



Canada

EMC & RF Test Report

As per

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

Unlicensed Intentional Radiators

on the

rMODIT3 Module 915MHz Proprietary Transmitter

Issued by: **TÜV SÜD Canada Inc.**
11 Gordon Collins Dr,
Gormley, ON, L0H 1G0
Canada
Ph: (905) 883-7255

Testing produced for

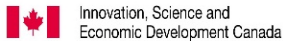


Prepared by:
Min Xie,
Sr. Project Engineer

See Appendix A for full client & EUT details.

Reviewed by:

Amir Emami,
Project Engineer



Registration #
6844A-3



Testing Laboratory
Certificate #2955.02



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



Registration #
CA6844



Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Table of Contents

Table of Contents	2
Report Scope	3
Summary	4
Test Results Summary	5
Notes, Justifications, or Deviations	6
Sample Calculation(s).....	7
Applicable Standards, Specifications and Methods.....	8
Document Revision Status	9
Definitions and Acronyms	10
Testing Facility	11
Calibrations and Accreditations	11
Testing Environmental Conditions and Dates	12
Detailed Test Results Section	13
Transmitter Spurious Radiated Emissions	14
Collocation - Transmitter Spurious Radiated Emissions	26
Appendix A – EUT Summary.....	43
Appendix B – EUT and Test Setup Photos.....	46

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
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 **rMODIT3 Module**. 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	rMODIT3 Module	
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:	rMODIT Module
FCC Certification #, FCC ID:	2ADCB-RMODIT3
Industry Canada Certification #, IC:	6715C-RMODIT3
EUT passed all tests performed	Yes
Tests conducted by	Min Xie
Report reviewed by	Amir Emami


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

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
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
FCC 15.207 RSS-GEN (Table 3)	Power Line Conducted Emissions	QuasiPeak Average	N/A
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	N/A
FCC 15.247(b)2 RSS-247 5.4(d)	Max Output Power	< 1 Watt	N/A
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	N/A
FCC 15.247(e) RSS-247 5.2(b)	Spectral Density	< 8 dBm (3 kHz BW)	N/A
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	
Product	rMODIT3 Module	
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:

The report is for a Class 2 Permissive change. A new stamped metal antenna is being added to the transmitter. The following tests are not applicable:


- 6 dB Bandwidth
- Power
- Power density
- Antenna conducted emission
-

For the Antenna requirement specified in FCC 15.203 (RSS-247 section 5.4(d)), the Stamped Metal is with 0 dBi gain which is less than the 6 dBi limit.

For the Restricted Bands of operation, the EUT is designed to only operate between 902 – 928 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 for each antenna, and it all occurs with the PCB positioned up. See *Appendix B* for test photos.

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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)

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


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 32:2015 A1:2019	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 7 2020	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	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Document Revision Status

Revision	Date	Description	Initials
000	June 4, 2021	Initial Release	MX
-	-	-	-

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
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.


Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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.

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


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)
2021 May 21, 25	Radiated Emissions	MX	24 – 25	42 – 45	101 – 103

Client	Acuity Brands Lighting, Inc	 Canada
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Detailed Test Results Section

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
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 300m)	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

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

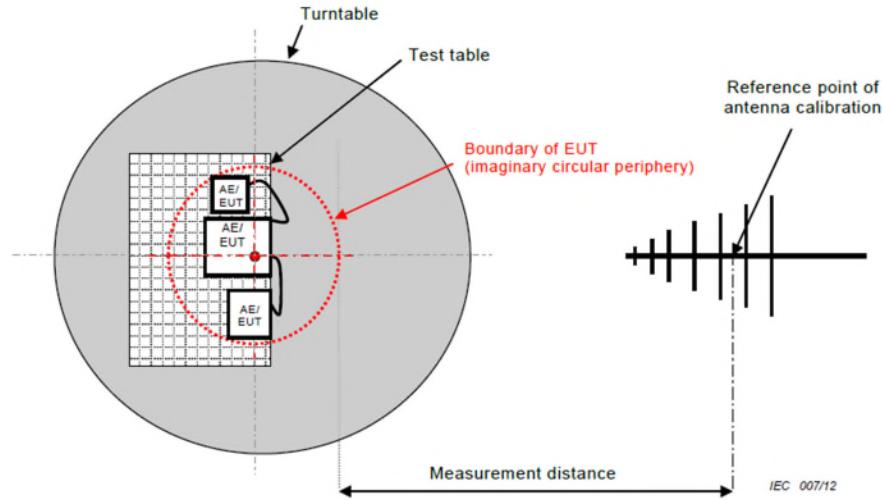
^bLimit is with 1 MHz measurement bandwidth and using an Average detector

^cLimit 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	rMODIT3 Module	
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.

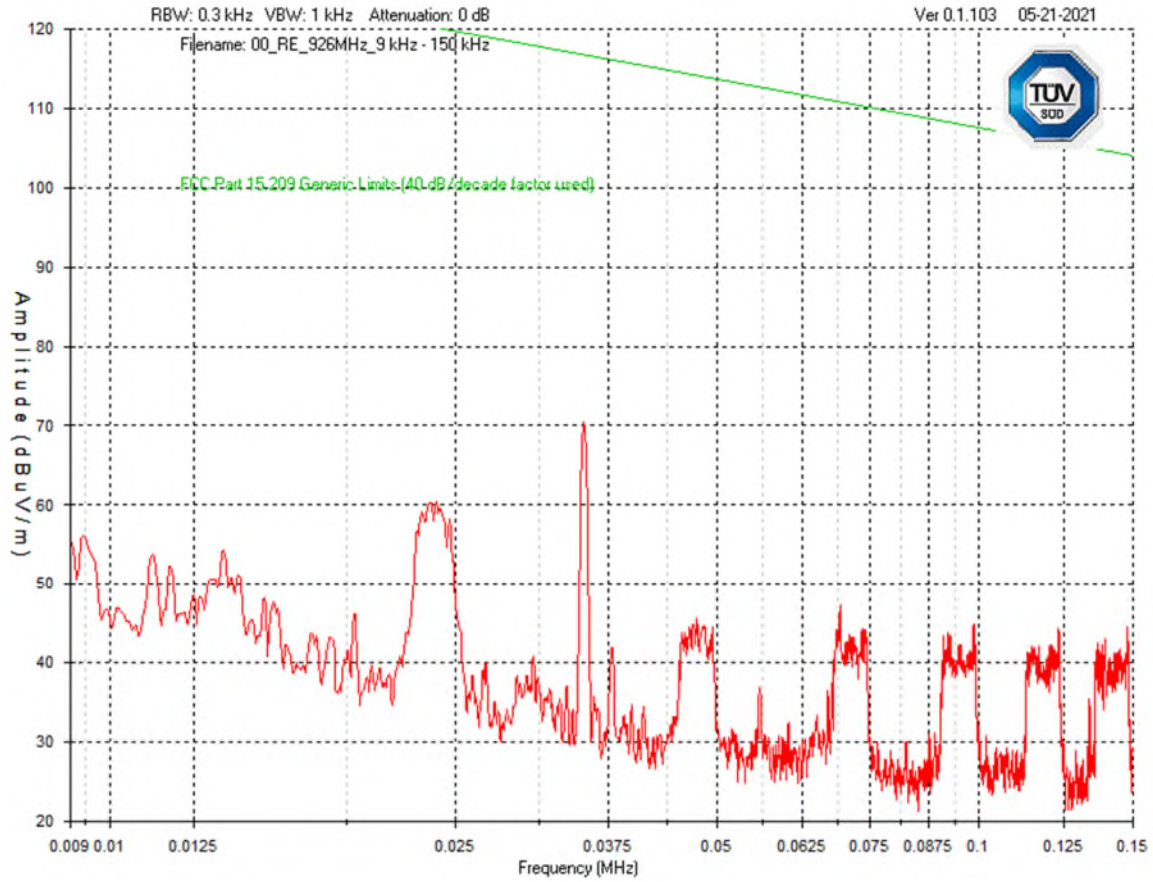
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of 9280 MHz).


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 output power for low, middle and high channels and each of the orthogonal axes of the PCB was checked. The worst case was used for the spurious emissions for each antenna, all of which occurred on the High Channel.

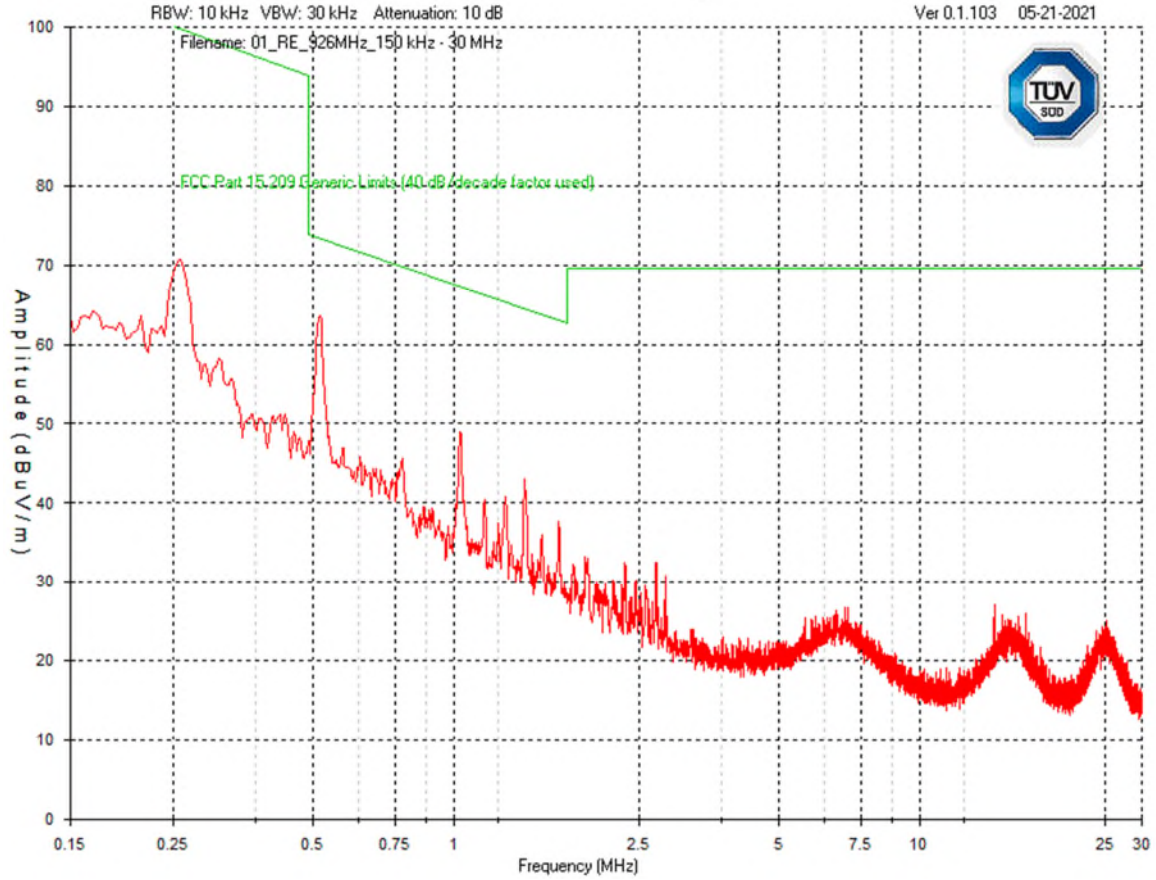
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Low Channel
9 kHz – 150 kHz
Peak Emission Graph



