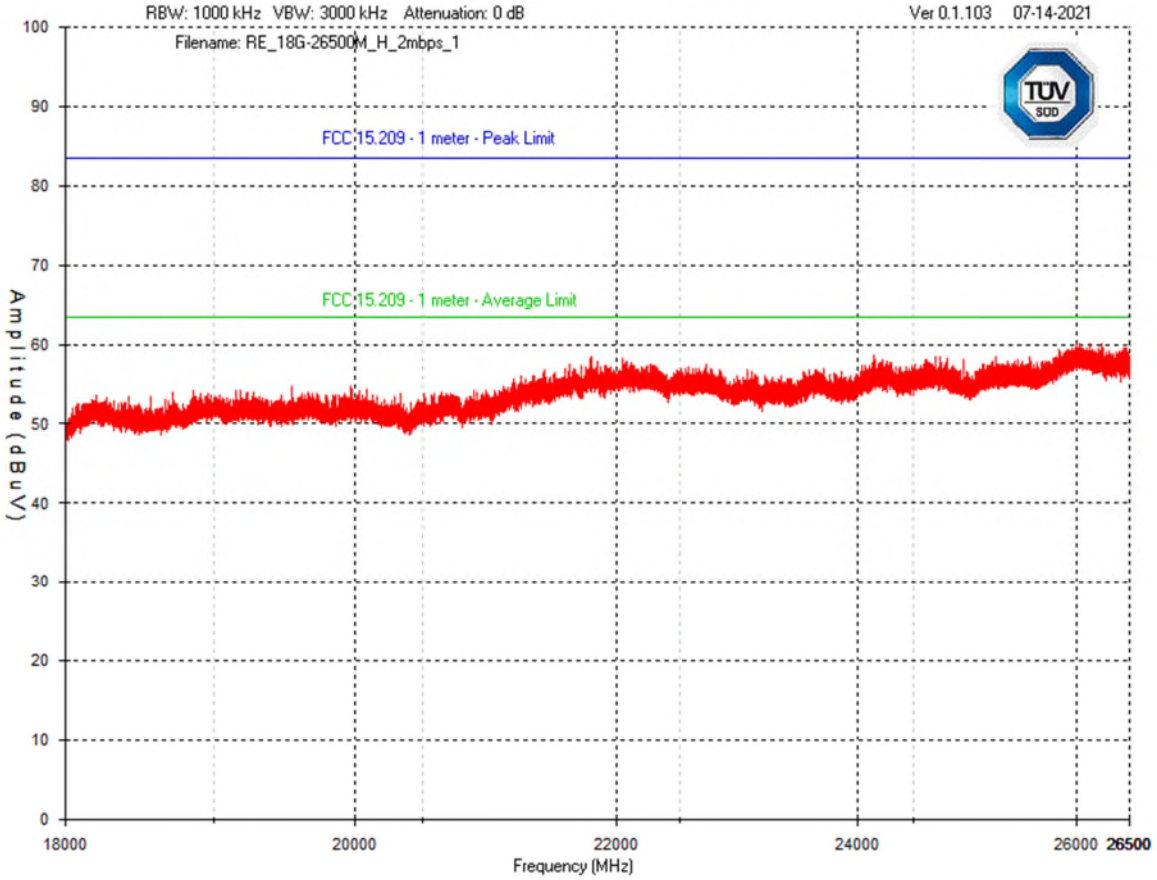
High Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

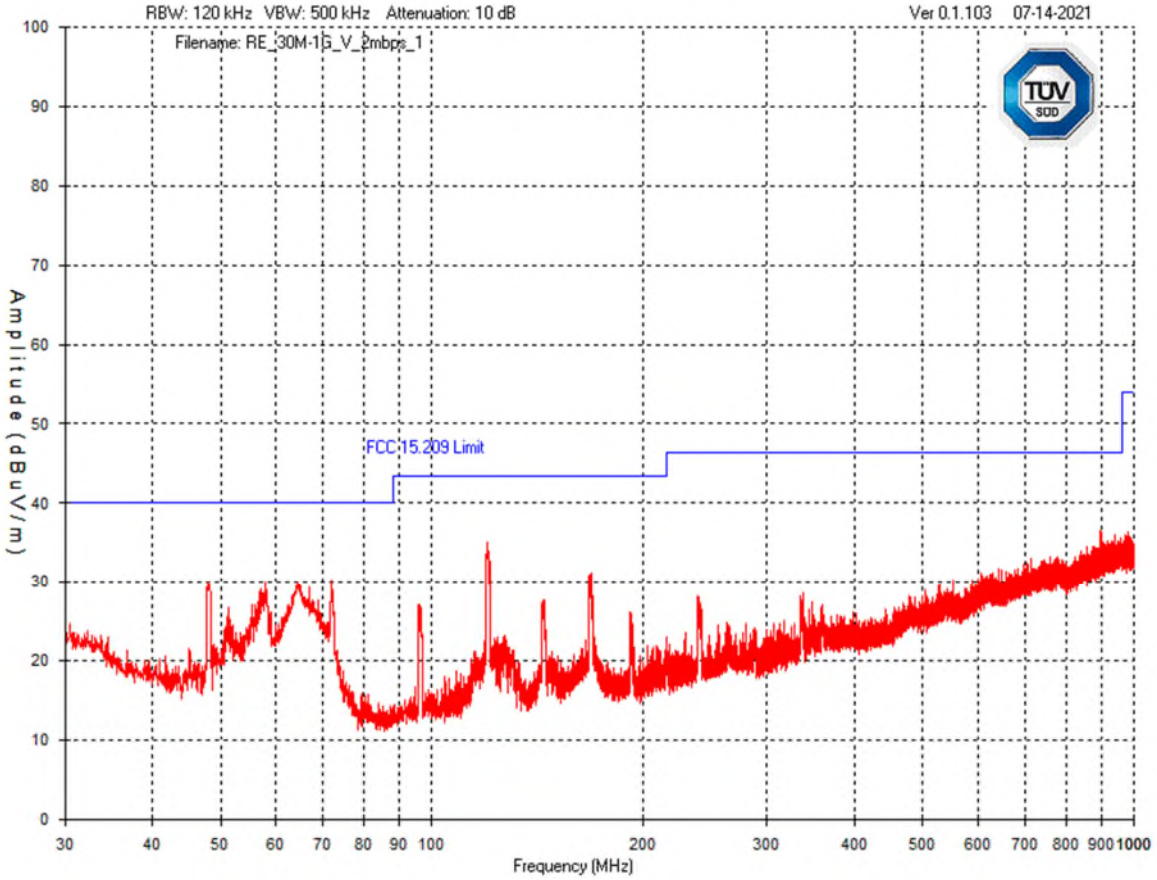
High Channel – 18 GHz – 26.5 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance.

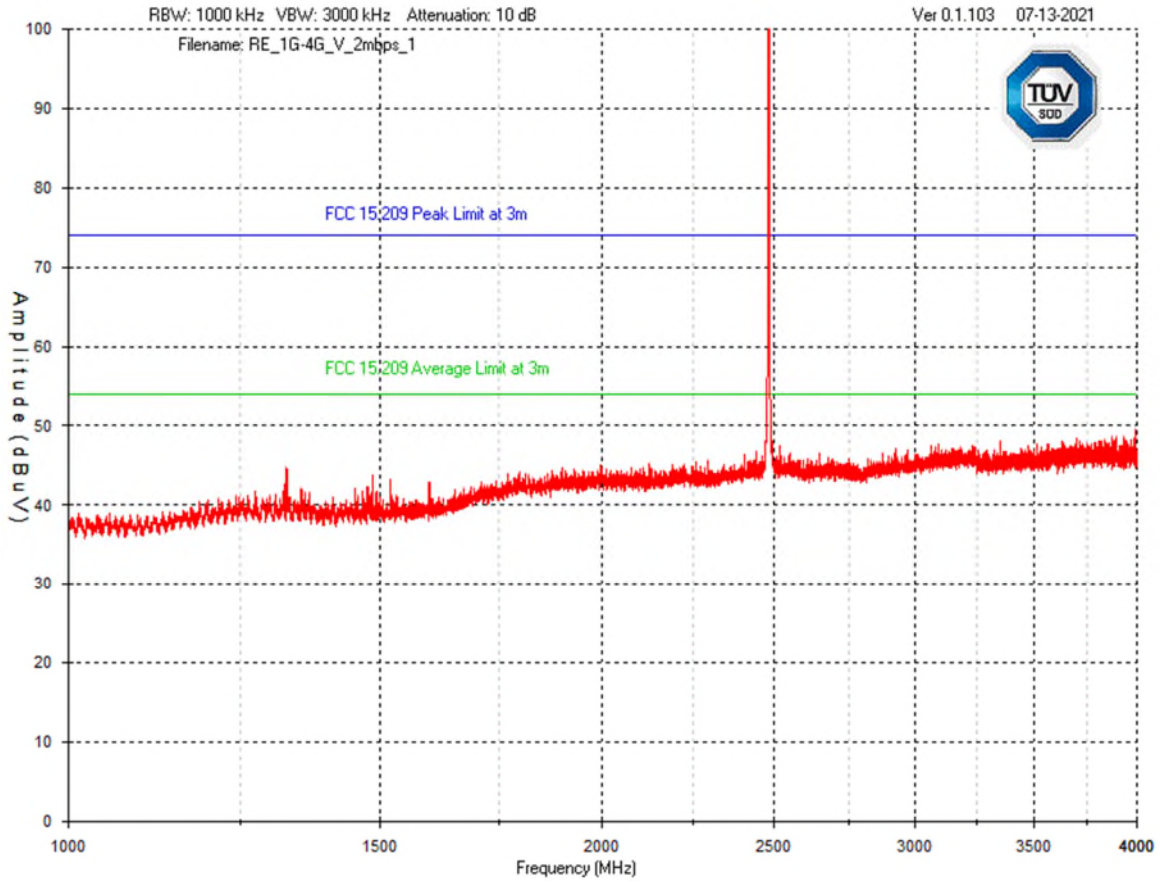
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel- 30 MHz – 1 GHz
Vertical - Peak Emission Graph



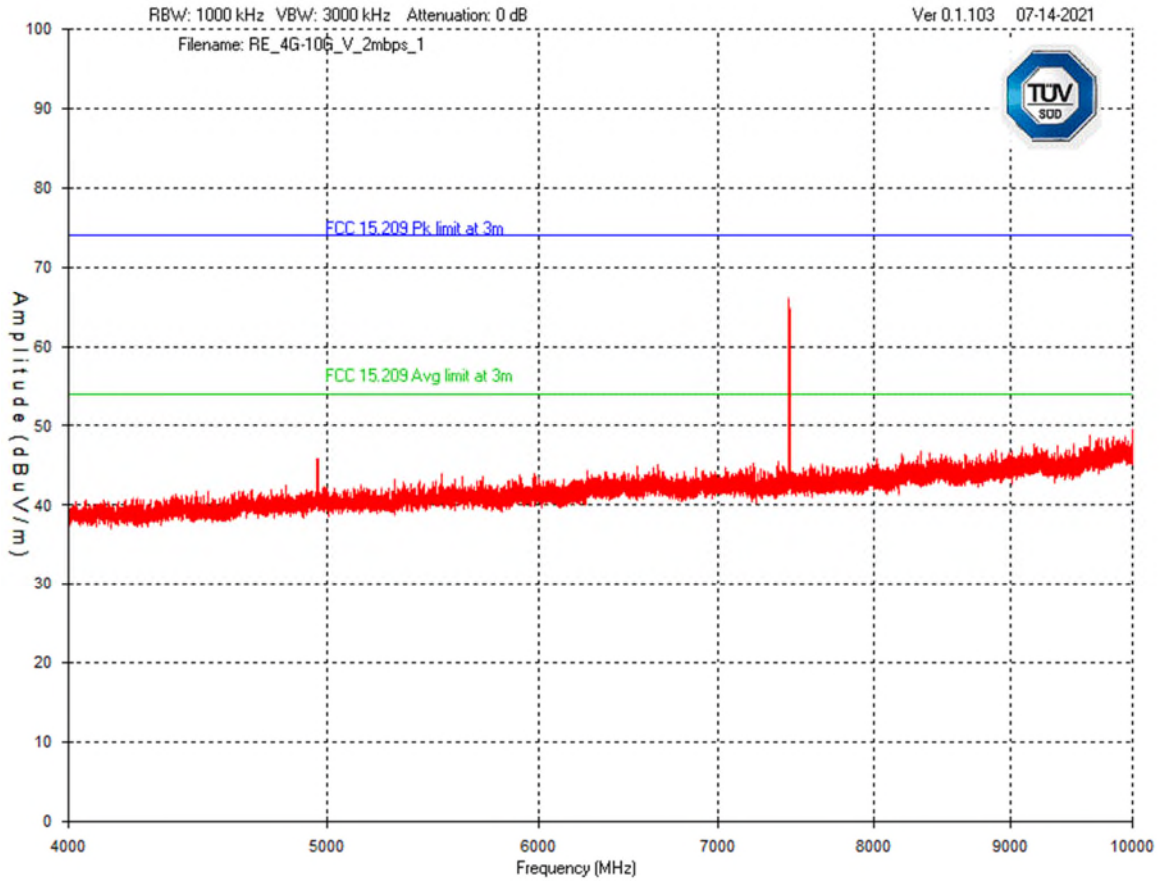
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel– 1 GHz – 4 GHz
Vertical - Peak Emission Graph