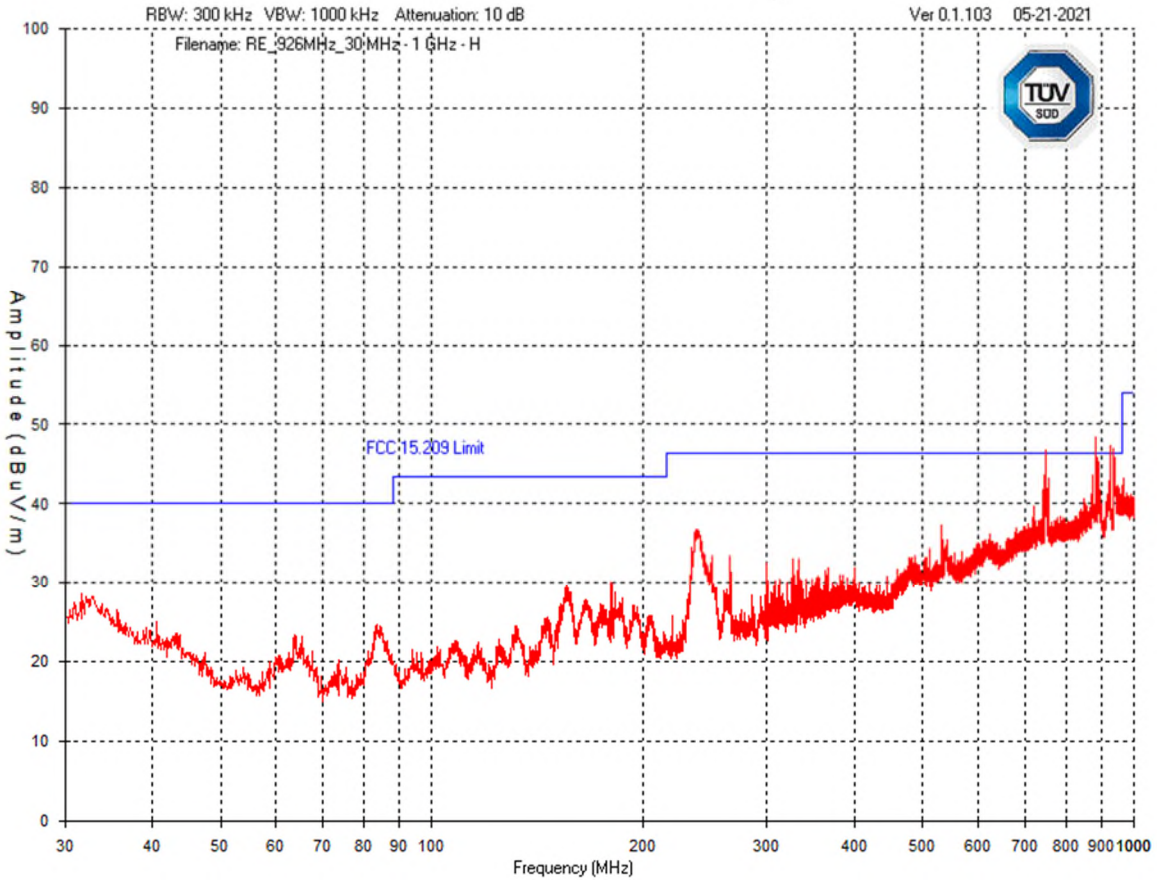
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel
150 kHz – 30 MHz
Peak Emission Graph



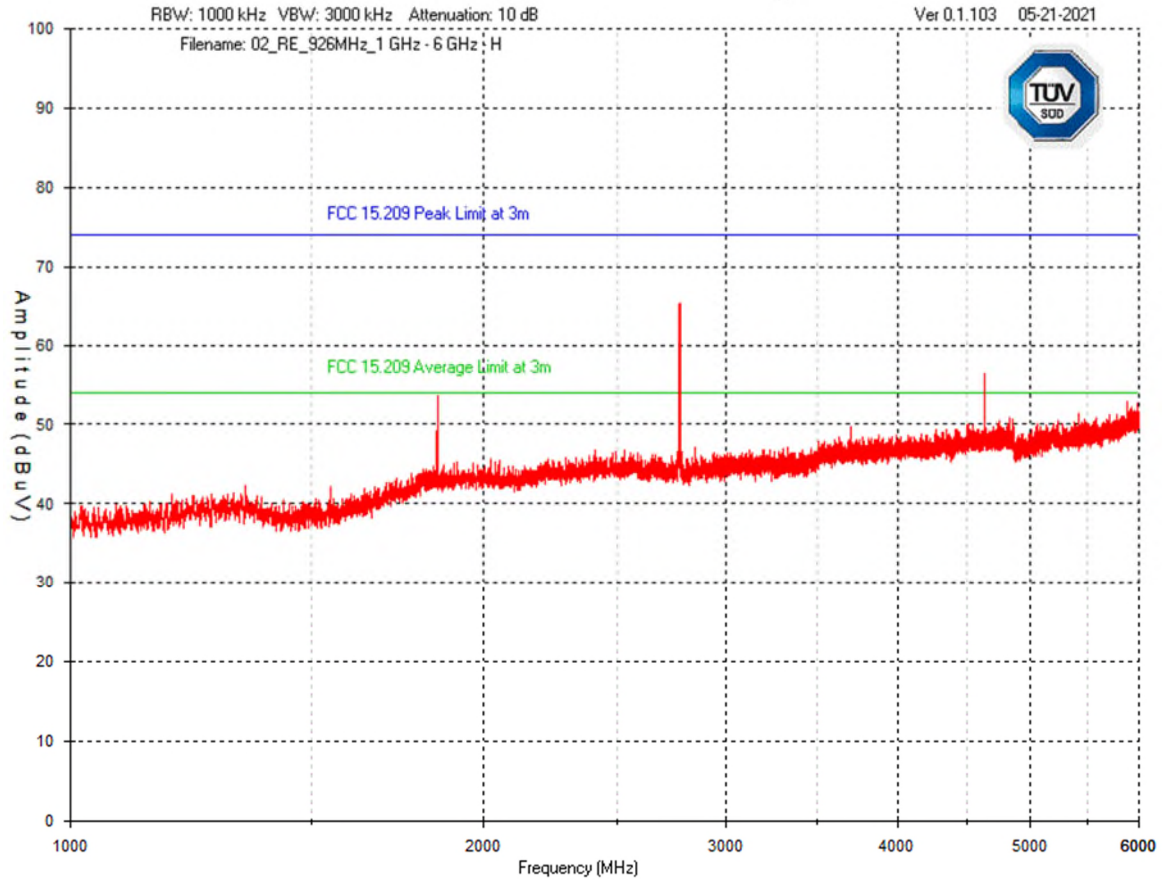
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


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



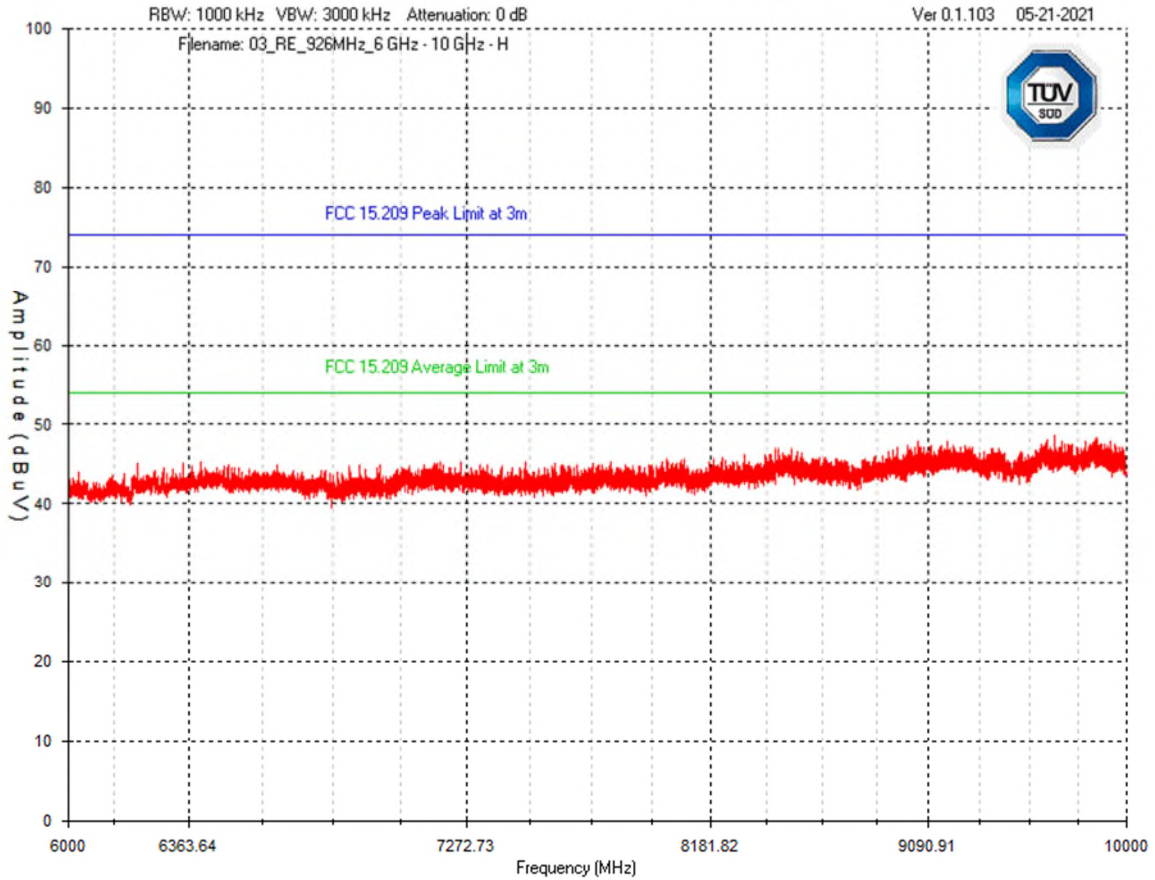
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 1 GHz – 6 GHz
Horizontal - Peak Emission Graph