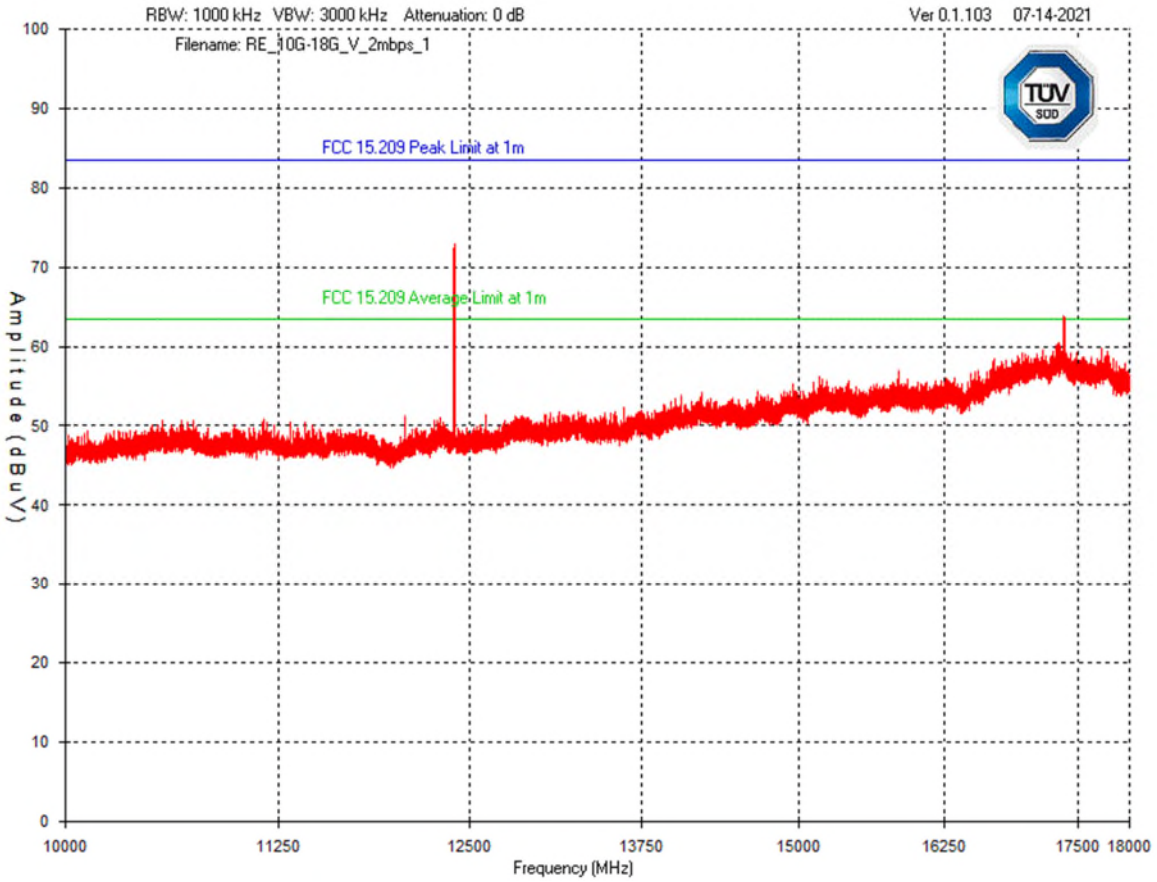
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

High Channel- 4 GHz – 10 GHz
Vertical - Peak Emission Graph




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

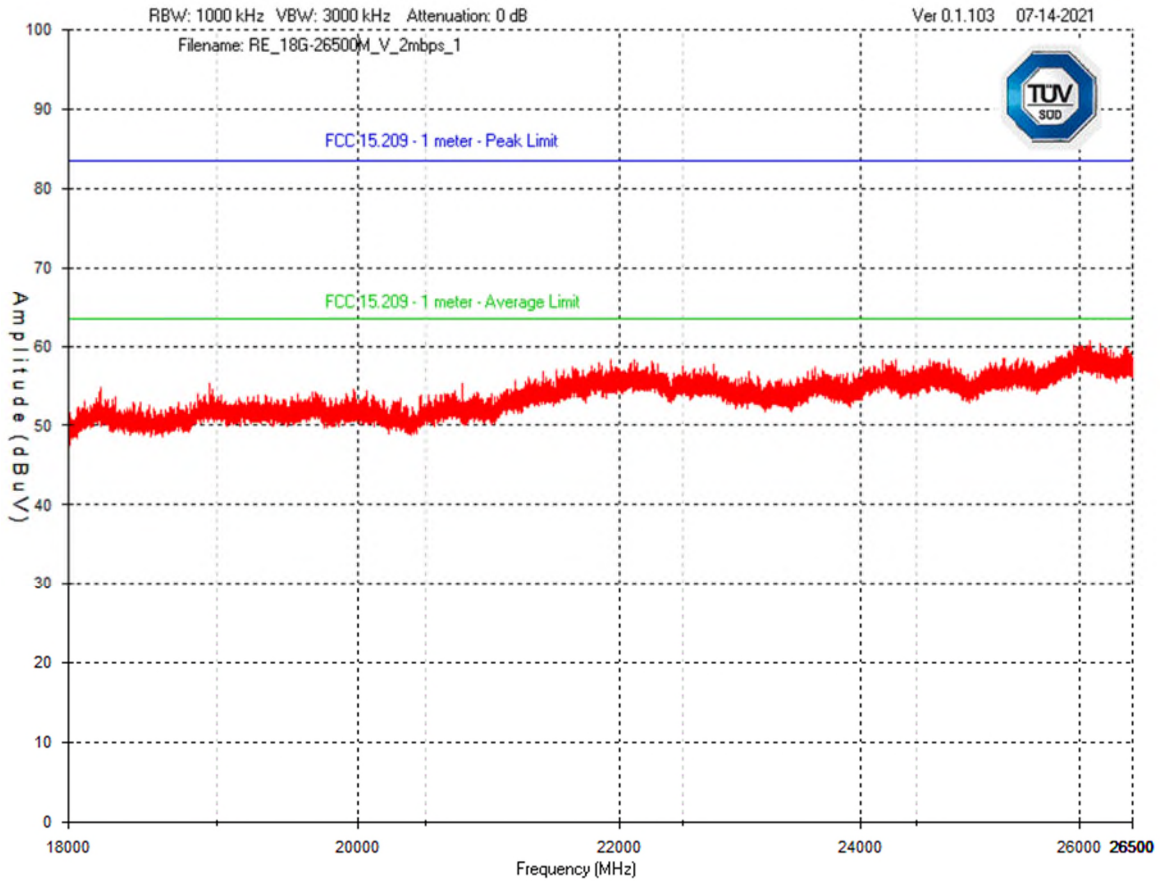
High Channel– 10 GHz – 18 GHz
Vertical - Peak Emission Graph




Plot was taken at a 1 meter distance.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

High Channel – 18 GHz – 26.5 GHz
Vertical - Peak Emission Graph

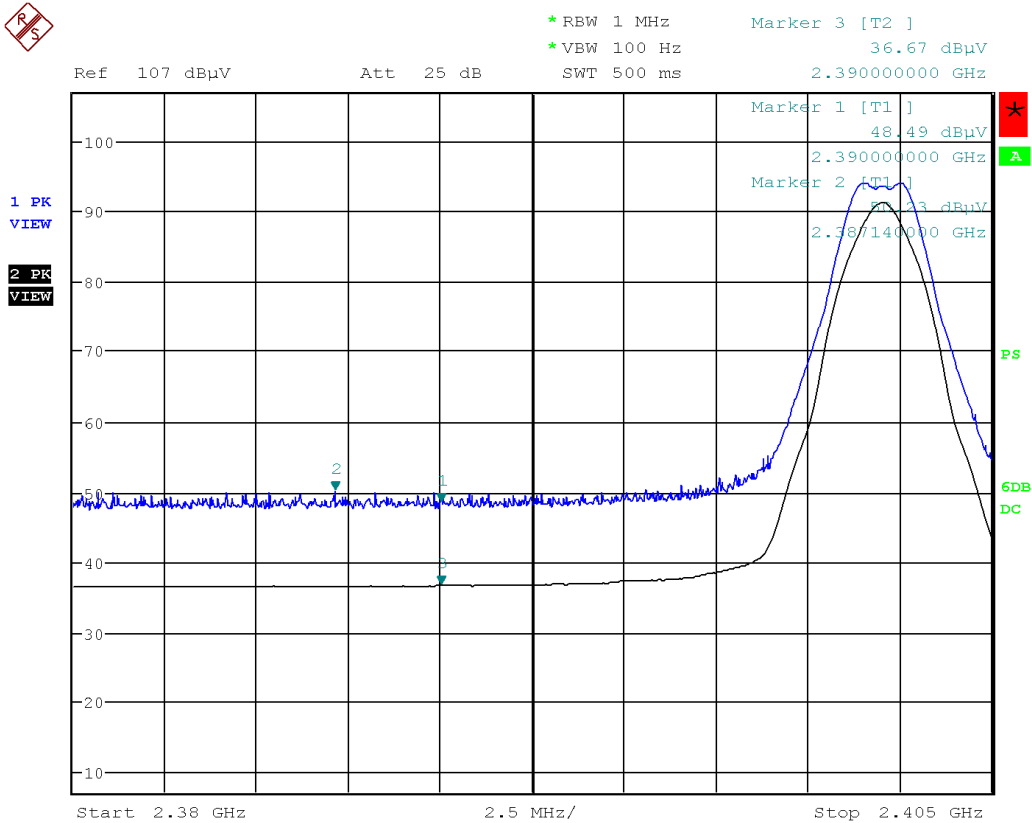


Plot was taken at a 1 meter distance.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Band Edges