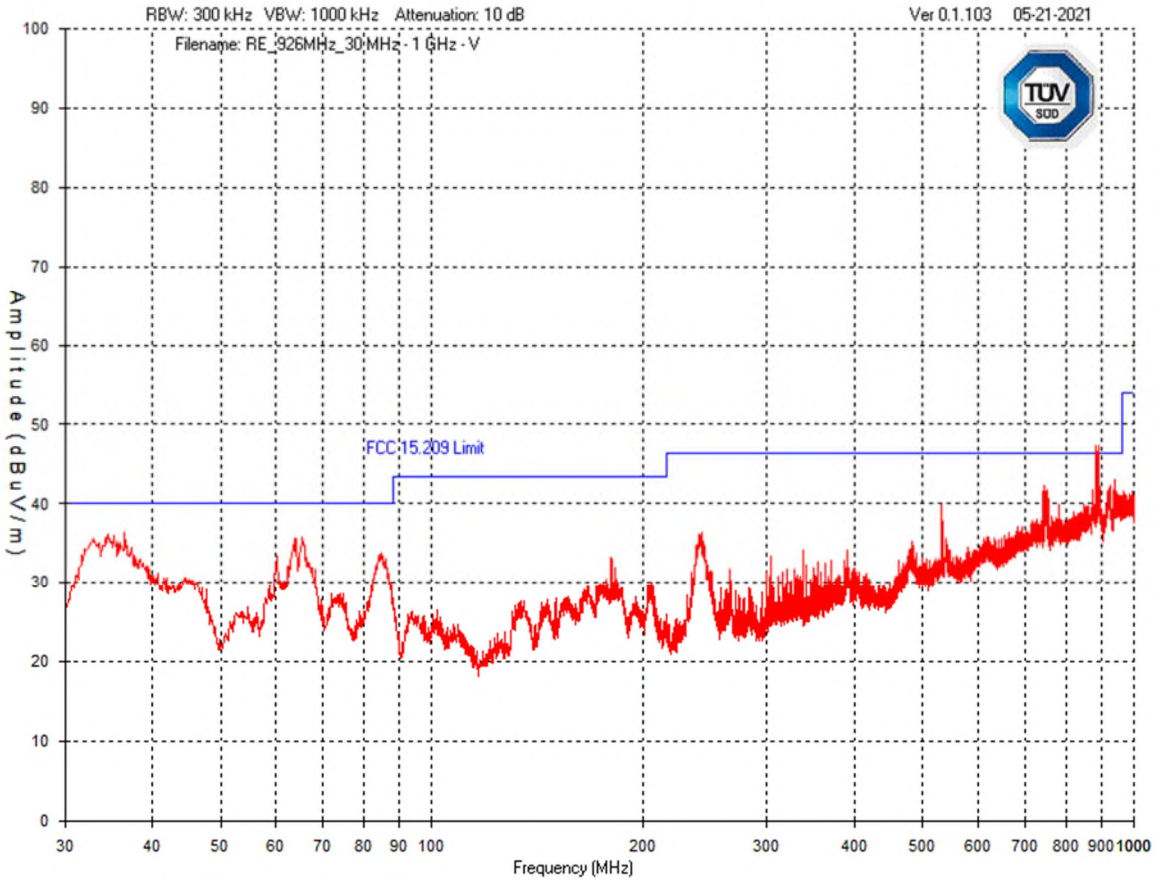
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 6 GHz – 10 GHz
Horizontal - Peak Emission Graph



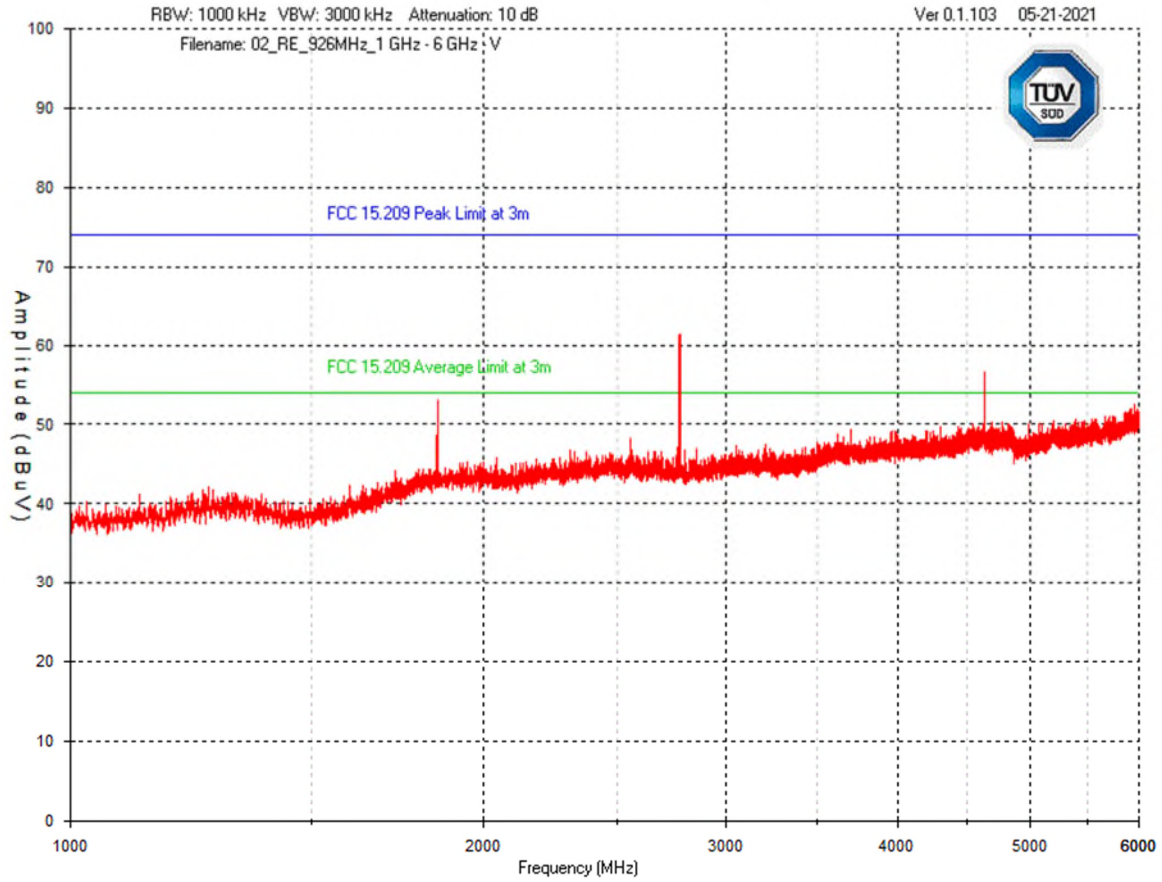
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


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



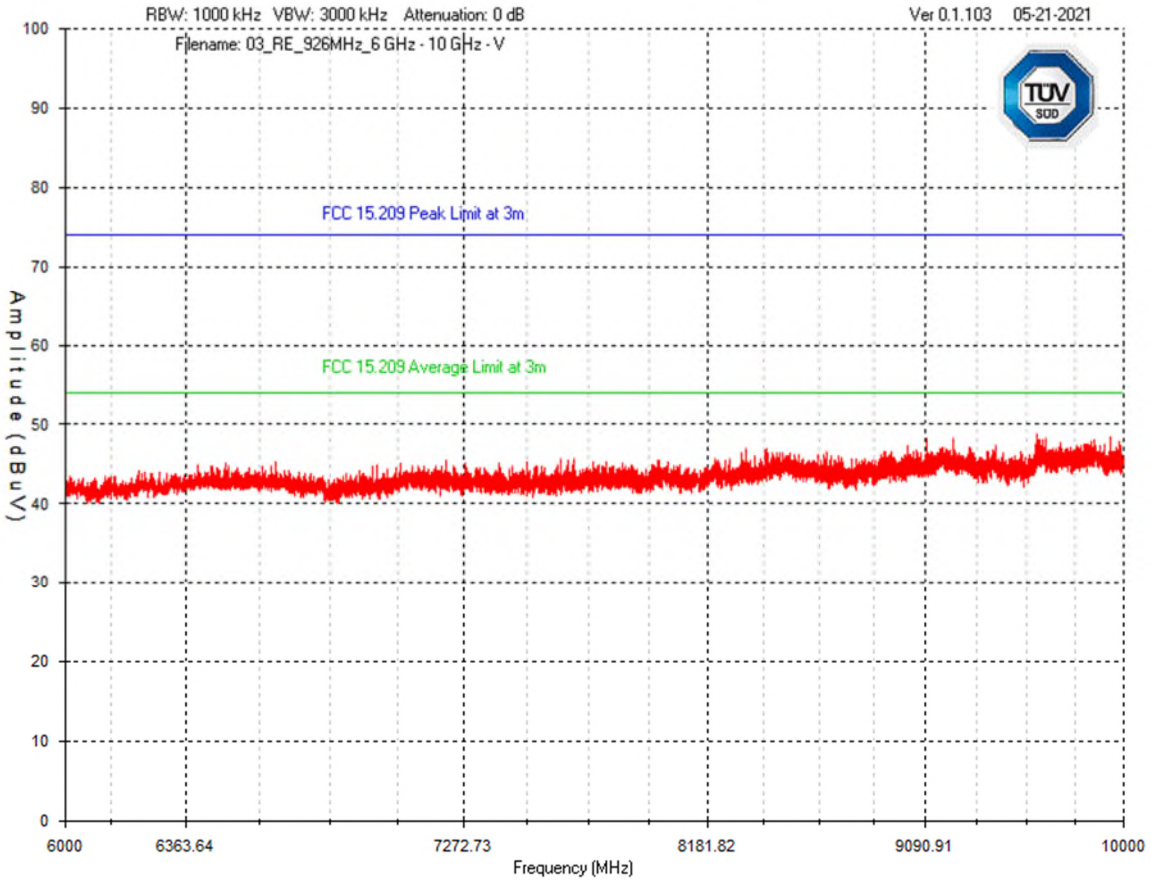
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 1 GHz – 6 GHz
Vertical - Peak Emission Graph



Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

High Channel – 6 GHz – 10 GHz
Vertical - Peak Emission Graph




Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Final Measurements and Results

The EUT passed. 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. Emissions outside the restricted bands were measured for informational purposes.