**Band Edge – Low Channel
Horizontal - Peak & Average Emission**

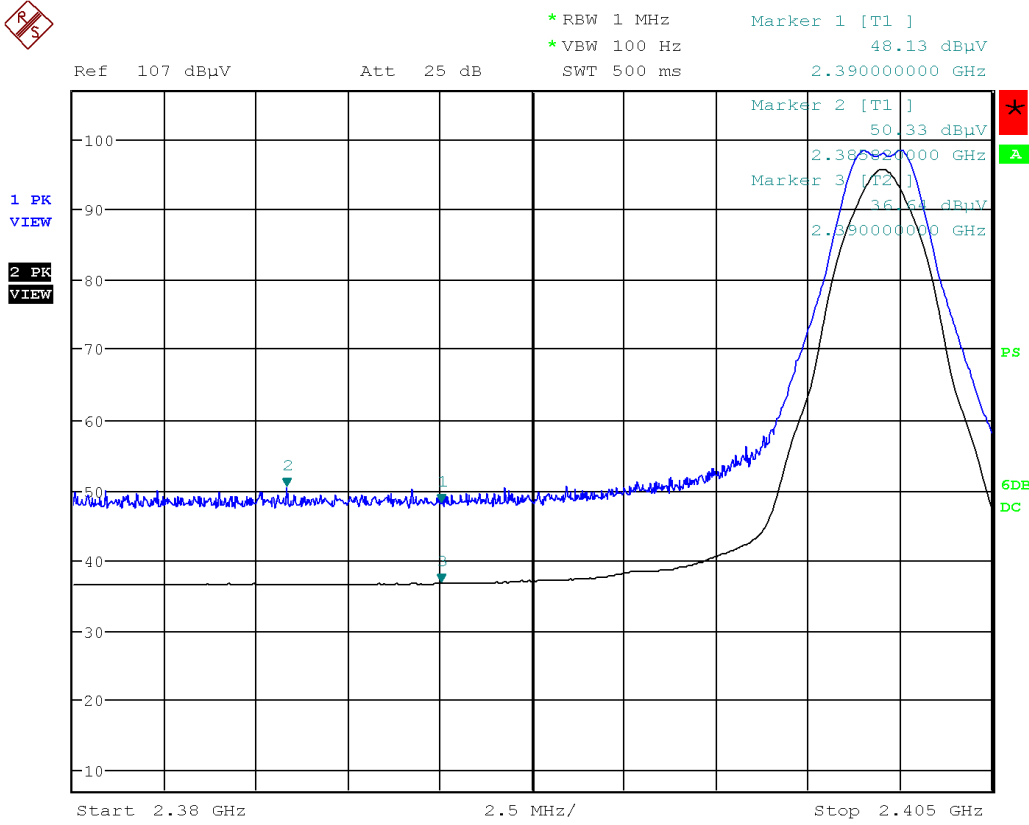


Date: 13.JUL.2021 19:00:54

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show the raw value. See the Final Measurements and Results section below for correct values.


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

**Band Edge – Low Channel
Vertical - Peak & Average Emission**

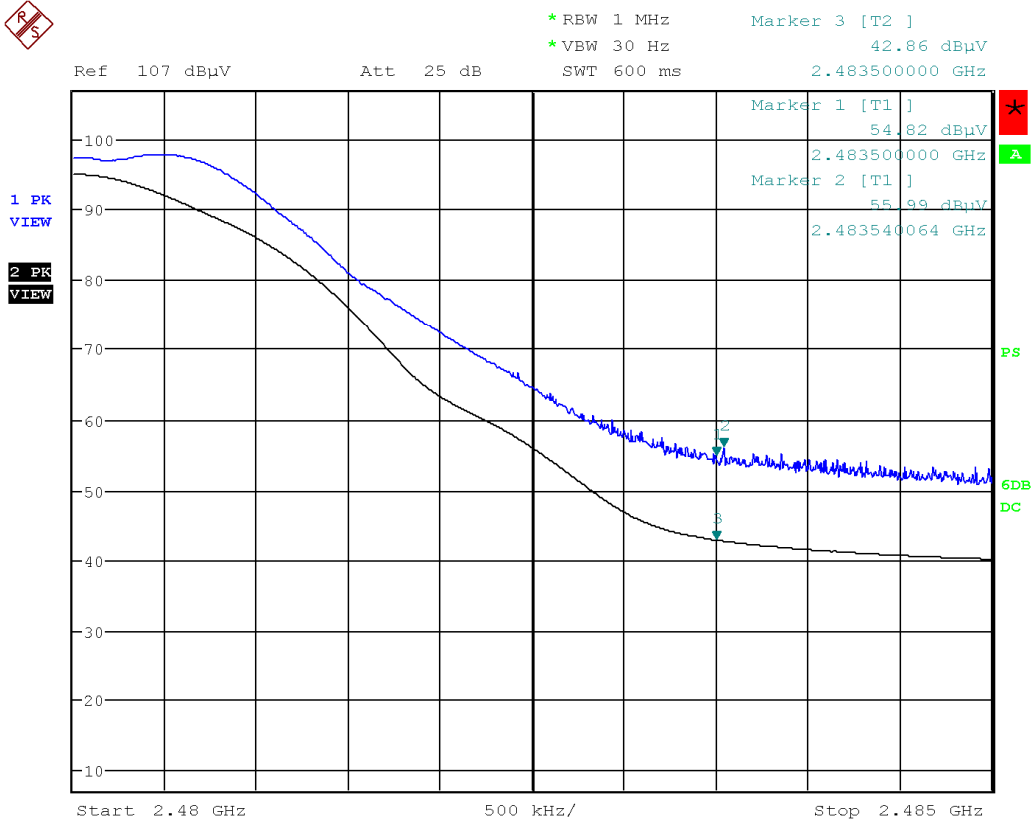


Date: 13.JUL.2021 18:50:51

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show the raw value. See the Final Measurements and Results section below for correct values.


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Band Edge – High Channel Horizontal - Peak & Average Emission

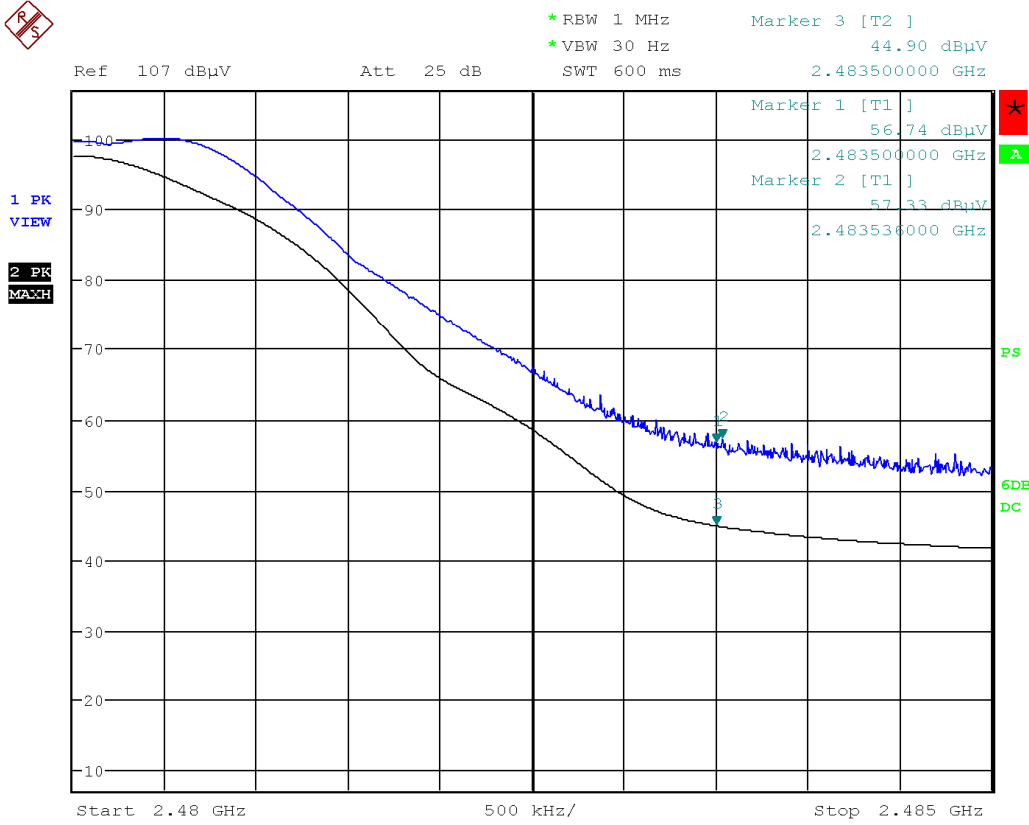


Date: 13.JUL.2021 17:57:36

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show the raw value. See the Final Measurements and Results section below for correct values.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


**Band Edge – High Channel
Vertical - Peak & Average Emission**



Date: 13.JUL.2021 18:21:50

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The markers show the raw value. See the Final Measurements and Results section below for correct values.

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Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Final Measurements and Results


In accordance with 15.247(d), only frequencies exceeding the 15.209 limit that occur within the bands listed in 15.205 need to be verified with a final detector.

The measurements were maximized by rotating the turn table over a full 0-360 rotation and the antenna height was varied from 1 m to 4 m.

Note: A duty cycle correction factor of -26.23dB (from a duty cycle of 4.88% for the 2.4 GHz transmission) is applied where indicated.

Mode: 1 Mbps Spurious Emissions

Frequency (MHz)	Detector	Received Signal (dBμV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Test Result
Horizontal Antenna Polarization									
527.96	PEAK	31.6	25.3	3.4	-28.6	31.7	46.4	14.7	Pass
30.74	PEAK	28.7	23.1	0.5	-28.4	23.9	40.0	16.1	Pass
430.50	PEAK	31.6	22.3	2.9	-28.6	28.2	46.4	18.2	Pass
407.68	PEAK	31.4	22.0	2.8	-28.6	27.6	46.4	18.8	Pass
348.68	PEAK	32.3	21.2	2.5	-28.5	27.5	46.4	18.9	Pass
335.48	PEAK	31.9	20.3	2.4	-28.5	26.1	46.4	20.3	Pass
7440.88	PEAK	59.8	29.2	8.9	-33.1	64.8	74.0	9.2	Pass
7440.88	AVG	53.8	29.2	8.9	-33.1	32.5 ^a	54.0	21.5	Pass
4960.38	PEAK	45.4	28.0	7.2	-32.5	48.1	74.0	25.9	Pass
4960.38	AVG	40.6	28.0	7.2	-32.5	17.0 ^a	54.0	37.0	Pass
17361.30	PEAK	44.8	36.5	13.7	-28.0	67.0	83.5	16.5	Pass
17361.30	AVG	37.5	36.5	13.7	-28.0	59.7	63.5	3.9	Pass
12399.40	PEAK	53.8	31.9	11.4	-30.8	66.3	83.5	17.2	Pass
12399.40	AVG	46.8	31.9	11.4	-30.8	59.3	63.5	4.2	Pass
Vertical Antenna Polarization									
119.78	QP	46.9	13.0	1.1	-28.4	32.6	43.5	10.9	Pass
47.89	PEAK	42.3	15.2	0.7	-28.4	29.8	40.0	10.2	Pass
72.00	PEAK	44.7	12.4	0.8	-28.4	29.5	40.0	10.5	Pass
64.70	PEAK	44.4	12.7	0.8	-28.4	29.5	40.0	10.5	Pass
168.03	PEAK	43.3	15.4	1.5	-28.4	31.8	43.5	11.7	Pass

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


169.23	PEAK	43.1	15.4	1.5	-28.4	31.6	43.5	11.9	Pass
7440.88	PEAK	60.0	29.2	8.9	-33.1	65.0	74.0	9.0	Pass
7440.88	AVG	55.7	29.2	8.9	-33.1	34.4 ^a	54.0	19.6	Pass
4959.18	PEAK	43.2	28.0	7.2	-32.5	45.9	74.0	28.1	Pass
4959.18	AVG	39.0	28.0	7.2	-32.5	15.5 ^a	54.0	38.5	Pass
12399.40	PEAK	56.6	31.6	11.4	-30.8	68.8	83.5	14.7	Pass
12399.40	AVG	52.5	31.6	11.4	-30.8	38.5 ^a	63.5	25.0	Pass
17361.70	PEAK	43.5	36.5	13.7	-28.0	65.7	83.5	17.8	Pass
17361.70	AVG	34.7	36.5	13.7	-28.0	56.9	63.5	6.6	Pass