Emissions Table

Antenna Configuration			Stamped Antenna						
Frequency (MHz)	Detector	Received Signal (dB μ V)	Antenna Factor (dB/m)	Cable Factor + Filter (dB)	Pre-Amp (dB)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Test Result
Horizontal Antenna Polarization									
881.322	QP	29.9	29.3	5.7	-29.7	35.2	46.4	11.2	Pass
926.153	QP	24.9	29.8	5.8	-29.3	31.2	46.4	15.2	Pass
934.887	QP	23.5	29.9	5.8	-29.2	30.0	46.4	16.4	Pass
748.572	QP	34.5	28.1	5.1	-30.7	37.0	46.4	9.4	Pass
889.473	QP	31.4	29.5	5.7	-29.6	37.0	46.4	9.4	Pass
743.429	QP	32.5	28.2	5.1	-30.7	35.1	46.4	11.3	Pass
754.007	QP	29.8	28.1	5.2	-30.7	32.4	46.4	14.0	Pass
2778.71	AVG	57.1	32.3	6.0	-34.3	50.8 ¹	54.0	3.2	Pass
4629.12	AVG	39.9	34.2	8.0	-32.7	39.1 ¹	54.0	14.9	Pass
1851.67	AVG	48.1	30.5	5.8	-34.9	39.2 ¹	54.0	14.8	Pass
5883.62	AVG	28.6	35.2	9.0	-32.3	40.5	54.0	13.5	Pass
2778.71	PEAK	61.4	32.3	6.0	-34.3	65.4	74.0	8.6	Pass
4629.12	PEAK	46.9	34.2	8.0	-32.7	56.4	74.0	17.6	Pass
1851.67	PEAK	52.2	30.5	5.8	-34.9	53.6	74.0	20.4	Pass
5883.62	PEAK	41.0	35.2	9.0	-32.3	52.9	74.0	21.1	Pass
Vertical Antenna Polarization									
887.92	QP	28.1	29.4	5.7	-29.6	33.6	46.4	12.8	Pass
882.777	QP	27.2	29.3	5.7	-29.7	32.5	46.4	13.9	Pass
36.5016	QP	30.8	19.8	1.6	-33.7	18.5	40.0	21.5	Pass
743.041	QP	31.4	28.2	5.1	-30.8	33.9	46.4	12.5	Pass
65.4192	QP	32.8	12.7	1.8	-33.6	13.7	40.0	26.3	Pass
750.028	QP	33.9	28.1	5.2	-30.7	36.5	46.4	9.9	Pass
2779.04	AVG	54.2	32.3	6.0	-34.3	47.9 ¹	54.0	6.1	Pass
4631.12	AVG	40.1	34.2	8.0	-32.7	39.3 ¹	54.0	14.7	Pass
1852.67	AVG	49.9	30.5	5.8	-34.9	41.0 ¹	54.0	13.0	Pass
5959.98	AVG	28.5	35.4	9.1	-34.3	40.6	54.0	13.4	Pass

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


2779.04	PEAK	57.4	32.3	6.0	-34.3	61.4	74.0	12.6	Pass
4631.12	PEAK	47.0	34.2	8.0	-32.7	56.5	74.0	17.5	Pass
1852.67	PEAK	51.7	30.5	5.8	-34.9	53.1	74.0	20.9	Pass
5959.98	PEAK	40.4	35.4	9.1	-32.4	52.5	74.0	21.5	Pass

¹The emissions at these frequencies are harmonics of the transmitter. The transmitter has a duty cycle of 30.48%. A Duty Cycle Correction Factor (DCCF) of $20\log(30.48\%) = -10.3$ dB was applied to the Average as per FCC KDB 55807v D01 v05r02. The Level was calculated per the following formula:

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

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	EM 6871	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
BiLog Antenna	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 – 10 GHz	WBH218HN	Q-par	Apr. 1, 2020	Apr. 1, 2022	GEMC 6375
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 286
Pre-Amp 9 kHz – 1 GHz	CPA9230	Chase	May 22, 2020	May 22, 2022	GEMC 301
Pre-Amp 1 – 10 GHz	HP 8449B	HP	Aug. 4, 2020	Aug. 4, 2022	GEMC 312
0.98GHz HPF	8IH40-980/T3750	K & L Microwave	NCR	NCR	GEMC 4256
4GHz HPF	11SH10-4000/T12000	K & L Microwave	NCR	NCR	GEMC 119
Band Reject Filter	BRC50722	Micro-Tronics	NCR	NCR	GEMC 186
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 27
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	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Collocation - 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 Section 12.2 of FCC KDB 558074 and ANSI C63.10 and with guidance from FCC KDB 996369.

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).


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 300m)	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

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

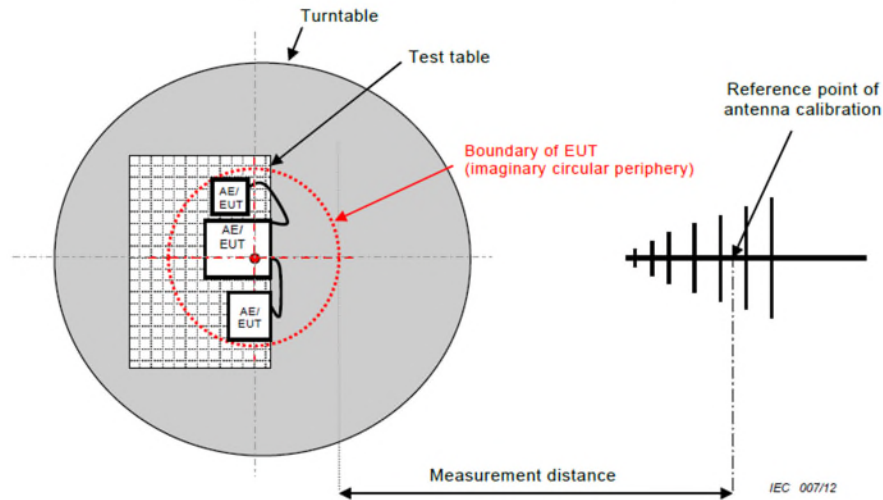
^bLimit is with 1 MHz measurement bandwidth and using an Average detector

^cLimit 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	rMODIT3 Module	
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.

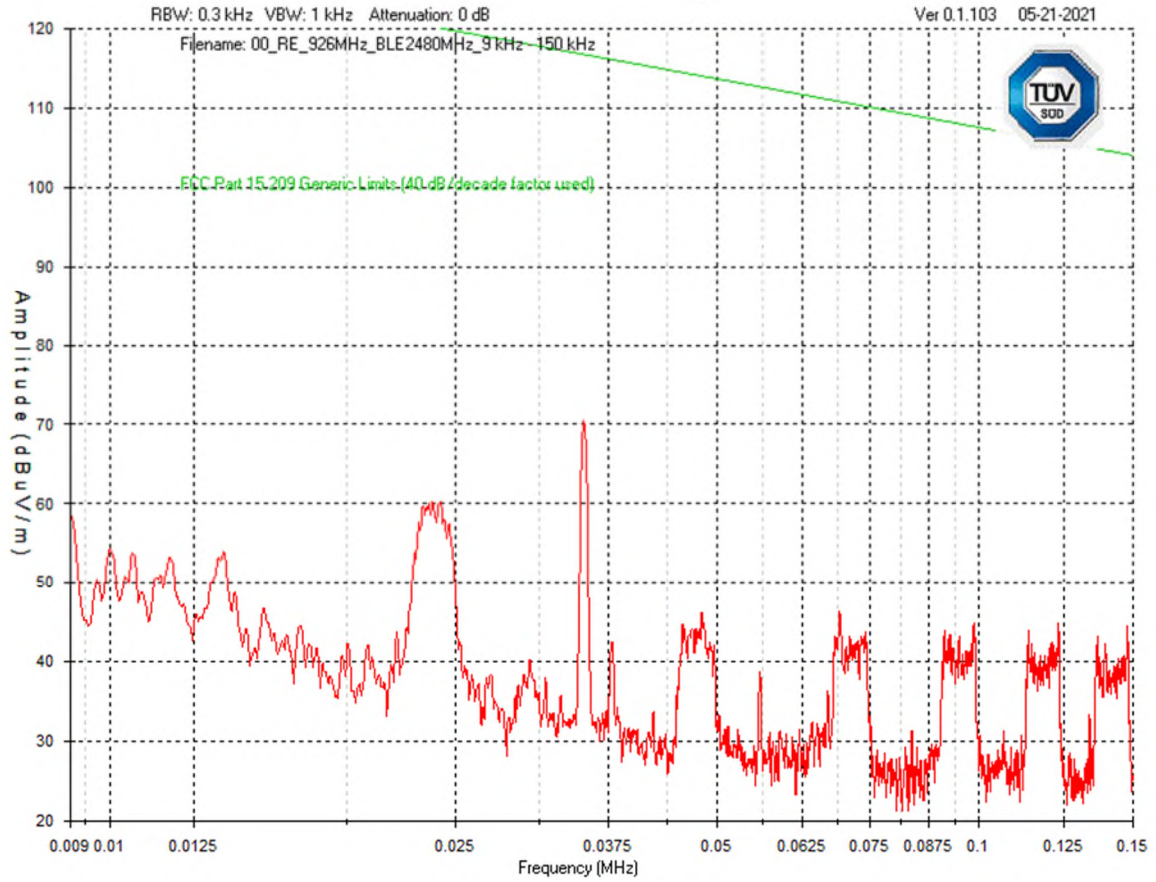
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the higher frequency range of:


- The 10th harmonic of the intentional radiator(s); or
- A minimum of 1 GHz or above 1 GHz if the device contains oscillators or clock frequencies higher than 108 MHz as per the table in Section 15.33(b)(1)

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.