^a The emissions at these frequencies are harmonics of the transmitter. The transmitter has a duty cycle of 4.88% (0.0488). A Duty Cycle Correction Factor (DCCF) of $20\log(0.0488) = -26.23$ dB was applied to the Average as per FCC KDB 55807v D01 v05r02. The Level was calculated per the following formula:

$$\text{Level} = \text{Received Signal} + \text{Antenna Factor} + \text{Cable Factor} + \text{Pre-Amp} + \text{DCCF}$$


Mode: 1 Mbps
Band Edges

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Atten (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel											
2389.96	PEAK	Horz	50.21	32	4.7	0.0	-34.1	52.81	74	21.19	PASS
2390.00	PEAK	Horz	48.19	32	4.7	0.0	-34.1	50.79	74	23.21	PASS
2390.00	AVG	Horz	36.7	32	4.7	0.0	-34.1	39.3	54	14.7	PASS
2380.14	PEAK	Vert	50.24	32	4.7	0.0	-34.1	52.84	74	21.16	PASS
2390.00	PEAK	Vert	48.32	32	4.7	0.0	-34.1	50.92	74	23.08	PASS
2390.00	AVG	Vert	36.64	32	4.7	0.0	-34.1	39.24	54	14.76	PASS
High Channel											
2483.86	PEAK	Horz	53.34	32.2	4.7	0.0	-33.8	56.44	74	17.56	PASS
2483.50	PEAK	Horz	52.43	32.2	4.7	0.0	-33.8	55.53	74	18.47	PASS
2483.50	AVG	Horz	41.11	32.2	4.7	0.0	-33.8	44.21	54	9.79	PASS
2483.84	PEAK	Vert	56.47	32.2	4.7	0.0	-33.8	59.57	74	14.43	PASS
2483.50	PEAK	Vert	53.66	32.2	4.7	0.0	-33.8	56.76	74	17.24	PASS
2483.50	AVG	Vert	42.88	32.2	4.7	0.0	-33.8	45.98	54	8.02	PASS

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

**Mode: 2 Mbps
Spurious Emissions**

Frequency (MHz)	Detector	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
Horizontal Antenna Polarization									
531.85	PEAK	31.1	25.5	3.4	-28.6	31.4	46.4	15.0	Pass
746.85	PEAK	27.2	28.1	4.5	-28.4	31.4	46.4	15.0	Pass
31.63	PEAK	30.2	22.5	0.5	-28.4	24.8	40.0	15.2	Pass
443.15	PEAK	31.2	22.4	3.0	-28.6	28.0	46.4	18.4	Pass
335.52	PEAK	32.2	20.3	2.4	-28.5	26.4	46.4	20.0	Pass
191.98	PEAK	31.0	16.0	1.6	-28.4	20.2	43.5	23.3	Pass
7441.78	PEAK	59.4	29.2	8.9	-33.1	64.4	74.0	9.6	Pass
7441.78	AVG	52.7	29.2	8.9	-33.1	31.5 ^α	54.0	22.5	Pass
4958.88	PEAK	44.7	28.0	7.2	-32.5	47.4	74.0	26.6	Pass
4958.88	AVG	37.4	28.0	7.2	-32.5	13.8 ^α	54.0	40.2	Pass
12398.10	PEAK	53.8	31.9	11.4	-30.8	66.3	83.5	17.2	Pass
12398.10	AVG	46.7	31.9	11.4	-30.8	33.0 ^α	63.5	30.5	Pass
17356.50	PEAK	43.5	36.6	13.7	-28.0	65.8	83.5	17.7	Pass
17356.50	AVG	36.4	36.6	13.7	-28.0	58.7	63.5	4.8	Pass
Vertical Antenna Polarization									
119.94	QP	47.2	13.0	1.1	-28.4	32.9	43.5	10.6	Pass
71.80	PEAK	45.4	12.4	0.8	-28.4	30.2	40.0	9.8	Pass
64.47	PEAK	45.0	12.8	0.8	-28.4	30.2	40.0	9.8	Pass
47.93	PEAK	42.6	15.2	0.7	-28.4	30.1	40.0	9.9	Pass
58.02	PEAK	44.3	13.4	0.7	-28.4	30.0	40.0	10.0	Pass
168.46	PEAK	42.8	15.4	1.5	-28.4	31.3	43.5	12.2	Pass
7438.78	PEAK	61.0	29.2	8.9	-33.1	66.0	74.0	8.0	Pass
7438.78	AVG	54.0	29.2	8.9	-33.1	32.7 ^α	54.0	21.3	Pass
4959.18	PEAK	43.2	28.0	7.2	-32.5	45.9	74.0	28.1	Pass
4959.18	AVG	34.0	28.0	7.2	-32.5	10.4 ^α	54.0	43.6	Pass
12398.10	PEAK	60.6	31.6	11.4	-30.8	72.8	83.5	10.7	Pass
12398.10	AVG	52.3	31.6	11.4	-30.8	38.3 ^α	63.5	25.2	Pass
17356.90	PEAK	41.5	36.6	13.7	-28.0	63.8	83.5	19.7	Pass
17356.90	AVG	33.0	36.6	13.7	-28.0	55.3	63.5	8.2	Pass

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

^a The emissions at these frequencies are harmonics of the transmitter. The transmitter has a duty cycle of 4.88% (0.0488). A Duty Cycle Correction Factor (DCCF) of $20\log(0.0488) = -26.23 \text{ dB}$ was applied to the Average as per FCC KDB 55807v D01 v05r02. The Level was calculated per the following formula:


$$\text{Level} = \text{Received Signal} + \text{Antenna Factor} + \text{Cable Factor} + \text{Pre-Amp} + \text{DCCF}$$

Mode: 2 Mbps
Band Edges

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBμV)	Antenna Factor (dB/m)	Cable Factor (dB)	Atten (dB)	Pre-Amp Gain (dB)	Level (dBμV/m)	Emission Limit (dBμV/m)	Margin (dB)	Result
Low Channel											
2387.14	PEAK	Horz	50.23	32	4.7	0.0	-34.1	52.83	74	21.17	PASS
2390.00	PEAK	Horz	48.49	32	4.7	0.0	-34.1	51.09	74	22.91	PASS
2390.00	AVG	Horz	36.67	32	4.7	0.0	-34.1	39.27	54	14.73	PASS
2385.82	PEAK	Vert	50.33	32	4.7	0.0	-34.1	52.93	74	21.07	PASS
2390.00	PEAK	Vert	48.13	32	4.7	0.0	-34.1	50.73	74	23.27	PASS
2390.00	AVG	Vert	36.64	32	4.7	0.0	-34.1	39.24	54	14.76	PASS
High Channel											
2483.54	PEAK	Horz	55.99	32.2	4.7	0.0	-33.8	59.09	74	14.91	PASS
2483.50	PEAK	Horz	54.82	32.2	4.7	0.0	-33.8	57.92	74	16.08	PASS
2483.50	AVG	Horz	42.86	32.2	4.7	0.0	-33.8	45.96	54	8.04	PASS
2483.54	PEAK	Vert	57.33	32.2	4.7	0.0	-33.8	60.43	74	13.57	PASS
2483.50	PEAK	Vert	56.74	32.2	4.7	0.0	-33.8	59.84	74	14.16	PASS
2483.50	AVG	Vert	44.9	32.2	4.7	0.0	-33.8	48	54	6	PASS


Notes:

- PEAK = Peak measurement
- AVG = Average measurement
- QP = Quasi-Peak measurement
- Horz = Horizontal
- Vert = Vertical
- Atten = Attenuator factor

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Loop Antenna 9 – 150 kHz	EM 6871	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 70
Loop Antenna 150 kHz – 30 MHz	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
BiLog Antenna 30 MHz – 1 GHz	3142-C	ETS-Lindgren	Nov. 25, 2020	Nov. 25, 2022	GEMC 8
Horn Antenna 1 – 4 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
Horn Antenna 4 – 18 GHz	WBH218HN	Q-par	Apr. 1, 2020	Apr. 1, 2022	GEMC 6375
Horn Antenna 18 - 26.5 GHz	SAS-572	A.H. Systems	Dec. 1, 2020	Dec. 1, 2022	GEMC 6371
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 12, 2021	Feb. 12, 2023	GEMC 168
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Dec. 20, 2019	Dec. 20, 2021	GEMC 189
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 287
RF Cable 10m	LMR-400-10M- 50Ω-MN-MN	LexTec	NCR	NCR	GEMC 274
RF Cable 2m	Sucoflex 104A	Huber+Suhner	NCR	NCR	GEMC 271
Emissions Software	0.1.103	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Power Spectral Density

Purpose

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation.

Limits and Method

The limits are defined in 15.247(e) and RSS-247 5.2(b).

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.


The method is given in FCC KDB 558074 Section 10.2.

Results

The EUT passed. Low, middle and high bands were measured.

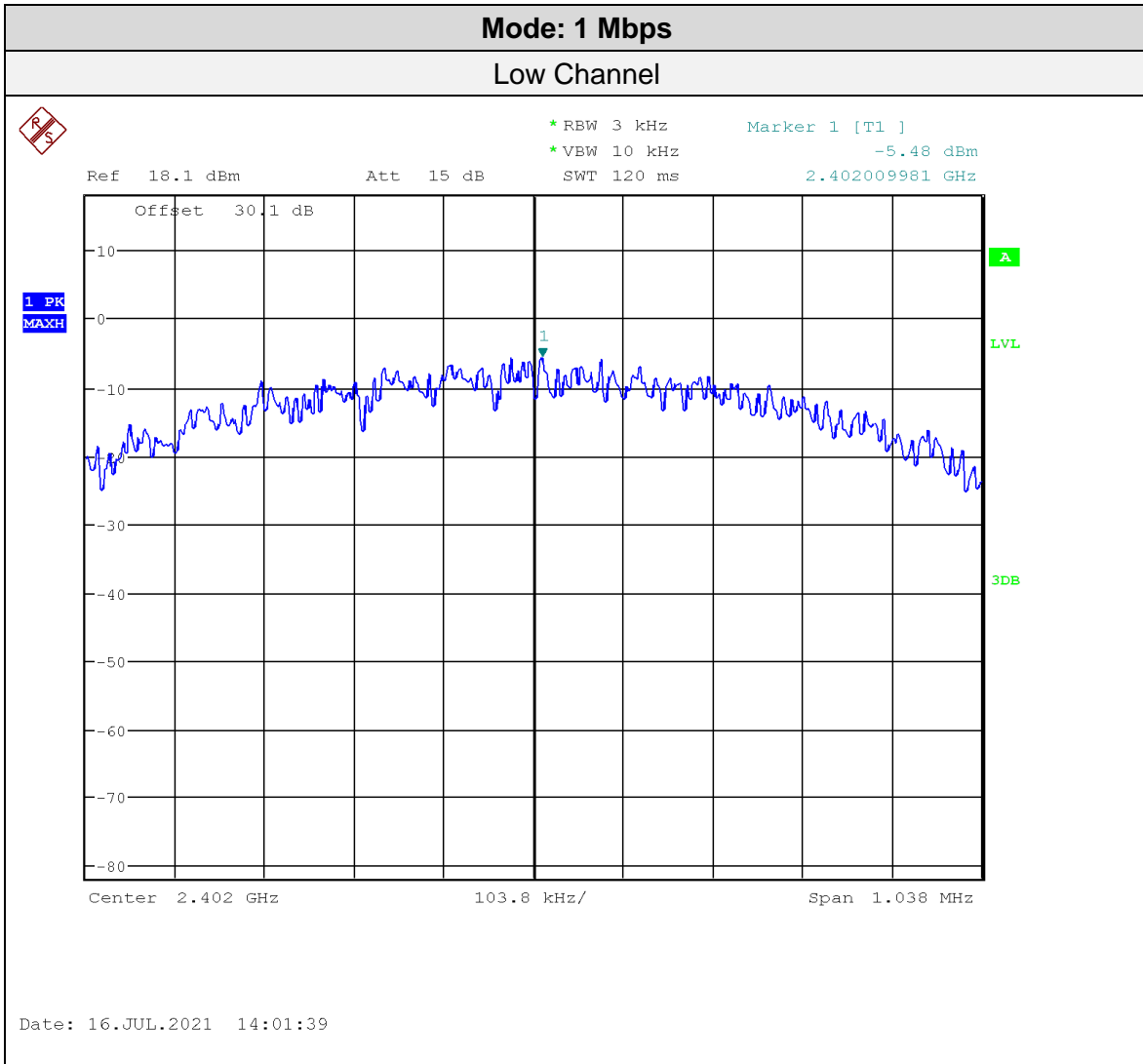
Mode: 1 Mbps		
Channel	Frequency (MHz)	PSD (dBm)
Low	2402	-5.48
Mid	2440	-5.60
High	2480	-5.80


Mode: 2 Mbps		
Channel	Frequency (MHz)	PSD (dBm)
Low	2402	-7.73
Mid	2440	-7.86
High	2480	-8.09

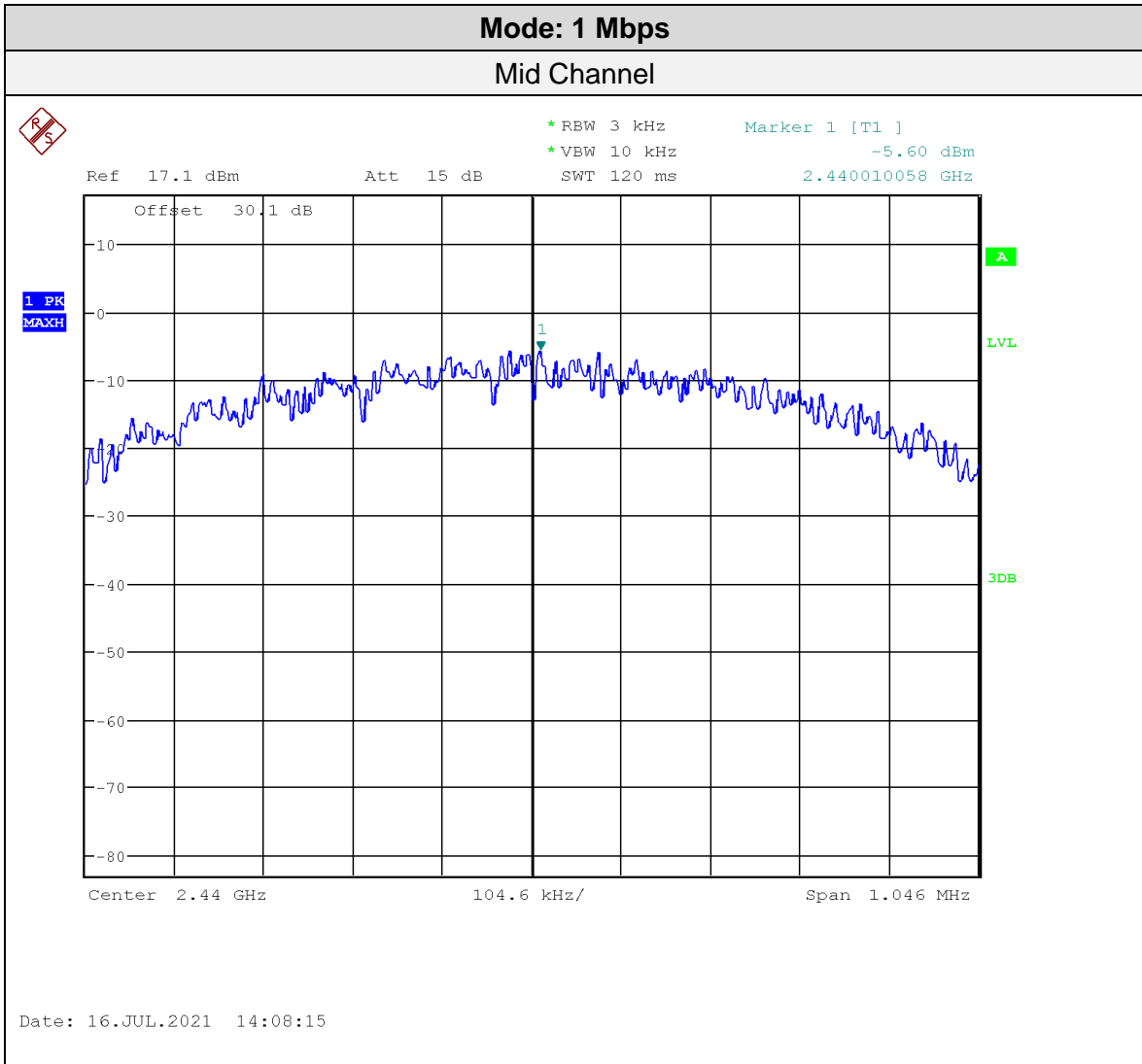
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Graphs

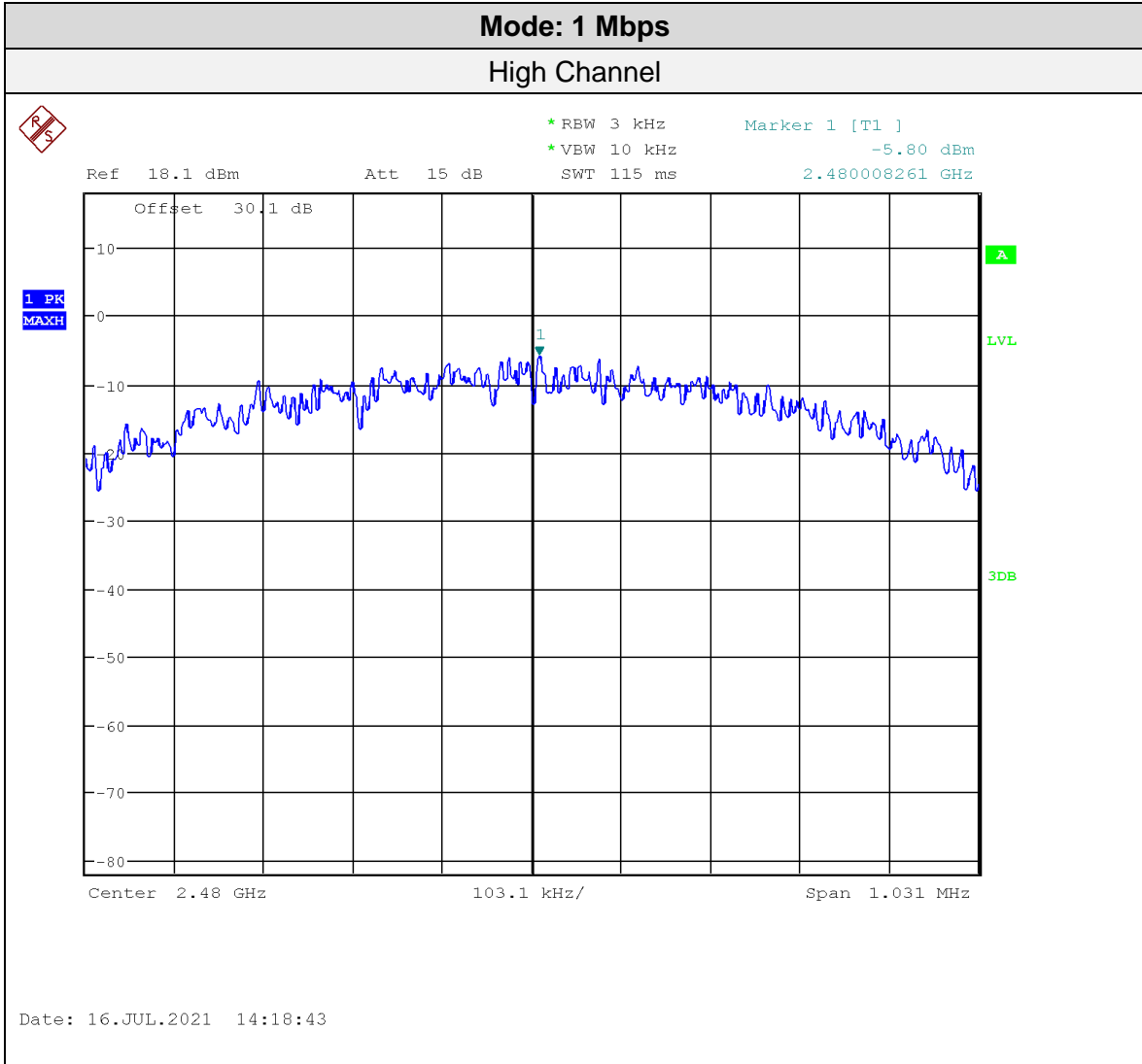
The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channels were investigated. The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer.




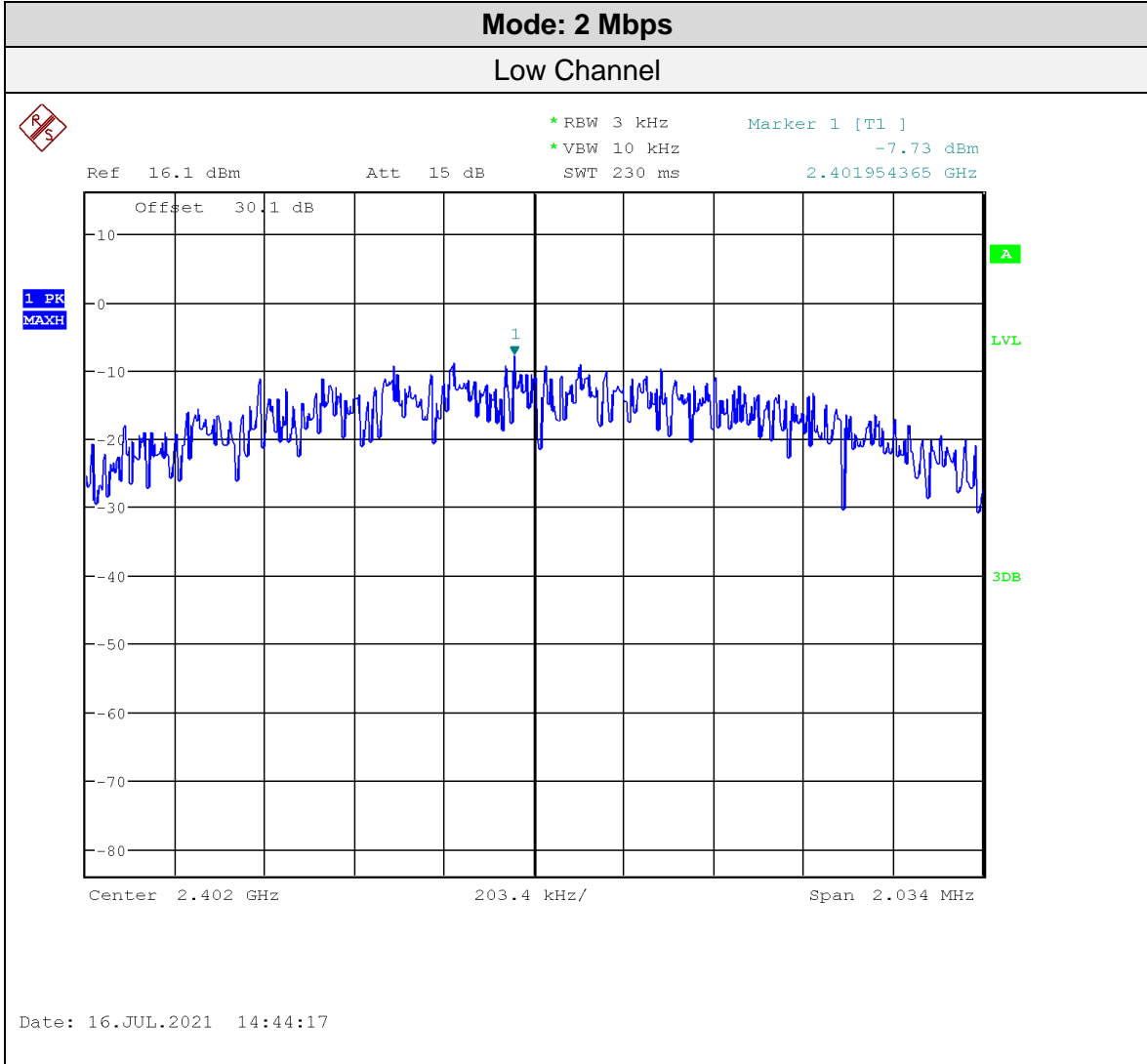
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