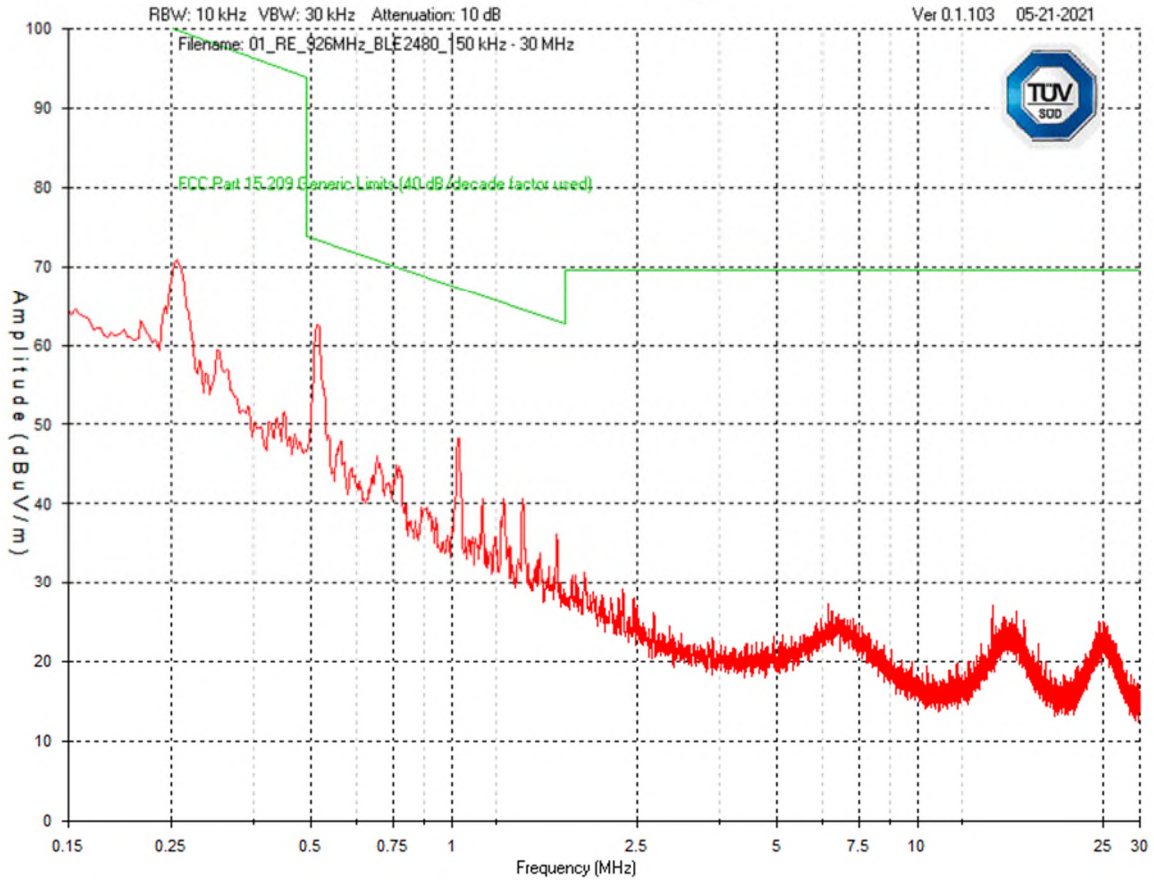
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


9 kHz – 150 kHz
Peak Emission Graph



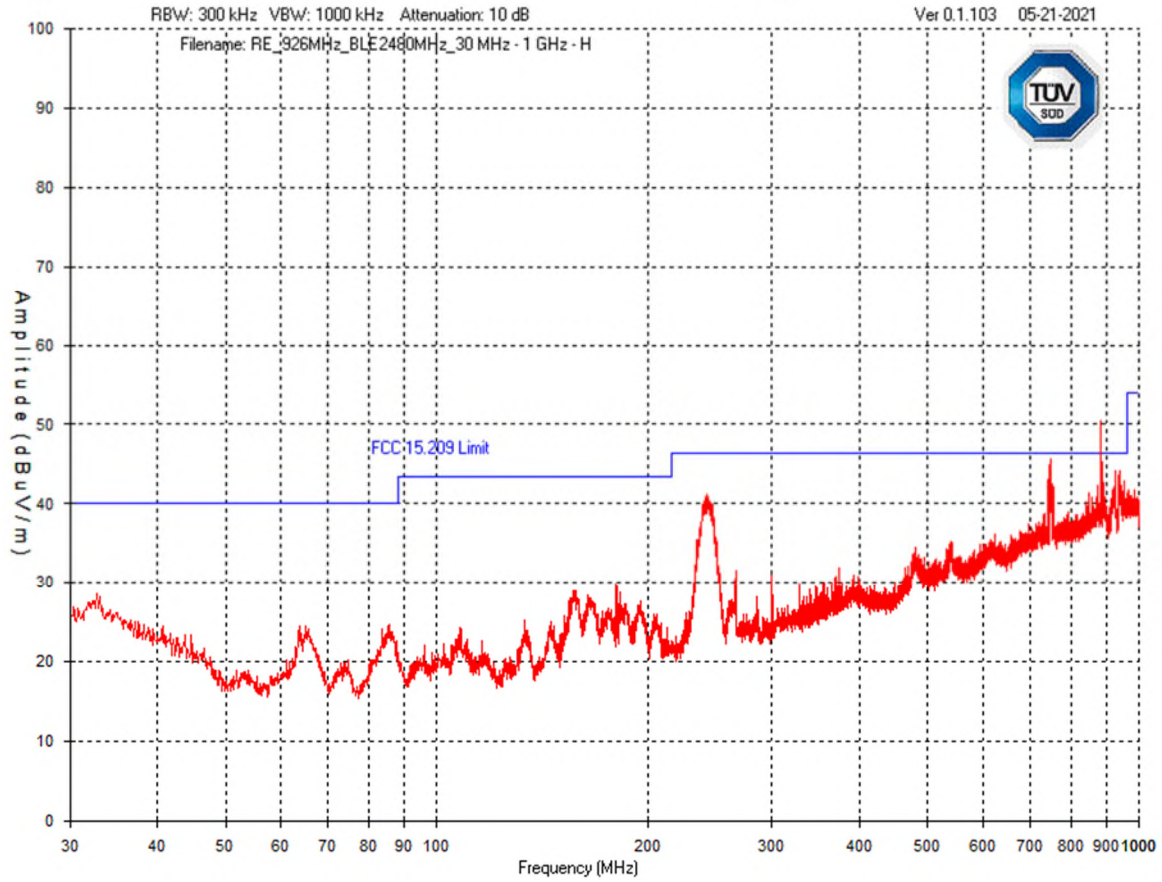
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


150 kHz – 30 MHz
Peak Emission Graph



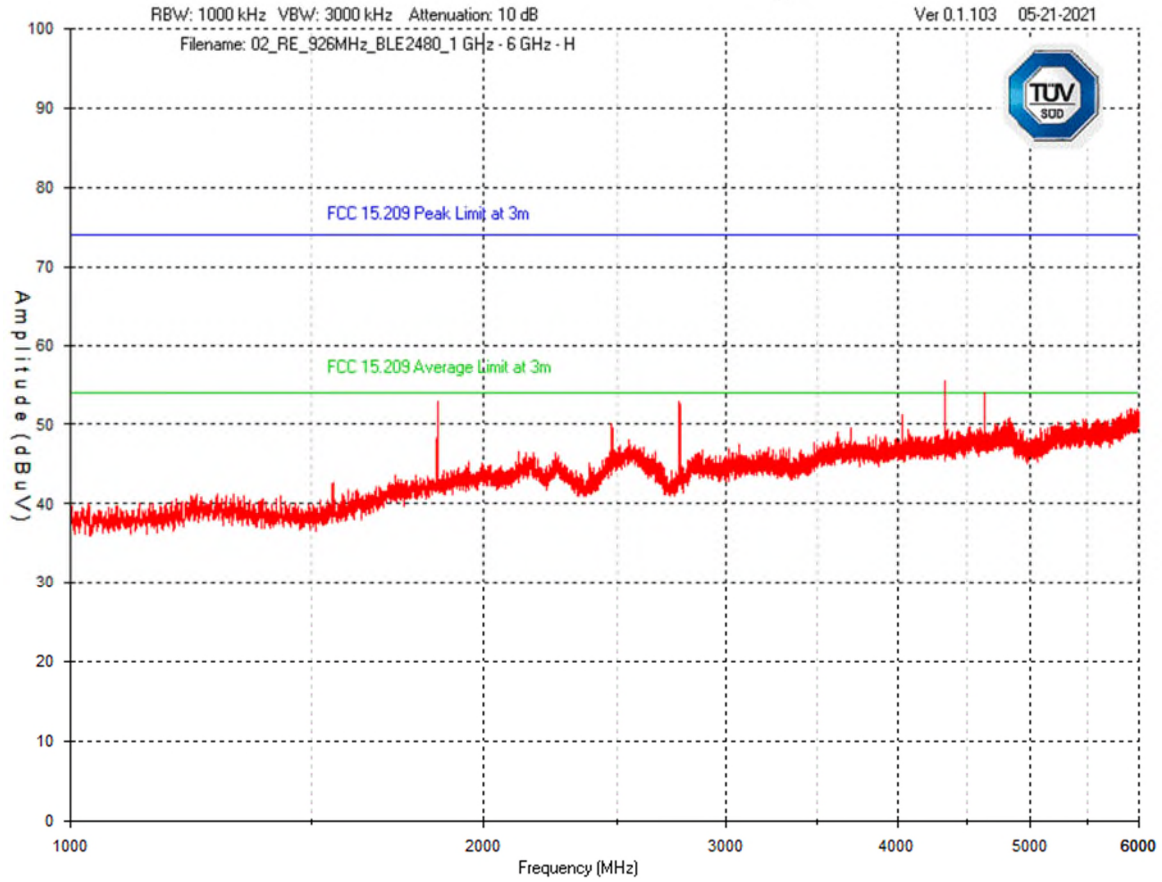
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


30 MHz – 1 GHz
Horizontal - Peak Emission Graph



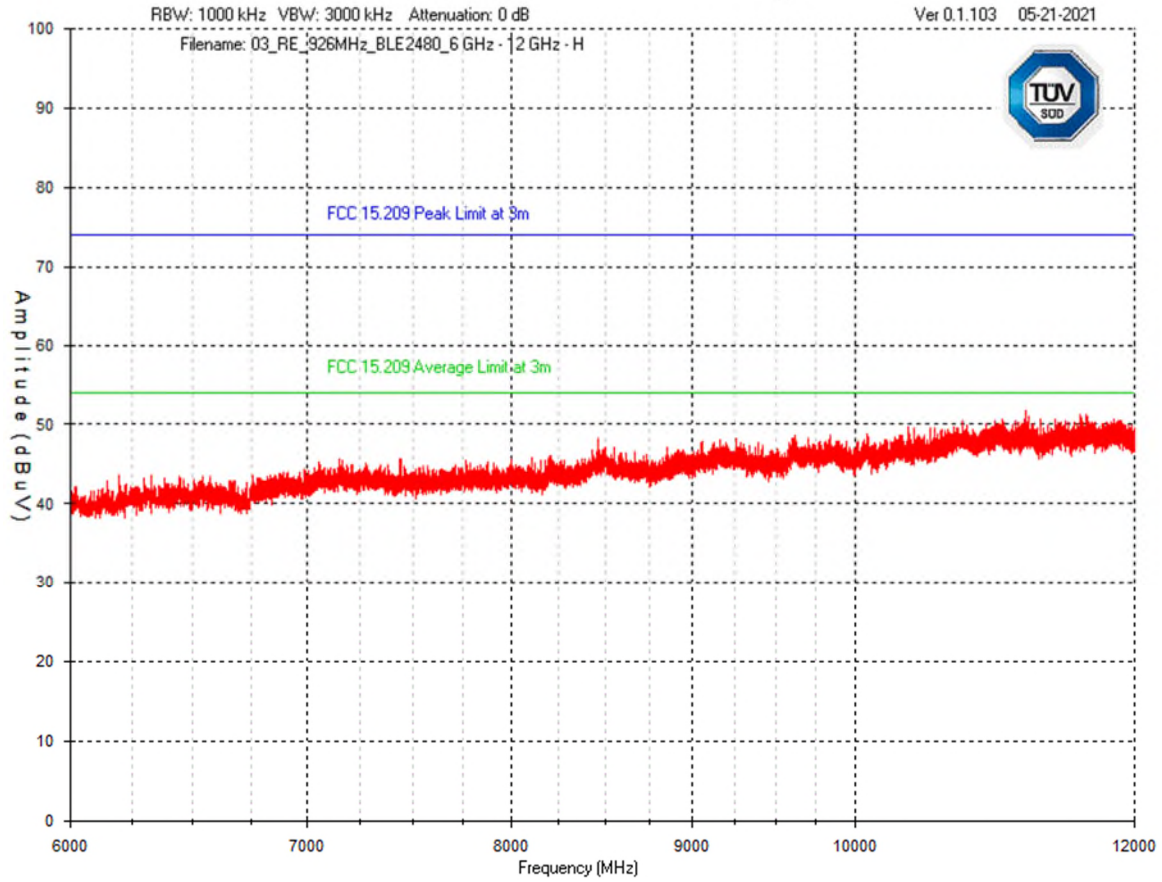
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