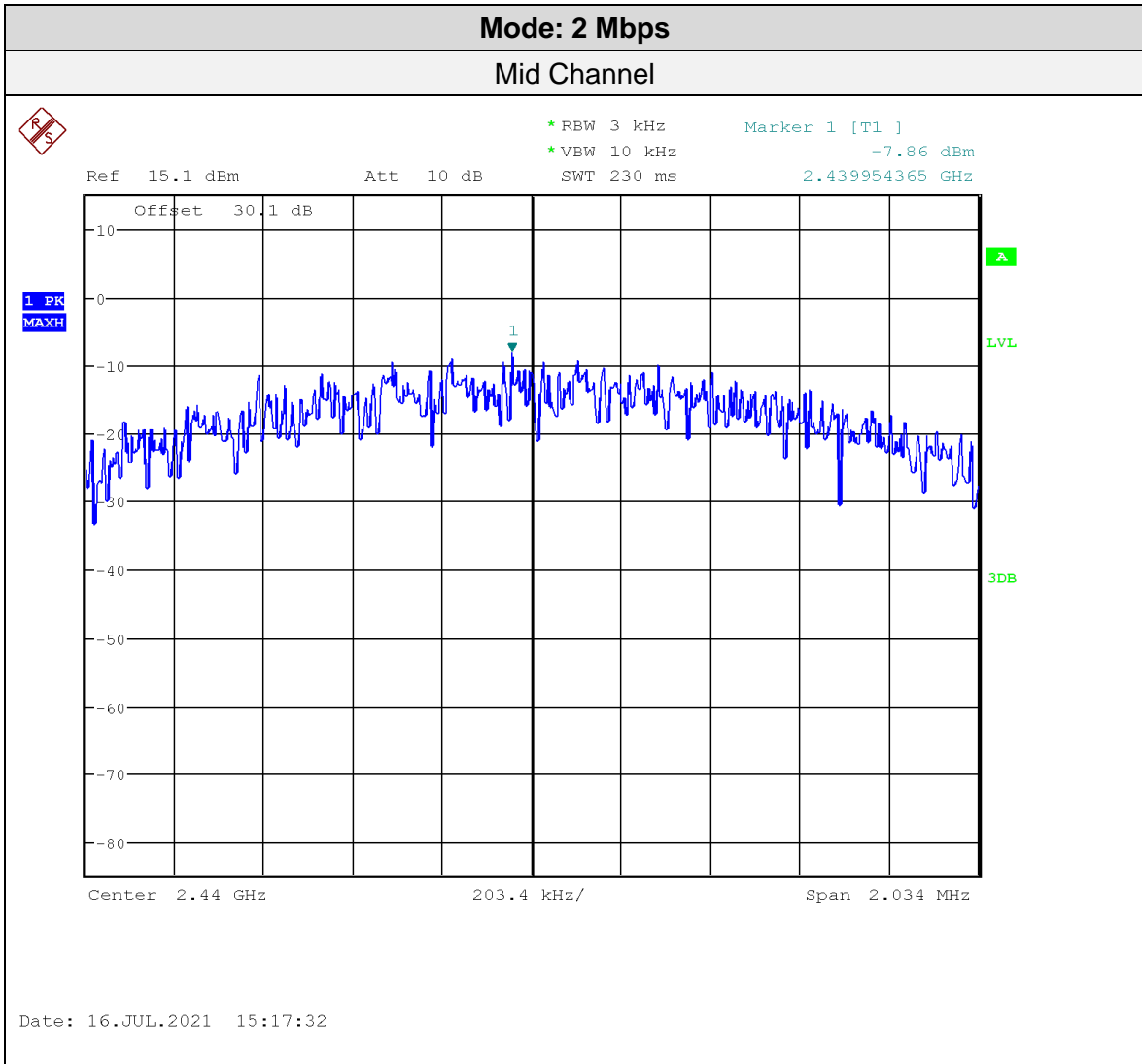
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




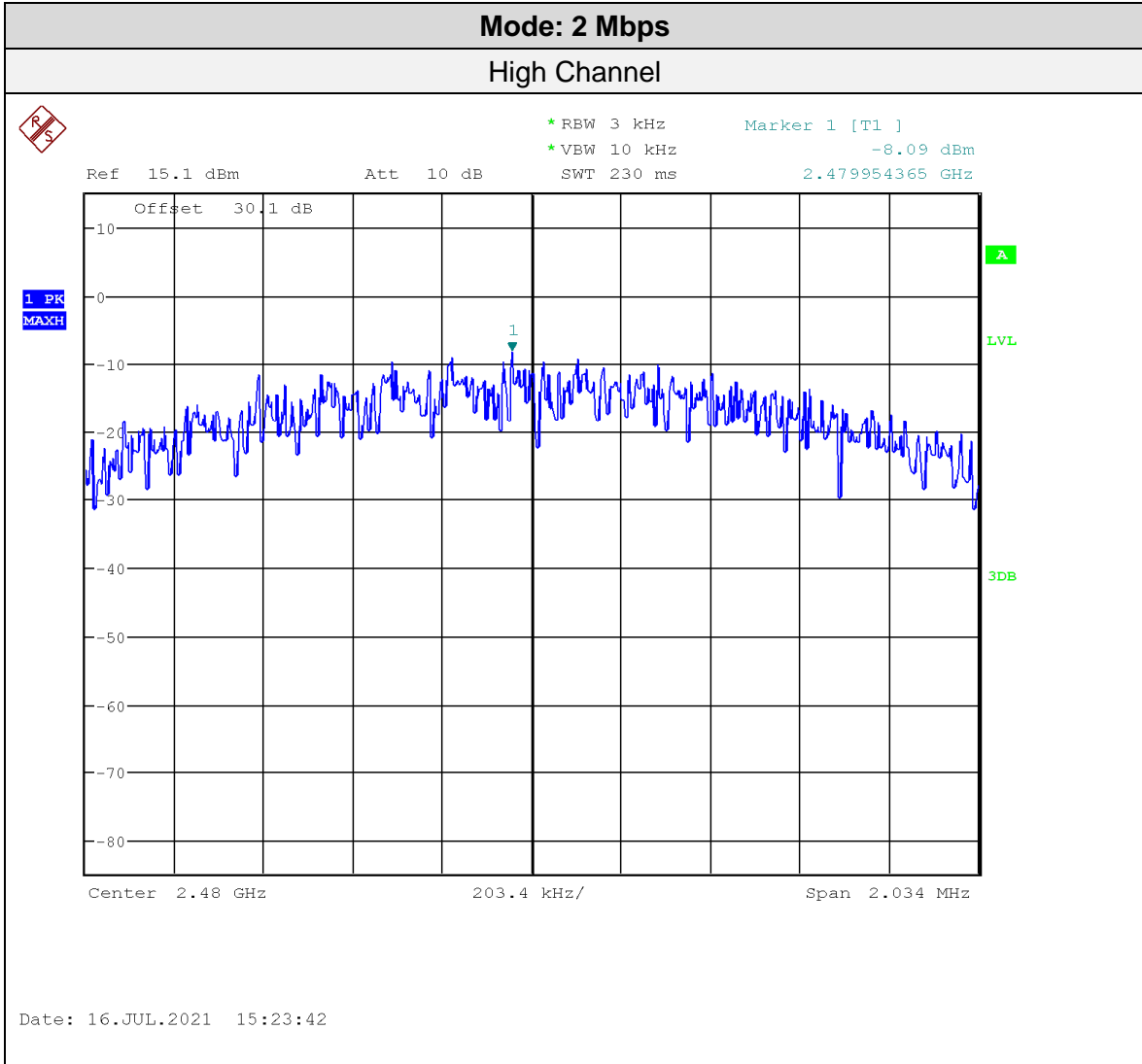
Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




See exhibits for photos showing the test set-up.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Oct. 25, 2019	Oct. 25, 2021	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133
Attenuator 20 dB	3M-20	Weinschel	NCR	NCR	GEMC 280

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits and Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207


Method is as defined in ANSI C63.4

Average Limits		Quasi-Peak Limits	
150 kHz – 500 kHz	56 to 46* dB μ V	150 kHz – 500 kHz	66 to 56* dB μ V
500 kHz – 5 MHz	46 dB μ V	500 kHz – 5 MHz	56 dB μ V
5 MHz – 30 MHz	50 dB μ V	5 MHz – 30 MHz	60 dB μ V

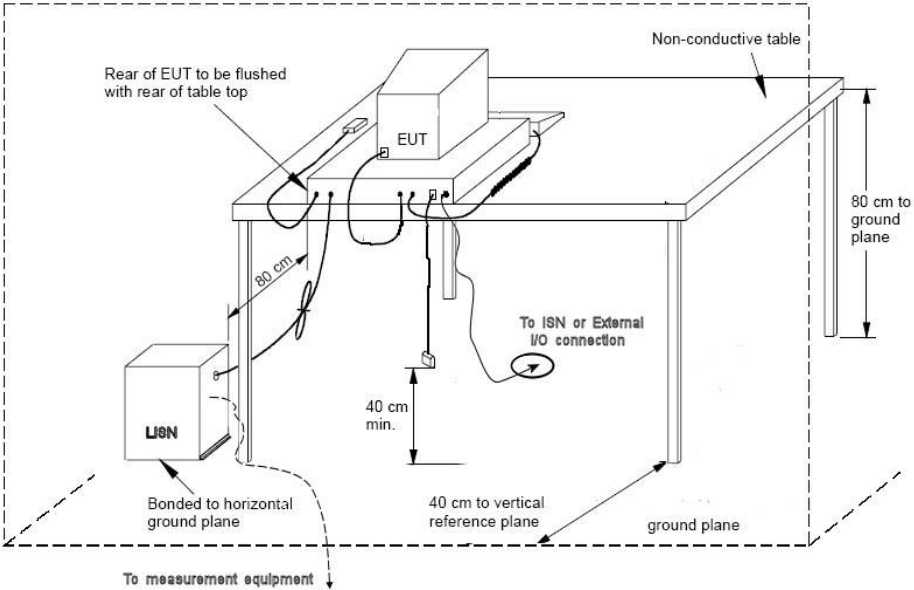
* Decreases linearly with the logarithm of the frequency

Both Quasi-Peak and Average limits are applicable and each is specified as being measured with a resolution bandwidth of 9 kHz. For Quasi-Peak, a video bandwidth at least three times greater than the resolution bandwidth is used.

Based on ANSI C63.4 Section 4.2, if the Peak or Quasi-Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Typical Setup Diagram




Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is $\pm 2.27\text{dB}$ with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

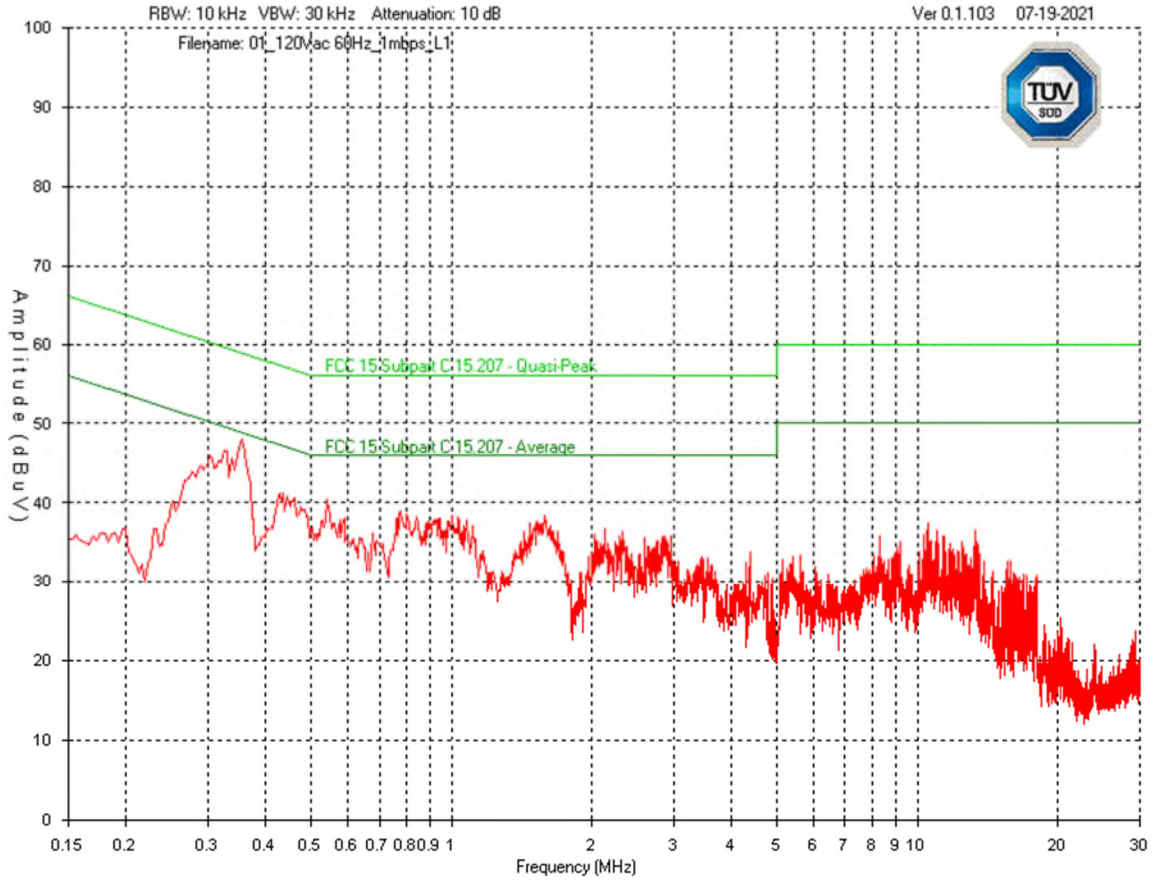
The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.


Test is performed using AC/DC adaptor XP Power model: VEL05US050-US-JA as a representative power supply. This adapter is provided by client for test purposes.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