1 GHz – 6 GHz
Horizontal - Peak Emission Graph



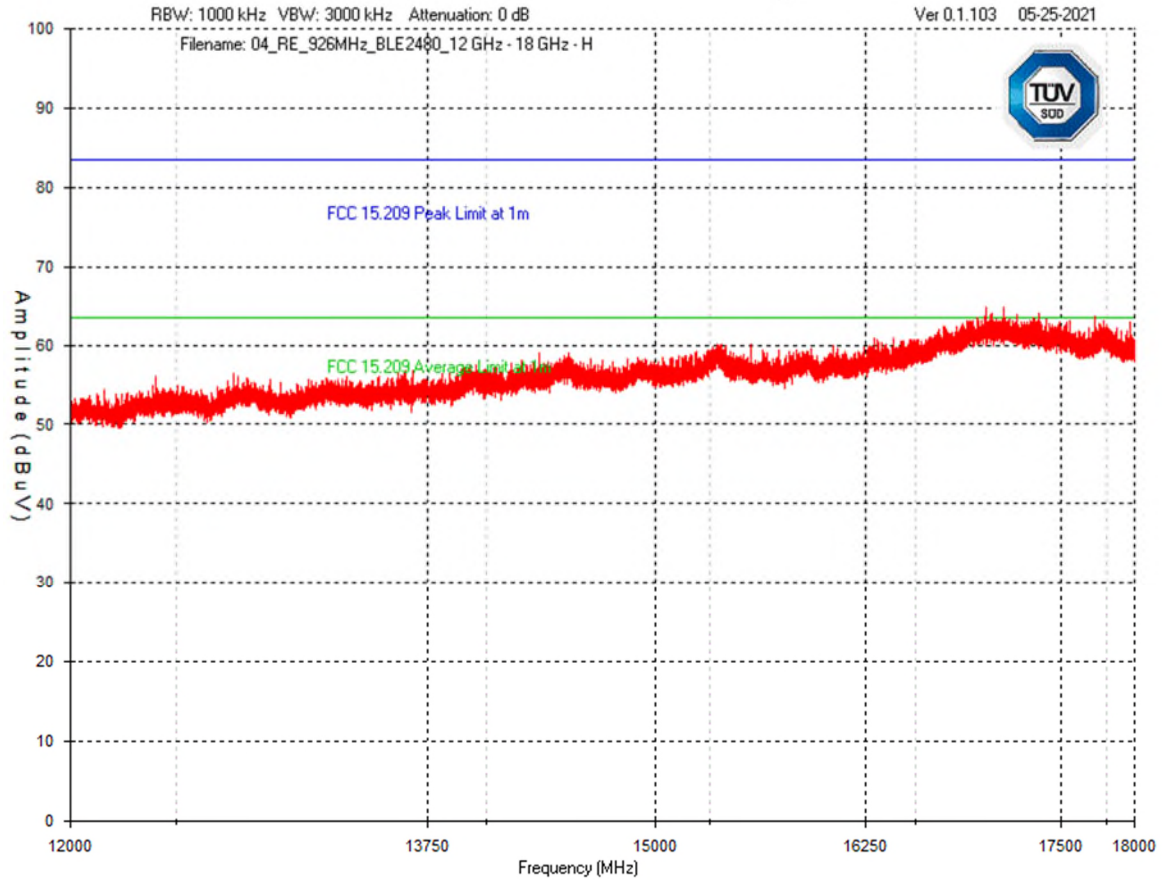
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

6 GHz – 12 GHz
Horizontal - Peak Emission Graph




Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

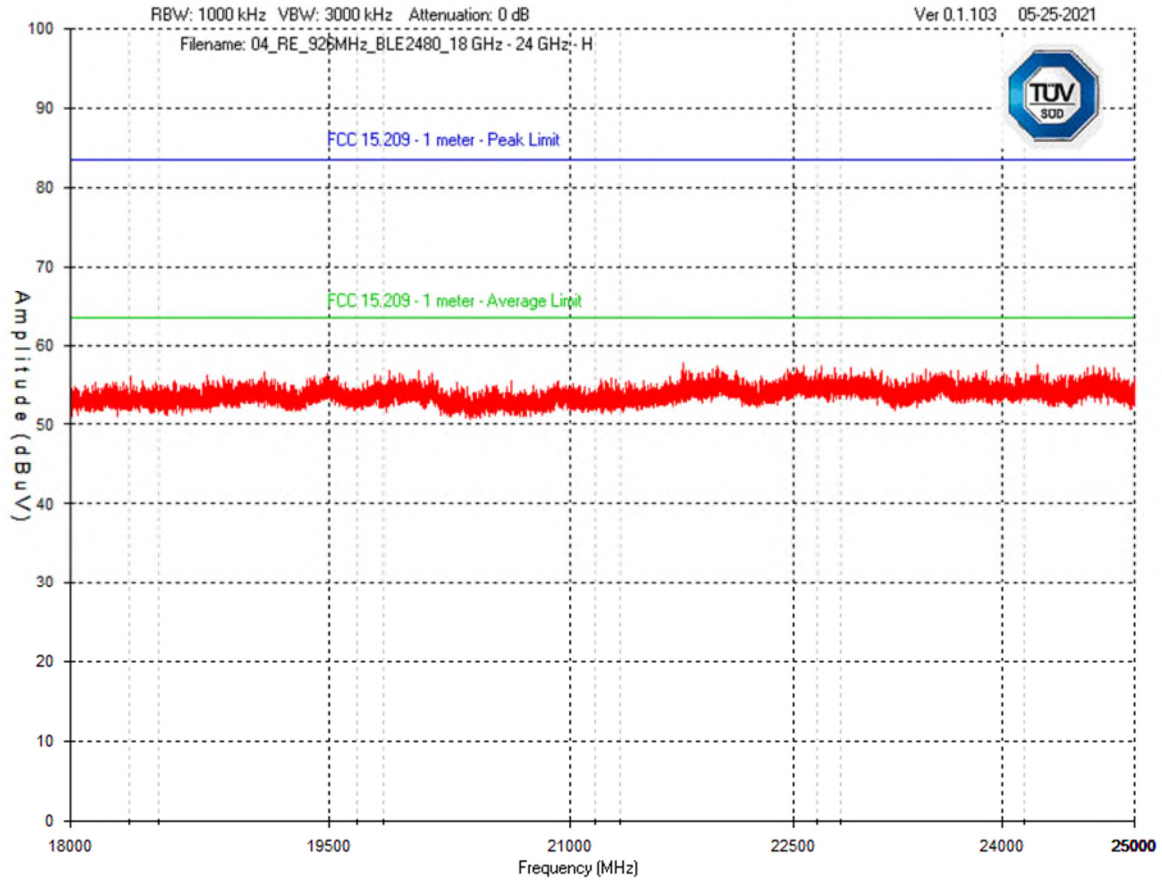
12 GHz – 18 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

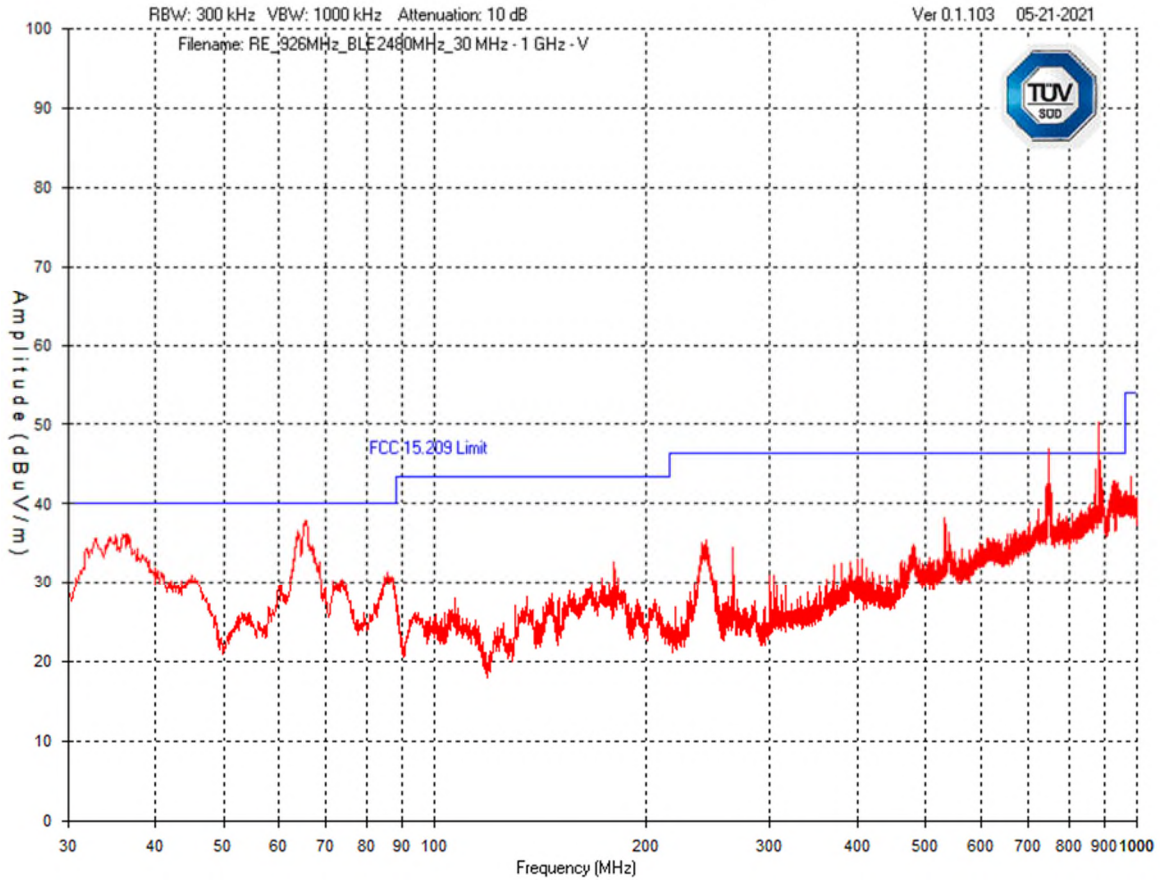
18 GHz – 25 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