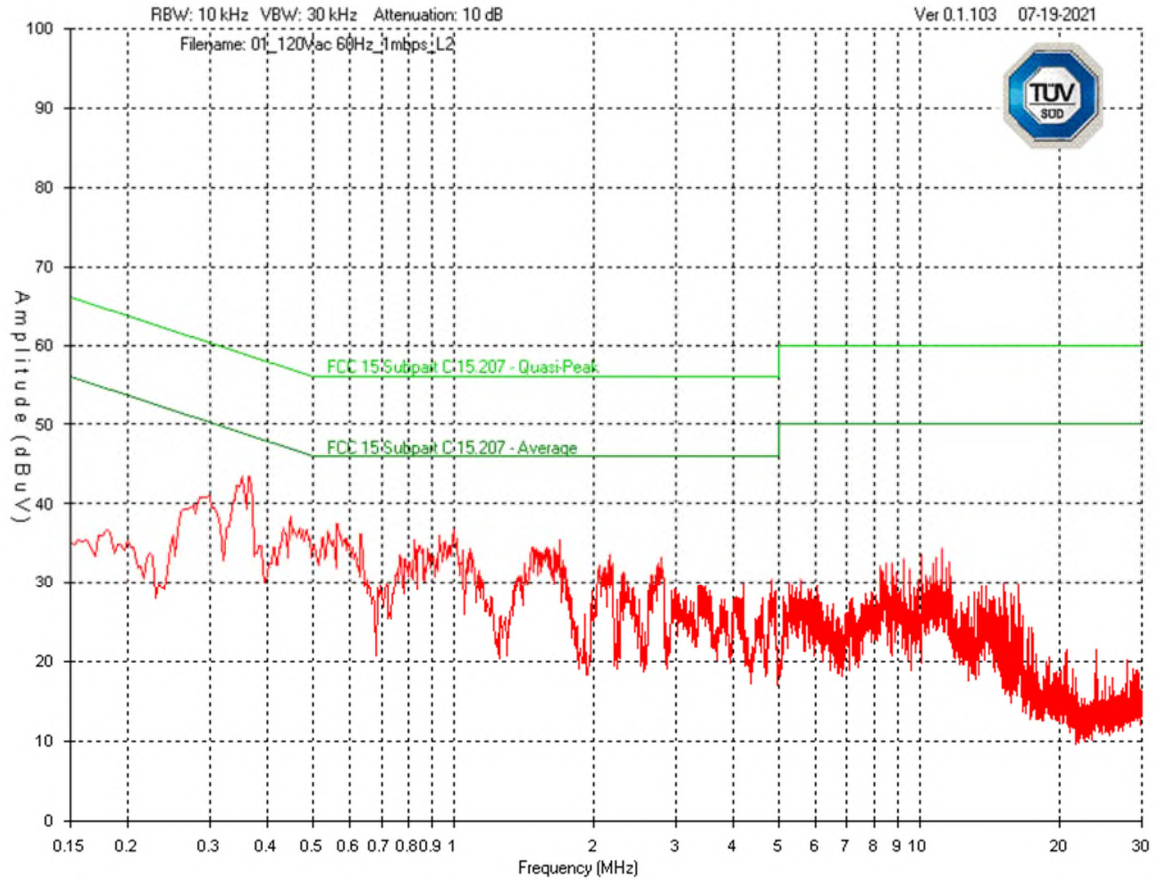
Mode: 1 Mbps


Line 1 (L1) – 120Vac 60Hz



Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

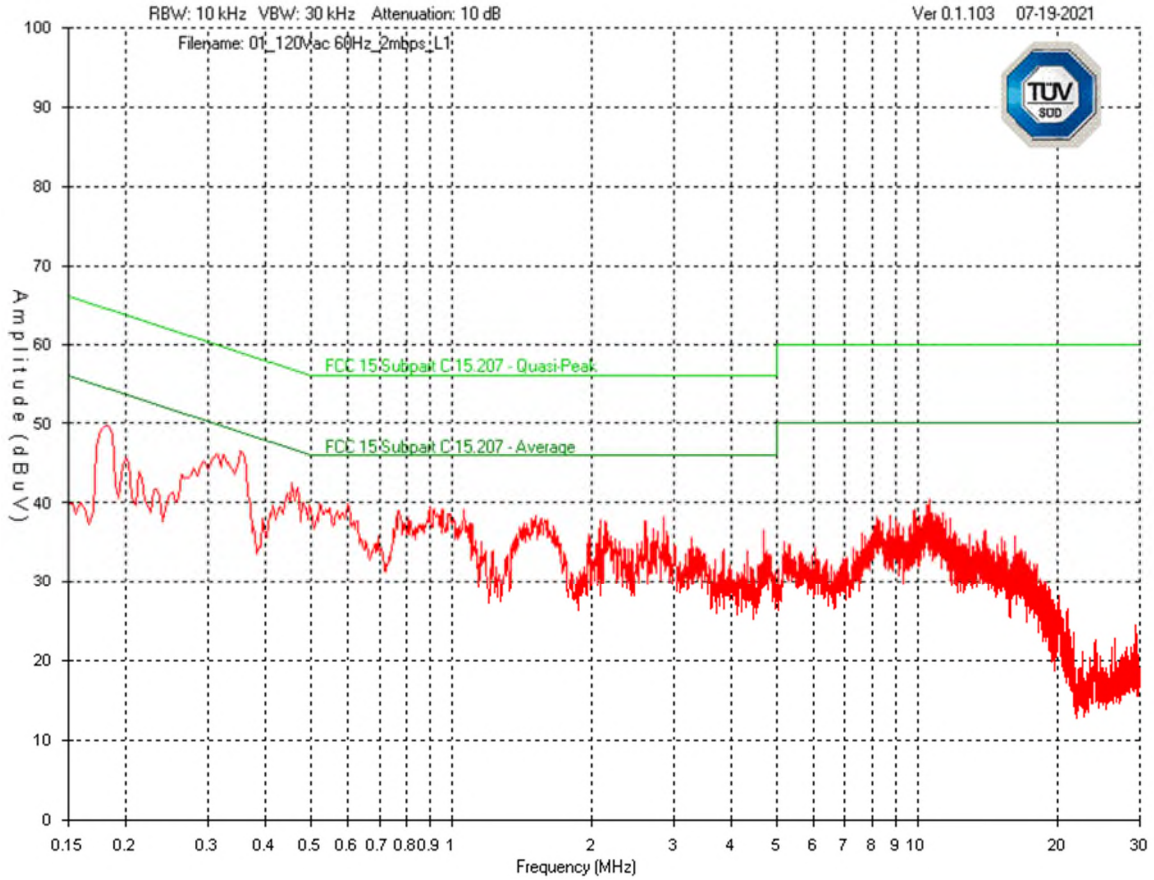
Line 2 (L2) – 120Vac 60Hz




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

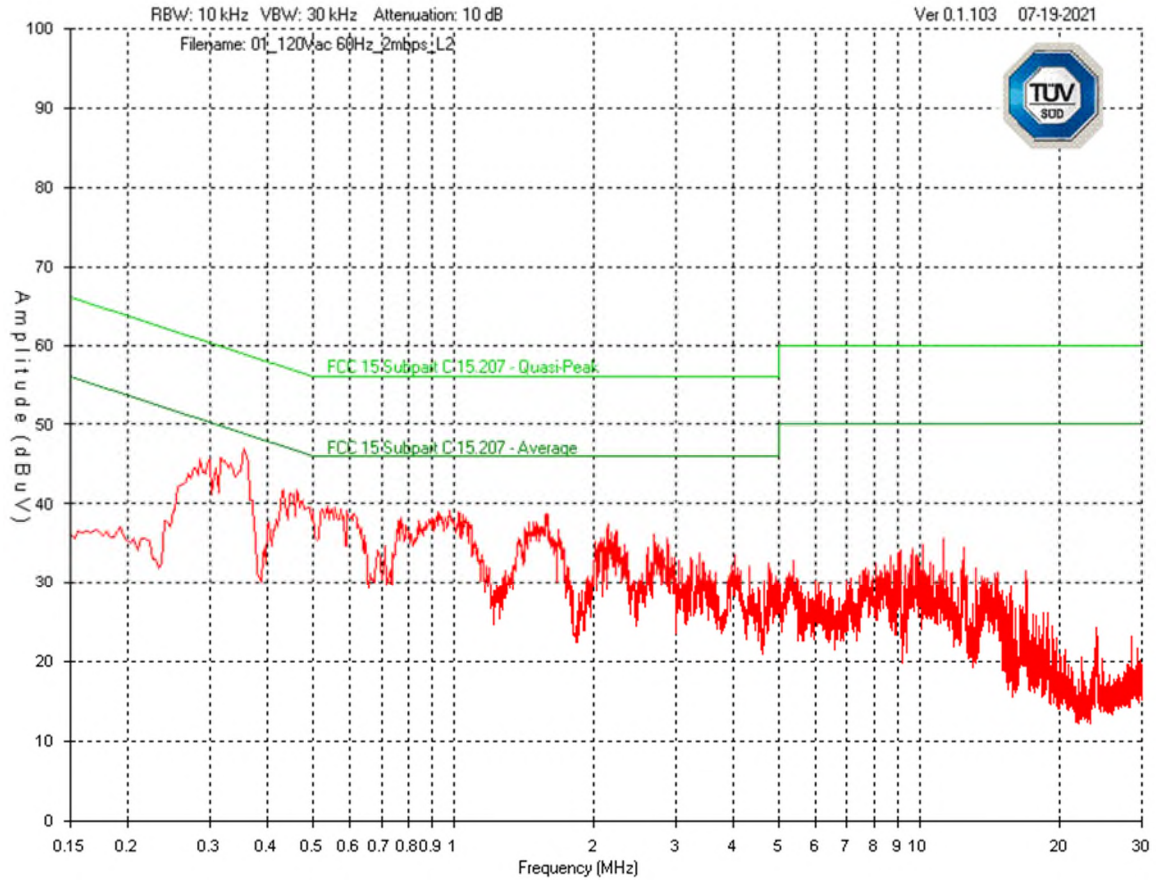
Mode: 2 Mbps


Line 1 (L1) – 120Vac 60Hz



Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Line 2 (L2) – 120Vac 60Hz




Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Final Measurements

Mode: 1 Mbps

Frequency (MHz)	Detector	Received Signal (dBμV)	Atten Factor (dB)	Cable Factor (dB)	LISN Factor (dB)	Level (dBμV)	QP Limit (dBμV)	AVG Limit (dBμV)	QP Margin (dB)	AVG Margin (dB)	Test Result
Line											
0.356	PEAK	37.9	10	0.1	0.0	48.0	58.8	--	10.8	--	Pass
0.356	AVG	18.7	10	0.1	0.0	28.8	--	48.8	--	20.0	Pass
0.436	PEAK	31.1	10	0.1	0.0	41.2	57.1	--	15.9	--	Pass
0.436	AVG	17.3	10	0.1	0.0	27.4	--	47.1	--	19.7	Pass
0.778	PEAK	28.9	10	0.1	0.0	39.0	56.0	46.0	17.0	7.0	Pass
1.586	PEAK	28.4	10	0.1	0.0	38.5	56.0	46.0	17.5	7.5	Pass
2.131	PEAK	26.7	10	0.1	0.0	36.8	56.0	46.0	19.2	9.2	Pass
2.327	PEAK	26.3	10	0.1	0.0	36.4	56.0	46.0	19.6	9.6	Pass
Neutral											
0.363	PEAK	33.3	10	0.1	0.0	43.4	58.7	--	15.3	--	Pass
0.363	AVG	17.8	10	0.1	0.0	27.9	--	48.7	--	20.8	Pass
0.449	PEAK	28.3	10	0.1	0.0	38.4	56.9	46.9	18.5	8.5	Pass
0.300	PEAK	31.0	10	0.1	0.0	41.1	60.3	50.3	19.2	9.2	Pass
1.001	PEAK	26.6	10	0.1	0.0	36.7	56.0	46.0	19.3	9.3	Pass
0.821	PEAK	25.4	10	0.1	0.0	35.5	56.0	46.0	20.5	10.5	Pass
1.689	PEAK	25.3	10	0.1	0.0	35.4	56.0	46.0	20.6	10.6	Pass

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Mode: 2 Mbps

Frequency (MHz)	Detector	Received Signal (dBµV)	Atten Factor (dB)	Cable Factor (dB)	LISN Factor (dB)	Level (dBµV)	QP Limit (dBµV)	AVG Limit (dBµV)	QP Margin (dB)	AVG Margin (dB)	Test Result
Line											
0.353	PEAK	36.4	10	0.1	0.0	46.5	58.9	--	12.4	--	Pass
0.353	AVG	19.9	10	0.1	0.0	30.0	--	48.9	--	18.9	Pass
0.456	PEAK	32.4	10	0.1	0.0	42.5	56.8	--	14.3	--	Pass
0.456	AVG	17.9	10	0.1	0.0	28.0	--	46.8	--	18.8	Pass
0.180	PEAK	39.7	10	0.0	0.0	49.7	64.5	--	14.8	--	Pass
0.180	AVG	17.9	10	0.0	0.0	27.9	--	54.5	--	26.6	Pass
0.898	PEAK	29.4	10	0.1	0.0	39.5	56.0	46.0	16.5	6.5	Pass
1.513	PEAK	28.3	10	0.1	0.0	38.4	56.0	46.0	17.6	7.6	Pass
2.852	PEAK	28.2	10	0.1	0.0	38.3	56.0	46.0	17.7	7.7	Pass
Neutral											
0.356	PEAK	36.9	10	0.1	0.0	47.0	58.8	--	11.8	--	Pass
0.356	AVG	19.3	10	0.1	0.0	29.4	--	48.8	--	19.4	Pass
0.462	PEAK	31.7	10	0.1	0.0	41.8	56.7	--	14.9	--	Pass
0.462	AVG	17.8	10	0.1	0.0	27.9	--	46.7	--	18.8	Pass
0.984	PEAK	29.0	10	0.1	0.0	39.1	56.0	46.0	16.9	6.9	Pass
1.582	PEAK	28.7	10	0.1	0.0	38.8	56.0	46.0	17.2	7.2	Pass
2.144	PEAK	27.3	10	0.1	0.0	37.4	56.0	46.0	18.6	8.6	Pass
1.675	PEAK	26.6	10	0.1	0.0	36.7	56.0	46.0	19.3	9.3	Pass

Notes:

PEAK = Peak measurement
 AVG = Average measurement
 QP = Quasi-Peak measurement


See exhibits for photos showing the test set-up.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Feb. 12, 2021	Feb. 12, 2023	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Jan. 16, 2020	Jan. 16, 2022	GEMC 302
RF Cable 3m	LMR-400-3M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 276
Attenuator 10 dB	6N10W-10	Inmet	NCR	NCR	GEMC 350
Emissions Software	0.1.103	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

FCC_ICES003_CE_Rev1

Client	Acuity Brands Lighting, Inc	 Canada
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Appendix A – EUT Summary

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

For further details for filing purposes, refer to filing package.

General EUT Description

Client / Manufacturer Details	
Organization / Address	Acuity Brands Lighting, Inc. 1 Acuity Way, Decatur, GA 30035 United States
Contact	Alex Bahk
Phone	7705935062
Email	alex.bahk@acuitybrands.com
EUT (Equipment Under Test) Details	
EUT Name	Haleon BTP
FCC ID	2ADCB-HALEON
IC ID	6715C-HALEON
Equipment category	BLE
EUT is powered using	Power supplied to EUT via AC/DC adaptor (provided by client for test purposes): XP Power model: VEL05US050-US-JA
Input voltage range(s) (V)	3.3 VDC
Rated input current (A)	< 1 amp
Nominal power consumption (W)	< 1 watt
Number of power supplies in EUT	1
Transmits RF energy?	2402MHz ~2480MHz
Basic EUT functionality description	Bluetooth Low Energy Radio
Modes of operation	Bluetooth Low Energy 1Mbps, 2Mbps
Frequency of all clocks present in EUT	38.4MHz, 32.7kHz
I/O cable description	USB to TTL
Available connectors on EUT	TAG
Peripherals required to exercise EUT	Lenovo T410 laptop PC XP Power model: VEL05US050-US-JA AC/DC power adapter
Dimensions of product	L: 40 mm, W: 22 mm, H: 11mm


Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For pictures of the EUT, see exhibits.

EUT Configuration

Please see separate exhibits for pictures.

- Wireless configured to transmit continuously at 100% duty cycle with modulation at max power.
- Low Channel: Ch 0 = 2402MHz
- Middle Channel: Ch 19 = 2440MHz
- High Channel: Ch 39 = 2480MHz
- For the Spurious Radiated Emissions and Power Line Conducted Emissions, the transmitter was set to Ch 39. Preliminary emissions tests were performed, and this configuration resulted in the worse case emissions levels.

Client	Acuity Brands Lighting, Inc	
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

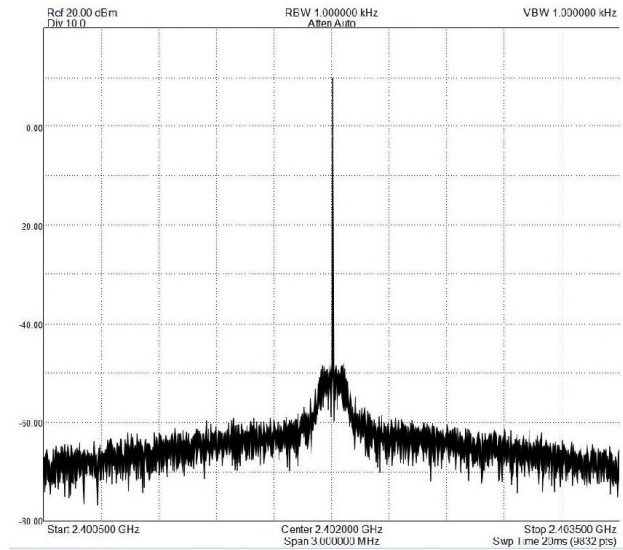
The following are setup, operation, and configuration instructions as provided by the client.




Acuity Brands, Inc.
One Lithonia Way
Conyers, GA 30012-3957
www.acuitybrands.com

Haleon BTP Test Commands

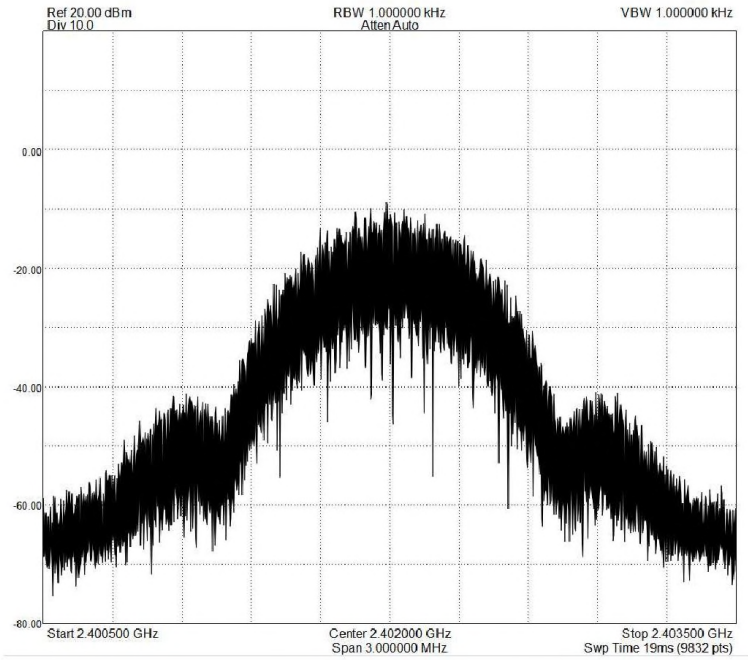
1. Serial Terminal
115200, 8, 1, 1
2. To set channel (use channel 0: 2402MHz, 19: 2440MHz, 39: 2480MHz)
Setchannel 0
3. Receiver On
RX 1
4. Stop Receiving
RX 0
5. To transmit CW tone at max power
Rx 0
Setchannel 0
Setpower 90 raw
Settxtone 1



Client	Acuity Brands Lighting, Inc	 Canada
Product	Haleon BTP	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

6. To transmit Constant modulated signal at max Power

Rx 0
Setchannel 0
Setpower 90 raw
Setblemode 1
Setble1mbps 1
Settxstream 1



7. To stop transmit constant modulated BLE signal

Settxstream 0