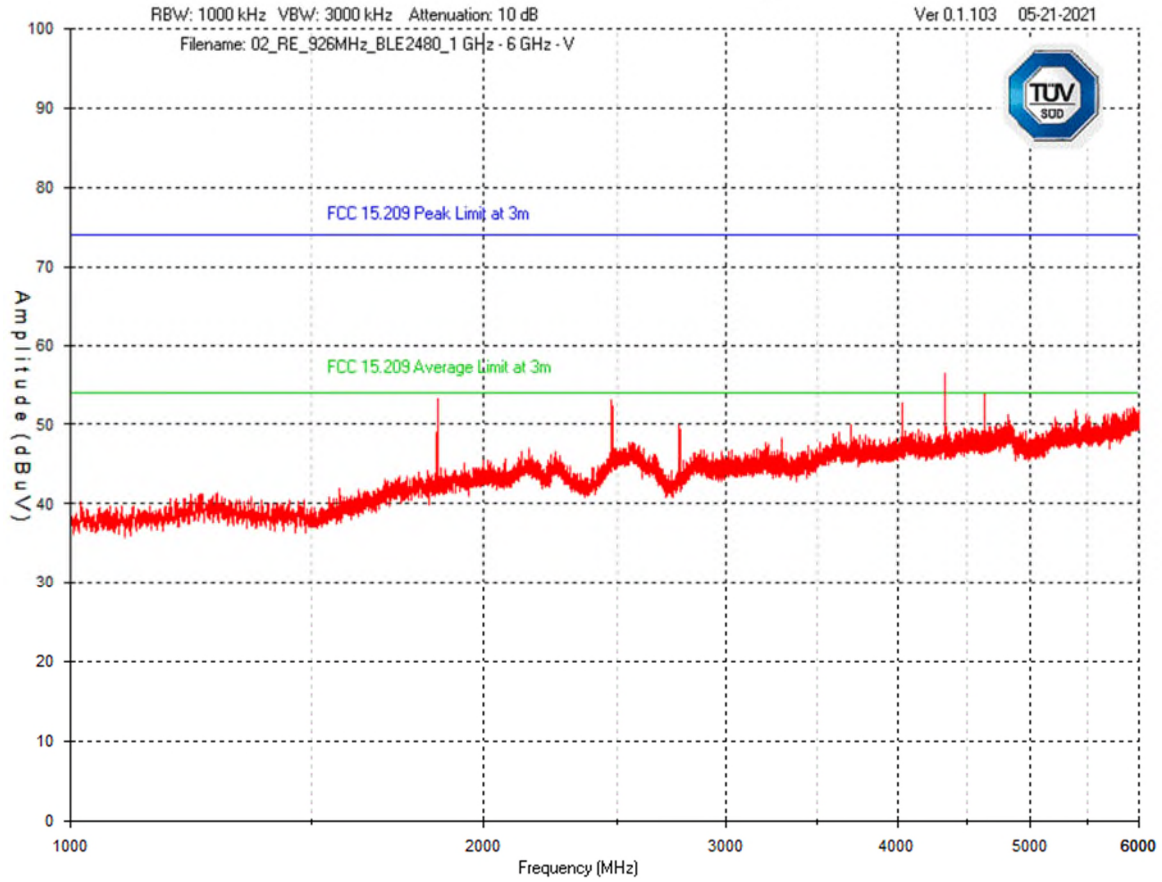
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


30 MHz – 1 GHz
Vertical - Peak Emission Graph



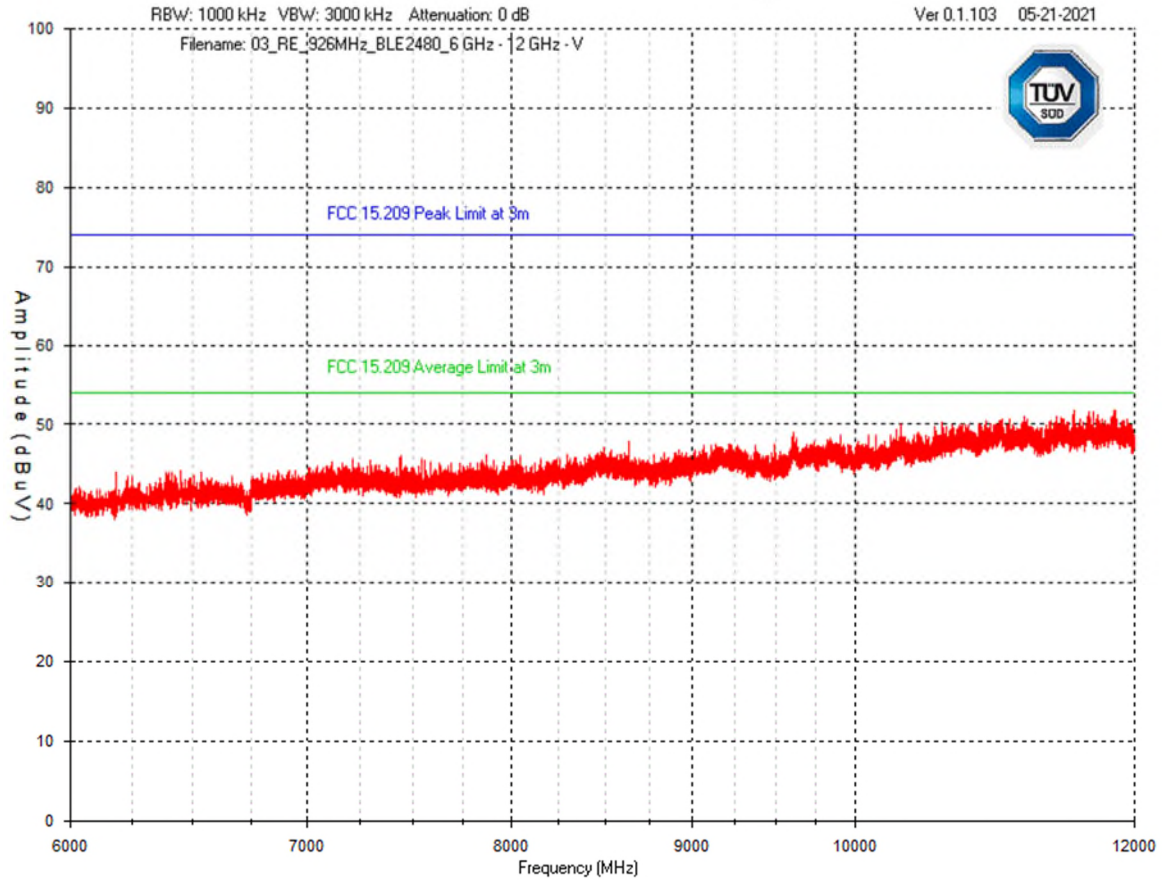
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


1 GHz – 6 GHz
Vertical - Peak Emission Graph



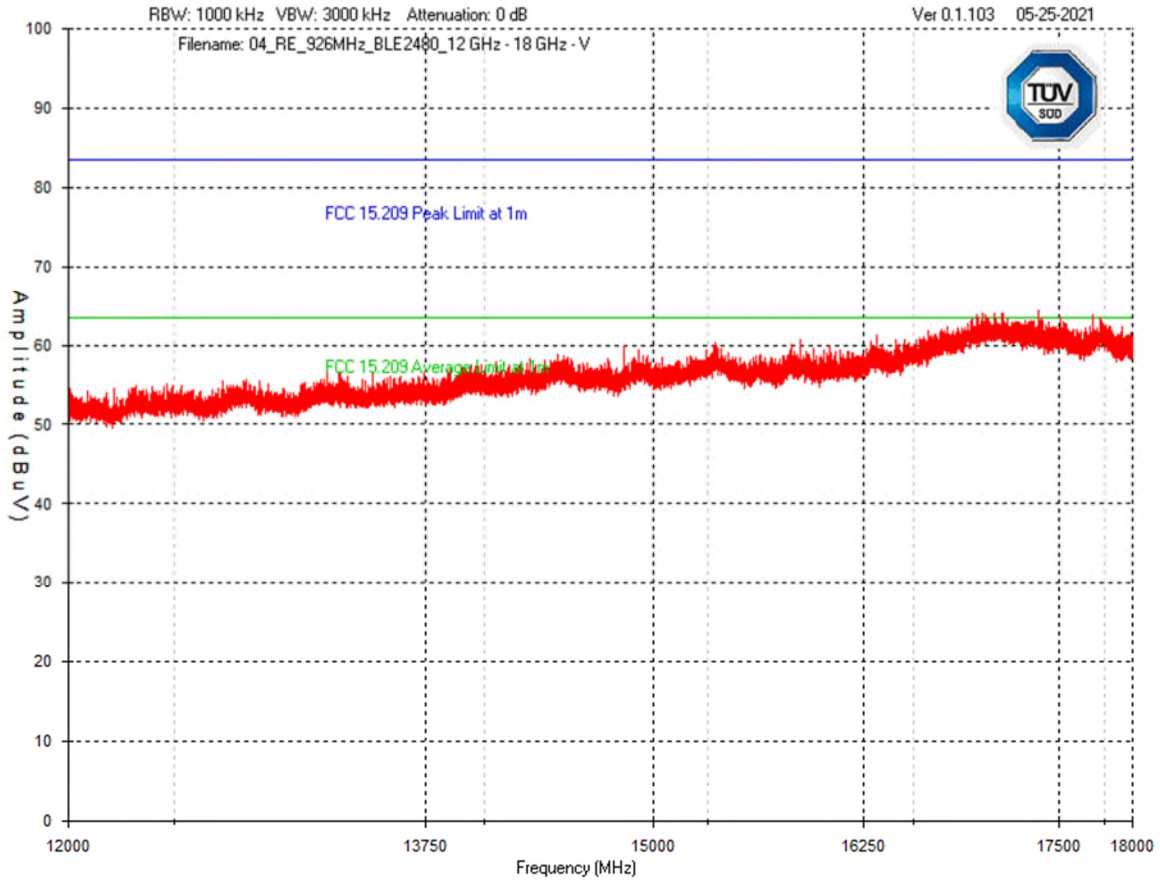
Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

6 GHz – 12 GHz
Vertical - Peak Emission Graph




Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

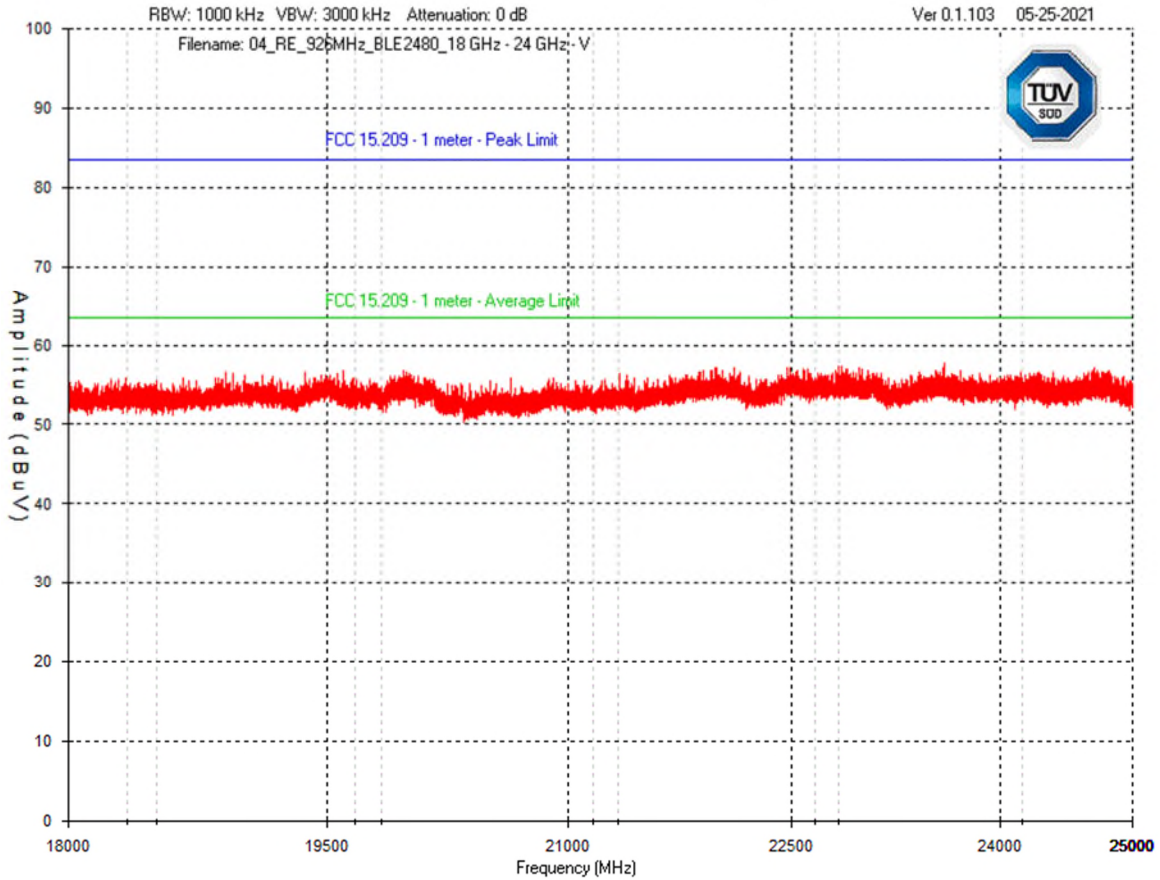
12 GHz – 18 GHz
Vertical - Peak Emission Graph




Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

18 GHz – 25 GHz
Vertical - Peak Emission Graph



Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.


Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Final Measurements and Results

The EUT passed. 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. Emissions outside the restricted bands were measured for informational purposes.

Emissions Table


Antenna Configuration			Stamped Antenna						
Frequency (MHz)	Detector	Received Signal (dBμV)	Antenna Factor (dB/m)	Cable Factor + Filter (dB)	Pre-Amp (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Test Result
Horizontal Antenna Polarization									
880.739	QP	30.4	29.3	5.7	-29.7	35.7	46.4	10.7	Pass
748.281	QP	34.5	28.1	5.1	-30.7	37.0	46.4	9.4	Pass
742.847	QP	33.2	28.2	5.1	-30.8	35.7	46.4	10.7	Pass
938.769	QP	23.9	29.9	5.9	-29.2	30.5	46.4	15.9	Pass
885.591	QP	30.3	29.4	5.7	-29.7	35.7	46.4	10.7	Pass
753.327	QP	28.8	28.1	5.2	-30.7	31.4	46.4	15.0	Pass
242.03	QP	50.9	18.1	2.8	-33.3	38.5	46.4	7.9	Pass
4332.33	AVG	40.1	33.7	7.6	-32.9	48.5	54.0	5.5	Pass
4034.55	AVG	37.2	33.6	7.2	-33.0	45.0	54.0	9.0	Pass
4631.12	AVG	44.5	34.2	8.0	-32.7	43.7 ²	54.0	10.3	Pass
2777.38	AVG	49.0	32.3	6.0	-34.3	42.7 ²	54.0	11.3	Pass
1851.67	AVG	51.4	30.5	5.8	-34.9	42.5 ²	54.0	11.5	Pass
4631.12	PEAK	44.5	34.2	8.0	-32.7	54.0	74.0	20.0	Pass
2777.38	PEAK	49.0	32.3	6.0	-34.3	53.0	74.0	21.0	Pass
1851.67	PEAK	51.4	30.5	5.8	-34.9	52.8	74.0	21.2	Pass
17120.9	AVG	31.8	37.0	14.5	-33.4	49.9	63.5	13.6	Pass
17726	AVG	31.9	35.3	15.0	-33.5	48.7	63.5	14.8	Pass
15383.6	AVG	33.1	33.9	13.7	-34.4	46.3	63.5	17.2	Pass
Vertical Antenna Polarization									
881.322	QP	27.4	29.3	5.7	-29.7	32.7	46.4	13.7	Pass
748.767	QP	34.2	28.1	5.2	-30.7	36.8	46.4	9.6	Pass
872.394	QP	25.8	29.1	5.6	-29.8	30.7	46.4	15.7	Pass
65.6132	QP	33.2	12.7	1.8	-33.6	14.1	40.0	25.9	Pass
931.588	QP	20.1	29.8	5.8	-29.3	26.4	46.4	20.0	Pass
926.056	QP	19.8	29.8	5.8	-29.3	26.1	46.4	20.3	Pass
36.5016	QP	30.6	19.8	1.6	-33.7	18.3	40.0	21.7	Pass

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

742.847	QP	31.8	28.2	5.1	-30.8	34.3	46.4	12.1	Pass
4332.67	AVG	41.4	33.7	7.6	-32.9	49.8	54.0	4.2	Pass
4034.88	AVG	40.1	33.6	7.2	-33.0	47.9	54.0	6.1	Pass
4631.45	AVG	44.2	34.2	8.0	-32.7	43.4 ²	54.0	10.6	Pass
1852.34	AVG	51.9	30.5	5.8	-34.9	43.0 ²	54.0	11.0	Pass
2777.71	AVG	46.0	32.3	6.0	-34.3	39.7 ²	54.0	14.3	Pass
4631.45	PEAK	44.2	34.2	8.0	-32.7	53.7	74.0	20.3	Pass
1852.34	PEAK	51.9	30.5	5.8	-34.9	53.3	74.0	20.7	Pass
2777.71	PEAK	46.0	32.3	6.0	-34.3	53.0	74.0	21.0	Pass
17367.9	AVG	31.6	36.5	14.7	-33.4	49.4	63.5	14.1	Pass
15856.8	AVG	32.7	33.7	13.8	-34.6	45.6	63.5	17.9	Pass


²The emissions at these frequencies are harmonics of the transmitter. The transmitter has a duty cycle of 30.48%. A Duty Cycle Correction Factor (DCCF) of $20\log(30.48\%) = -10.3$ dB was applied to the Average as per FCC KDB 55807v D01 v05r02. The Level was calculated per the following formula:

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


Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
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	EM 6871	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
BiLog Antenna	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 – 10 GHz	WBH218HN	Q-par	Apr. 1, 2020	Apr. 1, 2022	GEMC 6375
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 286
Pre-Amp 9 kHz – 1 GHz	CPA9230	Chase	May 22, 2020	May 22, 2022	GEMC 301
Pre-Amp 1 – 10 GHz	HP 8449B	HP	Aug. 4, 2020	Aug. 4, 2022	GEMC 312
0.98GHz HPF	8IH40-980/T3750	K & L Microwave	NCR	NCR	GEMC 4256
4GHz HPF	11SH10-4000/T12000	K & L Microwave	NCR	NCR	GEMC 119
HPF 6.4GHz-18GHz	HPM50112	Micro-Tronics	NCR	NCR	GEMC 329
2.4GHz-2.5GHz Notch Filter	BRM50702	Micro-Tronics	NCR	NCR	GEMC 230
Band Reject Filter	BRC50722	Micro-Tronics	NCR	NCR	GEMC 186
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 27
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	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Appendix A – EUT Summary


Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
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	
Organization / Address	Acuity Brands Lighting, Inc. 1 Acuity Way, Decatur, GA 30035 United States
Contact	Alex Bahk
Phone	770-593-5062
Email	Alex.Bahk@AcuityBrands.com
EUT Details	
EUT Name	rMODIT3
FCC ID	2ADCB-RMODIT3
IC ID	6715C-RMODIT3
Equipment Category	Integrated Wireless Sensor
Basic EUT Functionality	915 MHz wireless module with BLE
Connectors available on EUT	Pogo pin connector
Peripherals Required for Test	Laptop and debug board to configure the test firmware on the EUT via UART
Intentional Radiator Frequency	902 to 928MHz (Proprietary) 2402 to 2480 MHz (BLE)


Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see ‘Appendix B – EUT and Test Setup Photos’.

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

EUT Configuration

Please see Appendix B for a picture of the unit running in normal conditions.

- Wireless configured to transmit continuously at 100% duty cycle with modulation
- Low Channel: Ch 1 = 904MHz
- Middle Channel: Ch 6 = 914MHz
- High Channel: Ch 12 = 926MHz
- Power Level Register Setting: 200
- For the Spurious Radiated Emissions, the transmitter was set to Ch 12 which was the worst case.
- Co-location testing was performed with the above setting for sub-gig transmitter and the BLE was configured with the following:
- High Channel: Ch 39 = 2480MHz
- Power Level Register Setting: 37

Client	Acuity Brands Lighting, Inc	
Product	rMODIT3 Module	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Appendix B – EUT and Test Setup Photos

Refer to the files separate from this test report